Charles University

Faculty of Social Sciences
Institute of Economic Studies

Master's Thesis

The Czech banking sector: Determinants of Profitability

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Study program: **Economics and Finance**

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Declaration of Authorship

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

Prague, May 02, 2022 Bc. Daniel Hykl

Abstract

This thesis is concerned with Czech banking sector in 2015 – 2020 and its profitability. A set of bank-specific and macroeconomic variables is tested for profitability determination effects by a general profitability model estimated with system GMM, FE, and OLS methods, yearly and quarterly data are used. The results indicate negative effects on bank profitability of the following on both yearly and quarterly bases: capitalization, operational efficiency, and inflation change, and positive effects on bank profitability of the following on both yearly and quarterly bases: bank size and GDP growth. The thesis also analyzes quarterly changes in bank assets, liabilities, and equity. The results indicate systematic drops of liabilities and assets reported as of year-ends. Potential explanations are discussed along with suggestions for further research as this study presents a complex set of insights, results, and experience ready to be augmented with further efforts.

Keywords

Bank profitability determinant, ROA, ROE, capitalization, loan portfolio, deposit structure, bank's size, operational efficiency, cost-to-income ratio, non-performing loans, interest rate environment, the two weeks repo rate, GDP growth, CPI change

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Abstrakt

Tato teze se zabývá českým bankovním sektorem a jeho profitabilitou v období let 2015 – 2020. Množina bankovně-individuálních a makroekonomických proměnných je testována metodami system GMM, FE a OLS k identifikaci potenciálních determinantů bankovní profitability na ročních a kvartálních datech. Výsledky indikují negativní efekt následujících proměnných na bankovní profitabilitu na roční i kvartální bázi: kapitalizace, provozní efektivita, změna inflace, a pozitivní efekt následujících proměnných: velikost banky a růst HDP. Teze rovněž analyzuje kvartální změny bankovních aktiv, závazků a kapitálu. Výsledky indikují systematické poklesy závazků a aktiv vykázaných ke konci roku. Možná vysvětlení jsou diskutována spolu s návrhy pokračování výzkumu, tato teze obsahuje komplexní soubor výsledků, vhledu do situace a zkušeností, které jsou použitelné při dalším rozšíření studie.

Klíčová slova

Determinant ziskovosti banky, ROA, ROE, kapitalizace, úvěrové portfolio, struktura deposit, velikost banky, provozní efektivita, poměr provozních nákladů a výnosů, nevýkonné úvěry, úrokové prostředí, dvoutýdenní repo sazba, růst hrubého domácího produktu, změna spotřebitelského indexu cen

Název práce

Český bankovní sector: Determinanty ziskovosti

Bibliografický údaj

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Master's Thesis Proposal

Institute of Economic Studies
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Author:	**Bc. Daniel Hykl**	Supervisor:	Mgr. Magda Pečená, PhD.
Specialization	Finance, Financial Markets and Banking	Defence	June 2022

Proposed Topic: Determinants of bank profitability: Evidence from the Czech Republic

Motivation:

The Czech banking sector differs from other banking sectors in the region (EA, EU, Eastern Europe, Nordic banking) in many aspects and has lately enjoyed greater profits than the others, mainly the ones adopting the Euro. Suffering the credit crunch times and going through 4 years of FX interventions against appreciation of the domestic currency, the Czech sector had recovered, and the central bank began to increase the key rates after a long period of keeping the technical zero bound. However, this came to its end when the COVID pandemic hit Europe in March 2020.

Therefore, it is indeed desirable to study the profitability of the sector in detail to uncover the possible determinants of high performance of the banks. Identification of the main determinants and quantification of their effects may help to understand what had been done well in the sector to establish a firm basis upon which profits were being made which may not only help both the banks and the regulatory authorities get a detailed view of what is economically important and significant, but also where the main loopholes are and whether there potentially exist any unanticipated relationships that may be used to increase both individual and sectoral performance.

The Czech banking sector features several specific aspects, the main of which are the following:
1. Czech banks are on general – and compared to other neighbouring and related sectors – highly capitalized.
2. Czech banks are very profitable.
3. The Czech banking sector features very low credit risk in both retail and corporate lending which is demonstrated by a very low level of NPL.

Comparison of the results of this thesis' research and its contextual positioning among other existing research (mainly quantification of profitability determinants by Trujillo-Ponce, 2013) may offer explanation on why the Czech banks have been enjoying greater profitability than for example majority of the within-eurozone-located banks. The Czech sector also provides an unprecedented opportunity to study the profitability of the banking sector which has gone through several significantly different time periods lately – the credit crunch, 4 years of FX interventions, a long period of zero rates and a short recovery followed by quick return to the previously imposed zero rates caused by the COVID pandemic.

Hypotheses:

The thesis is going to test the following hypotheses that are formulated based on literature previously studying the subject matter (mainly Trujillo-Ponce, 2013, Meniucci-Paolucci, 2016):

Bank-specific effects
H1: There is a positive relationship between Loans-to-assets ratio and the bank's profitability.
H2: There is a positive relationship between a bank's capitalisation and its profitability.
H3: There is a positive relationship between a share of customer deposits in total liabilities and the bank's profitability.
H4: Efficiency positively affects bank profitability.
H5: Size of a bank positively affects its profitability.

Macroeconomic effects
H6: Economic growth positively affects bank profitability
H7: Inflation positively affects bank profitability.
H8: Interest rates positively affects bank profitability.

Regulatory framework effects
H9: Emergence of the resolution fund has been negatively affecting bank profitability.

Methodology:

The hypotheses are going to be tested in the following ways:

H1: Loans-to-assets ratio [%] is going to be calculated for every bank in every time period. The loans used for the variable definition are the total loans, no deductions of non-performing loans will be made. The variable is expected to have a positive effect on the outcome variable.
H2: Equity-to-assets ratio [%] is going to be used as a measure of a bank's capitalisation and will be assessed for every bank in every time period. The variable is expected to have a positive effect on the outcome variable.
H3: Depo-to-liabilities ratio [%] will be calculated as deposits of retail and corporate depositors to total liabilities of the bank. The variable is expected to have a positive effect on the outcome variable.
H4: Cost-to-income ratio [%] is going to be used as a measure of a bank's (operational) efficiency and is expected to have a positive effect on its profitability.
H5: Size of a bank will be measured by its total assets
H6: Annual real GDP growth rate is going to be used as a measure of economic growth and is expected to have a positive effect on the outcome variable.
H7: CPI annual inflation rate is going to be used as a measure of economic growth and is expected to have a positive effect on the outcome variable.
H8: CNB's 2W repo rate is going to be used as a measure of interest rate environment in the Czech banking sector and is expected to have a positive effect on the outcome variable.
H9: A dummy variable specified through existence of banks' duty to contribute to the national resolution fund is going to be used to capture the effect of substantial additional cost banks have been facing since the fund's emergence in 2015.

The model is going to be specified as follows:

$$Y_{i,t} = \alpha + \delta Y_{i,t-1} + \beta_1 Loans\text{-}to\text{-}Assets_{i,t} + \beta_2 Equity\text{-}to\text{-}Assets_{i,t} + \beta_3 Depo\text{-}to\text{-}Liabilities_{i,t} + \beta_4 Cost\text{-}to\text{-}Income_{i,t} + \beta_5 Size_{i,t} + \beta_6 GDPgrowth_t + \beta_7 CPI_t + \beta_8 RepoCNB_t + \beta_9 RF_{i,t} + \varepsilon_{i,t}$$

The model is going to be estimated for three different time periods:
(1) FX rate commitment (November 2013 – April 2017)
(2) Post-intervention recovery (April 2017 – March 2020)
(3) COVID distress (March 2020 – December 2020)

The data are going to be collected from the publicly available sources:
(1) Czech National Bank required information as per Act No. 163/2014 (quarterly data)
(2) EU required information as per Act No. 575/2013 (semi-annual data)

The number of banks including building societies operating in the Czech sector is 24. GMM is going to be used to estimate the model. Bootstrap is going to be used in case normality may not be assumed given the low number of banks in the dataset.

Additionally, the model will be enriched with some of the following controls introduced to better distinguish over important features of the Czech banking sector:
- Riskiness of a bank measured through provisions
- Quantification of a bank's strategy measured through e. g., interest rate offered on deposits

Profitability of the parent institution

Expected Contribution:

The thesis has an ambition to offer both identification and quantification of effects of the main profitability determinants of Czech banks. There has been broad research on the topic done in other European and non-European countries, but none has yet focused on the Czech banking sector – which indeed features several specifics as described in the previous sections of the proposal. As stated above, comparing the thesis' results to results of other existing research may shed more light on the differences between the Czech and other sectors as to explain what the main drivers of the differences in profitability are, implied indirectly from identification of the main drivers of the profitability of Czech banks (in addition to the aforementioned, Dietrich-Wanzenreid, 2011)

Begun to be explained in detail in the section Motivation already, the Czech sector features the following three aspects that are in pure theory incompatible: high capitalisation, high profitability, low level of risk. Despite the theories, Czech banks have been able to achieve all three at once which is a good opportunity to study their

profitability closely in order to uncover the channels via which profitability was being achieved along with very low risk and maintaining high levels of capital.

- Moreover, the dataset that will be created may also be perceived as a contribution since there is currently no dataset available that would include as many variables and important performance measures as the one planned to be collected and formed.

Outline:

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Conclusion

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7.

Contents

1 Introduction & Motivation

Czech business has been closely connected to its banking sector for decades. Ever since the totalitarian regime's collapse, roles of private ownership and enterprise in economic development of the country have been increasingly important and deterministic of the country's successes and potential. The Czech economy is a heavily bank-based one with a banking sector featuring high resilience and robustness to external shocks which has been showed many times throughout past – most recently after the emergence of the global pandemic of the coronavirus.

The Czech sector has been attaining all three parts of the famous magic triangle of investing that are usually held to be unattainable at once – the banks have been achieving high profitability, high liquidity, and low risk simultaneously. High proportion of Czech households' savings held in cash has founded a solid liquidity basis which has been utilized by Czech banks along with other resources of asset financing to capture convincing profits. Throughout 2013 – 2019, the country saw a period of a steady economic development enabling the banks expand their asset portfolios and enjoy very low proportions of non-performing assets. Among the results of a long period of rising profitability of banks, high capitalization shall be understood as the key to enhanced robustness and resilience of the sector.

While the banking sector was debated even before the pandemic hit the entire world, it has become a hot topic since then as the state of the sector directly influences the state of the national economy. After years of high profits, both operational and net incomes dropped sharply in 2020 and disappearance of the illusion of banks' invincibility threatened Czechia. What were the banks making their profits on throught last years? How are the drop in GDP, higher inflation and other shocks going to change banking performance? These and many other questions were raised while existing literature and studies were not holding their answers at hand.

This thesis made the first move with compiling an as large as possible dataset, delivering complex analyses of the determinants of banking profitability in the Czech sector, and offering numerous ways to continue at exploring how profitability is established in the sector. Even though not all the goals could be achieved, the thesis put together a comprehensive set of data, empirical results, and suggestions for further research to keep the efforts going and pursuing greater understanding and wider knowledge of the sector that could certainly be appreciated by the banking institutions, enterprise owners, academy, regulators, and other involved parties.

2 The Czech banking sector

2.1 General remarks

The Czech banking sector is a small non-euro sector. The inception of privately-owned banking is only dated to 1990s as the first signs of modern and developed banking only came after 1989's collapse of the totalitarian regime. Since then, the largest banks operating in the country have been acquired by foreign institutions and today, only few banks[1] are domestically owned. However, most of the banks operating in the Czech banking sector regard the sector as the main sector of their operations[2] including the largest ones.

The Czech Republic has not adopted the Euro. There have been discussions addressing the topic for a long time which have revealed the Euro is not supported by majority of the country's inhabitants. The most supported reasons against adoption of the currency are (1) loss of independence on the Eurozone's monetary policy, (2) loss of an effective tool usable at helping Czech exporters, (3) loss of an effective tool usable at combating inflation and maintaning price stability, with the last one being demonstrated in practice in 2013 – 2017. It shall be noted that these views are only presented and endorsed by experts with the public selectively choosing the arguments to accept or to oppose. The adoption of the Euro has become a strong topic of patriotic parties in the country as well as a big topic for groups spreading disinformation.

In addition to that, the Czech Republic has been relatively EU-sceptical and consequently, the adoption of the Euro has transfigured into a heavily political topic. Currently, the board of Czech National Bank does not show significant endorsement for adopting the Euro and the national government has rather been focusing on euro non-related topics since the beginning of its term in December 2021. However, the Czech banking sector is closely connected to the European banking system and to the neighbouring countries' sectors too. Majority of the banks in the Czech Republic is owned from abroad and banks have also been pro-active at establishing cross-border trade relationships.

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[1] There are 22 banks operating in the sector Including 4 building societies. 7 of the banks are owned domestically: PPF banka, J&T banka, Trinity banka, Fio banka, Creditas, Moneta Money Bank (listed) and Airbank. There are two partially state-owned banks operating in special regimes: CEB (Czech Export Bank) and NRB (National Development Bank; former CMZRB, Czech-Moravian Guarantee and Development Bank).

[2] Paradoxically, domestically owned PPF banka is the only one focusing on foreign markets despite being Czech and operating in the sector. However, there are close connections to Airbank with which PPF banka is able to practice strong presence in the Czech banking sector.

2.2 Specifics of the sector

The Czech sector features several qualities not usually attained at once. Czech banks are highly liquid, report high performance (ROA, ROE) and their overall riskiness is very low (high capitalization, excellent debt-service of debtors, hence very low NPLs and necessity for provisions).

Importantly, some of the today-specific qualities of the sector had not been observed prior to certain events that took place in past. The most significant changes in the sector's nature began to show during and after the central bank's FX commitment policy performed between 2013 and 2017.

Also, the emergence of the Single Resolution Mechanism and its incarnation into the Czech sector – The Resolution Fund – has had consequences that until today have been observed in the sector as banks adjust their attitude to large depositors storing their liquidity in banks at the end of a year and get creative at balance sheet figures reporting.

2.2.1 High liquidity

The Czech banking sector has been reporting high liquidity ratios in the recent years. Compared to similar sectors in the Central Europe, Czech banks have been enjoying considerably higher liquidity saturation despite gradually increasing demand for both corporate and consumer credit and mortgage lending.

The primary reason for what is seen today can be found in the sector's history. After the financial crisis that emerged after the Lehman Brother's collapse on September 15th, 2008, and forced central banks worldwide to decrease their key policy rates, the financial world was facing numerous problems including the so called Credit Crunch.

After decreasing the key rate – the two weeks repo rate – the Czech National Bank claimed it was going to start executing imposition of additional monetary measures to tackle inflation and other then-urgent problems hitting the national economy. An explanation was provided by the CNB: the central bankers were not convinced about usefulness of negative interest rates and were not willing to introduce such an unconventional – and an unprecedented – monetary policy instrument. Consequently, the FX commitment was announced on November 7th, 2013, and it was claimed the central bank was deploying this measure to support the national economy through cheaper exports and inter-currency differentials.

The CNB's goal was to keep the EUR/CZK FX rate equal to 27.00 which presented a significant weakening of the domestic currency from its market values around EUR/CZK 25.50. Within a week after the introduction of the FX rate commitment policy, the FX rate stabilized at EUR/CZK 27.00. The FX commitment was abandoned after three and half years in April 2017. During the time, the CNB purchased FX reserves on the market worth CZK 2.2 trillion which

present part of the core of the today's high liquidity of the sector. In April 2017, the FX rate targeting was abandoned, and the key rate began to be gradually lifted.

Foreign investors and players on the market – including the owners of some of the Czech banks – were buying the Czech currency and therefore accumulating the currency in their balance sheets. After the key rate of the Czech currency was increased, the domestic currency held by foreign financial companies – including parent institutions of the banks operating in the Czech Republic – began to be deposited in CNB. Mediated by Czech banks, the foreign parent institutions were able to achieve substantial interest income just on the money they took from the Czech National Bank during the FX commitment era. This was also enabled by the open interest parity between CZK and EUR. According to Skoumal (2019) and Teply (2018)[3], foreign companies did not even need to hold the Czech currency to use the described possibility since it was enabled by the market conditions to utilize FX swaps and still earn a positive profit. Skoumal implies this was harming Czech households repaying their mortgages loans as the central bank was keeping the key policy rate high enough to attract foreign investors to the domestic currency and hence keep the FX rate at the rates the regulator was targeting. Practically, the central bank was paying the investors for retaining the CB's monetary policy in effect, claims Skoumal.

Consequently, the banks in the Czech Republic were holding hundreds of billions of the domestic currency provided by their parent institutions which were repeatedly deposited in the CNB and earning the two weeks repo rate throughout 2017 – 2020. Given the high liquidity of such money and then competitive reward, banks were materializing their opporutinities heavily. High liquidity persisted in the sector even during the COVID crisis[4] and continued to provide banks with interest income when the key rates were back above their pre-COVID levels[5].

2.2.2 High performance

Czech banks have been reporting high magnitudes of their performance indicators compared to similar sectors in Europe. Recent years' ROAA and ROAE well above European averages demonstrate that the Czech sector recovered from the consequences of the 2008's financial crisis and has been delivering satisfying results.

In addition, two[6] of the three largest banks operating in the sector – Ceska sporitelna and Ceskoslovenska obchodni banka – are playing key roles within their parent instituions and all three are the best performing entities within the financial groups. Also, other banks in the sector

[3] Introductory banking lecture, prof. PhDr. Petr Teplý, PhD., IES FSV UK

[4] The repo rate was lowered from 225 bps to 25 bps shortly after the pandemic occurred in Europe in March 2020.

[5] The repo rate was increased to 500 bps in April 2022 attaining the highest value since 2008.

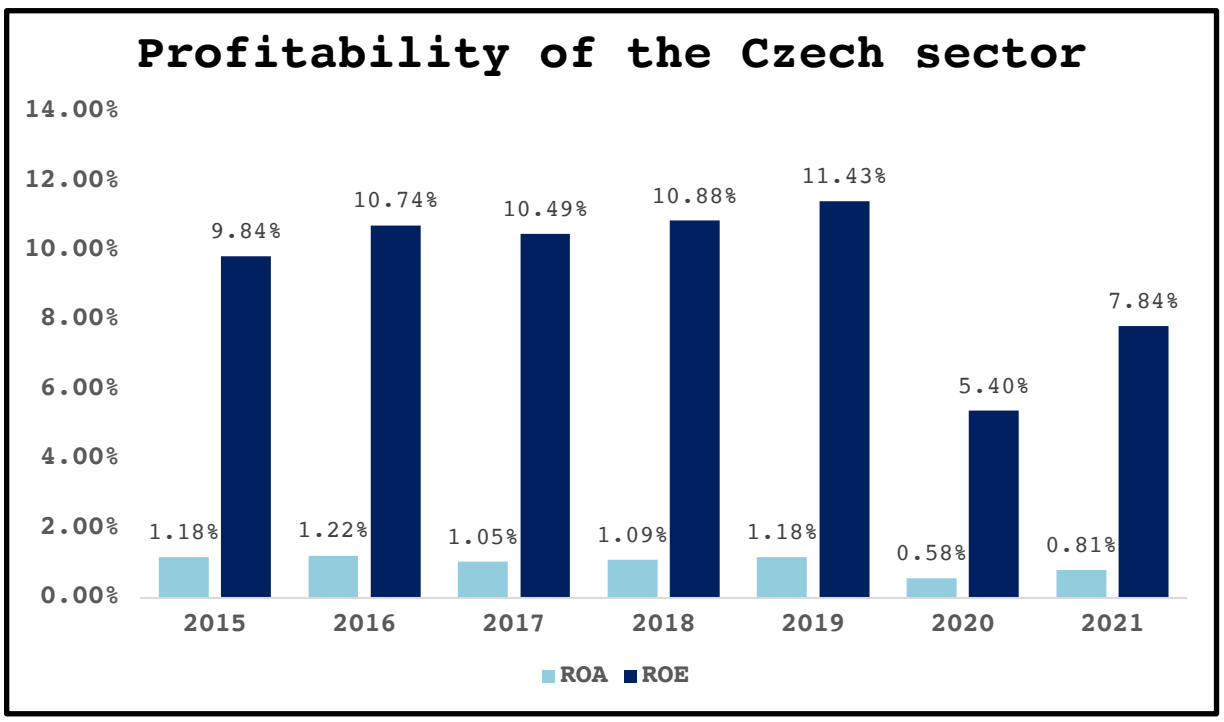
[6] The remaining large bank – Komercni banka – is a part of Societe Generale within with the Czech subsidiary represent a small part only.

have been generating high net incomes and distributing attractive dividends that are almost exclusively going out of the country[7].

However, there are some examples of successes of domestically owned banks, too. Airbank (owned by a Czech investment company PPF) is being sold to Moneta Money Bank as this thesis is being scribed in exchange to PPF share's gain at MMB's equity. As a result, a Czech bank is going to be sold to a listed bank and a Czech investment company is going to become the largest shareholder of the listed bank.

Exhibit 1, ***Profitability of the Czech banking sector***

Source: Author's analysis, data from ARAD



[7] CS owned by Erste Group (AT), CSOB owned by KBC Group (BE), KB owned by Societe Generale (FR), Unicredit Czech Republic and Slovakia owned by Unicredit (IT), Raiffeisenbank owned by Raiffeisen (AT)

2.2.3 Low riskiness

Czech banks have been reporting a low ratio[8] of non-performing loans to total loans in their balance sheets compared to similar sectors in Europe. Czech debtors – including both firms and households – are traditionally very disciplined, and a major part of Czech households' savings is held in cash in savings accounts in domestic banks and denominated in the domestic currency. As such, the sector enjoys a solid base of core deposits featuring rather long run off profiles.

From the regulatory point of view, the sector's regulator has been of a rigorous attitude and has been setting strict conditions on consumer credit provision and housing credit provision recently. Prior to the emergence of the COVID pandemic, Czech banks were restricted by a set of static limits at whether they were permitted to provide credit to a customer or not. The then-valid limits included a DTI[9] metric equal to 8, a DSTI[10] metric equal to 45% and the banks were not permitted to provide loans at LTV over 80% amounting to more than 15% of their total loan portfolios and were forbidden to provide loans at LTV over 90% whatsoever. The limits were abolished by the central bank in 2020 as a part of a wide package of measures introduced in reaction to the COVID pandemic aimed at supporting the domestic economy. As of April 01, 2022, these limits were reinstated and have been set as follows since then: DTI $\leq$ 8.5 ($\leq$ 9.5 in case the debtor's age does not exceed 36 years), DSTI $\leq$ 45% ($\leq$ 50% in case the debtor's age does not exceed 36 years) and LTV $\leq$ 80% ($\leq$ 90% in case the debtor's age does not exceed 36 years).

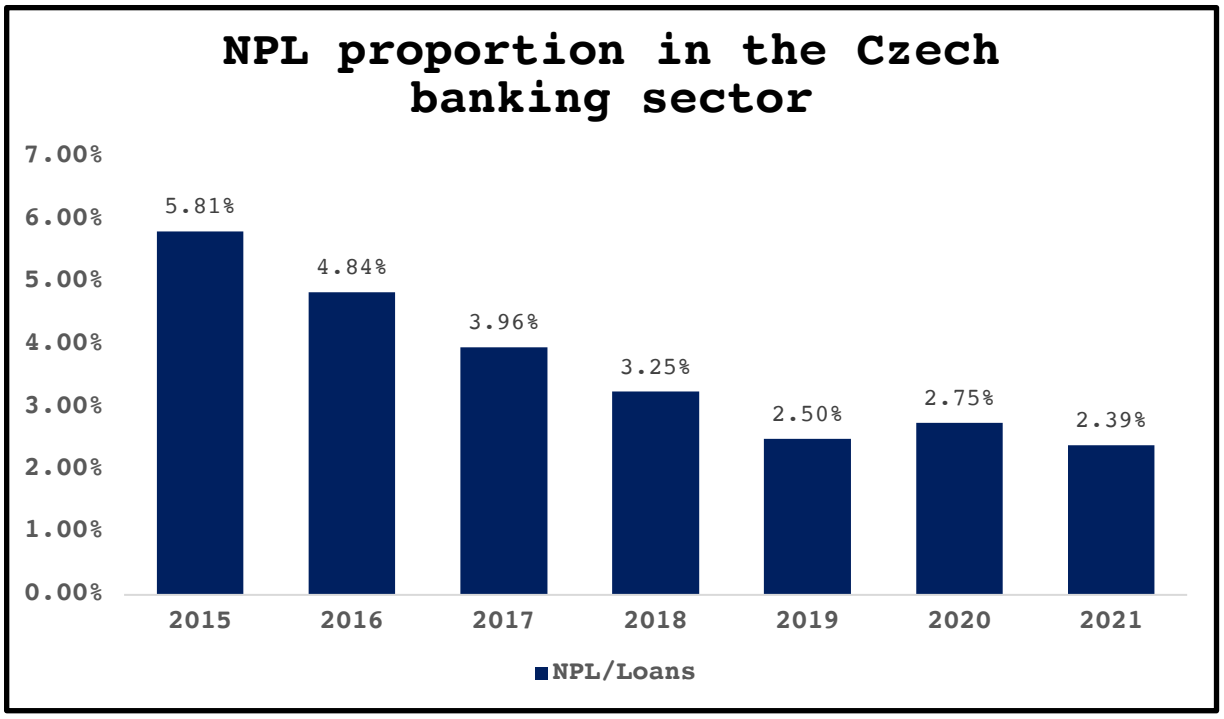
[8] Excluding partially state-owned banks (Ceska Exportni Banka, Ceskomoravska Zarucni a Rozvojova Banka, recently renamed to Narodni Rozvojova Banka), the objective of which is to guarantee or provide financing to projects that would not be able to secure full scale financing at the market under usual conditions

[9] Debt-to-Income ratio: A multiple of a yearly income of a customer that shall not be exceeded by the customer's total indebtedness when providing credit by a bank

[10] Debt-Service-to-Income: A portion of a monthly income of a customer that shall not be exceeded by the customer's total debt monthly service when providing credit by a bank

Exhibit 2, ***Ratio of NPLs to total loans in the Czech banking sector***

Source: Author's analysis, data from ARAD



2.2.4 Bank-based economy

Nearly every business action in the country is at some point connected to a bank. The Czech economy relies on banks heavily as the banking sector is playing the role of the main payment settler in the country's economy and banks are also providing a major part of debt present in enterprises' balance sheets. As such, banks are participating at both commercial firms' financing of operations and financing of debt.

Regarding households, the banking sector is playing the role of the main savings manager as Czech households traditionally store their balances in banks. Also, Czechs generally prefer banks over non-bank payment settlement companies. A major part of mortgage business in the country is controlled by banking entities as well as a major part of consumer financing to retail clients is provided by banks.

Banking enterprises also own numerous insurance companies operating in the country and are gradually earning additional market shares through cross-sell or product-bundling practices year-on-year. Typical examples of cross-sell practices used in the Czech sector include mortgage provisions followed by selling own insurance services to a client of a different insurance company usually not owned by a bank or providing car loans along with car insurance. Typical examples of product bundling practices used in the Czech sector include consolidation of several types of credit provided by other banks into one overarching loan provided by the bank providing the main services to the client sold along with a decreased-rate mortgage loan and investment services offering discounts and bonuses.

2.2.5 Foreign ownership of banks

The sector has been characterized by foreign ownership – the largest banks are owned by parent institutions headquartered in Austria, Belgium, France, and Italy. Belonging to a supranational banking group has been observed to be capable of mediating several advantages over small, domestically owned and domestically operating only institutions. These advantages mostly used by the largest banks in the sector include cost advantages at collecting resources, chances to use arbitrage opportunities on financial markets, opportunities to scale up technological solutions proven to be successful by foreign branches etc. Some of them are discussed in greater detail in the part of the thesis that comments on the empirical results as these synergies appear to be closely intertwined with the subject banks' sizes.

2.2.6 FX interventions and EUR/CZK differential

The sector had gone through 3.5 years of a firm FX commitment (EURCZK = 27.00) before it began to adapt to the new reality in April 2017. This 3.5-year long period resulted in a massive amount of FX reserves (CZK 2.2 trillion) accumulated in the balance sheet of CNB. The central bank is now paying the interest on the CZK counterparts of the interventionary balances that are being deposited by the foreign investors through their Czech subsidiaries.

Exhibit 3, ***Total volume of market operations performed during the FX commitment***

Source: Hykl (2020) with data from Czech National Bank's report on FX spot operations

CNB´s FX spot operations			
Year	**Period Month**	**EUR (millions)**	**CZK (millions)**
2013	March	7 499	202 470
2015	July	1 032	27 880
	August	3 735	100 830
	September	2 322	62 690
	November	369	9 900
	December	1 540	41 580
2016	January	2 154	58 160
	February	623	16 820
	April	393	10 610
	May	575	15 530
	June	313	8 450
	July	307	8 290
	August	1 059	28 590
	September	3 685	99 500
	October	3 961	106 950
	November	524	14 150
	December	3 257	87 940
2017	January	14 480	390 970
	February	8 139	219 700
	March	19 258	520 000
	April	653	17 630
Total spot operations		**€ 75 878 m**	**≈ CZK 2.05 trn**

2.2.7 The anomaly of the Resolution Fund

The Resolution Fund's emergence caused banks to be artificially lowering their balance sheet figures as of end of a year as described by Hykl (2020). Every bank's RF nominal contribution is determined based on the last-day-of-the-year balance sheet utilizing top-down approach, i. e., the banks are competing against each at lowering their balance sheet so that they are assigned a lower proportion of the total contribution.

3 Literature review

3.1 General remarks

This thesis is based on literature of two main streams: studies concerned with how banking profitability develops with various macroeconomic or bank-specific factors and studies concerned with quantification of effects of bank profitability determinants using system GMM-based and other methods. Relevant literature in addition to the studies discussed in the next section is commented in respective parts of the thesis focusing on hypotheses and potentially important variables playing their roles at determination of profitability in the banking sector.

This chapter focuses on the most important literature concerned with bank profitability viewed through its technical optics and identification of the respective effects and their magnitudes with GMM-based and other models. Most of the relevant literature used system GMM due to suspected endogeneity in financial data on banking business.

3.2 Bank profitability in literature

Bank profitability has been studied in detail by many economists and econometricians around the world, hence the experience with system GMM in the relevant literature is wide and very detailed. However, as every sector features own characteristics, most of the studies focused on one selected country/region. The following section presents papers along with their findings that studied a varied palette of banking sectors worldwide – different currencies, sizes of the sectors, concentration of banking business, or their tradition and level of establishment upon the national economies.

The determinants of banking profitability in the European banking sector were firstly analyzed by Molyneux and Thornton (1992) using data between 1986 – 1989 and using a set of explanatory variables comprising banking and financial specific determinants except inflation rate.

Trujillo-Ponce (2013) studied bank profitability in Spain and empirically analyzed the factors potentially determining profitability of Spanish banks throughout the period of 1999 – 2009. The study was originally motivated by the fact that Spanish banks had been succeeding at outperforming the average of the European Union throughout past before they decided to conduct such study – and continued to outperform the EU banking sector even longer. As such, the paper is used as one of the studies lying at the very core of this thesis' inspiration.

The paper introduced a set of comprehensive hypotheses, foundations of many of those presented great thought-provokers for this thesis, too. The study worked with a dataset comprising 89 banks and involved creation of generic variables including revenue diversification index and industry concentration index. Their model specification also included a set of dummy variables controlling for banktype (commercial banks, savings banks, credit cooperatives). The model specification assumed that disturbances contained unobserved bank-specific effects and idiosyncratic errors, too.

The results uncovered existence of numerous effects on both ROA and ROE as is summarized in the table below.

Exhibit 4, ***Trujillo-Ponce: Determinants of bank profitability in Spain***

Source: Trujillo-Ponce (2013)

Table 4
Determinants of bank profitability in Spain

Variables	ROA	ROE
Dep. $Var._{t-1}$	0.455 (0.085)***	0.398 (0.070)***
Loan/TA	0.005 (0.002)***	0.033 (0.007)***
NPL/GL	−0.041 (0.017)**	−0.913 (0.266)***
LLP/NL	−0.120 (0.038)***	−0.743 (0.358)**
Eq/TA	0.030 (0.011)***	−0.762 (0.136)***
Dep/TL	0.002 (0.001)**	0.036 (0.018)**
DepGR	0.000 (0.001)	0.011 (0.013)
CIR	−0.016 (0.003)***	−0.260 (0.043)***
Size	−0.032 (0.037)	−0.028 (0.713)
HHIRD	0.134 (0.229)	3.235 (4.632)
HHIIC	0.003 (0.001)***	0.032 (0.008)***
GDP	0.049 (0.013)***	0.604 (0.207)***
Inflation	0.058 (0.016)***	0.458 (0.279)
Interest	−0.088 (0.022)***	−0.590* (0.345)
Commercial Bank	0.016 (0.007)**	0.177 (0.118)
Savings Bank	0.006 (0.006)	−0.033 (0.106)
Constant	−0.542 (0.578)	5.907 (9.487)
z_1	955.42 (14)	652.72 (14)
z_2	5.78 (2)	10.77 (2)
m_1	−2.04	−3.05
m_2	1.01	−0.02
Hansen	75.95 (272)	71.59 (272)

This table reports the determinants of the profitability of Spanish banks during 1999–2009 using the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). The sample comprises 89 banks (697 observations). ROA is the pre-tax return on average assets. ROE is the pre-tax return on average equity. See Table 2 for a description of the rest of the variables. Except for HHIIC, GPD, inflation and interest, all variables are considered as endogenous in our model. We report heteroskedasticity-consistent asymptotic standard errors in parentheses, and significance levels are indicated as follows: ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level. z_1 and z_2 are Wald tests of the joint significance of the reported coefficients and of the bank type dummies, respectively, asymptotically distributed as χ^2 under the null of no significance, degrees of freedom in parentheses. m_i is a serial correlation test of order i using residuals in first differences, asymptotically distributed as N(0,1) under the null of no serial correlation. Hansen is a test of the over-identifying restrictions, asymptotically distributed as χ^2 under the null of no correlation between the instruments and the error term, degrees of freedom in parentheses.

The study discusses that along with showing existence of all expected and economically important effects, income diversification appears to enhance profitability in the Spanish sector, too, while banktype is not indicated to matter similarwise. The study employed OLS regression to estimate their profitability model in a similar manner to Bourke (1989) and Molyneux and Thornton (1992) to obtain robustness-check estimates. The study concludes with stating the effects' existence is supported by the results from OLS as the estimates retain their signs and statistical significance.

Interestingly, the results show that the effect of capitalization is positive on ROA but negative on ROE. In case of ROE, it can be mathematically argued that as the denominator or ROE rises, ROE falls – which is to be discussed later in the thesis. The effect on ROA is positive according to Trujillo-Ponce which would mean that the higher the capitalization, the greater the return on assets – from the banking point of view, this would imply that additional capital in a bank's balance sheet finances high-margin earning assets. In other words, higher capitalization introduced higher requirements on its yield – which is generally in concordance with corporate finance theory.

Horobet et al. (2021) estimated similar models to find determinants of banking profitability in the CEE banking sectors using a system GMM approach and data between 2009 and 2018. The authors used an additional dependent variable as a measure of banking profitability alongside ROE and ROA – the net interest margin (NIM). While they argue that the bank profitability is best measured by ROA thanks to absence of the leverage effect, it offers an explanation favoring ROE, too. The authors claim there is a possible limitation of ROA stemming from the existence of the off-balance-sheet assets that usually represent a very important source of profitability in case of European banks. The most important results include revelation of presence of negative effects of unemployment rate, inflation, budget balance, non-governmental credit, NPL rates, concentration of the sector, and capitalization rate on banking profitability in the CEE sectors.

Staikouras and Wood (2004) studied what determined the profitability levels of banks in the European sector throughout the period between 1994 – 1998 using OLS and FE models. Their results include statements regarding strong effects of macroecnomic environment – GDP variation and inflation had the strongest effects found in the data.

Goddard et al. (2004) went a step further at the efforts and discovered that while banking profitability was strongly linked to macreconomic environment influencing the banking sectors of the respective countries, the banks' profitability was also significantly tied to the sector's concentration and overall profitability. The study also explores the interlinkages between the concentration, profitability, and institutional growth.

Onofrei et al. (2018) used a dataset comprising 96 banks from operating in 7 countries of the CEE region to estimate the profitability model with a FE method. They found that domestic non-governmental credit had a significant and positive effect on bank profitability and claimed that inflation influenced bank profitability negatively.

There was a positive effect of inflation on banking profitability found by **Sufian (2009)** in data on banking business in Malaysia between 2000 and 2014. The study further explored the patterns of co-movements of inflation and banking profitability and discovered a positive effect of banks' capitalization rate.

Tan and Floros (2012) analyzed the interlinkages between the inflation and bank profitability (measured by combination of ROA and NIM) in the Chinese sector throughout the period 2003 – 2009. The study uncovered existence of a positive relation between inflation in the country and profitability of regionally operating banks and a negative effect of market concentration on the profitability of the market-based banks.

Pan and Pan (2014) continued at efforts to study the Chinese banking sector and supported the previous claims made by Tan and Floros regarding inflation's positive effect on bank profitability. **Jiang et al. (2003)** analyzed the banking sector of Hong-Kong using a panel data from 1992 to 2002 and obtained very similar results.

Andries et al. (2016) studied banking sectors in the CEE region during 2004 – 2013 and uncovered existence of a negative effect of inflation on banking profitability measured by ROA, ROE, and NIM. **Sayilgan and Yildrim (2009)** used a profitability model that served as an inspirational basis for Andries to estimate the model using data on Turkish banking institutions over 2002 – 2007. Similar results were obtained.

The Turkish system was also studied by **Atasoy (2007)** using a system GMM approach with an emphasis on inflation and found that it was positively linked to bank profitability, while the market concentration in the sector was affecting the profitability recorded in the sector negatively (effects on ROA only).

The negative effect of inflation is supported by **Boyd and Champ (2006)** who studied not only banks but also a set of non-governmental non-banking credit institutions and claimed the effect existed among them, too. Contrary, **Guru et al. (2002)** studied the bank profitability and its ties to inflation in the Malaysian banking sector during 1986 – 1995 and discovered that inflation was affecting bank profitability positively. **Abreu and Mendes (2002)** found a negative relationship between bank profitability and inflation in the European banking sectors (ROA and ROE) and between rate of unemployment and banks' profitability (ROA).

Demirgu-Kunt and Huizinga (1999) studied banking sectors in developing countries and proved that highly capitalized banks tend to be less profitable in the specific financial and economic environment. Their dataset comprised 80 countries and spanned throughout 1988 – 1995.

Cetin (2019) used OLS to estimate the profitability model using a panel including 2013 – 2015 data on G20 countries' banking sectors. The author found a negative impact of inflation on ROA in developed countries and later he found a positive effect of inflation on banking profitability in developing countries. The negative effect of inflation on ROA was also identified in the Turkish sector by **Akbas (2012)** who used banking data from within 2005 – 2010 and his results were previously suggested by **Boyd et al. (2001)** who used more robust methods (system GMM instead of difference GMM, robustness check estimates obtained from FE and OLS) and of course a different dataset. However, it was proved the effects remained very similar.

Flamini et al. (2009) identified a positive effect of inflation on banking profitability using a dataset comprising 41 countries from the Sub-Saharan region during 2000 – 2010. The study utilized a GMM-based approach, and the results support the previously commented findings of other studies and Cetin's hypothesis of the opposite-sign effect in the developed and developing countries.

Garcia-Herrero et al. (2009) identified that in China between 1997 – 2004, market concentration was having a negative effect on banking profitability, and they also discovered a positive effect of banks' capitalization levels on their profitability levels.

4 Data & Methodology

4.1 Data description & theory

The data was collected from various resources dependent on its nature and subject. The time interval with which this thesis is concerned spans from the first quarter of 2015 to the – and including – first quarter of 2021. Generally, the data used for the purpose of the thesis can be divided into two categories: bank-specific data and (macro)economic data.

4.1.1 Bank-specific data

Selected accounting figures regarding the balance sheet, the income statement and additional data provided by the banks reporting details on their loan portfolios were collected from the quarterly published materials required by the national regulator through its Decree No. 163/2014 Coll. On the performance of the activities of banks, credit unions and investment firms.

The sample comprises data on 22 banks in 25 quarters. The convention and structure of the published data tables changed several times during the selected time interval; hence the respective figures are appropriately recalculated and adjusted. Before 2015, Czech banks were not binded by a regulator's prescription on the structure of the published data. Consequently, the materials published by banks before 4Q14 would require enormous data management efforts at structuring and unifying to be prepared for an empirical analysis. As a result, the dataset records quarterly data beginning with the first quarter of 2015 and ending with the first quarter of 2021.

Between 1Q15 and 3Q16, a universal prescribed data structure existed, and the banks were with small exceptions following it well. These 7 quarters did not present significant issues with downloading the data and preparing it for an empirical analysis. The five following quarters, i. e., 4Q16 – 4Q17, were characterized by a relatively high degree of freedom of the banks at publishing the data. The previously followed structure was abandoned by many banks to publish their data with a greater level of detail but consequently, considerably lower unification governed the data structure. As such, the published materials needed to be processed with great attention on collecting the data in the desired structure. Finally, beginning with 1Q18, the prescribed data structure was followed closely again until 1Q21.

Although the data from the second and the third quarter of 2021 are available at the time of writing the thesis, inclusion of these quarters was made impossible to the author by distortion

of the structure of the published materials. Banks were allowed certain freedoms at structuring the published financial statements and the potential marginal effect of including 2 more quarters in the total data sample does not justify the amount of time needed for processing the data available in those published statements.

Alongisde the quarterly data, a dataset comprising yearly figures was created too in order to enable thorough analyses of bank profitability influencing effects on a yearly basis.

Bankscope was also utilized but only includes the largest banks operating in the Czech banking sector. Nevertheless, data from the database were used to check the data obtained from the materials published by the banks.

4.1.2 Macroeconomic data

A set of macroeconomic variables was collected and included in the empirical analysis to control for variables that influence banking profitability externally and to control for economic situation of the country within which the sector operates. Data on GDP growth and inflation (measured through CPI) are obtained from the published data of the Czech Statistical Office.

Data on the Czech National Bank's key policy rate – the two weeks repo rate – were collected from the CNB's website and two variables were created: one representing the year-average rate and one representing the within-quarter average of the repo rate. The reason for creation and usage of the latter is simple: banks in the Czech sector are heavily using the opportunity to earn interest income from depositing their liquidity into the central bank. As such, the repo auctions are performed every other day, hence, the banks are moving their liquidity practically every day. Also, all the other inter-bank rates are closely connected to the actual repo rate. Following these facts, it can be assumed that an average repo rate is a better proxy for the interest environment than a beginning-of-the-quarter variable in the case of intra-quarter analysis and analogously, the estimations based on yearly data follow the yearly average of the two weeks repo rate.

A variable was created to distinguish the quarters based on which an individual contribution to the Resolution Fund is calculated. As discussed in the respective chapter earlier in the thesis, banks are reflecting the contribution calculation in their end of year behavior and are artificially lowering their balance sheet figures. Should there also occur a decrease in the bank's profitability attributable to these practices, it needs to be properly controlled for. Thus, this binary variable attains 1 in the last quarters – fourth ones – and attains 0 otherwise.

4.2 Data collection

All publicly available data was collected in pursuit of maximum possible degree of statistical power of the obtained results. However, unexpected issues occurred at data collection, some of which presented rather substantial complications for the estimation methods used.

4.2.1 Introductory note on data collection

Most importantly, the dataset itself was the most limiting factor playing its role at the author's efforts at the research and analyses. Although the number of banks in the Czech Republic's banking sector has been over 45[11] for a long time, 22 institutions only are reporting and publishing their financial data in sufficient detail that is necessary for the methods and the model specifications tested by the thesis. Moreover, there have been changes to the structuring of the published files which made the data collection extremely time consuming and presented a rather very high risk of non-precision. As such, large VBA scripts, web-scraping methods and check mechanisms had to be developed by the author to successfully collect all publicly available data. Nevertheless, the number of banks publishing sufficient data could not be anyhow influenced and only remained 22.

This is considered a rather low number of institutions included in the panel of data and presented a limiting factor to the econometric methods that were used to estimate the model. As discussed further in the thesis, the results therefore cannot satisfy the thesis'original objective of quantification of the effects of the variables affecting banking profitability in the Czech Republic. Instead, it is the existence of the effects and their signs that can be claimed based on the set of results rather than their magnitudes.

The panel includes 25 quarters (1Q15 – 1Q21) in case of the quarterly frequency or 6 years (2015 – 2020) in case of the yearly frequency.

[11] There 23 branches of foreign banks that are not obligated to disclose as detailed information and data as the Czech based banks. Nevertheless, data on the 22 banks are covering roughly 90% of the sector as most of the branches are of negligible sizes – 2 branches only play non-negligible roles (Commerzbank, ING)

4.2.2 Dropped objectives

Consequently, some of the author's original ambitions had to be dropped due to size of the dataset that was collected and could not be anyhow widened. The following paragraphs list what was unfortunately not included in the research and results although it had originally been planned by the thesis proposal.

Dividing the time-period 1Q15 – 1Q21 into three shorter intervals

Unfortunately, the analysis of the whole time-period is not accompanied by three analyses focusing on the three originally planned shorter periods of time following the characteristics of events that were happening in the sector within these periods, that is, 1Q15 – 1Q17: FX commitment, 2Q17 – 1Q20: post-intervention recovery, 2Q20 – 1Q21: COVID. This is attributable to the size of the dataset and the fact that valid inference could not be obtained from estimating the profitability model on shortened data panels.

Analysis of the effects of the regulatory environment in the Czech sector on banking profitability

The thesis analyzed the data and estimated the profitability model on both datasets created, that is, the model was estimated on both quarterly and yearly frequency of the variables. Unfortunately, the quality of results differed substantially – the quarterly model features much less statistical significance than the yearly model, which was consequently chosen and presented as the main stream of the results. Any patterns of banks' behaviors that could observably be driven by the approaching year's end could therefore not be analyzed by the yearly model.

However, analysis of the potential effect of the end of the year is still presented further in the thesis and is focusing on changes in assets, liabilities, and equity of banks with relation to the end of the year.

4.3 Data management

4.3.1 Model specification and variables

The profitability model specified as follows:

$$Y_{i,t} = \alpha + \delta Y_{i,t-1} + \beta_1 Loans\text{-}to\text{-}Assets_{i,t} + \beta_2 Equity\text{-}to\text{-}Assets_{i,t} + \beta_3 Depo\text{-}to\text{-}Liabilities_{i,t} + \beta_4 Cost\text{-}to\text{-}Income_{i,t} + \beta_5 NPL\text{-}to\text{-}Loans_{i,t} + \beta_6 Size_{i,t} + \gamma_1 GDPgrowth_t + \gamma_2 CPIchange_t + \gamma_3 Repo_t + \varepsilon_{I,t}$$

The materials published by the banks do not include any of the desired variable, therefore they must be created based on the collected data. The following table provides details on how the model variables were constructed.

Variable	**Definition**[12]
ROA	$\frac{NI_{i,t}}{Assets_{i,t}} = ROA_{i,t},$
ROE	$\frac{NI_{i,t}}{Equity_{i,t}} = ROE_{i,t},$
Loans-to-Assets	$\frac{Gross\ Loans_{i,t}}{Assets_{i,t}} = \frac{Loans}{Assets_{i,t}} = LoAs_{i,t}$
Equity-to-Assets	$\frac{Total\ Equity_{i,t}}{Assets_{i,t}} = \frac{Equity}{Assets_{i,t}} = EqAs_{i,t}$
Depo-to-Liabilities	$\frac{Total\ Deposits_{i,t}}{Liabilities_{i,t}} = \frac{Depo}{Liabs_{i,t}} = DepoLi_{i,t}$
Cost-to-Income[13]	$\frac{Operational\ Cost_{i,t}}{Operational\ Income_{i,t}} = CtI_{i,t}$
NPL-to-Loans[14]	$\frac{Non-performing\ Loans_{i,t}}{Gross\ Loans_{i,t}} = \frac{NPL}{Loans_{i,t}} = NPLLo_{i,t}$
Size	$log(Total\ Assets_{i,t}) = Size_{i,t}$

[12] Denominators of the ratio-based variables use mostly averages. Therefore, no definitive denominator names such as "Total Assets" are used in case the denominator has an own specification or definition.

[13] Operational Cost and Operational Income of a bank are calculated based on the entire income statement of the respective bank.

[14] NPL of a bank is calculated based on the bank's published materials as required by the Decree No. 163/2014 Coll. issued by the national regulator. During 2015 – 2020, there were several changes of the reporting methodology.

GDP growth[15] $$100 * \left(\frac{GDP_t}{GDP_{t-1}} - 1\right) = GDPg_t$$

CPI change $$100 * \left(\frac{CPI_t}{CPI_{t-1}} - 1\right) = CPI\_ch_t$$

Repo[16] $$\sum_{k=1}^{K} \left[Reporate_k * \frac{D_k}{L}\right] = Repo_t,$$

K ... *Number of repo rate changes in the observed time interval,* $K \in \mathbb{N}$,

k ... *Order of the k-th repo rate in force in the observed time interval,* $k \in \{1, I, K\}$,

$Reporate_k$ ... *Magnitude in bps of the k-th repo rate in force in the observed time interval,*

D_k ... *Length of the time interval in days during which the k-th repo rate is in force,* $D \in \mathbb{N}$,

L ... *Length of the observed time interval, i. e., 365 days if yearly average repo rate is used, 90 days if quarterly average repo rate is used.*

4.3.2 Quarterly data

Balance sheet figures are reported in levels, i. e., their nominal values. As such, there was no need for adjustment of the reported numbers as the ratio-variables that were created for the purpose of the econometric analysis were defined as ratios of timely figures.

Income statement figures are reported cumulatively, i. e., the second quarter is reported as a sum of the first and the second quarter changes, the third quarter is reported as a sum of the second quarter and the third quarter change and the fourth quarter is reported as a sum of the third quarter and the fourth quarter change. As such, these cumulatively reported variables must be transformed into their quarterly changes so that correct calculations of the Cost-to-Income, ROA, and ROE variables are possible and can be used at a quarterly frequency. Hence, quarterly differences for the second, third, and fourth quarters were calculated (first quarters could be

[15] An average of expenditure and income method is used. Quarterly data use seasonally adjusted figures.

[16] Practically, the variable equals the average repo rate in a quarter or in a year.

used as reported) and based on these quarterly differences, quarterly CtI, ROA, and ROE variables were calculated.

The dependent variables are captured at a quarterly basis; therefore, the estimated effects of the explanatory variables shall be interpreted respectively.

4.3.3 Yearly data

Balance sheet figures are reported in levels, i. e., their nominal values. For the purpose of yearly variables creation, the quarterly balance sheet figures were used to calculate yearly averages of the base variables, i. e., assets, liabilities, and loans in denominators of the ratio-based variables are the average values in the respective years. The numerators of these variables capture the end of year figures.

Income statement figures are reported cumulatively. Hence, the fourth quarters always carry full-year information and can thus be used for calculations of all income statement-based variables, that is, CtI, ROA, and ROE.

The dependent variables are captured at a yearly basis; therefore, the estimated effects of the explanatory variables shall be interpreted respectively.

The profitability model and all respective regressions were run both using a dataset including and eliminating outliers. These regressions did not report any better quality of estimates or model performance and hence, results of estimating the model on the original (full) dataset are presented.

4.4 Main statistics

The following section presents the main data statistics of both yearly and quarterly data used to estimate the profitability model.

Exhibit 5, ***Distribution of variables, means, and standard deviations – yearly data***

Source: Author

Yearly data	Min	Q1	Median	Q3	Max	Mean	SD
ROA	-1.36	0.38	0.70	1.06	4.84	0.77	0.66
ROE	-9.47	4.38	9.04	13.25	25.40	9.00	6.34
Loans/Assets	22.19	63.36	77.41	88.02	99.49	73.69	17.35
Equity/Assets	1.43	6.64	8.57	11.81	20.43	9.35	3.96
Depos/Liabs	0.02	89.10	94.95	98.12	99.80	85.79	25.29
Cost-to-Income	5.72	21.19	28.33	43.48	68.28	32.18	14.36
NPL/Loans	0.00	0.87	2.38	4.67	49.32	5.68	10.18
Size	6.99	7.83	8.02	8.45	9.21	8.12	0.56
GDP growth	-1.66	3.71	5.85	6.54	7.04	4.62	3.04
CPI change	0.30	0.70	2.38	2.85	3.23	1.96	1.07
Repo	5.00	5.00	78.01	106.30	191.58	68.13	67.86

ROA, ROE, Loans/Assets, Equity/Assets, Depos/Liabs, Cost-to-Income, NPL/Loans, GDP growth, and CPI change in percentage points, Size is a logarithm of Total Assets, Repo in basis points

Exhibit 6, ***Distribution of variables, means, and standard deviations – quarterly data***

Source: Author

Quarterly data	Min	Q1	Median	Q3	Max	Mean	SD
ROA	-0.03	0.00	0.00	0.00	0.03	0.00	0.00
ROE	-0.26	-0.01	0.02	0.03	0.17	0.00	0.05
Loans/Assets	17.44	63.50	77.48	88.48	99.65	73.60	18.41
Equity/Assets	0.40	6.72	8.50	11.92	28.92	9.43	4.13
Depos/Liabs	0.01	88.51	95.67	98.24	99.87	85.79	25.22
Cost-to-Income	-263.69	19.63	29.53	45.00	118.34	31.38	23.99
NPL/Loans	0.00	0.63	2.15	4.52	66.16	5.93	11.63
Size	6.97	7.83	8.03	8.47	9.22	8.12	0.56
GDP growth	-7.91	0.93	1.29	1.55	7.75	1.16	2.42
CPI change	-0.50	0.20	0.49	0.70	1.83	0.53	0.53
Repo	5.00	5.00	25.00	116.67	208.33	67.34	75.37

ROA, ROE, Loans/Assets, Equity/Assets, Depos/Liabs, Cost-to-Income, NPL/Loans, GDP growth, and CPI change in percentage points, Size is a logarithm of Total Assets, Repo in basis points

The standard deviations are high at some variables (yearly and quartlerly NPL/Loans, GDP growth, Repo). This is attributable to the large dispersion of the data, and every such case has a logical explanation:

NPL/Loans may be heavily dependent on the business model and the risk appetite chosen by every bank. The banking sector has got limited amount of potential clients and hence limited total profit that can be made in a year within the sector. Therefore, banks are adopting different business models to capture all types of clients and to offer all types of services desired by different kinds of clients. Banks design their business models to help them at different projects – of course, these characteristics mean heterogenous risk profiles. Hence, there is no "right" NPL/Loans dispersion as there is no "best" solution of its setting with respect to the market. Therefore, the banks are not centering around a typical or optimized sector-wise value. Also, accordingly to what was previously stated about data in case of NPL, not much can be expected to be identified using data of such an unreliable quality.

GDP growth features high standard deviation because different eras of the Czech economy get captured by the time span of the data. An era of a steady economic growth (2015 – 2019) during which every year-on-year GDP growth figure was positive and of an "economically reasonable" magnitude. This was followed by a sharp decline in the country's GDP in 2020 which inflated the standard deviation of the variable.

CPI change is a case analogous to the GDP growth. A period of steady and relatively low CPIs was followed by an increased inflation attributable to numerous factors linked to the COVID pandemic and as a result, the standard deviation of the CPI change is inflated[17].

Repo follows the same pattern and in addition, its magnitude has been very low for years (1Q15 – 1Q17, the key policy rate was kept unchanged at 5 bps). Since April 2017, the rate was quickly raised to 225 bps in February 2020 and suddenly lowered to 25 bps in May 2020. The wide amplitude of its fluctuation inflated the standard deviation of the variable.

[17] 2020's data on inflation do not mirror the strongest inflationary pressures the Czech economy has been facing recently as the prices of energy and demand-pulled inflation began to translate into the economy in 2021.

4.5 Method description

The following model specification is estimated using primarily General Method of Moments method, more specifically the Arellano-Bond system GMM method:

$$Y_{i,t} = \alpha + \delta Y_{i,t-1} + \beta_1 Loans\text{-}to\text{-}Assets_{i,t} + \beta_2 Equity\text{-}to\text{-}Assets_{i,t} + \beta_3 Depo\text{-}to\text{-}Liabilities_{i,t} + \beta_4 Cost\text{-}to\text{-}Income_{i,t} + \beta_5 NPL\text{-}to\text{-}Loans_{i,t} + \beta_6 Size_{i,t} + \gamma_1 GDPgrowth_t + \gamma_2 CPIchange_t + \gamma_3 Repo_t + \varepsilon_{i,t}$$

The model is also estimated using the FE[18] method and simple OLS method with and without bootstrap and the results are compared. As every method presents a different kind of uncertainty that cannot be eliminated from the results and has own set of limitations, assumptions and imperfections, the set of results obtained from running several methods is interpreted rather as a whole and is primarily focusing on discussions of the existence of the implied effects rather than their magnitudes.

GMM

The model is estimated using the Arellano-Bover system GMM estimator. Following this method, the model is estimated in differences and levels jointly and is instrumented by both lagged dependent variable's differences and lagged dependent variable's levels. Consequently, the model is estimated with a help of a set of dummy variables.

The general specification of the estimated model is as follows:

$$DepVar_{i,t} = \alpha + \delta DepVar_{i,t-1} + X'_{i,t}\beta + Z'_t\gamma + (c_i + u_{i,t})$$

where $X'_{i,t}$ is a vector of bank-specific variables, Z'_t is a vector of macroeconomic and economy-related variables. The error term consists of a fixed-effect bank-specific time-invariant component c_i and an exogenous component $u_{i,t}$. Presence of time-invariant components disqualifies usage of a difference GMM model and other differencing-based estimation methods.

[18] The profitability model was estimated using RE deployed at all alternative specifications tested in the thesis, too. Comparing the results obtained from FE and RE and applying Hausman test at the choice of the more appropriate method indicated preference for the FE method.

FE

The model is estimated using the FE method mainly as a robustness check. Same specification is used for both ROE and ROA and for both quarterly and yearly frequency of the data. The estimates – their signs and statistical significances in the first place – are compared to the results obtained from other methods. Robust stardard errors are used.

OLS

The model is estimated using the simple OLS method mainly as a robustness check. Same specification is used for both ROE and ROA and for both quarterly and yearly frequency of the data. The estimates – their signs and statistical significances in the first place – are compared to the results obstained from other methods. Robust standard errors are used. Additionally, bootstrap is leveraged in an attempt to improve the inference of the results.

4.6 Hypotheses

Based on previously published studies and research papers, the factors affecting the banks'profitability can be categorized into two main groups.

The first group includes such profitability determinants that can be regarded as bank-specific factors, that is, direct consequences and results of each bank management's decisions. These factors include capitalization of a bank, its asset structure and quality, financial structure of its portfolio, size, efficiency, and revenue diversification.

The second group includes such factors that are linking banking profitability to the structure of national economy and general (macro)economic situation and environment within which the banking sector exists and operates. Examples of such factors include economic growth, interest rates, inflation, or regulatory environment.

Past performance: Return on Assets and Equity

Banking in not a day-to-day business. The profits made by banks are determined by their balance sheet management – namely, by the banks' ability to set pricing and durations so that risk limits of the bank are not breached, and positive economic value is delivered to the shareholders. One of the functions of a bank – traditionally presented in most of the banking literature – is commonly called maturity transformation. Banks transform the liabilities'short maturity into the assets' long maturity, i. e., banks are accepting short-durated deposits and other forms of financing and are providing long-durated loans and other types of assets.

Stemming from the long duration of assets, it is clear that a bank's revenue is not based on one-time incomes. Analogously, a bank's outflows are not formed by one-time expenses. As such, the profit earned on an asset sold today is going to be partitioned over time. Hence, if a bank terminates all sales and only decides to maintain its current assets as of January 01, its profit made during the year is not going to be none – rather, the bank will keep receiving the payments on its assets and will continue paying for its liabilities. It certainly depends on the bank's business model whether the profit in the year is going to amount to 20% of what it could have made did it never terminate the sales or 80% of such theoretical profit, but the main point is it is never going to be 0%.

Based on this non-zero persistence of past performance, the thesis is expecting to find the following: a bank's current profitability depends positively on its past profitability.

Core hypothesis: There exists a positive relationship between past profitability and current profitability of a bank.

Asset structure: Loans to Assets

Banking literature provides a general agreement that profitability of a bank is expected to increase with the share of loans in its portfolio of assets given that interest rates charged on loans are liberalized and the bank applies mark-up pricing (García-Herrero et al., 2009).

Any greater proportion of granted loans in a portfolio of a bank is usually connected to higher liquidity risk stemming from the bank's inability to cover for decreases in liabilities or inability of asset side of the balance sheet increases' funding. Therefore, banks holding low proportions of liquid assets (i. e., greater levels of liquidity risk) are more likely to be earning high profits.

Evidence can be found in recent studies and papers. These report a positive relationship between the proportion of loans granted in a bank's portofolio of assets and the bank's profitability. The literature includes Goddard et al. (2004), DeYoung and Rice (2004), Iannotta et al. (2007), Barros et al. (2007), Chiorazzo et al. (2008).

However, during the subject time this thesis focuses on, i. e., 2015 – 2020, the monetary authority in the country was pushing the key policy rates up and the banks were primarily focusing on capturing their profits on different banking fields than loans. Also, prior to this, the rates in the country were very low and banks were squeezed in a situation commonly described as "search for yield" – but the yield has been frequently discovered elsewhere but at loan granting business. As such, it may be discovered that the proportion of loans in banking portfolios in the Czech Republic was not a decisive factor at making profits from banking services in the respective time frame in the country.

Hypothesis 1: If there exists an effect of proportion of loans in the total asset portfolio of the banks in the country, it is of a positive sign.

Capitalisation: Equity to Assets

Banking literature provides a supported opinion that the cost of equity (capital) is the most expensive liability of a bank given the expected return is regarded[19] (García-Herrero et al., 2009, Hakenes & Schnabel, 2011). In addition to that, the industry itself frequently argues that higher requirements on equity directly increase costs of funding through riskiness of capital and hence through a higher required return. This is coherent with banks' generally negative perception of capital adequacy ratio increases (Admati et al., 2010).

[19] Not only the banking sector does attain this – generally, the cost of shareholders equity is the highest cost to an enterprise.

In opposition to what was suggested prior, reasons to believe that a well capitalized bank is likely to be well profitable exist. Berger (1995) discusses a "bankruptcy cost hypothesis" (cited also by Trujillo-Ponce, 2013) as follows: Let it be assumed a bank is capitalized below its equilibrium ratio level. Then, its expected costs of bankruptcy are high – and increases in capital ratios lead to increases in expected profits through diminishing interest expenses incurred from uninsured debt items. Similarly, it is stated by Athanasoglou et al. (2008) that this positive relation may be channeled because of the capital playing a role of a safety net in situations when the bank is suffering unexpected losses. This relationship would support the bank at financing its assets at lower interest rates, and thus increasing the expected level of profitability. This would also lead to offsetting of the equity cost.

Berger (1995) also discusses a "signaling hypothesis". This theory alternates the previously detailed one and states that private information is signaled by a bank's management. Under the theory, increases in capital stemming from a managerial decision of the bank's board of directors signal prospective future of the bank and are thereby endorsed.

Empirical studies covering this topic are numerous and they generally agree on existence of a direct linkage between level of capitalization and level of profitability. The literature includes Berger (1995), Athanasoglou et al. (2008), García-Herrero et al. (2009) and Alexiou & Sofoklis (2009).

However, the picture may not be as clear in case of profitability to equity. Higher capitalization with respect to the bank's assets decreases the bank's leverage, increases the bank's rating and hence may lower ROE requirements of the owners of the bank.

Moreover, high capitalization may not be a result of the bank's business decision. The best possible example of such event is presented by the decision of the Czech National Bank on dividend pay-out after the Czech sector was hit by the COVID pandemic in 2020. In pursuit of robustness of the sector's liquidity and capitalization, banks in the country were forbidden to distribute dividends and consequently, this capital ended up stocked in their balance sheets. This capital is not employed by the banks at any business operations since it is not used to finance the banks' assets as the boards are expecting the regulator's embargo to be lifted soon and are ready to approve the pay-outs. As a result, high capitalization achieved as described does not secure any increases in profitability.

As a result, no clear hypothesis is presented.

Hypothesis 2: There exists a relationship between the level of capitalization of a bank and the level of profitability of the bank as capitalization is an important aspect of the banking business.

Liability structure: Deposits to Assets

Many European banks have recently been financing increasing parts of their assets by exposing to the medium- and long-term wholesale markets. In the times of rising credit levels and improving conditions on financial markets, these decisions have brought greater costs than would have been incurred had the financing only been taken in the form of client deposits – although it provided the banks with greater degree of flexibility in financial structure of their balance sheets.

Given this, it is implied higher proportions of client deposits are likely resulting in increased levels of profitability through their lower costs compared to alternative ways of financing. Generally, the deposits represent a cheap, stable, and reliable resource of potential for growth. This view is also supported by Claeys & Vander Vennet (2008). Based on the discussed, the thesis studies existence of a relationship between the portion of client deposits in a bank's portfolio of liabilities and its profitability.

Hypothesis 3: There exists a positive relationship between the proportion of client deposits in a bank's liabilities and the bank's level of profitability.

Credit quality: Non-performing loans

A loan (or generally, an asset) is considered non-performing once the following condition is fulfilled: the asset delivers lower cashflows than the expected volumes of cashflows based on which the asset was priced and sold. Once an asset fails to return what it is meant to be returning, the asset owner – the bank – must start accounting for impairment, i. e., creating provisions.

Provisions directly harm the bank's profitability since they increase the cost side of the income statement. Hence, non-performing loans are expected to be negatively affecting banking profitability.

However, there may exist a compensation scheme helping banks with non-disciplined debtors or covering their losses stemming from other severe events. If – in theory – these compensations were to even exceed the budgeted cash income of the subject assets, the bank would be profiting from its loans turning non-performing through the compensations. Nevertheless, such situation is practically impossible. Although there have been events in past which made governments organize schemes aimed at helping banks in severe troubles, no bank can ever expect such compensations to be greater than the incurred losses. As such, this option is rejected.

Nevertheless, there exists a group of banks undergoing high risk at granting loans that are priced as adequately expensive, i. e., the interest income of the bank is highered by the risk-premium stemming from the higher risk appetite. Given that such business model would have been

adopted by no bank were it useless and non-profitable, it appears that the profitability rather relies on the bank's ability to organize their asset pricing. As such, high proportion of NPLs may deliver high profitability through expensive financing provided to non-defaulting or less-than-expected-defaulting clients.

As such, the effect of the proportion of non-performing loans in the whole loan portfolio should depend much more on each bank's business model and risk appetite. Hence, no clear effect is expected at this.

Hypothesis 4: There is no clear pattern in the effect of NPL/Loans on the profitability of a bank.

Efficiency: Cost-to-Income Ratio

Efficiency itself has been a big topic in the banking industry worldwide. More than ever, banks are nowadays going through operational transformations to achieve a so-called agile organization. Under this model, a considerable part of middle management is abolished to decrease the institution's managerial rigidity and to enable fast, efficient, and informed decision taking. Typically, the members of the board of director would manage several heads of teams[20] directly and these teams would comprise the workers delivering the actual labour results.

Certainly, the agile way of working is not the only topic in banking operations – along with all the efforts aimed at decreasing operational costs of banks, it is closely monitored not only by banks themselves but also by national regulators. Achieving operational efficiency is a strategic objective to every bank's owner because the more efficient the bank, the greater the owner's dividend, and therefore, it is important for every bank's management.

Advances in information, communication technology and financial technology have made it possible for banks to be performing numerous traditional services in a very efficient way. Consequently, operational efficiency of banks worldwide has been increasing and therefore, proxies for operational efficiency such as cost-to-income ratio have been decreasing.

Previous studies report that a bank's efficiency features a positive effect on the bank's profitability (García-Herrero et al., 2009). This implies that operational efficiency comes as a prerequisite for an increase in the banking industry's profitability. Also, Berger & Humphrey (1994) indicate that "managerial ability at monitoring and controlling the costs[21] is shown to be rather more important than economies of scope and economies of scale".

[20] Called squads, tribes, and groups

[21] The so-called X-efficiency

As suggested, the thesis studies existence of a relationship between operational efficiency and level of profitability.

Hypothesis 5: There exists a negative relationship between the cost-to-income ratio of a bank and the level of profitability of the bank.

Size

Literature presents consensus on an average cost curve in the banking industry: it is believed to be a flat U-shaped curve. Thus, medium-sized banks are implied to be the most cost-effective ones and outperforming the small and the large ones in terms of efficiency. A typical expectation would guide us towards thinking that with increasing size, the bank is able to achieve greater economies of scale and economies of scope, hence the profitability increases with the bank's size.

After surpassing a certain point, the sizey institution becomes too bureaucratic, managerially rigid, and internal processes get too complicated along with increasing complicatedness of organization and growing aparate necessary for sustaining operations of such a company. Operational costs of such bank begin to rise with size and hence the cost curve is diverted upwards (supported by Athanasoglou et al., 2008).

Contrary, it may be implied that the larger the bank, the greater the economies of scope since the bank can be benefiting from provision of joint services, related services or can perform other types of cross-selling. Nevertheless, Barros et al. (2007) found that large and diversified banks are more likely to be performing poorly in terms of cost-efficiency. In their explanation, this suggests that small and specialized banking institutions are able to work with informational asymmetry present at granting loans or providing banking services in a better way than big financial companies.

The so far presented arguments are not decisive in favor of any hypothesis and hence Czech context is mainly considered. The Czech sector is a small and very competitive sector. Banks are facing tough and prejudicing retail clients[22] in the sector and hence reputation, trust and customer loyalty are extremely precious assets Czech banks may possess. Generally, it seems that Czechs trust a bank more if it can demonstrate market power, robustness, and excellent track record. Also, Czech clients are comfortable and do not like traveling to branches if the kind of interaction with their bank requires an in-person contact. Therefore, this thesis assumes that the bigger the bank, the more likely it can stretch its powers to present itself to the clients in a way that clients are attracted to use its services. Moreover, big Czech banks have been

[22] A typical feature of the Czech banking sector stemming from numerous past events

gradually consolidating more parts of non-financial lives of Czech inhabitants, e. g., big banks are traditionally connected to insurance, banks have also cooperated with the Czech government on simplifying communication with national authorities and hence are participating even at provision of non-financial services to customers in the country. Also, big Czech banks seem to have wider, easier, and hence cheaper access to resources.

The studies implying banking industry's U-shaped cost curve worked with datasets comprising some banks much larger than Czechia's largest ones. It may well hold that although the cost curve would be of the U-shape in the Czech sector were there any big enough banks, there are currently none such banks and hence, the right upward sloping part of the curve is missing in the data on the Czech sector. As such, a linear positive effect shall be identified given all of the afore discussed.

Hypothesis 6: There exists a positive relationship between a bank's size and the level of the bank's profitability.

Economic situation: GDP growth

Under a positive economic growth and good economic conditions, enterprises active in the economy require credit and use banking services. In a growing economy, more and attractive opportunities naturally occur for banks and gradually more successful businesses demand more and more from banks as their portfolios of projects are expanding. In addition, solvency of both retail and corporate borrowers increases, and households demand more housing loans.

Analogously, in a poor economic environment, quality of banks' portfolios of loans is worsening and banks must hold more provisions to cover for expected credit losses. This reduces the banks' profitability.

Literature strongly endorsing this view includes Calza et al. (2003) or Athanasoglou et al. (2008). Based on the afore described, the thesis takes a stance and expects a direct relationship between the economic situation in the country and banking profitability.

Hypothesis 7: There exists a positive relationship between economic growth and profitability of banks.

Economic situation: Inflation

Regarding inflation, it is important whether the rate of inflation is fully anticipated by managers of banks or is not. If the former holds, the managers should be able to manage the bank's pricing in a way that growth of revenues outperforming growth of costs is secured. This would have a positive impact on the bank's profitability.

Contrary – maturity transformation is generally understood to be one of the main functions of a bank. Since the maturity mismatch present in the balance sheet of a bank stems from liabilities' average maturity being shorter than the one of assets, it may also be suggested that as inflation raises the interest rates in the economy on general, there is a time interval of non-zero length during which banks face increasing rates at their liability side of business but cannot react proportionately by raising the rates they charge at the asset side of their business. As a result, the profitability of banks would be harmed.

Revell (1979) studied the linkage of banking profitability to inflation and came with a conclusion arguing that the effect of inflation on the profitability of banks depends on how changes in price level affect salaries and other operating costs of banks.

Other studies including Alexiou & Sofoklis (2009) support existence of a positive effect of inflation on banking profitability.

Cetin (2019) suggests there exists a negative relationship between inflation and profitability recorded in the banking sector in developed countries and financial systems, and a positive effect of inflation on profitability of banks in developing countries and financial systems.

Hypothesis 8: There is a non-zero effect of inflation on the banking profitability.

Financial environment: The repo rate

It is generally known that under low interest rates, banks are facing the so-called "search for yield" which results in entering more risky positions on markets and restructuring the asset portfolios so that greater interest incomes are channeled. However, overall rise in general riskiness of the sector is generally not desirable. Also, a decrease in interest rates is not always 1:1 outweigheable by an increase in riskiness of the business performed by the bank. Therefore, profits are falling.

A different point of view states that low interest rates traded by banks are stemming from low monetary policy rates set by the central bank. As the key rate serves as the main interest rate indicator in the economy, it can be assumed that in a country with low monetary policy rates,

loans are granted at low interest rates, too. That is, banks are earning lower interest incomes than they would under higher interest rates.

It has been shown in practice recently that low interest rates combined with tight competition in the banking sector are severely limiting the number and quality of opportunities, hence, the banks must establish adequate pricing schemes for their services. Operating margins are pressurized, and profitability is harmed.

Litertaure supporting these views includes Bourke (1989), García-Herrero et al. (2009) and Avkiran (2009) who stated that not only low interest rates but also fluctuations in them are harming banks' profits because when a bank's management takes a decision to pursue a high level of interest rate risk in the banking book by fixing an interest rate on assets and letting the interest rate of liabilities float, an increase in the interest rates would diminish the bank's profits.

Moreover, the Czech sector features high liquidity, and it is well known that large banks are placing their liquidity in the central bank to earn the repo rate. Since this liquidity provided by the banks' foreign parent institutions would probably never be influcted into the market in the form of loans, the higher the interest rates, the higher the interest incomes of banks using this opportunity. However, the parent institutions are using this channel to rather boost their profits, not the profits of their subsidiaries in the Czech Republic. Czech banks are paying for the provision of this liquidity that is afterwards deposited with the national bank, but it may be assumed that the parent institution charges almost as much as the Czech subsidiary earns from the deposit to enhance own profits. Consequently, the profitability of the mediating entity may not be affected at all if the ratio of the interest income earned from the deposit and the interest expense charged by the liquidity providing parent institutions approaches 1:1. The profitability of the mediating bank may even be harmed if the average profit made on these transactions is lower than the average profit made on the rest of the asset portfolio.

Hypothesis 9: If there exists a non-zero effect of the repo rate on the banking profitability, it is of a negligible magnitude.

Abnormality induced by regulatory requirements: The Resolution Fund (RF) [23]

In 2015, the Single Resolution Mechanism and its Single Resolution Fund were incarnated in the Czech banking sector and consequently, Czech banks were paying their first annual contributions into the national resolution fund in spring 2017 based on determination of the contributions through top-down method using end-of-year accounting figures as of December 31st, 2015. The mechanism of the contributions determination works as follows: the regulator sets the annual contribution of the sector and distributes it over the contributing institutions so that the sum of individual transfers equals the predetermined annual contribution.

The annual contribution duty is distributed among the banks based on their share on the sector and overall riskiness as of end of the year. Hykl (2020) describes that the banks quickly adapted to the methodology of the individual contributions' determination. As a result, it has been observed that banks perform creative accounting practices to lower their reported balance sheet figures to circumvent high individual contributions. There are also banks making business out of taking these unwanted excess balance sheet items and suffering the increased individual contributions since these can be outearned through the other transactions they execute[24].

Consequently, profitability is harmed by both having to pay a contribution (calculated based on end-of-year numbers) and by additional transactions the banks execute to lower their assigned individual contributions.

Certainly, the resolution fund and the deposit insurance fund are not the only money-takers when it comes to banks' duties to provide financial coverage, contributions, or compulsory payments. Hence, the profitability may drop more than it is implied by the sum of the resolution fund duty and the deposit insurance duty.

It has been made clear during the writing of the thesis that this hypothesis cannot be reliably tested with the available data. It is not removed from the thesis as it presents an important topic in banking, and it is going to be discussed further in the thesis how could this hypothesis be tested by continued academic efforts.

Hypothesis 10: If there exists an observable drop in profitability at the end of the year, its magnitude is greater than what is transferred into the resolution fund and deposit insurance fund.

[23] The RF is not the only case of regulatory duties inducing events or behaviors of economic agents in the sector that do not follow market-driven or rational patterns. The RF may be the most significant one among others.

[24] Typically, this is performed by Czech banks that have strong business connections outside the European Union, e. g., banks in Russia or Asia.

Hypotheses – summary

The following table summarizes the suggested variables, the presented hypotheses, and the expected signs of coefficients. H10 is not tested by the profitability model.

Exhibit 7, ***Hypotheses summary***
Source: Author

Summary: Variables and Hypotheses overview	
Hypothesis: Variable	**Sign of the expected effect**
HC: Past performance	Positive sign
H1: Loans to Assets	If effect, positive
H2: Equity to Assets	Effect, sign unclear
H3: Deposits to Liabilities	Positive effect
H4: Cost to Income	Negative effect
H5: NPL to Loans	No pattern
H6: Size	Positive effect
H7: GDP growth	Positive effect
H8: Inflation	Effect, sign unclear
H9: Repo	If effect, sign unclear, small magnitude
H10: Regulatory duties	If effect, larger than sum of listed outflows

5 Results

5.1 Introductory note on the results

The thesis proposal presented a set of ambitious ideas and expectations on what was going to be discovered, analyzed, and what topics supported by empirical results were going to be introduced to a further academic debate. However, it has been made clear by several limiting factors that not every goal of the author could be achieved.

As described previously, the dataset is not particularly sizey, i. e., the number of banks that report and publish the desired data is only 22 and the time span over which the data can be collected has only reached 6 years so far – prior to 2015, there was no unified form of data structure and the banks were not required by the regulator to disclose as much information as they have been since 2015. In other words, research attaining the level of detail of this thesis cannot be carried out using data from before 2015.

As previously described, too, the thesis pursues an ambition to uncover rather existence of any potential effects than to quantify the magnitudes of such effects. The main method used for the purpose of this thesis is a system GMM estimator for dynamic panel data developed by Arellano and Bover. Fixed effects[25], simple OLS, and bootstrap are used to obtain alternative sets of estimates, too.

The results are presented in order (1) ROE, (2) ROA. Although ROA is generally believed to be a more reliable indicator of a bank's performance (a bank's leverage is part of ROE and changes in equity are usually less transparent and can be studied less reliably as equity is exposed to shareholders' decisions regarding dividends, capitalization etc.), this thesis' results for ROE feature greater statistical significance and sometimes can be interpreted or reasoned in a more concise and demonstrative way. Thus, ROE results are presented prior to ROA results that are discussed separately right after ROE, and the differences are debated, too.

The last section of the results discussed quarterly variation of assets, liabilities, and equity and tries to establish mantinels within which further efforts shall be conducted to gain greater level of understand and wider knowledge on the uncovered effects.

[25] The profitability model was estimated using RE deployed at all alternative specifications tested in the thesis, too. Comparing the results obtained from FE and RE and applying Hausman test at the choice of the more appropriate method indicated preference for the FE method.

5.2 Banking profitability: Yearly model

The following table summarizes the results of regressing the yearly dependent variable on its lagged values and a set of explanatory variables using yearly data and system GMM estimator.

Exhibit 8, ***System GMM: Yearly data***

Source: Author in Stata 17

System GMM: Yearly data				
	ROE		ROA	
	Estimate	z	Estimate	z
Y(t-1)	**0.43403***	1.77	**0.34418*****	2.46
Loans/Assets	-0.03080	-0.85	-0.00481	-1.51
Equity/Assets	**-0.40242*****	-2.84	0.00014	0.01
Depos/Liabs	-0.00647	-0.55	-0.00197	-1.02
Cost-to-Income	**-0.05671****	-2.01	**-0.00636****	-1.99
NPL/Loans	-0.11219	-1.27	-0.01116	-0.96
Size	**1.65095***	1.92	**0.14842****	2.14
GDP growth	**0.57919*****	4.34	**0.04180*****	3.97
CPI change	**-0.89264***	-1.68	-0.09556	-1.29
Repo	0.00297	0.34	0.00095	1.25
N (observations)	130		130	
N (groups)	22		22	
N (instruments)	12		12	
AR (1)	-2.23	0.026	-2.28	0.023
AR (2)	-0.47	0.639	-0.28	0.777
Sargan	2.64	0.268	3.87	0.145
Hansen	4.34	0.114	9.21	0.56

Statistical significance: * 0.10, ** 0.05, *** 0.01

Estimate reports the parameter estimate of each explanatory variable, *z* reports a z-statistic of the estimate (critical values 1.65, 1.97, and 2.33), twostep estimator and heteroscedasticity-corrected standard errors are used[26], *N (instruments)* reports the number of instrumental variables used by the system GMM estimator within its optimization mechanism (three for the lag identification, nine explanatory variables treated as exogenous), *AR (i)* reports a test of serial correlation of i-th order, *Sargan* and *Hansen* report a Sargan's J-test and a Sargan-Hansen test of overidentifying restrictions.

[26] Uncorrected SEs unreliable with a dataset of size (N, T) = (22, 6)

5.2.1 Model specification, reliability, and inference

The specification includes all explanatory variables that are available in the dataset. The yearly data comprises of 22 banks reporting over 6 years, two observations are missing[27]. Both regressions – ROE and ROA – reject the null hypothesis of a test of serial correlation of order one at 5% and do not reject a test of serial correlation of order two at 5%. Neither Sargan nor Hansen test of validity of overidentifying restrictions is rejected (p-values over .1, Hansen at ROA equal to .56 on the borderline but not rejected at 5%[28]). The twostep estimator is generally robust to any pattern of heteroscedasticity and corrected standard errors of the parameter estimates are used. Based on these results, the thesis proceeds to discuss uncovering of existence of the respective effects.

The relatively high degree of first-order autocorrelation present in the model may well be utilized at identification of the dependent variable's lags used as instruments for its first lag. This is utilized to control for the suspected endogeneity of the model introduced by regressing a variable on its own lagged values. However, the small size of the dataset may present a limit at the identification of the autocorrelation itself which is an additional reason to pursue rather uncovering of existence of the effects than their precise quantification.

5.2.2 Results: General remarks

The results obtained from the profitability model estimated by system GMM indicate existence of non-zero effects of the past profit performance, operational efficiency, size of the enterprise, and economic state of the country to the enterprise's current performance. The effects are statistically significant both for ROE and ROA.

Existence of non-zero effects of two variables to ROE and not to ROA is indicated – an enterprise's capitalization to its assets and yearly inflation in the country.

Indicated effects' signs are the same as expected by the hypotheses in case of past performance, operational efficiency, and GDP growth. There were no clear expectations regarding the sign of the effects of capitalization and inflation. These are debated further in the following section.

The table on the next page displays the four obtained sets of estimates from GMM, FE, OLS, and OLS with bootstrap:

Exhibit 9, ***Complete results: Yearly data***
Source: Author

[27] Hypotecni banka 2015, Expobank 2015

[28] However, the world does not change from white to black once the rejection borderline 0.05 is crossed – 0.056 is very close and thus the results should not be overlooked as unimportant due to one single statistic not fitting within an expected interval.

Yearly data												
	GMM				FE				OLS				OLS.b			
	ROE		ROA		ROE		ROA		ROE		ROA		ROE		ROA	
	Estimate	z	Estimate	z	Estimate	z	Estimate	z	Estimate	z	Estimate	z	Estimate	z	Estimate	z
Y(t-1)	**0.43403***	1.77	**0.34418*****	2.46	-0.01775	-0.17	0.05586	0.94	**0.46375*****	3.51	0.48696	1.58	**0.45560*****	4.28	**0.51999*****	4.09
Loans/Assets	-0.03080	-0.85	-0.00481	-1.51	0.04061	0.96	-0.00114	-0.23	-0.03966	-1.32	0.00049	0.15	**-0.04414***	-1.70	0.00027	-0.03
Equity/Assets	**-0.40242*****	-2.84	0.00014	0.01	**-0.43318****	-2.08	-0.00714	-0.29	**-0.45724****	-2.17	0.01169	0.63	**-0.46512*****	-3.04	0.00986	0.62
Depos/Liabs	-0.00647	-0.55	-0.00197	-1.02	0.15894	0.71	0.01884	0.87	-0.02262	-1.31	0.00089	0.54	-0.02108	-1.23	0.00080	0.58
Cost-to-Income	**-0.05671****	-2.01	**-0.00636****	-1.99	**-0.09039***	-1.96	**-0.01054****	-2.12	**-0.06615*****	-2.41	-0.00162	-0.49	**-0.06570*****	-2.35	-0.00178	-0.56
NPL/Loans	-0.11219	-1.27	-0.01116	-0.96	-0.07201	-0.99	-0.00164	-0.23	-0.06130	-1.40	-0.00460	-0.82	-0.06139	-1.38	-0.00467	-1.07
Size	**1.65095***	1.92	**0.14842****	2.14	6.14655	0.93	1.17065	1.32	1.33412	1.30	**0.27949***	1.93	1.34283	1.49	**0.24838*****	2.38
GDP growth	**0.57919*****	4.34	**0.04180*****	3.97	**0.51001*****	4.87	**0.04277*****	3.04	**0.51808*****	4.17	**0.03122****	2.05	**0.52365*****	4.60	**0.03469*****	2.74
CPI change	**-0.89264***	-1.68	-0.09556	-1.29	**-1.79330*****	-2.39	**-0.17293****	-2.25	**-1.39638***	-1.73	**-0.21368****	-2.14	**-1.44893****	-2.14	**-0.20501*****	-2.67
Repo	0.00297	0.34	0.00095	1.25	0.00622	1.02	0.00104	1.40	0.00675	1.03	0.00126	1.53	0.00813	1.26	**0.00122***	1.79
Constant					-47.64007	-0.82	-9.89857	-1.28	6.20802	0.73	-1.82029	-1.13	6.45562	-0.74	-1.57659	-1.36
N (observations)	130		130		86		86		130		130		130		130	
N (groups)	22		22		22		22		22		22		22		22	
N (instruments)	12		12													
AR (1)	-2.23	0.026	-2.28	0.023												
AR (2)	-0.47	0.639	-0.28	0.777												
Sargan	2.64	0.268	3.87	0.145												
Hansen	4.34	0.114	9.21	0.56												
R-sq (within)					0.701		0.582									
Corr(u_i, Xb)					-0.564		-0.888									
R-sq									0.771		0.596					
R-sq adjusted									0.747		0.554					
F-stat (df)					19.47***	11,21	6.77***	11,21	32.62***	10,97	14.28***	10,97				

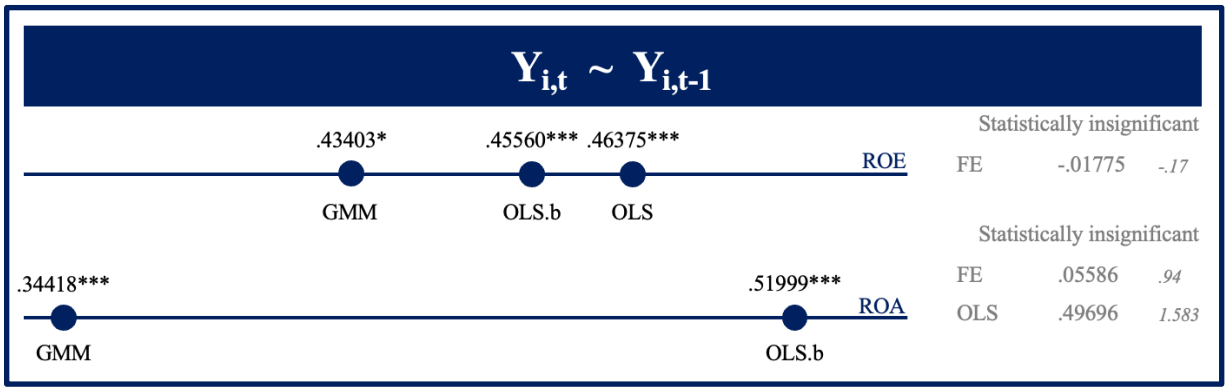
Statistical significance: * 0.10, ** 0.05, *** 0.01

5.2.3 Results: Discussion and partial conclusions

The following pages discussing the results are accompanied with diagrams providing additional estimates obtained from FE, OLS, and OLS with bootstrap so that the GMM results are challenged by alternative sets of results. Also, as the dataset is rather small, alternative sets of estimates provide robustness checks as well as rough ideas about the potential bias of the GMM results or the potential signs and magnitudes of the estimates. Again, the thesis does not pursue an ambition to quantify the magnitudes of the effects. Instead, existence of effects is attempted to be shown, discussed, and accompanied with suggestions for further research or how the data or the econometric methods could be alternated and improved to obtain better results. Statistically significant results only are discussed in the following part.

An effect of Loans/Assets to ROE is found by OLS with bootstrap only – this is excluded from the following discussion as one-out-of-four statistical significance does not justify stating the existence of such effect.

Note: The diagrams omit unitary zeros in pursuit of space saving, i. e., instead of "0.013", the diagrams show ".013". Coefficient estimates with magnitudes exceeding 1 are displayed in a usual matter. Statistically insignificant estimates are provided in grey to complete the results dashboard. Statistical significances indicated by stars: p-values 0.100*, 0.050**, 0.001***.



The results indicate that the original hypothesis expecting a positive effect of past profitability may hold. GMM estimates imply positive effects of both past ROE and past ROA. Additional sets of estimates obtained from estimating the profitability model by FE, OLS, and OLS with bootstrap support the GMM results as these sets of estimates have the same signs and are of similar magnitudes. Due to the dataset size, the set of all results is rather used as an indication of the effect's presence than quantification of the effect's magnitude.

In case of ROE, it is implied by the GMM estimate that one percentage point of extra profitability in the last year translates into 0.43 percentage points of extra profitability in the current year. In other words, 43.4% persistence of ROE is indicated. The 95% confidence interval of the GMM estimate is (0.04679, 0.82127). As such, zero is not included and hence the presence of the effect indicated by the estimates shall not be rejected. However, the confidence interval is rather wide and hence the thesis does not pursue an ambition to quantify the magnitude of the effect. The same issue is faced at most of other effects.

Both OLS without and with bootstrap indicate presence of an effect of the same sign and similar magnitude, the 95% confidence intervals do not include zero, the FE estimate is not statistically significant.

In case of ROA, it is implied by the GMM estimate that one percentage point of extra profitability in the last year translates into 0.34 percentage points of extra profitability in the current year, i. e., 34.4% persisntence of ROA in indicated. The 95% confidence interval of the GMM estimate is (0.07049, 0.61788). As such, zero is not included and hence the presence of the effect indicated by the estimates shall not be rejected. The width of the interval presents the same issue as the case of ROE faces – quantification of the magnitude would have been a too ambitious goal given the size of the dataset.

The estimate obtained from OLS using bootstrap to improve the inference provided an estimate magnitude of which is fifty percent greater than the one of the GMM estimate, the 95% confidence interval excludes zero, simple OLS and FE are not statistically significant.

Conclusion

The results indicate presence of a positive effect of past profitability on current profitability in both cases ROE and ROA. This is in concordance with what was originally expected to be found as positive persistence of profitability is one of the keys of the banking business. 43.4% persistence of ROE and 34.4% persistence of ROA are expectable magnitudes regarding the nature of the banking business.

The results indicate that the original hypothesis expecting a non-zero effect of capitalization may hold. The GMM estimate implies a negative effect of a bank's capitalization on its ROE, no effect indicated on the bank's ROA. Additional sets of estimates obtained from estimating the profitability model by FE, OLS, and OLS with bootstrap support the GMM result at ROE as these estimates have the same signs and are of similar magnitudes, no effect on ROA indicated by neither method. Due to the dataset size, the set of all results is rather used as an indication of the effect's presence than quantification of the effect's magnitude.

In case of ROE, it is implied by the GMM estimate that one percentage point of extra capitalization in the current year transfigures into a decline in current profitability by 0.40 percentage points. The 95% confidence interval of the GMM estimate is (-0.67986, -0.12496). As such, zero is not included and hence the presence of the effect indicated by the estimates shall not be rejected.

FE, OLS, and OLS with bootstrap indicate presence of an effect of the same sign and similar magnitude as is indicated by GMM, the 95% confidence intervals exclude zeros, all methods provided statistically significant estimates.

ROE – Discussion

Generally, it is believed that high capitalization pressurizes the institution's management to deliver higher ROE as equity financing is more expensive than other forms of asset financing. Hence, it may be surprising that higher capitalization carries a negative effect on ROE indicated by the estimated profitability model. There are several explanations for the negative sign of the effect, and they include reduced ROE requirements driven by high ratings or mathematical definition of ROE.

With higher capitalization, an institution's rating is usually improved, and this is followed by reduced requirements the shareholders place on the institution's ROE as improved rating signals lower risk and transmittently, the risk premium charged by the owners diminishes. Banks in the Czech sector are typically capitalized around 10% – 20% of their total assets. One percentage point change in capitalization is a substantial change and hence, it may not be of a great surprise that the implied magnitude of the effect of one percentage point of extra capitalization is implied to reduce a bank's profitability by nearly half a percentage point.

Another possible explanation offered by the thesis is a mathematical one. A bank's ROE is defined as its net income to its equity. Higher capitalization means more equity in the balance sheet – hence, the ROE's denominator increases and thus, the ROE decreases. As the profitability model regresses current ROE on the current value of Equity-to-Assets ratio, it may hold that the change in current capitalization does not transmit into the bank's profitability quickly enough to affect its profitability within the same year which would have been expected based on what was previously stated.

In case of ROA, no effect of capitalization on a bank's current profitability is indicated. It appears that the connection between current profitability and current capitalization gets lost as ROE is transformed to ROA. This may be signalling that the mathematical explanation discussed above may hold.

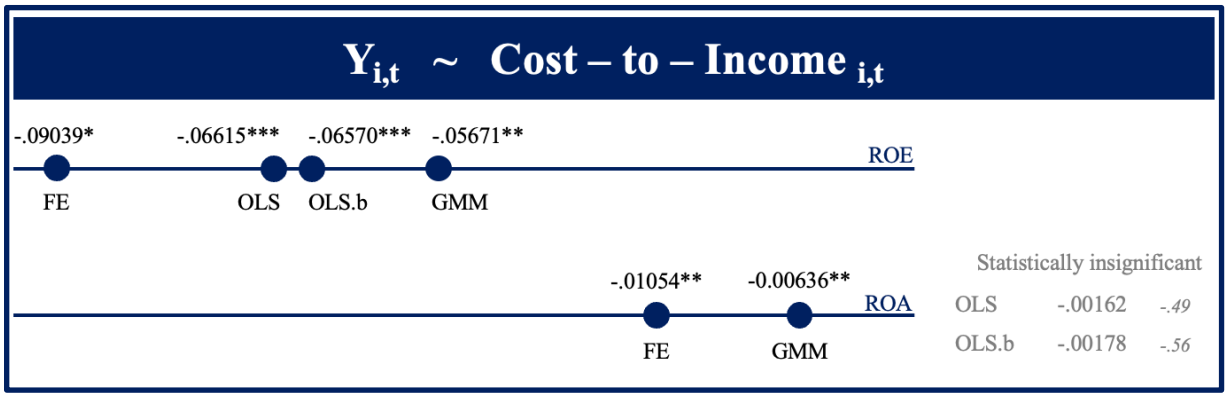
ROA – Discussion

Loss of statistical significance of estimates when ROA is the dependent variable may imply that virtually, there is no direct effect of current capitalization on a bank's current profitability. Let us assume the effect on ROE is found and explained by the mathematical aspect. Then, no reasoning based on banking business principles is left. As effects of capitalization on ROA are not statistically significant and effects on ROE are lacking business-oriented instances, it may appear that a bank's current profitability is not driven by its capitalization.

Applying a pure banking optics on this, level of capitalization of an institution shall before all be very business model dependent – some owners decide to provide more capital than the others. Also, the nature of the capital sitting in the bank's balance sheet is an important aspect of the problem. It should be analyzed in deeper detail which part of the bank's capital is employed at financing its assets and which part is, for example, idle and waiting to be paid-out as a dividend. There may be several reasons for banks not utilizing their capital fully. The issue is discussed further in the Suggestions for further research part.

Conclusion

The results indicate presence of a negative effect of an institution's capitalization on current ROE and indicate no effect on current ROA. This is not in concordance with what was originally expected to be found – the thesis assumed capitalization was a very important aspect of every bank's profitability, but the results imply that the capitalization is either not as important determinant of current profitability of a bank as the thesis was assuming or that the analysis suffers from omission of important data. More complex and detail-oriented analysis shall be performed to study the effects of capitalization precisely enough to draw conclusions.



The results indicate that the original hypothesis expecting a negative effect of current operational efficiency on current profitability may hold. GMM estimates imply negative effects to both ROE and ROA. Additional sets of estimates obtained from estimating the profitability model by FE, OLS, and OLS with bootstrap appear to support the GMM results as these sets of estimates show at least the same signs, the magnitudes are debatable. Due to the size of the dataset, the set of all results rather indicates the existence of the effect than quantifies its magnitude precisely.

In case of ROE, it is implied by the GMM estimate that one percentage point of extra cost-to-income ratio in the current year translates into -0.09 percentage points of extra profitability, i. e., 0.09 percentage points of ROE are lost after increasing the bank's operational cost with respect to its operational income by one percentage point. The 95% confidence interval of the GMM estimate is (-0.11189, -0.06889). As zero is not included in the interval, the presence of the effect indicated by the estimates shall not be rejected.

FE, OLS, and OLS with bootstrap incidate presence of an effect of the same sign, the magnitudes differ by half the magnitude of the GMM estimate. The 95% confidence intervals do not include zeros.

In case of ROA, it is implied by the GMM estimate that one percentage point of extra cost-to-income ratio in the current year translates into -0.006 percentage points of extra profitability, i. e., 0.006 percentage points of ROA are lost after increasing the bank's operational cost with respect to its operational income by one percentage point. The 95% confidence interval of the GMM estimate is (-0.01265, -0.00008). As zero is not included in the interval, the presence of the effect indicated by the estimates shall not be rejected.

FE estimate indicates presence of an effect of the same sign and of a magnitude almost double the magnitude of the GMM estimate – nevertheless, the magnitudes cannot be most probably fully trusted due to the dataset size. The 95% confidence interval excludes zero. Estimates obtained from neither OLS nor OLS with bootstrap are statistically significant.

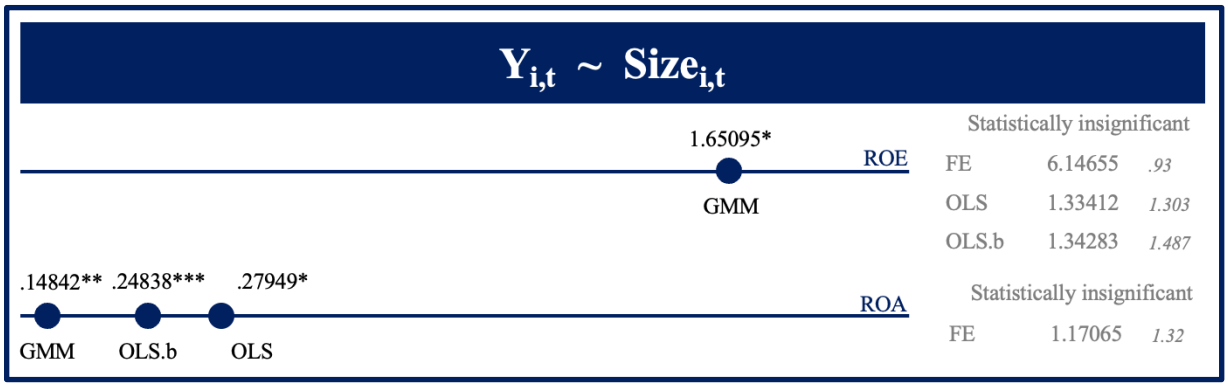
ROE and ROA – Discussion

The differences in estimates of the effects on ROE and ROA are attributable to the different bases of ROE and ROA – in case of ROA, the net income is divided by much greater number than in case of ROE, hence the smaller magnitudes of the estimates of the effects on ROA. As the average capitalization of a bank is around 10% to its total assets, the effect on ROE shall be roughly 10 times greater in magnitude than the one on ROA – this approximately holds.

While all four estimates of the effect on ROE are statistically significant, both OLS estimates of the effect on ROA are lacking statistical significance. There may be several explanations to this including an omitted variable bias. It appears there may be a different pattern in variation of current profitability to assets with current operational efficiency than in the case of current profitability to equity. However, the profitability model is estimated using the same specification to identify the effect on both. If there exists a variable capturing the described difference in variation, it is omitted in the regression using ROA and hence the statistical significance is diminished as the model specification cannot be used to identify the parameter.

Conclusion

The results indicate presence of a negative effect of an instituion's operational efficiency on both ROE and ROA. This is in concordance with what was originally expected to be found as non-efficiency of operations is harming profitability of every business on the planet. The ratio of the estimates roughly respects the ratio of the equity to assets in the sector. The effect's magnitude may appear very low – one percentage point worse operational efficiency taking not even 0.1% of ROE and probably less than 0.01% of ROA. However, the quantification of the magnitudes is not pursued by the thesis due to the limiting size of the dataset. Moreover, this may be very individual to every bank as the operational models of the Czech banks differ significantly from one another.



The results indicate that the original hypothesis expecting a positive effect of an institution's size on its current profitability may hold. GMM estimates imply positive effects of an institution's size on both ROE and ROA. Additional sets of estimates obtained from estimating the profitability model by FE, OLS, and OLS with bootstrap do not support existence of the effect on ROE and may support existence of the effect on ROA. The estimates have the same sign as the GMM ones, both OLS estimates of the effect on ROA differ in their magnitudes from the GMM estimate by roughly 75% of its magnitude. Due to the dataset size and not persuasive statistical significance, existence of the effects is indicated and no claims regarding the effects' magnitude are presented.

In case of ROE, it is implied by the GMM estimate that increasing an institution's size by 1% can deliver extra 1.65 percentage points of profitability to the institution's equity. The 95% confidence interval of the GMM estimate is (0.03674, 3.26516). As such, zero is not included in the interval, the presence of the effect indicated by the estimate may therefore not be a priori rejected.

FE, OLS, and OLS with bootstrap provided estimates that are not statistically significant. The estimate obtained from OLS using bootstrap reports a t-value equal to 1.487 which is near the 10% critical value, has the same sign and similar magnitude as the GMM estimate, but its 90% confidence interval includes zero that lies on its very borderline – the best available support of the effect's existence and its sign implied by GMM.

In case of ROA, it is implied by the GMM estimate that increasing an institution's size by 1% can deliver extra 0.15 percentage points of profitability to the institution's assets. The 95% confidence interval of the GMM estimate is (0.01280, 0.28403). As such, zero is not included in the interval, the presence of the effect indicated by the estimate may therefore not be rejected.

OLS and OLS with bootstrap provided estimates of the same sign and differing magnitude. As OLS may be overestimating the magnitude of the true effects, the ratio of the estimates of the effects on ROE and ROA roughly respects the sector's capitalization – assuming the true effect of size on ROA lies between the GMM and OLS estimates.

ROE and ROA – Discussion

The profitability model was estimated using the following alternative specification:

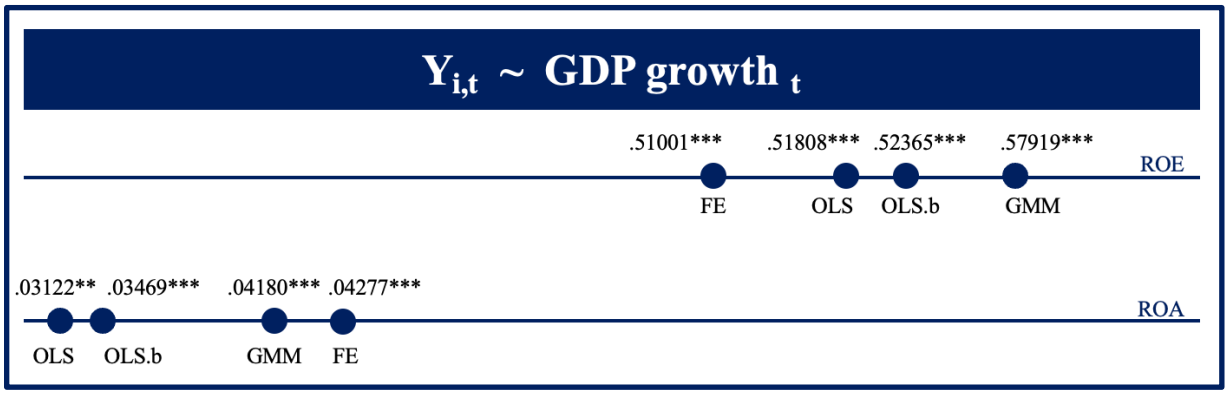
$$Y_{i,t} = \alpha + \delta Y_{i,t-1} + \beta_1 Loans\text{-}to\text{-}Assets_{i,t} + \beta_2 Equity\text{-}to\text{-}Assets_{i,t} + \beta_3 Depo\text{-}to\text{-}Liabilities_{i,t} + \beta_4 Cost\text{-}to\text{-}Income_{i,t} + \beta_5 NPL\text{-}to\text{-}Loans_{i,t} + \beta_6 Size_{i,t} + \theta Size^2_{i,t} + \gamma_1 GDPgrowth_t + \gamma_2 CPIchange_t + \gamma_3 Repo_t + \varepsilon_{i,t}$$

to control for a potentially U-shaped average cost curve which would be indicated if the estimate of the quadratic term controlling for the effect of an institution's size were statistically significant. No useful estimates were provided by such estimation – both estimates of the institution's size effect were not statistically significant.

A positive effect of an institution's size to its profitability implies existence of economies of scale in the sector. That is, large banks are put on comparative advantages at various aspects. The thesis suggests the main advantages include the following: greater institutional efficiency, better access to (cheaper) resources, more advanced liability pricing, greater market power, greater ability to suppress client pressure on liability pricing, access to high-volume transactions with other large institutions, international institutions, advantageous interactions with large parent institutions, and advantages at access to market opportunities including arbitrages. It may also be assumed that the larger the bank, the greater its reputational advantage over the smaller banks – this is attributable to the specific nature of the Czech clients and the sector.

Conclusion

The results indicate presence of a positive effect of an institution's size on its profitability. This is in concordance with what was originally expected to be found as the specifics of the sector favor the large banks over the smaller ones. No claims about magnitudes of the effects are made as the reliability of the estimates does not justify quantification ambitions.



The results indicate that the original hypothesis expecting a positive effect of the state of the country's economy on current banking profitability may hold. GMM estimates imply positive effects of GDP growth on both ROE and ROA. Additional sets of estimates obtained from estimating the profitability model by FE, OLS, and OLS with bootstrap support existence of the effect on both ROE and ROA. The estimates have the same signs as the GMM ones and even their magnitudes are very similar to the GMM estimates' ones. The estimates also report high statistical significance.

In case of ROE, it is implied by the GMM estimate that an additional percentage point of GDP growth in the country in a year translates to 0.58 percentage points increase in banking profitability to equity. The 95% confidence interval of the GMM estimate is (0.31746, 0.84092). As the interval does not include zero, the presence of the GDP growth's effect on banking profitability shall not be rejected.

FE, OLS, and OLS with bootstrap provided estimates of the same sign and similar magnitude as GMM. All three alternative estimates have smaller magnitudes than the GMM one – however, the thesis pursues no magnitude quantification goals and the magnitudes of these estimates are closer to one another than in the case of any previously discussed variable. The 95% confidence intervals all exclude zeros.

In case of ROA, it is implied by the GMM estimate than an additional percentage point of GDP growth in the country in a year translates to 0.04 percentage points increase in banking profitability to assets. The 95% confidence interval of the GMM estimate is (0.02118, 0.06242). As the interval does not include zero, the presence of the GDP growth's effect on banking profitability shall not be rejected.

FE, OLS, and OLS with bootstrap provided estimates of the same signs and similar magnitude as GMM. While both OLS estimates report lower magnitudes, FE reports higher magnitude than the one of the GMM estimate. Neither of the 95% confidence intervals includes zero.

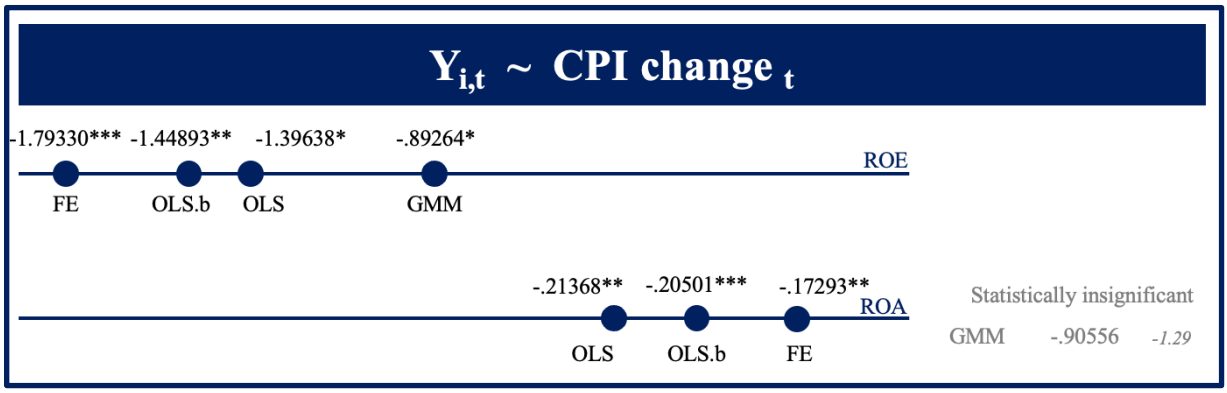
ROE and ROA – Discussion

The logic appears to be apparent – if the economy of a country grows, the profitability of its banking sector grows, too. The economic success of the country may be translating into banking profitability through possibility to increase margins on the assets of the banks and higher degree of monetization of undergone risk – risk premiums charged on risky loans and other assets are not offset by proportionally higher rate of non-performing assets as these are pulled by the economic growth and deliver the interest income to the bank. One of the direct effects of the business cycle may also be households' and firms' greater demand for credit.

It is interesting that a one percentage point increase in the GDP growth is implied to translate to 0.60 percentage points increase in ROE and not more than 0.05 percentage points increase in ROA – it shall not be assumed that the economic growth transfigures into banking profitability 1:1 immediately but the estimates are of a rather high magnitude given the nature of the banking business – as discussed before, banking profits are not made day-to-day and usually even no major part of profits secured by contracts closed in a year is recorded within the same year. The rather high magnitudes of the estimates may partially be explained by the limiting size of the dataset – the magnitudes shall not be 100% trusted. It should be of a thorough effort to conduct an academic research and analysis to uncover the effects of GDP growth on banking profitability as these results indicate the story is not straightforward – the discussion on the suggestion for further research follows later in the respective chapter.

Conclusion

The results indicate presence of a positive effect of the state of the economy of the country to banking profitability. This is in concordance with what was originally expected to be found as it makes the most rational and economic sense to assume that economic growth translates into such an important sector as banking – especially in such a heavily bank-based economy as the Czech Republic's one. Immediate transmission of 60% and 5% to ROE and ROA respectively of one percentage point increase in the country's GDP growth seems much and shall be analyzed further by a separate study as this thesis' results magnitudes are not fully reliable.



The results indicate that the orginial hypothesis expecting existence of a non-zero effect of the change of the CPI in the country on the banking profitability may hold and the literature consensus on negativity of the inflation's effect on banking profitability in developed sectors is hereby endorsed. A GMM estimate (90% statistical significance) implies a negative effect of CPI change on ROE, while it claims nothing about an effect on ROA due to statistical insignificance. Additional sets of estimates obtained from estimating the profitability model by FE, OLS, and OLS with bootstrap support existence of the effect on ROE and indicate presence of the effect on ROA. All estimates report the same sign while they differ in magnitudes.

In case of ROE, it is implied by the GMM estimate that an additional percentage point of CPI change in the country in a year is implied to lead to a 0.89 percentage points decline in the banking profitability. The 95% confidence interval of the GMM estimate is (-1.63765, -0.14763). As the interval excludes zero, the presence of the effect of the change in CPI on current banking profitability shall not be rejected.

FE, OLS, and OLS with bootstrap provided estimates of the same sign and greater magnitudes. The 95% confidence intervals exclude zeros. Due to non-extreme statistical significance of the main estimate (GMM) and less than 99% statistical significance of two of the alternative estimates (and even less than 95% statistical significance of one of the two estimates), there is no ambition to quantify the magnitudes of the effects precisely.

In case of ROA, no effect is indicated by the GMM estimate as it lacks statistical significance. A triplet of alternative estimates provided by FE, OLS, and OLS with bootstrap reports estimates ranging from -0.21368 to -0.17293, i. e., an additional percentage point of CPI change in country in a year is implied to lead to a 0.17% to 0.21% decline in the banking profitability. The 95% confidence intervals all exclude zero.

ROE and ROA – Discussion

The dispersion of magnitudes of the four obtained – although statistically significant – estimates is of a rather high degree and hence no claims are made about the size of the effect of CPI change on ROE. Although the FE method is usually believed to underestimate the true effect of a parameter and the OLS method is usually believed to overestimate the true effect of a

parameter, the GMM estimate does not fit between the two (three) in this case which only increases the awareness about non-reliability of the estimates' magnitudes. The ratio of estimates of the effect on ROE and on ROA roughly respects the proportion of sector's equity to sector's assets. The GMM estimate of the effect on ROA is not statistically significant, the alternative estimates provide an indication of existence of a negative effect on ROA.

When it comes to explanation of the negative sign of the effect, there are many factors potentially influencing the banking profitability through inflation. The explanations may be divided into two categories: the ones based on banking theory, and the ones based on understanding banking practice.

The most obvious theoretical explanation is built on the mismatch of durations between a bank's liabilities (short-durated) and assets (long-durated). Positive changes in CPI, that is, positive inflation[29] pressurize the overall interest rate level in the country. As the interest rate environment moves towards higher rates, a bank's liabilities featuring shorter duration than its assets are hit more severely – a greater proportion of the liabilities is repriced sooner than assets are affected. A bank's liabilities represent a set of balance sheet items that must be paid for – hence, the bank's costs go up as the financing of its assets gets more expensive. As such, the bank's profitability is harmed under a positive change of price level in the country as the duration mismatch channels the effect on the liabilities sooner and at greater immediate scale. The profitability model used by this thesis only regresses the current profitability on the current change in the consumer price index, therefore long-term adjustments and effects on assets delayed by their long durations and gradual balancing are not seen by the model.

However, this explanation utilizes several assumptions that may not be met. First of all, it assumes that the positive change in the price index is communicated and recognized by the country immediately – which is not true in the real world. This kind of data features a considerable delay in time and hence it is not meaningful to assume that every household and every firm in the country sense the inflation immediately and begin pressurizing their counterparties for higher wages or higher prices. Also, the previously described market forces do not work as promptly to present a substantial pressure as soon as the inflation level is announced – neither bargaining for higher wages nor large-scale repricing of goods and services are done in days and rather take weeks or months for several reasons.

The practical side of the problem involves the role of the central bank. As inflation leaves the range of tolerance, central bankers decide to perform a hike – the key policy rate is raised. Such a move immediately increases the interest rate level in the Czech banking sector through a

[29] No accelerating inflation! YoY difference in CPI equal to zero means that the CPI remained at the very same level, hence the price index did not change, hence the price level did not change. Positive changes of CPI signal positive inflation, not accelerating inflation!

simple mechanism: a greater proportion of banks' liabilities price is derived from a PRIBOR[30] rate which is closely connected to the key policy rate – the two weeks repo rate. As the repo rate goes up, PRIBOR rises, too – banks' liabilities are hit immediately, and the banks are paying more for financing of their assets. However, a liability of a Bank A is recorded as an asset of a Bank B – which is with non-zero probability a Czech bank operating in the Czech sector. Hence, the amount lost due to increased financing cost is recovered within the sector through higher yield on float-rate assets.

In addition to that, a major part of corporate loans provided by banks to non-financial enterprises in the country is charged a floating rate – again, derived from a PRIBOR rate. As such, rising price level pressurizing the interest rate level is bringing additional revenues to banks as the rates they charge on their floating assets go up.

The importance of the role of the central bank certainly assumes a relatively prompt reaction – which may not be true. The CNB's board meetings concerned with the interest rate decisions are run several times a year – with an average time between the meetings being approximately 7 weeks in normal times. Thus, the CNB's promptness at acting cannot be assumed to be full. Also, the central bank has been making rather cautious moves in the recent years – therefore, it may be assumed that its first interest rate decision driven by the bankers' desire to react to the inflation is not going to be of the magnitude needed to tackle the inflation.

Clearly, the mechanism which transmits the effect of inflation to banking profitability with a negative sign in not a simple one and would require targeted analyses to empower economists with robust estimates which could form a basis upon which conclusions could be formulated.

It shall always be explored whether the relationship found in the data is or is not driven by a purely random correlation. This case certainly poses a suspicion – the inflation was stable and low 2015 – 2019 and banking profitability was steadily rising and high in those times. In 2020, banking profitability suddenly dropped, and inflation suddenly went up. The profitability model was therefore estimated using data excluding the year 2020, too, to explore whether the identified negative effect of CPI change was driven by the coincidental countermovement of profitability and CPI change in 2020. However, the results did not change much – the negative effect of CPI change persisted in the model even after exclusion of 2020 and the overall quality of the estimation worsened substantially as an already small dataset was additionally trimmed.

It should also be explored what the co-movement of CPI change and Repo is and how it influences banking profitability. By default, the sign of the correlation coefficient is expected to be negative – as inflation rises, central banks begin tightening the monetary conditions by performing hikes, i. e., raising the key policy rate – the repo rate. With the suspicion that the

[30] Prague Interbank Offered Rate

CPI change variable may be masking the effect of Repo, several regressions were run using system GMM and FE to explore how the effects change with in- or excluding the variables of interest. The following table briefly summarizes what was found.

Exhibit 10, ***Summary of results: Including and excluding CPI change and Repo in and from the model specification***

Source: Author

Method & DepVariable	CPI change included	Repo included	CPI change stat. signif.	Repo stat. signif.	Quality of results
GMM_ROE	✓	✓	yes	no	original
GMM_ROE	✓	✗	yes	-	almost original
GMM_ROE	✗	✓	-	no	poor
GMM_ROE	✗	✗	-	-	poor
GMM_ROA	✓	✓	no	no	original
GMM_ROA	✓	✗	yes	-	almost original
GMM_ROA	✗	✓	-	no	poor
GMM_ROA	✗	✗	-	-	poor
FE_ROE	✓	✓	yes	no	original
FE_ROE	✓	✗	yes	-	almost original
FE_ROE	✗	✓	-	no	poor
FE_ROE	✗	✗	-	-	poor
FE_ROA	✓	✓	yes	no	original
FE_ROA	✓	✗	yes	-	almost original
FE_ROA	✗	✓	-	no	poor
FE_ROA	✗	✗	-	-	poor

All possible model specifications including or excluding the two variables of interest were estimated using system GMM and FE, original models highlighted in grey. Excluding Repo from the specification while keeping CPI change (rows following the original specification) did not harm statistical significance of the coefficient of CPI change but worsened the overall performance of the model in all four cases (GMM and FE, ROE, and ROA). Excluding CPI change from the specification while keeping Repo (third rows) provided a statistically significant coefficient of Repo in neither case using GMM nor FE and estimating the effects on ROE or ROA. Moreover, the overall performance of the model worsened severely which signals omission of an important variable. Excluding both variables from the specification had effects very similar to exlucing CPI change solely.

Conclusion

The results indicate presence of a negative effect of the CPI change on both ROE and ROA. The research and results performed within the efforts of this thesis are not complex enough to provide a full explanation of the mechanism causing the inflation to transfigure into banking profitability negatively within a year.

Estimating several alternative model specifications supported existence of the effect of CPI change and provided no evidence for the discussed potential effect of Repo. This is in line with the hypothesis of low residual margin kept by the mediating banks as discussed in section developing Hypothesis 10 in the chapter Data & Methodology – Hypotheses. It shall also be noted that throughout the observed time 2015 – 2020, CPI changes in the country were of rather a moderate magnitude and interest rates in the country were relatively low. Different effects of inflation or none effect at all may be present in the sector under different conditions. The results concerning inflation may be highly state-sensitive.

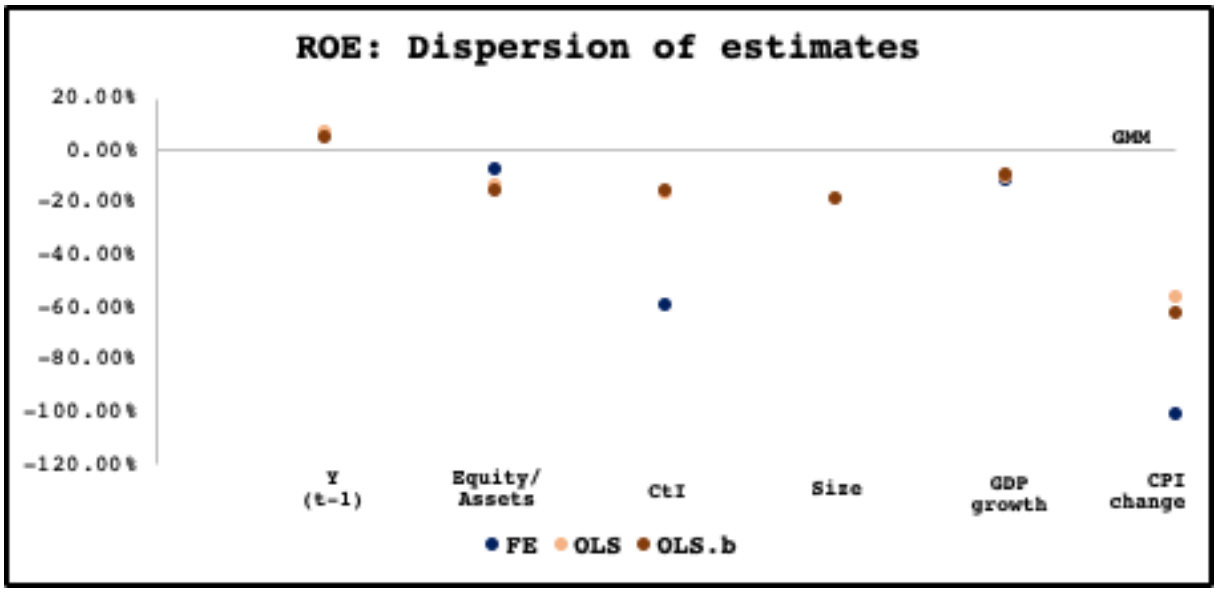
5.2.4 Dispersion of estimates

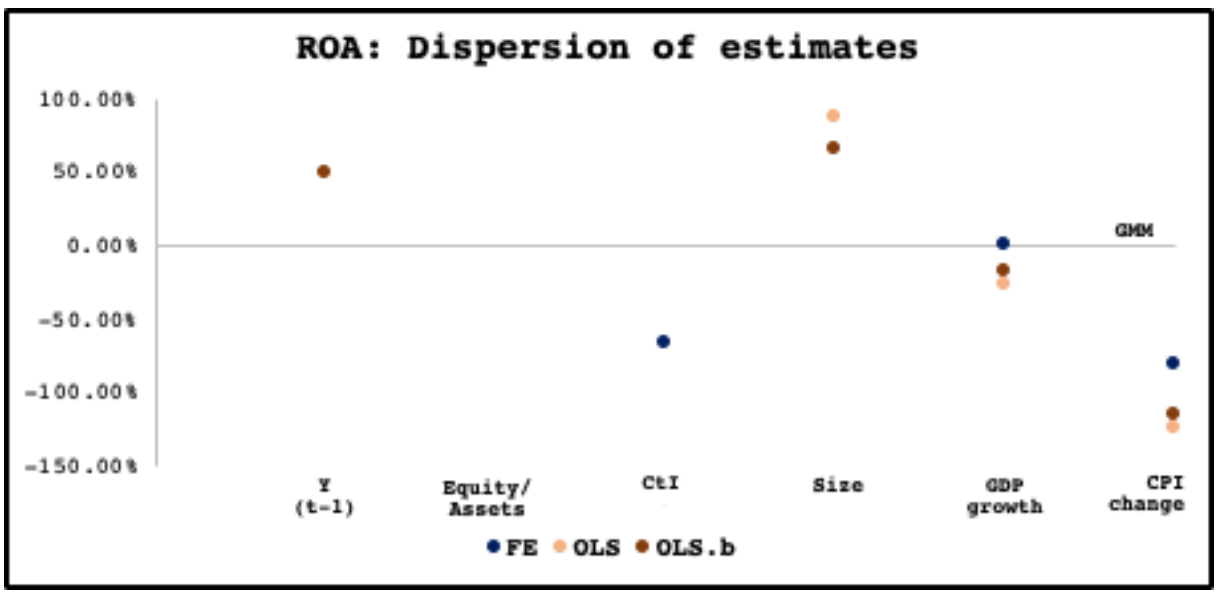
The following chart displays dispersion of the estimates obtained from GMM, FE, OLS, and OLS with bootstrap. Only statistically significant estimates are shown here. The magnitude of the GMM estimate is used as the base. In case the respective GMM estimate is not statistically significant, an average of all statistically significant estimates is used as the base.

Exhibit 11, ***ROE: Dispersion of estimates***

Exhibit 12, ***ROA: Dispersion of estimates***

Source: Author





In most cases, the magnitudes of the estimates of effects to both ROE and ROA differ from the ones of the GMM estimates, i. e., the estimates obtained from the main method employed in this thesis, substantially – hence, quantification of magnitudes of the effect would require deeper analyses using more suitable datasets. In this thesis, showing existence of the effects is pursued. Regarding the magnitudes, suggestions for further research are discussed later.

5.3 Banking profitability: Quarterly model

The following table summarizes the results of regressing the quarterly dependent variable on its lagged values and a set of explanatory variables using quarterly data and system GMM estimator.

Exhibit 13, ***System GMM: Quarterly data***

Source: Author in Stata 17

System GMM: Quarterly data				
	ROE		**ROA**	
	Estimate	z	Estimate	z
Y(t-1)	0.00566	0.16	-0.06313	-0.20
Loans/Assets	-0.00648	-0.68	0.00557	0.59
Equity/Assets	**-0.08187***	-1.82	-0.00310	-0.53
Depos/Liabs	0.00053	0.10	0.00008	0.17
Cost-to-Income	-0.00706	-0.98	**-0.00125***	-1.94
NPL/Loans	0.00423	0.26	0.00028	0.14
Size	**0.00472*****	3.74	**0.00022****	1.99
GDP growth	-0.00092	-0.81	0.00009	1.30
CPI change	**-0.04473*****	-7.62	**-0.00321*****	-3.36
Repo	**0.00005*****	2.92	0.000001	1.52
N (observations)	543		543	
N (groups)	22		22	
N (instruments)	12		12	
AR (1)	-3.35	0.001	-2.49	0.013
AR (2)	-0.002	0.997	0.42	0.676
Sargan	3.58	0.167	16.86	0.001
Hansen	5.38	0.068	4.20	0.872

Statistical significance: * 0.10, ** 0.05, *** 0.01

Estimate reports the parameter estimate of each explanatory variable, *z* reports a z-statistic of the estimate (critical values 1.65, 1.97, and 2.33), twostep estimator and heteroscedasticity-corrected standard errors are used[31], *N (instruments)* reports the number of instrumental variables used by the system GMM estimator within its optimization mechanism (three for the

[31] Uncorrected SEs unreliable with a dataset of size (N, T) = (22, 25)

lag identification, nine explanatory variables treated as exogenous), *AR (i)* reports a test of serial correlation of i-th order, *Sargan* and *Hansen* report a Sargan's J-test and a Sargan-Hansen test of overidentifying restrictions.

5.3.1 Model specification, reliability, and inference

The specification includes all explanatory variables that are available in the dataset. The quarterly data comprises of 22 banks reporting over 25 quarters, seven observations are missing[32]. Both regressions – ROE and ROA – reject null hypothesis of a test of serial correlation of order one at 5% and do not reject a test of serial correlation of order two at 5%. Neither Sargan nor Hanses test of validity of overidentifying restrictions is rejected (p-values over 5%) in case of ROE, Sargan test is rejected in case of ROA, Hansen test is not rejected. However, Hansen test is more important at system GMM model performance evaluation and as such, rejecting the Sargan test does not present a major obstacle to trustworthiness of the results given the usage desired by the thesis. The twostep estimator is generally robust to any pattern of heteroscedasticity and corrected standard errors of the parameter estimates are used. Results of the regression with quarterly data is used to check for presence of effects uncovered by running the regression with yearly data and to potentially discover any discrepancies between what can be found in yearly and quarterly data.

The relatively high degree of first-order autocorrelation present in the model may well be utilized at identification of the dependent variable's lags used as instruments for its first lag. This is utilized to control for the suspected endogeneity of the model introduced by regressing a variable on its own lagged values. However, the small size of the dataset (22 banks only) may present a limit at the identification of the autocorrelation itself which is an additional reason to pursue rather uncovering of existence of the effects than their precise quantification.

While yearly data do not face the problem of seasonality, inter-quarter variation is omitted at yearly frequency. Using quarterly data to estimate the profitability model may provide insights that cannot be captured with the yearly data only – there are events in banking business that are seasonal or happen once in a year only. Yearly profitability may be determined by a different set of factors than quarterly profitability – although a bank's yearly NI is a sum of four quarters and a bank's ROE is approximately a sum of four quarters, different effects may be discovered. Mainly, the lagged profitability represents a three-months old performance only instead of a twelve-months old performance. As such, the quarterly persistence of profitability may for sure differ from the yearly one which necessarily means that the quarterly effects of the other variables must not equal the effects provided by regressions using yearly data.

[32] 1, 2, 3, 4Q15 Hypotecni banka and 1, 2, 3Q15 Expobank

5.3.2 Results: General remarks

The results obtained from the profitability model estimated by system GMM indicate existence of non-zero quarterly effects of GDP growth, CPI change, and Repo on banking profitability. The results signal there may exist a quarterly effect on current banking profitability mediated through past performance, capitalization, operational efficiency, and size of the institution.

Indicated effects' signs are the same as implied by the results provided by the regressions with yearly data – a negative effect of capitalization, a negative effect of operational efficiency, a positive effect of size, a positive effect of GDP growth, and a negative one of CPI change. While the yearly results indicate a positive effect of past profitability, the quarterly results indicate a negative one. Also, the quarterly results imply a positive effect of Repo on banking profitability, but no effect of Repo was previously found in the yearly data.

The table on then next page displays the four obtained sets of estimates from GMM, FE, OLS, and OLS with bootstrap:

Exhibit 14, ***Complete results: Quarterly data***
Source: Author

Quarterly data												
	GMM				FE				OLS				OLS.b			
	ROE		ROA		ROE		ROA		ROE		ROA		ROE		ROA	
	Estimate	z	Estimate	z	Estimate	z	Estimate	z	Estimate	z	Estimate	z	Estimate	z	Estimate	z
Y(t-1)	0.00566	0.16	-0.06313	-0.20	-0.27654***	-15.06	-0.28707***	-19.48	-0.27374***	-6.53	-0.28510***	-3.95	-0.27407***	-6.58	-0.27150***	-6.58
Loans/Assets	-0.00648	-0.68	0.00557	0.59	0.01207	0.61	0.00095	0.58	0.00160	0.11	0.00076	0.72	0.00389	0.24	0.00275	0.17
Equity/Assets	-0.08187*	-1.82	-0.00310	-0.53	-0.03518	-0.44	0.00190	0.24	-0.08907	-1.27	-0.00337	-0.43	-0.08930	-1.29	-0.08730	-1.28
Depos/Liabs	0.00053	0.10	0.00008	0.17	0.04629	0.89	0.00490	0.76	-0.00463	-0.50	0.00002	0.02	-0.00504	-0.51	-0.00438	-0.45
Cost-to-Income	-0.00706	-0.98	-0.00125*	-1.94	-0.01184	-1.11	-0.00136	-1.61	-0.01449*	-1.69	-0.00131**	-2.03	-0.01727	-1.61	-0.01517	-1.61
NPL/Loans	0.00423	0.26	0.00028	0.14	0.02102	1.35	0.00321	1.39	0.00510	0.26	0.00198	1.02	0.00666	0.44	0.00707	0.47
Size	0.00472***	3.74	0.00022**	1.99	-0.00323	-0.17	0.00093	0.47	-0.00123	-0.33	0.00020	0.58	-0.00161	-0.39	-0.00187	-0.46
GDP growth	-0.00092	-0.81	0.00009	1.30	0.00172	1.39	0.00017***	2.95	0.00174**	2.17	0.00017***	3.25	0.00177***	2.51	0.00170***	2.44
CPI change	-0.04473***	-7.62	-0.00321***	-3.36	-0.04492***	-6.24	-0.00390***	2.95	-0.04485***	-10.80	-0.00389***	-9.73	-0.04512***	-10.84	-0.04468***	-10.91
Repo	0.00005***	2.92	0.000001	1.52	0.00006***	3.73	0.00001***	4.02	0.00007***	2.50	0.00001*	1.84	0.00007***	2.47	0.00007***	2.51
Constant					0.00413	0.03	-0.00946	-0.65	0.04568	1.11	0.00009	0.02	0.04832	1.09	0.04963	1.17
N (observations)	543		543		521		521		543		543		543		543	
N (groups)	22		22		22		22		22		22		22		22	
N (instruments)	12		12													
AR (1)	-3.35	0.001	-2.49	0.013												
AR (2)	-0.002	0.997	0.42	0.676												
Sargan	3.58	0.167	16.86	0.001												
Hansen	5.38	0.068	4.20	0.872												
R-sq (within)					0.269		0.256									
Corr(u_i, Xb)					-0.395		-0.345									
R-sq									0.268		0.254					
R-sq adjusted									0.253		0.239					
F-stat (df)					118.61***	10,21	88.02***	0.001	18.63***	10,510	17.34***	10,510				

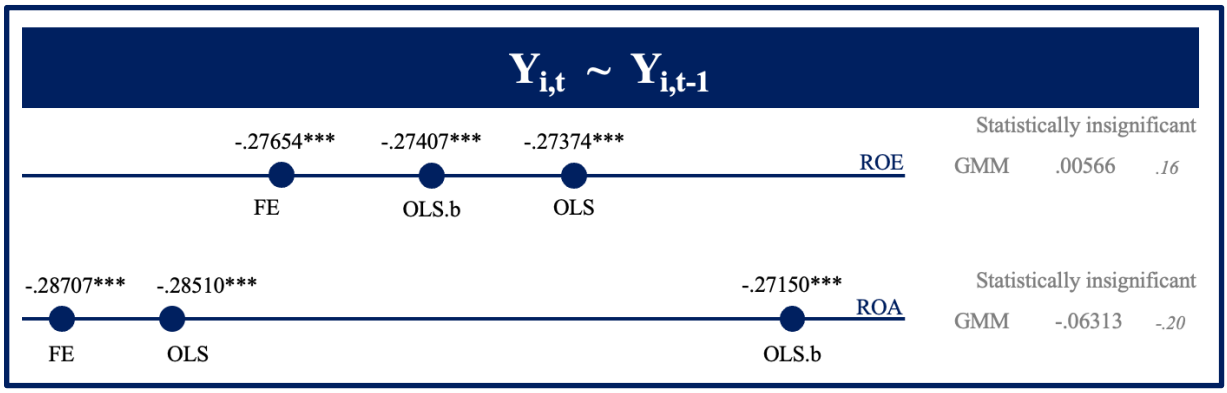
Statistical significance: * 0.10, ** 0.05, *** 0.01

5.3.3 Results: Discussion and partial conclusions

The following pages discussing the results are accompanied with diagrams providing additional estimates obtained from FE, OLS, and OLS with bootstrap so that the GMM results are challenged by alternative sets of results. Also, as the dataset is rather narrow in the cross-section (22 banks only), alternative sets of estimates provide robustness checks as well as rough ideas about the potential bias of the GMM results or the potential signs and magnitudes of the estimates. The quarterly results are mainly presented to cross-check the findings obtained from the yearly results and to potentially uncover any new facts that would have been missed under the usage of the yearly results only. Statistically significant results only are discussed in the following part.

An effect of Equity/Assets on ROE is found by GMM only – this is excluded from the following discussion as one-out-of-four statistical significance does not justify presenting existence of such effect at quarterly frequency alongside the yearly effect. However, the issue is debated further in the section concerned with suggestions for further research.

Note: The diagrams omit unitary zeros in pursuit of space saving in the same manner as previously. All other aspects and notations hold as previously.



The results indicate a negative effect of last-quarter profitability on the current-quarter profitability. This discovery acts against the original hypothesis of positive persistence of banking profitability. However, both GMM estimates of effects on ROE and ROA are not statistically significant and since system GMM is the main method of the thesis as it is the only one capable of controlling for endogeneity, extreme degree of awareness shall be applied at interpreting these results.

In case of ROE, it is implied by the other estimates that one percentage point of extra profitability in the last quarter translates into a decline in profitability in the current quarter. The indicated size is slightly below -0.27 percentage points and is mutually supported by all three estimates. The 95% confidence intervals all exclude zeros.

In case of ROA, it is implied by the other estimates that one percentage point of extra profitability in the last quarter translates into a decline in profitability in the current quarter. The indicated size is around -0.27 percentage points and is mutually supported by all three estimates. The 95% confidence intervals all exclude zeros.

ROE and ROA – Discussion

It is surprising that a bank's past profitability is implied to influence the current profitability negatively at quarterly basis. As aforementioned, the results must be interpreted with tolerance for imperfection of estimates' inference – not only are the GMM estimates not statistically significant but also are the results provided by regressions using a limited dataset.

Nevertheless, let it be assumed that the negative effect of past profitability holds, that is, higher profitability in the last quarter is immediately implied to be offset by reduced profitability in the following quarter. The explanation may be more realistic than it seemed right after being spotted. Studying a bank's profitability quarter-to-quarter certainly does not allow for combining as many events on both the sectoral and the respective-bank-specific level into one data entry. In other words, quarterly data on a bank's profitability do not allow for as substantial period-to-period differences as the yearly data. Consequently, quarterly profitability would tend to be much less deviating from its moving average based on several past datapoints. Then, a negative coefficient of the past profitability would imply that one percentage point of extra

profitability in a quarter surpasses the level of usual or average deviation from the moving average because in the very next quarter, the profitability is pulled back towards the moving average. In other words, the regression results imply that deviations from a bank's past profitability is immediately partially corrected.

This purely theoretical and technical explanation must be challenged with banking practice and reality. The most important question at solving the problem of immediately correcting profitability is the following: Is there anything in the banking business that boosts profitability at time t and poses no effect ever in future?

The answer is most probably yes, it does. Although the banking business is mostly centered around long-durated assets delivering regular instalments and interest income driven cash inflow, banks record several types of incomes that can be treated as one-time incomes given quarterly reporting frequency.

Let it be assumed a bank identifies an opportunity to execute a transaction (or more of them) of a certain type (let a repo transaction with the central bank be used in this example) with a positive NPV of a great magnitude at time t. The bank rationally decides to use this opportunity to boost its net income. It is assumed that a repo transaction is the subject transaction – hence, the profit is recorded immediately. Let it be assumed the opportunity's nominal value is big enough to pose a significant effect on the entire quarter's profitability.

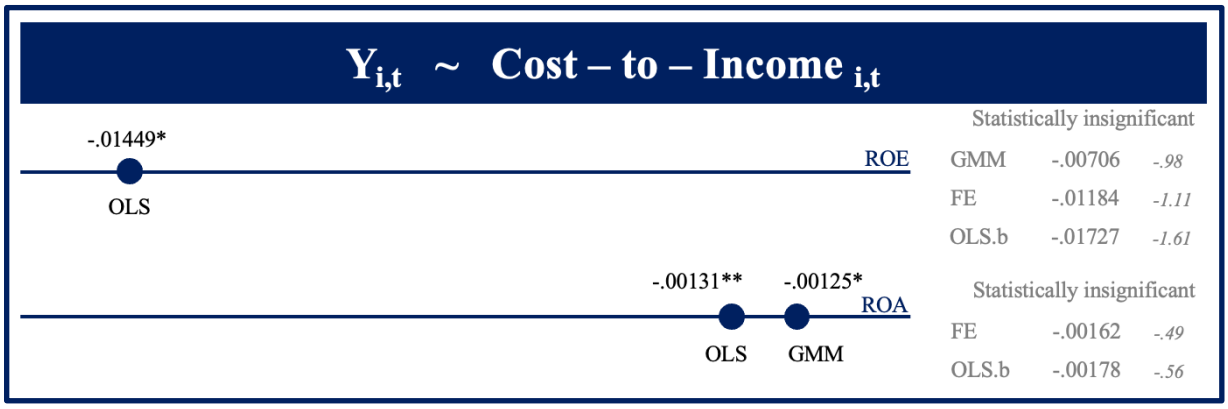
What if this opportunity is not identified in the following quarter? The bank continues its daily operations as it had been doing all the time in past – this time, without the substantial profit made on the subject transaction(s). The following quarter's profit is hence going to be lower by roughly the amount of the subject transaction's profit – the following quarter's profitability is hence immediately corrected down in comparison to the previous quarter.

Does this explain the negative coefficients? It does certainly not. Not only might nominal profit's corrections be partially explained by this instead of percentage profitability of the bank with respect to its assets or equity, but also such an effect features two components, and the immediate correction of the profit is the one coming after the other one. The described theoretical case would of course include the bank's profit being corrected down right after losing the chance to use the described opportunity, but the bank's profit would have been suddenly boosted after the opportunity was identified which would as such leave its footprint in the data saying: "the profit was boosted suddenly and corrected down followingly" instead of "the profit is corrected down immediately after a positive shock". Thus, this does not explain the negative coefficients of the past profitability. It would require continued and more detailed analyses and greater quality of the used data to uncover the pattern of persistence of quarterly profits in the banking sector.

Conclusion

The results indicate there may exist a negative effect of the past quarterly performance on the current quarterly performance. However, the effect is only indicated by supplementary methods used in this thesis since the main method – system GMM – does not identify any pattern in past-current profitability co-movement. Moreover, the thesis fails to provide a suggestion or a logical explanation of the negativity of the estimates of the coefficients of the past profitability.

Based on all afore described, the thesis does not state that existence of an effect of past profitability to current profitability at quarterly basis has been indicated.



The results may indicate a negative effect of bad operational efficiency on banking profitability. This would be in line with the originally expected sign of the coefficient. However, the GMM estimate of the effect of Cost-to-Income ratio on ROE is not statistically significant. The effect on ROE is only supported by the estimate obtained from an OLS regression without using bootstrap to improve the estimate's inference. One-in-four statistical significance not including the main method is considered unreliable and the effect on ROE at quarterly basis is hence not regarded as indicated by the regression results. The results of estimating the effects on ROA provide two statistically significant estimates including the estimate obtained from system GMM – which is statistically significant at 90% only.

In case of ROA, it is implied by the GMM estimate that cost-to-income ratio higher by one percentage point translates into a decline of ROA by slightly more 0.001 percentage points. The 95% confidence interval of the estimate is (-0.00251, -0.00002) and excludes zero.

One additional estimate provided by OLS without bootstrap is statistically significant – the 95% confidence interval includes zero and with the bootstrap that shall usually imrpvoe the estimates's inference, statistical significance is lost. No statistically significant estimate of the effect on ROA is provided by any of the other methods. Based on this, the thesis does not claim uncovering the effect's existence on ROA.

ROE and ROA – Discussion

While there exists a firm basis upon which support of existence of the effect of operational efficiency on yearly banking profitability can be developed, the quarterly results do not provide any convincing evidence of the effect's existence at quarterly basis. Although the OLS estimate of the effect on ROE without bootstrap provides a 95% confidence interval excluding zero, its statistical significance is 90% only and all the other estimates are statistically insignificant, situation with ROA not much better.

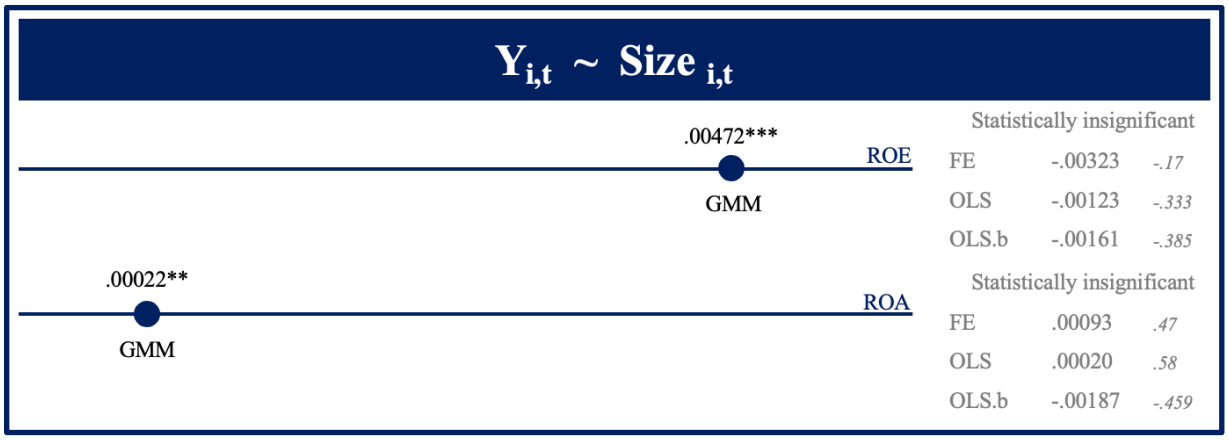
Strangely enough, it shall be crystal clear that severe operational efficiency harms a bank's profitability and yet no firm evidence is provided by the regressions. Moreover, the yearly cost-to-income is nothing other than a sum of quarterly operational costs over sum of quarterly

operational incomes. The banking- and business-driven point of view certainly endorses existence of the negative effect of high CtI on current profitability.

The explanation for not uncovering any pattern in countermovement of quarterly operational efficiency and profitability may be found in the quality of data, more specifically in high variance. The standard deviation of the Cost-to-Income variable is roughly 75% of its mean. Hence, the data dispersion is rather wide and given the small dataset, the effect cannot be properly identified. This effect would for sure require a thorough analysis utilizing better data for claims to be made about the operational efficiency's influence on a bank's profitability. Further discussion follows in the chapter focusing on suggestions for further research.

Conclusion

Although it makes perfect economic sense to claim existence of the negative effect of bad operational efficiency on a bank's profitability, the regression results using quarterly data provide no evidence to state that. However, the thesis finds it is rather an issue of the dataset as it is clearly based on both economic causality and accounting principles that the worse operational efficiency, the lower profitability.



The results indicate that the original hypothesis expecting a positive effect of an institutions's size on its current profitability may hold. GMM estimates imply positive effects of an institution's size on both ROE and ROA at quarterly basis. Additional sets of estimates obtained from estimating the profitability model by FE, OLS, and OLS with bootstrap are lacking statistical significance at every estimate. The ratio of the GMM estimates does not even approximately respect the sector's ratio of equity to assets – the estimate of the effect on ROE is more than 20 times greater in magnitude than the one of the effect on ROA.

In case of ROE, it is implied by the GMM estimate that increasing an institution's size by 1% can deliver extra 0.005 percentage points of quarterly profitability (- 79 -pprox.. 0.02 perc. Points of yearly profitability) to the institution's equity. The 95% confidence interval of the GMM estimate is (0.00225, 0.00718). As such, zero is not included in the interval, the presence of the effect indicated by the estimate may therefore not be a priori rejected.

No other statistically significant estimate is provided by any of the remaining methods.

In case of ROA, it is implied by the GMM estimate that increasing an institution's size by 1% can deliver a very little extra profitability to the institution's assets. The 95% confidence interval of the GMM estimate is (3.43e-06, 0.00044). As such, zero is not included in the interval, the presence of the effect indicated by the estimate may therefore not be rejected.

No other statistically significant estimate is provided by any of the remaining methods.

ROE and ROA – Discussion

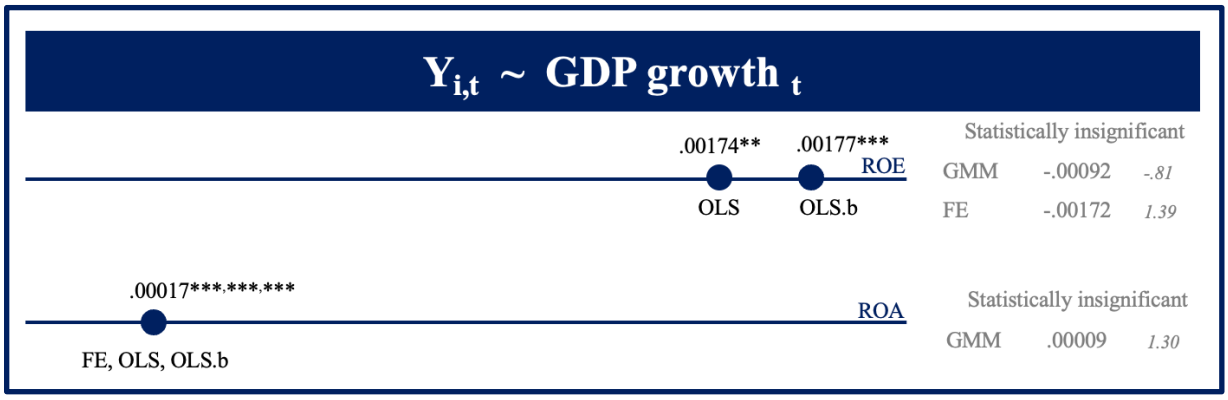
The profitability model was estimated with an additional variable, too – Size squared – included in the model specification in the same manner as in the case of yearly data to control for potential non-linearity of the size's effect on banking profitability. No useful estimates were provided by such estimation – both estimates of the institution's size effect were statistically significant with neither method used.

The findings obtained with quarterly data are statistically less powerful than those obtained with yearly data and do not differ in major characteristics – the sign of the effect. Partial loss

of statistical significance (no statistically significant estimates of the effect on ROA) may be explained by greater amplitude of the data variation and limited number of cross-sectional units used to identify the effect.

Conclusion

The results obtained from estimating the profitability model at quarterly data support the findings of the regression with yearly data. Size is indicated to have a positive effect on banking profitability in the Czech sector.



The results indicate a positive effect of GDP growth on banking profitability. The findings are in line with what was previously discussed regarding the yearly data. Nevertheless, both GMM estimates of effects on ROE and ROA are not statistically significant and since system GMM is the main method employed in the thesis, extreme degree of awareness shall be applied at interpreting the results.

In case of ROE, the two statistically significant estimates obtained from OLS without and with bootstrap imply that one percentage point of extra quarterly GDP growth in the country can add slightly less than 0.002 percentage points of banking profitability, that is, roughly 0.008 percentage points of extra profitability may be achieved in a year assuming that the persistence of the effect would be sufficient to allow for it. 95% confidence intervals exclude zeros.

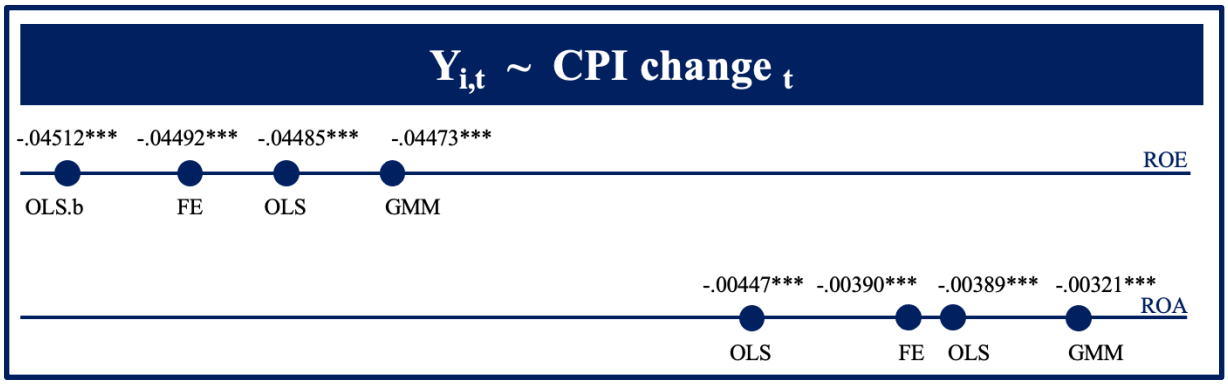
In case of ROA, all three statistically significant results evaluate the effect of a percentage point shock to quarterly GDP growth to be equal to slightly less than 0.002 percentage points of extra profitability brought to a bank, that is, roughly 0.008 percentage points in a year under the previously stated assumption. All confidence intervals exclude zeros.

ROE and ROA – Discussion

Even though both GMM estimate are not statistically significant, the other estimates are not only statistically significant but also do not differ from one another much in terms of their magnitudes. Combined with what was found using yearly data, it may be claimed there is an effect of quarterly GDP growth on quarterly banking profitability – however, further efforts at uncovering the patterns would be much appreciated as the main method capable of controlling from endogeneity is failing to provide evidence for existence of the effect in this case.

Conclusion

Combined with the findings from yearly data, there is a high probability of existence of the effect at quarterly basis, too, but is not supported by system GMM results. Hence, stating that the effect of GDP growth on quarterly profitability exists is rather driven by the author's judgement and intuition than pure data-driven analysis exclusively. Nevertheless, detailed further analyses would be required to provide more firm evidence at the quarterly basis.



The results indicate that the original hypothesis expecting existence of a non-zero effect of the change of the CPI in the country on the banking profitability may hold. The findings are in line with what was previously discovered using yearly data. Both GMM estimates are statistically significant and imply negative effects of CPI change on both ROE and ROA. Additional sets of estimates obtained from estimating the profitability model by FE, OLS, and OLS with bootstrap support existence of the effect on ROE and ROA. All estimates report the same sign and do not differ in magnitudes much.

In case of ROE, it is implied by the GMM estimate that an additional percentage point of CPI change in a quarter results in 0.04 percentage points decline in the quarterly banking profitability (~0.16 pct pts yearly). The 95% confidence interval of the GMM estimate is (-0.05624, -0.03323).

FE, OLS, and OLS with bootstrap provided estimates of the same sign and similar magnitudes. The 95% confidence intervals all exclude zeros, all estimates including the GMM one report very high statistical significance.

In case of ROA, it is implied by the GMM estimate that an additional percentage point of CPI change in a quarter results in roughly 0.004 percentage points decline in the quarterly banking profitability (~0.016 pct pts yearly). The 95% confidence interval of the GMM estimate is (-0.00508, -0.00134).

FE, OLS, and OLS with bootstrap provided estimates of the same sign and similar magnitudes. The 95% confidence intervals all exclude zeros, all estimates including the GMM one report very high statistical significance.

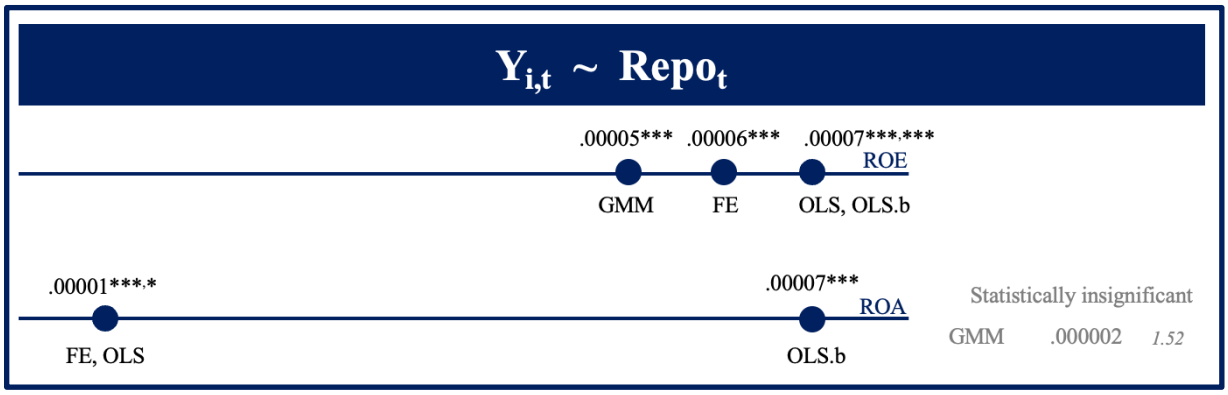
ROE and ROA – Discussion

The results are in line with the yearly results and report even better statistical significance and narrower confidence intervals. This may signal that the co-movement of the banking profitability and GDP growth quarter-to-quarter is interlinked.

The ambiguity introduced by insignificance of the Repo variable as discussed in the chapter dealing with yearly data is not relevant in this case as the Repo variable reports statistical significance, too.

Conclusion

The results confirm previously discovered negative effect of CPI change on banking profitability – this time at the quarterly basis. The results feature high statistical significance and did not have to be tested for spurious correlation with Repo as the latter provided statistically significant estimates of its effects as well.



The results indicate that the original hypothesis expecting rather small magnitude of a potentially existing effect may hold. The effect on ROE is supported by a statistically significant GMM estimate, the effect on ROA is supported by all other estimates but by the GMM estimate.

In case of ROE, it is indicated by the GMM estimate that one additional basis point of Repo can translate into 0.00005 percentage points of extra profitability. Hence, a standard hike performed by the central bank and kept for the entire quarter can induce additional profitability of 0.00125 percentage points in a quarter. The 95% confidence interval of the GMM estimate is (0.00002, 0.00008).

FE, OLS, and OLS with bootstrap provided estimates of the same sign and similar magnitudes, all 95% confidence intervals exclude zeros.

In case of ROA, the GMM estimate is not statistically significant. It is implied by all other estimates that a standard hike can induce additional profitability of 0.00025 to 0.00175 percentage points of extra profitability in a quarter. All three estimates are statistically significant, and their 95% confidence intervals exclude zeros.

ROE and ROA – Discussion

The results provide considerable evidence of the effect on ROE and the indication of the effect on ROA may not be a priori disregarded, too. It is generally believed that the interest rate environment majorly determines the banking profitability – through increasing interest rate level, banks boost their revenues, widen their margins, and can secure more net income. Certainly, the nominal values of banks' revenues go up with interest rates. But so do the nominal values of their costs. An explanation of very low coefficients of the effect of Repo on banking profitability is suggested in the following paragraph.

The profitability metrics of a bank expresses its ability to translate a certain part of its assets or equity into a profit. As such, profitability can be highered by high-margin business and – analogously – cannot be highered by transactions with low margins. The famous repo transactions with the central bank are the case of the low margins. Banks that perform these transactions in the Czech banking sectors do not usually use their own liquidity to earn the

interest income stemming from the magnitude of the repo rate – they are rather playing the role of the mediator. It is the liquidity provided by their parent institutions residing in foreign countries that gets deposited by the Czech subsidiaries into the Czech National Bank. Of course, the Czech banks earn the interest income but swap it abroad promptly keeping a tiny margin only. While the interest incomes are recorded in income statements of both the parent institution and the Czech bank, the profits are taken by the parent institution usually through an FX swap[33]. Consequently, the profitability as such is most probably not substantially positively affected by the level of the repo rate.

In addition to that, the monetary policy is delayed in reaction to CPI changes – the central bank does not usually take its decisions on the same day as macroeconomic figures are published by the Czech Statistical Office[34].

Conclusion

The results do not indicate any substantial effect of Repo on banking profitability in terms of magnitude but at the same time indicate its presence with great statistical significance. The magnitudes of the estimates are very small and are in line with theoretical explanations provided by the thesis. However, further efforts to uncover more about the effect of Repo on banking profitability would be greatly appreaciated as it is one of the most debated features of the Czech banking sector of today's era.

[33] A foreign bank F and a Czech bank C use an FX swap: F provides liquidity of volume L, C pays a swap rate S. C deposits the liquidity into CNB and earns an interest income equal to L * Repo * t/365. After collecting back the liquidity along with the interest income, C swaps L back to F and stops paying S. Hence, C paid L * S * t/365 to F and received L * Repo * t/365 from CNB. It appears in practice that S is almost equal to Repo. Hence, the actual profit is almost entirely taken by F.

[34] Discussed in deeper detail in the Hypotheses section in the first half of the thesis.

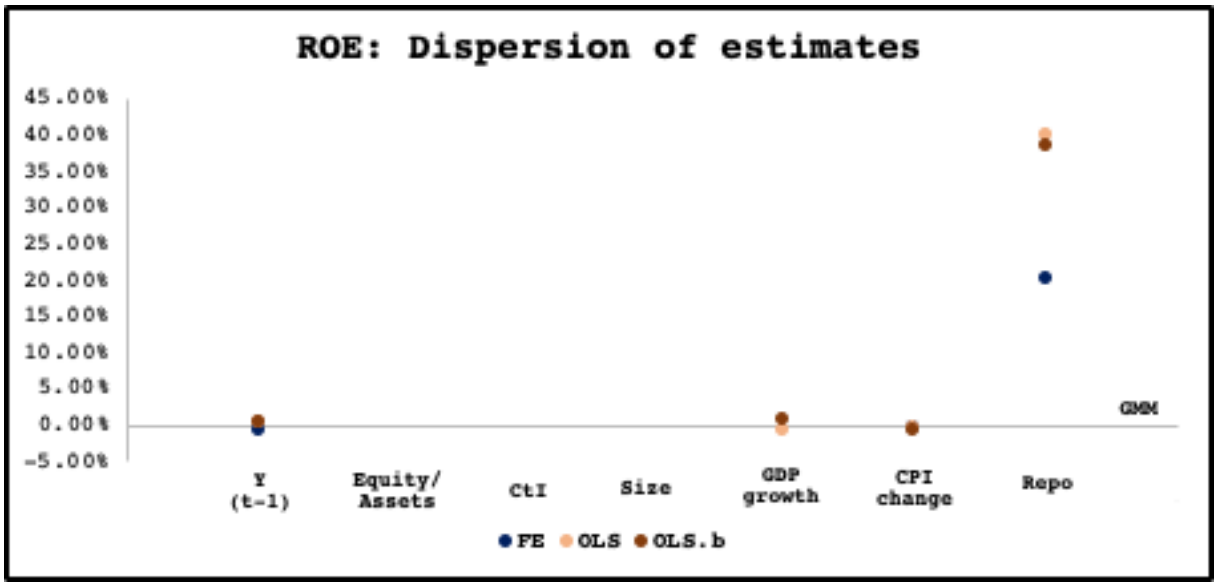
5.3.4 Dispersion of estimates

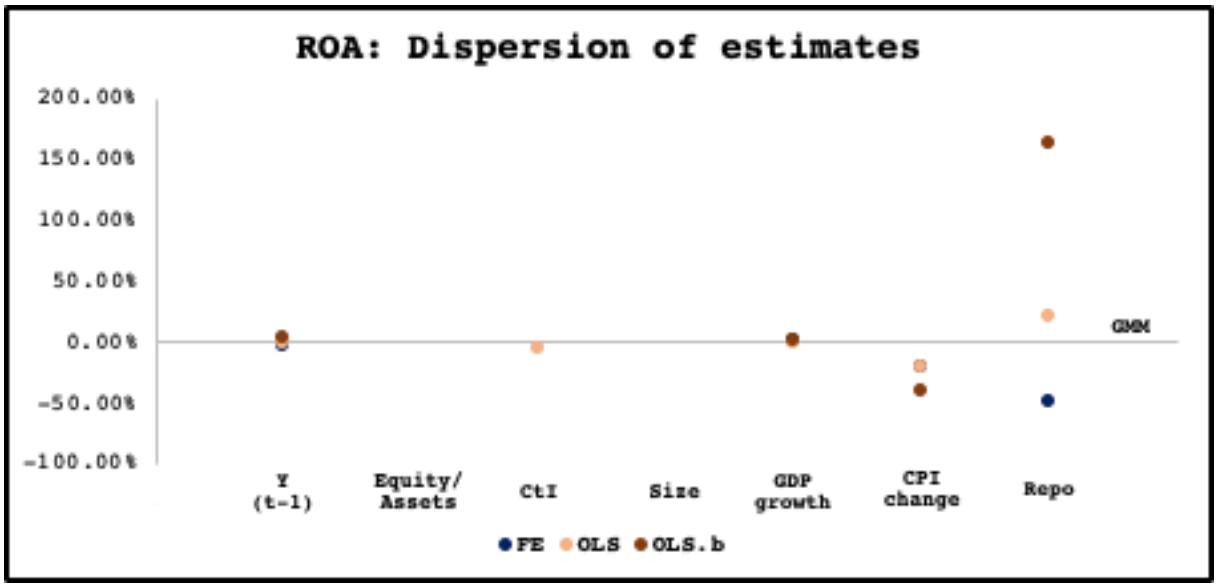
The following chart displays dispersion of estimates obtained from GMM, FE, OLS, and OLS with bootstrap. Only statistically significant estimates are shown here. Baseline chosen in the same manner as previously.

Exhibit 15, ***ROE: Dispersion of estimates***

Exhibit 16, ***ROA: Dispersion of estimates***

Source: Author





In most cases, the magnitudes of the estimates of effects on both ROE and ROA differ from the ones of the GMM estimates, i. e., the estimates obtained from the main method employed in this thesis, substantially – hence, quantification of magnitudes of the quarterly effects would require deeper analyses using more suitable datasets. In this thesis, showing existence of the effects is primarily pursued. Moreover, the quarterly regressions were run to challenge the yearly results in the first place – which could be used and discussed thoroughly.

5.4 Banking profitability: Summarizing remarks

The profitability model was estimated using yearly and quarterly data. ROE and ROA were used as dependendent variables and 4 sets of estimates were obtained from system GMM, FE, OLS, and OLS with bootstrap. While the thesis claims nothing about the estimates' magnitudes, existence of effects of some of the explored variables is henceforth indicated.

System GMM was used as the main method to obtain the results in the thesis. However, as the dataset comprises 22 banks and 6 years only, its sensitivity to model specification was suspected to be inflated. Three sets of estimates were therefore obtained from FE, OLS, and OLS with bootstrap. While these methods feature weaker capability to identify autocorrelation and endogeneity, they may be less sensitive to model specification and hence they provided a useful additional triplet of the coefficient estimates. All conclusions presented by the thesis were based on interpretation of the entire quadruplets of the results instead of relying on the individual ones in pursuit of biasedness avoidance. Although ROA is generally more reliable than ROE due to absence of leverage effect, it may nonetheless be less informative once the importance of off-balance-sheet items delivering profits is considerable. Model performances appeared to be higher with ROE used as the dependent variable. Hence, effects on ROE were discussed primarily.

Both sets of results – obtained from yearly and quarterly data – support existence of negative effects of the following variables: capitalization, operational efficiency, CPI change, and existence of positive effects of the following variables: an instition's size, GDP growth.

While positive persistence of bank profitability is found on the yearly basis, the quarterly data implies that positive shocks to both ROE and ROA are promptly corrected towards the original levels. While the key policy rate level (the repo rate) lacks statistical significance on the yearly basis, the quarterly data shows existence of a positive effect of the rate on profitability of banks.

All models were estimated in alternated specifications including dummy variables StaSpo (attaining 1 in case of building societies) and NonPriv (attaining 1 in case of state-owned enterprises). No such regression provided useful results and performance of every such model was severely worsened by the addition of extra variables.

This thesis collected all reachable data on the period 2015 – 2020 on both quarterly and yearly bases, quarterly and yearly datasets useable at econometric research were created, and a general profitability model was tested. Some of the most important determinants of bank profitability in the Czech sector were found, and it was discussed exhaustively how the study could be further improved. These achievements present a great contribution to the existing literature and empirically proved trends regarding the Czech sector and offer a comfortable set of insights and practical experience that can be used by anyone pursuing continuation of the efforts.

5.5 End of Year events: Sudden drops in Assets, Liabilities, and Equity

5.5.1 General remarks

As described earlier in the thesis, the Czech sector features an abnormality in banks's behavior regarding the end of the year. Based on EoY reported figures, financial and regulatory authorities derive several contribution duties and fees that must be paid by banks to respective funds or mechanisms. Hykl (2020) describes this with an emphasis on The Single Resolution Mechanism and its Czech incarnation, other cases include e. g. the Deposit Guarantee Scheme (DGS). The following chapter analyzes quarterly changes in bank assets, liabilities, and equity in order to discover whether there exist systematic drops in the reported accounting figures – and if there are such drops, potential explanations are discussed.

5.5.2 Data & Methodology

Quarterly data are used to estimate a model specified as follows:

$$DepVar(change)_{i,t} = \alpha + \beta_1 DepVar_{i,t} + \gamma_1 GDPgrowth_t + \gamma_2 CPIchange_t + \gamma_3 Repo_t + \boldsymbol{\rho EoY} + \varepsilon_{i,t}$$

FE and OLS are deployed at estimation of the models. DepVar represents Assets, Liabilities, and Equity, recorded in levels (nominals). It is suspected that the purposeful liabilities lowering is not practiced by every bank in the sector – standardization of the variable with respect to total assets or any other standardization of this kind may eliminate the effect to nominal changes. Respective dependent variable's QoQ changes are regressed on its nominal values and a set of variables that were previously identified as macroeconomic and statistically significant determinants of banking profitability. The thesis assumes the set of used variables – GDP growth (QoQ percentage changes), CPI change (QoQ percentage changes) and Repo (levels, bps) – may serve well at identifying the variation in the changes of dependent variables as the influence of an exogenous events is studied in this regression. Hence, no bank-specific variables are used as explanatory variables. EoY equals 1 for Q4 data and equals 0 otherwise.

The most important finding pursued in this regression is the coefficient of the EoY variable. A statistically significant and negative coefficient of the EoY's effect on liabilities may imply that liabilities are purposefully lowered as of the end of the year in the sector. It is expected that a statistically significant and negative coefficient of the effect on liabilities would be accompanied by a statistically significant and negative coefficient of the effect on assets as the changes in the balance sheets must offset one another. However, confidence intervals,

magnitudes of the coefficients and potentially even indications regarding the effect on equity may provide approximate mantinels within which further thinking, and research may be done.

5.5.3 Results

The tables on the next page summarize the results.

Exhibit 17, ***EoY events: Results***

Exhibit 18, ***EoY: 95% confidence intervals***

Source: Author

EoY events: Drops in Assets, Liabilities, and Equity												
	Assets				Liabilities				Equity			
	FE		OLS		FE		OLS		FE		OLS	
	Estimate	t	Estimate	t	Estimate	t	Estimate	t	Estimate	t	Estimate	t
DepVar (level)	0.13992***	2.4	0.02821***	3.13	0.13997***	2.39	0.02978***	3.03	0.36271**	1.91	0.01628***	3.38
GDP growth	-280669.6	-0.35	-275286.9	-0.37	-382057.1	-0.5	-373771.0	-0.53	107330.6	1.30	97932.06	1.09
CPI change	2.34e+07***	2.51	2.65e+07***	4.57	2.34e+07***	2.51	2.63e+07***	4.6	-382158.2***	2.42	174192.0	0.61
Repo	-97843.10***	-2.61	-69667.37***	-2.07	-99213.18***	-2.58	-72440.7***	-2.19	-698.72	-0.22	2521.04	1.07
EoY	-1.20e+07**	-1.87	-1.23e+07***	-2.25	-1.44e+07**	1.93	-1.39e+07***	-2.40	66376.69	0.26	608921.30	1.42
Constant	-3.87e+07***	-2.39	-8739632***	-2.04	-3.50e+07***	-2.4	-8142018**	-1.95	-9173537**	-1.88	-694444***	-2.30
N (observations)	521		521		522		522		522		522	
N (groups)	22		22		22		22		22		22	
R-sq (within)	0.170				0.275				0.106			
Corr(u_i, Xb)	-0.937				-0.927				-0.990			
R-sq adjusted			0.162				0.168				0.031	
F-stat (df)	6.19	5,21	9.17	5,515	15.92	5,21	19.39	5,515	40.73	5,21	4.60	5,515

Statistical significance: * 0.10, ** 0.05, *** 0.01

EoY: 95% confidence intervals						
	Assets		Liabilities		Equity	
	Estimate		Estimate		Estimate	
	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound
FE	-1.20e+07**		-1.44e+07**		66376.69	
	-2.54e+07	0.13e+07	-2.08e+07	-0.80e+07	-462486.4	595239.7
OLS	-1.23e+07***		-1.39e+07***		608921.30	
	-2.31e+07	-0.15e+07	-2.00e+07	-0.79e+07	-233681.2	0.14e+07

Statistical significance: * 0.10, ** 0.05, *** 0.01

Introductory note on the results

As previously discussed in other chapters, the estimates' magnitudes are not to be fully trusted due to the size of the dataset and in this case also due to the methods used. Signs are interpreted and used to articulate the indications discovered in the regressions. It would certainly require much more detailed research and specialized methodology to uncover the present effects fully and to reveal their true patterns. This part of the thesis is offered as the zero-th step of such research – there are clear indications of the abnormal EoY events. This accompanied with the explanations and thorough descriptions of the theoretical background and context provided by Hykl (2020) can serve as a starting point to any economist willing to pursue further discoveries and findings regarding the effects of regulatory environment in the Czech banking sector and namely the effects of the duty to contribute to the resolution fund and other duties involving derivation of the nominal value of the required transfers based on EoY accounting figures.

Assets – general remarks on results

FE and OLS provided very similar results in terms of signs, and some are not differing much even in their magnitudes. It appears that quarterly changes of banking assets are driven positively by nominal balances of assets and CPI change and negatively by Repo and EoY. The regression constants are negative, too. Statistical significance of the listed variables is high, the following 95% confidence intervals of statistically significant estimates do not exclude zeros: EoY (FE).

The positive coefficient of the nominal balance of assets indicates that the greater the sum of assets of a bank, the greater the implied quarterly change of its assets. In other words, nominally bigger asset portfolios are indicated to grow in greater nominal terms quarter-to-quarter. The positive coefficient of CPI change indicates that nominal levels in the economy are rising with inflation – which is very much expected and makes perfect economic sense. The negative sign of the coefficient of Repo indicates that with higher interest rates, banks are less willing to expand their asset portfolio. This is debated further in the discussion part. The negative constant indicates that ceteris paribus at the end of the year, the sector's liabilities are lowered.

Assets – EoY

Each coefficient estimate of the effect of the variable EoY reports a negative sign and their 95% confidence intervals are (-2.54e+07, 0.13e+07) obtained from FE and (-2.31e+07, -0.15e+07) obtained from OLS. Note that the CI indicated by FE includes zero, hence, the effect cannot be statistically distinguished from zero at 95% level.

Liabilities – general remarks on results

FE and OLS provided very similar results in terms of both signs, and some are not differing much even in their magnitudes. The results are very similar in their nature to what was previously discussed by the paragraph concerned with assets – please refer to that part for elaborated description of results. Statistical significance of the listed variables is high, the following 95% confidence intervals of statistically significant estimates do not exclude zeros: constant (OLS).

As the liabilities of a bank move very similarly to the bank's assets, it shall not be surprising that the results of estimating the effects of the explanatory variables on the changes in liabilities are very similar to the ones on the changes in assets. All explanations and reasoning elaborated in the previous part apply here, too.

Liabilities – EoY

Both estimates of EoY's effect report a negative sign and their 95% confidence intervals are (-2.08e+07, -0.80e+07) obtained from FE and (-2.00e+07, -0.79e+07) obtained from OLS. Neither CI includes zero, hence the effect is statistically distinguished from zero.

Equity – general remarks and EoY

FE and OLS provided two sets of results that differ significantly from one another, and performance of neither model is high. The results agree on a positive effect of equity's nominal balance on its quarterly change and agree on negativity of the constant. All other estimates differ greatly in their magnitudes and some of them even in their signs. As such, no systematic pattern in equity changes is indicated by the regression results.

Discussion

The EoY's effect on changes in liabilities is undoubtedly statistically distinguished from zero based on the obtained sets of results. It also appears that both confidence intervals are shifted further into the negative part of the axis. This thesis cannot make any claims about the effects' magnitudes and hence it is not claimed that the effect on liabilities is of a greater magnitude that the one on assets as it would normally be deduced based on the estimates and their confidence intervals – more precisely, as the CIs overlap, that the effect on liabilities MIGHT be of a greater magnitude.

The statistical reliability of the estimates of the effect of EoY on assets is not as high as the one of the effect on liabilities. While it cannot be reliably concluded that EoY hits liabilities more than assets, it can however be stated that this issue deserves a great deal of attention and shall be subject to further and more detailed research and analysis.

Conclusion

The thesis offers a preliminary set of results indicating existence of abnormal drops in banks' balance sheet figures as of the end of the year. This supports the hypothesis of existence of such events presented in the earlier chapters of the thesis. Although this shall not be attributed to the RF or DGS contributions exclusively, these drops may well be among other aspects induced by duties that are not stemming from the ordinary banking business but are rather introduced by regulatory requirements.

This thesis presents the first empirical step made towards uncoverage of what is happening in the banking sector as of EoY. While there may exist many other influences pushing the accounting figures down significantly as of EoY in the banking sector, the hypothesis of existence of the regulatory duties' negative effect shall not be a priori disregarded. Further research shall be performed to uncover the patterns of the effects fully as this may be of a great importance to both banks and regulators. It appears that today, the regulators may be relying on inefficient mechanisms and the banks are undergoing abnormal practices to circumvent the regulator's power. Consequently, the entire sector is suffering from unusual and non-banking driven events, elimination, or at least partial avoidance of which may help improve lifes of all interested parties – the banks, their customers, and finally the regulator, too.

6 Suggestions for further research

6.1 General remarks

The thesis studied the banking profitability in the Czech banking sector and tried to provide evidence for existence of effects of several either bank-specific or macroeconomic variables. While existence of several effects was indicated, there are variables left, effect of which was not identified in the regressions. However, we believe this may be a consequence of data insufficiency or non-suitability of the methods that were used. Therefore, the following paragraphs suggest how the study may continue to uncover more about behavior patterns of profitability in the sector and what determines it. All suggestions for further research discussed in the following paragraphs are primarily focusing on the Czech banking sector.

6.2 Suggestions for further research: Profitability determinants

6.2.1 Profitability persistence

It is surprising that while the effect of past profitability on a yearly basis is indicated to be positive, the quarterly basis implies a negative sign of the respective coefficient. While this may present a unique feature of the Czech banking sector, it may be beneficial to explore this difference at a broader scale. Compiling a dataset comprising various national sectors and banks operating in them may provide a solid basis for the analyses to be performed to explore the relationship between current and past profitability on both yearly and quarterly bases supra-sectorially. Evidence of presence of opposite effects on yearly vs quarterly basis in other sectors may establish a ground for further debate on the causes and consequences.

6.2.2 Loan portfolio and Deposit structure

A pure banking theory suggests that the greater the quality of a bank's loan portfolio, the less the assets impairment recorded in the balance sheet. Hence, the lower provisions, thus, the lower costs. Lower costs always mean higher profits assuming the incomes remain fixed. Nevertheless, the loan portfolio (its size with respect to total assets) is not implied to have a statistically significant effect on bank profitability by this study. One of the reasons may be hidden in the dataset's size – it may be too small to be able to identify all the parameters precisely. Hence, a specialized study focusing on how a bank's loan portfolio quality transfigures into its profitability may provide better results than a general one.

Banks report a wide range of data informing about countless characteristics of their loan portfolios. We suggest creation of a model that divides the loans per client type (retail, corporate, government), geography (domestic, EU-based, foreign), client acquisition rate (based on how many services of the bank the client purchases and whether the bank is the client's main bank) and other important categories. Regressing the loan portfolio's performance on these explanatory variables may provide an idea about importance of the respective sub-categories. After it is clear which parts of the asset (loan) portfolios play dominant roles, PCA may be used to create a generic variable representing the desired parts of the loan portfolios of the banks and this could be used at estimation of the general profitability model instead of the simple Total Loans to Total Assets ratio.

This is certainly closely watched by the banks themselves – costs are calculated at each segment separately and so are their profitabilities and other performances indicators. Obtaining such data from the banks would improve the quality of the research enormously.

The structure of deposits mirrors the loan portfolio in principle – it may be explored which types of deposits are the most important at determining the portfolio's performance and consequently, the dataset used at estimation of the general profitability model may be adjusted accordingly.

6.2.3 Capitalization

While the thesis presents an indication of capitalization's effect presence in the sector, it is unable to explore the effect further. It may be beneficial to uncover more details about how increased capitalization transmits into the profilitability of banks. Also, it may be important to distinguish over different types of equity held in banks' balance sheets.

Were there a model able to distinguish purposefully provided equity (with a parent's intention to capture more profits through a subsidiary) from equity balances ready to be paid-out as dividends (which may be stuck in the balance sheet due to the regulator's ban on dividends as shown during COVID) or balances accumulated through past positive performances that are put at no use currently, it could be explored which types of equity[35] are the most important ones at determining the equity's effect on profitability of banks. As capital and equity structure is one of the most regulated areas of banking, these insights would be appreciated by national and supranational regulators, too.

[35] In the Czech sector, paid-in capital and retained earnings seem to bet he most important parts of banks' equity as AT1 and T2 tend to be of rather negligible nominal values. Nevertheless, this shall be empirically tested.

6.2.4 Non-performing loans

The thesis does not present any findings regarding the ratio of NPLs to gross loans in the portfolios of Czech banks. It shall be stated that most probably, bad data quality is the major cause of the profitability model's failure at the effect identification. While it has been the most important determinant of loan portfolios profitability that high-quality loans are not provisioned, too frequent changes of the datasheet structure and gradually rising administrative requirements Czech banks are facing at reporting duties have worsened the quality of reported and published information severely.

Moreover, methodology of reporting and loan valuation changed several times during 2015 – 2020 which introduced additional inconcistency and unrealiability to the data. Further research efforts would require extreme knowledge of and experience at how banks are required to publish information on their NPLs and how the sheet structure changed over time. Better results could most probably be obtained with better data quality – which is however only attainable with perfect understanding of what goes where in the data sheets.

Perfect data could unfortunately not be achieved for the purpose of this thesis due to an extreme amount of time estimated to be necessary for producing a reliable data sub-set concerned with NPLs in the Czech banking sector.

6.2.5 GDP growth and state of the national economy

The thesis presented current-to-current relations of GDP growth and bank profitability. Most certainly, the effect of the state of the national economy persists in time and features non-zero delay. Hence, it shall be of a great importance to explore the effects of GDP growth on banking sector in the country. There are many studies concerned with the effect's size and transmission mechanism in other countries and could be with respective alterations and adjustments applied to the Czech banking sector as well.

Quantification of the total effect and description of its distribution over time would shed more light on how banks are benefiting from economic development of the environment in which they are operating and could help us understand what the time horizon is beyond which the GDP's effect is depleted.

Also, most probably there are many channels through which the effect of GDP growth on banking profitability is transmitted. Were the GDP growth's effect categorized into various sub-factors (heavy-industry production, manufacturing, services provided by small and medium enterprises, services provided by large service conglomerates, non-banking financial services etc.) in a model regressing bank profitability on such a set of explanatory variables, the most important transmission channels could be identified, and this may help at improving methods

of measuring effects of determinants of banking profitability. In addition to that, models using more lags of explanatory variables shall be used to identify the persistence of the effect over time.

6.2.6 CPI change and effects of inflation

Banking profitability may be regressed on various parts of inflation and its changes in the country. It may be assumed that banks are affected by all the following as they have an important role at practically entire business sector in the country: CPI, RPI, housing, imported-inflation, inflation expectations. Identification of those types of inflation most significantly affecting bank profitability may be beneficial as more appropriate data could be used to estimate the general profitability model.

Great attention shall also be paid to the existing literature that is suggesting existence of a negative effect of inflation on banking profitability in developed financial systems. The Czech banking sector shall be considered a developed sector and hence, a negative relation between inflation and bank profitability shall be expected. This is what the results of this thesis do support under the conditions in the Czech sector throughout the observed period.

It may however be beneficial if the effects of inflation on Czech banks were explored in a greater detail – especially now as the sector is most probably entering a turbulent era bringing volatile performance and periods of high inflation. Previously found effects that hold under a low inflation may be accordingly reconsidered and both banks and regulators may be in a better shape of readiness to react to what future brings.

6.2.7 The key policy rate: The two-weeks repo rate

The information on the most important determinant of the repo's potential to affect profitability of Czech banks is most probably well protected and is not going to be disclosed – the proportion of the total repo-enabled interest income that stays in Czech banks. This is a business secret of the banks realizing such transactions with the central bank as most of the liquidity deposited with the central bank originally comes from abroad from the parent institutions of the Czech subsidiaries. However, it may be identifiable from the published statements of the banks what were the volumes transferred into and from the CNB and it may also be identifiable what were the profits recorded by the mediating banks.

Once there exists a reliable source of knowledge on the margins Czech banks keep from this business and how these margins vary with the magnitude of the repo rate, the estimates of the effect on profitability of Czech banks may be improved.

6.2.8 Other important aspects of banking profitability

Most of the literature includes dummy variables distinguishing various banktypes (commercial, savings etc.) or ownership types (private non-listed owned by non-financial entity or financial entity, listed, state-owned) and succeed at obtaining statistically significant results. This thesis failed to do the same most probably due to the limiting size of the dataset. However, it would considerably improve the level of knowledge we have about Czech banks were we able to estimate these factors, too.

Potentially successful ways to achieve this goal include succeeding at widening the dataset with other entities (the dataset already includes all entities that are by law required to publish their data) or recapitulating the study after several years when the dataset can be significantly longer (the limited number of banks cannot be changed by this). Inclusion of banks operating in comparable sectors (Poland and Hungary may be considered good candidates) may also be considered one of the ways to widen the dataset. However, estimates provided by such regressions could no longer be interpreted in the context of the Czech sector exclusively.

6.3 Suggestions for further research: EoY events

Further efforts could bring additional knowledge and understanding of what drives the discovered drops in banking assets, liabilities, and equity. While those shall not be attributed to the regulatory duties exclusively, there is a considerably alarming chance they present a significant influence. As such, quantification of the regulatory environment's effect is a very desired goal of further research that shall be pursued to enable the sector work more efficiently and fairly towards its resilience, predictability, transparency, and reliability.

As the described behavior of banks designed to circumvent high contributions to the Resolution Fund is a specific feature of the Czech sector, comparing the fourth quarter changes in the balance sheet figures to the other quarters in the Czech sector and other sectors and analysis of such results may indicate the potential size of the effect the Czech rules set by the regulator is having on how the banks manipulate their EoY statements.

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8 List of Acronyms

ARAD	…	a public database containing time-series and aggregated data run by the Czech National Bank,
CEE	…	Central-Eastern Europe,
CNB	…	Czech National Bank,
CPI	…	Consumer Price Index,
CSO	…	Czech Statistical Office,
CZK	…	Czech Crown (Czech Koruna), the Czech national currency,
DepVar	…	Dependent Variable,
DGS	…	Deposit Guarantee Scheme,
DSTI	…	Debt-Service-To-Income
DTI	…	Debt-To-Income,
EoY	…	End of Year,
EUR	…	Euro, the Eurozone currency,
FE	…	Fixed Effects,
FX	…	Foreign echange (usually used with currency pairs),
GDP	…	Gross Domestic Product,
GL	…	Gross Loans,
GMM	…	Generalized Method of Moments,
HHIIC	…	Herfindahl-Hirschmann Index of Industry Concentration,
HHIRD	…	Herfindahl-Hirschmann Index of Revenue Diverzification,
LLP	…	Loan Loss Provisions,
LTV	…	Loan-to-Value,

NIM	…	Net Interest Margin,
NL	…	Net Loans,
NPL	…	Non-Performing Loans,
OLS	…	Ordinary Least Squares,
OLS.b	…	Ordinary Least Squares utilizing bootstrap,
PCA	…	Principal Components Analysis,
PRIBOR	…	Prague Interbank Offered Rate
Q4	…	Fourth quarter of a year,
QoQ	…	Quarter-on-quarter,
RE	…	Random Effects,
RF	…	The Resolution Fund,
RO(A)A	…	Return on (Average) Assets,
RO(A)E	…	Return on (Average) Equity,
RPI	…	Retail Price Index,
SRM	…	The Single Resolution Mechanism,
TA	…	Total Assets,
TL	…	Total Liabilities,
VBA	…	Visual Basic for Applications,
YoY	…	Year-on-year,
2W	…	Two weeks