

**Charles University in Prague**

Faculty of Social Sciences  
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DISSERTATION

**Bank fee and commission income – its  
determinants and impact on bank's  
profitability and risk**

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Academic Year: **2019/2020**

## 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, June 26, 2020

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Signature

## Acknowledgments

I would like to thank my supervisor doc. Ing. Zdeněk Tůma, CSc. as well as doc. PhDr. Petr Teplý, Ph.D. for leading me through the entire work. I am very grateful for their priceless comments and support. My sincere gratitude belongs also to Matěj Kuc for his recommendations and cooperation during the research.

I am grateful to my family for continuous encouragement and support during my studies.

This dissertation benefited from grants provided by the Charles University Grant Agency (projects No. 105815 and 488317) and the Grant Agency of the Czech Republic (projects No. 15-00036S and 18-05244S). The thesis is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 681228.

## Abstract

This thesis consists of five essays dealing with the fee and commission income in European banks from the macro, sector and bank level perspectives. This topic is of high relevance since fee income represents the largest part of the non-interest income of EU banks. The first part of the thesis deals with banks in general terms, while the second part is focused solely on cooperative banks, which represent approximately 20% of the EU banking sector. We compare the magnitude of the bank fee income across EU countries and study its determinants and impacts on banks' performance.

The first essay compares the magnitude of the fee income across EU countries with a special emphasis on the Czech Republic from a macroeconomic perspective. First, we conclude that Czech banks are not abnormally dependent on fee income and their outstanding performance can be attributed to sound risk management, high liquidity and sufficient capital buffers rather than to excessive fees. Second, our evidence suggests that the share of fee income had an increasing trend in EU countries in recent years, which might be connected to the effort to maintain sufficient profitability in the low interest rates environment. We also discuss how new entrants, the so called low-cost banks, changed the banking sector in the Czech Republic.

In the second essay, we study the determinants of the magnitude of the fee income share with a special emphasis on market concentration. Our results suggest that banks facing higher competition tend to expand into non-traditional fee-bearing services, which in turn increases their fee income shares. Moreover, higher fee income shares are connected to higher equity to assets ratios, since more capital is needed to prevent or manage the potential risks of the non-traditional activities.

The third essay analyses the impacts of the fee income share on banks' performance in terms of profitability, risks and risk-adjusted profitability in the EU. We do not find any diversification benefits from increasing the fee income share. However, higher reliance on equity financing and better quality loans enhance banks' performance.

The fourth essay examines the determinants of the fee income share of cooperative banks in the EU. Using analogous methodology to the second essay, we conclude that in cooperative banks, the fee income share decreases as competition increases. This is probably connected to the fact that these banks stick with traditional activities and the retail banking fees are driven down by the competition.

The last essay deals with a current topic of a low interest rate environment and its impact on the net interest margins of commercial and cooperative banks in the EU. We show that cooperative banks were much harder hit by the decreased market interest rates compared to commercial banks, which might be due to their ownership structure and more restrictive business regulations.

<b>JEL Classification</b>	C23, G21, L25
<b>Keywords</b>	Bank fee and commission income, market concentration, banks' performance, System GMM, European Union
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# Contents

<b>List of Tables .....</b>	<b>1</b>
<b>List of Figures.....</b>	<b>4</b>
<b>Acronyms .....</b>	<b>6</b>
<b>1 General introduction .....</b>	<b>8</b>
<b>I. Banks.....</b>	<b>23</b>
<b>2 A comparison of bank fee and commission income in the Czech Republic and in the EU.....</b>	<b>23</b>
2.1 Introduction .....	24
2.2 Literature review .....	25
2.3 Empirical analysis .....	27
2.3.1 Data and methodology .....	27
2.3.2 Fee income in the EU countries .....	29
2.3.2.1 Comparison of fee income magnitude across the EU countries .....	29
2.3.2.2 Relationship between market concentration and the magnitude of fee income .....	35
2.3.2.3 Profitability of EU banking sectors .....	39
2.3.3 Fee income in the Czech Republic.....	41
2.3.3.1 Different banking models in the Czech Republic.....	43
2.3.3.2 Case study: fee income in ČSOB, J&T, FIO .....	47
2.4 Conclusion.....	51
<b>3 Determinants of bank fee income in the EU banking industry - does market concentration matter?.....</b>	<b>53</b>

3.1	Introduction .....	54
3.2	Literature review .....	55
3.3	Empirical analysis .....	56
3.3.1	Data set.....	56
3.3.2	Methodology .....	57
3.3.3	Variables .....	59
3.3.4	Descriptive analysis .....	60
3.3.5	Results and findings .....	63
3.3.5.1	Summary of results and comparison with other researchers	67
3.4	Conclusion.....	68
3.5	Appendix .....	69

**4 The impact of fee income share on EU banks’ performance and its implication on drivers of banks’ business model changes..... 73**

4.1	Introduction .....	74
4.2	Literature review .....	75
4.3	Empirical analysis .....	76
4.3.1	Data set.....	76
4.3.2	Methodology .....	77
4.3.3	Variables .....	79
4.3.4	Descriptive analysis .....	80
4.3.5	Results and findings .....	83
4.3.5.1	Summary of results and comparison with other researchers	88
4.4	Conclusion.....	89
4.5	Appendix .....	91

**II. Cooperatives .....95**

<b>5</b>	<b>Net Fee and Commission Income Determinants of European Cooperative Banks.....</b>	<b>95</b>
5.1	Introduction .....	96
5.2	Literature review .....	97
5.3	Methodology .....	99
5.4	Variables.....	101
5.5	Data analysis.....	104
5.6	Results .....	107
5.7	Conclusion.....	109
<b>6</b>	<b>Net Interest Margin of Cooperative and Commercial Banks – which banking business model was more hit by the Low Interest Rate Environment? ....</b>	<b>110</b>
6.1	Introduction .....	111
6.2	Literature review .....	112
6.3	Data description.....	114
6.4	Methodological approach.....	117
6.5	Regression results.....	118
6.6	Further research opportunities.....	120
6.7	Conclusion.....	121
<b>7</b>	<b>Conclusion .....</b>	<b>122</b>
	<b>Bibliography .....</b>	<b>126</b>
	<b>Appendix A: Response to Opponents’ Reports and Committee Suggestions from Pre-defense.....</b>	<b>141</b>
A.1	Response to Comments from Prof. David Tripe Ph.D. ....	141

A.2	Response to Comments from doc. Tomáš Výrost Ph.D.....	144
A.3	Response to Comments from prof. Ing. Michal Mejstřík CSc.....	160
A.4	Committee Suggestions from Pre-defense .....	170

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# List of Tables

Table 2.1: Average net fee and commission income ratios of different groups of the EU countries compared to the EU averages (years 2007–2018) .....	35
Table 2.2: ČSOB NFCI decomposition in 2018 .....	47
Table 2.3: ČSOB NFCI by segments in 2018 .....	49
Table 2.4: J&T NFCI decomposition in 2018.....	49
Table 2.5: J&T NFCI by segments in 2018 .....	50
Table 2.6: FIO NFCI decomposition in 2018 .....	51
Table 3.1: Number of banks included in the study by country .....	57
Table 3.2: List of independent variables .....	59
Table 3.3: Wooldridge test for autocorrelation – NFCI/TI, NFCI/TA .....	64
Table 3.4: Relationship between NFCI share and HI – System GMM regression results .....	65
Table 3.5: Comparison of estimated signs and significance levels for the coefficients on NFCI magnitude.....	67
Table 3.6: Summary statistics of used variables .....	71
Table 3.7: Relationship between NFCI share and HI – robustness check .....	72
Table 4.1: Number of banks included in the study by country .....	77
Table 4.2: Independent variables .....	80
Table 4.3: Wooldridge test for autocorrelation.....	83
Table 4.4: Relationship between performance measures and NFCI/TI – System GMM regression results.....	86
Table 4.5: Results comparison with existing literature.....	88
Table 4.6: Summary statistics .....	93
Table 4.7: Check for presence of structural break .....	94
Table 4.8: Robustness check.....	94

---

Table 5.1: List of independent variables .....	101
Table 5.2: Correlation matrix.....	103
Table 5.3: Number of banks by country .....	104
Table 5.4: Descriptive statistics .....	106
Table 5.5: Regression results .....	107
Table 5.6: Robustness check.....	108
Table 6.1: Banks in dataset by country and ownership structure .....	115
Table 6.2: Regression results for commercial banks .....	119
Table 6.3: Regression results for cooperative banks.....	119
Table 6.4: Regression results for the whole dataset.....	120
Table A.1: Robustness test for Section 4 – models with insignificant AR (3) - using lag 3 and higher as instruments.....	146
Table A.2: Robustness test for Section 3 – model with significant AR (3) - using lag 4 and higher as instruments.....	147
Table A.3: Robustness test for Section 4 – model with significant AR (3) - using lag 4 and higher as instruments.....	148
Table A.4: Robustness test for Section 5 – model with significant AR (3) - using lag 4 and higher as instruments.....	149
Table A.5: Robustness test for Section 4 – separate test of the 2010-2014 period...	151
Table A.6: Robustness test for Section 3 – testing for nonlinearity .....	152
Table A.7: Robustness test for Section 4 – testing for nonlinearity .....	154
Table A.8: Robustness test for Section 5 – testing for nonlinearity .....	155
Table A.7: Robustness tests for Section 3 - excluding Ireland and negative NFCI/TI, using only crisis period .....	157
Table A.6: Robustness test for Section 4 – excluding Ireland .....	157
Table A.7: Robustness test for Section 5 – using only crisis period.....	157
Table A.10: Correlation matrix of Section 3.....	161
Table A.10: Relationship between NFCI share and technological development of the banking sector – System GMM regression results using data from Section 3 .....	162

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Table A.12: Relationship between NFCI share and technological development of the banking sector – System GMM regression results using data from Section 5 .....	164
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## List of Figures

Figure 2.1: Development of Net fee and commission income/Total income in the EU between 2007 and 2018 .....	30
Figure 2.2: Net fee and commission income/Total income in the EU – averages for 2007–2018.....	31
Figure 2.3: Development of Net fee and commission income/Total assets in the EU between 2007 and 2018 .....	32
Figure 2.4: Net fee and commission income/Total assets in the EU – averages for 2007–2018.....	33
Figure 2.5: Development of Net fee and commission income/GDP in the EU between 2007 and 2018.....	34
Figure 2.6: Net fee and commission income/GDP in the EU – averages for 2007–2018.....	34
Figure 2.7: Development of the Herfindahl index in the EU between 2007 and 2018 .....	36
Figure 2.8: Herfindahl index in the EU – averages for 2007–2018.....	37
Figure 2.9: Relation between Net fee and commission income/Total income and the Herfindahl index in the EU based on average data from 2007 to 2018 .....	39
Figure 2.10: Development of ROE in the EU between 2007 and 2018.....	40
Figure 2.11: Development of ROA in the EU between 2007 and 2018 .....	41
Figure 2.12: Czech banking sector – Total operating income decomposition 2007–2018 (in EUR millions).....	42
Figure 2.13: Czech Republic – Total operating income decomposition 2007, 2012 and 2018 (in %) .....	43
Figure 2.14: Development of the Herfindahl index in the Czech Republic between 2007 and 2018.....	44
Figure 2.15: Net Fee and Commission Income/Total Operating Income in Czech Banks in 2012 and 2018.....	46

---

Figure 3.1: Average NFCI/TI and NFCI/TA by bank type.....	61
Figure 3.2: Average HI from 2007 to 2014 .....	62
Figure 3.3: Development of average NFCI/TI by market concentration .....	63
Figure 3.4: Scatter plot NFCI share and HI .....	69
Figure 3.5: The development of banking sector in 2014 by country .....	70
Figure 3.6: Macroeconomic conditions in 2013 – Annual unemployment rate and real annual GDP growth.....	70
Figure 3.7: Macroeconomic conditions in 2013 – Long term interest rate and annual inflation rate .....	71
Figure 4.1: Average performance measures in 2005-2014.....	81
Figure 4.2: Development of average NFCI/TI.....	81
Figure 4.3: Development of average ROAE.....	82
Figure 4.4: Development of average ln (Z-Score) .....	83
Figure 4.5: Scatter plots .....	91
Figure 4.6: Average NFCI/TI 2005-2014 .....	92
Figure 4.7: Average HI 2005-2014 .....	92
Figure 4.8: Macroeconomic indicators in 2013 .....	93
Figure 5.1: Evolution of the average NFCI/TI in 2007-2014 .....	105
Figure 5.2: Evolution of the average HI in 2007-2014.....	106
Figure 6.1: Development of 1 M EURIBOR .....	116
Figure 6.2: Average net interest margin by ownership structure over time.....	117

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# Acronyms

<b>AIR</b>	Air Bank
<b>ATM</b>	Automated Teller Machine
<b>CEE</b>	Central and Eastern Europe
<b>ČS</b>	Česká spořitelna
<b>ČSOB</b>	Československá obchodní banka
<b>EQUA</b>	EQUA bank
<b>EU-27</b>	European Union, excluding Croatia
<b>FIO</b>	Fio banka
<b>GDP</b>	Gross Domestic Product
<b>GMM</b>	Generalized Method of Moments
<b>HI</b>	Herfindahl Index
<b>J&amp;T</b>	J&T Banka
<b>KB</b>	Komerční banka
<b>MONETA (GE)</b>	MONETA (formerly GE) Money Bank
<b>NFCI</b>	Net Fee and Commission Income
<b>NFCI/GDP</b>	Net Fee and Commission Income to Gross Domestic Product Ratio
<b>NFCI/TA</b>	Net Fee and Commission Income to Total Assets Ratio
<b>NFCI/TI</b>	Net Fee and Commission Income to Total Income Ratio
<b>NII/NONII</b>	Non-interest Income
<b>NIM</b>	Net Interest Margin

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<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>OLS</b>	Ordinary Least Squares
<b>PIIGS</b>	Portugal, Ireland, Italy, Greece, Spain
<b>RAEAR</b>	Risk-adjusted Equity to Assets Ratio
<b>RANIM</b>	Risk-adjusted NIM
<b>RAROOA</b>	Risk-adjusted ROAA
<b>RAROAE</b>	Risk-adjusted ROAE
<b>RB</b>	Raiffeisenbank
<b>RO(A)A</b>	Return on (Average) Assets
<b>RO(A)E</b>	Return on (Average) Equity
<b>TA</b>	Total Assets
<b>TI</b>	Net Total (Operating) Income
<b>UCB</b>	UniCredit Bank
<b>ZUNO</b>	ZUNO bank

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# 1 General introduction

In the last decades, the European banking sector has faced many challenges to which it needed to adapt. Widespread deregulation, technological development, increased competition, the financial crisis and the recently prevailing low interest rates posed large burdens on banks and tested their ability to cope with negative market development.<sup>1</sup> Increased systemic risk accompanied by decreased interest margins led to insufficient profitability for EU banks. To maintain sustainable performance, banks needed to seek new sources of profits. One way to compensate for compressed interest margins is to increase fee and commission income, which represents the highest share of the non-interest income of EU banks (Brei et al., 2019; ECB, 2016). This assumes switching from traditional commercial banking activities – deposits taking and loans providing – to non-traditional fee and commission bearing services, such as retail brokerage, insurance sales, securities issuance - which are generally the core businesses of investment banking.

For a long time, universal banking, which combines both commercial and investment banking activities, seemed to represent an optimal banking business model in terms of cost and profit efficiency (Vennet, 2002). The universal banking model is believed to have three main advantages: i) a broad range of services for customers, ii) lower costs due to economies of scale and scope, and iii) generally better stability due to their diversified operations (Schildbach, 2012). The costs and benefits of this type of bank were reassessed after the 2007-2009 global financial crisis, during which universal banks reported large losses (17 large universal banks accounted for more than half of the total financial sector losses, and 9 of them either failed, were nationalized or were placed on government-funded life support (Wilmarth, 2009)). Among other factors, excessive trading/derivative/market activities were one of the reasons why banks failed (Liikanen Report, 2012).

As a reaction to this, three different rules that should separate certain banking activities were suggested - the Volcker rule (2014) in the United States, the Liikanen

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<sup>1</sup> Similar development and challenges were faced also by banks outside the EU, see for example Chien and Morris (2017), Mendez-Carbajo (2020) and FRED (2020) for the most recent development of interest rates and Sun and Wheelock (2020) for bank lending standards and loan growth in the U.S.

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Report (2012) that was suggested by the European Commission and the Vickers Commission (2011) that was proposed in the United Kingdom. The extent and the strictness of the separation differ under each proposal, but they have in common the aim to separate trading from deposits.

The empirical evidence about the suitability of such a separation is mixed. While some of the researchers see clear diversification benefits from increasing non-interest income (Smith et al., 2003; Chiorazzo et al., 2008; Köhler, 2012, 2013; Saunders et al. 2020), others claim that diversification benefits are more than offset by the higher risks that are generally connected to fee-bearing activities (Lepetit et al., 2007; Stiroh, 2004a, 2004b; DeYoung and Rice, 2004a; Brunnermeier et al., 2019). The exact effect may be besides other factors dependent on the specific fee-generating services provided by the bank. DeYoung and Torna (2013) claim that during the financial crisis the probability of distressed bank failure decreased with pure fee-based non-traditional services such as securities brokerage and insurance sales, but raised with asset-based non-traditional activities such as venture capital, investment banking and asset securitization.

It is important to stress that universal banking is not unique because the banking business model cannot be sufficiently described only by the ‘commercial bank’, ‘investment bank’ or ‘universal bank’ labels. More different characteristics such as size, activities, the income model, the capital and funding structure, ownership, the corporate structure and the geographic scope need to be considered (Liikanen Report, 2012). The effect of expanding into fee-bearing activities may therefore differ across different types of banks. Nevertheless, since fee income represents the largest part of the non-interest income of European banks, an appropriate fee income policy is highly relevant not only for bank managers but also for policy makers.

Besides the diversification in banking, we are also concerned about market concentration and its effects on banks, mainly in terms of income composition and performance. In the EU banking industry we could observe an improvement in bank competition during the 2000s, which followed the deregulation of capital flows, the introduction of a single banking license, the removal of legal barriers to entry, and the creation of a single currency, which removed exchange risk (Weill, 2013). The theory

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has conflicting predictions about the impact of such market changes on banks' performance, mainly in terms of profit/cost efficiency and risks.<sup>2</sup>

The first studies dealing with the effects of market concentration on the banks, such as Berger and Hannan (1989) and Neumark and Sharpe (1992), generally supported the market-power hypothesis - more precisely the traditional structure-conduct-performance hypothesis. This hypothesis assumes that under market imperfections, banks are able to set prices which are less favourable for consumers. The relationship between market concentration and profitability found in these studies became weak after the inclusion of market share of the firm into the regression (Berger et al., 2004).

These results were followed by studies examining whether superior profits under the banking market concentration stems from market-power or rather the efficient structure hypothesis (Smirlock et al., 1984 and Shepherd, 1986). Cost X-efficiency suggests that well managed firms with superior production technologies have lower costs, and therefore are more profitable. At the same time these firms tend to have large market shares. In scale-efficiency theory, no superior management or technology is needed. It assumes that some firms are able to produce at more efficient scales with lower unit costs and higher unit profits. These firms tend to have large market shares (Berger, 1995).

Berger (1995) studied both hypotheses, market-power and efficiency, in the U.S. banking market. He found some evidence supporting X-efficiency and the relative-market-power hypothesis, which states that market power in pricing which leads to higher profits can be used only by firms with large market shares and well-differentiated products. However, the results were not very robust.

Berger and Hannan (1998) show that under higher concentration, a reduced pressure to minimize costs exist (managers have a "quiet life" since they do not need to work as hard in order to maintain low costs), which may lead to lower cost efficiency. Specifically in the U.S. banking industry the researchers found additional operating costs attributable to concentration to be much larger than the social loss generated by noncompetitive pricing. The "Quiet life" theory also was revealed by other researchers, for example Koetter et al. (2012).

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<sup>2</sup> A very detailed literature review on this topic is provided by Berger et al. (2004). We only summarize the main findings.

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Nevertheless, the “Quiet life” hypothesis was rejected by Maudos and de Guevara (2007). They support the previous studies and found a relationship between market power and cost X-efficiency. Still, they claim that welfare gains associated with increased competition are greater than the loss of bank cost efficiency. Similar results are found also by Restrepo-Tobón and Kumbhakar (2014). They claim that the relationship between market power and profit efficiency is weakened due to deregulation but not enough to support the “Quiet life” hypothesis.

Nowadays, the original, relatively simple approaches are already surpassed. For instance, size of banks or ownership plays a significant role because small, foreign or state owned banks can have different competitive advantages compared to large, domestically owned and privately owned banks. The same holds true for banks facing different regulations or institutional developments. Moreover, the research currently includes more than just price and profit measures; for instance, impacts on financial stability, net interest margins or on credit accessibility are being examined.

Keeley (1990) provides a theoretical background to the relationship between market power and risk taking. He claims that without monopolistic rents, banks will tend to increase their leverage and the riskiness of their asset portfolios. On a related note, Hellmann et al. (2000) supports deposit-rate controls as a regulatory instrument, since these are able to increase franchise values and eliminate gambling. Beck et al. (2013) claim that *“an increase in competition will have a larger impact on banks’ risk taking incentives in countries with stricter activity restrictions, more homogenous bank revenue structures, more generous deposit insurance and more effective systems of credit information sharing”*. On the other hand, there also exist arguments and empirical evidence supporting the view that greater competition may lead to lower bank risks. Berger et al. (2009) find increased loan portfolio risk in banks with higher market power. Similarly, Jayaratne and Strahan (1998) show that loan losses decreased after competition increased in the U.S. One of the causes may be that lower (competitive) interest rates increase the probability of the repayment of provided loans (Boyd and De Nicolo, 2005). Higher rates may also result in a riskier set of borrowers.

Risk-taking translates into overall financial stability The empirical evidence is mixed on this topic too. Boyd et al. (2004) show that banking crises are always more probable where there is competition rather than a monopoly. A similar result was found by Beck et al. (2006), who claim that crises are less likely in economies with more concentrated banking systems, or by Berger et al. (2009) who claim that a

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greater degree of market power decreases the overall risk exposure, despite the fact that it increases loan portfolio risk. On the other hand, Beck et al. (2003), Boyd et al. (2006) and De Nicolo and Loukoianova (2007) found competitive banking systems more stable. Allen and Gale (2004) show that the trade-off between competition and financial stability often does not hold. One of their important results is that efficiency in general equilibrium models as well as the innovation models developed by Schumpeter (1912) requires both perfect competition and financial instability.<sup>3</sup>

Demirgüç-Kunt et al. (2004) study the impact of bank regulations, market structure, and national institutions on bank net interest margins and overhead costs. They find that concentration is positively associated with net interest margins, but, when they were controlling for regulatory impediments to competition and inflation, they found that this relationship breaks down. Their results also suggest scepticism about the use of concentration measures to proxy the competitiveness of banking markets, which is also supported by Claessens and Laeven (2004) or Bolt and Humphrey (2015).

In this thesis, we are concerned also about the impact of increased market competition on the composition of income, more precisely on the effect on bank fee and commission income share. One can argue that higher market power enables banks to charge higher fees, and therefore increased competition will lead to lower fees or, in general, non-interest income. This relationship is found in DeYoung and Rice (2004a), who examine the effect of the Herfindahl index (HI) on the magnitude of non-interest income to bank assets ratio. But when they look solely at service charges on deposit accounts, the relationship seems to be the opposite. This may be connected to the fact that banks with high market power in other lines of business may feel less pressure to set high fees for their depositors. Other researchers such as Lepetit et al. (2008) find that higher concentration increases interest margins, since it is often associated with higher lending rates. The impact of market competitiveness on income composition, i.e. what share of income is represented by interest income and what share of income is represented by non-interest or fee and commission income, is studied by neither of these studies.

The first paper to investigate the relationship between market competition and income diversification is Moshirian et al. (2011). They find that competition increases the level of non-interest income. Moreover, the diversification effect differs

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<sup>3</sup> For a more detailed literature review on competition-stability/fragility hypotheses see Boyd and De Nicolo (2005).

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under different levels of competition. While non-interest income increases systemic risk on highly competitive banking markets, it can lead to the mitigation of those risks on highly concentrated banking markets.

The proper choice of concentration/competition measure is crucial. Perhaps unsurprisingly, the literature is not unanimous about the best approach to the measurement of competition. The more widely known methods include the Herfindahl index (Cowling and Waterson, 1976), Lerner index (Lerner, 1934), Rotschild or Bresnahan-Lau conduct index (Rotschild, 1942; Bresnahan, 1982; Lau, 1982), Panzar-Rosse H-statistic (Panzar and Rosse, 1987) and Boone index (Boone, 2008a; 2008b; Bikker and van Lauensteijn, 2015).<sup>4</sup>

The HI is computed as the sum of the squares of bank sizes defined as market share. It is classified as one of the structural methods which are based on the structure-conduct-performance paradigm, which suggests that highly concentrated markets cause collusive behaviour. Possibly due to its simplicity and good data availability, the HI is the most widely used measure of concentration in the theoretical literature. It is also often used as a benchmark for the evaluation of other concentration indices (Bikker and Haaf, 2000). The HI focuses on market shares but does not account for how they have been achieved. The empirical evidence on the suitability of this measure for market competition estimation is mixed. Some researchers suggest that concentration measures are, in general, poor measures of competition (see, for example, Claessens and Laeven, 2004). Nevertheless, other researchers have found the measure significantly negatively related to competition measures (see, for example, Bikker and Haaf, 2002).

The Lerner index and Rotschild or Bresnahan-Lau conduct index are functions of prices and marginal costs. The Lerner index is computed as the spread between average price and estimated marginal cost both divided by average price. The Rotschild or Bresnahan-Lau conduct index multiplies the Lerner index by market demand elasticity. The biggest advantage of these indices is the clear economic interpretation and rigorous theory behind the measures. On the other hand, the essential input, estimates of marginal cost, are often hindered by the limitations of functional form and measurement error (Bikker and Spierdijk, 2017). Moreover, for

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<sup>4</sup> For a detailed literature review and more extended list of measurement methods of competition see Bikker and Haaf (2000) and Chapter 1: Market power: competition among measures in Bikker and Spierdijk (2017).

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more productive banks, the observed input costs will exceed their true value and their measured spread from the output price will be lower. Therefore, more productive banks will appear to be even more competitive than they are (Bolt and Humphrey, 2015).<sup>5</sup> This problem is also faced by the Panzar-Rosse H-statistic. On the topic of the empirical evidence on the robustness of the Rothschild or Bresnahan-Lau conduct index, favourable results were found, for example, by Wolfram (1999), in contrast to Hyde and Perloff (1995).

The Panzar-Rosse H-statistic is the sum of the elasticities of gross revenue with respect to input prices. Recently, literature has increasingly suggested that this method suffers from extensive drawbacks (see, for example, Shaffer, 2004), and the result of the H-statistic cannot by itself determine the extent of competition (see, for example, Hyde and Perloff, 1995; Bikker et al., 2012 and Bikker and Spierdijk, 2017). Also, this method suffers from the above-mentioned problems with the identification of the key parameters. Furthermore, Bolt and Humphrey (2015) found it uncorrelated not only with the HI but also with the Lerner index.<sup>6</sup>

The Boone index computes relative profit differences across individual firms. It is based on the theory that higher-cost firms suffer relatively larger losses of profitability under substantial competition (Bikker and Spierdijk, 2017). In other words, efficiency is rewarded under increased competition. Similar logic was applied earlier by Hay and Liu (1997). Like the price cost-margin methods, the Boone index too is based on a robust theoretical background and it has the same data requirements that make it vulnerable to measurement error (Schiersch and Schmidt-Ehmcke, 2010). It neglects product quality and design, as well as the attractiveness of innovations (Leuvensteijn et al., 2011). Furthermore, the Boone index cannot be separately interpreted as a measure of competition without controlling for economies or diseconomies of scale (Bikker and Spierdijk, 2017). In addition, in the case of this measure, some empirical evidence suggests that the Boone index fails to indicate competition correctly (see, for example, Schiersch and Schmidt-Ehmcke, 2010).

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<sup>5</sup> For more advantages and disadvantages of these measures see for example Hyde and Perloff, (1995), Worthington (1990) and the literature review in Schiersch and Schmidt-Ehmcke (2010) and Bikker and Spierdijk (2017).

<sup>6</sup> Bolt and Humphrey (2015) suggest their own measure of competition in banks, which is based on efficient frontier analysis which, besides the traditional activities (loan providing and deposit taking), focuses also on fee-based activities.

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In the whole of this thesis we use the HI as the concentration/competition measure. The reason is mainly due to good data availability, which is often a problem for the other measures (see, for example, Bikker and Haaf, 2002). Furthermore, in using the HI we follow other authors dealing with similar issue such as DeYoung and Rice (2004a), Moshirian et al. (2011) or Köhler (2012).

The aim of the thesis is to study the fee and commission income in EU countries during the last years, more precisely during the 2008 financial crisis and the post-crisis period.<sup>7</sup> The study is performed on the macro, sectoral and individual banks levels. This thesis consists of five different essays. The first part of the thesis, consisting of three essays, deals with the fee and commission income in the EU banking sector in general. In the second part, consisting of two essays, the cooperative banking business model is discussed more deeply and the differences between commercial and cooperative banks are stressed.

Section 2 analyses the net fee and commission income in the EU from 2007 to 2018 on a macro level with a special emphasis set on the Czech Republic. In this section, we first compare the net fee and commission income magnitude across individual EU countries. For this purpose, we construct three financial ratios – net fee and commission income to total income, to total assets and to GDP - and examine their average values and their evolution in time. We conclude that the average fee income share of 25% in the EU corresponds to the prevailing commercial banking business model. The increasing trend of the fee income share that can be observed after the financial crisis supports the hypothesis of Brei et al. (2019) and ECB (2016) that in a low interest rate environment, banks may switch to fee-bearing services in order to maintain sufficient profitability. Moreover, we find that Czech banks exhibit lower shares of fee income compared to their EU peers. The reason why Czech banks

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<sup>7</sup> The individual papers included in this thesis cover slightly different time periods. In common they examine the period from 2008 to 2014/2015. Most of the papers use entries from the Bankscope which ceased to exist in this time, so it was not possible to retrieve more recent data. The most recent development of fee income is studied only on macro level using data until 2018. The starting point of the datasets differs slightly as well. Mostly, we use 2007 as the starting point. Still, when analysing bank performance, we included longer pre-crisis period to be able to study potential structural breaks. On the other hand, when studying a low interest rate environment, we started with 2008 since interest rates dropped first in reaction to the financial crisis. Still, the covered time periods are sufficiently close to each other to be able to compare the results found in individual papers and to drive general conclusions for the crisis and post-crisis period.

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outperform other EU banks lies in their sound risk management combined with sufficient liquidity and capital buffers rather than in the magnitude of their imposed fees.

Second, we study the banking sector competition and its relationship with the fee income share. We conclude that, on average, there is a moderate banking sector concentration in the EU. Moreover, the relationship between the Herfindahl index and the share of income represented by fees is negative, suggesting that increased competition tends to decrease the fee income share. This finding is against our expectations since increased competition is believed to be one of the reasons why banks switch to investment banking fee-bearing activities. The result suggests that the relationship between market competition and the income composition does not need to be so evident. Some banks might be limited to change their business model. Moreover, the inclusion of new banking activities requires long term adjustments. Therefore, in the short run, we can observe a decrease in fees as a reaction to increased competition. Since the analysis was performed on average data from 2007 to 2018, the time factor that can be relevant in the examined relationship is not taken into account. In general, the model applied in this section on macro data is very simplistic. A more robust analysis follows in Section 3 and Section 5, in which the estimation is performed on individual banks' data using advanced estimation methods.

Third, the essay examines the bank fees in the Czech Republic. We show that the share of fee income in the Czech banking sector followed a decreasing trend over the last few years. We also discuss the business model of the low-cost banks that entered the Czech banking sector in recent years. We claim that their initially unsustainable business model was connected mainly with clients' attraction. Currently, these banks that are in the Czech Republic are well established with increasing clientele and are generally profitable. We also provide a case study providing a detailed analysis of fee and commission income and expense in selected Czech banks. Based on this case study, we show a different structure of fees in individual banking business models.

Section 3 examines the determinants of the net fee and commission income magnitude in the EU banks from 2007 to 2014. For this purpose, various bank-, sector- and country-specific variables are used. Special attention is paid to the relationship between the market concentration and the fee income share. The analysis is performed on a panel dataset of 258 banks, most of which apply a commercial banking business model. We use the System Generalized Method of Moments for the

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estimation. This method is appropriate for our dataset since it is able to deal with the time persistency of the dependent variable and with explanatory variables that are not strictly exogenous. Other estimation methods (Fixed Effects and the Pooled Ordinary Least Squares) are used for robustness checks.

First, we found that banks facing higher competition tend to exhibit higher shares of net fee and commission income. More precisely, an HI of 1,000 (1,800), which is the lowest (highest) value of the HI corresponding to moderate concentration, decreases the net fee and commission income share of total income by 2.3 (4.14) percentage points. This means that on highly concentrated markets (HI over 1,800) the fee income share tends to be more than 1.84 percentage points lower compared to competitive markets (HI below 1,000). This result suggests that under increased competition, banks expand more aggressively into non-traditional fee-bearing activities, which is in line with our expectation.

Second, we conclude that a higher equity to assets ratio is related with higher shares of fee income. This is most likely connected with the need for more capital to prevent or manage the potential risks of the non-traditional activities. Third, a high deposits to assets ratio tends to increase the fee income share, which may possibly be attributed to the relatively high switching costs and to the close depositor-bank relationship in the EU banks. Finally, surprisingly, we did not find any evidence about the impact of the changing net interest margin on the fee income share. This might be connected to the examined time period, which ends in 2014. It is possible that banks were not able to react to decreasing interest rates and margins within this time horizon.

Moreover, we conclude that not only bank-specific and sector-specific factors are important determinants of fee income share, but that macroeconomic conditions also play a significant role. We thus support the results found by Kok et al. (2019) who claim that the fee and commission income differs depending on the macro-financial environment, and ignoring this could lead to a misinterpretation of banking sector stability.

Section 3.5 analyses the impact of the fee income share on EU banks' performance in terms of profitability, risk and risk-adjusted profitability and its effects on the drivers of banks' business model changes. We apply the System Generalized Method of Moments to a unique data set of 329 EU banks in the 2005-2014 period. This study provides three main findings. First, we did not find any diversification benefits by increasing the fee and commission income share. Increased reliance on fee income

does not only increase the riskiness of a bank measured by Z-Score but at the same time leads to lower profitability. Therefore, we can conclude that the increase in the fee income share that was observed during recent years in EU banks was driven mainly by external factors, such as technological development, increased competition, decreased interest margins, and the effort to maintain sufficient profitability under the changing markets rather than by internal attempts to diversify.

Second, higher reliance on equity financing and better quality loans, indicated by a lower ratio of loan-loss reserves to total loans, enhance banks' performance. Deposits seem to represent a cheap and not very risky source of finance, since they improve the net interest margin and return on average equity and simultaneously decrease insolvency risk. Third, bank business strategies and macroeconomic factors are crucial determinants of banks' performance and should not be neglected in related studies. Higher GDP growth is connected with the higher profitability of EU banks, while higher inflation has a negative impact on profitability as well as the riskiness of banks.

The second part of the dissertation deals with the cooperative banks in the EU. The cooperative business model is highly specific, mainly because of its ownership structure. Cooperative banks are owned by their customers and were originally designed as small-scale regional institutions. Often, they focus on retail banking because their members are mostly households and small enterprises (Hesse and Čihák, 2007). They are generally heavily involved in mortgages and, unlike commercial banks, they provide a narrower range of services. Moreover, cooperative banks provide their services only to their members (i.e. the owners of the bank), while commercial banks provide their services to clients (i.e. non-owners) (Kuc, 2014). This results in a different business objective for the two types of bank. Cooperative banks are trying to create maximum utility for all their stakeholders, which may result in a lower degree of profit maximization effort compared to commercial banks, which represent typical shareholder value banks (Fonteyne, 2007). Membership of cooperative banks is, therefore, not usually acquired for investment purposes (Kuc, 2014).

Nowadays, cooperative banks are often large organisations owned by thousands of owners, making the ownership structure very dispersed and the decision-making potentially less flexible. This dispersed ownership may lead to less effective monitoring of a bank's managers and to collusion between managers and the

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supervisory board (Brecht et al., 2002). The absence of effective monitoring may also allow the managers to pursue their own rather than the members' interests.

Fonteyne (2007) claims that cost of capital is generally lower in cooperative banks, which allows them to provide their products at lower prices. This advantage is offset by problems that may occur when quick fund-raising is needed. This is because, in some cases, the activities of cooperative banks on financial markets are legally restricted.

It is important to note that cooperative banking is not a single model, but differs among individual EU countries (see for example Ayadi et al. (2010) for individual differences). The above-mentioned characteristics of cooperative banks are typical but may not apply to all EU countries. Moreover, cooperative banking changes over time. The differences between commercial and cooperative banks have become less significant in recent years, but are still important enough to justify their individual treatment in empirical research.

Moreover, cooperative banks are particularly numerous and large in the EU. In 2011, there were approximately 3,800 cooperative banks with 6,900 billion Euros of total assets (Fiordelisi and Mare, 2014). In five EU member countries, cooperative banks represent more than 40% of the whole market (Hesse and Čihák, 2007), and overall, they account for approximately one-fifth of the European banking system (Fiordelisi and Mare, 2014). For these reasons, it is important to study this type of bank separately.

Section 5 deals with determinants of the net fee and commission income share in EU cooperative banks for the 2007 to 2014 time period. This essay uses a similar approach as that in Section 3 on the full set of EU banks. Again, we are mainly interested in the effect of changes in market competition on the magnitude of the fee income share. We have found a strong positive impact of bank concentration on the share of net fee and commission income, which proves that cooperative banks tend to have higher shares of fee income in less competitive markets. This is probably connected with the fact that they stick with their traditional deposit-taking and loan-providing model and the fees on these services are driven down by the competitors. Compared to commercial banks, cooperatives do not seem to expand heavily into non-traditional fee-bearing services under competition; therefore their overall fee income share decreases as the competitiveness of the sector increases. Similarly, as in Section 3, we conclude that higher fee income is connected with a higher equity to

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assets ratio. This result again hints at the higher riskiness of fee income compared to interest income.

The last essay in Section 6 deals with the topic of the low interest rate environment and its impact on the net interest margins of commercial and cooperative banks in the Eurozone. The low interest rate environment has prevailed in the EU since the financial crisis and led to a decrease in interest income on loans as well as in interest paid on deposits (i.e. banks' funding). The empirical literature suggests that low market interest rates have a negative effect on the net interest margin in the banking sector (Bikker and Vervliet, 2017, Altavilla et al., 2017, Borio et al., 2017, Claessen et al., 2018, Medaschi and Nuevo, 2017 and Genay and Posjasek, 2014). Nevertheless, the presented studies do not address the question about the relative performance of cooperative and commercial banks.

Based on the studies above, we concluded that commercial banks are more flexible when making business model adjustments when market conditions change and their profitability drops. Nevertheless, the reason why cooperative banks do not react to changes in competition and other market developments so quickly might be connected to the fact that they are able to maintain sufficient interest margins in these times.

We performed the analysis on a balanced panel dataset of 268 commercial and 726 cooperative banks for the 2008 to 2015 period. We employed the Fixed Effects estimation panel method.<sup>8</sup> As expected, we confirm a negative impact of a drop in market rates on the net interest margin. We conclude that cooperative banks were much harder hit by the decreased market interest rates compared to commercial banks. Therefore, we did not confirm our hypothesis that cooperative banks may feel less pressure to increase their fee income share because they are able to maintain higher net interest margins in the low interest rate environment. It seems that their ownership structure and more restrictive business regulations make them more vulnerable and provide them with fewer possibilities on how to cope with negative market development.

To the best of my knowledge, there are only a few studies examining fee income magnitude, its determinants and its impact on banks' performance in the EU in recent years. Most papers perform the analysis based on U.S. data or based on individual

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<sup>8</sup> Fixed Effects were used because they outperformed the other estimation methods that turned out to be either invalid or less efficient.

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countries, while this thesis considers the whole EU banking sector. The uniqueness of our dataset also lies in the examined time period around and after the financial crisis. This time period is especially interesting since it challenged the banking business models and their weaknesses emerged. As a reaction, banks took corrective actions, and governments and regulators implemented increased requirements for and more strict rules on the banking sector. Moreover, we perform the analysis on three levels – macro, sector and individual banks - which allows us to make more general conclusions about the fee income of European banks.

This thesis contributes to the current literature by also examining the impact of the market concentration on the magnitude of the fee income share. It is believed that increased competition leads to increased fee income shares since banks switch into non-traditional activities. However, the empirical evidence was missing. We found only Moshirian et al. (2011) dealing with this topic. Moshirian et al. (2011) use data from 20 developed countries (109 banks) from 1996 to 2010. Our analysis is based on more recent data for the whole EU except for Croatia. Furthermore, in this thesis, we deal with cooperative banks separately since we believe that their business model significantly differs from commercial banks, and therefore, the results might be different. We indeed confirm that cooperative banks react in a different way to increased competition compared to other banks.

We also believe that the methodology (the System Generalized Method of Moments) that we use for the estimation outperforms the standard approaches (Fixed Effects, Random Effects, and the Pooled Ordinary Least Squares) that have been used by other authors. This is due to the expected time persistence of the dependent variables, which makes the standard estimation methods inconsistent. Moreover, our approach is able to correctly treat not strictly exogenous explanatory variables. Nevertheless, the standardly used estimation methods were used for robustness tests. The results proved to be robust vis-à-vis the used estimation method as well as to major market changes, mainly speaking about the impact of the financial crisis on the relationship between the market concentration and the fee income share and the fee income share and banks' performance.

The contribution of the thesis is not only in the extension of the current empirical literature dealing with bank fees. The results presented here can also be used by policy makers. At the country level, our results suggest that no special policy treatment regarding fee income regulation is needed in the Czech Republic. This is because Czech banks are not extraordinarily dependent on fee income, which might

be potentially connected with higher risks compared to their EU peers. At the whole EU banking sector level, our results suggest that the discussed mandatory separation of certain non-traditional banking activities, such as trading, from retail banking could be beneficial since we did not find any diversification benefits from increasing the fee income share. In contrast, we have found evidence that a higher fee income share tends to increase the riskiness of EU banks.

# I. Banks

## 2 A comparison of bank fee and commission income in the Czech Republic and in the EU

**Published as:** Karolína Vozková, Petr Teplý (2020): An analysis of bank fee and commission income in the EU and in the Czech Republic in a low interest rate environment, Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration, Vol. 28, No. 2, pp. 1-8.

### *Abstract*

*This paper deals with the European banking sector's fee and commission income, with a special emphasis on the Czech Republic between 2007 and 2018. This topic is highly relevant, since fee income represents the largest portion of the non-interest income of EU banks, yet there is still no consensus on the optimal share of this type of income. Based on three financial ratios, we compare the magnitude of fee income across the EU banking sectors. Firstly, we conclude that Czech banks are not abnormally dependent on fee income, and their outstanding profitability is connected rather with sound risk management as well as with their sufficient liquidity and capital buffers. Secondly, we find that in the EU, fee income share followed an upward trend after the economic crisis, which might be connected with an effort to maintain the desired profitability in a prevailing low interest rate environment. We also study market concentration, which was moderate in the EU countries over the analysed period, and discuss the sustainability of the business model of the new Czech market entrants, the so-called low-cost banks, which provide most of their services without charging any fees.*

**Keywords:** bank fee and commission income, market concentration, bank performance, EU, low-cost banks, Czech Republic

**JEL classification:** G21, L25

## 2.1 Introduction

During the last decade, the European banking sector has faced many challenges. These were connected mainly to the global financial crisis, after which many banks were not able to maintain sustainable profits. Net interest income was declining due to low nominal growth and a long period of low interest rates. Nevertheless, interest is the main source of income of European banks, whose business is mainly oriented towards traditional commercial banking activities. One way how the compressed interest margins can be compensated for is by increasing fee and commission income, which represents the largest part of non-interest income in European banks. For some banks, the possibility of collecting more fees could be closely connected with the business activities from which they also collect interest income (ECB, 2016). For banks which are not able to switch to fee-bearing activities (in general, the activities of investment banks), fees might be complements to interest income rather than its substitutes. Moreover, increasing competition mainly from low-cost banks<sup>9</sup> and the negative attitude of the clients pushes this type of fee downwards.<sup>10</sup>

In this paper, we examine the magnitude of net fee and commission income (NFCI) in the EU, with a special emphasis on the Czech Republic. We analyse the evolution of the NFCI of the European banking sector in the years 2007 to 2018.<sup>11</sup> We examine the impact of market concentration on the magnitude of fee income and discuss the profitability of EU banks during the financial crisis and in the post-crisis period. We compare the magnitude of fee income in the Czech Republic with that of its EU peers and discuss whether Czech banks rely abnormally on fees. Looking closer at the Czech banking sector, we compare the income structure of individual banks and describe the differences between the traditional and low-cost banking business models.

The rest of the paper is structured as follows: Section 2.2 provides a literature review dealing with the causes of banks' increasing fee income share, as well as with the

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<sup>9</sup> Low-cost banks are banks whose business model is based on an internet platform. These banks provide only a limited portfolio of services, mostly without charging any fees (Hes and Jílková, 2016).

<sup>10</sup> For example, in the Czech Republic and Slovakia, a public survey on the most absurd bank fee was organized in the years 2005 to 2017 with the aim of putting pressure on banks to reduce or cancel those fees (Nacher, 2017).

<sup>11</sup> For the analysis of bank fee and commission income between 2007 and 2012 see Růžičková and Teplý (2015b).

optimal share of fee income. In Section 2.3, empirical analysis is provided. The first part of this section deals with the magnitude of banking sector fee income across the EU countries. It also analyses the relation between NFCI and banks' profitability, as well as the impact of increasing competition on the magnitude of banking fees. In the second part of this section, we deal with NFCI in the Czech banking sector and examine the different fee policies of selected Czech banks. Section 2.3.3.2 summarizes the paper and presents some final remarks.

## 2.2 Literature review<sup>12</sup>

There are various reasons why banks increase their NFCI share. Besides the attempt to diversify the portfolio of supplied services, it might be also connected with the need to substitute decreasing interest income. The literature suggests that increased competition (Moshirian et al., 2011) and prolonged periods of low interest rates (Brei et al., 2019; ECB, 2016) may force banks to switch to fee-bearing activities in order to remain sustainably profitable. Nevertheless, it is questionable whether such changes in provided services leading to the replacement of interest income by fee and commission income improve the performance of banks.

The optimal structure of banks' income should lead to increased stability and lower risks. Gambacorta and van Rixtel (2013) differentiate three main banking business models: i) commercial banks, with profits generated mainly from interest income, ii) investment banks, with profit largely dependent on non-interest income, with an NFCI/net total income ratio standardly over 40%, and iii) universal banks, which combine commercial and investment banking within one institution.<sup>13</sup> For a long time it was believed that universal banking offers optimal income diversification and financial stability. In response to the financial crisis, the economic costs and benefits of universal banks were reassessed and several restrictions concerning certain banking activities under one roof were considered.

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<sup>12</sup> For more detailed literature review see also Section 4.2.

<sup>13</sup> The division of banking models into three categories is, to a considerable extent, a simplification. For example, Liikanen et al. (2012) claim that the business models of banks are not one-dimensional, and therefore labels such as "commercial" or "investment bank" do not adequately describe the business model, its performance or its riskiness. There are more dimensions which need to be considered, such as size, activities, income model, capital and funding structure, ownership, corporate structure and geographic scope.

The main three alternatives to such a separation are as follows: the Volcker rule (2014) in the United States, the Liikanen Report (2012) suggested by the European Commission, and the Vickers Commission (2011) proposed in the United Kingdom. The Volcker rule forbids proprietary trading in deposit-taking institutions. The restriction is not very broad, but is quite strict, because the trading activities are not allowed to take place in different subsidiaries within the same group either. As well as proprietary trading, the Liikanen Report restricts market-making, but is not so strict. It proposes that proprietary trading and other significant trading activities should be carried out on a stand-alone basis if they form a significant share of a bank's business, i.e. if they exceed a certain (percentage) threshold of total assets. Still, the universal banking model would remain, since the activities are allowed to be performed by separate subsidiaries within the same group. The Vickers Commission's approach is even broader. It excludes a large set of banking activities from the protected entity, but the activities can still exist in different subsidiaries within the group, subject to intragroup constraints (Gambacorta and van Rixtel, 2013).

Whether such a separation of banking activities would really lead to improved financial stability, or whether less diversified banks would be more sensitive to market changes is questionable. The response to this question is probably highly dependent on the special features of the market in which the bank operates, on the nature of the clients, as well as on the specific conditions of the bank. In addition, the current literature is not unanimous about the optimal share of fee income and the impact of increasing fee and commission income share on banks' stability.

Lepetit et al. (2007) claim that "*banks expanding into non-interest income activities present higher risk and higher insolvency risk than banks which mainly supply loans*". Increased non-interest income may also lead to an overall rise in earnings volatility, since it is usually more volatile than interest income. The positive link with risk seems to be stronger for smaller banks and mainly driven by fee and commission activities.

Contrary to that statement of Lepetit et al. (2007), Köhler (2012) finds that banks' stability improves with increasing non-interest income, and that the effect decreases with bank size. In his later paper, Köhler (2013) finds substantial benefits from income diversification for smaller and more retail-oriented banks in Germany. These banks can become less risky by increasing their reliance on non-interest income. At the same time, larger and more investment-oriented banks should increase their share

of interest income to become more stable. This conclusion suggests that universal banking is the most appropriate banking business model.

Smith et al. (2003) state that income diversification can reduce the risk and stabilize the profitability of banks only if the different types of earnings are independent. Since they found a negative correlation between interest and non-interest income, it seems that non-interest income can stabilize a bank's total operating income.

Some of the above claims are supported by the findings of US researchers. DeYoung and Rice (2004b) find that higher reliance on fee-bearing activities tends to increase the volatility of banks' earnings streams. Moreover, DeYoung and Rice (2004a) conclude that well-managed commercial banks expand more slowly into non-interest activities. On a related note, Stiroh (2004a) claims that greater reliance on non-interest income increases overall riskiness in banks. He also states that the decreasing volatility of net operating income need not reflect the diversification benefits from non-interest income, but may be connected rather with the reduced volatility of net interest income.

Based on the existing literature, no general conclusion about the advantageousness of a specific banking business model and concrete optimal share of fee and commission income can be made.

## 2.3 Empirical analysis

### 2.3.1 Data and methodology

To investigate the magnitude of fee and commission income, we split the total operating income into three categories: The biggest part of net total operating income in EU banks consists of net interest income, i.e. generally the difference between interest obtained from issued loans and the interest paid on deposits. The second category is NFCI, which is the biggest part of non-interest income. This type of income is not only connected with standard commercial banking activities (deposit taking, loan provision), but is mainly obtained as a reward for non-traditional banking services such as retail brokerage, insurance sales, the issue of securities (in general, the core businesses of investment banking). The last category is other income, which covers all the income of a bank that differs from the previous two; in other words the income from non-core businesses.

Our empirical analysis consists of two parts. The first part investigates and compares the magnitude of NFCI across the EU countries. For this purpose, NFCI/Net total operating income (NFCI/TI), NFCI/Total assets (NFCI/TA) and NFCI/Gross domestic product (NFCI/GDP) ratios are used. Besides these ratios, we discuss the evolution of banks' profitability measured by Return on equity (ROE) and Return on assets (ROA)<sup>14</sup> and the impact of market concentration on the magnitude of NFCI. We use the annual data for the time period from 2007 to 2018<sup>15</sup>. The data were obtained from the European Central Bank (ECB) database. To make the analysis more accurate, we split the countries into five different groups, which are compared to each other. The first group includes all EU countries (EU); the second group consists of states which have adopted the euro as their common currency (EUROZONE); the third group is represented by Central and Eastern Europe countries (CEE<sup>16</sup>); the fourth group contains the countries which were the most badly hit by the financial crisis in 2008 and were unable to refinance their government debt or to bail out over-indebted banks on their own during the crisis (PIIGS<sup>17</sup>), and the last group consists solely of the Czech Republic.

The second part of the empirical analysis deals with fee and commission income in the Czech Republic. The data were obtained from the ECB and from the annual reports of individual banks. We comment on the development of the fee income of Czech banks between 2007 and 2018. We compare the fee strategies of individual Czech banks and we discuss how they have changed over last few years. Unlike the sector in many EU countries, the Czech banking sector has reported high capital and liquidity buffers in recent years, as highlighted by the CNB (2019b).

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<sup>14</sup> Although there might exist better profitability indicators such as Return on risk-weighted assets, we use ROE and ROA, since for these indicators comparable and good-quality data are available.

<sup>15</sup> For Austria, Cyprus, Germany, Denmark, Estonia, Spain, the United Kingdom, Greece, Ireland, Luxembourg, Latvia, Netherlands and Sweden the data are available starting from 2008. For Croatia, the data are available after its accession to the EU, i.e. starting from 2013. This fact was adequately treated in the analysis.

<sup>16</sup> Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia

<sup>17</sup> Portugal, Ireland, Italy, Greece, Spain

## 2.3.2 Fee income in the EU countries

### 2.3.2.1 Comparison of fee income magnitude across the EU countries

To assess the dependence of banks in individual EU countries on bank fees, we constructed three ratios, namely NFCI/TI, NFCI/TA and NFCI/GDP, and compared them with each other. We shall comment on the development of each ratio over the time period 2007 to 2018 and make a general conclusion about the fee income magnitude based on the averages of these ratios.

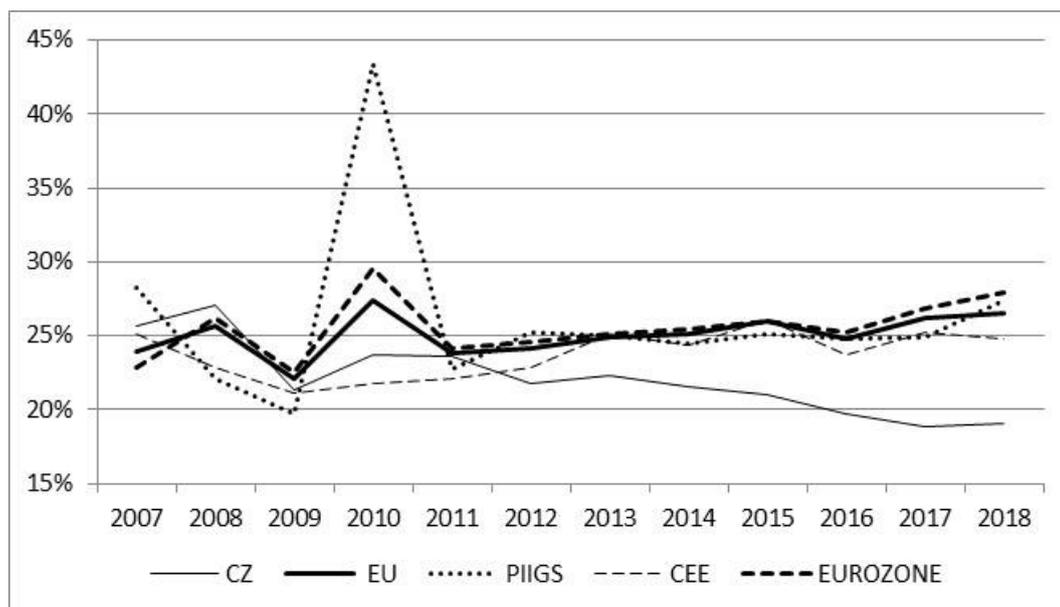
The development of NFCI/TI between 2007 and 2018 is depicted in Figure 2.1. A greater fluctuation in fee income share can be seen around the crisis years 2008-2010. After 2010, the NFCI/TI share stabilized, with a slowly increasing trend in all the examined groups. In all groups, we can observe a drop in NFCI/TI in 2009. In that year, NFCI/TI decreased the most in Germany, Luxembourg, Austria and the Czech Republic. In Germany, Austria and the Czech Republic, the drop in NFCI/TI is explained mainly by the increase in net total income accompanied by a stable or decreasing NFCI. This suggests the quick recovery of these economies after the financial crisis. In Luxembourg, both net total income as well as NFCI declined in 2009, but a relatively higher drop in NFCI caused the whole ratio to decrease.

The pronounced increase in NFCI/TI in 2010 in the PIIGS countries, as well as in the EU and the EUROZONE, is caused by a single outlying country, namely Ireland. Due to a sharp drop in net total operating income from more than EUR 17 billion to EUR 1.5 billion in 2010, the NFCI/TI of Ireland was 117.97%. This post-2008 Irish banking crisis resulted in a government bank bailout and, later, in financial support from the EU and the International Monetary Fund. Without Ireland, the 2010 NFCI/TI values would be 24.77% in the PIIGS, 23.95% in the whole EU, and 24.61% in the EUROZONE. In other words, excluding Ireland, the magnitude of NFCI/TI had returned to its pre-crisis values as early as 2010.

After the year 2010, a gradual growth in NFCI/TI among the EU countries can be observed, with a more pronounced increase in 2018. This was caused by an increase in EU banks' average NFCI of 1% accompanied by a 1% decrease in net total income. This suggests that EU banks probably compensated for the low interest rates by increasing fee and commission income.

Compared to its EU peers, the Czech Republic displayed a higher NFCI/TI in the pre-crisis period, while after the crisis it remained below the EU average. Moreover, the NFCI/TI of Czech banks had been decreasing since 2010. In 2018, it was almost 7.5 percentage points lower than the EU average.

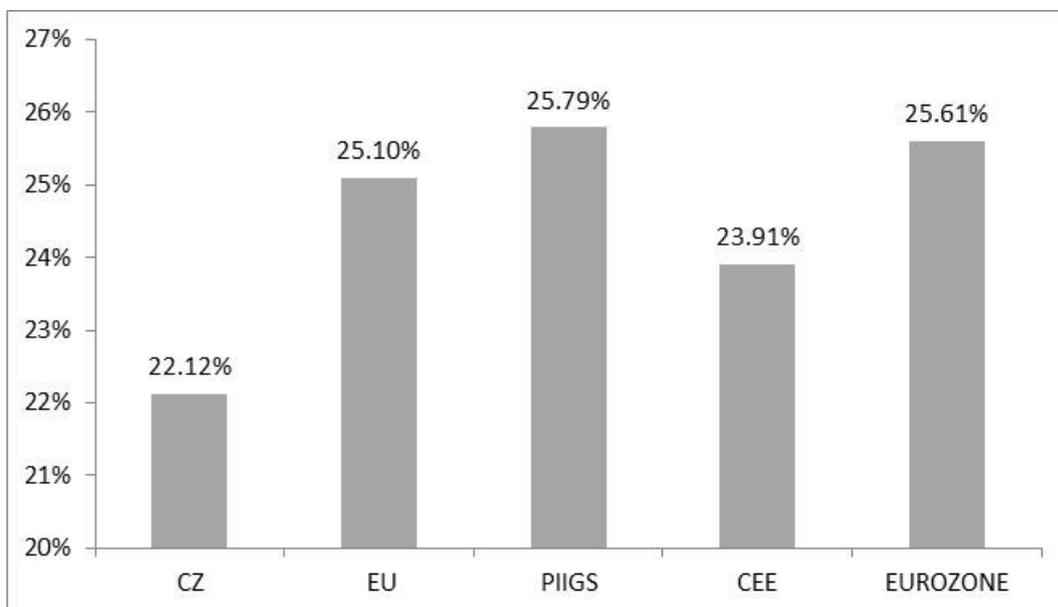
**Figure 2.1: Development of Net fee and commission income/Total income in the EU between 2007 and 2018**



Source: Authors based on the ECB database

The prevailing low fee income share in the Czech Republic compared to the rest of the EU is apparent also from Figure 2.2, which depicts the average NFCI/TI in individual groups of countries between 2007 and 2018. The average NFCI/TI in the Czech Republic is almost 3 percentage points lower than in the EU. In general, CEE countries have a lower than average NFCI/TI. On the other hand, the PIIGS exhibit the highest shares of fee income over the analysed period. This is heavily influenced by Ireland's NFCI/TI in 2010 as described above. After the exclusion of this outlying value, the PIIGS average NFCI/TI would be 24%, the EU's average would be 24.78% and the EUROZONE's average would be 25.14%. Among individual EU countries, only Malta (11.85%), Greece (14.81%), Cyprus (15.55%), Denmark (21.18%), Romania (21.31%) and Bulgaria (21.64%) report lower average fee income shares than the Czech Republic.

**Figure 2.2: Net fee and commission income/Total income in the EU – averages for 2007–2018**



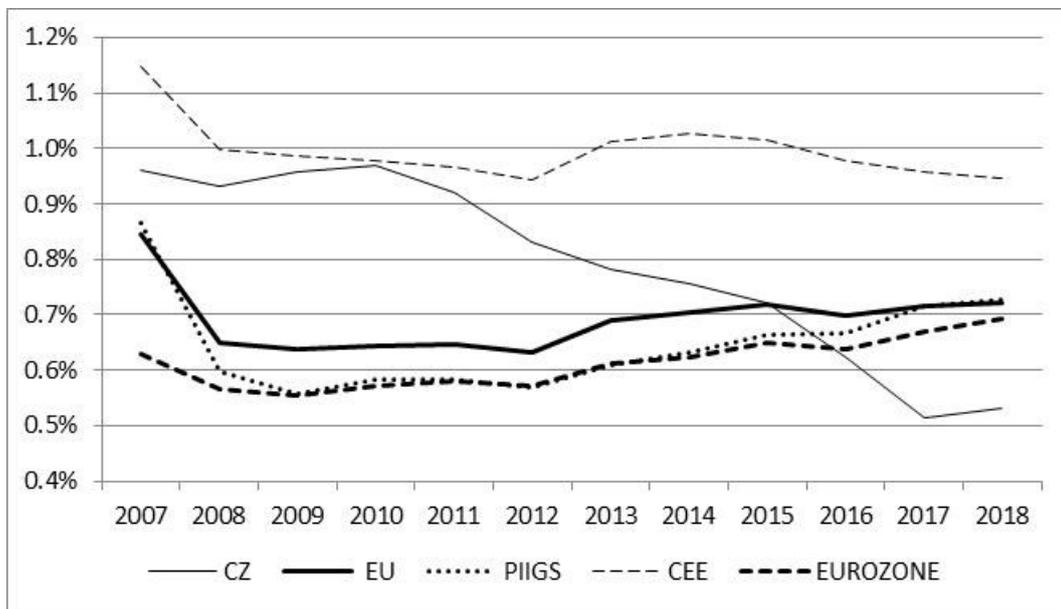
Source: Authors based on the ECB database

Figure 2.3 and Figure 2.4 depict the development and average NFCI/TA in the period 2007 to 2018. The average NFCI/TA in the Czech Republic is 0.1 percentage points higher than that of the EU countries. The only group exceeding the Czech NFCI/TA is the group of CEE countries. Figure 2.3 shows that the higher NFCI/TA in the Czech banking sector was present mainly in the years around the financial crisis. After 2010, this ratio exhibited a declining trend; more precisely, while in the years 2007 to 2010 NFCI/TA in the Czech banking sector was close to 1%, it dropped to nearly 0.5% in 2017. The EU average was reached in 2015, and after that year, the Czech Republic's NFCI/TA stayed below the EU values.

The higher values of NFCI/TA in the Czech Republic can be explained mainly by the low total assets of the banking sector in past years. This can be illustrated by comparing the Czech Republic with Finland. Both countries exhibit a very similar absolute amount of NFCI as well as NFCI/TI, but the Finnish banking sector has total assets more than twice as high. The continuous decrease in NFCI/TA in the Czech Republic was caused mainly by increasing total assets. While in the year 2007, the total assets of Czech banks were less than EUR 140 billion, in 2018 the amount almost doubled and reached more than EUR 270 billion. This was caused mainly by interventions of the Czech National Bank, which was aiming to maintain the exchange rate of the Czech koruna to the Euro at the level of 27 CZK/EUR. The interventions started in November 2013 and ended in April 2017. The biggest

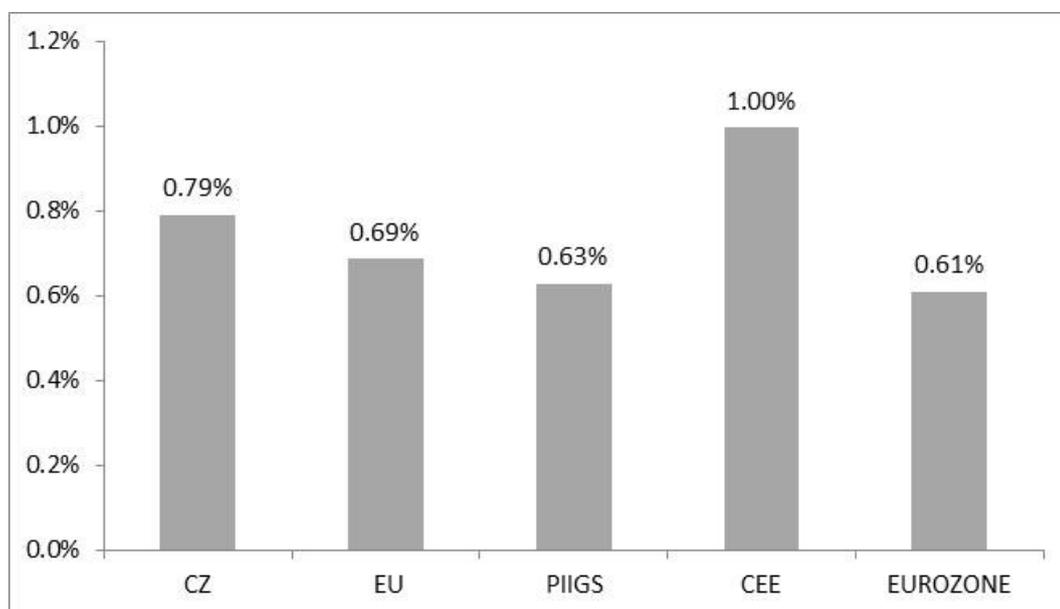
increase in total banking assets was observed in 2017, and in that year the interventions were most pronounced. This can be observed in the foreign exchange reserves of the Czech National Bank, which increased from EUR 81,345 million in 2016 to EUR 123,356 million in 2017 (CNB, n.d.). In general, a pronounced increase in the total assets of the banking sector between 2007 and 2018 can be observed in the CEE countries, while in the rest of the EU, banking assets were, rather, falling or constant. One exception is Finland, which saw a rise in total assets of 174%.

**Figure 2.3: Development of Net fee and commission income/Total assets in the EU between 2007 and 2018**



Source: Authors based on the ECB database

**Figure 2.4: Net fee and commission income/Total assets in the EU – averages for 2007–2018**

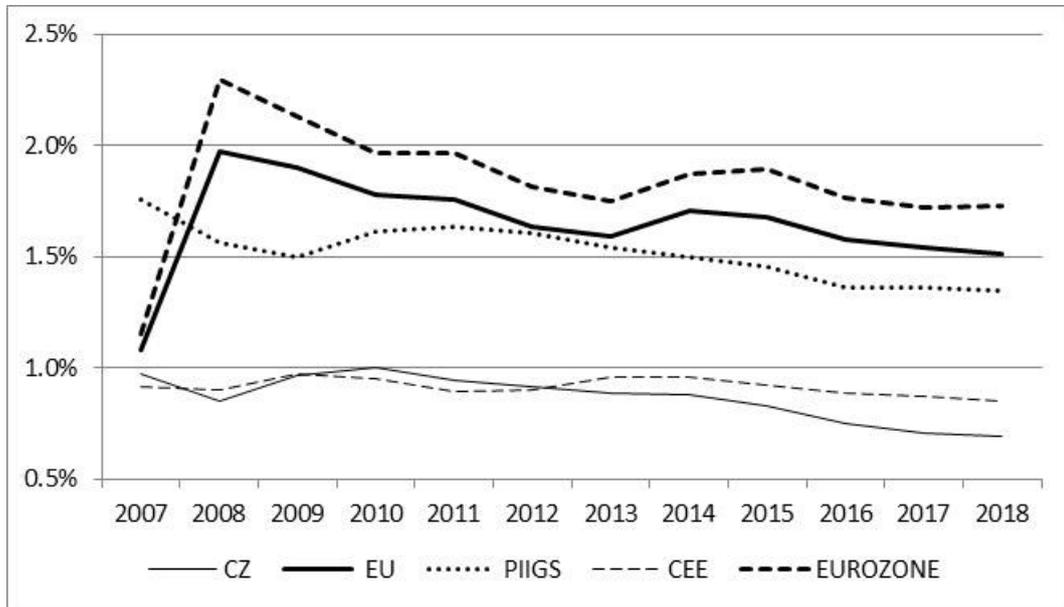


Source: Authors based on the ECB database

The last ratio that we use to compare the magnitude of NFCI in the EU countries is NFCI/GDP. The average NFCI/GDP in the Czech Republic is the lowest among the compared groups. The values in the other CEE countries are also moving close to the Czech values. The EU average is almost twice as high as that of the Czech Republic. In Figure 2.5, a high increase in NFCI/GDP can be observed between 2007 and 2008. This is caused by the missing data for 2007 for some countries as described above.<sup>18</sup> The decreasing trend of NFCI/GDP observed in all EU countries is mainly explained by increasing GDP.

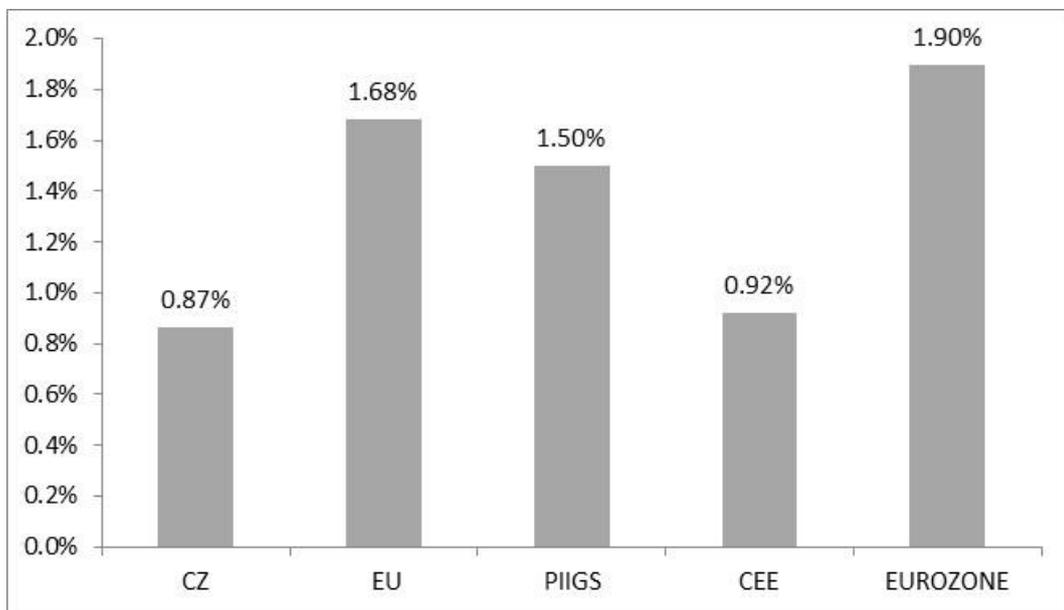
<sup>18</sup> To check this assumption, we replaced the missing data in 2007 by the values for 2008. After this correction, NFCI/GDP in the year 2007 was 1.94% in the EU, 1.59% in the PIIGS countries, 0.92% in the CEE, and 2.27% in the EUROZONE, and hence the huge jump between 2007 and 2008 for the EU and the EUROZONE groups was eliminated by this correction.

**Figure 2.5: Development of Net fee and commission income/GDP in the EU between 2007 and 2018**



Source: Authors based on the ECB database

**Figure 2.6: Net fee and commission income/GDP in the EU – averages for 2007–2018**



Source: Authors based on the ECB database

A summary of the results discussed above can be found in Table 2.1, which suggests that banks in the Czech Republic do not rely abnormally on fee and commission income. More precisely, NFCI/TI and NFCI/GDP ratios are lower in the Czech Republic compared to the rest of the EU. Only NFCI/TA exceeds the EU average, but

this is connected rather with the relatively small size of Czech banks than with high NFCI. Moreover, the trend of NFCI/TA in the Czech Republic is decreasing, and in recent years this ratio too has moved below the EU average.

**Table 2.1: Average net fee and commission income ratios of different groups of the EU countries compared to the EU averages (years 2007–2018)**

	NFCI/TI	NFCI/TA	NFCI/GDP
CZ	-	+	-
PIIGS	+	-	-
CEE	-	+	-
EUROZONE	+	-	+

*Source:* Authors' computation

### 2.3.2.2 Relationship between market concentration and the magnitude of fee income<sup>19</sup>

In order to assess the relationship between banking sector concentration and the magnitude of fee income, we retrieved from the ECB database the Herfindahl index (HI).<sup>20</sup> HI is commonly used to measure the concentration of a given market by assessing the size of firms in relation to the industry in which they operate. The HI's values range between 0–10,000. 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).

As can be seen in Figure 2.7, the market concentration of the European banking sector was moderate over the whole examined period,<sup>21</sup> with an average HI of 1,138

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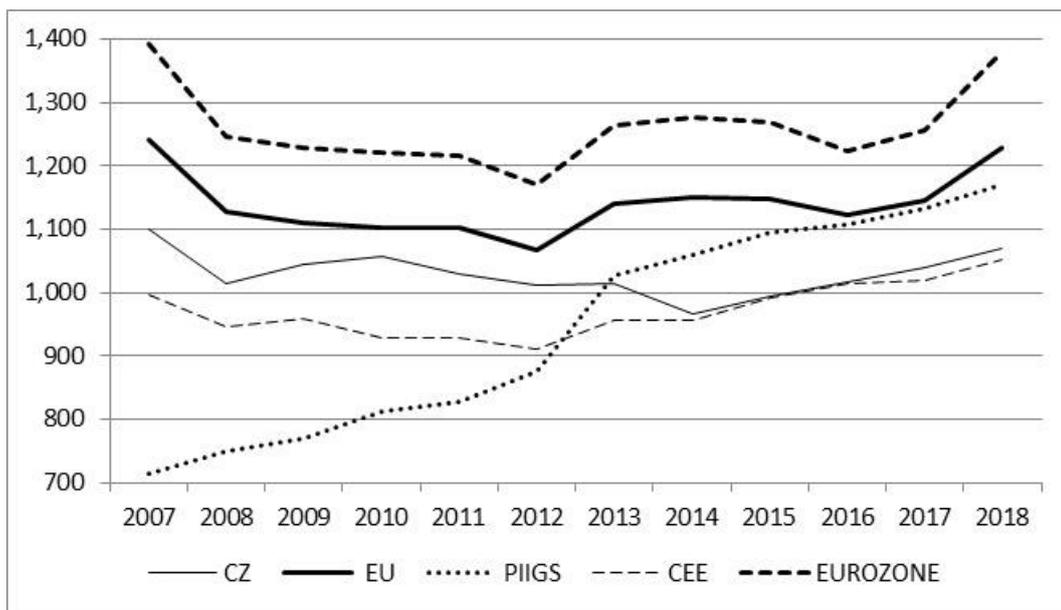
<sup>19</sup> A more detailed analysis of the impact of market concentration on fee income can be found in Sections 3 and 5.

<sup>20</sup> Among other market concentration indicators, we have chosen the HI mainly due to its good availability. The Lerner index and the Boone indicator, commonly used proxies for market concentration, are available in the FRED database only up until 2014. Moreover, the Lerner index may be influenced by other factors besides market concentration (Kraft, 2006). A disadvantage of the Boone indicator is that it assumes that banks generally pass on at least part of their efficiency gains to their clients (van Leuvensteijn et al., 2011).

<sup>21</sup> The initial drop in HI that can be observed in the EU, the EUROZONE and the CEE countries was most probably caused by missing data for some countries in 2007. To test this hypothesis we replaced the missing data by the values for 2008. After this correction, the HI for 2007 moved to 1,084 in the EU, while it moved to 1,227 in the EUROZONE, and to 850 in the CEE.

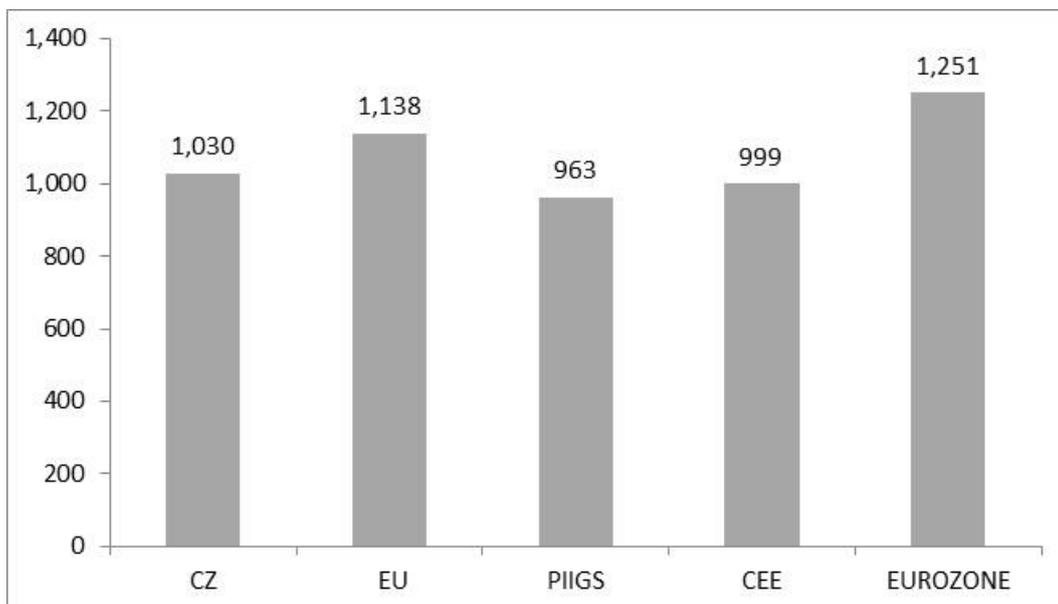
(see Figure 2.8). The HI of the Czech banking sector is constantly below the EU average, hence there is more competition between Czech banks. Nevertheless, on average, a moderate concentration prevails in the Czech Republic too. Only the PIIGS and CEE countries exhibit low average market concentration. This stems more from past years, because from Figure 2.7 it can be seen that in those countries, market concentration increased between 2007 and 2018. In the PIIGS countries the rise in the HI was caused by decreasing competition in Spain, Greece and Italy and was quite pronounced. It increased from 713 in 2007 to 1,171 in 2018. This might have been caused by the financial crisis, after which some banks merged and some ceased to exist. In 2018, all groups of countries exhibited moderate banking sector concentration.

**Figure 2.7: Development of the Herfindahl index in the EU between 2007 and 2018**



Source: Authors based on the ECB database

**Figure 2.8: Herfindahl index in the EU – averages for 2007–2018**



*Source:* Authors based on the ECB database

The theory suggests that higher competition should lead to lower fee and commission income, since competition pushes down the prices of individual services. Contrary, high concentration can lead to the formation of cartels, which prevent the players from reducing the imposed fees. Clients then have fewer possibilities to switch to a cheaper provider. This would suggest that the absolute value of fee income would decrease with more banks entering the market. This effect does not need to be very strong, because of the transaction costs connected with switching from one bank to another. We also assume that most clients are conservative and not flexible enough to deposit their money or take a loan from abroad because of financial fragmentation on EU markets. Moreover, as suggested by DeYoung and Rice (2004a) banks facing higher competition in lines of businesses such as lending may feel higher pressure to increase prices of fee-based services to their depositors.

Since we do not measure the magnitude of fee and commission income based on absolute, but rather on relative values, the result might be different. Increased competition would not have a negative effect on the magnitude only of imposed fees, but probably also on other types of bank income. Therefore, the share of total income represented by fees does not need to change. Furthermore, increasing market competition is assumed to be one of the main reasons why banks switch from traditional banking activities to non-traditional fee and commission income-bearing activities (Edwards and Mishkin, 1995, Davis and Tuori, 2000). Consequently, we

expect that a higher HI should lead to higher NFCI/TI. This expectation is also in line with findings of Moshirian et al. (2011).

In order to check this hypothesis on macro data, we plotted the relationship between NFCI/TI and HI averages between 2007 and 2018 in EU countries in a scatter plot (see Figure 2.9).

Figure 2.9 plots the following regression line:

$$\frac{NFCI}{TI} = -0.00004HI + 0.2923 + e, \quad 2.1$$

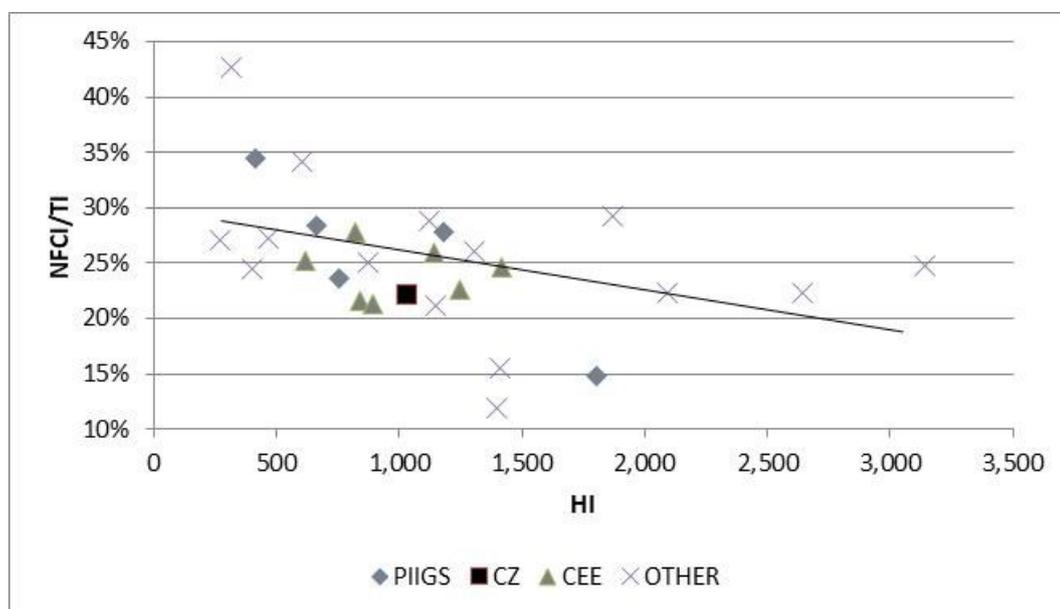
where  $e$  is the disturbance. The P-value of the coefficient is 0.0310, and, therefore, the coefficient is statistically significant. The  $R^2$  of the regression is 0.1684, meaning that the explanatory variable is able to explain almost 17% of the variance of the dependent variable, which does not indicate a very strong relationship.

The regression result suggests that in more concentrated markets, NFCI/TI tends to be lower, which is against our expectation. This surprising result shows that the relationship between market concentration and the magnitude of fee income might be ambiguous. It could also be connected with a quite extensive simplification of the model. We assume that switching to new activities and adjusting the business model is a relatively long process in banks. Therefore, the expected relationship might be found rather in panel data with longer time periods. In the short term, the effect of increased competition on imposed fees might be rather negative. Since our model uses average data between 2007 and 2018, the time effect, which might be important, is disregarded. The impact of increased competition on fee income might depend on which bank business model is applied. Some types of bank might be less willing or able to change their business activity even over longer time periods.<sup>22</sup> This fact too is disregarded in the model. Moreover, the model neglects many other explanatory variables which can affect the magnitude of NFCI/TI. Still, it needs to be noted that the found relationship does not seem to be very strong since  $R^2$  is quite low. By looking at fee income at a macro (country) level in the post-crisis period, we might find that significant changes in NFCI/TI magnitude in European banks are connected with the effort to compensate the decreased interest margins in the prevailing low interest rate environment rather than with changing competition.

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<sup>22</sup> See Sections 3 and 5, which contain a more detailed analysis of the connection between HI and NFCI/TI in different bank types.

**Figure 2.9: Relation between Net fee and commission income/Total income and the Herfindahl index in the EU based on average data from 2007 to 2018**



Source: Authors based on the ECB database

### 2.3.2.3 Profitability of EU banking sectors

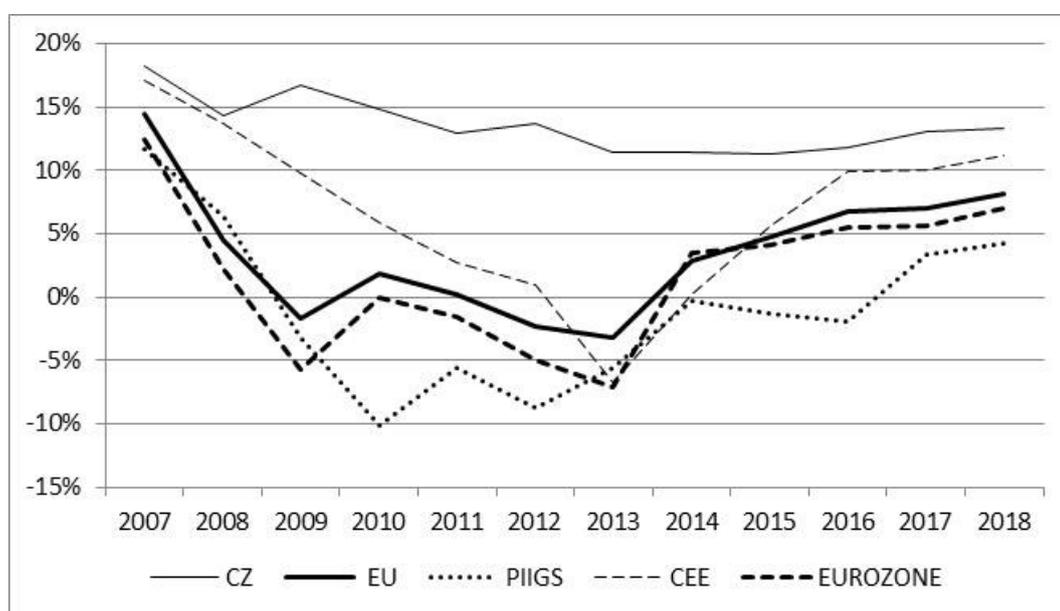
Figure 2.10 and Figure 2.11 depict the development of the ROE and ROA in the EU banking sector between 2007 and 2018. The impact of the financial crisis, which hit the whole EU and led to a drop in the profits of European banks, can be seen at first sight. The magnitude of the impact was, nevertheless, highly uneven. According to their own definition, it is clear that the crisis had the most severe effect on the PIIGS countries. In those countries, ROE dropped by more than 20 percentage points between 2007 and 2010. More precisely, their ROE in 2007 was 11.65% and in 2010 it was -10.13%. ROA followed a similar pattern. Moreover, the duration of negative profits was longest among the PIIGS countries. They did not return to black figures until 2017, while when examining the whole EU banking sector, positive profitability was reached already in 2014. Starting from 2015, the EU banking sector was further supported by ECB's quantitative easing which provided increased liquidity to banks in the EUROZONE.

It can be seen that in terms of profitability, the Czech banks were above the EU average during the whole period. Their ROE moved around 13.59%, with its highest value in 2007 (18.27%) and its lowest value in 2015 (11.28%). ROA attained 1.2% on average. On average, Czech ROE and ROA were the highest among all EU

countries. Furthermore, it can be seen that the volatility of profitability in Czech banks was much lower compared to that in its EU peers.

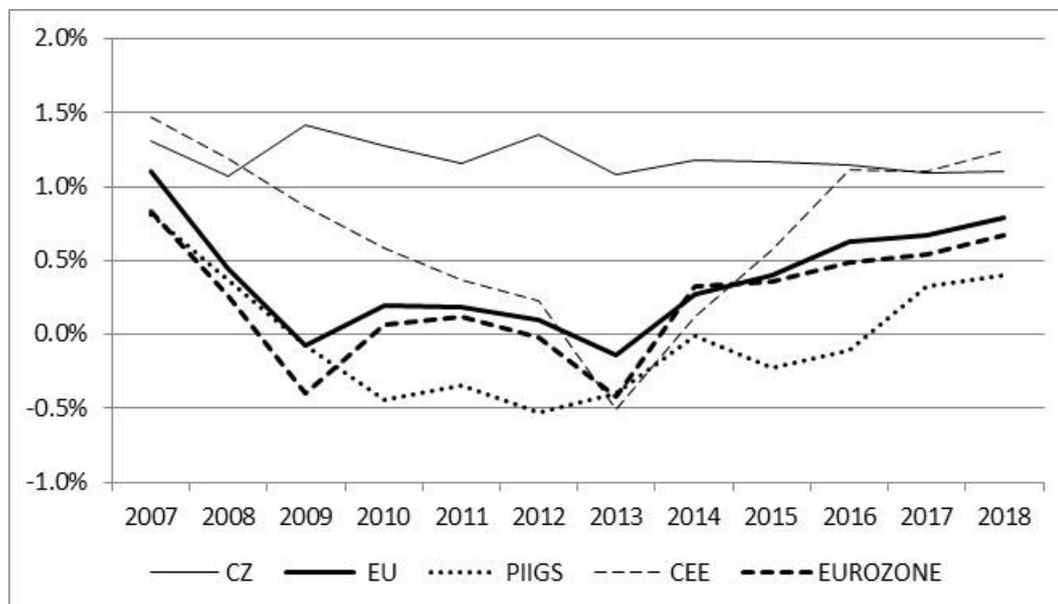
Other CEE countries also outperformed the rest of the EU in terms of profitability. The only year in which the CEE countries reported negative ROE and ROA was 2013. This was caused by Slovenia, which reported ROE -90.25% and ROA -7.99%. Without Slovenia, the indicators for the CEE region would be positive over the whole analysed period.

**Figure 2.10: Development of ROE in the EU between 2007 and 2018**



Source: Authors based on the ECB database

**Figure 2.11: Development of ROA in the EU between 2007 and 2018**



Source: Authors based on the ECB database

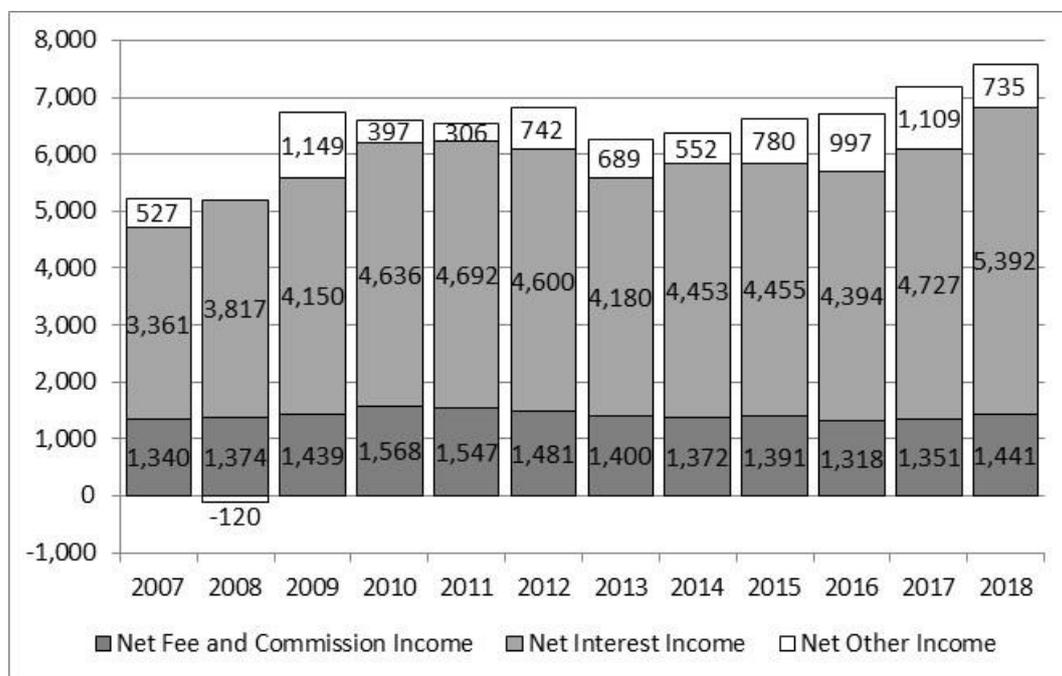
The following aspects played a role in preventing the Czech banks from suffering from large losses during the global financial crisis: i) there were very few exotic ‘toxic assets’ and low exposure to the PIIGS countries’ government bonds, ii) there was a focus on traditional conservative commercial banking concentrating on the domestic market, iii) there was low foreign exchange risk, since most activities in the Czech banks are undertaken in the domestic currency, iv) there was a centralized ‘under-one-roof’ structure and conservative supervision, v) there was a high volume of deposits (the loan-to-deposit ratio is constantly under 80%) and high liquidity leading to low dependency on the inter-bank market or the central bank, vi) there was also good systemic capitalization (the capital adequacy ratio is higher than 15% in the Czech Republic) and high quality of capital (EBF, 2012). All in all, we can say that the underlying soundness and high profitability of the Czech banking sector may be attributed to proper risk management and high cost efficiency rather than to a high level of bank fee and commission income, as will also be discussed in the following section.

### 2.3.3 Fee income in the Czech Republic

In this section, we shall describe and analyse the NFCI of the Czech banking sector. Figure 2.12 shows the decomposition of net total operating income between the years 2007 and 2018. It can be seen that largest part of income stems from interest. NFCI is

the second most important component of the net total operating income in Czech banks over the whole analysed period. At the same time, NFCI represents the largest part of non-interest income. This decomposition of net total operating income is typical for the commercial banking model which is predominant in all EU countries. On average, the yearly NFCI in the Czech banking sector has reached EUR 1,418 million. The lowest amount of NFCI was recorded in the year 2007 (EUR 1,340 million), while the largest was in the year 2010 (EUR 1,568 million). In absolute terms, fee and commission income was almost stable over the analysed period.

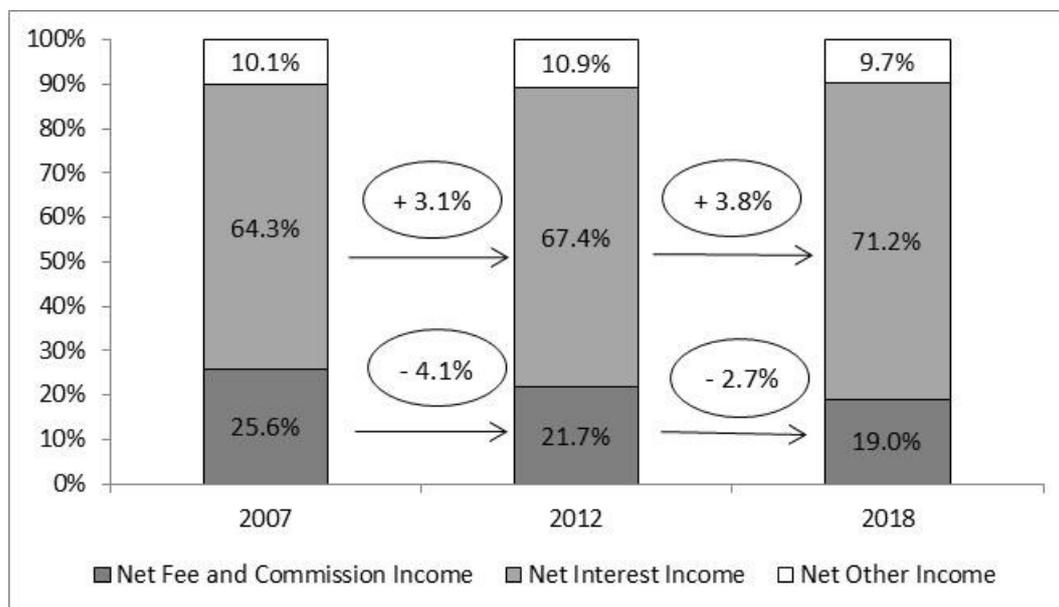
**Figure 2.12: Czech banking sector – Total operating income decomposition 2007–2018 (in EUR millions)**



Source: Authors based on the ECB database

It is worthwhile noting that while, in absolute terms, NFCI was nearly stable, in relative values we can observe a significant drop between 2007 and 2012 as well as between 2012 and 2018. Figure 2.13 shows that in relative values, NFCI fell by 4.1% between 2007 and 2012. Until 2018, NFCI/TI share decreased by a further 2.7%. This was caused mainly by increasing net interest income, which was not accompanied by a corresponding rise in NFCI. Therefore, the decrease in NFCI/TI was compensated for by an increase in the share of net interest income. The share of net other income remained almost unchanged.

**Figure 2.13: Czech Republic – Total operating income decomposition 2007, 2012 and 2018 (in %)**



Source: Authors based on the ECB database

### 2.3.3.1 Different banking models in the Czech Republic

As of December 31<sup>st</sup> 2018, the Czech banking sector consisted of 50 banking institutions: 4 large banks, 5 medium-sized banks, 9 small banks, 27 foreign bank branches and 5 building societies.<sup>23</sup> About 70% of the capital in the Czech banks originates in foreign countries, mostly in the EU. The TOP 4 banks dominated the market with a more than 60% share (CNB, 2019a).

The development of market concentration in the Czech Republic is depicted in Figure 2.14. It can be seen that over almost the whole analysed period, the market concentration was moderate. Only in the years 2014 and 2015 did the HI drop below 1,000, which indicates high competition.

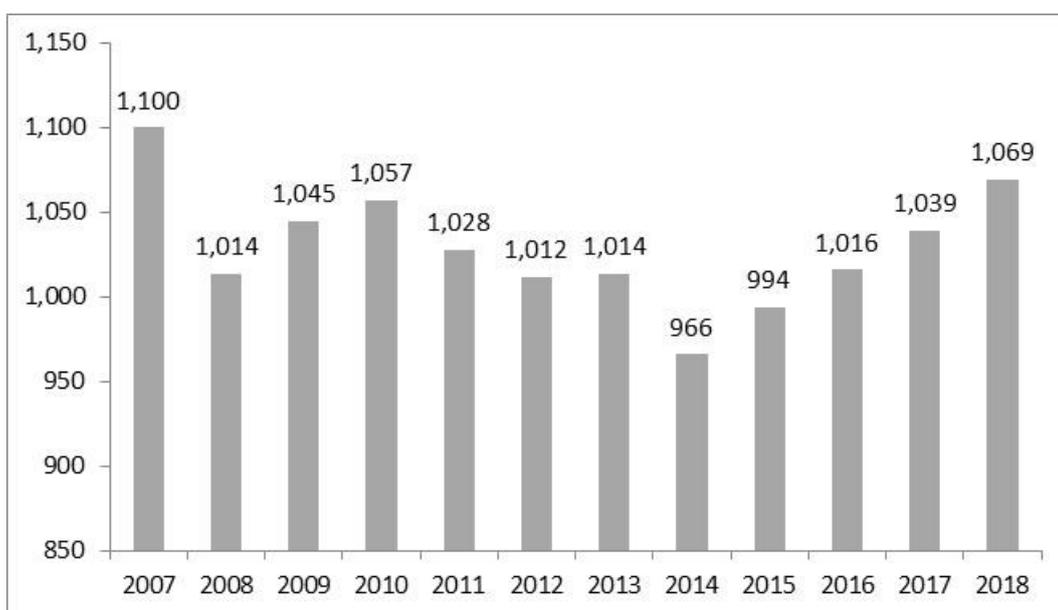
Among other factors, the Czech banking sector was greatly changed by new entrants known as “low-cost banks”, whose business model is based on an internet platform (Hes and Jílková, 2016). This type of bank provides only a limited portfolio of services, mostly without charging any fees. The first low-cost bank – mBank - entered the Czech market in 2007. Nowadays there are four low-cost banks in the Czech Republic – mBank, Air Bank (AIR), Fio banka (FIO) and EQUA bank (EQUA). Between the years 2010 and 2017, there was also ZUNO bank (ZUNO),

<sup>23</sup> For a complete list see CNB (2019a, p. 127).

which operated in the Czech Republic as a low-cost bank. After several unsuccessful years in which ZUNO suffered losses, the bank terminated its activities in 2017.

To attract new clients, low-cost banks often offer high interest on saving accounts. These excessive rates might, therefore, be perceived as acquisition costs rather than a money-making business. Besides other factors, the entry of this type of bank probably also had an impact on provided banking services and contributed to an increase in the efficiency of the whole Czech banking sector. This can be illustrated by the number of banking units, which significantly dropped from 2013. While in 2013, there were 2,277 banking units, in 2018 only 1,955 remained (CNB, 2019a). The whole banking sector is becoming more digital.

**Figure 2.14: Development of the Herfindahl index in the Czech Republic between 2007 and 2018**



*Source:* Authors based on the ECB database

Low-cost banks differ from commercial and investment banks also in terms of income structure. Not surprisingly, their zero-fee policy leads to very low or even negative NFCI. The NFCI/TI of individual Czech banks in 2012 and 2018 is depicted in Figure 2.15. It can be seen that, on average, NFCI/TI in the Czech banking sector decreased from 21.7% in 2012 to 19% in 2018. Nevertheless, these shares of fee income suggest that in the Czech Republic the traditional model of commercial banking prevails.

Figure 2.15 shows that the traditional commercial banks (Česká spořitelna (ČS), Československá obchodní banka (ČSOB), Raiffeisenbank (RB), Komerční banka (KB), UniCredit Bank (UCB), MONETA (formerly GE) Money Bank (MONETA (GE))) exhibited in both years NFCI/TI ranging from 16.3% (ČSOB in 2012) to 29.5% (ČS in 2012). In most of these banks NFCI/TI fell between 2012 and 2018. Only in the case of ČSOB can a slight increase of 1.4 percentage points be observed. This was probably caused by pressure from the low-cost banks, which caused a reduction in fees on services in the commercial banks. It seems that within the analysed time period, the commercial banks in the Czech Republic did not increase their overall NFCI/TI by substituting the decreasing fee income on commercial banking services with increased fee income on non-traditional activities.

On the other hand, the low-cost banks exhibited much more divergent NFCI/TI magnitudes compared to the traditional banks. NFCI/TI in these banks ranged from -11.8% (EQUA in 2012) to 37.4% (FIO in 2012). In general, we would expect to find very low or even negative NFCI/TI in low-cost banks. This feature can be observed in Air Bank and EQUA Bank. These two banks reported negative NFCI/TI in 2012. In 2018, their NFCI/TI increased significantly compared to 2012, but still remained negative or very low.

The increase in NFCI/TI might be connected to the fact that in 2012 the low-cost banks were starting up their business in the Czech Republic and needed to attract new clients. Their business model was initially very risky and not very profitable. This is connected with i) a significant reliance on funding from savings accounts – risky instruments that cannot be hedged by standard risk mitigation techniques (Džmuráňová and Teplý, 2013), ii) a limited product portfolio (e.g. savings and current accounts, consumer loans, mortgages), which makes them vulnerable to competition and low prices, iii) risky portfolios, since they relied solely on interest income and, most likely, lent money to risky borrowers (often rejected by traditional banks).

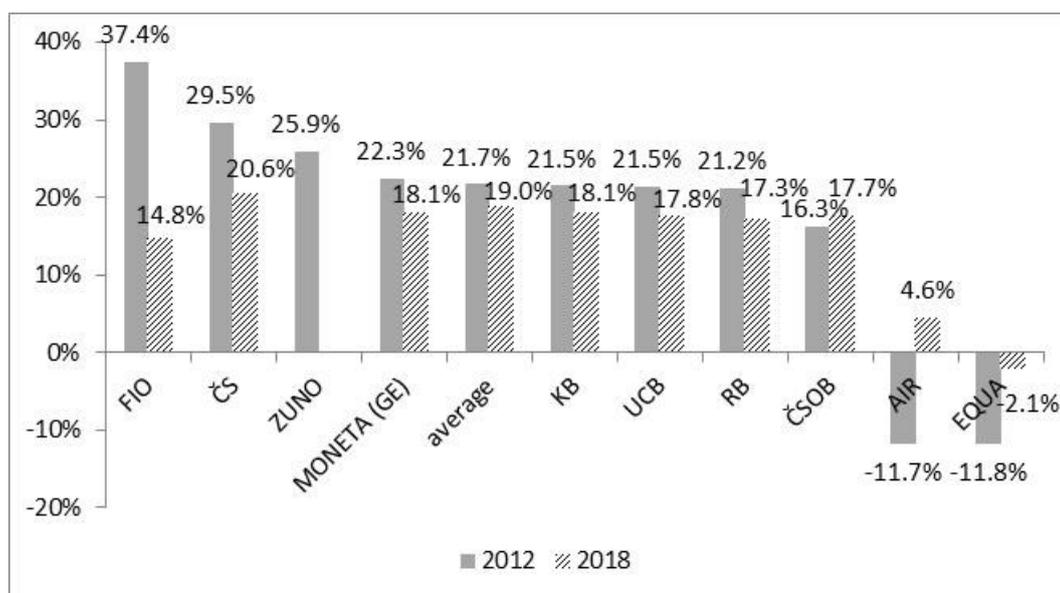
Nowadays, low-cost banks are well established in the Czech Republic and have a growing clientele. This can also be seen in the development of total operating income, which, from 2012 to 2018, increased by more than 8 times in Air Bank, and in EQUA Bank by even more than 24 times. Moreover, the fee and commission incomes and expenses of these banks have increased from tens to hundreds of millions of crowns. The clients of low-cost banks no longer need to be much riskier than the clients of traditional commercial banks. This claim is based on the

assumption that clients in the Czech Republic are still conservative and take loans from the banks in which they also have their deposits.

Two other low-cost banks in our sample – ZUNO and Fio banka – exhibited very high NFCI/TI in 2012. This was due to the special features of these banks. In ZUNO, the NFCI/TI of almost 26% was caused by the negative total operating income in this bank. Combined with negative NFCI (a net expense of CZK 6 million), the ratio ended up positive. For 2018 we do not have any value for ZUNO, because, as stated above, this bank closed in 2017 after several years of losses.

Fio banka was established as early as 1993<sup>24</sup>. Originally, its business was focused on securities trading. Further services and investment banking activities were gradually added until, in 2010, Fio banka obtained permission from the Czech National Bank to receive deposits and provide loans. Based on Figure 2.15, we can conclude that in 2012, Fio banka was still mainly oriented towards investment banking. Therefore its NFCI/TI of 37.4% matched the standard magnitude of NFCI/TI in investment banks. In 2018, the NFCI/TI of Fio banka dropped by more than half. This suggests that its reliance on investment banking activities decreased, and they were substituted by deposit-taking/loan-providing activities with a zero-fee policy.

**Figure 2.15: Net Fee and Commission Income/Total Operating Income in Czech Banks in 2012 and 2018**



Source: Authors based on data from individual banks and the ECB database

<sup>24</sup> Originally, FIO was a financial group without banking licence. It became a bank, and obtained a banking licence - in 2010.

### 2.3.3.2 Case study: fee income in ČSOB, J&T, FIO

Below, we discuss the detailed composition of fee and commission income in different types of banks based on examples from the Czech banking sector. In particular, we discuss fees and commissions in ČSOB as a representative of a universal bank, J&T Banka (J&T) as a representative of an investment bank or, rather, an investment oriented universal bank, and FIO as a representative of a transactional low-cost bank. Data and information for the analysis were taken from the 2018 annual reports (consolidated financial statements) of the individual banks (ČSOB, 2019; J&T, 2019; FIO, 2019).

#### ČSOB

ČSOB is a universal bank providing a wide range of products and services to all groups of clients, i.e. retail and small and medium enterprises, corporate and institutional clients. The ČSOB group's product portfolio includes, besides standard banking services, also mortgages and building savings loans, insurance products, pension funds, collective investment products and asset management, leasing and factoring and services related to equity trading on financial markets. ČSOB is classified as a large bank according to CNB (2019a).

The largest share of fee and commission income, as well as expenses, is attributed to payment services (see Table 2.2). This item represents 48.5% of total fee income and more than 66% of total fee expenses. Payment services are, on the income side, followed by the administration of credits and network income fees. The second largest item on the fee expense side is retail service fees. This fee income structure suggests that ČSOB is more of a commercial banking-oriented universal bank.

**Table 2.2: ČSOB NFCI decomposition in 2018**

	<i>CZK millions</i>	<i>%</i>
<b>Total fee and commission income</b>	<b>11,427</b>	<b>100</b>
Payment services	5,539	48.5
Administration of credits	1,534	13.4
Network income	995	8.7
Collective investments	861	7.5
Distribution	839	7.3
Securities	285	2.5
Custody	198	1.7
Asset management	31	0.3
Other	1,145	10.0

	<i>CZK millions</i>	<i>%</i>
<b>Total fee and commission expense</b>	<b>3,405</b>	<b>100</b>
Payment services	2,260	66.4
Distribution	25	0.7
Retail service fees	385	11.3
Commissions to agents	136	4.0
Other	599	17.6
<b>Net fee and commission income</b>	<b>8,022</b>	<b>-</b>

*Source:* Authors based on ČSOB (2019)

The rather traditional orientation of ČSOB is visible also when we examine the individual strategic business units (see Table 2.3). The operations of ČSOB can be divided into five different segments: Retail, Relationship Services, Financial Markets, Specialised Banking and the Group Centre. Retail includes traditional banking services such as deposits, loans and payment solutions provided to private clients and entrepreneurs, except for private banking customers. The NFCI attributable to this segment comprises payment services, the administration of credits, network income, distribution and other fees. About 34% of the total NFCI is attributed to this segment, which represents about 2%<sup>25</sup> of total assets and 32% of total liabilities.

Relationship services are provided to large corporate companies, small and medium enterprises, wealthy private banking customers, financial and public sector institutions, and include similar products to the Retail segment. Compared to Retail, the NFCI of Relationship Services also contains securities, custody and retail service fees. About 43% of the total NFCI of the ČSOB group is attributable to this business unit.

About 22% of net fee and commission income stems from the Financial Markets, Specialised Banking and Group Centre segments. Financial Markets include investment products and services and fund management activities and trading. NFCI includes securities, custody and asset management income fees and commissions to agents. Specialised Banking includes mortgages and pension funds, and the NFCI from this segment consists of the administration of credits, collective investment and distribution fees. The Group Centre includes the results of Asset and Liability Management and items not directly attributable to the other segments. The generated NFCI includes payment services and other fees.

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<sup>25</sup> The low share of Retail segment in total assets is mainly caused by the fact that ČSOB reports mortgages in the Specialised Banking segment.

**Table 2.3: ČSOB NFCI by segments in 2018**

Segment	NFCI		% of total assets	% of total liabilities
	CZK millions	%		
Retail	2,757	34.4	2	32
Relationship Services	3,474	43.3	21	31
Financial Markets	394	4.9	3	5
Specialised Banking	807	10.1	22	1
Group Centre	590	7.4	52	31
<b>Total</b>	<b>8,022</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Authors based on ČSOB (2019)

## J&T

J&T is an investment-oriented universal bank. It provides traditional banking activities such as term, notice and subordinated deposits, current accounts and payment cards; among investment products it offers mutual funds and bonds, and trading in securities and gold. The portfolio of J&T also comprises investment banking activities, business financing and assets and portfolio management. J&T is classified as a medium-sized bank according to CNB (2019a).

About 87% of fee income and 71% of fee expenses in J&T is attributable to securities and derivatives services (see Table 2.4). Only a minor share of fees is connected with traditional banking activities.

**Table 2.4: J&T NFCI decomposition in 2018**

	CZK millions	%
<b>Total fee and commission income</b>	<b>1,794</b>	<b>100</b>
Securities and derivatives for customers	1,562	87.1
Loan activities	68	3.8
Payment transactions	133	7.4
Other	31	1.7
<b>Total fee and commission expense</b>	<b>204</b>	<b>100</b>
Transactions with securities	144	70.6
Payment transactions	31	15.2
Other	29	14.2
<b>Net fee and commission income</b>	<b>1,590</b>	<b>-</b>

Source: Authors based on J&T (2019)

The orientation towards investment banking activities is again visible when we look at the NFCI generated by the individual segments (see Table 2.5). The Financial Markets segment, which includes trading and corporate finance activities, clearly

dominates in NFCI generation. Traditional banking activities such as loans, deposits and other transactions and balances with corporate customers (Corporate Banking segment), private banking and premium banking customers (Private Banking segment) and retail customers (Retail Banking segment) represent only 7% of total NFCI. Nevertheless, they form almost 40% of total assets and 92% of total liabilities, which suggests a substantial reliance of J&T on deposit financing. The remaining CZK 5 million is NFCI attributable to the ALCO segment, which includes balance sheet items of strategic importance which are managed by the Asset and Liability Committee.

**Table 2.5: J&T NFCI by segments in 2018**

Segment	NFCI		% of total assets	% of total liabilities
	CZK millions	%		
Financial Markets	1,470	92.5	15.8	0.2
Corporate Banking	102	6.4	35.9	32.3
Private Banking	8	0.5	3.5	16.9
Retail Banking	5	0.3	0.3	42.4
ALCO	5	0.3	43.1	1.8
Unallocated	-	-	1.4	6.4
<b>Total</b>	<b>1,590</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Authors based on J&T (2019)

## FIO

FIO's operations can be divided into two main areas – the provision of traditional banking services and the brokering of securities transactions. Among standard banking services, it offers current, savings and term deposit accounts, payments, payment cards and loans. FIO provides standard services based on a zero fee strategy, and is, therefore, classified as a low-cost bank. FIO is the largest Czech securities trader focused on smaller clients. Through its tool e-Broker, clients may buy and sell securities online. Its focus on trading is visible also from the structure of its assets, which consist largely of cash in hand and balances with the central bank, and which, compared to other banks, display only a limited amount of provided loans. FIO is classified as a small bank according to CNB (2019a).

From Table 2.6 it can be seen that, despite the zero fee policy, the largest share of fee income is generated from client accounts and loans and fees charged by card associations. The highest fee expenses are connected with the payment system and card transactions. Trading and other investment services generate about 20% of FIO's

fee income and 13% of fee expenses. Nevertheless, FIO’s NFCI/TI is rather low compared to other banks, which reflects its zero fee strategy.

**Table 2.6: FIO NFCI decomposition in 2018<sup>26</sup>**

	<i>CZK millions</i>	<i>%</i>
<b>Total fee and commission income</b>	<b>595</b>	<b>100</b>
Transactions with securities	96	16.2
Other investment services	20	3.4
Client accounts and loans	247	41.6
Fees charged by card associations	231	38.9
<b>Total fee and commission expense</b>	<b>277</b>	<b>100</b>
Payment system and card transactions	241	86.9
Transactions with securities	36	13.1
<b>Net fee and commission income</b>	<b>318</b>	<b>-</b>

*Source:* Authors based on FIO (2019)

## 2.4 Conclusion

This paper focuses on the analysis of bank fee and commission income in the European Union with a special emphasis on the Czech Republic. Based on the current literature, we commented on the reasons why banks switch to fee-bearing activities, and we discussed the optimal share of fee income. We concluded that there is no single optimal fee income strategy. The result is highly dependent on the specific features each bank and the banking sector in which it operates.

In the econometric part, we used the ratios of net fee and commission income to net total income, to total assets and to GDP to compare the magnitude of bank fees in the European countries. We also examined how these ratios developed between 2007 and 2018. The average share of income represented by fees and commissions is around 25% in the EU, which corresponds to the applied commercial banking business model. After the financial crisis in 2008, we can observe a gradual increase in fee income share, which might be caused by the prevailing low interest rates and the effort of banks to substitute missing profits from interest income. Moreover, we concluded that Czech banks are generally less dependent on fee income than their EU peers, and their fee income share exhibits a decreasing trend. The high profitability and stability of the Czech banking sector can be attributed mainly to sound risk management and sufficient capital and liquidity buffers.

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<sup>26</sup> FIO does not provide a division of NFCI per segment.

Since increased competition might be a reason why banks reassess their business strategies, which are, in turn, connected with changes in income structure, we also examined the development of market competition in the EU banking sector between 2007 and 2018. We conclude that in this time period the market concentration was moderate. Dealing with new entrants to the Czech banking sector, we described the business strategy of low-cost banks and its impact on the fee income share of those banks. We also claim that their originally unsustainable business model was mainly due to their efforts to attract clients. Nowadays, these banks are well-established in the Czech Republic, have an increasing clientele, and are generally operating in the black. As well as taking deposits, they began to provide loans and charge fees on some services. Currently, their business model seems to be sustainable, and it can be expected that these currently small banks will get bigger in the future.

### 3 Determinants of bank fee income in the EU banking industry - does market concentration matter?

**Published as:** Karolína Vozková, Petr Teplý (2018): Determinants of bank fee income in the EU banking industry – does market concentration matter?, Prague Economic Papers, Vol. 27, No. 1, pp. 3-20.

#### *Abstract*

*In this paper, we analyse key determinants of bank fee and commission income in the European Union with a special emphasis on market concentration. On a sample of 258 EU banks during the 2007-2014 period, we apply System Generalized Method of Moments. First, we argue that the banks facing higher competition tend to expand more aggressively into non-traditional activities and therefore they report a higher share of fee income on total income. Second, we found that a higher equity to assets ratio is related with higher shares of fee income since the bank needs more capital to prevent or manage the potential risks of the non-traditional activities. Finally, a high deposits to assets ratio tends to increase the fee income share, which may be possibly attributed to relatively high switching costs and to close depositor-bank relationship in the EU banks.*

**Keywords:** bank, fee and commission income, Generalized Method of Moments, Herfindahl index, market concentration

**JEL classification:** C23, G21, L25

### 3.1 Introduction

Business models for banking have changed significantly over the last few decades. The technological development and digitalization of services has increased the competition among financial institutions, which in turn led to decreased cost advantages of banks. As a result, the profitability of traditional bank activities dropped which consequently led to an expansion of bank activities into non-traditional fee and commission bearing services (Davis and Tuori, 2000).<sup>27</sup> In Europe, non-interest income (NII) has increased from 26% to 41% of total income between 1989 and 1998 (Lepetit et al., 2005). The most pronounced part of NII is net fee and commission income (NFCI) that accounted on average for 58% of all NII between 1993 and 1998 in EU countries. Nevertheless, the composition of NII 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).

A share of NII is connected with the bank business model. Commercial banks are mainly deposit taking and loan providing (i.e. traditional activities). They make money on charging higher interest on loans compared to what they are paying on client deposits. Investment banks provide potentially more risky products than commercial banks. This includes capital raising services, financial advisory to corporations as well as committing capital for securities issuance (i.e. non-traditional activities). Investment banks make their money mainly on trading, fee and commission income and report higher than 40% NFCI/total income ratio (NFCI/TI). Universal banks combine commercial and investment banking and their income composition reflects the combined structure of the business (Gambacorta and van Rixtel, 2013).

In this paper, we use EU banks' data to analyse the links between bank NFCI, business strategies, market and macroeconomic conditions between 2007 and 2014, with a special emphasis on the link between market concentration and NFCI share. 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 a higher level of competition is connected with higher share of fee income in the

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<sup>27</sup> Traditional activities include deposit taking and loan providing (core businesses of commercial banking). Non-traditional activities are for example retail brokerage, insurance sales, securities issuance (core businesses of investment banking).

banking sector. One can argue that increased share of NII is a product of diversification through which banks are seeking a balanced and sustainable structure of income. But the empirical evidence suggests that diversification benefits, decreased risk and increased risk-adjusted profitability, are often not present when increasing NII share (Stiroh, 2004a, 2004b, DeYoung and Rice, 2004a, Kim and Kim, 2010). This may be caused primarily by higher volatility of NII compared to interest income or by increasing correlation of NII with interest income observed in recent years (Stiroh, 2004a). Our hypothesis is based on the assumption that in highly competitive markets banks tend to increase their share of NII too far and the diversification benefits are more than offset by the increased exposure to volatile NII bearing activities.

The rest of the paper is structured as follows: Section 3.2 provides a literature review. In Section 3.3, we study the determinants of fee income magnitude, especially the impact of market concentration on NFCI. Section 3.4 summarizes the paper and provides our conclusions.

## 3.2 Literature review

The first paper examining the correlation between the Herfindahl index (HI) and NII was Moshirian et al. (2011). Based on data from 20 countries, they found that banks facing high concentration have lower levels of NII. They conclude that banks in highly competitive markets are more likely to engage in risky behaviour including expansion in non-traditional activities. A similar result was found in Růžičková and Teplý (2015a), on which this paper is based. Similarly as Hahm (2008), whose study is based on data from 29 OECD countries, Firth et al. (2013), who studies China's commercial banks, and U.S. studies Rogers and Sinkey (1999), DeYoung and Hunter (2003), DeYoung et al. (2004) and DeYoung and Rice (2004a), Moshirian et al. (2011) conclude that large banks with smaller net interest margin (NIM) exhibit higher NII.

Contrary to the U.S. evidence, Craigwell and Maxwell (2005) whose study is based on Barbadian banks found that larger banks are associated with lower NII. Shahida et al. (2006) found on a panel of Malaysian Islamic commercial banks no significant relationship between fee income and NIM. The literature is also not unanimous about the effect of core deposits on the income structure. While Rogers and Sinkey (1999), Bailey-Tapper (2010) and Kim and Kim (2010) found that banks with high NII have relatively fewer core deposits, DeYoung and Rice (2004a), Shahida et al. (2006) and

Busch and Kick (2015) found the opposite relationship. On the other hand, higher equity to assets ratio seems to be always connected with higher NII. DeYoung and Rice (2004a) included to the model also bank macroeconomic and sector specific factors that turned out to be also important determinants of banks' NFCI. The importance of external factor was later confirmed by Hahm (2008), Bailey-Tapper (2010), Kim and Kim (2010). We conclude that common factors determining income diversification exist but their impact on NII varies across countries. The largest differences can be identified when analysing the developed and developing economies separately.

### 3.3 Empirical analysis

In this section we examine what determines the magnitude of NFCI. Besides the basic bank interior and exterior factors, we also include market concentration as a determinant of NFCI.

#### 3.3.1 Data set

The analysis is based on EU-27 data from 2007 to 2014. The data were taken from the Bankscope database, ECB database, Eurostat, The World Bank DataBank and HelgiLibrary database. The final data set is a balanced panel. Our study is based on data from 258<sup>28</sup> EU banks (151 commercial banks, 35 savings banks, 26 cooperative banks, 18 real estate and mortgage banks, 10 investment banks, and 18 bank holdings and holding companies), i.e. on average we have data for almost 10 banks in each country available. Table 3.1 displays the number of banks included in the study by country.<sup>29</sup>

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<sup>28</sup> Descriptive analysis is based on data from 261 banks. From this analysis follows that there are 3 outliers in the data set which may influence the results (see also Figure 3.4) and therefore they were excluded for the final empirical analysis.

<sup>29</sup> The inclusion of more banks was not possible due to missing data. Strongly unbalanced panel could make the estimation inaccurate. Moreover, we excluded banks with negative operating income from the data set, because their NFCI/TI ratio would be misleading.

**Table 3.1: Number of banks included in the study by country<sup>30</sup>**

Austria	: 7	Germany	: 7	Netherlands	: 7
Belgium	: 6	Greece	: 5	Poland	: 10
Bulgaria	: 9	Hungary	: 6	Portugal	: 13
Cyprus	: 5	Ireland	: 4	Romania	: 7
Czech Republic	: 9	Italy	: 30	Slovakia	: 5
Denmark	: 7	Latvia	: 6	Slovenia	: 7
Estonia	: 2	Lithuania	: 5	Spain	: 11
Finland	: 3	Luxemburg	: 1	Sweden	: 28
France	: 28	Malta	: 3	United Kingdom	: 27

Source: Authors' computations

### 3.3.2 Methodology

Most of the current authors used FE, RE or pooled OLS estimation method for the analysis of NFCI (NII) magnitude determinants. Since we expect persistence in NFCI magnitude and the inclusion of a lagged dependent variable leads to inconsistency in the previous methods, we will apply System Generalized Method of Moments (GMM), which is appropriate for our data set with large number of banks and small number of time periods and is able to deal with explanatory variables that are not strictly exogenous.<sup>31</sup>

The general model of the data-generating process is as follows:

$$y_{i,t} = \alpha y_{i,t-1} + X'_{i,t} \beta + \varepsilon_{i,t} \quad 3.1$$

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

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

where  $|\alpha| < 1$ ,  $i = 1, \dots, N$  is the individual's index and  $t = 1, \dots, T$  is a time index. The disturbance is composed of the fixed effects  $\mu_i$  and the idiosyncratic shocks,  $v_{i,t}$ . Pooled OLS is inappropriate for the estimation because exogeneity assumption is violated since  $y_{i,t-1}$  and  $\mu_i$  are correlated (Wooldridge, 2002). Particularly, pooled

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<sup>30</sup> In order to get a representative data set for each country, we had to adjust the number of Italian, French, Swedish and British banks that was considerably higher than in other countries. Only the biggest banks were kept in the final data set.

<sup>31</sup> In our case for example *nim*, *cost\_inc*, *roae* or *eq\_ass* are predetermined or endogenous and therefore they need to be treated adequately. See Section 3.3.3 for variables description.

OLS attributes more predictive power to the lagged dependent variable than it should have (Roodman, 2006).

Nickell (1981) and Bond (2002) show that Least Squares Dummy Variable or Within Groups estimator are not able to eliminate the dynamic panel bias. Contrary to pooled OLS Within Groups estimator is biased downwards. The true estimate should lie between the pooled OLS and Within Group estimates. Therefore, we will use these two methods for a robustness check as suggested also in Bond (2002). Two transformations are commonly used for dynamic panel data. The first method, Difference GMM, 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:

$$\Delta y_{i,t} = \alpha_1 \Delta y_{i,t-1} + \Delta X'_{i,t} \beta_1 + \Delta v_{i,t} \quad 3.2$$

As by Within Group transformation, the fixed effects are no more present, but the lagged dependent variable is still endogenous. This can be addressed by assuming that  $v_{i,t}$  are serially uncorrelated. The largest drawback of this model is that all time-invariant regressors disappear. This gives rise to the System GMM developed in Blundell and Bond (1998). This method combines the differences equation (3.2) with the level equation (3.1). As long as  $v_{i,t}$  are serially uncorrelated, we do not need to have strict exogeneity of the explanatory variables. This framework allows using time-invariant variables. The instruments are differenced 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).

We include time dummies in the regressions,<sup>32</sup> because they make the assumption of no correlation between idiosyncratic shocks more likely to hold (Roodman, 2006, Sanya and Wolfe, 2011). We use one-step and two-step System GMM with clustered standard errors robust to heteroscedasticity and autocorrelation within individuals and with small sample corrections to the covariance matrix. 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 (2005) correction in two-step estimation.

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<sup>32</sup> The time dummies are not reported in the tables.

The estimation is performed in Stata. The estimation equation representing our model for each of the NFCI magnitude measure is as follows:

$$Y_{i,c,t} = \alpha + \beta Y_{i,c,t-1} + \gamma X_{i,c,t} + \delta Z_{c,t-1} + \epsilon W_{c,t} + \theta D_i + \vartheta T_t + (\mu_i + v_{i,c,t}) \quad 3.3$$

where:

- $Y_{i,c,t}$  ..... NFCI share of bank  $i$  in country  $c$  at time  $t$  (dependent variable), namely NFCI/TI and NFCI/total assets ratio (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  $t - 1$ ,
- $W_{c,t}$  ..... vector of banking sector-specific variables for country  $c$  at time  $t$ ,
- $D_i$  ..... bank type dummy,
- $T_t$  ..... time dummy,
- $\mu_i$  ..... unobserved bank-specific time-invariant effect,
- $v_{i,c,t}$  ..... disturbance term which is independent across banks.

### 3.3.3 Variables

The dependent variable captures the NFCI magnitude that is measured by NFCI/TI ratio (*nfc\_i\_ti*) and NFCI/TA ratio (*nfc\_i\_ta*). By choosing the proper explanatory variables, we follow the papers by DeYoung and Rice (2004a), Shahida et al. (2006), Moshirian et al. (2011), ECB (2013) and Fišerová et al. (2015). The independent variables are summarized in Table 3.2.

**Table 3.2: List of independent variables**

Variable	Description	Expected coefficient
<b>Bank-specific explanatory variables</b>		
<i>ln_ass</i>	Natural logarithm of total assets	+
<i>nim</i>	Net interest margin	-
<i>depos_ass</i>	Total customer deposits to asset ratio	-
<i>eq_ass</i>	Total equity to total assets ratio	+
<i>npl_loans</i>	Non-performing loans to gross loans ratio	?
<i>loans_ass</i>	Loans to assets ratio	-
<i>roae</i>	Return on average equity	+
<i>cost_inc</i>	Cost to income ratio	-
<b>Banking sector-specific explanatory variables</b>		
<i>hi</i>	Herfindahl index	-
<i>atms</i>	Number of automated teller machines per	?

Variable	Description	Expected coefficient
<i>cashless</i>	100,000 adults Number of all cards transactions (except e-money function) per capita	?
<b>Country-specific explanatory variables</b>		
<i>lag_gdp</i>	Lagged real annual GDP growth rate	?
<i>lag_inf</i>	Lagged annual inflation rate	?
<i>lag_unem</i>	Lagged annual unemployment rate	?
<i>lag_int</i> <sup>33</sup>	Lagged long-term annual interest rate	?

Source: Authors

Moreover, we include also lagged dependent variable (*lag\_dv*) and 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.

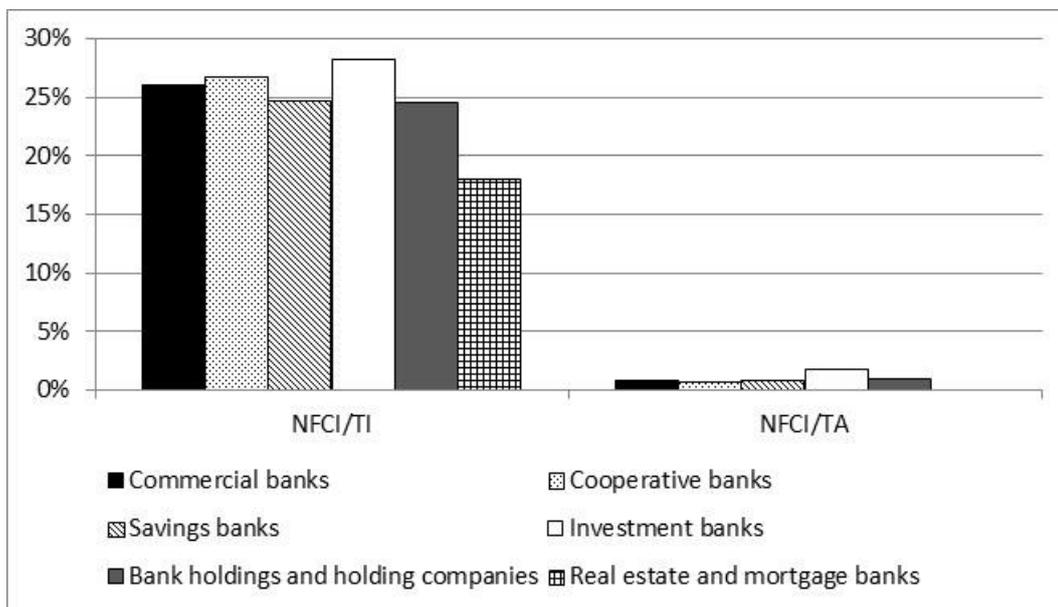
### 3.3.4 Descriptive analysis

In this section, we provide a descriptive analysis of used variables. Firstly, we analyse the dependent variables NFCI/TI and NFCI/TA. The scatter plots depicting the relationship between NFCI share and HI can be found in Figure 3.4. Figure 3.1 displays the mean NFCI/TI and NFCI/TA by bank type computed over the period 2007 to 2014. The lowest share of NFCI can be observed in real estate and mortgage banks which have NFCI/TI below 19% and NFCI/TA less than 0.4%. On the other hand, the highest share of NFCI was reported in investment banks with average NFCI/TI of 28.26% and average NFCI/TA of 1.78%.

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<sup>33</sup> According to the 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.

**Figure 3.1: Average NFCI/TI and NFCI/TA by bank type**



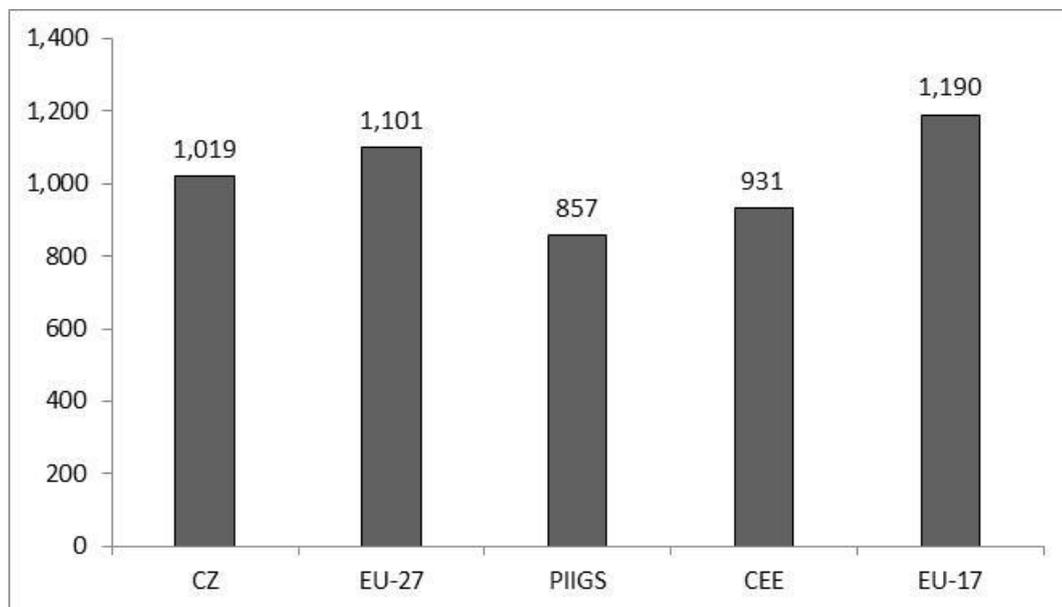
Source: Authors based on Bankscope

The HI's values range between 0–10,000. Values below 1,000 indicate low concentration, values of 1,000 to 1,800 correspond to moderate concentration, and HI over 1,800 indicates high concentration (Neven and von Ungern-Sternberg, 1998). Figure 3.2 displays that there is a moderate market concentration in the EU. The Czech Republic lies with the HI of 1,019 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<sup>34</sup> and Central and Eastern Europe (CEE) countries report the HI even lower than the Czech Republic. On the other hand, EU-17<sup>35</sup> countries post average HI of nearly 1,200. The relatively high HI is caused mainly by Finland, Estonia and Netherlands with HIs above 2,000.

<sup>34</sup> PIIGS refers to Portugal, Ireland, Italy Greece and Spain.

<sup>35</sup> EU-17 stands for Eurozone countries.

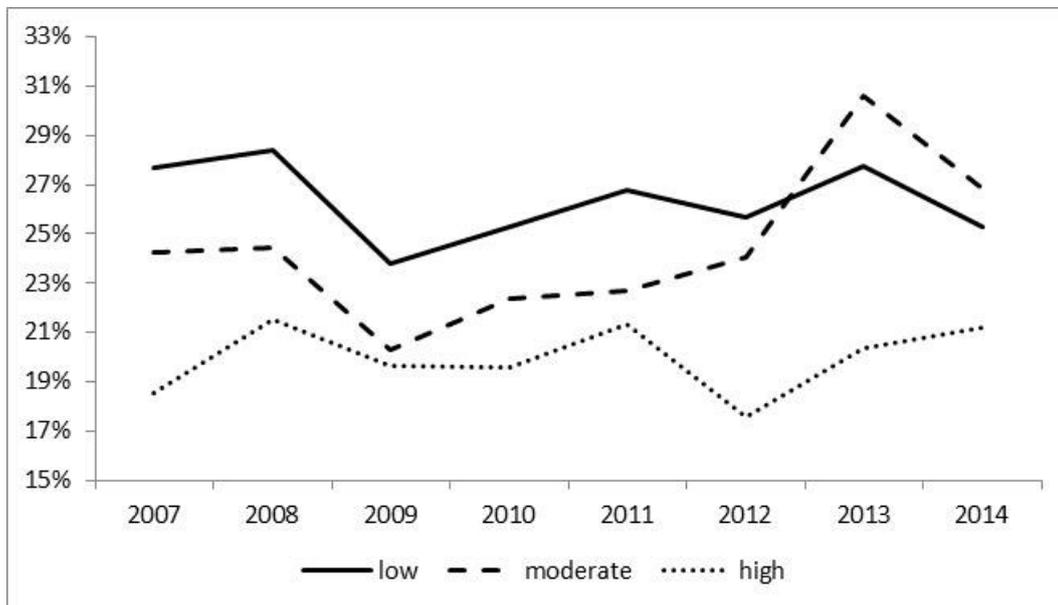
**Figure 3.2: Average HI from 2007 to 2014**



*Source:* Authors based on ECB

Figure 3.3 shows the evolution of average NFCI share from 2007 to 2014 by market concentration. As can be seen, the highest NFCI shares are reported in banks in countries with low concentration over the whole considered period, with exception of 2013 and 2014 in which countries with moderate concentration reported slightly higher NFCI/TI. The lowest NFCI/TI shares are present in banks that are facing low competition. This figure supports the hypothesis that increased competition forces banks to switch to non-traditional activities that bear high fee income.

**Figure 3.3: Development of average NFCI/TI by market concentration**



Source: Authors based on Bankscope and the ECB

Figure 3.5 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. Figure 3.6 and Figure 3.7 show country-specific macroeconomic indicators in year 2013.<sup>36</sup> It can be seen that the macroeconomic conditions of PIIGS are still very poor. This is reflected by the high government bond yields, very low or negative GDP growth rate and high unemployment rates. Table 3.6 shows summary statistics of used variables reporting the mean, median, standard deviation, minimum, maximum and 1<sup>st</sup> and 3<sup>rd</sup> quartiles of each variable.

### 3.3.5 Results and findings

Because there is no theory supporting our assumption about the autoregressive process in NFCI share, we performed in Table 3.3 Wooldridge test for autocorrelation. The null hypothesis of no first-order autocorrelation was rejected for both dependent variables. Therefore System GMM will be used as the main estimation method. Other methods will be applied for robustness check.

<sup>36</sup> In the model we are using lagged country-specific dependent variables and therefore the last observations entering the model are from 2013.

**Table 3.3: Wooldridge test for autocorrelation – NFCI/TI, NFCI/TA**

	<i>nfc_i ti</i>	<i>nfc_i ta</i>
F statistics	24.077	20.059
	(d.f. 1, 257)	(d.f. 1, 257)
p-value	0.0000	0.0000

H0: no first-order autocorrelation, d.f. = degrees of freedom

Source: Authors based on Bankscope

Table 3.4 shows the model that investigates the determinants of NFCI share in EU banks. System GMM yields the best estimation results, because for both dependent variables the lagged dependent variable is positive and significant with a 99% confidence level. The null hypothesis of no first-order autocorrelation in residuals is rejected in Arellano-Bond AR (1) for all models. For NFCI/TI models, we find also a positive and significant second lag and significant Arellano-Bond AR (2). For NFCI/TA higher lags were used as instruments because significant AR (2) made the second lag of the dependent variable endogenous. Furthermore, the significant AR (2) suggests that further lags of the dependent variable may be significant. This possible feature was tested among robustness tests. The Hansen test for overidentification with null hypothesis of exogenous instruments was not rejected. The rule of thumb 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 3.3.3. In order to obtain valid estimates, we excluded variables that were insignificant in the initial estimation with all defined independent variables and significantly correlated with other independent variables. More extended model specification was run among the robustness tests. The results proved to be robust to exclusion of correlated variables.

The coefficients of *eq\_ass* are positive and significant meaning that banks with lower capital risk are better able to expand into non-traditional bank activities and to collect more money on fee income. Contrary to our expectation, we found that *depos\_ass* is positively related with NFCI/TI as well as with NFCI/TA. This suggests that the depositors' demand for banking services is possibly inelastic and the European banks are able to exploit it by encouraging the depositors to undertake additional fee-based services and/or to charge more by selling those services at higher prices. It might also indicate a high switching costs. Higher cost to income ratio, meaning lower efficiency in expense management, increases NFCI/TI. The coefficients of *dhold* are

significantly positive. This suggests that bank holdings and holding companies display on average higher NFCI shares than other bank types. Moreover, *dcoop* and under one-step estimation also *dcom* are positively related with NFCI/TI. All other bank-specific variables are insignificant.

As depicted by Figure 3.3 and suggested by the correlation between NFCI/TI, NFCI/TA and *hi*<sup>37</sup>, 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 -0.0023 and -0.00005, 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 bank services which are potentially more risky than the traditional ones. This method of arriving at a 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 bank 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 bank activities.<sup>38</sup> Other bank sector-specific variables were excluded, because they were insignificant and highly correlated with *hi*. Among the country-specific variables, coefficients of *lag\_gdp* are significantly negative for model with NFCI/TI as dependent variable. Inflation rate does not seem to influence fee income magnitude in banks.

**Table 3.4: Relationship between NFCI share and HI – System GMM regression results**

Independent variables	Dependent variable			
	<i>nfc_i ti</i>		<i>nfc_i ta</i>	
	two-step	one-step	two-step	one-step
<i>lag_DV</i>	0.4392 (0.0705)***	0.4436 (0.0710)***	0.7502 (0.0696)***	0.7499 (0.0694)***
<i>lag2_DV</i>	0.2033 (0.0451)***	0.2036 (0.0454)***		
<i>nim</i>	-0.5112 (0.6350)	-0.5868 (0.6319)	0.0037 (0.0170)	0.0039 (0.0169)
<i>eq_ass</i>	0.3239 (0.0848)***	0.3207 (0.0864)***	0.0069 (0.0038)*	0.0069 (0.0037)*
<i>npl_loans</i>	-0.0750 (0.0501)	-0.0887 (0.0476)*	0.0015 (0.0014)	0.0016 (0.0014)
<i>cost_inc</i>	0.0848	0.0842	0.00005	0.00005

<sup>37</sup> The correlation between NFCI/TI and *hi* is -0.2316 and between NFCI/TA and *hi* is -0.1012, both significant at 5% level.

<sup>38</sup> See also Gambacorta and van Rixtel (2013) and DeYoung and Rice (2004b).

Independent variables	Dependent variable			
	<i>nfc_i ti</i>		<i>nfc_i ta</i>	
	two-step	one-step	two-step	one-step
	(0.0426)**	(0.0432)*	(0.0003)	(0.0003)
<i>depos ass</i>	0.1418	0.1442	0.0040	0.0039
	(0.0464)***	(0.0500)***	(0.0014)***	(0.0014)***
<i>hi</i>	-0.0023	-0.0024	-0.00005	-0.00005
	(0.0008)***	(0.0007)***	(0.000)**	(0.0000)**
<i>lag gdp</i>	-0.2472	-0.2317	0.0027	0.0025
	(0.0920)***	(0.0988)**	(0.0035)	(0.0034)
<i>lag inf</i>	0.0341	0.0238	0.0023	0.0026
	(0.1280)	(0.1360)	(0.0052)	(0.0052)
<i>dcom</i>	3.4632	3.6858	0.0660	0.0653
	(2.3534)	(2.1715)*	(0.0491)	(0.0453)
<i>dcoop</i>	4.6835	4.0640	0.0406	0.0519
	(2.4223)*	(2.3001)*	(0.0495)	(0.0454)
<i>dsav</i>	-0.5114	-0.3795	-0.0410	-0.0311
	(2.6458)	(2.5332)	(0.0656)	(0.0618)
<i>dinv</i>	2.7358	3.8057	0.1069	0.1068
	(3.6790)	(3.7700)	(0.1096)	(0.1083)
<i>dhold</i>	5.2706	4.9449	0.1341	0.1467
	(2.5074)**	(2.3856)**	(0.0692)*	(0.0707)**
<i>_cons</i>	-6.0392	-5.9981	-0.1444	-0.1414
	(4.1816)	(4.3919)	(0.0707)**	(0.0639)**
<b>Estimation diagnostics</b>				
Number of observations	1,548		1,806	
Number of groups	258		258	
Observations per group	6		7	
Number of instruments	174		246	
F test	22.75***	18.02***	58.47***	61.86***
Arellano-Bond AR (1)	-2.46**	-2.94***	-2.19**	-2.51**
Arellano-Bond AR (2)	-2.76***	-2.60***	-0.58	-0.58
	chi2(153)=172.52		chi2(225)=238.33	
Hansen test	Prob>chi2=0.134		Prob>chi2=0.259	

Robust standard errors adjusted for 258 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:* Authors based on Bankscope, Eurostat, the ECB and the World Bank

To make sure that the results are valid, 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. Mostly, only the significances have changed. We never observed one coefficient to be significantly positive under one specification and significantly negative under another. We performed also the robustness check described by Bond (2002). Our System GMM results proved to be valid since the estimate of lagged dependent variable lies above the FE estimate and below pooled OLS estimate (see Table 3.7).

### 3.3.5.1 Summary of results and comparison with other researchers

Table 3.5 provides the comparison of results found in our study and the current literature. Operators +/- stands for positive/negative coefficient significant at least at 10% level. 0 indicates that the estimated coefficient is insignificant. Unlike 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 NFCI represents the greatest part of NII in most of the banks.

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 NFCI shares. Deposits to assets ratio influences the NII share positively in U.S., German and Malaysian banks. On the contrary, in Jamaican and Korean banking markets, the effect seems to be the opposite. This may be caused by different levels of switching costs and dissimilar attitude of the customers. In the U.S., German and Malaysian markets the demand for bank services may be less elastic, which enables to charge higher fees on it. Our results suggest that EU-27 banking sector resembles the U.S., German and Malaysian banking market since the coefficient on *depos\_ass* is significantly positive in our study. We have estimated a negative relationship between HI and NFCI share. This result supports the findings of Moshirian et al. (2011). Macroeconomic conditions seem to play only limited role in NFCI share determination in most of the studies. Still, we are in line with Hahm (2008) that higher lagged GDP growth is connected with lower NII and therefore NFCI shares.

**Table 3.5: Comparison of estimated signs and significance levels for the coefficients on NFCI magnitude**

Authors	Data	Coefficients													
		<i>nim</i>	<i>eq</i>	<i>ass</i>	<i>npl</i>	<i>loans</i>	<i>cost</i>	<i>inc</i>	<i>depos</i>	<i>ass</i>	<i>hi</i>	<i>lag</i>	<i>gdp</i>	<i>lag</i>	<i>inf</i>
Rogers and Sinkey (1999)	U.S. banks, 1989 - 1993	-		+		+									-
DeYoung and Rice (2004a)	U.S. banks, 1989 - 2001														+
Craigwell and Maxwell (2005)	Barbadian banks, 1985 - 2001														0
Shahida, Abd. Ghafar, Sanep (2006)	Malaysian Islamic banks, 1994 - 2004	0		+		-									+
Hahm (2008)	29 OECD countries' banks, 1992 -	-		+		+		+					-		-

Authors	Data	Coefficients												
		<i>nim</i>	<i>eq</i>	<i>ass</i>	<i>npl</i>	<i>loans</i>	<i>cost</i>	<i>inc</i>	<i>depos</i>	<i>ass</i>	<i>hi</i>	<i>lag</i>	<i>gdp</i>	<i>lag</i>
	2006													
Bailey-Tapper (2010)	Jamaican banks, 1999 - 2010					+			-				0	
Kim and Kim (2010)	South Korean banks, 1999 - 2009									-				
Moshirian, Sahgal and Zhang (2011)	20 developed countries' banks, 1996 - 2010			+							-	0		0
Firth, Li, Wang (2013)	China's commercial banks, 1998 - 2007	-				0								
Busch, Kick (2015)	German banks, 1995 - 2011			+		0				+				
<b>This study (2016)</b>	<b>EU-27 banks, 2007 - 2014</b>	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 Sinkey (1999), Bailey-Tapper (2010) and Firth et al. (2013) are not using *npl\_loans* as a measure of loans quality but use provision for loan losses magnitude

Source: Authors based on individual papers and own results

Our results are in line with most of the current literature. Nevertheless, there are still opportunities for further research that should mainly aim to capture the banking market fragmentation better. Another improvement might be longer time period of the analysis. This would allow drawing more general results from the model. Moreover, since some variables needed to be excluded due to their correlation with HI, other measures capturing the technologic development in a given country that would not be correlated with other regressors should be included in the model.

### 3.4 Conclusion

This paper focused on key determinants of bank fee and commission income in the EU. 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 been yet accomplished neither on theoretical nor empirical levels.

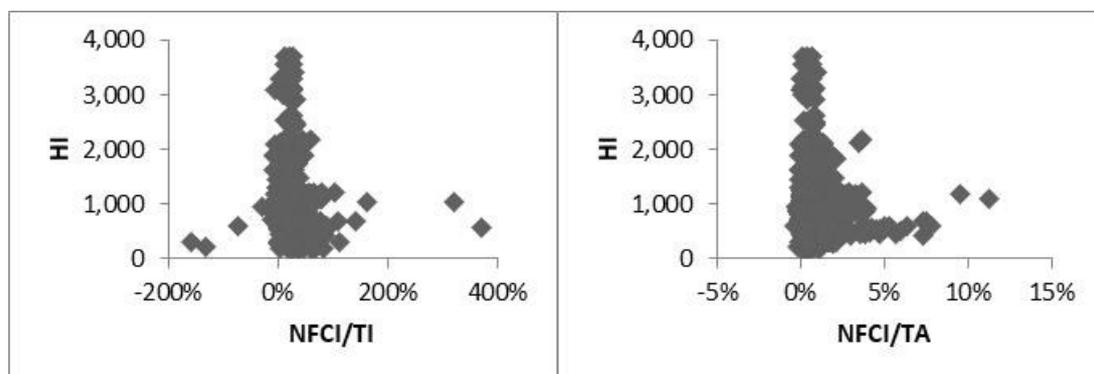
The study was performed on balanced panel data form 258 EU-27 banks spanning the period from 2007 to 2014. Unlike in the existing studies, we have used System GMM

estimation method as suitable for time persistent data. Different bank-specific, banking sector-specific and macroeconomic factors were considered. Our results confirm that the share 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 exhibit higher shares of fee and commission income.

Banks with a higher fee income share tend to rely more on equity financing, which in turn means that they report lower capital risk. This is possibly related to the fact that banks expanding into non-traditional businesses need more capital to prevent the potential risks of the new activity. Higher shares of fee income are also reported in banks with lower efficiency of expense management. Contrary to our expectation, we have found that high deposits to assets ratio, a proxy for traditionally-oriented banking, tends to be related with higher shares of fee income. This result seems to be largely dependent on the data used since the same relationship was found also in studies from the U.S. but not in studies from Jamaica and South Korea. Moreover, such conclusion may reflect either different levels of switching costs or different attitudes of bank clients. Our result suggests an inelastic depositors' demand for banking services what allows the European banks to sell more additional fee-based services and/or to sell those services at higher prices. Among macroeconomic conditions only GDP growth significantly affects banks' fee income policy, while other factors seem to play secondary role by fee income determination.

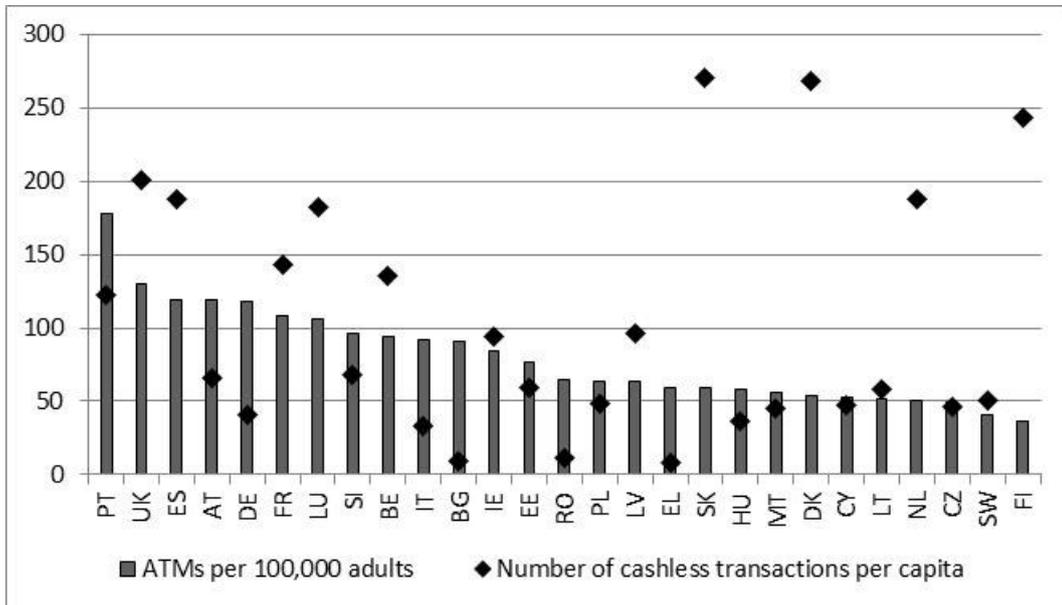
### 3.5 Appendix

**Figure 3.4: Scatter plot NFCI share and HI**



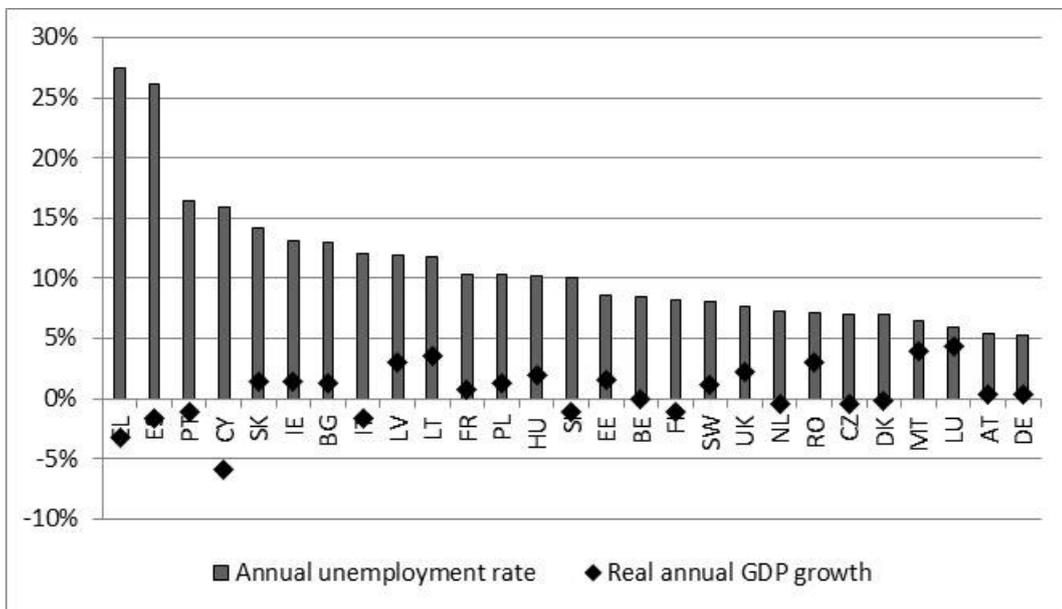
Source: Authors based on Bankscope and the ECB

**Figure 3.5: The development of banking sector in 2014 by country<sup>39</sup>**



Source: Authors based on World Bank and the ECB

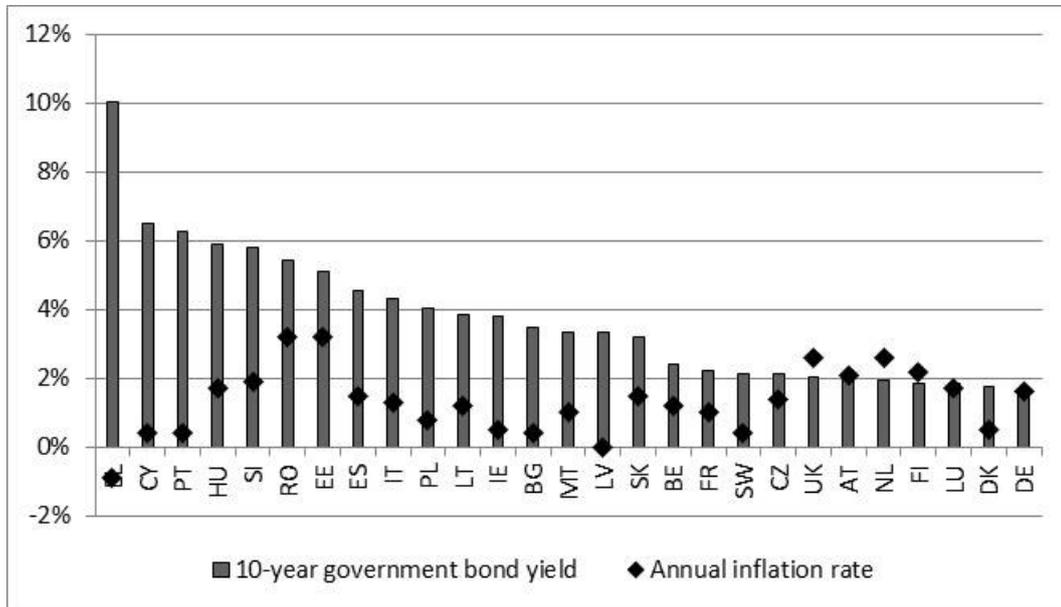
**Figure 3.6: Macroeconomic conditions in 2013 – Annual unemployment rate and real annual GDP growth**



Source: Authors based on Eurostat

<sup>39</sup> For Germany ATMs per 100 000 adults was not available in 2014 and therefore it was approximated by 2013 value.

**Figure 3.7: Macroeconomic conditions in 2013 – Long term interest rate and annual inflation rate**



Source: Authors based on Eurostat, the ECB and HelgiLibrary

**Table 3.6: Summary statistics of used variables**

Variable	Mean	Std. Dev.	Min	1st quartile	Median	3rd quartile	Max
<i>atms</i>	89.7	37.71	35.71	56.08	92.82	109.11	195.04
<i>cashless</i>	89.88	70.37	1.35	27.81	65.44	136.07	270.21
<i>cost inc</i>	63.89%	32.79%	9.05%	51.09%	59.99%	69.33%	656.76%
<i>depos_ass</i>	52.65%	23.53%	0.01%	37.17%	53.78%	72.73%	95.40%
<i>eq ass</i>	8.18%	5.67%	-45.82%	4.94%	7.05%	10.05%	56.19%
<i>hi</i>	858.5	512.58	183	519	797	1077	3700
<i>lag_gdp</i>	0.97%	3.52%	-14.80%	-0.60%	1.50%	2.70%	11.90%
<i>lag_inf</i>	2.56%	1.86%	-1.70%	1.60%	2.30%	3.30%	15.30%
<i>lag_int</i>	4.39%	2.02%	1.40%	3.36%	4.23%	4.80%	22.50%
<i>lag_unem</i>	8.76%	3.75%	3.10%	6.70%	7.90%	9.70%	27.50%
<i>ln ass</i>	16.55	2.47	10.55	14.82	16.66	18.24	21.67
<i>loans ass</i>	60.03%	19.26%	0.52%	49.77%	63.60%	74.19%	99.04%
<i>nfci_ta</i>	0.82%	0.77%	-0.42%	0.41%	0.69%	1.04%	11.22%
<i>nfci_ti</i>	25.37%	18.14%	-159.50%	17.56%	24.44%	31.16%	372.76%
<i>nim</i>	2.23%	1.44%	-0.47%	1.27%	2.04%	2.78%	13.40%
<i>npl_loans</i>	7.25%	8.60%	0.00%	2.30%	4.37%	8.59%	67.71%
<i>roae</i>	3.05%	29.86%	-992.29%	1.98%	6.31%	11.36%	185.71%

Source: Authors based on Bankscope, Eurostat, the ECB, HelgiLibrary and the World Bank

**Table 3.7: Relationship between NFCI share and HI – robustness check**

Independent variables	Dependent variable					
	<i>nfc_i ti</i>			<i>nfc_i ta</i>		
	OLS	System GMM	FE	OLS	System GMM	FE
<i>lag_DV</i>	0.5999 (0.0533)***	0.4392 (0.0705)***	0.2356 (0.0401)***	0.8437 (0.0479)***	0.7502 (0.0696)***	0.4858 (0.0535)***
<i>lag2_DV</i>	0.2254 (0.0306)***	0.2033 (0.0451)***	-0.0084 (0.0494)			

Robust standard errors adjusted for 258 clusters in index are in parentheses, \*\*\*/\*\*/\* indicates significance at 1%/5%/10%, other independents variables included in the regression are not reported in the table

*Source:* Authors based on Bankscope, Eurostat, the ECB and the World Bank

## 4 The impact of fee income share on EU banks' performance and its implication on drivers of banks' business model changes

**Published as:** Karolína Vozková (2019): The impact of fee income share on EU banks' performance and its implication on drivers of banks' business model changes, Prague Economic Papers, Vol. 29, No. 2, pp. 226-248.

### *Abstract*

*This paper contributes to the current literature dealing with drivers of bank business model changes. We analyse the relationship between fee and commission income share and banks' performance in terms of profitability, risk and risk-adjusted profitability in the European Union. We applied the System Generalized Method of Moments to a unique data set of 329 EU banks in the period 2005-2014, which resulted in three key findings. First, we did not find any diversification benefits by increasing the fee income share. Therefore, we can conclude that the increase in fee income share observed in recent years in EU banks was driven mainly by external factors, such as increased competition, rather than by internal reasons. Second, higher reliance on equity financing and better quality of provided loans enhance banks' performance. Third, bank business strategies and macroeconomic factors are crucial determinants of banks' performance.*

**Keywords:** bank, EU, fee and commission income, profitability, risk

**JEL classification:** C23, G21, L25

## 4.1 Introduction

An expansion of bank activities into non-traditional fee and commission bearing services can be observed over the last few decades (Brighi and Venturelli, 2016).<sup>40</sup> Banks are becoming more universal by combining traditional and non-traditional activities. Between 1989 and 1998, the non-interest income (NII) of EU banks increased from 26% to 41% of their total income (Lepetit et al., 2005). The most pronounced part of NII is net fee and commission income (NFCI), which accounted for almost 28% on average of the total income among EU banks in 2015 (ECB, 2016). Academicians, as well as bank managers, are mainly concerned with the impact of NII on the risk-return tradeoff. The theory of finance suggests that expanding into non-traditional activities should decrease the banks' risk level via diversification because fee income, trading income and other NII are not perfectly correlated with interest income (DeYoung and Roland, 2001; Smith et al., 2003). Moreover, 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.

Some authors, such as Stiroh (2004b), DeYoung and Rice (2004a) and Stiroh and Rumble (2006), find that diversification benefits are more than offset by increased exposure to potentially riskier fee bearing activities. For these banks, the decision to expand into non-traditional activities is possibly connected with reasons other than the effort to increase risk-adjusted returns and is possibly influenced by external factors. This might be connected with the technological development and widespread deregulation that increased the competition among financial institutions, which in turn led to decreased cost advantages of banks. As a result, the profitability of banks' traditional activities dropped, which consequently led to an expansion of banking activities into non-traditional fee and commission bearing services. An overall effort to find the optimal banking strategy and to identify the most appropriate level of bank fees can be observed.

Our study is motivated by the increasing share of NII in banks in recent years and the lack of literature dealing with this phenomenon in EU countries. Most of the current studies are based on US or individual countries' data from which it is not possible to draw a general conclusion about the EU banking market. In this paper, we use EU

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<sup>40</sup> Traditional activities include deposit taking and loan providing. Non-traditional activities are for example retail brokerage, insurance sales, securities issuance.

banks' data to analyse the links between bank NFCI magnitude, profitability, riskiness and risk-adjusted profitability in the period 2005-2014. Based on the results, we make conclusions about the basic reasons that why EU banks have increased their NII share in recent years. We also study whether the risk-return tradeoff (riskier activity - higher return) holds for NFCI.

The rest of the paper is structured as follows: Section 4.2 provides a literature review. In Section 4.3, we study the relationship between fee income magnitude and profitability, riskiness and risk-adjusted profitability of EU banks. Section 4.4 concludes.

## 4.2 Literature review

Stiroh and Rumble (2006), Goddard et al. (2008), Sanya and Wolfe (2011), and Gürbüz et al. (2013) provide detailed literature reviews on the link between income diversification and bank performance. We discuss only the most important papers. Stiroh (2004a), Stiroh (2004b), DeYoung and Rice (2004a) and Stiroh and Rumble (2006) conclude, based on US data, that diversification benefits might exist, but they are more than offset by the increased exposure to volatile NII-bearing activities and NII therefore tends to increase risk and decrease risk-adjusted profits.

Using data from OECD countries, Gischer and Jüttner (2003) discovered that higher fee to income ratios tend to decrease profitability, while Hahm (2008) and Moshirian et al. (2011) found an inverse effect of higher NII share. Higher reliance on non-traditional activities seems to increase the bank's profitability, but when also considering the macroeconomic factors, this relationship becomes weaker. Therefore, the revenue diversification does not necessarily imply a shift toward superior return-risk frontiers. Baele et al. (2007), Lepetit et al. (2008), Köhler (2012), Chiorazzo et al. (2008), Busch and Kick (2015), Dietrich and Wanzenried (2011), Dumičić and Ridzak (2013), and Köhler (2013) tested the correlation between NII and performance based on EU banks' data. In European studies, the results seem to be highly different, and Köhler (2013) claims that the link is highly dependent on bank type. The dependency of results on bank type is suggested also by Lee et al. (2014), who performed their study based on Asian banks' data.

Similar inconsistency of results can also be observed in studies of banking sectors in emerging economies. While Odesanmi and Wolfe (2007) found that diversification gains are present even though an increased share of NII lowers risk-adjusted profits,

Sanya and Wolfe (2011) found that the impact of NII share on risk-adjusted performance differs across various model specifications. Nevertheless, a higher share of NII tends to decrease the insolvency risk. Conversely, Gamra and Plihon (2011) found that higher reliance on NII has a negative impact on risk-adjusted profitability and increases insolvency risk.

We conclude that, despite the theory of finance, which suggests that diversification should lead to better risk-return tradeoffs and economies of scope, many papers have found that expansion of non-traditional activities decreases, rather than improves, bank's risk-adjusted performance. This may be caused by the higher volatility of NII compared to interest income (DeYoung and Roland, 1999; Stiroh, 2004a; Smith et al., 2003) or by the increasing correlation of NII with interest income (Stiroh, 2004a). The diversification effect also depends on the actual portfolio held by the bank (Köhler, 2013) and it affects small and large banks differently (Goddard et al., 2008; Köhler, 2013). Despite the fact that the literature is not unanimous about the effects of income diversification, it is very important to study how non-traditional activities affect the risk and profitability of banks, because these are crucial indicators for bank managers.

## 4.3 Empirical analysis

In this section, we examine the impact of the magnitude of NFCI on bank performance. In addition to the banks' basic interior factors, we include sector- and country-specific variables as determinants of the profitability, riskiness and risk-adjusted profitability of banks.

### 4.3.1 Data set

The analysis is based on EU data from 2005 to 2014. The data were taken from the Bankscope, Eurostat and ECB databases. The data set is a balanced panel including data from 329 EU banks (19 bank holdings and holding companies, 182 commercial, 57 savings, 45 cooperative, 17 real estate and mortgage and 9 investment banks). Table 4.1 displays the number of banks included in the study by country.<sup>41</sup>

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<sup>41</sup> The inclusion of more banks was not possible due to missing data. Moreover, we excluded banks with negative NFCI and operating income, because their NFCI/TI ratio would be misleading, and banks with negative Z-Scores, because we would not be able to construct the log transformation.

**Table 4.1: Number of banks included in the study by country**

Austria	13	Romania	11	Luxemburg	1	Hungary	5
Estonia	3	Bulgaria	8	Slovenia	5	Netherlands	8
Italy	33	France	55	Cyprus	3	Sweden	37
Portugal	11	Lithuania	5	Greece	1	Denmark	11
Belgium	3	Slovakia	6	Malta	3	Ireland	1
Finland	3	Croatia	15	Spain	12	Poland	13
Latvia	8	Germany	6	Czech Republic	11	United Kingdom	38

Source: Author

### 4.3.2 Methodology

We apply the System Generalized Method of Moments (GMM), which is appropriate for time-persistent data and data sets consisting of a large number of banks and a small number of time periods and is able to deal with explanatory variables that are not strictly exogenous.

The model is defined as:

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

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

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

where  $|\alpha| < 1$ ,  $i = 1, \dots, N$  is an individual index and  $t = 1, \dots, T$  is a time index. The disturbance is composed of the fixed effects,  $\mu_i$ , and the idiosyncratic shocks,  $v_{i,t}$ . Pooled OLS is inappropriate for the estimation because the exogeneity assumption is violated since  $y_{i,t-1}$  and  $\mu_i$  are correlated (Wooldridge, 2002). The least-squares dummy variable or within-groups estimator are unable to eliminate the dynamic panel bias (Nickell, 1981; Bond, 2002). It is suggested to use both the pooled OLS and the within-groups estimator as a robustness check, since both methods are biased in opposite directions (Bond, 2002).

Two transformations are commonly used for dynamic panel data. The first method, Difference GMM, originally developed by Holtz-Eakin et al. (1988) and by Arellano and Bond (1991), uses the first-difference transformation applied to equation (4.1). The fixed effects are no more present, but the lagged dependent variable is still

endogenous, which can be addressed by assuming that  $v_{i,t}$  are serially uncorrelated. The drawback of this method is that it does not allow for time-invariant variables.

The second method, System GMM, was developed by Blundell and Bond (1998), and it combines the differences equation with the level equation (4.1). As long as  $v_{i,t}$  are serially uncorrelated, the explanatory variables do not need to be strictly exogenous. Moreover, this method allows using time-invariant variables. The instruments are differenced to make them uncorrelated with the fixed effects (Sanya and Wolfe, 2011).

We include time dummies in the regressions because they make the assumption of no correlation between idiosyncratic shocks more likely to hold (Roodman, 2006, Sanya and Wolfe, 2011). We use two-step System GMM with clustered standard errors robust to heteroskedasticity and autocorrelation within individuals, and with small sample corrections to the covariance matrix. We apply Windmeijer's (2005) correction to prevent the downward bias of the standard errors estimation that may arise when the number of instruments is large (Arellano and Bond, 1991). The estimation is performed in Stata.

The estimation equation is:

$$Y_{i,c,t} = \alpha + \beta Y_{i,c,t-1} + \gamma X_{i,c,t} + \delta Z_{c,t-1} + \epsilon W_{c,t} + \theta D_i + \vartheta T_t + (\mu_i + v_{i,c,t}) \quad 4.2$$

where:

$Y_{i,c,t}$  ..... performance of bank  $i$  in country  $c$  at time  $t$ , measured as described in Section 4.3.3,

$Y_{i,c,t-1}$  .. performance of bank  $i$  in country  $c$  at time  $t - 1$ ,

$X_{i,c,t}$  ..... 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  $t - 1$ ,

$W_{c,t}$  ..... vector of banking sector-specific variables for country  $c$  at time  $t$ ,

$D_i$  ..... bank type dummy,

$T_t$  ..... time dummy,

$\mu_i$  ..... unobserved bank-specific time-invariant effect, and

$v_{i,c,t}$  ..... disturbance term, which is independent across banks.

### 4.3.3 Variables

The dependent variables capturing bank performance are:

- 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*):  $NIM_{i,t} = \frac{Interest\ income_{i,t} - Interest\ expense_{i,t}}{Assets_{i,t}}$
- Risk-adjusted ROAA (*raroaa*):  $RAROOA_{i,t} = \frac{ROAA_{i,t}}{\sigma(ROAA)_i}$
- 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*):  

$$\ln(RAEAR)_{i,t} = \ln\left(\frac{\frac{Equity_{t,i}}{Assets_{t,i}}}{\sigma(ROAA)_i}\right)^{42}$$

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

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

The literature on bank performance widely uses Z-Score as a measure of risk (Stiroh 2004a; Köhler, 2012). A higher Z-Score indicates a lower probability of insolvency. 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. Furthermore, we follow Köhler (2012; 2013) and also use individual components of Z-Score that capture the portfolio and the leverage risk as risk indicators. The portfolio risk is measured by RAROOA, while RAEAR stands for the leverage risk. For both measures, higher values indicate increased stability.

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<sup>42</sup> Log-transformation is needed due to high skewness of Z-Score and RAEAR.

By choosing the proper explanatory variables, we follow the actual best practice, which follows from the literature review in Section 4.2. Originally, we had 9 bank-specific, 3 sector-specific and 4 country-specific variables, but some of them had to be excluded due to their mutual correlation or insignificance. The independent variables used in the final analysis are summarized in Table 4.2.

**Table 4.2: Independent variables**

Variable	Description
<i>nfc_i_ti</i>	Net fee and commission income to total operating income
<i>depos_ass</i>	Total customer deposits to asset ratio
<i>eq_ass</i>	Total equity to total assets ratio
<i>loans_depos</i>	Loans to deposits ratio
<i>losres_loans</i>	Loan-loss reserves to gross loans ratio
<i>hi</i>	Herfindahl index
<i>lag_gdp</i>	Lagged real annual GDP growth rate
<i>lag_inf</i>	Lagged annual inflation rate

Source: Author

We also include a lagged dependent variable (*lag\_DV*) and 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, and 0 = real estate and mortgage banks.

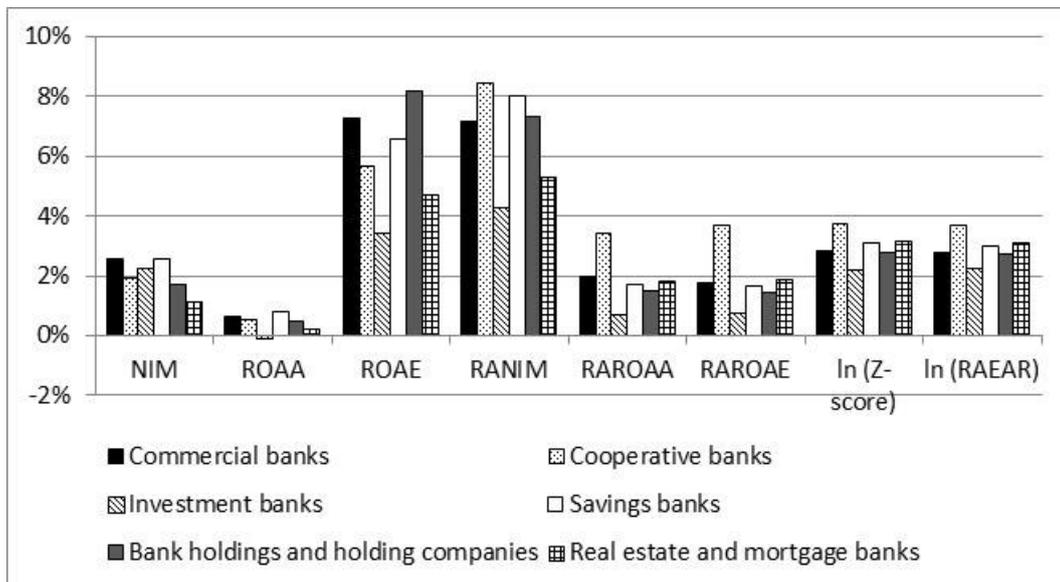
#### 4.3.4 Descriptive analysis

In this section, we provide a descriptive analysis of the variables used. The scatter plots depicting the relationship between the dependent variables and NFCI/TI can be found in Figure 4.5. Figure 4.1 displays the mean of each dependent variable by bank type computed over the period 2005-2014. Cooperative banks seem to outperform the other banking models in terms of stability and risk-adjusted profitability. The opposite holds true for investment banks. This is probably due to the small number of investment banks included in the study and the fact that 7 out of the 9 investment banks are from PIIGS<sup>43</sup> countries, which were the most affected by the 2008 financial crisis.

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<sup>43</sup> PIIGS refers to Portugal, Ireland, Italy Greece, Spain.

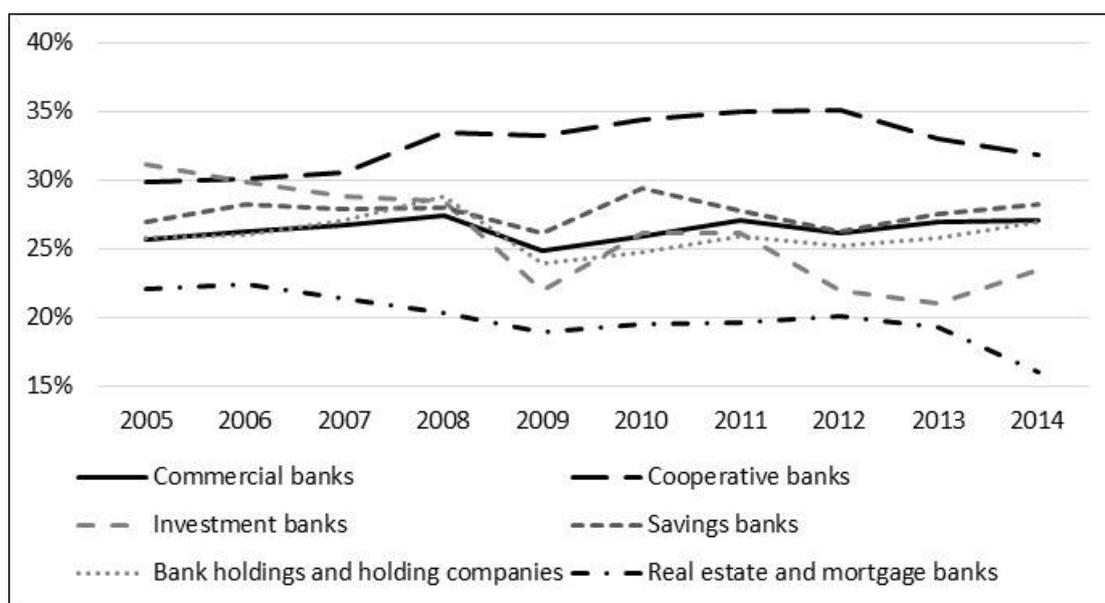
**Figure 4.1: Average performance measures in 2005-2014**



For NIM, ROAA, ROAE, RANIM, RAROOA, and RAROE, the values on the vertical axis are in %.  
 Source: Author, based on Bankscope

The average NFCI/TI reported in the dataset during the analysed period was 27.11%. The average NFCI/TI between 2005 and 2014 was the lowest in real estate and mortgage banks (20%) and the highest in cooperative banks (32.66%). Figure 4.2 shows that, after the financial crisis, most of the banks' NFCI/TI dropped by almost 3%, but returned to the pre-crisis values within one year.

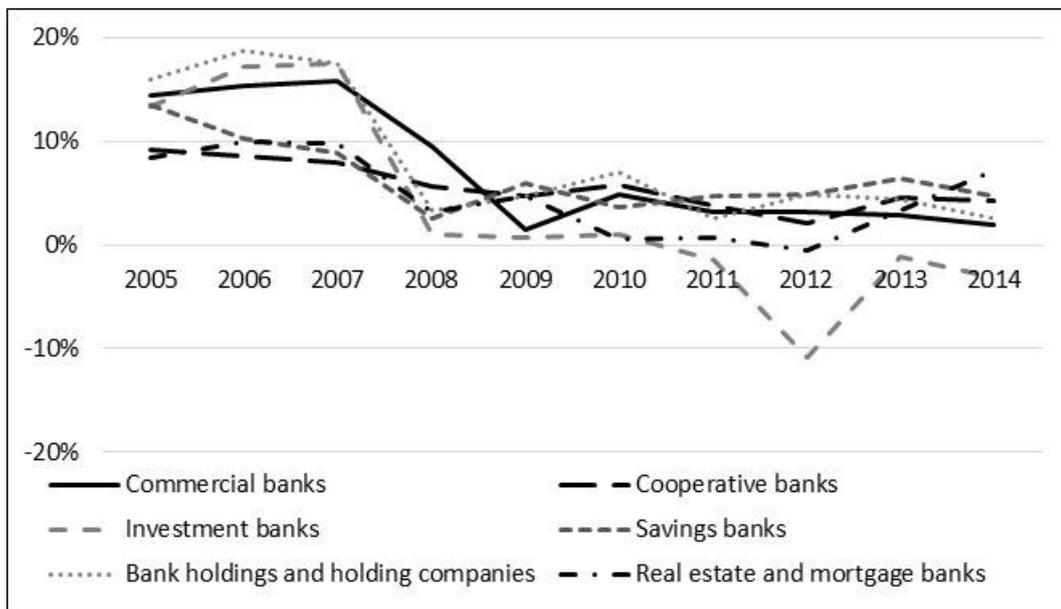
**Figure 4.2: Development of average NFCI/TI**



Source: Author, based on Bankscope

Figure 4.3 shows the evolution of the average ROAE from 2005 to 2014 by bank type. As seen, the ROAE dropped by approximately 10% in all bank types after the financial crisis in 2008 and remained at similar levels until 2014. The most pronounced decrease in the ROAE was observed in investment banks. Again, this could be related to the special features of the group, which is represented by a low number of banks, mainly from PIIGS countries.

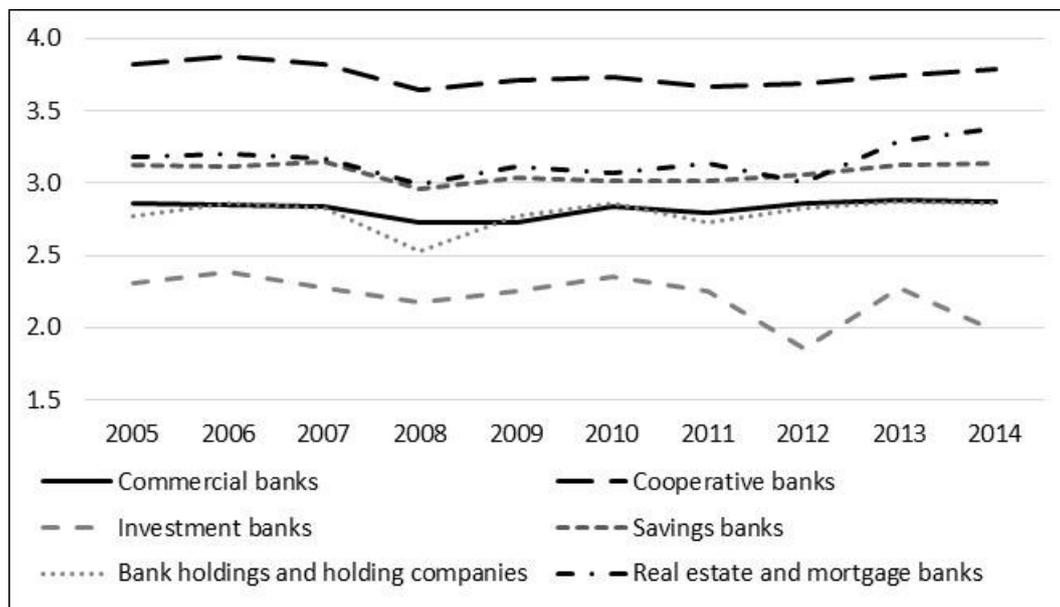
**Figure 4.3: Development of average ROAE**



Source: Author, based on Bankscope

Figure 4.4 shows that, compared to ROAE, which significantly decreased after the crisis, the ln (Z-Score) was much more stable. In 2008, there was only a short-term deterioration in the ln (Z-Score) (i.e., an increase in the probability of insolvency).

**Figure 4.4: Development of average ln (Z-Score)**



Source: Author based on Bankscope

Figure 4.6 shows average NFCI/TI by country. The highest share of fee income was reported for 2005-2014 in Spain, while the lowest was reported in Ireland. Generally, the PIIGS countries reported extreme NFCI/TI on both sides compared to other EU countries. Figure 4.7 shows the average Herfindahl index (HI) by country. On average, there is a moderate banking sector concentration in the EU. Figure 4.8 shows country-specific macroeconomic indicators in 2013. It can be seen that the macroeconomic conditions of the PIIGS countries are still very poor. This is reflected by very low or negative GDP growth rates. Table 4.6 shows summary statistics of the variables used.

### 4.3.5 Results and findings

The Wooldridge test for autocorrelation proved autocorrelation for all the dependent variables (Table 4.3). Therefore, System GMM will be used as the main estimation method. Other methods will be applied for a robustness check.

**Table 4.3: Wooldridge test for autocorrelation**

	ROAA	ROAE	NIM	RAROOA	RAROE	RANIM	ln (Z-Score)	ln (RAEAR)
F statistics	9.902	52.864	74.035	211.975	204.863	518.410	11.478	220.306
p-value	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008	0.0000

H0: No first-order autocorrelation, degrees of freedom (d.f. 1, 329)

Source: Author, based on Bankscope

The regression results of the model that investigates the determinants of profitability, riskiness and risk-adjusted profitability in EU banks can be found in Table 4.4. In all the regressions, the coefficient of *lag\_DV* is significantly positive, proving the necessity of the application of an estimation method suitable for dynamic panel data. The first-order autocorrelation in residuals is also proven by the Arellano-Bond AR (1) test. Moreover, the significant AR (2) test suggests that there may exist even longer time persistence in NIM and all risk-adjusted profitability measures, which was tested by the robustness tests. The results were not significantly influenced by the inclusion of higher lags of the dependent variable in the regressions. We instrument all endogenous and predetermined variables with their lagged values. In models with significant AR (2), higher lags of *lag\_DV* were used as instruments because the second lag of the dependent variable is endogenous. The model is unlikely to suffer from overidentification because the Hansen test proves the exogeneity of instruments, and the rule of thumb that instruments should not exceed the number of groups is not violated. The significant F-test indicates the joint significance of the variables used in all models.

The effect of NFCI/TI on banks' performance is stable with the performance measure used. Not only does higher NFCI/TI decrease the profitability measured by NIM, ROAA and ROAE, but it also tends to increase the insolvency and portfolio risk, while the effect on leverage risk does not seem to be present. It is then straightforward that risk-adjusted performance measures are also deteriorated by higher fee income shares. We do not find any positive diversification effects from increasing fee income share. Therefore, the expansion into NFCI-bearing activities seems to be connected with external drivers rather than with the effort to achieve better risk-return tradeoffs. This might reflect the fact that higher NFCI/TI is connected with higher competition. Vozková and Teplý (2018) claim that competition pushes banks to offer more non-traditional fee income bearing services, which are potentially riskier than the traditional ones. Moreover, competition decreases profitability, which might explain why increased NFCI is connected with both a decrease in profitability (general decrease in profitability due to competition) and an increase in riskiness (due to higher exposure to more volatile NFCI). Therefore, with increased NFCI share, we cannot observe the standard risk-return tradeoff. Nevertheless, it is possible that, without the expansion into fee-bearing activities, the banks' performance would deteriorate due to high competition more than in cases of increased reliance on non-traditional activities. Therefore, the standard risk-return tradeoff is not generally rejected for NFCI.

The measure of liquidity, *loans\_depos*, seems to have a significantly negative impact on ROAA, ROAE and risk-adjusted profitability measures, but the size of the coefficients is so small that we do not take them into consideration. *Depos\_ass* has a positive impact on NIM, ROAE, RAROOA and ln (Z-Score), which proves that deposits count as rather cheap sources of funds, and this method of financing is connected with low risk. The coefficient of *losres\_loans* is significantly negative in all the models, with the exception of NIM and RANIM, which supports the hypothesis that higher loan-loss reserves are a sign of poor quality of loans. As expected, higher *eq\_ass*, the banks' ability to meet its obligations and absorb potential losses, increases the bank's stability.

*Hi* has a significantly negative coefficient in almost all the performance models, but the coefficient is close to zero; therefore, market competition does not seem to play an important role in determining the performance of EU banks. This might be because, in almost all the EU countries, there is moderate market concentration (see Table 4.8). On the other hand, country specific variables, as expected, seem to be very important. While higher GDP growth leads to better bank' performance, inflation tends to have the opposite impact.

Business models influence the banks' profitability and stability. The highest profitability can be found in commercial and cooperative banks, while real estate and mortgage banks display lower profitability using all three measures. Using NIM, investment banks also have high profits while using ROAE, and bank holdings and holding companies seem to be the most profitable. Cooperative banks outperform the other types of banks in terms of risks and risk-adjusted profitability. These findings are in line with Figure 4.1.

To make the assumption of no correlation between idiosyncratic shocks more likely, we included time dummies for the years 2006 (*t06*) to 2013 (*t13*)<sup>44</sup> in the estimation. The coefficients of the time dummies do not suggest any clear structural break. To formally test for structural break after the financial crisis, we performed separate regressions for the time periods 2005–2007 and 2008–2010. We did not find many significant differences among the results. Only the coefficient *depos\_ass* in the NIM, ROAA, RANIM and ln (RAEAR) regressions in the time period 2008-2010 turned out to be significantly negative, which is not in line with our overall results. This might be because, after the crisis, there was a general drop in returns connected to

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<sup>44</sup> More time dummies could not be included due to their mutual correlation.

traditional banking activities. Nevertheless, the coefficients of NFCI/TI, in which we are mainly interested, are consistently negative under all the specifications. During the crisis, the negative impact of the higher share of fee income on banks' performance increased slightly (see Table 4.7). The missing evidence of a structural break in the impact of NFCI/TI on banks' performance during the crisis is probably because NFCI/TI measures relative, rather than absolute, values of fee income, and relative values are more stable over time.

**Table 4.4: Relationship between performance measures and NFCI/TI – System GMM regression results**

Independent variables	Dependent variable							
	NIM	ROAA	ROAE	RANIM	RAROA	RAROE	ln (Z-Score)	ln (RAEAR)
lag_DV	0.7725*** (0.0000)	0.3226*** (0.0000)	0.3521*** (0.0000)	0.9297*** (0.0000)	0.7258*** (0.0000)	0.6967*** (0.0000)	0.7665*** (0.0000)	0.8708*** (0.0000)
nfc_i_ti	-0.0078*** (0.0000)	-0.0088** (0.0230)	-0.1652*** (0.0000)	-0.0115** (0.0000)	-0.0188*** (0.0000)	-0.0169*** (0.0000)	-0.0046*** (0.0000)	-0.0017*** (0.0020)
loans_depos	-0.0000 (0.2530)	-0.0000*** (0.0010)	-0.0000** (0.0120)	0.0000 (0.3770)	-0.0000*** (0.0000)	-0.0000*** (0.0000)	0.0000 (0.1520)	0.0000 (0.7360)
depos_ass	0.0022** (0.0470)	0.0005 (0.8240)	0.0629** (0.0140)	0.0022 (0.1820)	0.0050** (0.0420)	0.0042 (0.1440)	0.0025** (0.0200)	0.0000 (0.8890)
losres_loans	0.0048 (0.3950)	-0.1297*** (0.0000)	-1.0478*** (0.0000)	-0.0098 (0.1060)	-0.0648*** (0.0000)	-0.0658*** (0.0000)	-0.0350*** (0.0000)	-0.0161*** (0.0000)
eq_ass	0.0111*** (0.0010)	0.0340** (0.0150)	0.2117*** (0.0070)	0.0091* (0.0980)	0.0176** (0.0100)	0.0111 (0.1150)	0.0227*** (0.0000)	0.0141*** (0.0000)
hi	-0.0000 (0.1850)	-0.0000** (0.0350)	-0.0018*** (0.0030)	-0.0000** (0.0190)	-0.0002*** (0.0000)	-0.0002*** (0.0000)	-0.0001*** (0.0000)	-0.0000*** (0.0000)
lag_gdp	0.0308*** (0.0000)	0.0564** (0.0110)	0.3329** (0.0150)	0.0465*** (0.0000)	0.0071 (0.5010)	0.0044 (0.6730)	-0.0069 (0.1240)	-0.0013 (0.5170)
lag_inf	0.0034 (0.7060)	-0.0596*** (0.0080)	-0.8312*** (0.0010)	-0.0577*** (0.0000)	-0.0906*** (0.0000)	-0.0884*** (0.0000)	-0.0331*** (0.0000)	-0.0116*** (0.0000)
dcom	0.2462*** (0.0000)	0.5140*** (0.0010)	5.6076*** (0.0010)	0.0753 (0.3940)	0.3107** (0.0300)	0.2637* (0.0810)	0.0175 (0.7160)	-0.0308 (0.1910)
dcoop	0.2407*** (0.0000)	0.3959** (0.0170)	4.9246*** (0.0080)	0.1365 (0.2680)	0.6632*** (0.0010)	0.8077*** (0.0000)	0.1860** (0.0140)	0.0358 (0.2730)
dsav	0.2203*** (0.0000)	0.2817* (0.0510)	1.5128 (0.4200)	-0.0444 (0.6850)	-0.0835 (0.5810)	-0.0800 (0.6230)	-0.1045* (0.0720)	-0.0755*** (0.0050)
dinv	0.3737*** (0.0060)	0.2440 (0.2180)	5.6742** (0.0330)	0.1522 (0.2890)	0.0837 (0.6660)	0.0784 (0.7390)	-0.1403 (0.1650)	-0.1256** (0.0210)
dhold	0.1960*** (0.0070)	0.4124*** (0.0040)	5.9953*** (0.0010)	0.1129 (0.3990)	0.1156 (0.4610)	0.0746 (0.6570)	0.0488 (0.4020)	-0.0194 (0.5260)
t06	-0.0926**	0.1566	4.7983	-0.4834*	0.2466*	*0.3354	-0.0038**	-0.0421**

Independent variables	Dependent variable							
	NIM	ROAA	ROAE	RANIM	RAROOA	RAROE	ln (Z-Score)	ln (RAEAR)
t07	(0.0385) -0.0786**	(0.1319) 0.0752	(0.8307) 4.2603	(0.0693) -0.4148*	(0.0808) 0.2078*	(0.0871) 0.3358*	(0.0257) -0.0206**	(0.0145) -0.0693**
t08	(0.0449) 0.0262**	(0.1573) -0.4164	(0.8778) -1.6203	(0.0782) -0.1351*	(0.0864) -0.7457	(0.0919) -0.5256	(0.0253) -0.1198**	(0.0119) -0.1127**
t09	(0.0457) -0.2013**	(0.1721) -0.1369	(0.9600) -0.2901	(0.0802) -0.4569*	(0.1029) -0.0536*	(0.1062) 0.0573*	(0.0295) 0.0814**	(0.0149) 0.0725**
t10	(0.0465) 0.1128**	(0.1170) 0.2412*	(0.9634) 2.5988	(0.0968) 0.0243*	(0.0957) 0.1989*	(0.0988) 0.1826*	(0.0288) -0.0178**	(0.0150) -0.0164**
t11	(0.0436) -0.0428**	(0.0954) -0.1238	(1.0756) -0.4779	(0.0873) -0.1201*	(0.0915) -0.1095*	(0.0866) -0.0334*	(0.0338) -0.0253**	(0.0168) -0.0447**
t12	(0.0358) -0.1563**	(0.1154) -0.1270	(0.7681) 0.5620	(0.0624) -0.4323*	(0.0717) -0.0931*	(0.0704) -0.0284*	(0.0232) 0.0703**	(0.0110) 0.0333**
t13	(0.0319) -0.0613**	(0.1560) 0.3003*	(0.9389) 2.4410	(0.0650) -0.1728*	(0.0847) 0.2702*	(0.0829) 0.2840*	(0.0320) 0.0893**	(0.0113) 0.0269***
_cons	(0.0295) 0.2536***	(0.0883) 0.4331***	(0.8299) 3.6246	(0.0579) 0.9152***	(0.0791) 0.9108***	(0.0749) 0.9279***	(0.0244) 0.7604***	(0.0097) 0.4821***
	(0.0030)	(0.0080)	(0.1150)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
<b>Estimation diagnostics</b>								
Number of observations	2,961	2,961	2,961	2,961	2,961	2,961	2,961	2,961
Number of instruments	317	326	326	317	317	317	326	326
F-test	278.81***	34.72***	49.85***	378.54***	110.73***	106.57***	295.51***	740.74***
Arellano-Bond AR (1)	-4.94***	-2.5**	-5.18***	-10.73***	-11.55***	-11.24***	-2.81***	-8.55***
Arellano-Bond AR (2)	-2.5**	0.2	0.22	-4.94***	2.94***	3.96***	1.33	0.05
Hansen test	321.49	323.46	324.92	319.02	321.12	319.47	322.55	322.68

Robust standard errors adjusted for 329 clusters in index are in parentheses, \*\*\*/\*\*/\* indicates significance at 1%/5%/10%, *\_cons* stands for constant  
*Source*: Author based on Bankscope, Eurostat, ECB

In addition to including higher lags in the NIM and risk-adjusted profitability regressions and testing the crisis period separately, we also performed robustness tests among the regressions by excluding investment banks, since they are outlying in some aspects. Since it is very difficult to stipulate the ideal number of instruments in System GMM, a part of the robustness check comprises regressions estimating the same model using other/fewer instruments. The results proved to be robust to these changes. Moreover, the System GMM results proved to be valid, since the estimate of the lagged dependent variable lies between the FE and pooled OLS estimate (see Table 4.8).

#### 4.3.5.1 Summary of results and comparison with other researchers

Table 4.5 provides a comparison of our results with the current literature. Most of the other academic papers have examined the impact of NII and not just NFCI on bank performance. Nevertheless, we believe the results may be compared because NFCI represents the greatest part of NII in most of the banks.

It can be seen that the literature is not unanimous about the link between fee income and the bank performance. The greatest disunity is found by RAROOA and Z-Score, where all the possible outcomes were found in similar quantities. The relationship is probably highly dependent on other internal and external conditions faced by the bank. In our study, NFCI/TI has a negative impact on all the profitability, stability and risk-adjusted profitability measures. The performance of EU banks seems to decrease with increased reliance on NFCI. The link between NFCI/TI and ROAA, RAEAR was insignificant under some model specifications tested among the robustness tests. Interestingly, only one paper listed below tested the impact of NII or fee income share on RANIM. This may be because NIM is, compared to other profitability measures, more stable and thus risk-adjusting may not be as important. Nevertheless, we constructed the RANIM measure and found that fee income not only decreases NIM but also decreases RANIM.

Our evidence of the negative impact of NFCI/TI on banks' performance is against the results found in Dietrich and Wanzenried (2011), who performed the analysis based on Swiss banks; Chiorazzo et al. (2008), who used data from Italian banks; and Busch and Kick (2009) and Köhler (2012; 2013), who used data from German banks. This might be because those studies made their analysis using data from only one country. Sanya and Wolfe (2011) analysed the link in emerging economies and found that the result is heavily dependent on the exact model specification. Most of the other studies were based on US data or included banks from different countries. Our results are in line with those that show that the relationship between fee income share and banks' performance is negative.

**Table 4.5: Results comparison with existing literature**

Author	Dependent variable							
	ROAA	ROAE	NIM	RAROOA	RAROE	RANIM	Z-Score	RAEAR
Stiroh (2004a)		0			-		-	
Gischer and Jüttner (2003)	-		-					
DeYoung and Rice (2004a)		+			-			

Author	Dependent variable							
	ROAA	ROAE	NIM	RAROOA	RAROE	RANIM	Z-Score	RAEAR
Stiroh (2004b)				-/0	-		-/0	
Stiroh and Rumble (2006)	0	0		-	-		-	
Odesanmi and Wolfe (2007)				-	-			
Goddard et al. (2008)	0	+		0	0			
Chiorazzo et al. (2008)				+	+			
Hahm (2008)	+/0						0	
Lepetit et al. (2008)			-					
Busch and Kick (2009)	+	+		+	+			
Dietrich and Wanzenried (2011)	+	+	+					
Gamra and Plihon (2011)				-	-			-
Moshirian et al. (2011)	+							
Sanya and Wolfe (2011)				+/-/0	+/-/0		+	
Köhler (2012)				+		+	+	
Dumičić and Ridzak (2013)			-					
Köhler (2013)				+/0	+/-/0		+/0	+
<b>This study (2019)</b>	-/0	-	-	-	-	-	-	-/0

+/- indicates a statistically positive/negative coefficient at the 10% level or better, 0 indicates insignificant coefficients, in case the results changed under different model specifications or in robustness tests, there are more results reported in one cell, 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

There are two further key research opportunities resulting from our paper. First, the diversity of banking models and banking market fragmentation should be analysed in more detail. The exact impact of the fee income share depends on the business model and the bank size. Whereas traditional banks mainly dependent on interest income can possibly gain by increasing their NFCI, non-traditional banks should instead rely more on interest income to stabilize their profits. Second, since some variables needed to be excluded due to their mutual correlation, other measures capturing bank-, sector- and country-specific factors should be included in the model.

## 4.4 Conclusion

In this paper, we contributed to the existing literature by studying the impact of NFCI on banks' performance in the EU using a unique cross country data set. From the results, we are able to draw conclusions about the reasons why EU banks expand into non-traditional fee-bearing activities, and we fill a gap in the literature dealing with drivers of bank business model changes. Fee income represents almost 30% of the total income of EU banks, and it is therefore crucial to set and maintain an

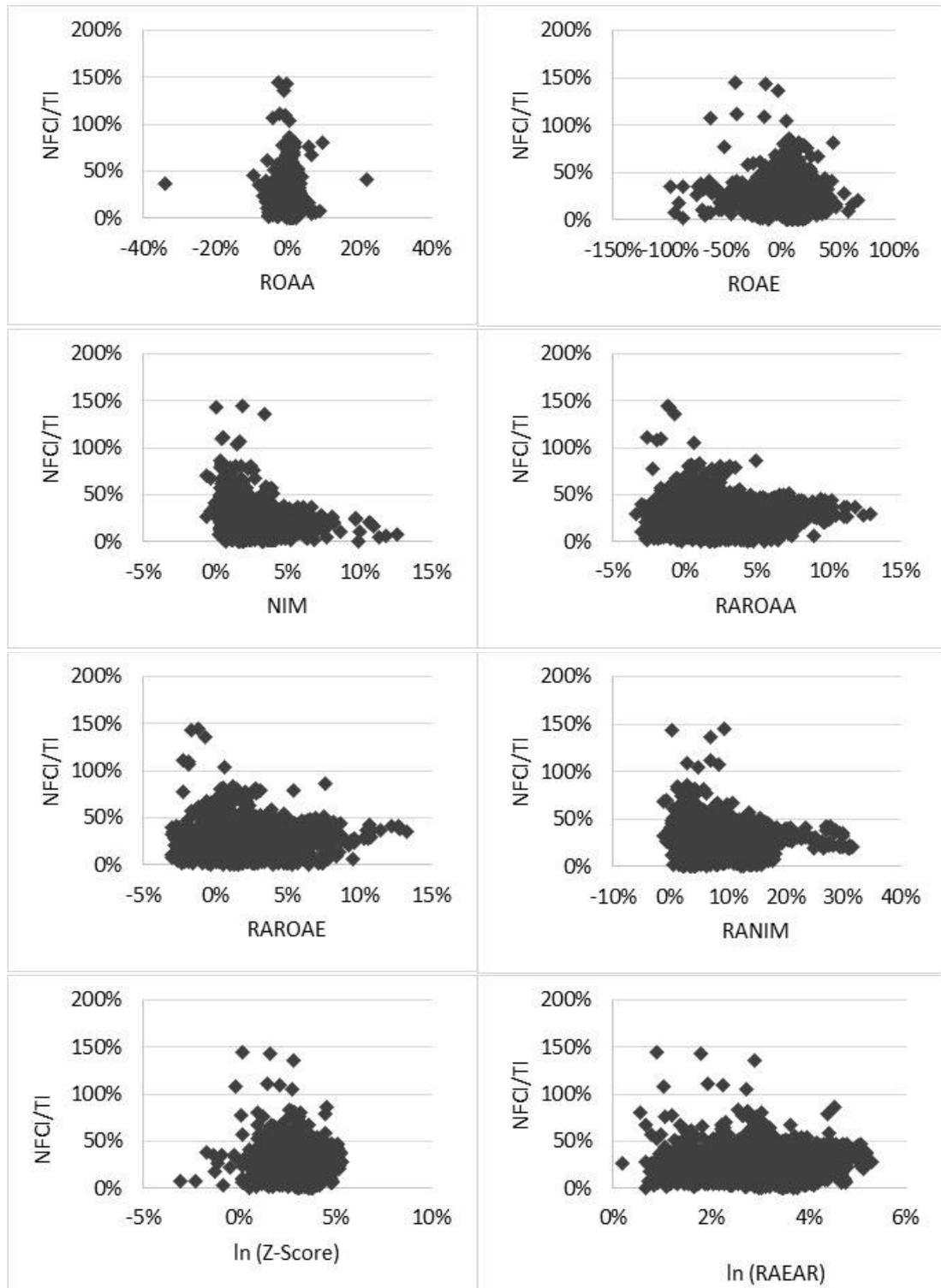
appropriate fee policy. However, both theoretical and empirical evidence about the optimal share of fee income is mixed.

We used balanced panel data from 329 EU banks during the period 2005-2014. We employed the System GMM estimation method, since it is suitable for dynamic panel data. Different bank-specific, banking sector-specific and macroeconomic factors were considered. We were primarily concerned with the relationship between fee income magnitude and banks' performance, which was measured by different profitability, risk and risk-adjusted profitability measures. The analysis suggests that banks depending more on fee income tend to be less profitable and riskier. We did not find any diversification benefits. Based on this result, we claim that substantial levels of fee income might be the result of the effort to maintain sufficient profitability in increasingly competitive markets, rather than the attempt to diversify. Moreover, non-traditional activities are potentially riskier than traditional banking activities. Nevertheless, increasing the share of fee income might lead to increased stability in banks that rely solely or heavily on interest income. On the other hand, investment banks should instead rely more on interest income to stabilize their profits. Our results suggest that EU banks are already universal enough, and therefore the current shift in fee income share does not lead to increased risk-adjusted profitability.

Our results confirm that the share of fee income is highly dependent on the banks' business models, as well as on market conditions. Deposits seem to represent a cheap and not very risky source of finance, since they improve NIM and ROAE and simultaneously decrease insolvency risk. A higher ratio of loan-loss reserves to total loans, a sign of poor quality of provided loans, has a negative impact on all performance measures, which is in line with our expectations. As expected, greater reliance on equity financing leads to higher stability in banks. Among macroeconomic conditions, both GDP growth and inflation significantly affect banks' performance.

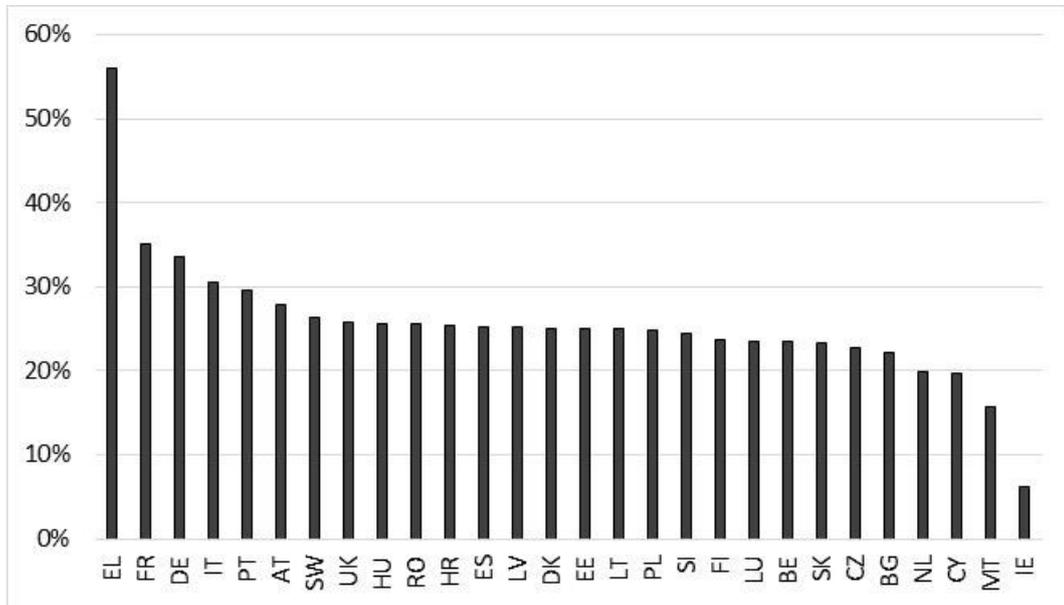
## 4.5 Appendix

**Figure 4.5: Scatter plots**



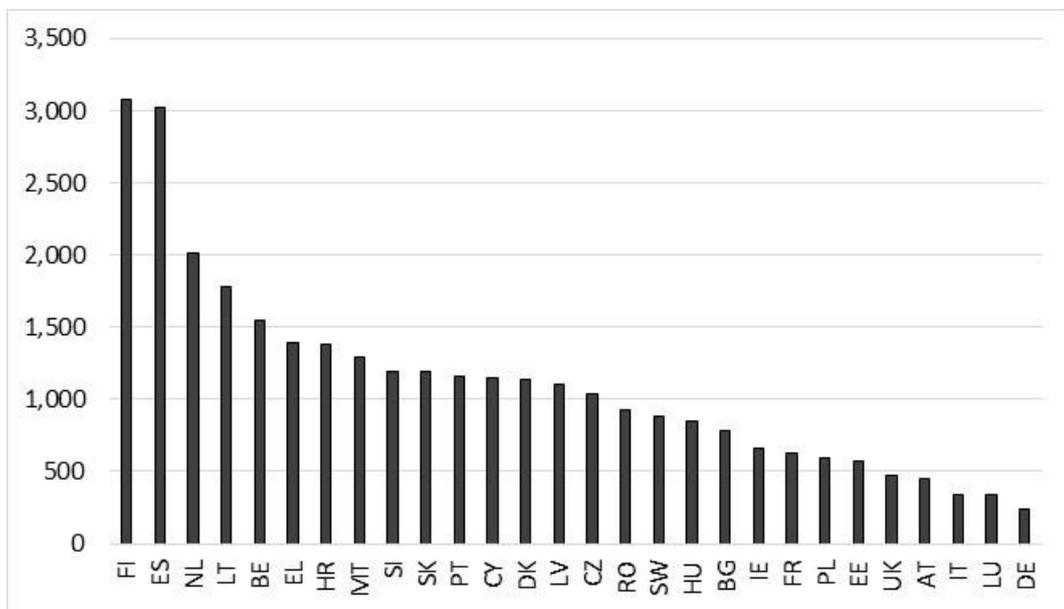
Source: Author, based on Bankscope

**Figure 4.6: Average NFCI/TI 2005-2014**



Source: Author, based on Bankscope

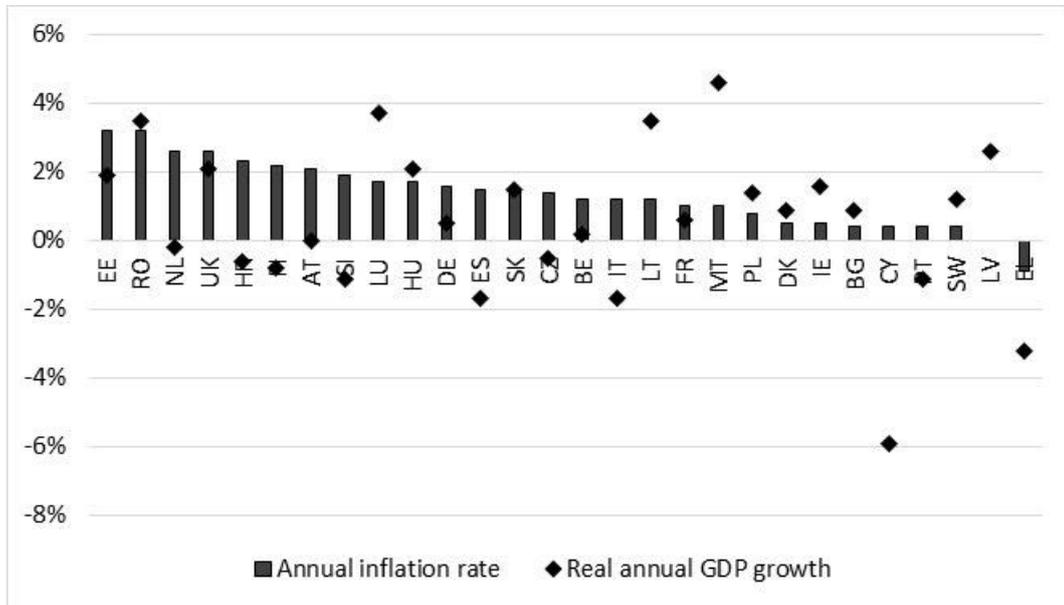
**Figure 4.7: Average HI 2005-2014**



HI's values range between 0–10,000, higher values of HI stand for higher concentration

Source: Author, based on the ECB

**Figure 4.8: Macroeconomic indicators in 2013**



Source: Author, based on Eurostat, ECB

**Table 4.6: Summary statistics**

Variable	Min	1st quartile	Median	3rd quartile	Max
<i>roae</i>	-98.82%	3.7%	7.24%	12.41%	67.29%
<i>roaa</i>	-34.03%	0.25%	0.59%	1.05%	21.91%
<i>nim</i>	-0.62%	1.4%	2.12%	2.96%	12.63%
<i>raroae</i>	-3.05%	0.5%	1.51%	3.1%	13.31%
<i>raroaa</i>	-3.43%	0.53%	1.6%	3.16%	12.89%
<i>ranim</i>	-1.21%	4.42%	6.47%	8.99%	31.53%
<i>ln z score</i>	-3.08	2.45	3.03	3.6	5.33
<i>ln_raear</i>	0.2	2.38	2.95	3.51	5.29
<i>nfcit</i>	0%	19.95%	26.38%	33.44%	145.13%
<i>loans_depos</i>	4.49%	82.22%	107.81%	153.57%	1000000%
<i>depos_ass</i>	0.01%	36.78%	55.57%	74.14%	96.16%
<i>losres_loans</i>	0.01%	1.18%	2.39%	4.06%	41.87%
<i>eq_ass</i>	1.08%	5.78%	8.16%	11.73%	71.4%
<i>hi</i>	174	523	726	1061	4039
<i>lag_gdp</i>	-14.8%	0.2%	1.7%	3.1%	11.9%
<i>lag_inf</i>	-1.7%	1.6%	2.2%	3.2%	15.3%

Source: Author, based on Bankscope, Eurostat, ECB

**Table 4.7: Check for presence of structural break**

<i>NFCI/TI</i>	Dependent variable							
	NIM	ROAA	ROAE	RANIM	RAROOA	RAROE	ln (Z-Score)	ln (RAEAR)
2005-2007	-0.0205*** (0.0073)	-0.0073*** (0.0094)	-0.2173 (0.1420)	-0.0466** (0.0128)	-0.0391** (0.0147)	-0.0270** (0.0168)	-0.0063*** (0.0039)	-0.0033*** (0.0049)
2008-2010	-0.0372** (0.0120)	-0.0087** (0.0231)	-0.3897 (0.2778)	-0.0738** (0.0466)	-0.0364** (0.0305)	-0.0463** (0.0330)	-0.0195*** (0.0079)	-0.0070*** (0.0070)

Robust standard errors adjusted for 329 clusters in index are in parentheses, \*\*\*/\*\*/\* indicates significance at 1%/5%/10%, other independent variables included in the regression are not reported  
*Source:* Author, based on Bankscope, Eurostat, ECB

**Table 4.8: Robustness check**

<i>lag DV</i>	Dependent variable							
	NIM	ROAA	ROAE	RANIM	RAROOA	RAROE	ln (Z-Score)	ln (RAEAR)
pooled OLS	0.8405*** (0.0000)	0.4342*** (0.0000)	0.4705*** (0.0000)	0.9813*** (0.0000)	0.8713*** (0.0000)	0.8499*** (0.0000)	0.9217*** (0.0000)	0.9626*** (0.0000)
System GMM	0.7725*** (0.0000)	0.3226*** (0.0000)	0.3521*** (0.0000)	0.9297*** (0.0000)	0.7258*** (0.0000)	0.6967*** (0.0000)	0.7665*** (0.0000)	0.8708*** (0.0000)
FE	0.5804*** (0.0000)	0.2047*** (0.0000)	0.1419*** (0.0000)	0.4584*** (0.0000)	0.1525*** (0.0000)	0.1646*** (0.0000)	0.0698 (0.1800)	0.2730*** (0.0000)

Robust standard errors adjusted for 329 clusters in index are in parentheses, \*\*\*/\*\*/\* indicates significance at 1%/5%/10%, other independent variables included in the regression are not reported  
*Source:* Author, based on Bankscope, Eurostat, ECB

## II. Cooperatives

### 5 Net Fee and Commission Income Determinants of European Cooperative Banks

**Published as:** Karolína Vozková, Matěj Kuc (2016): Net Fee and Commission Income Determinants of European Cooperative Banks, *International Journal of Economics and Management Engineering*, Vol. 10, No. 12, pp. 3919-3924.

#### *Abstract*

*Net fee and commission income is one of the key elements of a bank's core income. In the current low-interest rate environment, this type of income is gaining importance relative to net interest income. This paper analyses the effects of the bank and country specific determinants of net fee and commission income using a dataset of cooperative banks from European countries in the 2007-2014 period. To do that, a dynamic panel data method (the system Generalized Method of Moments) was employed. Subsequently, alternative panel data methods were run as robustness checks of the analysis. The results are twofold. First, a strong positive impact of bank concentration on the share of net fee and commission income was found, which proves that cooperative banks tend to have higher shares of fee income in less competitive markets. This is probably connected to the fact that they retain their traditional deposit-taking and loan-providing model and the fees on these services are driven down by their competitors. Second, compared to commercial banks, cooperatives do not expand heavily into non-traditional fee bearing services under competition; therefore, their overall fee income share decreases as the competitiveness of the sector increases.*

**Keywords:** Cooperative banking, Dynamic panel data models, Net fee and commission income, System GMM

**JEL classification:** C23, G21, L25

## 5.1 Introduction

The topic of banks' non-interest income (NONII) has been largely analysed because its share increased significantly during the last decades. NONII has increased from 26% to 41% of total income from 1989 to 1998 in Europe (Lepetit et al., 2005). It is assumed that the technological development and digitalization of banking led to increased competition, which decreased the cost advantages, and, in turn, the profitability of traditional - deposit taking and loan providing - banking services. By seeking new profits, commercial banks expanded their activities into non-traditional fee and commission bearing services, such as retail brokerage, insurance sales, and securities issuance (Davis and Tuori, 2000; Williams and Rajaguru, 2013). Currently, this effect is probably strengthened by the prevailing low interest rates that may also cause banks to change their business model and switch to fee bearing activities in order to maintain sufficient profitability (Brei et al., 2019; ECB, 2016). Contrary to commercial banks, many European cooperative banks still retain their traditional deposit taking-loan granting model.

This paper examines the determinants of the magnitude of net fee and commission income (NFCI) in cooperative banks in European countries from 2007 to 2014. We analyse NFCI separately, since it represents the most pronounced part of NONII. It accounted for an average of 58% of all NONII from 1993 to 1998 in EU countries (ECB, 2000). We test the relationship between NFCI and different bank, banking sector and country specific variables with a special emphasis on market concentration. Increased competition among financial institutions is assumed to be one of the main reasons for commercial banks to switch to fee bearing non-traditional activities, and therefore, in their case, NFCI to total income (NFCI/TI) tends to increase as competition increases (Moshirian et al., 2011; Růžičková and Teplý, 2015a). We hypothesize that the relationship between market concentration and NFCI/TI will be the opposite in cooperative banks, i.e., cooperative banks will have higher shares of fee income in concentrated markets. The hypothesis is based on the fact that many European cooperative banks are not providing non-traditional services and their fee income is generated only by the fees that are imposed on deposit-taking and loan-providing. The fees on these services have significantly dropped during the last few years due to new market entrants, the so-called "low-cost" banks, that are providing services without fees and are making profits mainly on interest income or trading income. However, this business model proved to be contrary to cooperative banks, making them very unstable during the crisis in 2008 and many of them ceased

to exist in this period. The crisis also resulted in banking sector consolidation in many countries, and the competition among European banks decreased in the years following the crisis.<sup>45</sup>

The rest of the paper is structured as follows. Section 5.2 provides the literature review. Section 5.3 describes the methodology that was used for the estimation. In Section 5.4, the used variables are described. Section 5.5 contains the data analysis. Section 5.6 provides the results and their discussion. Section 5.7 concludes the paper and states the final remarks.

## 5.2 Literature review

The literature examining the determinants of bank NONII has grown. Rogers and Sinkey (1999) find that banks with high NONII shares tend to be larger, have smaller net interest margins (NIM), and have relatively fewer core deposits and exhibit less risk. Banks with low NIMs and few core deposits earn less revenue from traditional activities and must therefore engage in NONII bearing services in order to remain profitable. A similar link between NONII, bank size and NIM was also found in Firth et al. (2013) using a set of China's commercial banks.

The group of researchers around DeYoung also concluded that NONII shares are positively correlated with bank size (DeYoung and Hunter, 2003; DeYoung et al., 2004; DeYoung and Rice, 2004a). They also find that well managed banks generate lower amounts of NONII because they do not tend to expand into activities that have poor risk-return tradeoffs. DeYoung and Rice (2004a) include bank external factors in the model, and they claim that banks located in states with strong economies and banks with high market power are able to generate more NONII. Moreover, they find that banks with more developed payment technologies generate increased fee income.

Shahida et al. (2006) applied the Rogers and Sinkey model on a 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 and exhibit less risk. This indicates that Islamic banks with traditional sources of funds have more non-traditional activities as sources of income. A similar result was found by Busch and

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<sup>45</sup> See Figure 5.2 for the development of the Herfindahl index in the examined EU countries from 2007 to 2014.

Kick (2015) who conclude that higher NONII is connected with a higher level of core deposits.

In South Korean banks, based on 1999–2009 panel data, the lending strategy (loan to assets ratio) and the core deposit to total assets ratio are negatively correlated with the NONII share (Kim and Kim, 2010). In addition to those two indicators, only technology variables turned out to be significant in this study. While some technologies increase income diversification, others tend to decrease it.

Hahm (2008) finds, based on data from 29 OECD countries, that larger and more profitable banks with relatively low NIMs and low loan to asset ratios tend to have higher NONII ratios. The author also claims that risk-taking banks and less cost efficient banks are diversifying their revenues more aggressively by increasing their NONII. Among the macroeconomic factors, the GDP growth rate, inflation rate and market capitalization seem to be important determinants of NONII ratio.

While there are more studies trying to document the determinants of NONII shares at the bank level, the literature studying the relation between market concentration on the country level and the magnitude of NFCI is very limited. The first paper that examined the correlation between HI and NONII was Moshirian et al. in 2011. Based on data from 20 developed countries (109 banks) for the sample spanning the period from 1996 to 2010, they find that banks in high concentration countries have lower levels of NONII activity. Moreover, they include a variable measuring the change in market competition, which turns out to be significant and negative. This means that even though the concentration is a slowly moving variable, small changes can also significantly influence the income composition of banks. This indicates that banks in highly competitive markets are more likely to engage in risky behaviour including expansion in non-traditional activities. Similarly, large banks with smaller NIMs have higher NONII. The negative relationship between market concentration and fee income share is supported by Růžicková and Teplý (2015a).

The current literature dealing with the impact of market concentration on the magnitude of fee income used data sets with different types of banks. We believe that the impact of the market concentration on fee income is not equal for different banking business models. Commercial banks, which mainly rely on traditional businesses, may be forced to diversify into non-traditional services by the competition; for investment banks, it may be the opposite. In general, banks are

becoming more universal (combining traditional and non-traditional services) in recent years.

There is no single model of cooperative banking in Europe. In fact, the cooperative banking scheme differs significantly from country to country, as seen in Ayadi et al. (2010). For example, the cooperative banks in some countries became universal companies that are almost indistinguishable from commercial banks (Liikanen et al., 2012). In the countries with which we are dealing<sup>46</sup>, this does not hold true. In those countries, cooperative banks are still mainly oriented on traditional banking services. Therefore, their fee income shares should generally be lower than those in investment or universal banks and they should decrease as the competition increases.

We conclude that common factors determining the income diversification can be found. However, their impact on the NONII varies across countries and individual business models. Moreover, there are factors influencing the composition of bank income that need to be studied more deeply.

### 5.3 Methodology

Since the NFCI share is persistent over time, we will use a dynamic panel data model for the estimation. We will apply the System GMM, which can deal with endogeneity and leads to robust estimates. The general model of the data-generating process is as follows:

$$y_{i,t} = \alpha y_{i,t-1} + X'_{i,t} \beta + \varepsilon_{i,t} \quad 5.1$$

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

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

where  $|\alpha| < 1$ ,  $i = 1, \dots, N$  is the individual's index and  $t = 1, \dots, T$  is a time index. The disturbance is composed of fixed effects  $\mu_i$  and idiosyncratic shocks,  $v_{i,t}$ . The exogeneity assumption that is required for the consistency of the pooled OLS estimation model is violated since  $y_{i,t-1}$  and  $\mu_i$  are correlated (Wooldridge, 2002). A Least Squares Dummy Variable or Within Groups estimator (FE) is not able to eliminate the dynamic panel bias (Nickell, 1981; Bond, 2002). It is suggested that both the pooled OLS and Within Groups estimator be used as robustness checks since

<sup>46</sup> See Section 5.5 for the countries list.

both methods are biased in opposite directions (Bond, 2002). While the FE tends to underestimate the true value of the coefficient, the pooled OLS overestimates it.

There are two approaches for dealing with the endogeneity problem. The first method is the Difference GMM, which applies the first-difference transformation to the original model (Holtz-Eakin et al., 1988; Arellano and Bond, 1991). This yields the following equation:

$$\Delta y_{i,t} = \alpha_1 \Delta y_{i,t-1} + \Delta X'_{i,t} \beta_1 + \Delta v_{i,t} \quad 5.2$$

The fixed effects are no longer present, but the lagged dependent variable is still endogenous, which can be addressed by assuming that  $v_{i,t}$  is serially uncorrelated. The drawback of the difference GMM method is that it does not allow for time-invariant variables.

The second method is called the System GMM, and it combines the differences in equation (1.2) with the level equation (1.1) (Blundell and Bond, 1998). The instruments are differenced to make them uncorrelated with the fixed effects. This method allows using time-invariant variables.

To make the assumption of no correlation between idiosyncratic shocks more likely to hold, we include time dummies in the regressions (Roodman, 2006). We use a two-step System GMM with clustered standard errors that are robust to heteroscedasticity and autocorrelation within individuals and with small sample corrections to the covariance matrix. We apply the Windmeijer correction order to prevent the downward bias of standard errors that may arise when the number of instruments is large (Windmeijer, 2005; Arellano and Bond, 1991).

Our estimated model takes following form:

$$Y_{i,c,t} = \alpha + \beta Y_{i,c,t-1} + \gamma X_{i,c,t} + \delta Z_{c,t-1} + \epsilon W_{c,t} + \theta D_i + \vartheta T_t + (\mu_i + v_{i,c,t}) \quad 5.3$$

where

$Y_{i,c,t}$  NFCI/TI share of bank  $i$  in country  $c$  at time  $t$ ,

$Y_{i,c,t-1}$  NFCI/TI share of bank  $i$  in country  $c$  at time  $t - 1$ ,

$X_{i,c,t}$  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  $t - 1$ ,

$W_{c,t}$  vector of banking sector-specific variables for country  $c$  at time  $t$ ,

$D_i$  bank type dummy,

$T_t$  time dummy,

$\mu_i$  unobserved bank-specific time-invariant effect, and

$v_{i,c,t}$  disturbance term that is independent across banks.

## 5.4 Variables

The dependent variable captures the NFCI magnitude that is measured by the NFCI/TI ratio ( $nfc\_ti$ ). The independent variables are summarized in Table 5.1.

**Table 5.1: List of independent variables**

<b>Variable</b>	<b>Description</b>
<b>Bank-specific explanatory variables</b>	
<i>Natural logarithm of total assets</i> ( $\ln\_ass$ )	size measure
<i>Net interest margin</i> ( $nim$ )	a ratio of the difference between income from the investment of depositors' funds and the income attributable to depositors to total assets
<i>Total customer deposits to asset ratio</i> ( $depos\_ass$ )	a proxy for traditional relationship banking
<i>Total equity to total assets ratio</i> ( $eq\_ass$ )	a measure of capital risk
<i>Loan impairment charges to gross loans ratio</i> ( $impaired$ )	a measure of the credit risk and loan quality
<i>Loans to assets ratio</i> ( $loans\_ass$ )	a measure of the loan volume and the lending strategy of a given bank
<i>Return on average equity</i> ( $roae$ )	a proxy for management quality. It captures the bank's profitability.
<i>Cost to income ratio</i> ( $cost\_inc$ )	a measure of the efficiency of expense management

<b>Variable</b>	<b>Description</b>
<b>Banking sector-specific explanatory variables</b>	
<i>Herfindahl index (hi)</i>	a proxy for the banking sector concentration. The HI's values range between 0–10,000 (0%–100%). A value below 1,000 indicates a low concentration, a value of 1,000 to 1,800 correspond to a moderate concentration, and an HI over 1,800 indicates a high concentration (Neven and von Ungern-Sternberg, 1998).
<i>Number of automated teller machines per 100,000 adults (atms)</i>	a measure of the development and application of new technology in a given banking sector
<i>Number of all cards transactions (except e-money function) per capita (cashless)</i>	a measure of the development and application of new technology in a given banking sector
<b>Country-specific explanatory variables</b>	
<i>Lagged real annual GDP growth rate (lag_gdp)</i>	a measure of the economic activity in the country
<i>Lagged annual inflation rate (lag_inf)</i>	percentage increase in the consumer price index
<i>Lagged annual unemployment rate (lag_unem)</i>	affects besides other the decisions of customers about their use of certain banking services
<i>Lagged long-term annual interest rate (lag_int)</i>	10 year government bond yield in the given country

*Source:* Authors

A correlation matrix of all variables is provided in Table 5.2. We decided to drop some variables due to their high correlation with other explanatory variables, mainly with HI, in order to avoid multicollinearity. Furthermore, we excluded those variables that were insignificant in the initial estimation.

**Table 5.2: Correlation matrix**

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
<i>nfc_i_ti</i> [1]	1.00							
<i>ln_ass</i> [2]	0.17	1.00						
<i>nim</i> [3]	-0.12	0.11	1.00					
<i>depos_ass</i> [4]	-0.26	-0.42	-0.11	1.00				
<i>eq_ass</i> [5]	-0.01	-0.23	0.34	-0.11	1.00			
<i>impaired</i> [6]	-0.07	-0.13	-0.34	-0.12	0.00	1.00		
<i>loans_ass</i> [7]	0.08	-0.08	0.10	-0.12	0.30	-0.08	1.00	
<i>roae</i> [8]	-0.11	0.18	0.88	-0.06	0.09	-0.37	0.00	1.00
<i>cost_inc</i> [9]	0.33	-0.14	-0.41	0.16	-0.14	-0.21	0.04	-0.34
<i>hi</i> [10]	0.12	-0.02	0.05	-0.03	0.21	0.09	0.07	-0.01
<i>atms</i> [11]	-0.29	-0.29	-0.02	0.47	-0.09	-0.11	0.05	0.02
<i>cashless</i> [12]	0.24	0.00	0.03	0.09	0.16	-0.01	0.03	-0.02
<i>lag_gdp</i> [13]	-0.58	-0.03	0.04	0.15	-0.12	-0.13	-0.06	0.03
<i>lag_inf</i> [14]	-0.05	-0.12	-0.01	-0.02	0.05	0.04	0.07	-0.05
<i>lag_unem</i> [15]	-0.15	-0.08	-0.02	0.13	0.12	0.18	0.00	-0.01
<i>lag_int</i> [16]	-0.04	-0.12	-0.01	-0.32	0.19	0.33	0.12	-0.04

	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
<i>nfc_i_ti</i> [1]								
<i>ln_ass</i> [2]								
<i>nim</i> [3]								
<i>depos_ass</i> [4]								
<i>eq_ass</i> [5]								
<i>impaired</i> [6]								
<i>loans_ass</i> [7]								
<i>roae</i> [8]								
<i>cost_inc</i> [9]	1.00							
<i>hi</i> [10]	-0.03	1.00						
<i>atms</i> [11]	-0.01	-0.19	1.00					
<i>cashless</i> [12]	0.09	0.69	-0.17	1.00				
<i>lag_gdp</i> [13]	0.04	-0.12	0.07	-0.02	1.00			
<i>lag_inf</i> [14]	-0.01	0.01	0.11	-0.01	0.44	1.00		
<i>lag_unem</i> [15]	-0.12	0.31	0.38	0.06	-0.29	-0.08	1.00	
<i>lag_int</i> [16]	-0.14	0.14	-0.04	-0.04	-0.10	0.14	0.40	1.00

Source: Authors

In the end we decided to use following independent variables in the proposed model: the net interest margin, ratio of equity to assets, loan impairment charges to gross loans ratio, cost to income ratio, deposit to assets ratio, Herfindahl index, lagged real annual GDP growth rate and lagged annual inflation rate.

## 5.5 Data analysis

We created a balanced dataset containing 189 European cooperative banks with annual data from the 2007-2014 period. The source for banking variables is the BankScope database. Moreover, macroeconomic data are retrieved from the Eurostat database and banking sector concentration data are taken from the European Central Bank database. We included only banks with all available requested data for every time period. To deal with the double-counting problem, we used consolidated bank statements only in the case that no unconsolidated statements were available for a given cooperative bank. This treatment is needed because the cooperative banks in some countries tend to create complex hierarchical structures.

Most of the banks in our dataset come from four countries (Austria, Germany, Spain and Italy). This is no surprise due to the high share of cooperatives in the total banking market in these countries. France also traditionally has a high share of cooperative banking in total, but it is formed by a couple of large institutions, unlike the abovementioned countries. For an overview of the number of cooperative banks by country, see Table 5.3.

**Table 5.3: Number of banks by country<sup>47</sup>**

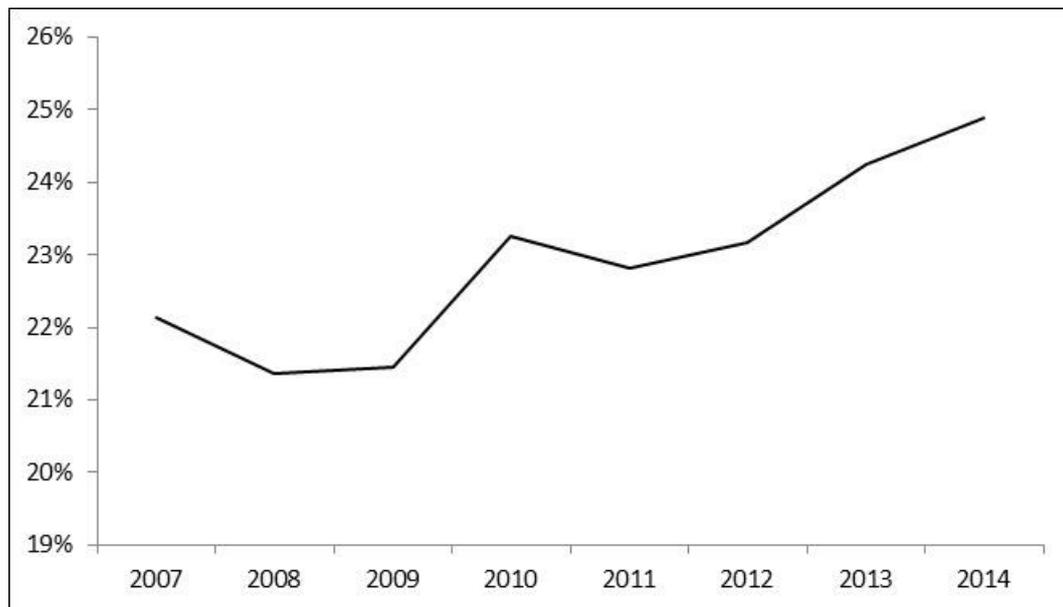
Country	Number of banks	Share
Austria	53	28%
Germany	56	30%
Denmark	2	1%
Spain	29	15%
Finland	1	1%
France	8	4%
Italy	40	21%
<b>Total</b>	<b>189</b>	<b>100%</b>

*Source:* Authors

<sup>47</sup> All banks with negative operating income or NFCI were excluded from the final dataset since their NFCI/TI would be misleading.

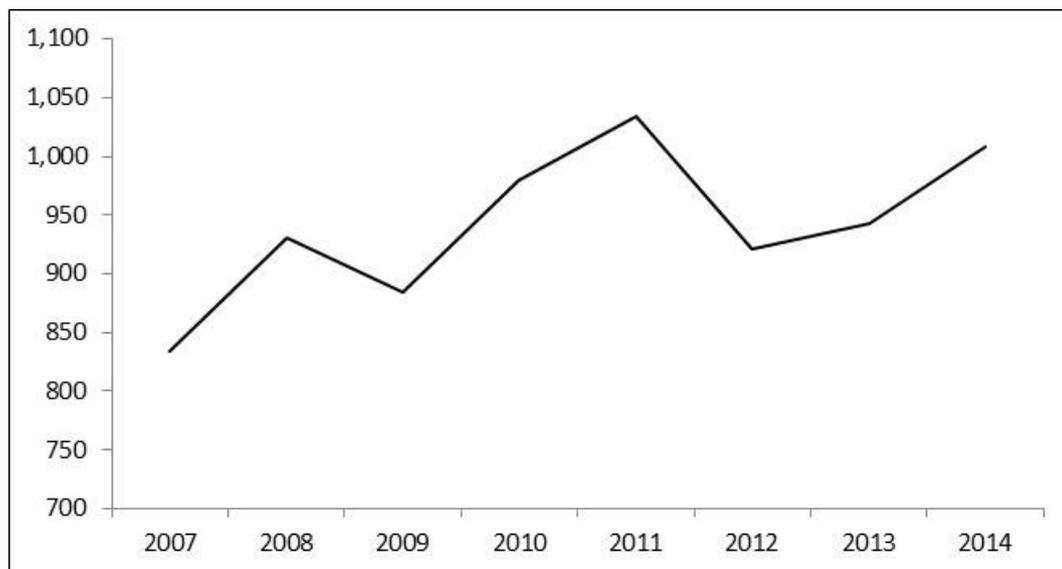
Looking at the evolution of the dependent variable NFCI/TI, we can clearly see an increasing trend (see Figure 5.1). This is in line with the statements in the first two sections of this paper.

**Figure 5.1: Evolution of the average NFCI/TI in 2007-2014**



*Source:* Authors

We are mainly interested in the effect of competition on banking fees, and therefore, we also present the evolution of the average Herfindahl index for the countries in our dataset (Figure 5.2). The Herfindahl index has a slightly increasing trend, which means a more concentrated (or less competitive) market. This is no surprise since the time span of our analysis covers the period of the economic crisis where market consolidation is common. In our sample, an increase of the Herfindahl index can be seen, especially in Spain and Italy.

**Figure 5.2: Evolution of the average HI in 2007-2014**

Source: Authors

For a better picture of the data, the descriptive statistics of all variables are presented in Table 5.4.

**Table 5.4: Descriptive statistics**

Variable	Minimum	1st quartile	Median	3rd quartile	Maximum
<i>nfc_i</i>	1.5	17.7	22.6	27.3	71.2
<i>ln_ass</i>	10.4	12.9	14.2	14.8	21.4
<i>nim</i>	-3.5	0.1	0.3	0.5	2.3
<i>depos_ass</i>	2.0	54.8	73.5	81.2	95.5
<i>eq_ass</i>	1.2	6.0	7.7	9.7	23.8
<i>impaired</i>	-8.1	0.2	0.6	1.0	13.5
<i>loans_ass</i>	4.0	51.7	64.9	75.4	96.0
<i>roae</i>	-116.8	1.8	3.6	5.8	29.0
<i>cost_inc</i>	12.8	56.8	65.1	72.5	320.0
<i>hi</i>	183.0	307.0	406.0	454.0	3700.0
<i>atms</i>	35.7	107.0	113.0	118.3	157.7
<i>cashless</i>	22.6	29.9	40.5	51.7	268.6
<i>lag_gdp</i>	-8.3	-1.0	1.1	3.3	5.2
<i>lag_inf</i>	-0.2	1.6	2.1	2.8	4.1
<i>lag_unem</i>	2.5	3.5	4.2	5.6	17.3
<i>lag_int</i>	1.1	3.1	3.8	4.3	6.8

Source: Authors

## 5.6 Results

This paper focuses on the effect of banking concentration on the fee income of European cooperative banks. We can see a strong positive effect of market concentration on NFCI/TI from the regression results in Table 5.5. A positive link between NFCI/TI and the Herfindahl index was suggested also by the correlation matrix in Table 5.2, Figure 5.1 and Figure 5.2. This indicates that the cooperative banks in the competitive markets lose their NFCI from their operations because they tend to retain the traditional deposit-taking and loan-granting model and typically do not expand into extensive fee services as other banks do. On the other hand, if the market is becoming less competitive, cooperative banks are able to gather fees from traditional banking products. This is also the case for the current post-crisis consolidation of the banking market in selected European countries.

Looking at the effects of other included variables in the presented model, we can see that a higher equity to asset ratio is also connected with a higher relative share of fees to total income. The explanation may be that lesser-leveraged cooperative banks may need their equity for assets with higher risk weights that are connected with significant fee income (just as with consumer lending). Another independent variable with a positive effect of fee income is the lagged annual inflation rate. Conversely, the net interest margin, loan portfolio quality (loan impairment charges to gross loans ratio), efficiency (cost to income ratio), the proxy for traditional banking activities (deposits to assets ratio) and the measure of economic activity (lagged real annual GDP growth rate) proved to be insignificant.

**Table 5.5: Regression results**

Dependent variable	Coefficient	Std. error	Significance
<i>lagged dependent variable</i>	0.921	0.021	***
<i>constant</i>	0.956	0.126	
<i>nim</i>	-0.659	0.498	
<i>eq_ass</i>	0.146	0.061	**
<i>impaired</i>	-0.156	0.138	
<i>cost_inc</i>	0.003	0.014	
<i>depos_ass</i>	-0.016	0.011	
<i>hi</i>	0.001	0.000	**
<i>lag_gdp</i>	0.127	0.079	
<i>lag_inf</i>	0.872	0.212	***

Diagnostics		
number of observations	1512	
number of instruments	197	
Wald test	361.5	***
Arellano-Bond AR(1) test	-6.28	***
Arellano-Bond AR(2) test	-2.76	***
Hansen test	133.2	***
year dummies	Yes	

*significance codes: \*\*\* = 0.01, \*\* = 0.05, \* = 0.1*

*Source:* Authors

The results of our System GMM regression show that the coefficient of the lagged dependent variable is positive, its value is below 1 and it is highly significant, which are the necessary conditions for correct dynamic panel data estimation methods. The Arellano-Bond AR (1) strictly rejects the null hypothesis of no first-order autocorrelation in the residuals, and thus, this test also supports the appropriateness of the selected methodology. The Arellano-Bond AR (2) test suggests that we may also include a second lag of the dependent variable in the regression. The inclusion of a second lag was tested during the robustness tests. The regression generally performed poorly, and therefore, we decided to leave the second lag of the dependent variable out of the main model. The Hansen test for overidentification with the null hypothesis of exogenous instruments was not rejected and the Wald test rejects that all the variables are jointly insignificant.

Moreover, we run a robustness check, as suggested by Bond (2002) and described in the methodology. Our model has passed this robustness check since the estimated coefficient by the System GMM lies between the values that were estimated by the FE and OLS. The results can be seen in Table 5.6.

**Table 5.6: Robustness check**

Method	FE	GMM	pooled OLS
lag_NFCI/TI	0.643	0.921	0.938
	(0.022)	(0.021)	(0.009)

*Source:* Authors

## 5.7 Conclusion

This paper focuses on the key determinants of the bank fee and commission income in European cooperative banks. Since fee income represents the largest part of the non-interest income that is earned by banks, it remains a major challenge for bank management to set and maintain appropriate fee policies. Nevertheless, solving the optimal fee structure has yet to be accomplished on either theoretical or empirical levels.

The study is performed on balanced panel data from 189 European cooperative banks spanning the period from 2007 to 2014. Unlike existing studies, we use the System GMM estimation method since it is suitable for time persistent data. Different bank-specific, banking sector-specific and macroeconomic factors are considered. We are primarily concerned about the potential relationship between the market concentration and fee income magnitude, which in fact turns out to be present. The analysis suggests that cooperative banks facing higher competition tend to exhibit lower shares of fee and commission income, which can be attributed to the fact that they mostly concentrate on taking deposits and providing loans and those fees tend to decrease as competition increases. Compared to commercial banks, cooperatives do not expand into non-traditional fee bearing and potentially riskier services when the competition increases, and therefore, their overall fee income share is pushed down by the competition.

Cooperative banks with a higher fee income share tend to rely more on equity financing, which in turn means that they report lower capital risk. This is possibly related to the fact that banks that are highly involved in fee bearing businesses need more capital to prevent the potential risks of those activities. Other bank-specific explanatory variables, including the net interest margin, loan portfolio quality (loan impairment charges to gross loans ratio), efficiency (cost to income ratio) and the proxy for traditional banking activities (deposits to assets ratio), proved to be insignificant.

Among the macroeconomic conditions, only the lagged annual inflation rate significantly affects cooperative banks' fee income policy while other factors seem to play secondary roles in fee income determination.

## 6 Net Interest Margin of Cooperative and Commercial Banks – which banking business model was more hit by the Low Interest Rate Environment?

**Published as:** Karolína Vozková, Matěj Kuc (2019): Net Interest Margin of Cooperative Banks in Low Interest Rate Environment, *International Journal of Economics and Management Engineering*, Vol. 13, No. 2, pp. 138-142.

### *Abstract*

*This paper addresses the impact of a decrease in interest rates on the performance, measured by net interest margin, of commercial and cooperative banks in the Eurozone. The analysis was performed on balanced dataset of 268 commercial and 726 cooperative banks spanning the 2008–2015 period. We employed a fixed effects estimation panel method. As expected, we found a positive relationship between market rates and net interest margin. Our results suggest that the impact of negative interest income differs across individual banking business models. More precisely, cooperative banks were hit much harder by the decrease in market interest rates compared to commercial banks.*

**Keywords:** cooperative banks, performance, negative interest rates, risk management

**JEL classification:** C23, G21, L25

## 6.1 Introduction

A low or even negative market interest rate environment can have serious negative consequences for banking performance. The European Central Bank (ECB) entered the unfamiliar territory of negative interest rates on July 11<sup>th</sup>, 2013, when it decreased its deposit facility to -0.10%. ECB policy rates continued to reach record low levels in the following years. The two-week repo rate finally hit the zero bound (decreasing the deposit facility to -0.40% bps at the same time) in March 2016.

There would have not been a problem with negative rates if the banks were able to pass them symmetrically to their clients. To keep the net interest margin (NIM) at the same level, banks need to decrease interest rates on both the asset and liability sides of the balance sheet as market rates go down. In other words, they need to pass through negative market funding rates to the clients.

It is often politically as well as legally difficult to charge negative interest rates on deposits. No one wants to be the first mover towards negative rates and draw negative publicity for the bank. Moreover, it is legally questionable whether it is possible to charge negative rates on deposits to retail clients as well as to small corporates. For this reason, we cannot find negative interest rates on retail deposits in the price list of any bank in the Eurozone.

Banks therefore often try to keep a positive margin on the asset side by adding interest rate floors on reference rates (EURIBORs) of the floating rate loan contracts. These attempts triggered a series of lawsuits against such practices across Europe.

The goal of this paper is to test the relative resiliency of European cooperative and commercial banks to the current low market interest rate environment. Our hypothesis is that this low interest rate environment has a more severe impact on the performance of the cooperative banks. There are several reasons to support this hypothesis. First, shareholders can take actions faster than cooperative banks members (because of dispersed ownership) in case of need. Second, commercial banks tend to operate more in financial markets and therefore are able to substitute some of the relatively expensive client funding with market funding at rates below zero. Third, there are fewer restrictions on commercial banks business, e.g., on the usage of derivatives. Therefore, commercial banks are able to use interest rate swaps to hedge against adverse interest rate movements. Fourth, commercial banks tend to be bigger than cooperatives. Higher business diversity can help in risk mitigation.

Cooperative banks focus on traditional banking activities that are tightly connected to the real economy (taking deposits and granting loans to retail clients and small enterprises). As cooperative banks form approximately 20% of the European banking market (and even close to 40% in some countries), we consider the focus on their performance in the current market situation to be absolutely crucial for the health of the banking sector and the whole economy of the European Union (McCarroll and Habberfield, 2012).

The structure of this paper is as follows. A literature review of influential papers on banking performance in a low interest rate environment from a theoretical as well as empirical perspective is included in Section 6.2. The data included in our analysis are described in Section 6.3. The methodological approach is described in Section 6.4. The results of our analysis are provided in Section 6.5. Further research opportunities are outlined in Section 6.6. Finally, the conclusion is given in Section 6.7.

## 6.2 Literature review

A negative interest rate environment was only a theoretical concept until a few years ago. Empirical evidence on the effect of a low interest rate environment on banking performance is therefore very recent. The reader therefore should not be surprised that most of the papers in this review section come from 2015 and later. Nevertheless, the impact of low interest rates on the banks and the economy as a whole is significant, and the amount of related literature has multiplied greatly.

Bikker and Vervliet (2017) use both static and dynamic modelling methods and show that an unusually low interest rate environment does not decrease the profit of US banks. The profit is maintained due to lower credit provisioning as the interest income of banks decreases. Lower credit provisioning, however, brings significantly higher risk for banks' stability. The study also shows that the banks do not try to replace decreasing interest income by expanding their trading activities.

Similar results have been found in Europe as well. The analysis of Altavilla et al. (2017) shows that monetary easing and unconventional monetary policies (such as negative interest rates) do not translate into lower profit of banks in the short term thanks to lower provisioning, which offsets the negative impact of decreasing interest income. This study also shows that a protracted period of low interest income harms banks' profit.

Borio et al. (2017) use a dataset of 109 large international banks (from both Europe and the USA) and show that there is strong dependence of banking profits on monetary policy rates, especially if the latter are at a low level. They find the same correlation as the authors above between interest rates, loan loss provisions and interest income of banks. Furthermore, they claim that unusually low interest rates and an unusually flat term structure erode bank profitability. The only difference in the study of Borio et al. (2017) is that in case of an interest rate hike, interest rate income effects outweigh the higher loss provisions, and, hence, profit is higher. Studies by Bikker and Vervliet (2017) and Altavilla et al. (2017) show that both effects offset each other when rates go down. This points to an asymmetric reaction of banks to interest rate increases and decreases.

Hanzlík and Teplý (2019) examine key determinants of the net interest margin of EU banks in the zero lower bound environment based on data from 629 banks between 2011 and 2016. They find a positive, concave relation between short-term rates and net interest margin. The described nonlinearity in the impact of market rate on profitability is in line with the findings of Borio et al. (2017) and Bikker and Vervliet (2017). Moreover, they conclude that net interest margin differs significantly among distinct bank business models.

Claessens et al. (2018) tackle the effect of a long-lasting low interest rate environment on banking profitability (in terms of net interest margin). They use a sample of more than 3000 banks from 47 countries from 2005 to 2013. They quantify that a one-percentage-point decrease in market rates translates to an 8-bps decrease in net interest margin. Should the market rates already be low (defined here as 3M EURIBOR below 1.25%), the effect is much more severe: the decrease in net interest rate margin is then 20 bps. Furthermore, every additional year of low rates decreases NIM by 9 bps thanks to gradual balance-sheet repricing.

Medaschi and Nuevo (2017) trace the evolution of profitability of Swedish and Danish banks. Monetary policy rates in both countries are negative. The authors show that banks in both countries rely mainly on wholesale funding. They claim that this fact decreased interest expenses and therefore improved their interest margin. The study shows that, interestingly, the banks' profitability improved in time, despite the negative rate environment. They attribute the fact to the boom in housing loans (thanks to low interest rate levels). However, the central banks of both countries see this reliance on the housing market as a risk to a financial stability in the region.

Genay and Podjasek (2014) from the Federal Reserve Bank of Chicago show on the set of American banks that a low interest rate period is associated with decreased profitability for banks, particularly for small institutions. Nevertheless, such effects are small compared to the positive effects that small interest rates bring to the economy.

Memmel (2008) shows that the worst possible interest rates scenario (260 historical interest rates shocks were applied) for German cooperative and savings banks profit is a bear flattener (short-term interest rates go up, and the long term remains nearly unchanged).

Most of the studies presented in this literature overview used panel data methods to estimate the effects of monetary policy (and low interest rates specifically) on banking performance. Either simple pooled OLS model, fixed effects model, random effects model or, in case of persistence in the dependent variables, dynamic panel data models such as System GMM were used.

Stylized facts to be taken from this review are that low market interest rates harm the net interest margin in the banking sector (Bikker and Vervliet, 2017, Altavilla et al., 2017, Borio et al., 2017, Claessen et al., 2018, Medaschi and Nuevo, 2017 and Genay and Posjasek, 2014). Studies (Bikker and Vervliet, 2017, Altavilla et al., 2017 and Borio et al., 2017) show that a low interest rate environment is connected with lower loan loss provisions, which may increase instability in the future. The presented studies mostly do not distinguish between different ownership structures of banks. Papers comparing the relative performance of cooperative and commercial banks are so far absent.

## 6.3 Data description

We use BankScope as a main data source of banking data. Interest rate statistics are retrieved from Eurostat. To avoid double counting of individual banks at different levels of consolidation, we use consolidated bank statements only in case no unconsolidated statements are available for the bank in the database. The same setup is used in a paper written by Hesse and Čihák (2007).

We included all banks in the Eurozone that had all necessary data available for the 2008–2015 period. These dates are selected to include the whole current period of decreasing market interest rates. In the analysis, we include only the Eurozone

countries, where both cooperative and commercial banks are active. Full data availability is needed in order to have a balanced data set.

We obtained data on 726 cooperative and 268 commercial banks. Altogether we have 994 institutions from eleven Eurozone countries included in our dataset. Because of different degrees of vertical integration and distinct histories, there are several cooperative banking models among the European countries. Therefore, we may see only one cooperative bank in the whole country, such as in Finland or the Netherlands, or there may exist many small institutions alongside each other, such as in Germany or in Italy. For detailed information about cooperative banking models in different European countries, please see Ayadi et al. (2010), Goglio and Leonardi (2012) or Kuc and Teplý (2018).

For the number of banks in our dataset divided by country and ownership structure, see Table 6.1.

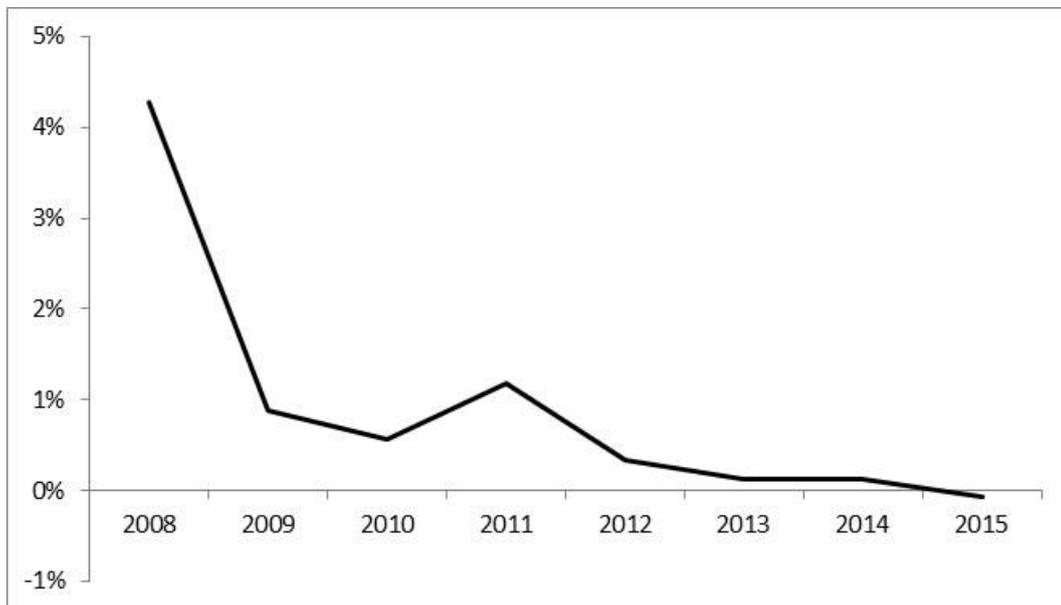
**Table 6.1: Banks in dataset by country and ownership structure**

Country	Number of Banks		
	Cooperative	Commercial	Total
Austria	23	28	51
Belgium	3	12	15
Germany	390	56	446
Spain	2	11	13
Finland	1	5	6
France	46	58	104
Italy	257	45	302
Luxembourg	1	25	26
Netherlands	1	13	14
Portugal	1	8	9
Slovenia	1	7	8
<b>Total</b>	<b>726</b>	<b>268</b>	<b>994</b>

*Source:* Authors

We retrieved annual averages of 1M EURIBOR rates in order to have a proxy for short-rate interest rates in the Eurozone. 1M EURIBOR is on a clearly downward trend during the observed period. The annual average fell from 4.3% in 2008 to -0.07% in 2015. 1M EURIBOR development is depicted on Figure 6.1.

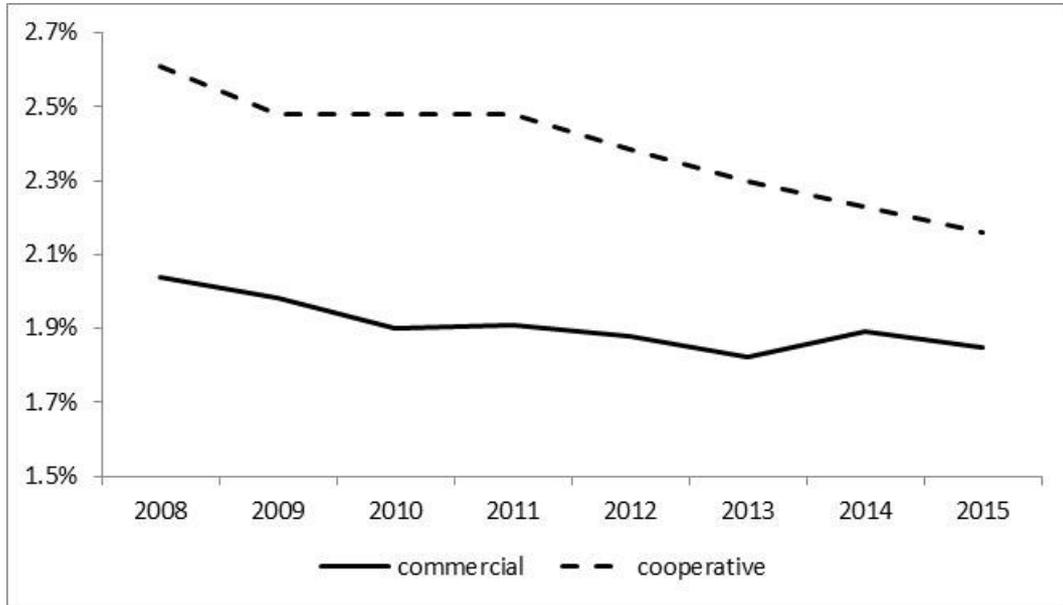
**Figure 6.1: Development of 1 M EURIBOR**



*Source:* Authors based on Eurostat

In Figure 6.2, we plot the development of the average net interest margin of commercial and cooperative banks over time. We can see that the net interest margin of cooperative banks is higher compared to that of commercial banks, but it is decreasing much faster over time (as market rates go down). Of course, more sophisticated analysis is needed to assess the impact of low interest rates on both ownership structures. Our methodological procedure is described in the following section.

**Figure 6.2: Average net interest margin by ownership structure over time**



Source: Authors based on Bankscope

## 6.4 Methodological approach

Most of the studies interested in banking performance in a low interest rate environment use panel data analysis methods. We would like to estimate following equation:

$$NIM_{ijt} = \alpha + \beta_1 EQ_{ijt} + \beta_2 NONINT_{ijt} + \beta_3 SECSH_{ijt} + \beta_4 STRATE_t + \beta_5 STEEP_t + \varepsilon_{ijt},$$

6.1

where  $NIM$  is net interest margin for bank  $i$  from country  $j$  in time  $t$ ,  $EQ$  is share of equity to assets for given bank,  $NONINT$  is a share of non-interest income in total banking income,  $SECSH$  stands for the share of securities in total balance sheet size,  $STRATE$  stands for 1M EURIBOR (short-term market rate),  $STEEP$  stand for yield curve steepness (it is the difference between the 10-year and 3M market interest rates) and finally  $\varepsilon$  is the error term. Variable selection is based on studies presented in the literature review section.

Now, a series of tests are to be run to decide which panel data method we should use for our estimation. The Breusch-Pagan Lagrange multiplier test strongly rejects, and pooled OLS estimation is therefore less efficient compared to a random effects model. To decide between a fixed effects and random effects model we use the

Hausman test. The test rejects the null hypothesis at the 1% significance level, showing that fixed effects estimation is efficient but random effects is not. The tests show us that we should employ fixed effects estimation for our analysis.

Cooperative banking models differ significantly from country to country. Studies show that in such a case, to avoid problems with precision of the estimates, cluster-robust standard errors at the country level should be used (Moulton, 1986 and Cameron and Miller, 2015).

All together, we will run three regressions. The first one will be run on the dataset comprised solely of cooperative banks, the second one will include only commercial banks and the third one will include all the banks in our dataset. This will help us to reveal whether cooperative banks are truly hit more by a period of low interest rates.

## 6.5 Regression results

We use Stata to run regression equation 6.1 using the methodology described in the previous section. The results for commercial banks are presented in Table 6.2 below.

They show a positive relation between share of equity (*EQ*) and net interest margin. The reason is twofold. First, the more equity on a bank's balance sheet, the less liabilities are present, and therefore the bank has fewer problems with repricing into negative rates territory. The second reason is that the banks with a higher share of equity on their balance sheets are expected to run a riskier business, and therefore they need to earn a higher margin. The share of non-interest income in total banking income (*NONINT*) as well as the share of securities in total balance sheet size (*SECSH*) seem to have no effect on the interest margin of commercial banks. This shows that the degree of non-traditional business of commercial banks (such as investment into securities) seems to have no effect or only a very limited effect on the interest margin.

Finally, our variable of interest, the short-term interest rate level (*STRATE*), has a positive and significant effect (at the 5% significance level). It shows that, for commercial banks, a decrease of 1M EURIBOR by one percentage point decreases banks' net interest margin by 6 bps. This result is comparable with the result found in Cleassens et al. (2017). Interestingly, yield curve steepness (*STEEP*) does not seem to affect the interest margin of commercial banks.

**Table 6.2: Regression results for commercial banks**

<b>Commercial banks</b>			
<u>Variable</u>	<u>Cons</u>	<u>Std Err</u>	<u>Sig.</u>
EQ	3.88	0.64	***
NONINT	-0.47	0.44	
SECSH	0.32	0.51	
STRATE	0.06	0.03	**
STEEP	0.02	0.30	
cons	1.56	0.19	***
Nr. Obs.		2144	
Prob>F		0.00	
R sq		0.10	

Source: Authors

Note: \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%

We repeated the estimation procedure for the subset of cooperative banks. The results are provided in Table 6.3. We can find several differences compared with the regression run on the set of commercial banks. First, the more cooperative banks rely on traditional deposit-taking and loan-granting activities, the worse the effect on their interest margin, as the estimated coefficients of the *NONINT* and *SECSH* variables show. Yield curve steepness (*STEEP*) now has a significantly positive effect on the banking margin.

**Table 6.3: Regression results for cooperative banks**

<b>Cooperative banks</b>			
<u>Variable</u>	<u>Cons</u>	<u>Std Err</u>	<u>Sig.</u>
EQ	5.77	1.24	***
NONINT	-5.75	0.42	***
SECSH	-0.93	0.23	***
STRATE	0.10	0.02	***
STEEP	0.07	0.02	**
cons	3.19	0.06	***
Nr. Obs.		5808	
Prob>F		0.00	
R sq		0.57	

Source: Authors

Note: \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%

The effect of interest-rate decreases (*STRATE*) has the expected sign – the lower the rates, the lower the net interest margin is. Interestingly, the effect of rate changes on cooperatives is almost twice as large compared to commercial banks: a decrease of 1M EURIBOR by one percentage point decreases cooperative banks’ net interest margin by 10 bps. The share of equity (*EQ*) has the same sign as in the commercial banks regression, but the effect is once more stronger for cooperative banks.

Finally, we run regression equation 6.1 on the combined dataset of both commercial and cooperative banks. The estimated coefficients show the expected signs. The significance codes are a mix of what we have seen in the results for both banking ownership types separately. Therefore, it shows that there is important difference in the behaviour of both groups, and researchers should take this fact into account.

**Table 6.4: Regression results for the whole dataset**

<b>Whole dataset</b>			
Variable	Cons	Std Err	Sig.
EQ	5.21	1.12	***
NONINT	-0.81	0.51	
SECSH	-0.52	0.38	
STRATE	0.11	0.05	**
STEEP	0.08	0.02	***
cons	1.85	0.17	***
Nr. Obs.		7952	
Prob>F		0.00	
R sq		0.21	

*Source:* Authors

*Note:* \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%

## 6.6 Further research opportunities

An interesting extension of this study would be to use dynamic panel data methods such as System GMM. Of course, more indicators than net interest margin could be studied in order to have more complete picture of different behavioural patterns of both ownership structures, but that task goes beyond the scope of this paper.

## 6.7 Conclusion

This paper investigates the relative performance of cooperative banks and commercial banks in the current low interest rate environment. To do so, we created a balanced dataset of 268 commercial and 726 cooperative banks from the Eurozone spanning the 2008–2015 period. We employed a fixed effects estimation panel method for our analysis. The results showed that the market interest rate level matters for the net interest margin of both banking groups. Nevertheless, the effect of the interest rate change is almost two times stronger for cooperative banks. Moreover, cooperative banks are affected by the slope of the yield curve, unlike commercial banks. Our results show that cooperative banks react significantly differently from commercial banks to interest rate changes, which is an important finding for policy makers and regulators.

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## 7 Conclusion

In recent years, traditional banking activities have become less central to European banks, while fee and commission income has gained in importance. Nowadays, bank fees represent about 25% of total income, which makes them the most important part of banks' non-interest income. This long-term shift towards non-traditional banking services started in the 1980s and was connected with technological developments and the digitalization of financial institutions including innovations in information and communications which were induced by increasing competition among other things. It was further fuelled by worldwide deregulation, which removed the barriers to banks' providing investment banking and insurance services.<sup>48</sup> Banks began to adopt a universal banking model and transformed themselves into multi-product, multi-market, financial service conglomerates which offer retail and investment banking, brokerage, insurance, and wealth management services (Berger et al., 2015).

The question remains of how the increasing fee income share affects the performance of individual banks and, more importantly, how it affects the whole banking sector's stability. This question gained in importance in the aftermath of the financial crisis of 2008, during which bank regulators were dealing with the task of making the banking system more resilient to prevent the recurrence of bailouts. Governments reacted by increasing capital requirements, enhancing regulation and the supervision of liquidity, or by reforming accounting disclosure rules. One of the central measures discussed was the separation of certain banking activities. The exact form and extent of the split differed between the individual proposals, but all of them suggested separating trading from deposits.

Empirical evidence of the benefit of such a separation is mixed. Some academicians see clear diversification benefits in the expansion into fee-bearing activities, while others claim that the benefits are more than offset by the increased risks connected to these services. This thesis contributes to the research dealing with this topic.

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<sup>48</sup> See for example the Gramm-Leach-Bliley Act (also known as the Financial Services Modernization Act of 1999).

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Besides examining the impact of fee income share on banks' performance, we are also interested in the effect of the banking sector's concentration on banks. Like the debate around the diversification in banking, the literature on the effect of the concentration on banks' performance and banking system stability also yields mixed results. Rather than studying the impact of market concentration on banks' performance in terms of profitability and riskiness directly, as has already been done by several researchers, we are mainly concerned about its impact on fee income share.

We perform the analysis at the macro, sectoral and individual bank levels using EU data from the 2008 financial crisis and post-crisis period.<sup>49</sup> At a country level, we are mainly interested in the development of fee income share during recent years. We show that the share of income represented by fees increased between 2007 and 2018. This might be connected to the effort of the banks to maintain sufficient profitability in the currently prevailing low interest rate environment. We also analyse the development of the Herfindahl index as a measure of concentration and its impact on fees. While at a country level the results obtained about this relationship are not very robust, we obtained important results at the individual bank level.

We show that banks facing higher competition tend to have higher shares of fee income. We argue that this is connected to the fact that increased competitive pressure forces banks to expand more aggressively into non-traditional fee-bearing activities which are potentially connected to higher risks. An alternative explanation provided by the literature is that banks with higher market power rents in lending and other lines of business may feel less pressure to impose high fees on services to their depositors. While this reasoning may work under increasing market power, it is highly improbable that increased competition would lead to an increase in the fees imposed, for example, on bank accounts, since competition is expected to drive those fees down. Moreover, if this were the case, we would expect increased fee income not to lead to higher risk, since income streams, like the fees on bank accounts, include low risk. This is not in line with our evidence.

Our analysis suggests that banks which depend more on fee income tend to be less profitable and riskier. Based on this result, we claim that substantial levels of fee

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<sup>49</sup> Despite the fact that the individual presented papers cover slightly different time periods, all of them cover the crucial crisis and post-crisis years 2008-2014. This allows us to derive a general and comparable conclusion based on the individual papers.

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income might be the result of the effort to maintain sufficient profitability on markets with increasing competition and decreasing interest rates, rather than the attempt to diversify. Moreover, as was already stated above, non-traditional activities are potentially riskier than traditional banking activities. This is also supported by our finding that higher fee income shares tend to be connected with a higher equity to assets ratio. This suggests that fee income activities are more capital-demanding. Our results suggest that EU banks are so universal that a shift in fee income share does not lead to diversification benefits and increased risk-adjusted profitability.

This finding also has an important policy implication, which suggests that the discussed mandatory separation of certain trading activities from the core business of banks might be beneficial for the stability of the banking system.

Since the results are potentially dependent on the applied business model, we study the determinants of the fee income share of cooperative banks separately. Despite the fact that cooperative banking represents about 20% of the whole EU banking system, these banks are often neglected by economic research. Contrary to the previously described results, we find that cooperative banks facing higher competition tend to exhibit lower fee income shares. This is probably connected with the fact that they stick with their traditional deposit-taking and loan-providing model, and the fees on those services are driven down by their competitors.

Our fee income analysis includes, besides the bank specific indicators, banking sector and macroeconomic explanatory variables, which are sometimes neglected by other authors. We show that these are important indicators of banks' performance as well as of banks' income composition. While higher GDP growth and lower inflation seem to be connected with superior banking sector performance, they tend to decrease fee income share. This again suggests that banks use the fee income at least to some extent to compensate for decreased margins and profitability when market conditions deteriorate.

Unlike the other researchers, we use the System Generalized Method of Moments as the main estimation method for the analysis of fee income at the individual bank level. This method outperforms standardly used approaches such as the Fixed Effects and the Pooled Ordinary Least Squares as it allows for time persistency and time invariant variables and is able to deal with the endogeneity of explanatory variables. Our results are quite robust to changes in subsamples of the data and estimation techniques when it comes to the set of instruments in the System GMM. We did not

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find any evidence about the presence of structural breaks around the financial crisis in 2008 in connection with the fee income share and its impact on banks performance. This is possibly connected to the fact that we measure fee income as a relative value to total income rather than in absolute terms, which makes it relatively stable.

Using individual banks data, we do not find a significant relationship between the net interest margin and fee income share. A possible explanation is that banks were not able to react to decreasing interest rates and margins within the examined time horizon, which ended in 2014. Nevertheless, the theory, as well as our analysis performed on country-level data covering the period until 2018, suggest that the effort to maintain sufficient profitability in the low interest rate environment might be one of the reasons forcing banks to switch to non-traditional services. We therefore study how low interest rates affect the net interest margin of credit institutions. We are mainly interested whether the impact on cooperative banks differs significantly from the impact on commercial banks, because one of the reasons why cooperative banks do not react to certain market changes with an increase in fee income share might be that they are able to generate higher net interest margins compared to commercial banks. We conclude that in both commercial and cooperative banks, net interest margin decreases with a cut in interest rates. This effect is more pronounced for cooperative banks. This might be connected with their ownership structure and more restrictive business regulations. The ability to keep superior profits on traditional banking activities seems not to be the reason why cooperative banks do not adjust their services in the same manner as other credit institutions.

Despite the fact that we have studied bank fee and commission income from different perspectives, there still remain uncovered areas of study that could be further analysed. Below, we suggest further research opportunities that are, from our point of view, the most interesting ones. Firstly, technological development, regulation and central banks' policies should be considered as determinants of fee income share and banks' performance. Secondly, comparison with banks outside the EU banking sector could be provided to understand how banks in different countries react to increasing competition and other banking sector and macroeconomic changes. Thirdly, a longer and more unified time period for the analysis would allow more general results to be drawn from the model. Fourthly, since market concentration seems to influence significantly the fee income share, the diversification benefits of non-interest income could potentially differ under different levels of banking sector concentration. More detailed analysis dealing with this feature of the market could be further developed.

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# Appendix A: Response to Opponents' Reports and Committee Suggestions from Pre-defense

Dear Opponents,

I would like to thank you for your helpful comments and remarks. It helped me to improve the quality of my dissertation thesis. Below, I respond to all your remarks and describe the individual changes that were made in reaction to your review. I hope and believe that I addressed all your remarks properly and sufficiently.

## A.1 Response to Comments from Prof. David Tripe Ph.D.

- 1) A key novel aspect of the thesis, and of Chapter 2 (Essay 1) in particular, is the linking of diversification into non-interest income generation with competitive conditions in the relative banking market. This is based on a working paper by Moshirian et al (2011) and a subsequent follow-up working paper by Ruzickova and Teply (2015a). Neither of these working papers appear to have yet been published in a refereed journal. A stronger justification for this diversification/competition proposition is provided by the findings from the second essay of the thesis (Chapter 3), where a statistically significant negative coefficient is found for the Herfindahl Index. It would have been good to have seen some discussion of the economic significance of this relationship.

It is interesting to note that De Young & Rice (2004a) also include a Herfindahl Index in their study, and get a majority of significant negative coefficients (although one positive coefficient and a number that are insignificant). Their interpretation of their findings is somewhat different from that offered in this thesis. Lepetit et al (2008) find a relationship between concentration ratio and net interest income.

*Response: The information about the economic significance of the relationship between the Herfindahl index and fee income share was added in Section 1 (General introduction) on page 17.*

*The reference of De Young & Rice (2004a) and Lepetit et al (2008) and their finding about the impact of market concentration on banks' income composition was added in Section 1 (General introduction) on page 12.*

- 2) Where competition is such an important part of this thesis, it is surprising that we find no discussion of the literature on the measurement and effects of competition in the thesis, apart from an unsupported comment on page 27 and some not very robust argument in footnote 13 on page 25. For the impact of competition on performance, one could start with references such as Berger (1995), Berger et al (2004), Claessens & Laeven (2004), Maudos & De Guevara (2007), Beck et al (2013) and Weill (2013). In relation to measurement, further study might additionally include Bikker et al (2012), Rostrepo-Tobon & Kumbakhar (2014) and Bolt & Humphrey (2016). These should provide a foundation for some more extensive discussion.

The implication of this is that a rather stronger justification would be required for use of the Herfindahl Index as a competition measure, and that a more robust, dynamic argument (perhaps taking account of Schumpeter's (1912) discussion of monopolistic competition) should be assembled to explore the relationship between competition and non-interest income. I also note that I am unimpressed by the lack of comment on the  $R^2$  reported on page 28, which does not indicate a strong relationship.

*Response: The literature review on the measurement and effects of competition was added in Section 1 (General introduction) on pages 9-15 of the thesis. I also discuss and explain the choice of concentration/competition measure. Nevertheless, a formal testing of the used concentration measure goes beyond the scope of this thesis. A comment to  $R^2$  reported in Section 2.3.2.2 was added on page 38.*

- 3) On page 9, I don't understand the word "neglected" at the end of the second paragraph.

*Response: By this, I mean that due to the use of averages, the time factor that can play a role in the estimation is not considered. The formulation was changed.*

- 4) On page 10, lines 3 to 5, it is noted that banks have more capital to prevent or manage the risks of non-traditional activities. These will be operational risks, and

may be able to be identified as such if banks are reporting a decomposition of their capital requirements (under Basel II).

*Response: Unfortunately, I do not have access to the data with capital requirements decomposition of individual banks to formally verify the above-mentioned link between capital held to cover operational risks and fee income share. I was able to find only consolidated data on operational risk exposure for EU countries participating in the Single Supervisory Mechanism provided by ECB, but only starting from 2015.<sup>50</sup> Moreover, capital held to cover operational risks covers also other operational risks and, therefore, I doubt that it would be possible to make valid conclusions based on this capital item.*

- 5) The reference identified as Stiroh (2002) should be Stiroh (2004) – and the other Stiroh (2004) reference will need adjusting accordingly.

*Response: The references were corrected.*

- 6) At the top of page 20 and elsewhere, are the differences between the estimated average ratios statistically significant?

*Response: First of all, it is necessary to specify that the presented average ratios were not estimated but computed. I did not test formally for the statistical significance of the differences in computed average ratios between individual groups of countries. Still, it is reasonable to assume that not all of the differences would be in all cases statistically significant since the groups of countries are in some cases largely overlapping (mainly speaking about the EU and the EUROZONE groups). Nevertheless, the sense of these graphs was rather descriptive. It aimed to show the development of fee income in last years across individual groups of European countries.*

- 7) In figure 2.5, since the data for 2007 are clearly problematic, why should the data series not be adjusted to begin from 2008?

*Response: There are two main reasons why I included the year 2007 into the data series. Firstly, I consider it is important to include the pre-crisis values to see what effect on the data had the financial crisis in 2008. Moreover, this chapter is prerequisite mainly for the papers dealing with net fee and*

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<sup>50</sup> See <https://www.bankingsupervision.europa.eu/banking/statistics/html/index.en.html>.

*commission income determinants (Section 3 and Section 5). Since the time period covered in these two papers starts with the year 2007, I wanted to remain consistent with it.*

- 8) It might be helpful if the introductory chapter provided some comment on the different time periods covered by the individual studies.

*Response: The comment on the different time periods covered by the individual studies was added as a footnote no. 7 to the General introduction (Section 1, page 15) and further as a footnote no 50 to the Conclusion (Section 7, page 123).*

- 9) The Hesse & Cihak (2007) reference is duplicated in the listing.

*Response: One of the references was removed.*

## A.2 Response to Comments from doc. Tomáš Výrost Ph.D.

- 1) As for the formal aspects, the thesis should be more precise in conforming to the citation norms when citing online sources.

*Response: Where possible, the citation of online sources was extended by publishing institution, ISSN, ISBN or other more precise identification. Two sources initially provided only in the dissertation text were added in the Bibliography (see CNB (n.d.) and Nacher (2017)). Webpages were deleted from the Bibliography – these were used mainly as sources of data, which is described already in the main text of the dissertation.*

- 2) Most importantly, the thesis should include an integrating conclusion, which is currently notably missing. While it is true that the introduction does provide some discussion, it is limited to the presentation of individual results of each chapter, followed by a listing of the contributions. As the thesis has been submitted as a collection of treatises, the individual results should lead to some encompassing conclusion. This is particularly necessary, as the papers span varying time periods on different sets of banks, sometimes presenting conflicting results (e.g. with respect to the Herfindahl index in chapters 2 and 5). I consider this a major precondition for a successful defense.

*Response: A conclusion was added as Section 7. Furthermore, General introduction (Section 1) was extended to stress the interconnection between individual papers presented in the thesis.*

- 3) My second major concern is with the validity of the econometric treatment of the system GMM. The choice of this estimator is justified, to avoid the Nickell bias and to avoid some restrictions of difference GMMs. However, if the assumption of serial independence in the original errors hold, the AR(2) term for the differenced residuals should not be significant. As this is the case in most presented chapters, the second lags of endogenous variables might not be appropriate instruments. As the system GMM is used as the main modelling tool in the thesis, a discussion on the validity of the econometric treatment would be very welcome.

*Response: In order to form a valid estimation, a proper choice of instruments is crucial in the System GMM. In models with significant AR (2) I always used higher lags as instruments for the lagged dependent variable, as described in the individual papers. Nevertheless, there were cases in which I used second lags as instruments for some other endogenous variables, always in combination with higher lags. This was mainly in cases in which I tested the inclusion of a second lagged dependent variable as an explanatory variable in the regression, and its coefficient turned out to be insignificant, while at the same time the Arellano-Bond AR (2) test also turned out to be insignificant. Therefore, the real presence of higher order serial correlation was rather unlikely, despite the significant AR (2).*

*Still, I admit that the second lags of endogenous variables should not be standardly included as instruments in regressions with significant AR (2), and since the proper choice of instruments is an important aspect of the System GMM, I have run a set of estimations with different instruments among robustness tests. This procedure was carried out for all models, and the results proved to be robust to instrument changes.*

*Nevertheless, based on a suggestion, I have run additional robustness tests for models with significant AR (2). The procedure of the robustness tests was as follows: Firstly, I tested for the presence of AR (3) and AR (4) to make sure that higher lags are proper instruments. AR (3) and AR (4) turned out to be insignificant for the NIM, RAROOA and RAROOE models in Section 4 making*

use of third and higher lags of endogenous variables valid instruments. Moreover, in these models I also tested the inclusion of a second lagged dependent variable. After this inclusion, AR (2) in all models turned out to be insignificant, which again supports the appropriateness of third lags as instruments. The results of these models using lag 3 and higher as instruments are reported in Table A.1.

**Table A.1: Robustness test for Section 4 – models with insignificant AR (3) - using lag 3 and higher as instruments**

<i>Independent variables</i>	<i>Dependent variable</i>					
	<i>NIM</i>		<i>RAROA</i>		<i>RAROE</i>	
<i>lag DV</i>	0.8033*** (0.0324)	0.8163*** (0.0893)	0.7946*** (0.032)	0.6653*** (0.047)	0.7638*** (0.0397)	0.6766*** (0.0531)
<i>lag2_DV</i>		-0.0126 (0.0823)		0.1436*** (0.037)		0.0988** (0.0394)
<i>nfc_i</i>	-0.0047** (0.0019)	-0.0047** (0.0019)	-0.0118*** (0.0038)	-0.0098** (0.0038)	-0.0095** (0.0043)	-0.0085* (0.0043)
<i>loans depos</i>	0.0000 (0.0000)	0.0000 (0.0000)	0.0000*** (0.0000)	0.0000*** (0.0000)	0.0000*** (0.0000)	0.0000** (0.0000)
<i>depos ass</i>	0.0004 (0.0012)	0.0003 (0.0012)	0.0024 (0.0022)	0.0021 (0.0021)	0.0031 (0.0025)	0.0031 (0.0025)
<i>losres_loans</i>	0.0060 (0.0047)	0.0066 (0.0045)	-0.0404*** (0.0089)	-0.0349*** (0.0087)	-0.045*** (0.0092)	-0.0402*** (0.0089)
<i>eq ass</i>	0.0044 (0.0035)	0.0043 (0.0035)	0.0159** (0.0073)	0.0153** (0.0068)	0.0195** (0.0079)	0.0187** (0.0073)
<i>hi</i>	0.0000 (0.0000)	0.0000 (0.0000)	-0.0001*** (0.0000)	-0.0001*** (0.0000)	-0.0001*** (0.0000)	-0.0001*** (0.0000)
<i>lag gdp</i>	0.032*** (0.0062)	0.0328*** (0.0062)	0.0107 (0.0106)	0.0237** (0.0106)	0.0041 (0.0108)	0.0111 (0.0109)
<i>lag inf</i>	-0.0036 (0.0104)	-0.0056 (0.011)	-0.0964*** (0.0153)	-0.0963*** (0.0166)	-0.0952*** (0.0153)	-0.099*** (0.0165)
<i>dcom</i>	0.1854*** (0.0572)	0.1801*** (0.0571)	0.1446 (0.1173)	0.0908 (0.1114)	0.1066 (0.1257)	0.0667 (0.1217)
<i>dcoop</i>	0.1569** (0.0669)	0.1445** (0.0684)	0.3078* (0.1663)	0.2335 (0.1526)	0.398** (0.1974)	0.3787** (0.1877)
<i>dsav</i>	0.1989*** (0.0628)	0.1967*** (0.0614)	-0.1496 (0.1245)	-0.1393 (0.1194)	-0.1756 (0.1395)	-0.1544 (0.1344)
<i>dinv</i>	0.3024** (0.1238)	0.2877** (0.1301)	-0.0551 (0.1708)	-0.0945 (0.1684)	-0.0625 (0.2005)	-0.0826 (0.1997)
<i>dhold</i>	0.1391* (0.0739)	0.1312* (0.0742)	-0.0310 (0.1389)	-0.1380 (0.1318)	-0.0494 (0.1429)	-0.1322 (0.1374)
<i>_cons</i>	0.3166*** (0.097)	0.3303*** (0.1003)	0.7388*** (0.216)	0.7086*** (0.2145)	0.622*** (0.229)	0.5861** (0.2285)

*Robust standard errors adjusted for 329 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, in all models with one lag of dependent variable AR (2) is significant, in all models with two lags of dependent variable AR (2) is insignificant*  
 Source: Author based on Bankscope, Eurostat, and the ECB

*In models with significant AR (3), namely in the RANIM model in Section 4 and the NFCI/TI models in Section 3 and Section 5, I have used instruments starting from lag four and higher. Again, I have included higher lags of the dependent variable in the regression. In the case of significant AR (3), I have included further lags one by one up to three lags. The estimation results are provided in Table A.2, Table A.3 and Table A.4.*

**Table A.2: Robustness test for Section 3 – model with significant AR (3) - using lag 4 and higher as instruments**

<i>Independent variables</i>	<i>Dependent variable</i>	
	<i>nfc</i>	<i>ti</i>
<i>lag_DV</i>	0.5946*** (0.1147)	0.546*** (0.0963)
<i>lag2_DV</i>	0.0397 (0.0771)	-0.0775 (0.0834)
<i>lag3 DV</i>		0.1549 (0.096)
<i>nim</i>	-0.6921 (0.8209)	-0.8521 (0.7605)
<i>eq ass</i>	0.3183* (0.1722)	0.3584** (0.1514)
<i>npl loans</i>	-0.0335 (0.0594)	-0.0005 (0.06)
<i>cost_inc</i>	0.105*** (0.0365)	0.0799** (0.0399)
<i>depos_ass</i>	0.1099 (0.0667)	0.1347** (0.0537)
<i>hi</i>	-0.0023* (0.0013)	-0.0029** (0.0012)
<i>lag gdp</i>	-0.2104** (0.0919)	-0.2503*** (0.0899)
<i>lag inf</i>	-0.0533 (0.1349)	-0.2805 (0.2145)
<i>dcom</i>	4.7602* (2.7856)	5.3326* (2.7951)
<i>dcoop</i>	5.6029* (2.8759)	6.0473** (2.8397)
<i>dsav</i>	2.0454	1.4212

<i>Independent variables</i>	<i>Dependent variable</i>	
	<i>nfcit</i>	
	(3.0501)	(2.9846)
<i>dinv</i>	3.5822	3.3767
	(3.6095)	-3.9344
<i>dhold</i>	6.1074*	7.171**
	(3.2074)	(3.2425)
<i>cons</i>	-6.4348	-5.3349
	(4.0447)	(4.5354)

Robust standard errors adjusted for 258 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, in model with two lags of dependent variable AR (2) is significant, in model with three lags of dependent variable AR (2) is insignificant

Source: Author based on Bankscope, Eurostat, the ECB and the World Bank

**Table A.3: Robustness test for Section 4 – model with significant AR (3) - using lag 4 and higher as instruments**

<i>Independent variables</i>	<i>Dependent variable</i>		
	<i>RANIM</i>		
<i>lag_DV</i>	0.9396***	0.924***	0.969***
	(0.02)	(0.0628)	(0.0596)
<i>lag2 DV</i>		0.0178	-0.3308***
		(0.0606)	(0.0709)
<i>lag3 DV</i>			0.3085***
			(0.0381)
<i>nfcit</i>	-0.0097**	-0.0096**	-0.0051
	(0.0046)	(0.0046)	(0.0047)
<i>loans_depos</i>	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)
<i>depos_ass</i>	-0.0007	-0.0003	0.0001
	(0.0027)	(0.0028)	(0.0029)
<i>losres loans</i>	0.0001	0.0001	-0.0068
	(0.0084)	(0.0087)	(0.0085)
<i>eq ass</i>	-0.0048	-0.0049	0.0014
	(0.0081)	(0.0083)	(0.0082)
<i>hi</i>	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)
<i>lag_gdp</i>	0.0528***	0.0573***	0.0555***
	(0.0108)	(0.0115)	(0.0114)
<i>lag_inf</i>	-0.0577***	-0.061***	-0.0494***
	(0.0135)	(0.0151)	(0.0165)
<i>dcom</i>	0.0151	-0.0083	-0.1211
	(0.1192)	(0.1221)	(0.1314)
<i>dcoop</i>	0.0137	-0.0058	-0.0908
	(0.1466)	(0.1532)	(0.1677)

<i>Independent variables</i>	<i>Dependent variable</i>		
	<i>RANIM</i>		
<i>dsav</i>	0.0293 (0.1258)	-0.0097 (0.1282)	-0.1914 (0.1405)
<i>dinv</i>	0.0860 (0.1938)	0.0420 (0.188)	-0.0098 (0.2156)
<i>dhold</i>	0.1294 (0.1668)	0.0627 (0.1632)	-0.0423 (0.1693)
<i>_cons</i>	1.0781*** (0.2926)	1.0408*** (0.2965)	0.8152*** (0.305)

Robust standard errors adjusted for 329 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, AR (2) remains significant in all models suggesting possibly significant further lags – further lags were tested and turned out to be insignificant

Source: Author based on Bankscope, Eurostat, and the ECB

**Table A.4: Robustness test for Section 5 – model with significant AR (3) - using lag 4 and higher as instruments**

<i>Independent variables</i>	<i>Dependent variable</i>		
	<i>nfcit</i>		
<i>lag DV</i>	0.959*** (0.0278)	1.0738*** (0.0914)	1.0708*** (0.1029)
<i>lag2_DV</i>		-0.1213 (0.0907)	-0.2856** (0.1508)
<i>lag3 DV</i>			0.1828** (0.0852)
<i>nim</i>	1.7827* (0.9024)	1.6058* (0.9055)	2.2934** (0.9829)
<i>eq ass</i>	0.0695 (0.0788)	0.0030 (0.0876)	0.0720 (0.0937)
<i>impair_loans</i>	0.7658*** (0.2732)	0.7171*** (0.2573)	0.9288*** (0.2693)
<i>cost inc</i>	0.0512** (0.0212)	0.0459* (0.0254)	0.0714** (0.0292)
<i>depos_ass</i>	-0.0081 (0.0126)	-0.0103 (0.0118)	-0.0095 (0.0132)
<i>hi</i>	0.0002 (0.0004)	0.0007 (0.0005)	0.0002 (0.0004)
<i>lag_gdp</i>	0.3614*** (0.112)	0.3142*** (0.1175)	0.371** (0.1458)
<i>lag inf</i>	1.4301 (0.2563)	1.1468*** (0.2902)	1.162*** (0.3613)
<i>_cons</i>	-8.8624*** (1.8947)	0.0133 (2.0518)	-2.5936 (2.2589)

*Robust standard errors adjusted for 258 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, in models with two and three lags of dependent variable AR (2) is insignificant, coefficient of hi is close to significant*

*Source: Author based on Bankscope, Eurostat, and the ECB*

*In general, I conclude that the results are robust to changes in the set of instruments. I have never observed a significantly positive coefficient turn into a significantly negative one, or vice versa.<sup>51</sup> Sometimes, I observed a significant coefficient turning into an insignificant one. Also, the magnitude of the coefficient did not change significantly under individual model specifications. Still, the use of higher lags as instruments sometimes led to a less efficient estimation. This feature was expected because such long-term persistency in banking is rather unlikely, so the relationship between current values and, for example, the four-year-old values of the same variable might be relatively weak.*

*In general, it is questionable whether the above constructed models are reliable from the economic perspective. Despite the fact that they display, in some aspects, superior statistical robustness compared to the original models, it would be rather incorrect to expect that in the real world there would be such long-term persistency in the banking sector. Moreover, after the inclusion of three lagged dependent variables, some models displayed a very high coefficient of first lag (in some cases over 1), a negative coefficient of second lag and a positive third lag, often with similar magnitude to lag 2. Again, there is no economic justification for this finding.*

*In order to analyse what might have caused the unexpected longer-term persistency in some of the models in the dissertation, I carried out some additional tests. I searched for further outliers or model misspecifications in terms of the choice of explanatory variables. Among this tests, besides other, I tried excluding the PIIGS countries, which were the hardest hit by the crisis, from the analysis. The results proved to be resistant both to these tests and to the exclusions. An appropriate choice of explanatory variables follows not only from the robustness tests but also from the theory (see for example DeYoung and Rice (2004a), Shahida et al. (2006), Moshirian et al. (2011)).*

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<sup>51</sup> *Only for the coefficients of loans\_depos in the RAROA and RAROAE models did the sign change, but since the magnitude of the coefficient is close to zero, it has no real impact on the final results.*

*For the models that measure banks' performance presented in Table A.1, the suggested greater time persistency probably stems from the covered time period, which also includes the financial crisis. When examining the post-crisis period (2010-2014) separately, the model suggested solely the expected first order autocorrelation (see Table A.5).*

**Table A.5: Robustness test for Section 4 – separate test of the 2010-2014 period**

<i>Independent variables</i>	<i>Dependent variable</i>		
	<i>NIM</i>	<i>RAROA</i>	<i>RAROE</i>
<i>lag DV</i>	0.4838*** (0.1269)	0.3346* (0.1737)	0.3953** (0.1571)
<i>nfc_i ti</i>	-0.0198*** (0.005)	-0.0658*** (0.0145)	-0.0634*** (0.013)
<i>loans depos</i>	0.0000 (0.0000)	0.0000* (0.0000)	0.0000 (0.0000)
<i>depos_ass</i>	0.0073* (0.0038)	-0.0355* (0.0187)	-0.0295* (0.0177)
<i>losres loans</i>	0.0278** (0.011)	-0.1306** (0.0512)	-0.0997** (0.047)
<i>eq_ass</i>	0.0299 (0.0193)	0.0306 (0.0836)	-0.0033 (0.0728)
<i>hi</i>	0.0000 (0.0000)	-0.0002 (0.0002)	-0.0002 (0.0001)
<i>lag_gdp</i>	0.0195 (0.0146)	0.095** (0.0382)	0.0982*** (0.0341)
<i>lag_inf</i>	0.0229 (0.0227)	-0.0271 (0.045)	-0.0096 (0.0423)
<i>dcom</i>	0.5176*** (0.1545)	0.3430 (0.6289)	0.1966 (0.6332)
<i>dcoop</i>	0.5628*** (0.1805)	0.4091 (0.8495)	0.6090 (0.8629)
<i>dsav</i>	0.4976*** (0.1665)	0.4154 (0.6488)	0.4767 (0.6033)
<i>dinv</i>	0.5235 (0.3325)	-1.0619 (0.925)	-0.9403 (1.0011)
<i>dhold</i>	0.3766** (0.1712)	-0.7050 (0.6503)	-0.6592 (0.6313)
<i>cons</i>	0.3376 (0.3078)	5.2928*** (1.2989)	4.8018*** (1.2046)

<i>Estimation diagnostics</i>	<i>Dependent variable</i>		
	<i>NIM</i>	<i>RAROOA</i>	<i>RAROAE</i>
<i>Number of observations</i>	1316	1316	1316
<i>Number of groups</i>	329	329	329
<i>Observations per group</i>	4	4	4
<i>Number of instruments</i>	40	39	39
<i>F test</i>	24.88***	7.41***	7.95***
<i>Arellano-Bond AR (1)</i>	-2.62***	-3.23***	-3.83***
<i>Arellano-Bond AR (2)</i>	0.05	-0.36	-0.59
<i>Hansen test</i>	26.58	27.80	27.67

Robust standard errors adjusted for 329 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 based on Bankscope, Eurostat, and the ECB

*I have also tested the pre-crisis and crisis period separately, but since the time span was too short, static estimation methods (pooled OLS, FE, RE) needed to be used. I tested for structural breaks also in the remaining models with significant AR (2). But for these models I was unable to obtain subsamples with a sufficiently long time period to perform the System GMM. Again, I tested the individual time spans using static estimation methods. The results proved to be robust across individual time periods (see also the response to the following comment).*

*In the remaining three models, the compensating values of the coefficients of adjacent lags suggest a potential violation of linearity. To test for this feature, I constructed the natural logarithm of the dependent variable,  $e$  raised to the power of the dependent variable and the dependent variable squared.<sup>52</sup> Using the dependent variable squared in the estimation improved the regression results by removing the excessive time persistency (see Table A.6, Table A.7 and Table A.8).*

**Table A.6: Robustness test for Section 3 – testing for nonlinearity**

<i>Independent variables</i>	<i>Dependent variable</i>
	<i>(nfc<sub>it</sub> ti)<sup>2</sup></i>
<i>lag_DV</i>	0.4913*** (0.1007)
<i>nim</i>	-16.2141 (80.0479)

<sup>52</sup> In order to be able to construct the natural logarithm of the dependent variables, all banks that exhibited negative or zero values were excluded.

<i>Independent variables</i>	<i>Dependent variable</i> <i>(nfcit<sub>i</sub>)<sup>2</sup></i>
<i>eq_ass</i>	34.3656** (15.8113)
<i>npl_loans</i>	-9.8826* (5.8344)
<i>cost_inc</i>	16.2867** (7.6512)
<i>depos_ass</i>	5.4760 (4.3126)
<i>hi</i>	-0.1919*** (0.0706)
<i>lag_gdp</i>	-9.2351 (9.4086)
<i>lag_inf</i>	10.8311 (11.314)
<i>dcom</i>	157.9658 (226.7876)
<i>dcoop</i>	126.3693 (220.3738)
<i>dsav</i>	-181.9713 (278.193)
<i>dinv</i>	403.5407 (426.375)
<i>dhold</i>	251.4113 (236.6565)
<i>cons</i>	-909.6018 (654.7255)
<b><i>Estimation diagnostics</i></b>	
<i>Number of observations</i>	1729
<i>Number of groups</i>	247
<i>Observations per group</i>	7
<i>Number of instruments</i>	232
<i>F test</i>	13.81***
<i>Arellano-Bond AR (1)</i>	-2.15**
<i>Arellano-Bond AR (2)</i>	-1.21
<i>Hansen test</i>	229.41

Robust standard errors adjusted for 247 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 based on Bankscope, Eurostat, the ECB and the World Bank

**Table A.7: Robustness test for Section 4 – testing for nonlinearity**

<i>Independent variables</i>	<i>Dependent variable</i> <i>(RANIM)^2</i>
<i>lag DV</i>	0.9766*** (0.0177)
<i>nfc_i_ti</i>	-0.1513*** (0.035)
<i>loans depos</i>	0.0000* (0.0000)
<i>depos ass</i>	0.05** (0.0236)
<i>losres loans</i>	-0.0085 (0.0831)
<i>eq_ass</i>	0.1389 (0.0931)
<i>hi</i>	-0.0014** (0.0005)
<i>lag_gdp</i>	0.5784*** (0.1637)
<i>lag inf</i>	-0.6558*** (0.2235)
<i>dcom</i>	-0.1311 (1.2963)
<i>dcoop</i>	-0.0683 (1.8516)
<i>dsav</i>	-2.5035 (1.6993)
<i>dinv</i>	2.2852 (1.5902)
<i>dhold</i>	0.4779 (1.608)
<i>cons</i>	7.4273*** (2.1996)
<b><i>Estimation diagnostics</i></b>	
<i>Number of observations</i>	2925
<i>Number of groups</i>	325
<i>Observations per group</i>	9
<i>Number of instruments</i>	317
<i>F test</i>	661.96***
<i>Arellano-Bond AR (1)</i>	-5.12***
<i>Arellano-Bond AR (2)</i>	-0.36
<i>Hansen test</i>	320.18

Robust standard errors adjusted for 325 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 based on Bankscope, Eurostat, and the ECB

**Table A.8: Robustness test for Section 5 – testing for nonlinearity**

<i>Independent variables</i>	<i>Dependent variable</i>
<i>lag_DV</i>	0.8443*** (0.0554)
<i>lag2 DV</i>	0.1153** (0.0569)
<i>nim</i>	94.0125** (40.1065)
<i>eq ass</i>	4.0418 (3.7857)
<i>impair_loans</i>	23.0223 (14.6713)
<i>cost inc</i>	2.0153** (0.8038)
<i>depos ass</i>	-0.6394 (0.6181)
<i>hi</i>	0.0472* (0.0253)
<i>lag_gdp</i>	14.398*** (4.9915)
<i>lag inf</i>	66.2329*** (13.0508)
<i>_cons</i>	-394.1148*** (79.6927)
<b><i>Estimation diagnostics</i></b>	
<i>Number of observations</i>	1134
<i>Number of groups</i>	189
<i>Observations per group</i>	6
<i>Number of instruments</i>	123
<i>F test</i>	113.61***
<i>Arellano-Bond AR (1)</i>	-2.84***
<i>Arellano-Bond AR (2)</i>	-1.43
<i>Hansen test</i>	120.09

Robust standard errors adjusted for 189 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, due to significant second lagged dependent variable, instruments were used starting from lag 3

Source: Author based on Bankscope, Eurostat, and the ECB

*Based on the performed robustness tests described above, I conclude that the results are robust. An interesting additional finding is the suggested positive relationship between NIM and NFCI/TI in cooperative banks. It is commonly believed that banks tend to compensate for decreasing net interest margins with fee income. This does not seem to be true for cooperative banks, whose fee income share increases with higher NIM. This again supports the assumption that cooperative banks rather tend to stick with traditional banking activities even in times in which NIM is decreasing.*

*To summarize, the conclusions drawn in the individual papers are valid despite the fact that in some cases a potentially better set of instruments could be applied. Despite its drawbacks, I believe that the applied System GMM outperforms other estimation methods.*

- 4) P. 19 - the pronounced increase in NFCI/TI in 2010 is explained to be caused by Ireland, which has experienced a problematic period post-2008 Irish banking crisis. As the inclusion of Ireland causes a significant spike, what is the justification for keeping Ireland in the dataset? Are the results from other chapters also influenced by Ireland? The sensitivity of the results vis-à-vis major market events should be discussed at least in a common introduction/conclusion, as it may influence the relevance of research presented in all chapters.

*Response: Section 2 is meant to provide a general overview of the development of bank fees across the EU countries. That is the reason why Ireland also remains in the dataset despite the fact that it is, in some aspects, outlying. To make this clear, I describe in Section 2 how the results change after the exclusion of Ireland.*

*The results from the other sections are not heavily influenced by Ireland. In Section 3, Irish banks represent 4 out of 258 banks included in the analysis. In Section 4, I have 1 Irish bank out of 329. Section 5 and Section 6 do not include Irish banks.*

*To make sure that Irish banks do not heavily influence the overall result, I performed a robustness test by excluding Irish banks from the dataset. Moreover, for Sections 3, 4 and 5, I also tested the crisis period (2008-2010) separately to check for structural breaks. The results for structural breaks in Section 4 are provided in Appendix (Section 4.5) to that section, in Table 4.7, to be precise.*

The results of those robustness checks for other sections are provided below. I report only the coefficient of interest.

**Table A.9: Robustness tests for Section 3 - excluding Ireland and negative NFCI/TI, using only crisis period**

<i>HI coefficient</i>	<i>Dependent variable</i>	
	<i>nfc_i ti</i>	<i>nfc_i ta</i>
<i>excluding Ireland</i>	-0.0023** (0.0009)	-0.0001*** (0.0000)
<i>using only period 2008 - 2010</i>	-0.0064*** (0.0012)	-0.0002 0.3239
<i>excluding negative NFCI<sup>53</sup></i>	-0.0024*** (0.0009)	-0.0001** (0.0000)

Robust standard errors adjusted for clusters in index are in parentheses, \*\*\*/\*\*/\* indicates significance at 1%/5%/10%, other independent variables included in the regression are not reported  
Source: Author, based on Bankscope, Eurostat, ECB

**Table A.10: Robustness test for Section 4 – excluding Ireland**

<i>NFCI/TI coefficient</i>	<i>Dependent variable</i>							
	<i>NIM</i>	<i>ROAA</i>	<i>ROAE</i>	<i>RANIM</i>	<i>RAROOA</i>	<i>RAROE</i>	<i>ln (Z-Score)</i>	<i>ln (RAEAR)</i>
<i>excluding Ireland</i>	-0.0079*** (0.0017)	-0.0091** (0.0039)	-0.1712*** (0.0420)	-0.0116*** (0.0029)	-0.0189*** (0.0030)	-0.0170*** (0.0032)	-0.0148 (0.0103)	-0.0017*** (0.0006)

Robust standard errors adjusted for clusters in index are in parentheses, \*\*\*/\*\*/\* indicates significance at 1%/5%/10%, other independent variables included in the regression are not reported  
Source: Author, based on Bankscope, Eurostat, ECB

**Table A.11: Robustness test for Section 5 – using only crisis period**

<i>HI coefficient</i>	<i>Dependent variable</i>
	<i>nfc_i ti</i>
<i>using only period 2008 - 2010</i>	0.0031*** (0.0012)

Robust standard errors adjusted for clusters in index are in parentheses, \*\*\*/\*\*/\* indicates significance at 1%/5%/10%, other independent variables included in the regression are not reported  
Source: Author, based on Bankscope, Eurostat, ECB

I conclude that the results are stable in individual robustness tests. Despite the fact that the financial crisis had a great impact on EU banks, the relationship between the market concentration and the fee income share, as well as the relationship between the fee income share and banks' performance, seems to be stable among the individual examined time periods. The information about the

<sup>53</sup> This robustness test consisted in exclusion of all banks with negative NFCI from the dataset. Together, 10 banks were excluded. See also response to comment 7).

*sensitivity of the results vis-à-vis major market events was also added to the General introduction (Section 1, page 21) and Conclusion (Section 7, pages 124-125).*

- 5) P. 28 – when describing the surprising result from equation 2.1, several alternative explanations are offered – making the approach selected quite simplistic and weak. Again, the introduction should explain how the results from the first paper are complemented by a more complex approach in following chapters.

*Response: The information was added to the General introduction (Section 1, page 16).*

- 6) P. 29 – in Fig. 2.9, the regression seems to be sensitive to influential observations from the 'other' group. Can these be identified and discussed? As the p-value of the slope coefficient is about 0.03, removing the one or two influential observations might make the coefficient insignificant.

*Response: The "other" group includes all EU countries except for the CZ, CEE and PIIGS, i.e. Sweden, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Finland, France, United Kingdom, Austria, Belgium, Cyprus, Germany, Denmark and Estonia. It is true that the exclusion of some observations may lead to the insignificance of the coefficient. Even now, the explanatory power of the regression is rather weak (the model is highly simplified and  $R^2$  relatively low). But since the aim of Section 2 is in general rather descriptive and the section is meant to serve as the starting point for the rest of the dissertation, I decided to keep all EU countries in the regression despite the fact that some of them might be outlying and excessively influence the overall result. More robust analysis of the relationship between market concentration and the magnitude of fee income share is provided in Section 3 and Section 5.*

- 7) P. 42 – in footnote 21, there is not enough clarity on what number, size and kind of banks has been omitted. Also, how does this relate to the datasets in other chapters – were similar choices been made there as well?

*Response: Reduction of the data from the originally obtained dataset from Bankscope was made in all the presented papers. The procedure was the following (in parentheses, I specify to which sections the individual step applies):*

- 1) *I excluded all banks with missing data in order to have a balanced panel dataset. (Section 3, Section 4, Section 5 and Section 6)*
- 2) *I excluded banks with negative operating income, because the NFCI/TI ratio would be misleading. (Section 3, Section 4 and Section 5)*
- 3) *I excluded banks with negative NFCI, because the NFCI/TI ratio would be misleading. (Section 4 and Section 5<sup>54</sup>)*
- 4) *I excluded all banks with a negative Z-Score, because its log transformation would not be possible. (Section 4)*
- 5) *I excluded all banks that were mistakenly identified by Bankscope as cooperative banks (for example Sberbank). (Section 5 and Section 6)*
- 6) *I excluded some banks from countries that reported too many of them. Without this correction the results would be driven too much by these countries (in Section 3 – I excluded 330 Italian, 39 French, 13 Swedish and 9 British banks, in Section 4 – I excluded 37 French, 12 British and Swedish and 8 Italian banks, and in Section 5 – I excluded 301 Italian and 809 German banks<sup>55</sup>)*

*The reduction of banks was made primarily for Italy, for which I had too many data entries (for example in the original dataset in Section 3, Italian banks represented more than 50%). This is connected to the fact that in Italy, the same banks operating in different regions constitute separate legal entities. Something similar holds true for the German cooperative banking system, which is highly dispersed. Due to regional divisions, these banks are much smaller than those in other countries. In order to have a representative data set, I kept just the biggest representatives (for example in Section 3, the original dataset included 19 Cassa di Risparmio banks - I kept only 2 of them). Other possible ways to treat this issue were considered, but since I am not aware of the exact accounting and consolidation techniques used in individual countries, they could lead to inaccuracy.*

- 8) P. 102 – unlike the other chapters, chapter 6 uses a regular fixed-effects panel model. As in other cases a dynamic panel model is used, how may this

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<sup>54</sup> *In Section 3, 10 banks with negative NFCI were kept in the analysis. Their exclusion was tested by robustness tests. The results proved to be robust to this exclusion. See also Table A.9 in response to comment 4).*

<sup>55</sup> *For Section 6 this adjustment was not necessary, since I was not interested in country-specific explanatory variables. Still, among robustness tests I tested the exclusion of 50% and 80% of the Italian and German cooperative banks. The results proved to be robust to this exclusion.*

inconsistency in modelling choices be justified? It is understandable to make different choices in different papers, but as this thesis is a collective work, it would be helpful to understand the validity and logic for the choices.

*Response: In Section 6, we used fixed effects because the estimation diagnostics in other approaches suggested invalidity or lower efficiency of the estimation methods.*

### A.3 Response to Comments from prof. Ing. Michal Mejstřík CSc.

- 1) While the prevailing long-run movement away from traditional interest-based bank business toward non-traditional business has been somehow reflected in the reviewed draft thesis, unfortunately its up-to date roots (innovations in information, communications, and financial technologies induced in part by increasing competition from other financial institutions and markets) are not properly addressed by the author.

*Response: Not only competition, but also technological developments and digitalization are among the most pronounced factors influencing the banking sector in recent years. The link between new technologies and non-interest income magnitude was examined, for example, by DeYoung and Rice (2004a).*

*I am aware of this fact and I tried also to capture the development and application of new technologies in a given banking sector in the originally defined model of fee income share determinants. I proxied the technological development by the number of automated teller machines per 100,000 adults (atms) and by the number of all cards transactions (except the e-money function) per capita (cashless) (see also Table 3.2 in Section 3 and Table 5.1 in Section 5). Unfortunately, due to the high correlation of these variables with other explanatory variables, and mainly due to their correlation with the variable of interest (HI) (see Table A.12 below for the correlation matrix of Section 3, and Table 5.2 in Section 5 for the correlation matrix of Section 5), I was forced to drop the variables capturing technological development from the final estimation. Their inclusion in the model would lead to multicollinearity and misleading results.*

**Table A.12: Correlation matrix of Section 3**

	<i>nfc_i_ti</i>	<i>nfc_i_ta</i>	<i>ln_ass</i>	<i>nim</i>	<i>depos_ass</i>	<i>eq_ass</i>	<i>npl_loans</i>	<i>loans_ass</i>	<i>roae</i>	<i>cost_inc</i>	<i>hi</i>	
<i>nfc_i_ti</i>	1											
<i>nfc_i_ta</i>	0.4952*	1										
<i>ln_ass</i>	0.006	-0.2268*	1									
<i>nim</i>	-0.1058*	0.3135*	-0.3945*	1								
<i>depos_ass</i>	0.0382	0.2414*	-0.4571*	0.4113*	1							
<i>eq_ass</i>	0.0496*	0.2921*	-0.5399*	0.3820*	0.2196*	1						
<i>npl_loans</i>	0.0097	0.1011*	-0.1482*	0.1763*	0.0513*	0.1489*	1					
<i>loans_ass</i>	-0.2249*	-0.0865*	-0.2537*	0.2367*	0.2087*	0.1363*	-0.0126	1				
<i>roae</i>	-0.018	0.0748*	0.0048	0.1014*	0.0389	0.0592*	-0.3011*	-0.0304	1			
<i>cost_inc</i>	0.2689*	-0.021	0.0078	-0.1876*	-0.0093	-0.1297*	0.1112*	-0.1012*	-0.2212*	1		
<i>hi</i>	-0.1379*	-0.0719*	-0.1581*	0.0471*	0.0837*	0.1084*	0.0215	0.0543*	-0.008	-0.0385	1	
<i>atms</i>	0.1292*	-0.023	0.3346*	-0.2458*	-0.2795*	-0.2155*	-0.0465*	-0.1459*	-0.015	0.1326*	-0.3350*	
<i>cashless</i>	-0.0448*	-0.1496*	-0.0004	-0.2786*	0.0211	-0.004	-0.3185*	0.0303	0.0473*	0.0051	0.1754*	
<i>lag_gdp</i>	-0.025	0.0484*	-0.0876*	0.1711*	0.0612*	0.0158	-0.2312*	0.0169	0.1603*	-0.0412	0.0225	
<i>lag_unem</i>	0.0409	0.0166	-0.0429*	-0.0574*	-0.0252	0.1324*	0.3053*	-0.0347	-0.0889*	0.0503*	0.0506*	
<i>lag_inf</i>	-0.0613*	0.1022*	-0.1164*	0.3014*	0.0560*	0.0658*	0.0790*	0.0907*	-0.036	-0.0803*	0.0682*	
<i>lag_int</i>	-0.001	0.1222*	-0.1410*	0.2104*	0.0318	0.1371*	0.4315*	0.0667*	-0.1362*	0.0784*	0.1401*	
<i>dcom</i>	0.0457*	-0.011	0.1158*	0.1320*	-0.0164	-0.0705*	0.1774*	-0.1126*	-0.03	0.0262	0.1450*	
<i>dcoop</i>	0.0265	-0.0606*	0.0932*	-0.0986*	-0.0617*	-0.0600*	-0.0443*	-0.0019	0.0122	0.0152	-0.0771*	
<i>dsav</i>	-0.013	0.0412	-0.4007*	0.1308*	0.3630*	0.2843*	-0.1396*	0.1833*	0.0357	-0.0428	0.0096	
<i>dinv</i>	0.0318	0.2497*	-0.1215*	0.0453*	-0.1385*	0.1552*	0.1207*	-0.1069*	-0.004	-0.0717*	-0.0571*	
<i>dhold</i>	-0.012	0.0309	0.2616*	-0.1025*	-0.1230*	-0.1128*	-0.0870*	-0.1222*	0.0045	0.0383	-0.039	
		<i>atms</i>	<i>cashless</i>	<i>lag_gdp</i>	<i>lag_unem</i>	<i>lag_inf</i>	<i>lag_int</i>	<i>dcom</i>	<i>dcoop</i>	<i>dsav</i>	<i>dinv</i>	<i>dhold</i>
<i>atms</i>		1										
<i>cashless</i>		-0.0639*	1									
<i>lag_gdp</i>		-0.1691*	-0.0394	1								
<i>lag_unem</i>		0.1875*	-0.1598*	-0.2770*	1							
<i>lag_inf</i>		-0.0841*	-0.2730*	0.2629*	-0.1974*	1						
<i>lag_int</i>		0.0105	-0.4771*	-0.2793*	0.4042*	0.2447*	1					
<i>dcom</i>		-0.0556*	-0.3537*	0.0571*	0.0939*	0.1718*	0.1936*	1				
<i>dcoop</i>		0.0986*	-0.1016*	-0.0770*	0.0254	-0.0789*	-0.04	-0.3928*	1			
<i>dsav</i>		-0.3009*	0.3806*	0.0426	-0.0505*	-0.1156*	-0.1456*	-0.4647*	-0.1309*	1		
<i>dinv</i>		0.1596*	-0.0152	-0.0654*	0.0425	-0.035	0.0533*	-0.2357*	-0.0664*	-0.0785*	1	
<i>dhold</i>		0.1458*	0.1217*	-0.018	-0.1173*	-0.033	-0.0873*	-0.3309*	-0.0932*	-0.1103*	-0.0559*	1

\* indicates significance at 5% level

Source: Author based on Bankscope, Eurostat, the ECB, HelgiLibrary and the World Bank

*The significant correlation between HI, cashless and atms also suggests that the technological development of the banking sector is at least partly induced by changes in market concentration, as suggested in your opponent's report. More precisely, increased market concentration seems to decrease the number of*

*ATMs in a given country, while the effect on the number of cashless transactions is the opposite.*

*Below, I provide the results of models using proxies for technological development in the banking sector as explanatory variables.<sup>56</sup> As can be seen, the number of cashless transactions seems to be negatively related to fee income share, while the number of ATMs has no (NFCI/TI regression) or positive (NFCI/TA regression) impact. It suggests that banks do not impose high fees on new payment technologies such as credit cards, debit cards, electronic checks, etc. but that they seem, rather, to motivate the client to use these services instead of cash payments, which are potentially more costly for the bank. On the other hand, a good ATM infrastructure seems to be a service subject to a charge.*

*Interestingly, the coefficient of NIM turned out to be significantly negative in the NFCI/TI models. This suggests that banks were switching to fee-bearing activities after their margins dropped as a consequence of the low interest rates that prevailed after the financial crisis. But this relationship turns out to be weak in the robustness tests.*

**Table A.13: Relationship between NFCI share and technological development of the banking sector – System GMM regression results using data from Section 3**

<i>Independent variables</i>	<i>Dependent variable</i>			
	<i>nfc_i ti</i>		<i>nfc_i ta</i>	
<i>lag DV</i>	0.5043 (0.0971)***	0.5189 (0.0966)***	0.7499 (0.0719)***	0.7527 (0.0697)***
<i>lag2 DV</i>	0.1286 (0.0512)**	0.1262 (0.0509)**		
<i>nim</i>	-0.9946 (0.5211)*	-0.8722 (0.5257)*	0.0011 (0.015)	0.0046 (0.0162)
<i>eq_ass</i>	0.2400 (0.0945)**	0.2353 (0.0948)**	0.0065 (0.0035)*	0.0067 (0.0037)*
<i>npl_loans</i>	-0.0899 (0.0514)*	-0.0583 (0.0489)	0.0009 (0.0013)	0.0016 (0.0013)
<i>cost_inc</i>	0.0944 (0.0473)*	0.0933 (0.048)*	0.0000 (0.0003)	0.0000 (0.0003)
<i>depos_ass</i>	0.0817	0.0892	0.0035	0.0038

<sup>56</sup> As in the original models, I have found significant AR (2) in NFCI/TI regressions, suggesting the possible presence of a higher order serial correlation. Therefore, higher lags were used as instruments for endogenous variables. Moreover, I performed robustness tests similar to the one described in Appendix A.2, in response to comment No.3. The results proved to be robust.

<i>Independent variables</i>	<i>Dependent variable</i>			
	<i>nfc_i ti</i>		<i>nfc_i ta</i>	
	(0.0427)*	(0.0415)**	(0.0013)**	(0.0013)***
<i>cashless</i>	-0.0112		-0.0002	
	(0.005)**		(0.0001)*	
<i>atms</i>		0.0100		0.0005
		(0.0111)		(0.0003)*
<i>lag_gdp</i>	-0.1204	-0.1387	0.0034	0.0036
	(0.0942)	(0.0996)	(0.0033)	(0.0033)
<i>lag_inf</i>	0.1089	0.1697	0.0008	0.0026
	(0.1366)	(0.128)	(0.0049)	(0.0051)
<i>dcom</i>	4.1750	4.7368	0.0452	0.0624
	(1.8525)**	(1.865)**	(0.0435)	(0.0459)
<i>dcoop</i>	4.6245	5.3206	0.0248	0.0390
	(2.0724)**	(2.1359)**	(0.0447)	(0.0473)
<i>dsav</i>	3.0896	2.8772	-0.0244	-0.0253
	(2.1667)	(2.119)	(0.0637)	(0.0569)
<i>dinv</i>	5.0007	4.9556	0.0979	0.0910
	(3.3202)	(3.3497)	(0.1022)	(0.1096)
<i>dhold</i>	4.9133	4.9488	0.1306	0.1232
	(2.2411)**	(2.2411)**	(0.0677)*	(0.0698)*
<i>_cons</i>	-6.0869	-9.6203	-0.1175	-0.2325
	(3.9295)	(3.4206)***	(0.0716)	(0.0743)***
<b><i>Estimation diagnostics</i></b>				
<i>Number of observations</i>	1548	1548	1806	1806
<i>Number of groups</i>	258	258	258	258
<i>Observations per group</i>	6	6	7	7
<i>Number of instruments</i>	220	220	246	246
<i>F test</i>	26.84***	24.33***	67.42***	61.93***
<i>Arellano-Bond AR (1)</i>	-2.12**	-2.14**	-2.19**	-2.19**
<i>Arellano-Bond AR (2)</i>	-2.50**	-2.49**	-0.59	-0.59
<i>Hansen test</i>	118.1	219.39	238.09	235.97

Robust standard errors adjusted for 258 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 based on Bankscope, Eurostat, the ECB and the World Bank

The results for cooperative banks are studied separately. In the case of cooperative banks, neither of the explanatory variables capturing technological development has a significant role in bank fee income share determination. Furthermore, the coefficient of NIM is also insignificant, which possibly again indicates that cooperative banks stick with traditional banking services and are not so flexible in changing their business model.

**Table A.14: Relationship between NFCI share and technological development of the banking sector – System GMM regression results using data from Section 5**

<i>Independent variables</i>	<i>Dependent variable</i>	
	<i>nfc</i>	<i>ti</i>
<i>lag_DV</i>	0.9307 (0.02)***	0.9265 (0.0225)***
<i>nim</i>	-0.0797 (0.4924)	-0.0239 (0.4814)
<i>eq_ass</i>	0.1296 (0.0642)**	0.1316 (0.058)**
<i>impair loans</i>	-0.0557 (0.1417)	-0.0539 (0.1325)
<i>cost inc</i>	0.0037 (0.0099)	0.0061 (0.0098)
<i>depos ass</i>	-0.0107 (0.011)	-0.0087 (0.0107)
<i>cashless</i>	0.0038 (0.0032)	
<i>atms</i>		-0.0094 (0.0076)
<i>lag_gdp</i>	0.1936 (0.0798)**	0.2022 (0.0786)**
<i>lag_inf</i>	1.6709 (0.2421)***	1.6926 (0.2416)***
<i>cons</i>	-1.0636 (1.3565)	-0.0456 (1.4453)
<b><i>Estimation diagnostics</i></b>		
<i>Number of observations</i>	1323	1323
<i>Number of groups</i>	189	189
<i>Observations per group</i>	7	7
<i>Number of instruments</i>	186	186
<i>F test</i>	486.81***	356.04***
<i>Arellano-Bond AR (1)</i>	-6.75***	-6.69***
<i>Arellano-Bond AR (2)</i>	-3.23***	-3.17***
<i>Hansen test</i>	171.67	172.28

Robust standard errors adjusted for 189 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: Authors based on Bankscope, Eurostat, and the ECB

Based on the above described results, I conclude that the impact of new technologies on fee income share magnitude differs among the individual implemented technologies and can differ also across individual types of financial institutions. Still, it is important to note that I provide above only two proxies for

*technological developments in the banking system, while more of them may and should be defined and examined to enable more general conclusions to be drawn about the relationship between technological developments and fee income share magnitude. Such detailed analysis goes beyond the scope of this dissertation. The inclusion in the analysis of explanatory variables capturing the technological developments was suggested as a further research opportunity (see Section 7, page 125).*

2) Chapter 1 Introduction

Five essays represent the different facets of the bank fee and commission income within Europe. The author should overcome limited interconnection of papers and segments and integrate her findings into one whole. At first the subset of banks and then subset of cooperative banks – there should be added some wider and deeper comparison of different/ similar behaviour within both clusters than just page 19. In addition, current structure of thesis based upon chapters = published papers results in overlapping of different findings that are not sufficiently integrated in the synoptic, well-arranged review of conclusions and contributions.

*Response: The description of further differences between commercial and cooperative banks was added in Section 1 (General introduction) on pages 18-19. To stress the interconnectedness of individual presented papers, I have strengthened Section 1 (General introduction) and added a conclusion as Section 7.*

3) Chapter 2 A comparison of bank fee and commission income in the Czech Republic and in the EU including market concentration

Starting from general description of bank fee and commission income within EU, the author is jumping to her crucial hypothesis testing. I am afraid that she is over relying on one sided approach only adopting competition and HI as its measure as a core explanatory variable. The question is to explain why, there are number of other potential explanatory variables and problems. Even then the discussion of the role and measurement of competition should be better structured and referred.

*Response: I agree that the model used in Section 2, which should capture the link between market concentration and fee income share, is a very simplistic one and*

*does not take into consideration all necessary factors that may influence the relationship and, more generally, the decomposition of banks' total income. This model is provided only to give some background and context to the topic. The whole of Section 2 remains largely descriptive. In general, since Section 2 provides the analysis based at the macro level, a really robust model dealing with fee income share determinants would be difficult to construct, since data at country-level do not sufficiently capture the differences between individual banks. More robust analysis, including bank-, sector- and country-specific explanatory variables, is provided in later sections, more precisely in Section 3 for banks in general, and in Section 5 for cooperative banks.*

*A discussion of the role and measurement of competition was added in Section 1 (General introduction) on pages 9-15.*

- 4) Chapter 3 Determinants of bank fee income in the EU banking industry - does market concentration matter?

It further develops the similar approach as Chapter 2 and comments can be replicated.

Response: *I do not think that Section 3 develops a similar approach to that of Section 2. It is true that it analyses the same hypothesis, but the approach used is much more advanced and the performed analysis more detailed and robust. While Section 2 uses country-level data and shows only the very basic relationship between market concentration and fee income share, Section 3 uses individual banks' data and assumes not only market concentration but also other bank-, banking sector- and country-specific variables to be important determinants of bank fee income share. Originally, I defined 8 bank-specific explanatory variables, 3 banking sector-specific explanatory variables and 4 country-specific (macroeconomic) explanatory variables (see Section 3.3.3, Table 3.2). The choice of explanatory variables followed from the theory and other empirical studies such as DeYoung and Rice (2004a), Shahida et al. (2006), Moshirian et al. (2011), ECB (2013) and Fišerová et al. (2015). The final model does not use all the defined explanatory variables, mainly due to their mutual correlation. The inclusion of more variables could lead to a multicollinearity problem and less efficient estimation. Still, I believe that the model is well defined and uses adequate explanatory variables, which is also proved by the fact that the results were published in an impact factor journal.*

- 5) Chapter 4 The impact of fee income share on EU banks' performance and its implication on drivers of banks' business model changes

Below quoted author's conclusions should be more substantiated: "Therefore, we can conclude that the increase in the fee income share that was observed during recent years in EU banks was driven mainly by external factors, such as increased competition (?? MM) , decreased interest margins, and the effort to maintain sufficient profitability rather than by internal reasons. Second, higher reliance on equity financing and better-quality loans enhance banks' performance. Third, bank business strategies and macroeconomic factors are crucial determinants of banks' performance."

*Response: The conclusion mentioned above follows from results found in Section 4, in which more details are provided. Still, I agree that the summarizing information from Section 1 (General introduction) was too generalized and, therefore, I extended this part of Section 1 (General introduction) (see pages 17-18).*

- 6) [...] that illustrates rapid growth of total assets of the key world central banks reflecting „unconventional“ policy of quantitative easing QE. Balance sheet of central banks had increased between 2008 (it was around USD7tn) and 2019 up to USD15tn = tripled.

Given the glut of liquidity (except for Greece, Italy and Spain) the most of banks were living in Good Weather environment that should be properly reflected in the model as well. I am afraid that competition factor was suppressed. But it should be properly tested and verified.

*Response: I agree that quantitative easing, or credit easing, to use a possibly more suitable term, by the ECB is an important determinant of EU banks' income and profitability (see for example Demertzis and Wolff, 2016). Based on this comment, I included a note about the start of the ECB's quantitative easing, and the increased liquidity of banks in the EUROZONE associated with it, in Section 2.3.2.3.*

*Unfortunately, I cannot measure the effect of the ECB's quantitative easing on EU banks' performance and income composition at the level of individual banks directly, because the dataset covers the time period only until 2014, and the above mentioned interventions first started in March 2015. Nevertheless, I tried*

*to capture the impact of economic conditions and the environment in which the banks were operating by including the real annual GDP growth rate and annual inflation rate in the regressions. As expected, these conditions turned out to be important determinants not only of the banks' profitability and riskiness but also of the banks' income decompositions. An analysis of the impact of central banks' policies on banks has been suggested among further research opportunities (see Section 7, page 125).*

7) Chapter 5 Net Fee and Commission Income Determinants of European Cooperative Banks

The authors replicated earlier approach to different data set and also the comments might be repeated.

„This essay uses a similar approach as that in Section 3 on the full set of EU banks. Again, we are mainly interested in the effect of changes in market competition on the magnitude of the fee income share. We have found a strong positive impact of bank concentration on the share of net fee and commission income, which proves that cooperative banks tend to have higher shares of fee income in less competitive markets. Compared to commercial banks, cooperatives do not seem to expand heavily into non-traditional fee-bearing services under competition; therefore their overall fee income share decreases as the competitiveness of the sector increases. Similarly, as in Chapter 3, we conclude that higher fee income is connected with a higher equity to assets ratio. This result again hints at the higher riskiness of fee income compared to interest income“.

*Response: Although Section 5 replicates the approach of Section 3, it uses different dataset (cooperative banks), and the conclusions differ from those in Section 3 (banks) significantly. I believe that there is an important value added of this section. In general, cooperative banks are often neglected in the economic research even though that their business model differs from the other banks and therefore they may react on changing market conditions distinctly which I also prove in the thesis.*

8) Chapter 6 Net Interest Margin of Cooperative and Commercial Banks – which banking business model was more hit by the Low Interest Rate Environment?

The last essay (chapter 6) deals with the topic of the low interest rate environment and its impact on the net interest margins of commercial and cooperative banks in the Eurozone, and is the reviewer's favourite.

I agree that one should not miss a possible reason for the significantly higher profitability of banks with high non-interest to interest income ratios: the low interest rate environment that has prevailed since the financial crisis of 2007–2009 and led to a reduction of both banks' interest income on loans as well as banks' funding (e.g., deposit) costs. Anyway, the empirical evidence of other authors suggests that the net effect on banks' net interest margins, defined as net interest income divided by interest earning assets, was generally negative (e.g., Borio, C., Gambacorta, L., Hofman, B., 2017. The influence of monetary policy on bank profitability. *Int. Financ.* 20, 48–63., Claessens, S., Coleman, N., Donnelly, M., 2018. 'Lowfor-long' interest rates and banks' interest margins and profitability: Cross-country evidence. *J. Financ. Intermediation* 35, 1–16, Chen, P. Morris 2017, <https://research.stlouisfed.org/publications/economicsynopses/2017/06/30/the-rising-federal-funds-rate-in-the-current-low-long-term-interest-rate-environment/>). In fact, low (short-term) interest rates can depress banks' net interest margins because, for many types of deposits, rates were sticky downward. Nevertheless see also recent developments that has changed that perspective <https://fredblog.stlouisfed.org/2020/04/unexpected-changes-to-thebenchmark-u-s-interest-rate/> <https://fredblog.stlouisfed.org/2020/03/bank-lending-standards-and-loan-growth/> and <https://fred.stlouisfed.org/series/T10Y3M>.

*Response: Based on the suggestion above I extended the part dealing with the description of the low interest rate environment and the impact on the net interest margin in Section 1 (General introduction), where I included also references on suggested literature dealing with that topic (see page 20). The sources dealing with interest rates in the U.S. were added as a footnote 1 (see page 8). Furthermore, since there are important differences among the EU banking sector compared to countries outside the EU and the reaction on decreasing interest rates and other changes in the banking sector and macroeconomic conditions may differ across these countries, an analysis based on a more extended dataset that would include also countries outside the EU was suggested among further research opportunities (see Section 7, page 125).*

- 9) As I said there are number of recent inspirative studies dealing with issue of Bank fee and commission income - its determinants and impact on bank's profitability and risk. And the author's conclusions and those studies should be properly benchmarked in a transparent way.

*Response: Most of the suggested sources and some more were added (in case they were not already included) in the thesis. There are two suggested sources to which I have unfortunately no access. More precisely:*

- *Issahag et al 2019, Non-interest Income, Risk and Bank Performance*  
<https://journals.sagepub.com/doi/abs/10.1177/0972150919837061?journalCode=gbra#>
- *Borroni, Rossi, 2019, Bank Profitability: Measures and Determinants*  
[https://link.springer.com/chapter/10.1007/978-3-030-15013-6\\_2](https://link.springer.com/chapter/10.1007/978-3-030-15013-6_2)

*Therefore, I could not include them into the thesis.*

## A.4 Committee Suggestions from Pre-defense

- 1) Examine the structure of fees vis-a-vis banks' business model with the use of data (for example, annual reports of selected banks).

*Response: I have included the analysis of the structure of fees in individual banks' business models as Section 2.3.3.2. The analysis was performed as a case study based on annual reports of selected Czech banks.*