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Institute of International Studies

Department of Russian and East European Studies

Master's Thesis

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Determinants of Commercial Banks' Financial Performance in Central and East European Countries

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Declaration

1. I hereby declare that I have compiled this thesis using the listed literature and resources only.
2. I hereby declare that my thesis has not been used to gain any other academic title.
3. I fully agree to my work being used for study and scientific purposes.

In Prague on 07/2024 Yixuan Zhang

References

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Abstract

Numerous external shocks have challenged the banking sector in the CEE region and thus attracted a lot of academic attention since the 1990s. Among all the studies, more scholars have taken into consideration what factors affect the banking sector performance in this special region. This dissertation aims to find out the influence of specific factors in banks' financial performance, including bank-specific, industry-specific, and macroeconomic factors, and several dummies are also considered to proxy whether a bank is in the euro area or not and whether the banks' performance has improved or deteriorated during the research period. In this dissertation, an unbalanced panel data with 96 banks from 15 CEE countries and 11 years from 2011 to 2021 was selected and 5 CAMEL indicators were used to measure the bank's financial performance. The empirical results show that the four bank-specific factors, the industry-specific factors, and the GDP growth tend to have distinct impacts on the five CAMEL indicators. Generally, a lower inflation rate would improve banks' financial performance. Meanwhile, differences are also disclosed in those influential factors behind banks' financial performance in euro-area countries and non-euro area countries or EU countries and non-EU countries.

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1. Introduction

Background of the Dissertation

The financial performance of banks in the CEE region has been a subject of considerable interest, especially since the transition from centrally planned economies to market economies in the early 1990s. The region's unique economic, political, and regulatory landscapes provide a fertile ground for understanding various determinants of bank performance. Research on this topic has explored a range of factors, including macroeconomic conditions, bank-specific characteristics, industry structure, and institutional factors. Athanasoglou, Delis, & Staikouras (2006) investigated the impact of macroeconomic conditions on bank profitability in several CEE countries and found that positive GDP growth and stable inflation were associated with higher bank profitability, while high interest rates negatively affected banks' net interest margins. Košak & Čok (2008) analyzed the influence of bank-specific characteristics on the profitability of CEE banks, and their results showed that larger banks and those with higher capital adequacy ratios tended to be more profitable. Banks with better asset quality, as indicated by lower non-performing loan (NPL) ratios, also performed better than their counterparts in Košak & Čok's study. Additionally, Yildirim & Philippatos (2007) examined the effects of market structure and competition on the performance of banks in transition economies, including CEE countries. They found that increased competition generally leads to lower profitability but higher efficiency among banks. Bonin, Hasan, & Wachtel (2005) investigated the impact of institutional and regulatory reforms on the efficiency and performance of banks in transition economies and concluded that effective regulatory frameworks and strong institutional environments significantly enhance bank performance by reducing risks and promoting stability.

Apart from the above studies, more and more researchers turned to investigating the impact of the financial crisis and the COVID-19 pandemic on bank performance in CEE countries as well. Studies exploring the effects of financial crises on the performance of banks in the CEE region focused on profitability, stability, lending activities, and

regulatory responses. The main results showed that the financial crisis harmed profitability, credit risk, lending activity, and market valuation. The papers investigating the impact of the pandemic on the CEE countries have similar results. The report by the European Investment Bank (2020) highlighted those banks experienced a decline in return on asset (ROA) and return on equity (ROE) due to increased credit risks and lower income from core banking activities, and the decline in profitability was more pronounced in countries with stricter lockdown measures. The International Monetary Fund (2021) highlighted that while capital adequacy ratios remained above regulatory minimums, liquidity pressures increased due to withdrawals and reduced funding.

Research Questions

A series of banking reforms have taken place in the CEE region, including banks' liberalization, privatization, and recapitalization, and in this context, many scholars studied the banking sector in CEE transition economies since the 1990s (Barisitz, 2008). They used different methods to represent banks' financial performances, and which one was the optimal method that could more precisely demonstrate the comprehensive character of the banking sector has become one of my research questions. What is more, after recognizing different kinds of banks' financial performance, the subsequent question lies in figuring out those influential factors that are affecting these kinds of bank performance.

Moreover, the entrance to the European Union (EU) began in 2004 in CEE countries sparked the interest of scholars to investigate whether becoming an EU member or not affects the bank's financial performance which also aroused my interest. EU membership brings about several changes that can impact bank performance. For example, the alignment of banking regulations and supervisory standards with EU directives has improved risk management, transparency, and overall stability of banks in CEE countries (Ayadi, Arbak, & De Groen, 2012). However, compliance with EU regulatory standards can be costly, particularly for smaller banks with limited resources

(Barrell, FitzGerald, & Riley, 2010). The effect of EU membership on bank profitability varies depending on the bank's size, market strategy, and adaptability which means that although some banks benefit from improved regulatory environments and increased market opportunities, others face challenges due to competition and compliance costs (Demirgüç-Kunt & Huizinga, 2001).

Meanwhile, the euro area, comprising the countries that have adopted the euro as their currency, shows great impact on commercial banks' performance in CEE region as well. This influence manifests through various channels, for instance, CEE countries pegging their currencies to the euro or aiming for euro area membership, have reduced exchange rate volatility which could decrease foreign exchange risk for banks. This stability fosters a more predictable operating environment and thus an improved performance (De Grauwe & Schnabl, 2008). The integration with the euro area has boosted trade volumes between CEE countries and euro area members, and increased capital inflows into CEE countries. These increased trade and capital inflows provide banks with a larger demand for banking services with additional capital, enhanced liquidity, and more lending activities (Brzoza-Brzezina, Kolasa, & Makarski, 2013; Herrmann & Winkler, 2009). Therefore, the relationship between the euro area and bank performance in CEE countries has become one of my research questions.

Research Gap and Contribution

This dissertation aims to find and contribute to the current research gaps and academic blanks. For example, in terms of banks' financial performance, most authors use ROE, ROA, and net interest margin (NIM) as the proxy of bank profitability. Few studies adopt CAMEL, the more comprehensive set of indicators, which might be a better proxy for banks' financial performance. Then, for the scope of the study, current studies on the determinants of banking performance focus only on a single country or a limited number of countries in one small region, and the targeted banks to be studied in those studies are thus also limited, unavoidably leading to some bias in their results. Few

studies extended this scope to a larger region and to more countries to include more representative banks in the study. Thus, my dissertation intends to fill this gap by adopting the CAMEL indicator as the proxy for banks' financial performance and extending the scope to most of the countries in the CEE region. What is more, the majority of current studies in this field only analyze the effects of bank-specific and macroeconomic factors on banks' profitability, and those industry-specific factors are ignored, such as the intensity and competitiveness of the banking sector in one country. Thus, this small gap is also filled in my dissertation by including market concentration (concentration ratio) as an industry-specific factor, to more precisely reflect the complex characteristics of CEE countries' banking systems.

Outline of the Dissertation

The rest of the dissertation is structured as follows: the second part is the literature review section, which first reviews and summarizes the empirical studies on the bank's financial performance from both the performance ratio and the CAMEL approach and then analyzes the studies on determinants of banks' financial performance from bank-specific, industry-specific and macroeconomic-specific factors respectively. The last part of the literature review section focuses on the banking sector in the CEE region, including the development of the banking sector in the CEE Region and the current study of banks' performance in the CEE Region. Then, the third section is data and methodology, which first describes the data sources and the horizon of the study. The formula of different empirical models and the dependent variables and explanatory variables to be employed in those regression models are also introduced and explained in this part. The fourth section summarizes the regression model results, evaluating the impact of independent variables on various aspects of the financial performance of CEE banks. Additionally, five by-group regressions for the above five models are also constructed in this part to compare the results between EU and non-EU countries. Finally, the conclusion and future improvement are shown in the fifth section.

2. Empirical Literature Review

In this section, different strands of literature in this field are reviewed, including different methods to study banks' financial performance, and various studies on the determinants of banks' performance.

2.1. Studies on Banks' Financial Performance

Most studies on banks' financial performance use performance ratios such as ROE, ROA, and NIM as determinants of bank profitability. The country scope in these studies, especially in Europe, has both a single country and a selected region of countries. On the other hand, only a few studies use the CAMEL approach, and most of those studies focus on a single country, instead of a selected region of countries. Although some of the studies that used the CAMEL approach selected a specific region, most of them only chose some representative banks in this region, which would be subjective.

2.1.1. Performance Ratio (ROA, ROE, NIM) Approach

Return on average assets (ROAA) and NIM were employed by Kosmidou, Tanna, & Pasiouras (2005) to figure out the influence of bank-specific characteristics, macroeconomic conditions, and financial market structure on UK banks' earnings. Through their study, the equity-to-assets ratio is disclosed to be one of the main determinants behind banks' profitability. However, the other two bank specific factors, the cost-to-income ratio and the size of banks, both have negative impacts on banks' profits. Moreover, the improving effects of several external factors, including gross domestic product (GDP) growth, inflation, and the concentration ratio of the banking industry on the banking sector's profits are also proved.

Another case of the single country study is for the country of Greece. Kosmidou (2008) examined both the internal and external determinants of the performance represented by the ROAA of 23 Greek banks from 1990 to 2002 which was the period of EU integration. A higher level of ROAA was unveiled to be connected with banks' higher

capital adequacy and lower cost-to-income ratios. The impact of the size of a bank on the banks' ROAA was positive and statistically significant only when the external macroeconomic factors were considered in the models. While inflation has a significantly negative influence on ROAA, GDP growth has an extremely beneficial impact.

Recently, studies on banks' performance have been researched by various scholars in other parts of the world as well. For example, Kirimi, Kariuki, & Ocharo (2022) analyzed the effect of financial soundness on the financial performance of Kenyan commercial banks from 2009 to 2020. They used ROA, ROE, NIM, and earnings per share (EPS) as measures of financial performance, and chose CAMEL variables as financial soundness indicators. Their results indicated significant relationships between these performance indicators and various financial soundness variables. Furthermore, Ha Nguyen (2023) investigated the impact of credit risk on the financial performance of commercial banks in Vietnam, using ROA, ROE, and NIM as key performance indicators. A ten-year period from 2006 to 2016 is covered in their study and a dynamic difference Generalized Method of Moments (GMM) model is adopted to deal with model issues. From their study, banks' financial performance in Vietnam, indicated by their ROE and NIM, are found to remain consistent across the 10 years. Moreover, although the effect of loan loss provision ratio and capital adequacy are not found, the significant negative effects of size and NPL ratio on ROA and ROE are disclosed.

Molyneux & Thornton (1992) were the first to include multiple countries in this field of study. They evaluated the influential factors behind bank performance among 18 countries in Europe. Additionally, this study replicated Bourke's methodology that concentration was positively related to banks' earnings. Their results showed that European banks' return on capital was positively associated with concentration ratio, interest rates, and state ownership. Their results supported the expense preference

expenditure theories[1], yet had no contribution to the Edwards-Heggestad-Mingo risk avoidance hypothesis.[2]

Athanasoglou, Delis, & Staikouras (2006) researched the bank-specific, industry-related, and macroeconomic determinants of the banking sector's profitability represented by ROA and ROE from 7 South Eastern European countries between 1998 and 2002. They found that except liquidity, all other bank-specific determinants significantly affect bank profitability. What is more, in line with the structure-conduct-performance hypothesis, the association between concentration and bank's financial performance is positive. However, a positive effect between banking reform and profitability cannot be identified. Regarding the macroeconomic determinants, the results are surprising that inflation positively affects profitability which may be a result of the failure of inflation expectations by bank customers. What is more, GDP growth does not show any significant effects on banks' profitability.

Pasiouras & Kosmidou (2007) used ROAA to evaluate a bank's performance and examined how a bank's specific and macroeconomic characteristics affected the financial performance of banks in 15 EU countries from 1995 to 2001. The results showed that both bank's specific and external factors would impact the performance of domestic and foreign banks. All the variables are significant, but to varying degrees for domestic and international banks; the only exception is the concentration level in the case of domestic banks' earnings.

In order to specifically look into how a nation's economic development and income

[1] Expense-preference theory posits that under certain conditions, managers who favor higher expenses may utilize preferred inputs in quantities exceeding those warranted by profit maximization. Edwards (1977) formalized this concept by demonstrating its validity under two common variations of expense preference.

[2] The Edwards-Heggestad-Mingo theory (Edwards & Heggestad, 1973; Heggestad & Mingo, 1976) illustrates that increased concentration in the banking sector leads banks to hold less risky assets and adjust their behavior in various other ways.

group level affect bank profitability, Dietrich & Wanzenried (2014) employed a large sample consisting of over 10,000 institutions from 118 different countries between 1998 and 2012. They measured the banks' profitability using ROAA, ROAE, and NIM and discovered that the factors influencing profitability varied significantly in terms of importance, sign, and magnitude among high-, middle-, and low-income nations.

2.1.2. CAMEL Approach

The CAMEL framework, created in 1979 by U.S. bank supervisory authorities, has evolved into a comprehensive tool for evaluating the performance of the banking sector. This framework has become an indispensable tool for supervisory authorities in various countries due to its comprehensive approach to assessing bank performance. The term CAMEL stands for five critical dimensions of a bank's operations: Capital adequacy, Asset quality, Managerial quality, Earnings and profitability, and Liquidity. In response to the growing importance of risk management in the financial industry, the CAMEL framework was expanded in 1996 to include a sixth component, resulting in the CAMELS framework. The added "S" represents Sensitivity to market risk, which underscores the necessity of evaluating how external market conditions, such as fluctuations in interest rates, exchange rates, and equity prices, can impact a bank's earnings and capital (Sarker, 2006). These six parameters are essential indicators of a bank's financial health and are recommended by the International Monetary Fund (IMF) and the World Bank (2005). However, some studies question the inclusion of the Sensitivity to market risk component due to the inherent difficulties in accurately measuring the effects of financial asset price variations on banking operations. After introducing the origin and definition of the CAMEL approach, the remaining part focuses on the studies on the influential factors behind the CAMEL indicators, which are of great intuition and would help the construction of the empirical part for my own dissertation.

Among all the influential factors behind the fluctuation of the CAMEL indicators, those

endogenous and industry-specific factors are the most direct and relevant ones. Anton, Coskun & Georgievskiet (2018) selected 128 banks in 9 countries for the period of 2009 to 2014 and investigated how bank-specific and industry-specific factors would affect these CAMEL indicators. In their findings, the size of the bank impacts on CAMEL indicator negatively, and the asset quality and earnings are usually better for banks with higher levels of business mix. Size had a negative impact on capital adequacy and liquidity, but the banking sector's concentration ratio had a beneficial impact. Prodanov, Yaprakov, & Zarkova (2022) focused on estimating the influence of endogenous factors on the bank performance in Bulgaria. They calculated the CAMEL scores and ranked the banks concerning capital adequacy, asset quality, managerial quality, earnings sufficiency, liquidity, and overall performance respectively in 2014, 2017, and 2020. The results showed that restructuring, consolidation, and competition have significant effects on the Bulgarian banking system.

Then, the change of the external environment is also one of the most essential factors in determining banks' financial performance and many scholars tried to figure out their associations. Taking the economic crisis for example, Georgios & Elvis (2019) investigated and illustrated how it would impact on the banking system of all Balkan countries by using CAMEL methodology. They compared 8 Balkan banks by calculating the final average CAMEL scores from 2009 to 2016 and identified that the global financial crisis has severely impaired banks' capital adequacy in this region because of the bank run, the difficulty in finding sources of funding, and the increased level of non-performing loans.

There are also strands of literature that focus on how these CAMEL indicators would develop over time. For instance, Atikogullari (2009) focused on the area of Northern Cyprus's 5 largest banks in the post-2001 and used a similar approach to the previous studies based on the CAMEL system. The results suggested that the managerial quality and earnings had improved, whereas the capital adequacy and liquidity had deteriorated

during the study period.

Banks in different countries or regions tend to perform distinctly in their CAMEL indicators, and this regional difference is also highlighted and studied by many scholars. Roman & Şargu (2013) selected 15 banks in Romania from 2004 to 2011. They found that the largest bank in Romania only performed well in the area of managerial quality and profitability, while a weak result was found in liquidity indicators. All banks had good capitalization and were able to respond to potential losses. They determined the strengths and weaknesses of each of the 15 banks as well. Moreover, Hyz & Gikas (2015) selected only 4 main domestic banks in Greece from 2008 to 2013 by applying the CAMEL indicators to analyze their financial performance. They found that the main problems in those banks were poor asset quality and the worse macroeconomic environment after the financial crisis.

2.2. Studies on Determinants of Banks' Financial Performance

During the last several decades, the banking sector has transformed a lot in both its operating model and regulation environment. Both internal and external factors have affected its financial performance. After introducing the methods that are adopted to proxy commercial banks' financial performance in empirical studies, the studies related to those influential factors that might affect bank performance are summarized and explained respectively in the below part.

2.2.1. Bank-specific Factors

Bank-specific factors are those micro factors that are only connected with a bank's conditions. These factors may vary from bank to bank and affect a bank's financial performance significantly. Normally, four bank-specific variables are studied most by scholars in this field, which are size, deposits, business mix and diversification, and operating efficiency. These four bank-specific factors will be explained in respective in the below subsections.

Size

The size of the bank is often proxied by the logarithm of its assets, which is measured by most of the studies in the banking sector (Athanasoglou, Brissimis, & Delis, 2008; Petria, Capraru, & Ihnatov, 2015). Even though it is thought to be a influential factor behind banks' performance, the association between them is still complex and multifaceted. Most studies assumed a positive correlation between size and bank performance. Larger banks are supposed to benefit from economies of scale, which leads to reduced costs and improved efficiency (Berger & Mester, 1997; Wheelock & Wilson, 2001; Goddard, Molyneux, & Wilson, 2004; Menicucci & Paolucci, 2016). Meanwhile, larger banks are thought to have better risk management capabilities (Demsetz & Strahan, 1997) and better access to capital markets which can diversify their risk more effectively (Hughes & Mester, 2013). However, some of the studies found a negative relationship between size and bank performance. Increased size leads to managerial inefficiencies and higher operating costs (Stiroh, 2004; Sufian & Chong, 2008). At the same time, larger banks may face higher regulatory and compliance costs (Berger & DeYoung, 2001), and are more prone to systemic risks (Laeven, Ratnovski & Tong, 2014) which would detract from performance by increasing regulatory burden and decreasing the operating stability. A few studies also suggested that there is no linear effect between the two variables, and there is often an optimal size range where banks perform best, with diminishing returns or diseconomies of scale beyond this range. What is more, no obvious proof of economies of scale was disclosed in the banking sector in the studies of Athanasoglou, Brissimis, & Delis (2008) and Lee & Kim (2013).

Deposits

Deposit is the total amount of deposits that a bank has, which represents the funding raised by external customers. Contrary to other traditional industries, the bank's funding sources often comes from deposits, trading liability, debt, and equity. The impact of

bank deposits on performance has been widely researched by scholars with different metrics to measure deposits. “The ratio of total deposits to total assets” is used by most scholars to measure the deposit level of a bank (Berger & Humphrey, 1994; Altunbas, Evans & Molyneux, 2001; Pasiouras & Kosmidou, 2007; Kosmidou, 2008). In this setting, they found that higher levels of total deposits to total assets are associated with increased efficiency and profitability by providing a stable funding source. This positive relationship between deposits and bank performance can also be seen in most of the studies using “the growth rate of deposits” as a proxy for banking growth (Smirlock, 1985; Athanasoglou, Brissimis, & Delis, 2008; Berger & Bouwman, 2009; Mercieca, Schaeck & Wolfe, 2007). However, Demirgüç & Detragiache (1998) found that while deposit growth can improve performance, excessive growth may be a double-edged sword, potentially leading to instability. Dietrich & Wanzenried (2014) also argued that this effect was unclear and that higher growth may be attractive to new entrants, but after the increase in the participant's number, the profit per bank may reduce a lot. Other scholars use “the natural logarithm of total deposits” to reflect this variable (Sufian & Chong, 2008; Flamini, McDonald, & Schumacher, 2009) and made an argument that banks with a larger deposit base operating by a larger number of branches, reflected through the log transformation, may be more profitable.

Business Mix and Diversification

The relationship between business mix and diversification, and bank performance varies based on the level and type of diversification, and the method chosen to calculate the revenue diversification. Most scholars adopted “the ratio of other operating income to average total assets” to measure the off-balance sheet activity’s impact on the bank's performance because, in this way, this ratio links total assets from the balance sheet and other operating income from the profit and loss statement, providing a more holistic view of a bank's financial activities. By considering both statements, researchers can capture a wider range of financial operations and their impacts, leading to a more thorough analysis. For instance, DeYoung & Rice (2004) and Stiroh (2004) proxied

banks' diversification in this way and found that banks with higher non-interest income ratios tend to exhibit greater volatility in earnings, although they might achieve higher risk-adjusted returns. On the contrary, the research of Goddard, Molyneux, & Wilson (2004) showed that banks with higher ratios of non-interest income tend to have higher growth and profitability.

Besides this method, other scholars took "the ratio of non-interest income to total income" as a proxy for banking activity diversification and contributed to a mixed conclusion. Chiorazzo, Milani, & Salvini (2008) argued that banks with higher non-interest income ratios exhibit better performance and lower risk in a sample of Italian banks. However, Elsas, Hackethal, & Holzhäuser (2010) found that in German banks, diversification leads to decreased performance due to higher risk exposure. What is more, the Herfindahl-Hirschman Index (HHI) was carried out to measure revenue diversification as well. Baele, Jonghe, & Vennet's (2007) results showed that banks with diversified revenue streams show higher profitability and reduced risk, while the result from Laeven & Levine (2007) showed evidence that moderate diversification improves performance, but excessive diversification leads to discounts.

Operating Inefficiency

The relationship between operating inefficiency and banks' financial performance is also thought to be significant and thus studied by many scholars. Rashid & Jabeen (2016) and Antoun, Coskun, & Georgievski (2018) include operating inefficiency in their model by the ratio of operating expenses to interest income as a bank-specific determinant of financial performance. The result of Rashid & Jabeen (2016) demonstrated that there is no significant impact of operating inefficiency on bank performance. However, Antoun, Coskun, & Georgievski (2018) found that operating inefficiency has no impact on asset quality and earnings but has a negative influence on capital adequacy only if the lagged value is considered and in the absence of macroeconomic indicators.

Other scholars used the Efficiency ratio as a proxy of operating efficiency and analyzed the relationship between operating efficiency and bank performance. The results showed that operating efficiency has multifaceted impacts on bank performance. Sufian (2011) examined the Korean banking sector and found a positive relationship between operating efficiency and profitability. Altunbas, Carbo, Gardener, & Molyneux (2007) analyzed European banks and found that more efficient banks had lower non-performing loan ratios and thus lower credit risk. On the other hand, Maudos & de Guevara (2004) revealed that banks with higher efficiency sometimes have lower interest margins due to competitive pressures. Berger and DeYoung (1997) developed the "bad management hypothesis" which suggests that banks focusing excessively on cost-cutting might overlook credit quality, leading to higher default rates and instability. Moreover, some papers proposed that the relationship between efficiency and performance is non-linear, with diminishing returns beyond a certain point of efficiency (Hughes & Mester, 2013; Akhigbe & McNulty, 2011).

2.2.2. Industry-specific Factors

Industry-specific factors are those factors related to the banking sector and the middle environment, and the most widely studied industry-specific factor in this field is the concentration ratio of the banking industry, which is thought to be connected with individual banks' performance.

Concentration Ratio

The relationship between concentration ratio and market performance was first established by Bain in 1951. Bain (1951) formalized the Structure-Conduct-Performance (SCP) paradigm, which links market concentration with firm behavior and performance. His work in the 1950s and 1960s emphasized the importance of concentration ratios in analyzing market power and competition. Since then, the concentration ratio has been applied to different industries including the banking sector.

Scholars such as Berger and Hannan (1989) have extensively studied banking concentration and its effects, building on the foundational work of earlier economists and adapting it to the specifics of the banking industry. The application of concentration ratios to banking specifically became more prominent in the latter half of the 20th century, as researchers and policymakers sought to understand the implications of market structure on bank performance and stability. Regulatory bodies, such as the Federal Reserve and the Department of Justice in the United States, have used these metrics in their analysis of bank mergers and competitive behavior in the banking sector.

The concentration ratio in the banking industry is often calculated as the proportion of assets of the three largest commercial banks to total commercial banking assets. Most of the scholars supported the SCP hypothesis, positing that higher market concentration leads to greater profitability due to increased market power and reduced competition (Berger & Hannan,1989; Goddard, Molyneux & Wilson, 2004; Maudos & De Guevara, 2007). However, if the industry becomes more concentrated because of more intensified interbank competition, the effect of this industry-specific factor might turn the opposite (Berger, 1995). Uhde & Heimeshoff (2009) also suggested that higher market concentration can negatively impact financial stability, as large banks in concentrated markets may take on excessive risks. And the results of Casu & Girardone (2006) and Athanasoglou, Brissimis, & Delis (2008) revealed that the degree of concentration is not necessarily related to the degree of competition.

2.2.3. Macroeconomic Factors

These are the macroeconomic indicators that are related to the economic condition of a country as a whole and are also thought to be influential factors behind commercial banks' financial performance. Among all these macroeconomic factors, GDP growth and inflation rate are the two most-studied ones.

GDP per Capita Growth

The relationship between economic growth, particularly GDP per capita growth, and bank performance is crucial in understanding how macroeconomic conditions influence the financial sector. Many scholars used the annual percentage growth rate of GDP per capita to represent economic growth and found that it had complex and varied impacts on bank performance. On the one hand, economic growth generally enhances bank profitability through the increase of demand for financial services and the expansion of credit (Levine, 1997; Demirgüç-Kunt & Huizinga, 1999), and reduces NPLs as borrowers are more capable of meeting their debt obligations during economic expansions (Fofack, 2005). On the other hand, it can also increase competition and risk-taking behavior, potentially harming bank performance (Jayaratne & Strahan, 1998; Ranciere, Tornell & Westermann, 2008). Some former studies of banks in this region found economic growth had no obvious impact on bank performance (Căpraru & Ihnatov, 2014; Djalilov & Piesse, 2016). These findings underscore the importance of considering macroeconomic conditions in banking sector analysis and strategic planning.

Inflation Rate

The inflation rate, which represents changes in the typical consumer's cost of purchasing a basket of goods and services that may be constant or vary at predetermined intervals, is the other macroeconomic element that is included in many research. Most of the studies have shown a negative impact of the inflation rate on bank performance. Fisher & Molyneux (1996) indicated that high inflation, reflected by a rising CPI, can lead to increased loan defaults. Borrowers' real incomes may not keep pace with inflation, reducing their ability to service debts. Moinescu (2013) found that inflation increases banks' operational costs, such as wages and utility expenses, thereby reducing profitability. However, Athanasoglou, Brissimis, & Delis (2008) found that the inflation rate does not have a statistically significant impact on bank profitability in some contexts. The effect of CPI on bank performance may be neutral due to banks' ability to adjust interest rates and other financial products to mitigate inflation risks. The result

of Boyd & Champ (2006) suggested that inflation can lead to higher nominal asset values, which can improve banks' balance sheets and collateral values.

2.3. Studies on Banks in the CEE Region

After introducing the studies on the different ways to proxy banks' performance and on the possible determinants behind banks' financial performance, the focus of this literature review section shifts to the relevant studies in the CEE region, in which the development path of the banking sector in this region and the current studies on bank performance in this region are illustrated respectively.

2.3.1. The Development of the Banking Sector in the CEE Region

The CEE region, characterized by geopolitical tensions and significant reforms, has undergone substantial transformations in its banking sector. These changes make the region a compelling subject for study. The post-socialist reforms initiated the liberalization and privatization of banking sectors in the CEE region in the 1990s, and since then the banking sector has undergone significant transformation. The EU accession of CEE countries began in 2004 has driven regulatory harmonization and increased foreign investment, the global financial crisis started in 2008 has led to increased consolidation and regulatory tightening, the UK Brexit decision made in 2016 has also led to compliance adjustments and relocations of some bank institutions, and the COVID-19 pandemic with geopolitical challenges arose in 2020 has tested the resilience and recovery condition. This significant region comprises both EU and non-EU countries and different groups of countries such as Central European countries, Baltic States, and Southeastern Europe. Each of them has unique developmental trajectories influenced by various factors.

Market-oriented Reforms in the 1990s

During the 1990s, CEE countries transitioned from centrally planned economies to market-oriented economies, setting the foundation for a more robust banking sector.

Despite initial difficulties, these reforms led to greater financial stability, global economic integration, and improved services.

The banks in central European countries focused on privatization, regulation reforms, management of NPLs, financial stability, and capital market development (Bonin, Hasan, & Wachtel, 2014). For example, the rapid privatization of state-owned banks in Poland attracted significant foreign investment. The establishment of asset management companies like The Bank Guarantee Fund (Bankowy Fundusz Gwarancyjny) to manage NPLs contributed a lot to the national financial system (Bonin, Hasan, & Wachtel, 2014). Early 1990s reforms in the Czech Republic focused on privatization and the establishment of a competitive banking environment. The creation of the Czech Consolidation Agency in 2001 helped manage bad loans as well (Rod, 2015). Meanwhile, the privatization process of banks in Hungary led to comprehensive reforms, and the Hungarian Financial Supervisory Authority (HFSA) was established to oversee the financial sector (Nyers, 2008). In this background, capital markets were developed to support investment and economic growth. Stock exchanges were established, and bonds and other financial instruments became more prevalent. These changes gave the chance to banks to play a crucial role in developing capital markets by providing essential services and acting as intermediaries for capital flows (Rostowski, 1995).

Similarly, the banks in southeastern Europe also focused on privatization, regulation, management of NPLs, and stable measures, however, faced some initial delays (Hunya & Dobrinsky, 2002). For example, Bulgaria's privatization of state-owned banks along with the establishment of the Bulgarian National Bank as a regulatory authority and the assignment of the currency board arrangement in 1997 as a financial system stabilization measure. At the same time, Romania established the Romanian Asset Management Company to help manage NPLs (Bonin, 2004). Although some achievements had been reached, both Bulgaria and Romania brought in relatively

flimsy reform measures in the first part of the 1990s, inheriting from the communist regime's profoundly skewed economic systems. But since 1997, the two nations' economic strategies have drastically diverged from one another. The Romanian muddling-through policy and the Bulgarian shock therapy are distinguishable. International organizations gave Bulgaria's reform policy a higher mark than Romania's, which is known for having a credibility issue (Hunya & Dobrinsky, 2002).

The banks in the Baltic States focused more on liberalization and foreign investment, particularly by Scandinavian banks, along with digital banking and transparent governance (Uiboupin & Vensel, 2002). For instance, Estonia implemented a swift liberalization and privatization which attracted some Scandinavian banks, creating a highly efficient banking sector. And Estonia's early adoption of digital banking services set a benchmark in the region. Latvia’s banking sector underwent a rapid transformation with significant foreign ownership, and thus its regulatory reforms focused on enhancing transparency and governance. Similar to its Baltic neighbors, Lithuania privatized state-owned banks and attracted foreign investment, leading to a competitive and integrated banking sector (Koivu, 2002).

The EU Accession Began in 2004

The accession of some CEE countries to the EU beginning in 2004 had a significant impact on their banking sectors. First, those CEE countries that joined the EU had to align their banking regulations with EU directives and standards, which improved the regulatory environment, increased transparency, and enhanced financial stability. Meanwhile, the adoption of Basel I, II, and later Basel III standards led to better risk management practices and more robust capital requirements. (Kowalski, 2013) Second, EU accession made CEE markets more attractive to foreign banks, leading to increased FDI with a boom in capital, advanced technology, and improved management practices in the banking sector. Although the presence of foreign banks brought better services, more innovation, and improved efficiency, more enhanced competition occurred.

(Bonin, Hasan, & Wachtel, 2014) Third, the financial integration among Europe facilitated cross-border banking activities, allowing banks in CEE countries to expand their operations, financial products, and client base across the EU. EU membership also contributed to economic convergence with Western Europe, fostering economic stability and growth. This, in turn, positively impacted the banking sector by reducing macroeconomic risks. (Bonin, Hasan, & Wachtel, 2014) Finally, the financial infrastructure had a brand-new environment. The development and modernization of payment systems improved the efficiency and security of financial transactions. The enhanced supervisory frameworks and the establishment of stronger oversight mechanisms contributed to the stability and soundness of the banking sector. (Matthäus-Maier, 2005) Unlike those banks in the EU, the banks in non-EU countries faced more regulatory challenges, more significant economic volatility and geopolitical tensions, and limited presence of foreign banks which affected the level of innovation and competition in the banking sector (Efthyvoulou & Yildirim, 2014).

The Financial Crisis Started in 2008

Before the global financial crisis, the loan portfolio was growing rapidly, risk premiums were low, liquidity was abundant, leverage was high, asset prices were rising rapidly, and real estate bubbles were serious. However, during the crisis, the banking system including the banks in all CEE countries faced significant performance difficulties (Andrieș, Capraru, Ieșan-Muntean, & Ihnatov, 2016). First, many CEE countries experienced a sudden withdrawal of foreign capital as parent banks in Western Europe repatriated funds to shore up their balance sheets. This led to liquidity shortages in CEE banks. The reduction in available credit and interbank lending led to a credit crunch, making it difficult for businesses and consumers to obtain loans. (Epstein, 2014) Second, the financial crisis triggered a severe economic downturn in many CEE countries leading to declining economic activity, rising unemployment, and a significant increase in NPLs. The recession eroded the profitability and stability of banks and caused some bankruptcy. (Terazi & Şenel, 2011) Third, due to the rapid

collapse of financial markets, governments in several CEE countries intervened to support their banking sectors, providing bailouts and capital injections to stabilize banks. Meanwhile, institutions like the IMF and the EU provided financial assistance and loans to support CEE economies and their banking sectors. (Epstein, 2014) Fourth, the crisis highlighted weaknesses in regulatory frameworks, thus, stronger banking regulations and supervisory practices had been applied. For EU member states in the CEE region, the European Central Bank and other EU institutions played a crucial role in providing oversight and support to stabilize the banking sector, and the banks implemented tighter lending standards and more stringent credit assessment procedures to mitigate risks. (Howarth & Quaglia, 2016) Last, a wave of consolidations and mergers occurred to stabilize the banking sector due to the failure of several banks in the CEE region. Banks started to restructure their portfolios by selling off non-core assets and focusing on core banking activities to reduce exposure to risky assets and improve their balance sheets. (Efthyvoulou & Yildirim, 2014)

The COVID-19 Pandemic with Geopolitical Challenges Arose in 2020

The COVID-19 epidemic, which posed unprecedented challenges to the CEE banking industry after the 2008 financial crisis, was the primary factor influencing the trends in CEE banking in recent years. Similar to the financial crisis, the pandemic caused a sharp economic contraction and uncertainty, leading to higher unemployment, and a higher NPL ratio. Operational challenges and digital transformation have occurred during this period inevitably, especially for those banks in central and southeastern European countries. In the Baltic states, thanks to the strong digital banking infrastructure, the impact of the pandemic was mitigated a lot, and thus the sector focused more on enhancing cybersecurity and digital services (Bank of Estonia, 2021; Bank of Latvia, 2021; Bank of Lithuania, 2021). What is more, for all the banks in CEE countries, the reduced economic activity and lower interest rates negatively impacted banks' profitability. Increased provisions for loan losses due to higher NPLs further strained financial performance. Hence, banks need to improve operational efficiency and cut

costs to maintain financial stability. This included optimizing branch networks and investing in technology. (European Central Bank, 2020) Additionally, the geopolitical tensions, especially involving Russia, led to sanctions and trade restrictions that affected the CEE region. Banks had to navigate these sanctions, which contributed to currency volatility, affecting foreign exchange markets and increasing the risk for banks involved in international trade and finance. (IMF, 2022)

2.3.2. The Current Study of Banks' Performance in the CEE Region

The current studies of the bank sector's performance in the CEE region have different methods of analyzing their bank performance and different aspects of indicators that affect it. The majority of related studies analyze the effects of bank-specific and macroeconomic factors on banks' profitability. Similar to the studies focused on other regions or countries, most authors focused on the CEE region, relying mostly on performance ratios such as ROA, ROE, and NIM as predictors of bank performance. Some studies also employ the CAMEL technique to assess the banks' financial performance. Several studies have used stochastic frontier analysis (SFA) and data envelopment analysis (DEA) to measure the efficiency and performance of CEE banks.

Marius and Bogdan (2010) examined the effects of banking system reforms and financial liberalization on the performance of banks in 17 CEE nations between 2004 and 2008. They discovered that financial openness index, interest rate liberalization, and banking reformation all contribute to increased overall productivity and cost effectiveness.

Andries (2011) investigated the factors of banking sector efficiency and productivity in seven CEE nations from 2004 to 2008 by using SFA and DEA techniques. They found that the efficiency grew continually in the CEE countries due to increased competition upon EU accession, the changes in the regulation environment, and the entry of foreign banks. Meanwhile, a productivity index was constructed to assess the growth in

productivity of banks, and they discovered that owing to technological advancements, productivity improved significantly in 2008 compared to 2004.

Andrieş, Cocriş, & Ursu (2012) examined the impact of the financial crisis on the performance of banks across 19 countries from CEE countries for the period 2004 – 2010. They used ROAA, NIM, and Distance to Default (ZSCORE) to reflect the bank's performance and discovered that banks in non-EU nations had a significant fall in profitability and stability during the financial crisis. Another finding is that the best-performing banks throughout the financial crisis had much greater core equity capital and a stronger concentration on traditional banking activities.

Roman & Sargu (2015) thought that liquidity risk was the key problem that needed to be tackled in the banking sector during the period of financial crisis. Thus, they focused on the effects of bank-specific factors on liquidity in 7 CEE countries from 2004 to 2011 and found that the most influential factors on the banks' liquidity are the total capital ratio, impaired loans to total loans ratio, and the return on average equity (ROAE).

Psillaki & Mamatzakis (2017) looked into how structural changes and financial regulations affected the cost-effectiveness of banks in ten CEE nations between 2004 and 2009. They followed the methodology of Mamatzakis, Kalyvas & Piesse (2013) to measure the cost efficiency scores by using the SFA method, whilst they used panel regressions to examine the impact of regulation and liberalization on bank performance. Their results showed that structural reforms on labor and business markets strengthened the bank performance and the implementation of credit regulation and capitalization had a positive effect on the cost efficiency.

Using a panel data analysis, Onofrei, Bostan, Roma, & Firtescu (2018) examined 96 banks from 7 CEE countries between 2003 and 2012 and found that the GDP per capita

growth, domestic non-governmental credit, loan loss reserves, and cost-to-income ratio all significantly affect banking profitability in this region.

Antoun, Coskun, and Georgievski (2018) examined the macroeconomic and bank-specific factors influencing bank performance by using unbalanced panel data from nine CEE nations between 2009 and 2014. Based on CAMEL measures, they created a financial performance index and discovered that size had a negative impact on banks' asset quality and profitability while business mix and inflation had a favorable impact. On the other hand, size had a negative impact on capital adequacy and liquidity as well, whereas bank concentration and economic growth had a beneficial impact.

Using data from 2009 to 2018, Horobet, Radulescu, Belascu, & Dita (2021) looked at the factors influencing bank profitability in CEE nations using a two-step GMM technique. They discovered that several variables, including the unemployment rate, inflation rate, concentration ratio, and non-performing loans, had a negative effect on profitability and recommended changing policy to improve bank performance.

3. Data and Methodology

In this section, the sources of data, the selection of the dependent variables and explanatory variables, and the methodology that is applied in this dissertation are illustrated.

3.1. Data Sources and Variables

In the first part of this section, I will elaborate more on the sources of data and the construction of the variables that are employed in the following empirical analysis. The focus is put on the coverage of my dissertation and how the dependent variables are constructed through the factor analysis.

3.1.1. Period and Horizon of the Study

The dataset is a wide and unbalanced panel with 11 years and 96 units. From 2011 to 2021, the annual data of these eleven years is selected in this dissertation. The eleven years are chosen because I try to employ the most updated data and at the same time get rid of the impact of the global financial crisis in 2008 and 2009. Overall, 96 banks in 15 CEE countries are studied, including 8 EU members of the Czech Republic, Estonia, Hungry, Lithuania, Latvia, Poland, Slovenia, and the Slovak Republic; 7 non-EU members of Albania, Bulgaria, Belarus, Moldova, Montenegro, Romania, and Ukraine (as of the end of 2021). The selection is due to the availability of data. Some CEE countries, such as the Republic of Serbia, the Republic of Croatia, and Bosnia and Herzegovina are not included because they have a large number of missing values.

3.1.2. Dependent Variables

In this subsection, how the dependent variables that are placed on the left-hand side of the regression model are constructed is explained, as well as the sources of those data. Five CAMEL indicators of the 96 banks in the 15 CEE countries are gathered, each of the 5 main categories of capital adequacy, asset quality, managerial quality, earnings and profitability, and liquidity has one indicator. More detailed information on these CAMEL indicators can be found in Table 1, and all of them are available from BankFocus[3], which is a solution from Moody's analytics and an authoritative source of data in the banking sector.

Table 1: CAMEL Indicators

Capital Adequacy	Capital funds / Total liabilities excluding hybrid capital and subordinated liabilities
Asset Quality	Net loans / Total loans
Managerial Quality	Income-to-cost Ratio
Earnings and Profitability	ROAE
Liquidity	Liquid assets / Total assets

[3] More detailed information of this website could be found at https://login.bvdinfo.com/R0/BankFocus

Capital Adequacy

Compared to other ratios such as equity to asset ratio, I use the ratio of capital funds to total liabilities excluding hybrid capital and subordinated liabilities to calculate capital adequacy. The larger the ratio, the better the bank's capital adequacy. This ratio focuses on Core Capital, which consists of equity and retained earnings, and excludes hybrid capital and subordinated liabilities. Compared to hybrid instruments, core capital is more stable and less likely to be affected by market fluctuations. Furthermore, in the CEE countries, financial markets can be more volatile, and banking sectors might be more susceptible to economic fluctuations. This ratio highlights the most reliable and liquid forms of capital, ensuring a clearer picture of a bank's financial strength and ability to absorb losses. And this selection also aligns with the regulation which prioritizes certain forms of capital over others, ensuring compliance and relevance.

Asset Quality

The net loan is the amount of loans after deducting loan loss reserves. Loan loss reserves are funds set aside to cover potential losses from bad debts. Total Loan is the gross amount of loans a bank has issued. The larger the ratio of net loans to total loans, the better the asset quality for the reason that a higher ratio means fewer reserves are needed, suggesting that the bank's loan portfolio is of higher quality with lower expected losses. Unlike the NPL ratio, which focuses solely on non-performing loans, the Net Loans / Total Loans ratio considers the entire loan portfolio. It thus provides a more comprehensive picture of the bank's asset quality. Meanwhile, the simplicity and clarity of this ratio make it easy to compare across different banks and over time, which may be beneficial for stakeholders to analyze the asset quality as well.

Managerial Quality

The cost-to-income ratio is often used in assessing managerial quality by a lot of researchers, while this ratio evaluates managerial inefficiency. To make the dependent

variable clearer and more consistent, I chose the income-to-cost ratio to measure how effectively the bank's management works. A higher income-to-cost ratio indicates more efficient management. This ratio is defined as a ratio of total income to operating expenses and directly measures the bank's ability to generate income relative to its operating costs. It provides a clear measurement of managerial efficiency in controlling costs and maximizing income. At the same time, this ratio aligns well with the broader goal of enhancing profitability. By focusing on the relationship between income and costs, it ensures that management is incentivized to optimize both revenue generation and cost control.

Earnings and Profitability

The ROAE is defined as net income to average shareholders' equity. This ratio is similar to ROE but uses the average equity over a period, providing a more accurate measure of profitability by smoothing out fluctuations in equity levels. This is particularly important in the CEE region, where economic conditions can be more volatile. What is more, unlike the ROA and ROAA, ROAE focuses on shareholder value, aligning with the primary goal of increasing shareholder value. It reflects the bank's ability to generate profits from the capital provided by shareholders. And NIM narrowly focuses on interest-earning operations, while ROAE has an overall review of profitability. Therefore, I choose ROAE as the indicator representing banks' profitability in the CEE region.

Liquidity

Liquid assets are those assets that can be quickly and easily converted into cash without significant loss of value within one year. The Liquid Assets / Total Assets ratio is straightforward to calculate and is more available among all the banks than the other ratios such as liquidity coverage ratio and net stable funding ratio. The simplicity of this ratio also makes it easier to compare across different banks and over time. This is beneficial for stakeholders analyzing the liquidity of banks in the CEE region, providing

a standardized measure. A higher ratio indicates that a larger portion of the bank's assets are liquid and readily available to meet short-term obligations, which is crucial in managing liquidity risk. On the other hand, a declining ratio can serve as an early warning sign of liquidity stress, prompting timely intervention and corrective measures. This is particularly important in the CEE banking sector, where rapid response to liquidity issues is critical.

Table 2: Correlation Coefficient

	CA	AQ	MQ	EP	L
CA	1				
AQ	-0.215***	1			
MQ	0.057*	0.173***	1		
EP	0.020	0.181***	0.130***	1	
L	-0.072**	-0.015	0.026	-0.003	1

The above table shows the correlation coefficients among those five CAMEL indicators, which could provide some useful information about the relationship between different kinds of bank performance before the empirical part of my dissertation. From the table, the negative correlation of -0.215 between capital adequacy and asset quality is noticeable and it is significant at 99% confidence level, which reveals the conflict between these two kinds of bank performance. Another negative correlation is found between liquidity and capital adequacy, and the correlation coefficient of -0.072 is significant at a 95% confidence level. Moreover, at the 99% confidence level, the positive correlations among asset quality, profitability, and managerial quality are also revealed, representing the positive associations among the three indicators for bank performance. Managerial quality and capital adequacy are also correlated with a positive correlation coefficient of 0.057. However, it is only significant at the 90% confidence level.

3.1.3. Independent Variables

This subsection introduces the independent variables that are included in the regression models, including their meanings and sources. All of the independent variables can be

classified into three categories, including the Bank-specific category, Industry-specific category, and Macroeconomic category. Therefore, those independent variables will be introduced in their category respectively.

Bank-specific category

This category includes those independent variables that are related to the specific bank, including the total assets of the bank, which measures the size of the bank; the proportion of the total deposits to the total assets of the bank, which measures the relative deposit level of a bank; the proportion of other operating income to the average assets, which measures the business diversification of a bank; the proportion of operating expense to interest income, which measures the operating inefficiency of a bank. Similar to the CAMEL indicators, all of these bank-specific explanatory variables are obtained from BankFocus.

Industry-specific category

Variables that are related to the banking sector instead of the individual bank are included in this category to evaluate how the banking sector would affect the performance of an individual bank. In my model, the main industry-specific variable is the concentration ratio[4] of the banking sector, which measures the competitiveness and concentration of the banking sector. This ratio is obtained from the Global Financial Development Database of the World Bank[5], which is also a trustworthy source of financial data.

Macroeconomic category

Variables that are only related to the macroeconomic environment are categorized in this group to evaluate how the macroeconomic environment would affect the micro

[4] The bank concentration ratio is the assets of the three largest banks in one country as a share of the all assets of all commercial banks in this country.

[5] More detailed information of this website could be obtained from: https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database

performance of each bank. These variables include GDP per capita growth, which measures the economic development of one country; and Consumer Price Index (CPI), which measures the inflation rate of one country. A dummy variable is also included in this category, representing whether one country has joined the Eurozone to evaluate how this regional cooperation organization would affect individual bank performance.

Below is the summary of the above-mentioned explanatory variables, including their dimension, their expected influence on banks' financial performance as well as their sources. The expected impacts of these explanatory variables on bank performance are just the general expectations and they will be compared with the real results of the following regression models. It also makes sense that the impact of one explanatory variable on bank performance may vary if bank performance is proxied by different variables. Based on the studies on determinants of banks' financial performance, most of the determinants have a diversified impact on the five aspects of the bank's performance. First of all, an optimal size, deposits, and business mix should impact positively on banks' financial performance. However, a higher level of these indicators might not contribute to some aspects of the bank's performance. For instance, the size and deposits of a bank may become a double-edged sword --- On one hand, bigger size and deposits might bring economies of scale, however, on the other hand, if they become too big, it may also lead to the problem of diseconomies of scale and may cause managerial inefficiencies and higher operating costs. The business mix may bring the bank more investment earnings, while too diversified business may lead to higher risk and thus worse asset quality. Similar situations could be seen for the variables of inflation and the euro area, and the real impact of them could only be obtained from the empirical analysis. Then, the association between a bank's operating efficiency and its financial performance is expected to be positive. In my study, I use the operating expense as a share of interest income to measure the operating inefficiency. Therefore, the expected impact of this explanatory variable becomes negative. Additionally, higher market concentration leads to greater profitability due to increased market power and

reduced competition, while market concentration can negatively impact financial stability, as large banks in concentrated markets may take on excessive risks. Last, the influence of economic growth seems to be positive by increasing the demand for financial services, expanding the credit, and decreasing the NPLs.

Table 3: Summary of Explanatory Variables

Dimension	Variable	Expected Impact	Data Source
	Bank-Specific		
Size	Total Asset to GDP	+/-	BankScope
Deposits	Total deposits / total assets	+/-	BankScope
Business Mix	Other operating income / average assets	+/-	BankScope
Operating Inefficiency	Operating expense / interest income	-	BankScope
	Industry-Specific		
Bank Concentration	Concentration ratio of the banking sector	+/-	World Bank
	Macroeconomic		
Economic Growth	Annual GDP per capita growth	+	World Bank
Inflation	The growth rate of the CPI index	+/-	World Bank
	Dummy		
Euro Area	Whether the country joins the euro area	+/-	-

3.2. Methodology and Empirical Models

In this part, the methodology is introduced, and the empirical models are constructed and explained at the same time.

In this dissertation, to deal with the wide panel data, the fixed effect regression model is carried out, which could not only capture how each explanatory variable would affect the dependent variable but also figure out how the dependent variable would vary across different units and different years.

Because in this dissertation, five factors are used to represent the performance of each bank, five fixed effect regression models will be built respectively to see how

explanatory variables would affect these three kinds of bank performance indicators.

$$CA_{it} = \alpha_0 + \alpha_1 CA_{it-1} + \alpha_2 Size_{it} + \alpha_3 Dep_{it} + \alpha_4 Busmix_{it} + \alpha_5 Opef_{it} + \alpha_6 CR_{it} + \alpha_7 GDP_{it} + \alpha_8 INF_{it} + \alpha_9 Euro_{it} + \varepsilon_{it}$$

$$AQ_{it} = \beta_0 + \beta_1 AQ_{it-1} + \beta_2 Size_{it} + \beta_3 Dep_{it} + \beta_4 Busmix_{it} + \beta_5 Opef_{it} + \beta_6 CR_{it} + \beta_7 GDP_{it} + \beta_8 INF_{it} + \beta_9 Euro_{it} + \varepsilon_{it}$$

$$MQ_{it} = \gamma_0 + \gamma_1 MQ_{it-1} + \gamma_2 Size_{it} + \gamma_3 Dep_{it} + \gamma_4 Busmix_{it} + \gamma_5 Opef_{it} + \gamma_6 CR_{it} + \gamma_7 GDP_{it} + \gamma_8 INF_{it} + \gamma_9 Euro_{it} + \varepsilon_{it}$$

$$EP_{it} = \delta_0 + \delta_1 EP_{it-1} + \delta_2 Size_{it} + \delta_3 Dep_{it} + \delta_4 Busmix_{it} + \delta_5 Opef_{it} + \delta_6 CR_{it} + \delta_7 GDP_{it} + \delta_8 INF_{it} + \delta_9 Euro_{it} + \varepsilon_{it}$$

$$L_{it} = \zeta_0 + \zeta_1 L_{it-1} + \zeta_2 Size_{it} + \zeta_3 Dep_{it} + \zeta_4 Busmix_{it} + \zeta_5 Opef_{it} + \zeta_6 CR_{it} + \zeta_7 GDP_{it} + \zeta_8 INF_{it} + \zeta_9 Euro_{it} + \varepsilon_{it}$$

On the left-hand side of the five models are the dependent or explained variables. To be more specific, CA_{it}, AQ_{it}, MQ_{it}, EP_{it} and L_{it} stands for Capital Adequacy, Asset Quality, Managerial Quality, Earnings and Profitability, and Liquidity for Bank i at Time t respectively. On the right-hand side, α_0, β_0, γ_0, δ_0 and ζ_0 are the constant terms; CA_{it-1}, AQ_{it-1}, MQ_{it-1}, EP_{it-1} and L_{it-1} are the lagged values of each kind of bank performance, which is employed to evaluate how the performance of a bank is affected by its last year performance; and ε_{it} is the error term. The other explanatory variables are included as introduced in the previous subsection.

After the introduction of all the variables and the empirical model, the pre-estimation test is conducted to ensure the result of the panel regression is robust and unbiased. The

stationarity test is carried out to ensure that all variables do not contain unit roots, and thus problems such as spurious regression could be avoided. The Fisher-type unit-root test is conducted for all variables respectively and the below table is the summary of the results.

Table 4: Result of the stationarity test for all variables

Variable	Z-statistics	P-value	Result
Capital Adequacy	2.6621	0.0039	Stationary
Asset Quality	16.7691	0.0000	Stationary
Managerial Quality	18.0912	0.0000	Stationary
Earnings and Profitability	29.4348	0.0000	Stationary
Liquidity	7.3509	0.0000	Stationary
Logarithm of Total Assets	-2.0681	0.9807	Non-Stationary
Total Deposits to Total Assets	2.2203	0.0132	Stationary
Other Operating Income to Average Asset	20.2671	0.0000	Stationary
Operating Expense to Interest Income	8.8845	0.0000	Stationary
Concentration ratio	2.1223	0.0169	Stationary
GDP Per Capita Growth	40.4094	0.0000	Stationary
Growth rate of CPI Index	3.0068	0.0013	Stationary
Total Assets to GDP	2.5408	0.0055	Stationary

H0: All panels contain unit roots, Ha: At least one panel is stationary, d = 0

From the above table, we can conclude all five dependent variables are stationary at the 99% confidence level. Additionally, apart from the logarithm of the total assets, all other explanatory variables are stationary at the 95% confidence level. The null hypothesis of all panels containing unit roots cannot be rejected for the logarithm of the total assets and it must be transformed into a stationary one to be included in the regression. In the last row of Table 3 is the result of the unit root test for the total assets to GDP, and the stationarity of this variable is noticeable and therefore it is included instead in the

regression model.

Table 5: Descriptive Statistics

Variable Name	Obs	Mean	SD	Min	Median	Max
Capital Adequacy	1054	0.137	0.058	-0.003	0.133	0.455
Asset Quality	1019	0.931	0.065	0.462	0.953	1.000
Managerial Quality	1046	1.783	0.643	0.301	1.703	5.895
Earnings and Profitability	1053	0.060	0.437	-12.470	0.091	1.353
Liquidity	1045	0.977	0.361	-10.666	0.993	1.000
Size	1056	82.504	89.557	0.000	52.982	590.199
Deposit	1054	0.817	0.099	0.057	0.831	0.975
Business Mix	1052	0.017	0.014	-0.063	0.013	0.157
Operating efficiency	1053	1.038	2.154	-57.051	0.896	25.346
Concentration Ratio	1056	59.793	13.331	26.986	60.626	98.729
GDP Growth	1056	0.028	0.034	-0.152	0.033	0.157
Inflation	960	0.026	0.042	-0.016	0.021	0.465

After appropriate variable transformation and ensuring the stationarity of all variables, the descriptive statistics are summarized in the above table, which includes the number of observations, mean, standard deviation, minimum, median, and maximum value of all the related variables of the empirical part.

Then, preliminary tests are also carried out to show the appropriateness of the fixed effect models. Firstly, comparisons between the pooled model and fixed effect model are made for all five specifications and the results are summarized in the below table. F tests are carried out with the null hypothesis that all u_i equal to zero. If the p-value is small enough, then we can reject the null hypothesis that all u_i equal to zero with confidence and conclude that the fixed effect model is better than the pooled model.

Table 6: Comparison between Fixed effect model and Pooled model

Models	F	P value	Which one is better
CA	3.40	0.000	Fixed effect model
AQ	8.58	0.000	Fixed effect model
MQ	3.15	0.000	Fixed effect model

EP	3.05	0.000	Fixed effect model
L	1.34	0.023	Fixed effect model

From the above table, it can be concluded that for all the five model specifications, the null hypotheses of the F tests can all be rejected and the fixed effect model is preferred over the pooled model.

Then, comparisons between the fixed effect model and random effect model for the five model specifications are also conducted to evaluate whether the constant is correlated with those explanatory variables. The Hausman tests are employed for each model specification and its null hypothesis is that the difference in the coefficients is not systematic. Rejecting the null hypothesis means the fixed effect model is preferred over the random effect model. The results of those Hausman tests are also summarized in the below table.

Table 7: Comparison between Fixed effect model and Random effect model

Models	**F**	**P value**	**Which one is better**
CA	305.53	0.000	Fixed effect model
AQ	48.80	0.000	Fixed effect model
MQ	258.17	0.000	Fixed effect model
EP	233.02	0.000	Fixed effect model
L	219.12	0.000	Fixed effect model

Noticeably, all five model specifications have huge F values and small p values in those Hausman tests. Therefore, it can be concluded from the above table with confidence that the fixed effect model is preferred to the random effect model for all five cases, meaning that the constants in all five models are not correlated with those explanatory variables.

4. Results

In this section, the results of the cross-section fixed effect regression models concerning five types of bank performance will be displayed respectively in tables, and in each table, there will be 8 specific models with different settings, which will enable us to compare and figure out the most important influential factor behind the performance of banks in the CEE regions. Model 1 only includes bank-specific indicators and model 2 adds concentration ratio, the industry-specific indicator, into the model. Then, GDP Growth and inflation rate are also included as the macroeconomic indicators in the third model. In model 4, besides these variables, several dummy variables are also considered. First of all, is the dummy variable of the euro area, which is added to compare the influence of the euro area membership. Then, different years are also added as time dummies into the model to figure out the impact of different years. Additionally, a by-group regression will also be conducted to see how factors will affect bank performance differently in EU countries and non-EU countries.

4.1. Capital Adequacy

The table below shows the empirical results when capital adequacy is used as the dependent variable to proxy the financial performance of banks. The estimated coefficient of each explanatory variable and its standard error are shown. The standard notations for statistical significance are adopted. In model 1, looking at the four bank-specific factors only, it is noticeable that the size of the bank, the deposit level, and the business mix of the bank are three influential factors behind the bank's capital adequacy. These three explanatory variables are all significant at the 99% confidence level. Firstly, the relative size of banks contributes to banks' capital adequacy negatively. It may be due to that large banks do not need such a high level of capital. Additionally, in line with the former expectation, the business mix is positively correlated with banks' capital level, meaning that a broader business mix forces banks to hold more capital. Then, in this case, the deposit level of banks is also negatively correlated with banks' financial performance in this perspective, as its estimated coefficient is -0.364.

Operating inefficiency, however, seems to be an insignificant factor in this model specification, which means banks' capital adequacy is not strongly associated with this factor. Then, in model 2, the concentration ratio is added as an industry-specific factor. In this model, the results of the other four bank-specific factors remain the same and the statistical significance of this industry-specific factor is shown. The estimated coefficient is -0.004 and it is significant at the 99% confidence level, representing that a more concentrated banking sector tends to impact the capital adequacy of commercial banks negatively. Then, including two macroeconomic indicators in model 3, the other explanatory variables retain their significance and magnitudes. Nonetheless, the negative impact of GDP growth and inflation rate are both proved with the 95% confidence level and the 99% confidence level respectively. In other words, in a rapidly developing country with positive GDP per capita growth and inflation rate, there is less need for external capital for banks. Lastly, in the fourth model, several dummy variables are considered to evaluate the influence of the euro area and different years on banks' capital adequacy. Looking at the results of this model, the estimated coefficient of the euro area is positive and significant at the 90% confidence level, meaning banks' capital adequacy tends to be higher in the euro area than their counterparts out of the euro area. For those year dummies, the year 2011 is omitted as it is used to be a benchmark when we evaluate the meaning of the coefficients of other year dummies, the year 2021 is also automatically omitted due to its collinearity with some other years. In this model, most coefficients of the year dummies are positive, meaning that compared to 2011, the capital adequacy of banks in the CEE region has improved in the other years since then.

Model 5 to Model 8 are models with similar settings to Model 1 to Model 4, and the only difference is that the lagged value of the dependent variable is included to measure how the lagged value of the bank performance can affect the current bank performance. Looking at the results from Model 5 to Model 8, it is noticeable that the estimated coefficients of lagged performance in all models are significant at the 99% confidence level, representing the consistency of banks' capital adequacy in continuous years.

Meanwhile, it is also noticeable that the results of other explanatory variables remain almost the same after including the lagged performance in the model.

Table 8: Empirical Results - Model of Capital Adequacy

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size	-0.0003***	-0.0003***	-0.0003***	-0.0003***	-0.0002***	-0.0002***	-0.0002***	-0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Deposits	-0.364***	-0.362***	-0.352***	-0.361***	-0.239***	-0.237***	-0.236***	-0.243***
	(0.021)	(0.021)	(0.022)	(0.022)	(0.019)	(0.019)	(0.019)	(0.019)
Business	0.452***	0.452***	0.650***	0.0561***	0.519***	0.529***	0.536***	0.504***
Mix	(0.107)	(0.106)	(0.119)	(0.123)	(0.099)	(0.099)	(0.099)	(0.102)
Operating	-0.0003	-0.0002	0.001	0.001	-0.001	-0.001	-0.001	-0.001
Inefficiency	(0.0004)	(0.0005)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Concentration	-	-0.0004***	-0.001***	-0.0000	-	-0.0003**	-0.0002*	0.0001
Ratio		(0.0001)	(0.0002)	(0.0002)		(0.0001)	(0.0001)	(0.0002)
GDP Growth	-	-	-0.058**	0.005	-	-	-0.014	0.294
			(0.029)	(0.060)			(0.024)	(0.050)
Inflation Rate	-	-	-0.074***	-0.059*	-	-	-0.061***	-0.059**
			(0.029)	(0.033)			(0.024)	(0.027)
Lagged	-	-	-	-	0.497***	0.490***	0.488***	0.485***
Performance					(0.025)	(0.025)	(0.025)	(0.025)
Euro Area	-	-	-	0.013*	-	-	-	0.010
				(0.008)				(0.006)
Year2011				0 (omitted)				
Year2012	-	-	-	0.028***	-	-	-	0.023***
				(0.006)				(0.005)
Year2013	-	-	-	0.023***	-	-	-	0.015***
				(0.006)				(0.005)
Year2014	-	-	-	0.014**	-	-	-	0.007
				(0.006)				(0.005)
Year2015	-	-	-	0.009*	-	-	-	0.003
				(0.005)				(0.004)
Year2016	-	-	-	0.015***	-	-	-	0.011**
				(0.005)				(0.004)
Year2017	-	-	-	0.016***	-	-	-	0.012***
				(0.005)				(0.004)

Year2018	-	-	-	0.122***	-	-	-	0.010***
				(0.005)				(0.004)
Year2019	-	-	-	0.013***	-	-	-	0.009**
				(0.005)				(0.004)
Year2020	-	-	-	0.010	-	-	-	0.007
				(0.008)				(0.007)
Year2021				0 (omitted)				
Constant	0.456***	0.474***	0.474***	0.432***	0.273***	0.287***	0.287***	0.256***
	(0.018)	(0.019)	(0.020)	(0.021)	(0.018)	(0.019)	(0.019)	(0.020)
Observations	1052	1052	958	958	956	956	956	956
Groups	96	96	96	96	96	96	96	96
R-square	0.0989	0.1031	0.0995	0.1319	0.5656	0.5603	0.5657	0.6024
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No	No	No	Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

4.2. Asset Quality

The table below shows the empirical results when asset quality is used as the dependent variable to proxy the financial performance of banks. The same notations as in the table in Section 4.1 are kept here.

Similarly, model 1 only includes the four bank-specific factors as the explanatory variables, and this time, looking at the banks' financial performance from the perspective of asset quality, different regression results can be witnessed. Just like in the model of capital adequacy, banks' relative size, deposit level, and business mix are still very significant factors in the first model, representing their great influence on banks' asset quality. The positive correlation between asset quality and banks' relative size is also noticeable at the 99% confidence level, meaning bigger banks are less likely to face asset quality problems. However, deposit level and business diversity are both connected negatively with banks' asset quality, with estimated coefficients of -0.09 and -0.443 respectively. For the former, when banks have a high level of deposits, they might feel pressured to deploy these funds into loans and other earning assets to

generate returns. This pressure can lead to aggressive lending practices, where banks might lower their credit standards to issue more loans quickly, potentially compromising the quality of the assets. For the latter one, a more diverse business portfolio would also cover those businesses with higher risks and impair the asset quality of commercial banks. Then, in the second model, the newly added explanatory variable concentration ratio is proved to be a relevant factor and it would also help improve a bank's asset quality. This might mean that in a more concentrated and competitive banking sector, banks are also forced to improve their asset quality to ensure their survival. Meanwhile, adding this industry-specific factor does not significantly influence the estimated coefficients of the other variables, as their estimated coefficients remain stable in the second model. In model 3, although GDP per capita growth does not have a significant coefficient, the result for an inflation rate of -0.091 is highly significant. Therefore, we could conclude from this model that economic growth does not affect banks' asset quality in the CEE regions, whereas a higher inflation rate might do harms to banks in this respect. Additionally, after adding the two macroeconomic indicators, operating inefficiency became a significant factor and is affecting banks' asset quality negatively. This makes sense, as a lower level of asset quality might be seen in an environment with lower efficiency and management capability. Then, in the fourth model, the dummy variables for the euro area and the different years are also included to check their influence on the dependent variable. Although the dummy of the euro area is proved to be an insignificant factor behind banks' asset quality, the significance of those year dummies is noticeable. Compared to the year 2011, most other years, from 2012 to 2018, tend to have lower levels of asset quality. And the years 2019 and 2020 are found to have no obvious difference from the year 2011.

Model 5 to Model 8 are models with similar settings to Model 1 to Model 4, and the only difference is that the lagged value of the dependent variable is included to measure how the lagged value of the bank performance can affect the current bank performance.

In terms of banks' asset quality, the significance of banks' lagged performance could be found at a 99% confidence level in all four models, and the positive value of about 0.75 represents the strong and positive correlation between the banks' asset quality in two continuous years. Additionally, after adding the lagged performance as a new explanatory variable, size, deposits, concentration ratio, and GDP growth only impact the asset quality when the euro area and year dummies are not included. The significant impact of business mix on asset quality is removed, and only operating inefficiency and inflation rate remain two significant factors in all the models at the 90% and 99% confidence levels respectively. Furthermore, the estimated coefficient of the euro area turns to negative and significant at the 90% confidence level after adding the lagged performance, meaning banks' asset quality tends to be higher out of the euro area than their counterparts in the euro area.

Table 9: Empirical Results - Model of Asset Quality

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size	0.0002***	0.0002***	0.0003***	0.0001	0.0001*	0.0001*	0.0001**	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Deposits	-0.090***	-0.094***	-0.098***	-0.061*	-0.042*	-0.049**	-0.046*	-0.039
	(0.033)	(0.032)	(0.035)	(0.035)	(0.025)	(0.025)	(0.024)	(0.025)
Business	-0.443***	-0.447***	-0.433**	-0.053	-0.162	-0.178	-0.098	0.026
Mix	(0.165)	(0.164)	(0.191)	(0.195)	(0.136)	(0.136)	(0.133)	(0.139)
Operating	0.001	0.0005	-0.006***	-0.006***	-0.002*	-0.002**	-0.002*	-0.002*
Inefficiency	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Concentration	-	0.001***	0.001**	-0.0002	-	0.001***	0.0004***	0.0002
Ratio		(0.0002)	(0.0002)	(0.0003)		(0.0002)	(0.0002)	(0.0002)
GDP Growth	-	-	0.058	-0.005	-	-	0.119***	0.035
			(0.046)	(0.095)			(0.032)	(0.069)
Inflation Rate	-	-	-0.091**	-0.162***	-	-	-0.156***	-0.206***
			(0.046)	(0.052)			(0.034)	(0.040)
Lagged	-	-	-	-	0.751***	0.749***	0.761***	0.747***
Performance					(0.026)	(0.025)	(0.025)	(0.026)
Euro Area	-	-	-	0.013	-	-	-	-0.015*
				(0.012)				(0.008)

Year2011				0 (omitted)				
Year2012	-	-	-	-0.031***	-	-	-	-0.015**
				(0.010)				(0.007)
Year2013	-	-	-	-0.034***	-	-	-	-0.018**
				(0.010)				(0.007)
Year2014	-	-	-	-0.040***	-	-	-	-0.018***
				(0.009)				(0.007)
Year2015	-	-	-	-0.036***	-	-	-	-0.013**
				(0.008)				(0.006)
Year2016	-	-	-	-0.036***	-	-	-	-0.011*
				(0.008)				(0.006)
Year2017	-	-	-	-0.026***	-	-	-	-0.005
				(0.007)				(0.005)
Year2018	-	-	-	-0.017**	-	-	-	-0.002
				(0.007)				(0.005)
Year2019	-	-	-	-0.009	-	-	-	-0.001
				(0.008)				(0.005)
Year2020	-	-	-	-0.013	-	-	-	-0.008
				(0.013)				(0.009)
Year2021				0 (omitted)				
Constant	0.990***	0.959***	0.966***	1.016***	0.265***	0.244***	0.229***	0.270***
	(0.028)	(0.030)	(0.032)	(0.034)	(0.033)	(0.033)	(0.033)	(0.035)
Observations	1017	1017	934	934	921	921	921	921
Groups	95	95	95	95	95	95	95	95
R-square	0.0600	0.0797	0.1146	0.1350	0.7512	0.7508	0.7459	0.7756
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No	No	No	Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

4.3. Managerial Quality

The table below shows the empirical results when managerial quality is used as the dependent variable to proxy the performance of banks. The same notations as in the table in Section 4.1 are kept here.

Similarly, model 1 only includes the four bank-specific factors as the explanatory variables, and this time, looking at the banks' financial performance from the perspective of managerial quality, different regression results can be witnessed. In this model, all four bank-specific factors are significant at the 95% confidence level. The positive estimated coefficients of 0.001, 0.763, and 10.413 for size, deposit, and business mix respectively represent their positive associations with managerial quality. In other words, better management capabilities are more likely to be found in a bigger commercial bank with higher deposit levels and more diverse business combinations. Similarly, the negative value of -0.016 for operating inefficiency also shows the strong relationship between banks' operating efficiency and managerial quality. The directions of these four bank-specific factors are within my former expectations. In the second model, the newly added explanatory variable concentration ratio is proved to be an irrelevant factor and it would not affect a bank's managerial quality. In model 3, similar results could also be found, and banks' managerial quality is proved to be unaffected by the macroeconomic environment. Then, in the fourth model, the dummy variable for the euro area and different years are also included to check their influence on the dependent variable. However, these newly added dummies are all found to be irrelevant to banks' managerial quality, meaning no statistical difference between the managerial quality of euro-area banks and non-euro-area banks is found and the management capability remains relatively stable across the several years.

However, as we can see from the table below the R squares are extremely small in Model 1 to Model 4 compared to those in Model 5 to Model 8, so the overall explanatory power of Model 1 to Model 4 appears extremely weak. In this case, the results of Model 5 to Model 8 which include the lagged performance of managerial quality as the main determinant of banks' managerial quality are more useful to us. Model 5 to Model 8 are models with similar settings to Model 1 to Model 4, and the only difference is that the lagged value of the dependent variable is included to measure whether the lagged value of the bank performance can affect the current bank

performance. In terms of banks' managerial quality, the significance of banks' lagged performance could be found at a 99% confidence level, and the positive value of about 0.50 represents the strong and positive correlation between the banks' managerial quality in two continuous years. This makes sense, as the level of managerial quality is a long-term indicator and it can hardly be changed in the short run. Additionally, after adding the lagged performance as a new explanatory variable, the significance of size can no longer be found and the significance for the other three bank-specific factors remains unchanged.

Table 10: Empirical Results - Model of Managerial Quality

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size	0.001**	0.001***	0.001	0.002***	-0.0001	-0.0001	0.0000	0.0005
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0004)	(0.0005)	(0.0005)	(0.0005)
Deposits	0.763***	0.777***	0.990***	0.928***	0.796***	0.804***	0.805***	0.800***
	(0.247)	(0.248)	(0.248)	(0.251)	(0.203)	(0.204)	(0.203)	(0.205)
Business	10.413***	10.418***	7.281***	6.197***	5.216***	5.238***	5.424***	5.096***
Mix	(1.258)	(1.258)	(1.357)	(1.410)	(1.114)	(1.116)	(1.119)	(1.160)
Operating	-0.016***	-0.015***	-0.075***	-0.073***	-0.053***	-0.052***	-0.051***	-0.050***
Inefficiency	(0.006)	(0.006)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)
Concentration	-	-0.002	-0.003*	-0.002	-	-0.001	-0.001	-0.001
Ratio		(0.002)	(0.002)	(0.002)		(0.001)	(0.001)	(0.002)
GDP Growth	-	-	0.241	-0.411	-	-	0.354	0.133
			(0.330)	(0.687)			(0.270)	(0.578)
Inflation Rate	-	-	-0.279	-0.228	-	-	-0.365	-0.224
			(0.325)	(0.376)			(0.282)	(0.337)
Lagged	-	-	-	-	0.497***	0.497***	0.499***	0.500***
Performance					(0.026)	(0.026)	(0.026)	(0.026)
Euro Area	-	-	-	0.111	-	-	-	0.016
				(0.087)				(0.071)
Year2011				0 (omitted)				
Year2012	-	-	-	-0.002	-	-	-	-0.050
				(0.069)				(0.058)
Year2013	-	-	-	-0.017	-	-	-	-0.057
				(0.071)				(0.060)

Year2014	-	-	-	0.071	-	-	-	0.050
				(0.065)				(0.054)
Year2015	-	-	-	0.071	-	-	-	0.009
				(0.057)				(0.048)
Year2016	-	-	-	0.087	-	-	-	0.041
				(0.061)				(0.051)
Year2017	-	-	-	-0.032	-	-	-	-0.106**
				(0.053)				(0.044)
Year2018	-	-	-	0.023	-	-	-	-0.003
				(0.053)				(0.044)
Year2019	-	-	-	-0.039	-	-	-	-0.061
				(0.054)				(0.045)
Year2020	-	-	-	-0.121	-	-	-	-0.065
				(0.092)				(0.077)
Year2021				0 (omitted)				
Constant	0.895***	0.997***	1.038***	0.991***	0.215	0.242	0.233	0.257
	(0.214)	(0.229)	(0.227)	(0.245)	(0.179)	(0.190)	(0.190)	(0.205)
Observations	1043	1043	954	954	947	947	947	947
Groups	96	96	96	96	96	96	96	96
R-square	0.0006	0.0009	0.0009	0.0264	0.7117	0.7089	0.7162	0.7241
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No	No	No	Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

4.4. Earnings and Profitability

The table below shows the empirical results when earnings and profitability is used as the dependent variable to proxy the performance of banks. The same notations as in the table in Section 4.1 are kept here.

From the table below, in model 1 which looks at those bank-specific factors only, it is noticeable that the bank's size, the bank's business mix, and the bank's operating inefficiency are three influential factors behind the bank’s earnings and profitability. Business mix is significant at the 99% confidence level, operating inefficiency is

significant at the 95% confidence level, and size is significant at the 90% confidence level. Additionally, in line with the former expectation, the business mix largely improves the bank's performance, as its estimated coefficient is 16.793. Operating inefficiency contributes to banks' performance negatively, which means the more efficient the bank is, the more profitability it earns. In this case, the bank's size helps improve its financial performance slightly, as its estimated coefficient is 0.001. Deposit, however, seems to be an insignificant factor behind banks' earnings and profitability. Then, in model 2, the concentration ratio is added as an industry-specific factor. In this model, the results of the other four bank-specific factors remain the same except the operating inefficiency becomes significant at the 99% confidence level and the statistical significance of this industry-specific factor is shown. The estimated coefficient is 0.003 and it is significant at the 90% confidence level, representing that a more concentrated banking sector is beneficial to the profitability of commercial banks. Including two macroeconomic indicators in model 3, the results of the bank-specific and industry-specific factors are all the same with model 2, and the positive impact of GDP growth and the negative influence of the inflation rate are both proved with a 95% confidence level. Lastly, in the fourth model, several dummy variables are considered to evaluate the influence of the euro area and different years. Although the estimated coefficient of the euro area is positive, it is not significant at any confidence level, which means banks' performance in the euro area and out of the euro area are statistically indistinguishable. For those year dummies, the year 2011 is omitted it is used to be a benchmark when we evaluate the meaning of the coefficients of other year dummies. In this model, the coefficients of the year dummies are all negative, while the year dummies from 2018 to 2020 are not significant at any confidence level, meaning that compared to 2011, the banks' performances are worse from 2012 to 2018, and the worst performance could be found in the year of 2014. The banks' performances between 2018 and 2020 are similar to that in 2011.

Model 5 to Model 8 are models with similar settings to Model 1 to Model 4, and the

only difference is that the lagged value of the dependent variable is included to measure how the lagged value of the bank performance can affect the current bank performance. Looking at the results from Model 5 to Model 8, it is noticeable that the estimated coefficients of lagged performance in all models are insignificant. Therefore, we could conclude that in the CEE region, banks' earnings and profitability can hardly be influenced by their lagged value. Meanwhile, it is also noticeable that the results of other explanatory variables remain almost the same after including the lagged performance in the model.

Table 11: Empirical Results - Model of Earnings and Profitability

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size	0.001*	0.001*	0.002**	0.0004	0.001**	0.001**	0.002**	0.0005
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposits	-0.083	-0.105	-0.334	-0.021	-0.284	-0.336	-0.333	-0.032
	(0.275)	(0.275)	(0.295)	(0.294)	(0.298)	(0.298)	(0.297)	(0.295)
Business	16.793***	16.790***	22.557***	25.714***	22.338***	22.203***	22.574***	25.724***
Mix	(1.404)	(1.402)	(1.616)	(1.654)	(1.628)	(1.626)	(1.623)	(1.659)
Operating	-0.016**	-0.017***	-0.090***	-0.095***	-0.089***	-0.092***	-0.090***	-0.095***
Inefficiency	(0.006)	(0.006)	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)	(0.013)
Concentration	-	0.003*	0.004*	-0.003	-	0.004**	0.004*	-0.003
Ratio		(0.002)	(0.002)	(0.003)		(0.002)	(0.002)	(0.003)
GDP Growth	-	-	0.846**	0.505	-	-	0.842**	0.508
			(0.393)	(0.804)			(0.394)	(0.805)
Inflation Rate	-	-	-0.817**	-1.503***	-	-	-0.826	-1.540***
			(0.387)	(0.441)			(0.272)	(0.446)
Lagged	-	-	-	-	-0.009	-0.009	-0.015	-0.033
Performance					(0.030)	(0.030)	(0.030)	(0.030)
Euro Area	-	-	-	0.039	-	-	-	0.040
				(0.102)				(0.102)
Year2011				0 (omitted)				
Year2012	-	-	-	-0.169**	-	-	-	-0.168**
				(0.081)				(0.081)
Year2013	-	-	-	-0.267***	-	-	-	-0.269***
				(0.084)				(0.084)

Year2014	-	-	-	-0.321***	-	-	-	-0.323***
				(0.076)				(0.076)
Year2015	-	-	-	-0.215***	-	-	-	-0.218***
				(0.067)				(0.068)
Year2016	-	-	-	-0.278***	-	-	-	-0.280***
				(0.072)				(0.072)
Year2017	-	-	-	-0.138**	-	-	-	-0.142**
				(0.063)				(0.063)
Year2018	-	-	-	-0.060	-	-	-	-0.059
				(0.062)				(0.062)
Year2019	-	-	-	-0.039	-	-	-	-0.037
				(0.064)				(0.064)
Year2020	-	-	-	-0.033	-	-	-	-0.033
				(0.107)				(0.108)
Year2021				0 (omitted)				
Constant	-0.229	-0.398	-0.305	0.051	-0.097	-0.293	-0.306	0.064
	(0.238)	(0.255)	(0.270)	(0.287)	(0.257)	(0.273)	(0.272)	(0.289)
Observations	1052	1052	958	958	955	955	955	955
Groups	96	96	96	96	96	96	96	96
R-square	0.0292	0.0321	0.0621	0.0871	0.0524	0.0578	0.0603	0.0835
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No	No	No	Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

4.5. Liquidity

The table below demonstrates the empirical results when liquidity is used as the dependent variable to proxy the performance of banks. The same notations as in the table in Section 4.1 are kept here.

From the table below, it is obvious that the influential factors behind the bank's performance have changed a lot when liquidity is used to evaluate the performance of banks in the CEE region. In Model 1, only looking at the four bank-specific factors, none of them are proved to be a significant explanatory variable, which means that all

the four bank-specific factors, including size, deposits, business mix, and operating efficiency are found to be irrelevant to the level of liquidity of a bank in the CEE region. Then, in Model 2 and Model 3, the industry-specific factors and the macroeconomic indicators are added to the original model. However, unlike the previous 4 models "CAME", only the inflation rate is found to be significant and negatively influences the banks' liquidity. In the fourth model, after those year dummies are included in the model, the concentration ratio becomes significant at a 95% confidence level, which means less concentrated banking sector in the CEE region is found to be beneficial to its liquidity level. Meanwhile, the negative impact of GDP growth and the negative influence of the inflation rate are both proved with a 99% confidence level. The estimated coefficients of GDP growth and inflation rate are -5.367 and -5.295 respectively. Consequently, it can be concluded that a bank's liquidity level is highly affected by its level in the macroeconomy. The estimated coefficient of the euro area is negative and significant at a 95% confidence level, which means the banks' liquidity in the euro area is lower than those out of the euro area. This result may be due to the portfolio motive, which is that when a bank runs out of profitable lending opportunities, investing deposits in liquid assets can be the most advantageous use of these deposits (Stulz, Taboada & van Dijk, 2022). For those banks out of the euro area, they have fewer opportunities to find the more profitable lending and have worse risk resistance, and thus their ratio of liquid assets to total assets is higher than those in the euro area. For those year dummies, all the coefficients of the year dummies are negative, meaning that compared to 2011, the banks' performances are worse than in any other year.

Model 5 to Model 8 are models with similar settings to Model 1 to Model 4, and the only difference is that the lagged value of the dependent variable is included to measure how the lagged value of the bank performance can affect the current bank performance. The size becomes significant at a 90% confidence level only after adding the lagged value of banks' liquidity, all the variables, and dummies. All the other three bank-specific variables are still insignificant at any confidence level. Meanwhile, the newly

added lagged liquidity of the bank has also proved to be a negative significant factor behind banks' liquidity performance at the confidence level of 99%. This negative result means that the banks may have worse liquidity than their performance in the year before.

Table 12: Empirical Results - Model of Liquidity

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Size	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Deposits	-0.219	-0.209	-0.151	0.037	-0.220	-0.190	-0.110	0.102
	(0.250)	(0.251)	(0.268)	(0.263)	(0.282)	(0.283)	(0.266)	(0.260)
Business	0.744	0.746	1.326	1.968	0.361	0.436	0.883	1.504
Mix	(1.276)	(1.276)	(1.466)	(1.479)	(1.549)	(1.549)	(1.460)	(1.463)
Operating	0.001	0.001	0.010	0.008	0.003	0.005	0.009	0.008
Inefficiency	(0.216)	(0.006)	(0.012)	(0.012)	(0.013)	(0.013)	(0.012)	(0.012)
Concentration	-	-0.001	-0.0004	-0.005**	-	-0.002	-0.001	-0.005**
Ratio		(0.002)	(0.002)	(0.002)		(0.002)	(0.002)	(0.002)
GDP Growth	-	-	-0.566	-5.367***	-	-	-0.575	-5.609***
			(0.357)	(0.719)			(0.354)	(0.712)
Inflation Rate	-	-	-3.728***	-5.295***	-	-	-3.766***	-5.426***
			(0.351)	(0.395)			(0.354)	(0.391)
Lagged	-	-	-	-	-0.109***	-0.111***	-0.121***	-0.150***
Performance					(0.034)	(0.034)	(0.032)	(0.031)
Euro Area	-	-	-	-0.227**	-	-	-	-0.239***
				(0.091)				(0.090)
Year2011				0 (omitted)				
Year2012	-	-	-	-0.576***	-	-	-	-0.602***
				(0.072)				(0.071)
Year2013	-	-	-	-0.559***	-	-	-	-0.605***
				(0.075)				(0.074)
Year2014	-	-	-	-0.491***	-	-	-	-0.513***
				(0.068)				(0.067)
Year2015	-	-	-	-0.341***	-	-	-	-0.354***
				(0.060)				(0.060)
Year2016	-	-	-	-0.446***	-	-	-	-0.466***
				(0.064)				(0.064)
Year2017	-	-	-	-0.239***	-	-	-	-0.251***

				(0.056)				(0.055)
Year2018	-	-	-	-0.242***	-	-	-	-0.255***
				(0.055)				(0.055)
Year2019	-	-	-	-0.278***	-	-	-	-0.291***
				(0.057)				(0.056)
Year2020	-	-	-	-0.702***	-	-	-	-0.733***
				(0.096)				(0.095)
Year2021				0 (omitted)				
Constant	1.202***	1.278***	1.248***	1.998***	1.334***	1.444***	1.360***	2.186***
	(0.216)	(0.232)	(0.245)	(0.257)	(0.245)	(0.260)	(0.245)	(0.256)
Observations	1052	1052	958	958	958	958	958	958
Groups	96	96	96	96	96	96	96	96
R-square	0.0001	0.0000	0.1163	0.1104	0.0000	0.0000	0.1126	0.1037
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	No	No	No	Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

4.6. Comparison of EU and Non-EU countries

In the previous results, the differences between banks in the euro area and outside the euro area in determining different kinds of bank performance are disclosed, and it can be concluded that banks in the euro area would have significantly higher capital adequacy levels, whereas lower asset quality and liquidity levels compared to their counterpart outside of the euro area. Therefore, it would be more interesting if we could find out whether EU countries and non-EU countries would have such significant differences. However, because adding another dummy variable of the EU into the current model could lead to the problem of strong collinearity with the dummy variable of the euro area, and could only shift the mean estimates, by-group regressions which could split the sample into two sub-samples and allow all the estimated coefficients to differ are conducted instead to compare how different factors would affect bank performance differently in EU and non-EU countries.

4.6.1. By-group Regression: Capital Adequacy

The table below is the result of the by-group regression when bank performance is proxied by capital adequacy, and banks are divided into two different groups, which is decided by whether this bank is in an EU or non-EU country. To save place, I only show and compare the result for one setting of the model, in which all bank-specific, industry-specific, and macroenvironmental factors, year dummies, and the lagged performance are included (just like the setting of model 8 in Table 8).

Generally speaking, the difference in the influential factors behind capital adequacy between banks in EU countries and non-EU countries is not huge. From Table 13 we can see that apart from size and operating inefficiency, the estimated coefficients for other factors have the same signs and significance levels. Size is not significantly correlated with capital adequacy for banks in those non-EU countries although the negative impact of operating inefficiency on capital adequacy is found. Then, compared to the non-EU group, more year dummies in the EU group are significant and positive, which means they are better off for the EU banks in their capital adequacy after 2011. However, for those non-EU countries, no significant change in banks' capital adequacy is found across the 11 years.

Table 13: Empirical Results - Model of Capital Adequacy

Variables	**EU Countries**	**Non-EU Countries**
Size	-0.0002***	-0.0001
	(0.0000)	(0.0001)
Deposits	-0.206***	-0.319***
	(0.020)	(0.043)
Business	0.396***	0.477***
Mix	(0.134)	(0.176)
Operating Inefficiency	0.001	-0.004**
	(0.001)	(0.002)
Concentration Ratio	0.0001	0.0001
	(0.0002)	(0.0004)
GDP Growth	0.095	-0.016

	(0.081)	(0.076)
Inflation Rate	-0.036	-0.050
	(0.142)	(0.036)
Lagged Performance	0.453***	0.499***
	(0.034)	(0.042)
Euro Area	0.010	0 (omitted)
	(0.007)	
Year2011	0 (omitted)	
Year2012	0.026***	0.019*
	(0.007)	(0.011)
Year2013	0.020**	0.010
	(0.008)	(0.011)
Year2014	0.013	-0.001
	(0.008)	(0.010)
Year2015	0.009	-0.005
	(0.008)	(0.009)
Year2016	0.016**	0.008
	(0.008)	(0.009)
Year2017	0.014***	0.013
	(0.005)	(0.009)
Year2018	0.014***	0.006
	(0.005)	(0.008)
Year2019	0.012**	0.007
	(0.005)	(0.008)
Year2020	0.017*	-0.003
	(0.010)	(0.012)
Year2021	0 (omitted)	
Constant	0.223***	0.331***
	(0.024)	(0.045)
Observations	647	309
Groups	65	31
R-square	0.4915	0.6871
Individual FE	Yes	Yes
Year FE	Yes	Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

4.6.2. By-group Regression: Asset Quality

The table below is the result of the by-group regression when bank performance is proxied by asset quality. To save place, I only show and compare the result of model 8 in Table 9.

Compared to the group of EU countries with the group of non-EU countries, although lagged performance is the most significant and influential factor behind banks' asset quality in both EU and non-EU countries, differences in the significance for other explanatory variables are still noticeable. First of all, the level of deposits is significantly and negatively correlated with banks' asset quality in those non-EU countries, which means banks with more deposit levels tend to face more problems in asset quality. Additionally, one of the macroeconomic factors, the inflation rate is also very significant only for those non-EU countries. This means that a higher inflation rate tends to impair the asset quality of banks in those non-EU countries and would not have a significant influence on the asset quality of banks in those EU countries. Lastly, for those year dummies, significant and negative estimated coefficients are found in the years 2012, 2013, and 2014 for EU countries and in the years 2014 and 2015 for those non-EU countries, meaning that the decrease in the asset quality for banks appeared later in the non-EU countries.

Table 14: Empirical Results – Model of Asset Quality

Variables	**EU Countries**	**Non-EU Countries**
Size	0.0001	-0.0000
	(0.0000)	(0.0002)
Deposits	-0.024	-0.115*
	(0.022)	(0.064)
Business	-0.033	0.099
Mix	(0.157)	(0.278)
Operating Inefficiency	-0.001	-0.001
	(0.001)	(0.003)
Concentration Ratio	-0.0001	0.001
	(0.0002)	(0.001)

GDP Growth	-0.054		0.003
	(0.092)		(0.125)
Inflation Rate	-0.235		-0.207***
	(0.163)		(0.065)
Lagged Performance	0.811***		0.701***
	(0.033)		(0.046)
Euro Area	-0.016**		0 (omitted)
	(0.008)		
Year2011		0 (omitted)	
Year2012	-0.015**		-0.027
	(0.008)		(0.018)
Year2013	-0.021**		-0.025
	(0.009)		(0.018)
Year2014	-0.016*		-0.032*
	(0.009)		(0.017)
Year2015	-0.009		-0.026*
	(0.009)		(0.015)
Year2016	-0.010		-0.023
	(0.009)		(0.015)
Year2017	-0.005		-0.009
	(0.006)		(0.014)
Year2018	-0.006		0.0005
	(0.006)		(0.013)
Year2019	-0.001		-0.007
	(0.006)		(0.013)
Year2020	-0.012		-0.019
	(0.011)		(0.020)
Year2021		0 (omitted)	
Constant	0.221***		0.360***
	(0.042)		(0.082)
Observations	618		303
Groups	64		31
R-square	0.7736		0.7487
Individual FE	Yes		Yes
Year FE	Yes		Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

4.6.3. By-group Regression: Managerial Quality

The table below is the result of the by-group regression when bank performance is proxied by managerial quality. To save place, I only show and compare the result of model 8 in Table 10.

There are no big differences in the influential factors behind managerial quality between banks in EU countries and non-EU countries except for GDP growth and the year dummies. From Table 15, deposits, business mix, operating efficiency, and lagged performance have a relatively similar positive effect in the two groups, the estimated coefficients for these variables are quite similar for those banks in both EU and non-EU countries. However, GDP growth is only an influential factor in determining banks' managerial quality in EU countries and is found irrelevant in non-EU countries. It may be due to the competitive environment in EU markets, especially during periods of rapid economic development, which would push EU banks to adopt best practices in management to survive and thrive. Lastly, compared to the EU group, more year dummies in the non-EU group are significant and negative, which means the better off for the EU banks in their managerial quality after 2011.

Table 15: Empirical Results – Model of Managerial Quality

Variables	**EU Countries**	**Non-EU Countries**
Size	0.001	-0.0003
	(0.001)	(0.001)
Deposits	0.542**	1.180***
	(0.249)	(0.398)
Business	4.468***	5.898***
Mix	(1.705)	(1.682)
Operating Inefficiency	-0.049***	-0.045***
	(0.012)	(0.017)
Concentration Ratio	-0.001	-0.004
	(0.002)	(0.004)
GDP Growth	2.592**	-0.795

	(1.018)	(0.761)
Inflation Rate	-0.642	-0.631
	(1.774)	(0.390)
Lagged Performance	0.526***	0.478***
	(0.033)	(0.045)
Euro Area	0.124	0 (omitted)
	(0.085)	
Year2011	0 (omitted)	
Year2012	0.156*	-0.248**
	(0.083)	(0.109)
Year2013	0.097	-0.175
	(0.098)	(0.107)
Year2014	0.146	-0.093
	(0.097)	(0.102)
Year2015	0.046	-0.048
	(0.094)	(0.090)
Year2016	0.139	-0.067
	(0.098)	(0.089)
Year2017	-0.026	-0.233***
	(0.063)	(0.085)
Year2018	0.084	-0.138*
	(0.063)	(0.081)
Year2019	0.053	-0.201**
	(0.065)	(0.080)
Year2020	0.160	-0.159
	(0.121)	(0.119)
Year2021	0 (omitted)	
Constant	0.203	0.257
	(0.282)	(0.414)
Observations	638	309
Groups	65	31
R-square	0.7348	0.6647
Individual FE	Yes	Yes
Year FE	Yes	Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

4.6.4. By-group Regression: Earnings and Profitability

The table below is the result of the by-group regression when bank performance is proxied by earnings and profitability. To save place, I only show and compare the result of model 8 in Table 11.

From Table 16, although similar influential factors are found in determining the earnings of banks in EU countries and non-EU countries, differences are still observable. First of all, the magnitudes of the coefficients of those significant factors are higher for banks in non-EU countries than in EU countries. For instance, the coefficient of the operating inefficiency for banks in non-EU countries and EU countries are -0.109, and -0.026 respectively. More obviously, the coefficient of the business mix for banks in non-EU countries is 45.091, whereas, for banks in EU countries, it is only 2.198, which discloses that the diversity of banks' business is affecting non-EU countries more significantly. Although the business mix contributes a lot to the earnings in banks of non-EU countries, increased reliance on noninterest revenue may be associated with higher bank risk and poorer risk-adjusted profitability (Stiroh, 2004), and some non-traditional banking operations, such as venture capital and asset securitization, may raise the likelihood of failure (DeYoung & Torna, 2013). In this context, the results of such a big difference between EU and non-EU banks may be due to that EU banks have better compliance management and only accept the less risky non-traditional investment. Normally, the less risky projects have less profitability. Secondly, lagged performance is only significant for banks in EU countries in determining banks' profitability, which shows the greater continuity of banks' earnings in EU countries. Lastly, comparing the significance and magnitude of the time dummies in the two groups, it can also be concluded that for banks in non-EU countries, the earnings and profitability suffered a significant deterioration after 2012, and this deterioration is not that significant for banks in EU countries. What is more, the banks in EU countries recovered from the deterioration more quickly than those banks in non-EU countries.

Table 16: Empirical Results – Model of Earnings and Profitability

Variables	**EU Countries**	**Non-EU Countries**
Size	-0.0001	0.001
	(0.0003)	(0.002)
Deposits	0.078	-0.270
	(0.132)	(0.820)
Business	2.198**	45.091***
Mix	(0.897)	(3.565)
Operating Inefficiency	-0.026***	-0.109***
	(0.006)	(0.036)
Concentration Ratio	-0.001	-0.004
	(0.001)	(0.008)
GDP Growth	0.861	0.840
	(0.540)	(1.544)
Inflation Rate	-2.217**	-1.643**
	(0.956)	(0.735)
Lagged Performance	0.352***	-0.056
	(0.037)	(0.046)
Euro Area	0.016	0 (omitted)
	(0.046)	
Year2011	0 (omitted)	
Year2012	-0.024	-0.280
	(0.044)	(0.219)
Year2013	-0.135***	-0.400*
	(0.052)	(0.218)
Year2014	-0.118**	-0.620***
	(0.052)	(0.209)
Year2015	-0.092*	-0.429**
	(0.051)	(0.187)
Year2016	-0.059	-0.526***
	(0.052)	(0.182)
Year2017	-0.046	-0.219
	(0.034)	(0.177)
Year2018	-0.025	-0.090
	(0.034)	(0.169)

Year2019	-0.024	-0.102
	(0.034)	(0.167)
Year2020	-0.011	-0.018
	(0.064)	(0.242)
Year2021	0 (omitted)	
Constant	0.126	-0.079
	(0.151)	(0.817)
Observations	647	308
Groups	65	31
R-square	0.4011	0.2159
Individual FE	Yes	Yes
Year FE	Yes	Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

4.6.5. By-group Regression: Liquidity

The below table is the result of the by-group regression when bank performance is proxied by liquidity. To save place, I only show and compare the result of model 8 in Table 12.

When banks' financial performance is measured by the level of liquidity, the gap between banks in EU countries and non-EU countries is the biggest. In Table 17, it is noticeable that the liquidity of banks in EU countries is only connected with size, Business mix, operating inefficiency, and lagged value of the liquidity level, and all other explanatory variables are found insignificant. Nonetheless, for banks in non-EU countries, besides the size and lagged performance, all the other explanatory variables that are significant are different from those banks in EU countries. Business mix and operating inefficiency seem to have no impact on the liquidity level, whereas all the industry-specific and macroeconomic factors play essential roles in determining banks' liquidity in non-EU countries. The estimated coefficient of concentration ratio is -0.019 and is significant at a 95% confidence level, which reveals that less concentration in the non-EU banking sector tends to lead to a higher liquidity level. The estimated

coefficient of GDP growth and the inflation rate also show that non-EU banks tend to have lower liquidity levels when the external economic environment is better and the inflation is higher. It is noticeable that the lagged value of the liquidity level positively influences the liquidity of EU countries, while negatively impacting the liquidity of non-EU countries. It seems that the speculation is riskier and regulation is looser for the banks in non-EU countries. With better economic environments and better liquidity levels previous year, non-EU banks chose to invest more in less liquid assets with higher returns than those banks in EU countries. For those year dummies, in the non-EU group, all the years have a significant and negative coefficient, which means that compared to 2011, banks in the non-EU have worse liquidity performance from 2012 to 2020. Comparatively, except for the result in 2019, no significant difference across different years is found in banks' liquidity in the EU countries.

Table 17: Empirical Results – Model of Liquidity

Variables	**EU Countries**	**Non-EU Countries**
Size	0.00001**	-0.004*
	(0.000)	(0.002)
Deposits	0.002	-0.392
	(0.003)	(0.820)
Business	-0.046**	4.025
Mix	(0.020)	(3.568)
Operating Inefficiency	-0.002***	0.055
	(0.0002)	(0.036)
Concentration Ratio	0.0000	-0.019**
	(0.0000)	(0.008)
GDP Growth	0.006	-7.864***
	(0.012)	(1.553)
CPI	-0.010	-6.505***
	(0.021)	(0.734)
Lagged Performance	0.689***	-0.178***
	(0.032)	(0.053)
Euro Area	-0.001	0 (omitted)
	(0.001)	

Year2011		0 (omitted)
Year2012	-0.001	-1.408***
	(0.001)	(0.220)
Year2013	-0.001	-1.197***
	(0.001)	(0.220)
Year2014	-0.0003	-1.049***
	(0.001)	(0.211)
Year2015	-0.0002	-0.593***
	(0.001)	(0.188)
Year2016	-0.001	-0.766***
	(0.001)	(0.184)
Year2017	-0.0002	-0.520***
	(0.001)	(0.178)
Year2018	-0.0000	-0.509***
	(0.001)	(0.171)
Year2019	-0.003***	-0.559***
	(0.001)	(0.168)
Year2020	0.0001	-1.236***
	(0.001)	(0.244)
Year2021		0 (omitted)
Constant	0.309***	3.866***
	(0.032)	(0.820)
Observations	648	310
Groups	65	31
R-square	0.8895	0.2014
Individual FE	Yes	Yes
Year FE	Yes	Yes

Note: Robust standard errors in parentheses.

*** means significance at the 99% confidence level; ** means significance at the 95% confidence level; * means significance at the 90% confidence level.

5. Conclusion, Contribution, and Future Improvement

5.1. Conclusion

The analysis conducted across multiple models reveals significant insights into the determinants of banks' capital adequacy, asset quality, managerial quality, earnings and profitability, and liquidity. All 5 regression models initially focus on bank-specific

factors, including size, deposit levels, business mix, and operating inefficiency, and then introduce the industry-specific factors, macroeconomic indicators, regional and year dummies, and lagged performance. The results show that although all the independent variables play crucial roles, different impacts have been found on different dependent variables.

5.1.1. Varied Effects of Bank-specific Variables

First of all, the relative size of a bank is found to be a double-edged sword for banks' financial performance, because its impacts on different kinds of bank performance vary in different circumstances. For its negative influences, its negative impacts on bank's capital adequacy are revealed in all 8 model specifications, and it would also impair banks' liquidity after including all independent variables. However, size has a positive impact on asset quality and profitability if only the year dummies are excluded, and contributes to managerial quality only when the lagged performance is not included. However, as defined in Section 4.3, the R square is extremely small if not adding the lagged performance, so the explanatory power of size to managerial quality seems insignificant.

Similarly, the complicated situation could also be applied to the bank's deposit level. It is found to be negatively related to the dependent variable in most model specifications of capital adequacy and asset quality and positively associated with the dependent variable in the model of managerial quality. However, bank's deposit level is found to have no impact on both profitability and liquidity.

Additionally, when it comes to banks' business diversification, the results of this dissertation find it could largely improve banks' performance from the aspects of capital adequacy, managerial quality, and profitability. However, there is also a negative relationship between business mix and asset quality when the dummies and lagged performance are not considered. And similar to deposits, the business mix also has no

impact on the liquidity of the banks.

Then, in terms of operating efficiency, its influences on banks' financial performance are generally positive. Although no relationships have been found between operating efficiency and the two dependent variables of capital adequacy and liquidity, its positive effects on asset quality, managerial quality, and profitability are disclosed.

5.1.2. Macro Impacts and Time-variant Performance

The introduction of industry-specific factors, macroeconomic indicators, dummies, and lagged value of banks' performance further enriches the understanding, highlighting the nuanced impacts of concentration ratios, GDP growth, and inflation rates on different kinds of bank performance. Moreover, the inclusion of lagged dependent variables underscores the robustness of these findings over time, reinforcing the persistent nature of banking performance.

From the estimated coefficients, the concentration ratio of the banking sector is found to have a negative impact on capital adequacy and liquidity and a positive impact on asset quality and profitability, meaning a more concentrated banking industry would impair banks' capital adequacy and liquidity but help improve asset quality and profitability. Moreover, no correlation between market concentration and managerial quality is found in this dissertation.

The GDP growth, as one of the macroeconomic indicators, is weakly correlated with different types of bank performance. Although it is found to be negatively correlated with capital adequacy and liquidity, and positively correlated with asset quality and profitability in some specifications, these associations are so weak that including other variables might easily remove them. Comparatively, the inflation rate seems to be more significant on banks' performance as a macroeconomic indicator. Apart from the model of managerial quality, all other models disclose the significant and negative influence

of a higher inflation rate, representing higher inflation might harm banks' performance from the perspectives of capital adequacy, asset quality, profitability, and liquidity. Similarly, the lagged values of bank performance also have significant effects on most of the dependent variables representing banks' performance except for the model of profitability. To be more specific, lagged capital adequacy, asset quality, and managerial quality of the bank are proven to contribute to the banks' performance respectively, meaning these kinds of bank performance are more consistent across time.

What is more, comparing the coefficients of those time dummies, we could also get some insights into the trend of different bank performances. Compared to the year of 2011, when the world just got rid of the negative impact of the global financial crisis, capital adequacy seems to be the only one that got largely improved. Asset quality, profitability, and liquidity all became more deteriorated in most of the years after 2011, and no significant differences were found between 2011 and after 2011 for managerial quality.

5.1.3. Regional Nuances and Dichotomies

Lastly, different influences of the euro area and EU on different types of bank performance are compared through the dummy of the euro area and the by-group regressions. Banks that are inside the euro area perform better in terms of capital adequacy, and this is within my former expectations because the banks are usually easier to get external capital in the euro area. However, what is out of my expectation is that banks outside the euro area had higher levels of asset quality and liquidity than their counterparts in the euro area. For asset quality, banks in the euro area may have stricter supervision on the provision of bad debts and thus have a larger size of provision, whereas banks outside the euro area may choose to deliberately under-provision for bad debts. For liquidity, those banks out of the euro area have fewer opportunities to find the more profitable lending and have worse risk resistance, and thus investing deposits in liquid assets can be the most advantageous use of these deposits which could increase

liquidity on the surface. There are no differences found between the banks outside and inside the euro area in managerial quality and profitability.

In terms of EU and non-EU banks, although some nuances exist, the differences in the influential factors behind capital adequacy, asset quality, and managerial quality are not huge. Firstly, apart from size and operating inefficiency, the estimated coefficients for other factors have the same signs and significance level for banks' capital adequacy in both EU and non-EU countries. Size is found to have negative impact only on banks in EU countries, and operating efficiency contributes to banks' capital adequacy only in non-EU countries. Secondly, except for deposits and inflation rate, all the other explanatory variables have a similar impact on the banks' asset quality. The level of deposits and inflation rate are negatively correlated with banks' asset quality only in those non-EU countries. Thirdly, only the impact of GDP growth is different for managerial quality between the banks inside and outside the EU. The GDP growth only contributes to managerial quality inside the EU. For those year dummies, the banks in the EU countries had better performance in capital adequacy and managerial quality than their counterparts in non-EU countries, and the decrease in asset quality for banks appeared later in the non-EU countries.

Contrary to the three indicators above, the differences in the influential factors behind profitability and liquidity between banks in EU countries and non-EU countries are larger. For the impact of profitability, most obviously, the coefficient of the business mix for banks in non-EU countries is about 22 times larger than the banks in EU countries, which discloses that the diversity of banks' business is affecting non-EU countries more significantly. What is more, the lagged profitability is only significant and positive for banks in EU countries, which shows the greater continuity of banks' earnings in EU countries. When comes to the impact of liquidity, the gap between banks in EU countries and non-EU countries is the biggest. Besides the size and lagged performance, all the other explanatory variables that are significant are different

between banks inside and outside the EU. Business mix and operating inefficiency only negatively impact the banks' liquidity in EU countries, and concentration ratio, GDP growth, and inflation rate only have negative impacts on non-EU banks' liquidity. For the year dummies, we can conclude that the banks in non-EU countries suffered a more deteriorated performance than those banks in EU countries after 2012 in both profitability and liquidity.

5.2. Contribution

These findings in the dissertation significantly advance the understanding of the determinants of banks' performance in CEE countries and provide a detailed analysis of the varied impacts of different determinants on the CAMEL indicators.

A key contribution of this dissertation is the integration of a comprehensive set of variables, encompassing bank-specific factors (size, deposit levels, business mix, operating inefficiency), industry-specific factors (concentration ratio), macroeconomic indicators (GDP growth, inflation rates), euro area and year dummies, and lagged performance metrics. This multifaceted approach allows for a more exhaustive analysis compared to previous studies, which may have focused on a narrower set of variables. By extending the range of performance indicators and contextual variables, the study provides a more holistic understanding of the determinants of bank performance.

By analyzing data across different years and comparing the performance of banks inside and outside the euro area, my research highlights the temporal and regional variations in bank performance determinants. This aspect of my study aligns with and extends the findings of earlier works like those of Pasiouras and Kosmidou (2007), who investigated performance across different European banking systems. My study, however, provides a more detailed comparison between EU and non-EU banks, shedding light on specific regional dynamics that influence bank performance.

The findings on the negative impact of size on capital adequacy and liquidity, and its positive impact on asset quality and profitability under certain conditions, contribute to the ongoing debate about the role of bank size in performance. These results provide additional evidence to the mixed findings in the literature, such as those by Berger, Dick, Goldberg, and White (2007), who discussed the complex relationship between bank size and performance.

The positive impact of business mix on capital adequacy, managerial quality, and profitability, along with the effects of operating efficiency, underscore the importance of these factors in enhancing bank performance. This extends the work of previous scholars like Stiroh (2004), who emphasized the role of diversification in banking. My research adds depth by showing how business mix affects different performance dimensions and by highlighting the lack of impact on liquidity, which provides a more rounded understanding of these relationships.

The insights derived from the introduction of industry-specific factors and macroeconomic indicators, such as the negative impact of concentration ratios and the varied effects of GDP growth and inflation, offer valuable implications for policymakers. These findings suggest that regulatory frameworks and economic policies need to consider these diverse impacts to foster a stable and efficient banking sector in the CEE region.

Finally, my study paves the road for future research by highlighting the differential impacts of performance determinants in EU and non-EU countries in the CEE region. This comparative analysis can be a foundation for further investigations into how regional economic integrations and regulatory environments shape bank performance.

5.3 Limitations and Future Improvements

5.3.1. Data Scope and Temporal Range

Due to the accessibility of the data, the study focuses on the period from 2011 to 2021, which may not fully capture the long-term trends and cyclical variations in the banking sector, especially considering significant events, such as the European debt crisis and subsequent economic fluctuations, and the political tensions. Meanwhile, the frequency of data is yearly in this study, however, if the monthly or seasonal data could be accessed, the features of the time could be more precisely captured, which may affect the outcome as well.

Future research could extend the temporal range of the study to include more data which would provide a more comprehensive understanding of the determinants of bank performance in CEE countries over different economic cycles.

5.3.2. Variable Selection and Model Complexity

The study uses a comprehensive set of variables but may still miss other potential determinants of bank performance, such as technological advancements, customer satisfaction, or environmental factors. Additionally, the complexity of the models might lead to issues. For example, there is an inherent overlap between managerial quality and operating inefficiency as they both involve components of costs and income. The income-to-cost ratio (managerial quality) is essentially a broad measure of efficiency that includes all income and costs, whereas the operating expense to interest income ratio (operating inefficiency) focuses specifically on operational expenses and interest income. This overlap can sometimes blur the distinction between managerial quality and operating efficiency, making it challenging to isolate the effects of one on the other. The reason I did not remove operating inefficiency is that this factor has a significant impact on the other 4 dependent variables. And after the correlation test, there is hardly a correlation between managerial quality and operating inefficiency, so this overlap would not impact the coefficient and significant level of other explanatory variables.

Nevertheless, apart from the partial correlation test I have done between the dependent variable and the independent variable, which could control for other variables to understand their unique contributions. Future research may employ hierarchical regression by entering variables in steps to see how much additional variance is explained by each variable, which could account for the overlap. The inclusion of interaction terms can also help to capture these effects explicitly. These methods can help in distilling the core factors that drive performance without overlapping effects.

6. References

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