UNIVERSITÀ DEGLI STUDI DI MACERATA

DEPARTMENT OF ECONOMICS AND LAW

DOCTORAL RESEARCH COURSE IN
QUANTITATIVE METHODS FOR POLICY EVALUATION

CYCLE: XXXVI

THESIS TITLE

COMPETITION AND REGULATORY POLICY IN THE BANKING INDUSTRY: AN ECONOMETRIC ANALYSIS OF THE IMPACTS OF COMPETITION AND REGULATIONS ON ECONOMIC GROWTH

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YEAR: 2024
(quello della discussione finale)

Dedication

I would like to dedicate this thesis to all my family and loved ones, especially Benedicta Dadzie and Gregory Ivan Donkor for their affection and show of love throughout my studies. I also dedicate this thesis to the memory of Omar Peprah Idris for his unwavering encouragement and belief in my abilities which inspired me to pursue a PhD program.

Acknowledgment

First and foremost, I extend my sincere gratitude to the University of Macerata for granting me admission to pursue my PhD in Quantitative Methods for Policy Evaluation with research focus on Applied Econometrics. Secondly, I am deeply indebted to my dedicated supervisors, Professor Roy Cerqueti, Professor Leo Fulvio Minervini, and Professor Anna Grazia Quaranta for their unwavering supports, valuable feedback and thorough guidance from the moment I proposed my research topic till my thesis defense. Special thanks to Professor Anna Grazia Quaranta for the substantial contribution to my thesis, including the provision of banks' financial data from BankFocus database. Moreover, I express my heartfelt gratitude to my colleagues, Dr. Benjamin Owusu and Dr. Luca Lodi for their significant contributions and advice throughout my doctoral journey. Additionally, I equally appreciate the efforts of Mr. Harry Bonsu for encouraging and motivating me to pursue a PhD program. Furthermore, I am grateful to Pastor Faith for the concerns and supports throughout my studies at the University of Macerata. Lastly, I am also thankful to my family and loved ones, especially Benedicta Dadzie and Gregory Ivan Donkor for their continued supports throughout my academic journey.

Declaration

I hereby declare that this PhD thesis is the original work of Patrick Donkor submitted to the Doctoral School of the University of Macerata on 30th June 2024 as a requirement for the partial fulfilment of a Doctoral of Philosophy degree in Quantitative Methods for Policy Evaluation. The content of this thesis can be reproduced for educational or research purposes without violating the author's rights or infringing upon the laws of the University of Macerata.

Table of Contents

List of Tables

Chapter 1

Competition Policy in the Banking Industry: An Analysis of the Impacts of Banking Competition on Economic Growth

Abstract - Chapter 1

Banking competition has become a topical issue of concern in recent years. Fundamentally, competition within the banking industry is essential for promoting efficiency, stability and economic growth.

Despite the abundance of literature on banking competition, the investigation into its impacts on economic growth remains relatively complex. Empirical studies that examine this link have produced mixed and complex effects, which seem to suggest that, the relationship between banking competition and economic growth is non-linear.

This paper analyzes the role and impacts of banking competition on economic growth, employing a Panel Smooth Transition Regression (PSTR) and using Lerner Index and Boone indicator as competition measures for 1867 banks within 19 eurozone countries over the period from 2015 – 2020.

The study reveals that banking competition and economic growth have a non-linear relationship that depends on the degree of market power that banks have. The main findings of this study show that in a more competitive market, banking competition promotes economic growth, while in a less competitive market, banking competition stifles economic growth.

KEYWORDS: Banking competition; Market power; Market concentration; Market structure; Economic growth.

1.1 Introduction

Measuring the degree of competition has always been a problem in economics, considering the numerous methods for measuring competition. Amongst these methods are the Lerner index, Boone indicator, Herfindahl-Hirschmann Index (HHI) and Panzar and Rosse H-statistic as well as concentration ratios. In various ways, scholars have either expressed criticism or acknowledged the robustness of these indicators as competition measures in their studies.

Banking competition is one of the key drivers of financial stability and economic growth in many countries. Competition within the banking industry is a topical issue of concern to many governments because of its strong influence on monetary policy. In the literature, we will examine the role of banking competition in fostering economic outcomes, and explore the

theoretical models for measuring competition.

In measuring competition, marginal cost is a prerequisite for estimating Lerner index and Boone indicator. Since the marginal costs cannot be obtained directly from banks' financial data, most scholars estimate the marginal costs using the translog cost function. As to whether the translog cost function is able to accurately measure marginal costs in practice is an unanswered question yet. The contribution of this paper is to comparatively measure competition with both Lerner and Boone indices using average costs as a proxy for marginal costs and then estimate the impacts of these competition measures on economic growth for 1867 banks within 19 eurozone countries over the period from 2015 to 2020 by employing a panel regression technique.

The main findings of this study show that, banking competition promotes economic growth in a more competitive market, especially when banks become innovative and offer quality and attractive services such as lower fees, lower lending rates, higher deposit rates to attract customers and gain market share, which can lead to increased savings and investments, thereby promoting economic growth. Conversely, in a less competitive market, banking competition stifles economic growth, particularly banks with high market power (less competition) may have more control to manipulate the prices of banking services by offering higher fees, higher interest rates and poor quality services which could lead to decreased savings and investments, hence hindering economic growth. The findings further disclose that, the relationship between banking competition and economic growth is non-linear, complex and varies depending on the degree of market power that banks have.

In this paper, we review the existing literature on the role of banking

competition in section two. Section three analyzes the theoretical models for measuring competition. Section four examines the link between banking competition and economic outcomes. Section five presents the empirical models. Section six provides data description. Section seven offers empirical estimation and the analysis of the results whiles section eight draws some conclusions on the findings.

1.2 The role of banking competition

Economists use a number of theoretical framework to analyze the role of banking competition. Amongst these theories are the market power theory, contestable market theory, structure-conduct-performance theory and efficiency theory.

1.2.1 Market Power Theory:

In an imperfect market, larger firms with significant market shares may have more control over the market dynamics, including the ability to influence the supply and demand of goods and services to set prices above the marginal cost.

The intuition behind market power theory is that firms with market power have the ability to manipulate supply and demand of goods and services by reducing production to create scarcity and intensifying advertisements and branding to increase demand, which allows them to raise prices and earn higher profit margins than those in more competitive markets. This theory suggests that in the absence of effective competition, firms with substantial

market power have the ability to control market conditions such as prices, production levels and entry barriers to their benefit which can lead to market distortions, signalling the need for competition in promoting higher efficiency for consumers.

Bresnahan (1989) reviews several empirical studies on market power in industries and the study reveals a significant evidence of the existence of market power in many industries. The findings also show a complex relationship between market power and economic welfare which depends on several factors such as the degree of market power, elasticity of demand and the level of market competition. The existence of too much market power in many industries can hinder competition, leading to negative impacts on consumer welfare.

The existence of market power in industries are mainly caused by the presence of the entry conditions. Stigler (1964) argues that effective barriers to entry such as regulatory restrictions or economies of scale can reduce competition, allowing incumbent firms to earn higher profits by charging higher prices. On the contrary, Chatterjee (1991) investigates the factors that explain the gains resulting from vertical mergers and the author opines that, on the average, firms increase their market power as a result of mergers.

Following the studies by shepherd (1986) and Mensi and Zouari (2010), only firms with significant market shares and diversified products have the power to fix prices and gain abnormal profits. The presence of the barriers to entry for new banks within the banking industry is a contributing factor to the existence of market power which allows firms to manipulate prices and therefore there is the need to review the entry conditions in the banking

industry which will allow prospective new banks to enter the industry and compete with the incumbent banks.

1.2.2 Contestable Market Theory:

Considering the crucial role that competition plays in fostering economic performance, firms should be allowed to contest rival firms. Particularly, new firms that want to enter the market to contest incumbent firms should not be prevented. One way to achieve this is to remove or reduce the barriers to entry in order to pave way for new entrants to enter the market and compete. A contestable market is a market where firms can freely enter and leave with low sunk costs without any obstacles.

In an effort to overcome the barriers to entry, Baumol (1982) introduced the contestable market theory in his book: 'Contestable Markets and the Theory of Industrial Structure' which seeks to discipline market power and promote competitive environment due to the continuous threat of new entrants. The contestable market theory is an economic concept that states that firms with few rivals behave in a competitive manner when the market they operate in has weak entry conditions and allow for potential new entrants.

Baumol et al. (1982a) find that although a market may be natural monopoly, however, in a contestable market, the presence of new entrants will induce a competitive behaviour by the incumbents. The authors argue forcefully that potential entry disciplines monopoly. The presence of barriers to entry for new banks is the cause of market concentration or market power in the banking industry and therefore the continuous threat of potential market entry by banks' rivals can stimulate a competitive environment in the

banking industry which can fiercely overcome the market concentration or market power.

Coccorese and Pellecchia (2022) argues that entry and exit in contestable markets are costless because of low or no barriers and this may lead to a perfect market competition regardless of its concentration. In market contestability, new firms enter the market without any restrictive regulations such as licensing requirements, legal barriers, and capital requirements, as well as other entry conditions that would impede their entry and this therefore makes the entry and exit in contestable markets generally easier and 'costless' as compared to markets with high entry and exit barriers.

Martin (2000) analyzes the theory of perfectly contestable markets and the findings portray that the theory of market contestability is essential for regulatory intervention and it is used as a slogan to defend a deregulation policy. The theory of contestable markets is more or less a theory of market performance since the market forces will tend to produce an efficient market structure. If a market is perfectly contestable, the variance in market shares ought to be less and its structure will be efficient in long run equilibrium. (Kessides, 1988; Martin, 2000).

1.2.3 Structure-Conduct-Performance (SCP) Theory:

Another theoretical framework scholars use to assess the role of banking competition is the structure-conduct-performance theory. Industrial Organization (IO) focuses on the structure of industries in the economy and the behaviours exhibited by firms and individuals operating within these industries. The structure-conduct-performance theory aims at assessing the

industry structure studies by considering the market structure of industries to determine their conduct and performances.

The structure conduct performance theory was proposed by economist Edward S. Mason in his book "Price and Production Policies of Large-Scale Enterprises in 1939 to examine the causal relationships between market structure, market conduct and market performance. The SCP theory was later modified by economist Joe S. Bain in his book "Barriers to New Competition: Their Character and Consequences in Manufacturing Industries" in 1956 to examine how market concentration and entry barriers influence a firm's conduct and performance. Bain (1956) establishes that the market structure of an industry plays a significant role in shaping its conduct, which subsequently affects the performance of individual firms. According to Bain (1956), higher market concentration as measured by concentration ratios or Herfindahl-Hirschman Index (HHI) is associated with higher market power, lower competition, higher prices and eventually greater profits.

The structure-conduct-performance theory suggests that the market structure of an industry influences the conduct of firms in that industry, which in turn affects the economic performance of those firms within the industry. Following the definition of structure-conduct-performance by Tan (2016), market structure can be measured by a number of factors, including the number of competitors in an industry, the heterogeneity of product and the cost of entry and exit. Conduct refers to a number of specific actions taken by a firm, which include price taking, product differentiation, tacit collusion and exploitation of market power. The performance of the firm can be measured from a number of indicators such as productive efficiency,

allocative efficiency and profitability.

The theory indicates a positive relationship among market structure, market conduct and market performance such that a more competitive market structure in the banking industry may lead to a more competitive behaviour of banks and better economic performance of banks and vice versa.

Bain (1951) uses a financial data of 143 firms in an industry to examine the relationship between industry concentration (measured by market share of the largest firms) and profit rates in the manufacturing sector during the period of 1936-1940. Specifically, the study considers the market share of the four largest firms within each industry and the study results indicate that industries with four-firm concentration ratios above 70% had distinctly high profit rates of 11.8 than those with concentration ratios below 70% with profit rates of 7.5. The findings also suggest a positive relationship between industry concentration measured by the market share of the largest firms and profit rates such that, higher levels of concentration is associated with higher profit rates for firms operating within those industries and vice versa.

1.2.4 Efficient-Structure (ES) Theory:

A strong competition compels firms to provide quality products at low price in order to retain customers and even attract potential customers. The efficiency theory which was developed by Demsetz (1973) postulates that competition within an industry leads to greater efficiency, as firms are forced to offer better services at lower costs in order to attract and retain customers. Demsetz (1973) argues that market competition encourages innovation and promotes efficiency through lower costs, higher quality and improved customer

satisfaction in order to remain competitive.

Competition helps to promote efficiency. There are several ways in which competition can promote efficiency. Stigler (1958) asserts that economies of scale can enhance efficiency and result in lower costs. Thus, efficiency will be improved when firms increase production level with lower average costs and provide opportunities for specialization, innovation and improved marketing and distribution. Baumol et al. (1982) argue that the efficiency theory can be applied to the concept of contestability. For instance, Baumol et al. (1982) demonstrates that, in an imperfect market where there are market inefficiencies and distortions such that firms have market power and the entry barriers are present to prevent new firms from entering and competing effectively, the market can promote efficiency if they are contestable and the barriers to entry are low. The efficiency theory suggests that, a competitive banking industry can lead to lower interest rate, greater access to credit, more innovation and better customer satisfaction and these factors potentially stimulate efficiency.

To summarize, all these theoretical frameworks and their corresponding studies suggest that, in a perfect market, competition has positive effects in the banking industry while in an imperfect market, market power and market concentration have negative impacts in the banking industry. A strong competition can lead to lower market power, lower prices, higher quality products, better services and greater efficiency for consumers which are indications that banking competition stimulates efficiency and promotes economic growth in the banking industry while in a less competitive market, firms with substantial market power can manipulate the market conditions

including prices, production levels, and entry barriers to their advantage by reducing the output level so as to charge higher prices and earn higher profits margins than those in a more competitive markets.

1.3 Theoretical models for measuring competition

Theoretically and empirically, there is no clear consensus on how to measure banking competition, despite the extensive research that has been done on the topic. According to Coccorese (2009), in theoretical studies, it is straightforward to measure market competition using the number of operating banks as a market competition measure, while in empirical studies, it is more difficult to find a suitable method of measuring the competitiveness of banks. Beck (2008) identifies market structure measures, competition measures, and regulatory measures as three different groups of indicators which have been generally used in the literature to measure the degree of competition among banks.

1.3.1 Market Structure Measures

Market structure measures are indicators that focus on the characteristics of the market, such as the number of firms, size of firms, number of competitors, market conduct indicators, market performance indicators, Herfindahl-Hirschman index (HHI) and concentration ratios.

In the literature, some scholars mostly employ indicators such as

concentration ratios and Herfindahl-Hirschman index (HHI) as market structure measures for measuring competition. The Herfindahl-Hirschman Index is a widely used indicator of market concentration in an industry for measuring the extent to which market shares are concentrated among few large firms. The concentration ratio indicates the size of firms in relation to the industry as a whole by summing the percentage of the market share held by few large firms in an industry. Both the Herfindahl-Hirschman index and the concentration ratios are used to measure market concentration. A lower market concentration indicates greater competition among the firms in an industry, while a higher market concentration suggests less competition among the firms in an industry.

Bikker and Haaf (2000) defines Herfindahl-Hirschman index as the sum of the squares of the bank sizes measured as market shares. The HHI is calculated by squaring the market share of each firm within the industry and summing the results of the squared market share of each firm to get the HHI score for the industry. By squaring the market shares of each firm within the industry, Hirschman's measure provides greater weight to larger firms and this underscores the importance of large firms within an industry in market concentration. According to Coccorese (2009), market structure measures are easy to calculate and do not need to be estimated and so they do not require any assumptions on the behaviour characteristics of banks. Although it is easy to calculate HHI, the calculation becomes more difficult especially when there is large number of firms within the industry and more time periods.

Chang and Tremblay (1991) measure the economic performance of factor markets in an oligopoly or oligopsony setting and the authors conclude that

under special conditions, the firm index is equivalent to the Lerner index while the industry index is also equivalent to the Herfindahl-Hirschman index. Thus, unlike the Lerner index and Boone indicator which provide indices for each firm within an industry, the concentration ratios and the Herfindahl-Hirschman index only give the index for the entire industry without disclosing the individual index of each firm.

While market structure measures are commonly acknowledged and employed to assess banking concentration, they have not escaped criticisms. These indicators can be regarded as "crude" measures, because they measure the actual market shares without allowing inferences on the competitive behaviour of banks. For instance, they do not take into account that banks with different ownership behave differently, and that banks might not compete directly with each other in the same line of business (Beck, 2008). Shaffer and Spierdijk (2020) claim that the concentration indices are widely considered to fall short as a reliable measure of market power. OECD (2010) conducts a study on the relationship between market concentration and competition in the financial sector using concentration ratios and the study findings reveal the link between market concentration and competition to be generally unreliable. Most importantly, the literature on market structure measures is inconclusive on whether market structure determines bank behaviour under the structure-conduct-performance theory or market structure is determined by performance under the efficiency theory. According to Iveta (2012), the Herfindahl-Hirschman index often serves as a benchmark for evaluating other concentration indices in the theoretical literature. For robustness checks, other structural models should be employed to complement the market structure

measures.

An important factor which determines the competitiveness of an industry under the market structure measures is the number of firms in an industry. The concentration ratio and the Herfindahl-Hirschman index specifically lay much emphasis on the size of industry. For instance, more firms in an industry may lead to less market concentration and more competition while less firms within an industry may result in greater market concentration and less competition.

The following empirical studies employ market structure measures such as the concentration ratio and the Herfindahl-Hirschman index to estimate the impacts of banking competition on economic performance and the empirical evidence from these studies is quite mixed.

Ferhat and Erkam (2013) analyze the structure of Turkish electricity market using concentration ratio (CR4 and CR8) and Herfindahl-Hirschman Index computed with sales from production of the firms in Turkish electricity market between 1993-2011 and the authors opine that the structure of the market is said to be highly concentrated in CR4 and Herfindahl-Hirschman Index. This indicates an oligopolistic market where four largest firms hold a significant share of the market, potentially leading to a less competitive market environment.

Using a panel data of 923 commercial banks from 27 European Union countries for the period of 2001–2009, Căpraru and Andrieş (2015), assess the relationship between concentration and financial fragility using the concentration ratios and the Herfindahl-Hirschman index. The study results for the concentration ratio indicate that, higher concentration (i.e. less

competition) measured by the CR5 has a negative impact on financial stability and this confirms the competition-stability theory. However, the results for the Herfindahl-Hirschman index show that, an increase in concentration (i.e. less competition) measured by the HHI increases the financial stability of banks, hence support the competition-fragility theory.

Bonaccorsi di Patti and Dell'Ariccia (2004) use Herfindahl-Hirschman index to investigate the effects of banking competition on firm creation in the non-financial sector and their study find evidence of a bell-shaped relationship between bank market power and firm creation. The authors show that firms operating in relatively transparent industries, the bank market power has positive impact on firm creation while firms operating in more opaque industries, the bank market power has negative impact on firm creation. Their study result is an indication that the connection between bank market power and firm creation is context-dependent and can vary based on the levels of asymmetric information.

The study by Cetorelli and Gambera (2001) explores the link between bank concentration and the level of growth of different industries. The authors follow the methodological approach of Rajan and Zingales (1998) and as well use the data of Rajan and Zingales (1998) to investigate the effects of bank concentration on the growth of industries that are largely dependent on external financing. Their results find a substantial evidence that banking concentration measured by the market share of the top three or five banks, stimulates growth in industries that are highly dependent on external financing by facilitating credit access to younger firms. The authors also find that banking concentration depresses industrial growth. Thus, banking

concentration has both positive and negative influence on industrial growth and this therefore supports the idea that banking competition has mixed effects on economic growth.

In line with the empirical studies of Rajan and Zingales (1998) and Cetorelli and Gambera (2001), Deidda and Fattouh (2005) exploit the cross-country data of Rajan and Zingales (1998) to estimate the impacts of banking industry concentration on economic growth in per-capita income and their findings suggest that banking concentration has inverse relationship with per-capita income growth and industrial growth in low-income countries and these empirical evidence support the idea that more concentration and less competition in the banking industry may slow down economic growth in per-capita income.

Collender and Shaffer (2003) analyze the empirical relationship between the changes in local bank market regulation, market structure and economic performance using Herfindahl-Hirschman index and the authors find evidence similar to the empirical evidence of Deidda and Fattouh (2005) that the Herfindahl-Hirschman index of bank deposits has a negative influence on real per capita personal income growth in both the short-run and long-run empirical models, an indication that more banking concentration and less competition may reduce economic growth in real per capita personal income.

1.3.2 Competition Measures

The concentration ratios and Herfindahl-Hirschman Index (HHI), which are market structure measures, provide quantitative assessments of the market concentration. The market structure measures are tools to examine the extent

to which market shares are distributed across all firms in the market.

One of the key issues raised in the literature about the contestability theory by Baumol et al. (1982) and Claessens and Laeven (2005) is the use of market structure proxies which could lead to results that reflect market structure determinants other than competition. Leuvensteijn (2008) employs a theoretical model to explain why the widely-applied HHI fails as a reliable competition indicator. The author argues that the standard intuition behind HHI is based on a Cournot model with symmetric firms, where a fall in entry barriers reduces the HHI and with firms that differ in efficiency, an increase in competition raises the HHI. Beck (2008) describes the market structure indicators as crude measures since they measure the actual market shares without allowing inferences on the competitive behaviour of banks.

In addressing these issues, Coccorese (2009) indicates that since the assessment of the degree of effective competition requires specific structural models that incorporate the competitive behaviour of firms, the competition level of an industry cannot be measured using only the market structure indices. The market structure indicators are necessary but not sufficient for measuring effective competition.

Measuring competition using both the market structure measures and some specific structural models including the New Empirical Industrial Organization (NEIO) models is a masterstroke that heaves a sigh of relief in the empirical evidence. The New Empirical Industrial Organization (NEIO) models are more robust measures which allow for a thorough analysis of competition by considering firm behaviour, market dynamics, entry and exit barriers, as well as other factors that influence market competition.

The most commonly used measures within the New Empirical Industrial Organization framework are Lerner index, Boone indicator and Panzar-Rosse H-statistic. These metrics are often employed in empirical studies within the NEIO framework to estimate market power which provides insights about the competitiveness of firms within the industry. Studies by Hyde and Perloff (1995), Bikker et al. (2012), and Shaffer and Spierdijk (2015) demonstrate that the Panzar-Rosse H-statistic is not a suitable measure of market power and has been relegated to the same category as the concentration measures. The methodological approach of this study will limit itself to the use of only Lerner index and Boone indicator since the primary focus of this study is to measure competition with these indices.

Lerner Index

Demirguc-Kunt and Peria (2010) illustrate that an alternative way to measure banking competition is to compute direct measures of market power since greater market power implies less competition and vice versa. The concept of Lerner index as a measure of market power and competition was proposed by Abba P. Lerner in his seminal paper titled "The Concept of Monopoly and the Measurement of Monopoly Power" published in 1934. In his paper, the author measures monopoly power as the inverse of price elasticity of demand and therefore establishes that demand elasticity is a crucial determinant of monopoly power. Relative to the measurement of monopoly power by Lerner (1934), Casu and Girardone (2009) emphasize that the Lerner index of monopoly power is an indicator of the degree of market power and it is a commonly used measure of competition in the banking literature.

De Guevara and Maudos (2007) and Carb´o et al. (2009) define Lerner index as a measure of market power of a firm using the firm's estimated mark-up as a measure of the competition within a particular industry. Blair and Sokol (2014, p. 325) report in their study that the Lerner index has ultimately become the standard measure of market power among economists. Essentially, the Lerner index measures the extent by which a firm exercises market power or monopoly power to set prices above its marginal costs. As reported by Jimenez et al. (2007) and Berger et al. (2009), the Lerner index is a direct measure of the degree of market power because of its concentrated pricing power which is apparent in the difference between the price and the marginal cost thereby capturing the extent to which a firm can fix its price beyond the marginal cost.

According to Lerner (1934), Lerner index is calculated as the difference between the price set by the firm (P) and its marginal cost (MC), divided by the price (P). The larger the difference between price and marginal cost, the higher the Lerner index, hence the greater the level of market power. The values of Lerner index range from a low value of zero (0) to a high value of one (1). A high Lerner index value shows that the firm has a higher market power while a low Lerner index value demonstrates that the firm operates in a highly competitive market. When the Lerner index is zero, it means the price is equal to the marginal costs (i.e. P=MC), which signifies a perfect competition where firms have no market power to manipulate the prices of goods and services. However, when the index is one, it indicates a relatively higher market power where firms are able to charge prices of goods and services above the marginal costs (i.e. P¿MC), hence less competition.

Various empirical studies employed Lerner index to measure banking competition. To contribute to the issue of banking competition and financial stability, particularly the link between market power and risk exposure, Berger et al. (2009) employ Lerner index to investigate the connection between market power and risk exposure using data for 8235 banks in 23 developed nations during 1999-2005. Their study results confirm the traditional "competition-fragility" hypotheses that banks with higher degree of market power are less exposed to risk. Moreover, their findings also support the "competition-stability" hypotheses that market power increases loan portfolio risk.

Carbó, Humphrey and Rodriguez (2003) use different market competition indicators, including the Lerner index to investigate the link between deregulation, banking competition and regional growth in five large regions in Spain from 1986-1998, The authors specifically analyze the changes in regional competition and growth. Their findings of the Granger-causality tests show that differences in competition are not associated with improved regional growth. The results also indicate that deregulation in the Spanish banking sector increases deposit rates and decreases loan rates.

Using the banking sector data of 15 European Union countries during 1993-2002, De Guevara and Maudos (2007) employ Lerner index to analyze the relationship between market power in the loan and deposit markets and efficiency. Their findings show a positive relationship between market power and cost efficiency of banks, signalling a contradiction of the "quiet life" hypothesis proposed by Berger and Hannan (1998).

Boone Indicator

Another indicator within the NEIO framework which is used most recently to measure competition in the banking industry is Boone indicator (Boone, 2008). The brain behind Boone indicator supports the well-known efficiency hypothesis which mainly links performance to efficiency (Demsetz, 1973; Goldberg and Rai, 1996; Smirlock, 1985).

The Boone indicator was first introduced in 2000 by Jan Boone in his paper titled "A New Way to Measure Competition". In this paper, Boone proposed the "Boone indicator" as an alternative measure of competition that captures the relationship between performance and efficiency. He further refined and expanded the concept of Boone indicator in 2001, 2004 and 2008.

Boone et al. (2005) argue that traditional market concentration measures such as the Herfindahl-Hirschman index and the concentration ratios do not capture the dynamics of competition and the relationship between market share and profitability. Boone (2000, 2001, 2004, and 2008) therefore proposes the Boone indicator which mainly measures the relationship between performance, in terms of profits and efficiency in terms of marginal costs. The indicator is premised on the notion that in a more competitive market, efficient firms in an industry are rewarded with higher profits or market shares while the less efficient firms are harshly punished with low profits or market shares (Boone, 2008; Albaity et al. 2019). In measuring competition, his model seeks to capture the impacts of firms' marginal costs on their profits, which therefore highlights the need to consider firms profitability when measuring competition.

Building upon the theoretical models outlined in Boone (2000, 2001, and

2004), as well as studies by Boone et al. (2005) and CPB (2000), The Boone indicator model, proposed by Boone, is well grounded on two notions. Firstly, it suggests that more efficient firms, characterized by lower marginal costs, tend to achieve greater market shares or profits. Secondly, the model advances that this relationship between efficiency characterized by lower marginal costs and performance characterized by greater market shares or profits is stronger in a highly competitive market.

In such market, competition can increase in two distinct ways. Firstly, competition intensifies as the services offered by different banks become closer substitutes. Secondly, competition increases when the barriers to entry decrease, facilitating easier access for new players into the market (Leuvensteijn et al., 2007). In the model, Boone et al. (2004) satisfy both conditions outlined by Leuvensteijn et al. (2007) by proving that efficient banks characterized by lower marginal costs experience an increase in their market shares through stronger substitution among banks' offerings and reduced entry costs.

In line with the theoretical models of Boone (2000, 2001, 2004, and 2008), the Boone indicator in our model is estimated as the ratio between banks' performance measured by profit (ROA) and efficiency measured by average costs (AC) for the period from 2015-2020. From the theoretical literature, the Boone indicator is generally expected to exhibit a negative value since banks with relatively lower marginal costs (indicating higher efficiency) are anticipated to experience an increase in market share in order to align with the concept of relative profit differences. Higher value of β in absolute terms demonstrates larger effects and stronger competition in the market as the

inefficient banks (with higher marginal costs) would be punished more harshly.

The calculation of marginal cost is a prerequisite condition for estimating Lerner index and Boone indicator. Thus, marginal costs are needed for the estimation of the competition indices. In line with economic theory, a more accurate measure of marginal cost can be derived from the translog cost function.

The translog cost function is derived from a production function which mainly describes the quantities of inputs and outputs required and the cost needed to produce a level of output (Greene, 2008a). In the banking competition literature, the translog cost function which provides a second order approximation of cost function are used to estimate the marginal cost of production for banks (Clark and Speaker, 1994; Coccorese, 2009; Weill, 2013; Mirzaei and Moore, 2014).

A number of studies use Boone indicator in measuring competition and its impact on a range of economic outcomes, including financial stability, efficiency and profitability. Using the accounting data of UK firms, Boone et al. (2005) investigate the relationship between the relative profits measure and the traditional measures. The authors compare Boone indicator with commonly used traditional measures such as the concentration indices, the Herfindahl index and price cost margins (PCM) and their study results show that in markets where goods are symmetrically differentiated and where firms differ in their marginal cost, the traditional measures can be poor indicators of the degree of competition, while the new relative profits measure performs better and may provide a useful empirical complement to price-cost margins in both policy and econometric analysis. In other words, their findings provide

empirical evidence that the Boone indicator is a better measure of competition than the market structure measures.

Using Boone indicator as a proxy for banking competition, Cobbinah et al. (2020) employ the Generalized Method of Moments style Panel Vector Autoregressive estimation model to explore the relationship between banking competition and banking stability of 10 countries in West Africa over the period of 2000–2014. The authors find that banking competition enhances stability. The findings from the granger causality test also show that the relationship between banking competition and banking stability is bidirectional. Overall, their results portray that banking competition promotes banking stability.

Kramarić and Miletić (2019) examine the influence of competition on soundness of Croatian insurers using Boone indicator as a measure of competition. The authors employ several firm-level, industry-level and macroeconomic variables to analyse Croatian insurers that operated over the pre-EU accession period of 2008–2012 as well as the post-EU accession period of 2013–2017. The findings of the analysis reveal that efficient insurers make higher profits in post-EU accession period during which competition increased and this supports the notion underpinning Boone indicator that efficient firms are rewarded with higher profits in a competitive market environment.

To summarize the competitive measures, considering the aforementioned empirical evidence, it becomes obvious with few unavoidable exceptions that the New Empirical Industrial Organization (NEIO) techniques generally support a positive relationship between banking market power and economic

performance (Coccorese, 2009).

1.3.3 Regulatory Measures

The third measure of banking competition is by the use of the regulatory measures. Measuring effective competition requires a comprehensive understanding of the market which involves a holistic approach that takes into account the market structure, market conduct, and market performance, as well as other dynamics of the market.

Baumol (1982), Baumol et al. (1982a), Martin (2000), and Coccorese and Pellecchia (2022) argue that contestable markets promote a competitive environment for firms to compete as a result of the threat of new entrants. Regulatory policies such as entry requirements, entry barriers for domestic and foreign banks, activity restrictions, government control, bureaucratic hurdles, and other regulatory requirements as well as institutional indicators like the country's contractual and informational framework impede new banks from entering into the market to compete the incumbents. However, in a contestable markets, where there is low or no barriers to entry, the presence of new banks will induce a competitive behaviour by the incumbent banks.

To achieve market contestability in the banking industry, a regulatory intervention such as deregulation of the industry is needed to encourage banking competition and stimulate economic growth. Deregulation of the banking industry allows new banks to freely enter and leave the industry with low sunk costs without any obstacles.

With regards to studies that employ regulatory policies as measures of competition, Martin (2000) examines the theory of perfectly contestable

markets and the study results reveal that the theory of market contestability is appropriate for regulatory intervention and it is adopted as a slogan to advocate for deregulation policies. The findings also indicate that the theory of contestable markets provides guidelines for regulatory practices such as allowing freedom of entry and exit, permitting price flexibility, and ensuring equal access of competitors and this seems likely to offer improvements as compared to the inflexible regulatory practices of the past.

Bailey et al. (1983) conduct a study on airline contestability to examine the changes in market concentration in airline city-pair markets following deregulation to determine the presence or absence of entry barriers in these markets. Their findings reveal a decline in concentration across nearly all distance and size classifications examined, where monopoly or near-monopoly markets transitioned to duopoly and near-duopoly levels in one year. The reduction in market concentration may be caused by a reduction in barriers to entry which led to a slight increase in competition from monopoly to duopoly markets.

In addressing the connection between deregulation, airfares and changes in market concentration, Bailey et al. (1985) investigate the determinants of airfares in 1981. They find evidence (1985, p. 165) that the fare in a less competitive market with two equal-sized airlines (i.e. with a Herfindahl index of 0.5) was 6% lower than the monopoly fare and a highly competitive market with four equal-sized airlines (i.e., with a Herfindahl index of 0.25) was 11% lower than the monopoly fare. The analysis of the finding reveals three things. First, the airfare in a monopoly market is higher than in a competitive market. Second, the airfare in a less competitive market is higher than in a more

competitive market. Third, as the airline is deregulated for new airlines to enter the industry, the airfare reduces, supporting the contestability theory that where there is low or no entry barriers, the presence of new airlines will induce a competitive behaviour which will reduce the airfare.

In examining the nexus between competition and deregulation, Call and Keeler (1985) analyze the relationship between airline deregulation, airfares, and market behaviour and their findings portray a significant positive effect of market concentration as measured by the Herfindahl index on deregulation and airfares.

To recapitulate, the studies above mainly highlight a positive relationship between market concentration and airfares. They suggest that a deregulatory policy has a significant influence on market concentration. For instance, a reduction in entry barriers may lead to a less concentrated and more competitive industry.

1.4 Link between Banking Competition and Economic outcomes

Researchers in both theoretical and empirical studies have extensively examined the effects of banking competition on a range of economic outcomes. These outcomes encompass areas including, financial stability, bank efficiency, bank profitability, interest rates, financial innovation, risk management, information sharing, credit accessibility, customer satisfaction and economic growth.

Theoretical models have made contrasting predictions on the relationship

between banking competition and economic outcomes. These mixed predictions could vary between static and dynamic models. The following analyzes the connection between banking competition and some economic outcomes.

1.4.1 Competition-Stability vs Competition-Fragility Hypothesis

In the literature, two opposing hypotheses regarding the impact of banking competition on banking stability exist, namely competition-stability hypothesis and competition-fragility hypothesis. The competition-stability hypothesis emphasizes the positive impact and the potential benefits of competition in enhancing stability, while the competition-fragility hypothesis highlights the negative impact and the potential risks associated with intense competition in undermining banking stability.

Cobbinah et al. (2020) explore the relationship between banking competition and banking stability of 10 countries in West Africa over the period of 2000–2014. Their study findings from the Granger causality test suggests a bidirectional relationship between banking competition and bank stability. Thus their results portray that banking competition may contribute to enhanced banking stability and vice versa, supporting both the competition-stability and competition-fragility views.

Using a panel of 923 commercial banks from 27 European Union countries for the period of 2001–2009, Căpraru and Andrieş (2015), test the nexus between concentration and fragility using the concentration ratios and the Herfindahl-Hirschman index. The study results for the concentration ratio

indicate that increased concentration and less competition have a negative impact on financial stability, thus confirming the competition-stability theory. On the contrary, the results for the Herfindahl-Hirschman index also show that higher concentration and less competition increase the financial stability of banks, hence supporting the competition-fragility theory.

The relationship between banking competition and stability is complex and these empirical studies have confirmed the mixed findings and contribute to the ongoing debate between competition-stability and competition-fragility.

1.4.2 Competition-Efficiency vs Quiet-Life Hypothesis

Similarly, diverging theoretical results are found for the competition-efficiency relationship, where the 'efficient-structure' hypothesis and the 'quiet-life' hypothesis are considered. The efficient-structure hypothesis suggests that competition stimulates firms to innovate and operate efficiently and this positively influences efficiency while the quiet-life hypothesis asserts that less competition tends to exhibit lower levels of effort, innovation and overall productivity and this negatively affects efficiency.

Homma et al (2014) employ data on large banks in Japan to investigate the relationship between firm growth and efficiency in the banking industry. The authors jointly test the efficient structure hypothesis and the quiet-life hypothesis and they find evidence that in a competitive market, more efficient banks experience significant growth, leading to a strong economic impact, and this confirms the efficient-structure hypothesis which posits a positive relationship between a bank's efficiency and its market structure. However, the authors also assert that a less competitive market reduces banks' efficiency,

and this aligns with the quiet-life hypotheses which predicts a negative relationship, indicating that in markets with limited competition, banks may become complacent and less motivated to improve their efficiency.

1.4.3 Banking competition and relationship lending

Additionally, the relationship between banking competition and relationship lending is a subject of controversy, with some studies predicting that competition impedes long-term lending relationships with small and medium-sized enterprises, while others suggest that competition boosts relationship lending.

Using the small business data, Petersen and Rajan (1995) examine the effect of credit market competition on lending relationships and the authors provide evidence to support the hypothesis that the degree of competition in credit markets is important in influencing the value of lending relationships. The authors find that in a more concentrated and less competitive credit markets, the lending relationship is enhanced and creditors are motivated to provide financing to firms that face constraints in accessing credit because creditors find it easier to learn and understand the benefits that come from assisting credit-constrained firms. Thus in a competitive credit market environment, the intense competition pressure hinders the lending relationships between borrowers and lenders, hence reduce financing availability such as loans.

Contrary to the study by Petersen and Rajan (1995), Boot and Thakor, (2000) addressed the question of whether relationship banking can survive competition. The authors investigate the connection between interbank

competition and relationship lending as well as the link between capital market competition and relationship lending. Their study results indicate that an increase in interbank competition leads to more relationship loans but with reduced added value, while capital market competition reduces relationship lending but increases the value of individual relationship loans.

The findings highlight the complex relationship between competition and relationship lending, indicating that changes in competition levels in both the interbank market and capital market have distinct effects on relationship lending.

1.4.4 Banking Competition and Firm creation

The relationship between banking competition and firm creation is another area which provides diverging views in the literature. Different views and opinions exist in respect of how competition levels in the banking industry affects the creation of new firms. While some studies predict a positive relationship between banking competition and firm creation, others conjecture a negative relationship.

Bonaccorsi di Patti and Dell'Ariccia (2004) investigate the effects of banking competition on firm creation in the non-financial sector and their study finds evidence that the bank market power of firms operating in relatively transparent industries has positive impact on firm creation while the bank market power of firms operating in more opaque industries has negative impact on firm creation.

The findings of the study indicate that the level of bank market power has differing effects on firm creation depending on the transparency of the

industries in which firms operate.

1.4.5 Banking Competition and Economic Growth

Ambiguity also exists regarding the competition-growth relationship. In the literature, there is no clarity on the relationship between banking competition and economic growth, while some studies predict a positive relationship, others speculate about a negative relationship.

Coccorese (2009) employs a panel data of 113 countries over the period from 1993-2012 to investigate the link between banking competition and economic growth and the study findings report that there is no clear evidence regarding the role of banking competition in promoting real economic activity. The author concludes that there is a slight tendency for scholars to accept the idea that too much competition among banks is not advantageous to the economy.

Additionally, the study by Cetorelli and Gambera (2001) explores the link between bank concentration and the level of growth of different industries. Their study results find a substantial evidence that banking concentration stimulates growth in industries that are highly dependent on external financing by facilitating credit access to younger firms. However, the study results further reveal that banking concentration depresses industrial growth. These studies report both positive and negative impacts of banking competition on economic growth.

To sum up, theoretically and empirically, there is no clear consensus on the relationship between banking competition and economic outcomes. There is lack of clarity surrounding the relationship between banking competition

and economic performance. The empirical studies discussed show differing views and opinions on whether competition has positive, negative or mixed effect on economic outcomes.

1.5 Methodology

The study employs the new empirical industrial organisation methods such as Lerner index and Boone indicator in measuring competition. The Lerner index and Boone indicator is estimated in the first step and the estimated competition indices are then used along with other macroeconomic variables to estimate the impacts of banking competition on economic growth using fixed and random effects models in the second step.

1.5.1 Lerner Index

According to Lerner (1934), the Lerner index is measured as the difference between price and marginal cost, divided by price.

$$L_{it} = \frac{P_{it} - \mathrm{MC}_{it}}{P_{it}} \tag{1}$$

Where Lit is the Lerner index for bank i at time t, Pit is the price of banks output for bank i at time t, MCit is the marginal costs for bank i at time t.

Practically, one important weakness of the Lerner index is that, the available banks' financial data do not correspond to the prices and costs required to calculate the Lerner index and so researchers use many debatable choices to proxy prices and costs (Bikker et al., 2007). Following the approach in the studies by Weill (2005), Fernandez de Guevara et al. (2005), Berger

et al. (2009), Fungáčová et al. (2010) and Demirguc-Kunt and Peria (2010) who use some balance sheet variables as proxies for price and marginal costs in the estimation of Lerner index.

To compute the Lerner index, the price (P) is calculated as the ratio of total revenues (i.e. Interest revenue plus operating revenue) to total assets whiles the marginal costs (MC) is estimated through a translog cost function. Since the marginal cost cannot be measured directly, the translog cost function is used to estimate the total cost from which the marginal cost is derived.

The estimation of the marginal costs through the translog cost function is complex and comes with many challenges and significant errors. The following studies highlight some criticisms of using the translog cost function to estimate marginal cost. According to Greene (2008b), the translog cost function introduces a potential problem that, it is not necessarily monotonic or globally convex, which is in contrast to the Cobb-Douglas function. Das and Drine (2011), Sherman and Gold (1985) and Fries and Taci (2005) used different proxies for inputs and outputs as well as different ways of estimating the prices, potentially resulting in inaccuracies when estimating the marginal costs through the translog cost function. Another challenge is the difficulty in identifying the inputs and outputs used in the translog cost function. It's very difficult to find data about the prices charged by the banks even if a researcher is able to identify the variables of interest (Daglish et al., 2015). Obtaining proxies for price from banks' financial data suggests that each bank faces a different set of prices which violates the assumptions made about perfect input markets and this potentially leads to inaccurate measurement (Koetter, 2006).

However, since marginal cost cannot be obtained directly from banks financial data, coupled with the few challenges associated with the use of translog cost function in estimating the marginal costs, some empirical studies proposed different proxies for marginal costs. White (2007) argued that if the long-run average cost (AC) curve is horizontal, then the long-run average cost (AC), average variable cost (AVC) and marginal cost (MC) are all identical. Thus, the average cost, average variable cost and marginal cost are equal and can be used interchangeably. Griffith et al. (2005) and Mahmood and Muhammad (2017) used the average variable costs as a proxy for marginal costs, whiles J. Bikker and Van Leuvensteijn (2008), Schaeck and Cihak (2010, 2014), Mirza et al. (2016) and Cummins et al. (2017), proxied the marginal cost by average cost.

To address these issues, similar to the studies of J. Bikker and Van Leuvensteijn (2008), Schaeck and Cihak (2010, 2014), Mirza et al. (2016) and Cummins et al. (2017), we propose to use the average costs as a proxy for the marginal costs to estimate the Lerner index. The average cost is calculated as the ratio of total cost to output which is given below:

$$\mathrm{AC}_{it} = \frac{\mathrm{TC}}{Q} \tag{2}$$

Where AC is the average cost, TC is the total cost which is measured as the sum of operating expenses and interest expense and Q is the output which is assumed to be the total assets. The modified Lerner index is given as follows:

$$L_{it} = \frac{P_{it} - \mathrm{AC}_{it}}{P_{it}} \tag{3}$$

Where L is the Lerner index, P is the price of the good, and AC is the average cost which is assumed to be equal to the marginal cost.

Once the average cost and the price of the output are computed, we can estimate the Lerner index for each bank and obtain a direct measure of bank competition.

1.5.2 Boone Indicator

Another indicator for measuring banking competition is Boone relative profit difference which is popularly known in the literature as Boone indicator. To estimate Boone indicator, you need to first estimate profit and marginal cost.

The study follows the theoretical models of Boone (2000, 2001, and 2004), Boone et al. (2004) and CPB (2000), where Boone indicator is estimated as the ratio between banks' performance measured as profit (ROA) and efficiency measured as marginal costs (MC) over a given period of time which is shown below:

$$\mathrm{ROA}_{it} = \alpha + \beta \mathrm{MC}_{it} \tag{4}$$

Where ROAit is return on asset for bank i at time t, MCit is marginal cost for bank i at time t and the parameter β is Boone indicator.

Abel and Marire (2021) use the average cost as a proxy for marginal cost in estimating Boone indicator, while Griffith et al. (2005) and Mahmood and Muhammad (2017) use the average variable costs as a proxy for marginal cost in estimating Boone indicator, we use a similar approach to estimate

Boone indicator where the proxy for profit is the return on assets and the marginal costs is proxied by the average costs.

The average cost is already estimated in eq. (2) while the ROA is measured as the ratio between profit after tax and the total assets which is specified as follows:

$$\text{ROA}_{it} = \frac{\text{Profit-After-Tax}}{\text{Total Assets}} \tag{5}$$

The modified profit function becomes:

$$\ln(\text{ROA}_{it}) = \alpha + \beta \ln(\text{AC}_{it}) \tag{6}$$

Where ROA is return on assets for bank i at time t which is estimated in eq. (5) and AC is average cost for bank i at time t estimated in eq. (2) and the parameter β is the Boone indicator. Higher value of β in absolute terms demonstrates large effect and strong competition within the industry as the inefficient banks (with higher marginal costs) would be punished more harshly. To address heteroskedasticity, eq. (6) has been estimated in natural log-linear terms for empirical purposes.

Once the profit (ROA) and the average cost (AC) are calculated, we can therefore estimate the Boone indicator for each bank and obtain a direct measure of bank competition. Finally, for each bank, a 6-year Lerner index and Boone indicator are calculated.

1.5.3 Panel Regression

The second step of the methodology is to estimate the impacts of the competition measures on economic growth. In order to investigate a possible causal link between banking competition and economic growth, we built a panel of banks and countries and estimated the following growth regression using fixed and random effects. Since Lerner index and Boone indicator are substitutes or alternative proxies for banking competition, we estimate separate regression models, each including one competition measure at a time to avoid potential multicollinearity issues in the model.

The growth regression model with Lerner index and control variables as regressors is given below:

$$\text{GROWTH}_{ct} = \alpha_1 \text{LERNER}_{ct} + \beta \ln(X_{ct}) + \varepsilon_{ct} \tag{7}$$

The growth regression model with Boone indicator and control variables as regressors is as follows:

$$\text{GROWTH}_{ct} = \alpha_1 \text{BOONE}_{ct} + \beta \ln(X_{ct}) + \varepsilon_{ct} \tag{8}$$

Where GROWTHct, is the average annual growth rate of GDP per capita of country c (c = 1,...,N) at time t (t = 1,...,t), LERNERct represents the Lerner index of the banking competition measure, BOONEct represents the Boone indicator of the banking competition measure, Xct is a vector of control variables and εct is the error term.

1.5.4 Panel Smooth Transition Regression (PSTR) Model

The Panel Threshold Regression (PTR) model was first developed by Hansen (1999) for non-dynamic panels with individual-specific fixed effects to test whether financial constraints affect investment decisions. Later González et al. (2005) introduced the Panel Smooth Transition Regression (PSTR) model to investigate the impacts of capital market imperfections on corporate investment decisions.

Hansen (1999) panel threshold regression (PTR) model has a drawback as it assumes that all variables in the model are strictly exogenous. Similarly, the traditional nonlinear regression methods such as polynomial or piecewise regression models that are used to investigate the nonlinear relationship between variables have some notable limitations that the panel smooth transition model can resolve.

González et al. (2005) emphasize that the PSTR allows coefficients to change smoothly as a function of the threshold variable and avoids the abrupt changes through regimes as in Hansen (1999) panel threshold regression model (PTR). According to González et al. (2005) and Lin (2013), the observations in PSTR models are divided into homogenous groups or regimes according to the value of the threshold variable. The estimated coefficients vary between firms and time that deal with firm heterogeneity and time instability of coefficients (Fouquau et al., 2008; Li et al., 2015).

In recent times, PSTR model has been generally adopted to investigate the nonlinear relationships between variables and the threshold effects on variables (Ben Cheikh and Ben Zaied, 2020; Doumbia, 2018; Fouquau et al.,

2008; Khue and Lai, 2020; López-Villavicencio and Mignon, 2011; Zortuk and Çeken, 2015).

In our study, we use the panel smooth transition regression model to examine the potential nonlinear relationship between competition and economic growth. Using PSTR model to estimate the impacts of competition on economic growth would necessarily reveal the nonlinear relationship between competition and economic growth such that low and high competition levels would possibly have diverse impacts on economic growth depending on the number of regimes in the model.

PSTR Model Specification

The Panel Smooth Transition Regression (PSTR) model developed by González et al. (2005) with two extreme regimes is defined as:

$$y_{it} = \mu_i + \lambda_t + \beta_0^1 x_{it} + \beta_1^1 x_{it} g(q_{it}; \gamma, c) + u_{it}$$

For $i = 1, \ldots, N$, and $t = 1, \ldots, T$, where N and T denote the cross-section and time dimensions of the panel, respectively, y_{it} represents the dependent variable. μ_i indicates the fixed individual effects. λ_t represents time effects. $\mathbf{x}_{it}$ is a vector of k explanatory variables. ε_{it} are the error terms. q_{it} is the value of the transition variable, and $g(q_{it}; \gamma, c)$ is the transition function.

The Panel Smooth Transition Regression (PSTR) model is based on a transition function $g(q_{it}; \gamma, c)$, which largely depends on a transition variable denoted q_{it}.

Following González et al. (2005), Terasvirta (1994, 1998), Jansen and Terasvirta (1996), and Terasvirta et al. (2010, Chapter 3), the logistic

transition function is specified below:

$$g(q_{it};\gamma,c) = \left[1 + \exp\left(-\gamma \prod_{j=1}^{m}(q_{it} - c_j)\right)\right]^{-1}$$

Where c_j represents the threshold parameter and γ represents the smooth transition parameter. z_{it} represents a vector of explanatory variables that will have constant coefficients over time and individuals and will not enter the nonlinear part of the model.

To estimate the impacts of banking competition on economic growth, we use the following econometric model:

$$GROWTH_{i,t} = \alpha_0 + \alpha_1 COMP_{i,t} + \beta X_{i,t} + \gamma(COMP_{i,t} - c)G(COMP_{i,t};c,q) + \epsilon_{i,t}$$

Where $GROWTH_{i,t}$ represents the economic growth for bank i at time t. $COMP_{i,t}$ is the competition variable for bank i at time t. $X_{i,t}$ is the control variables for bank i at time t. α_0, α_1 and β are parameters of the model. γ is a parameter that captures the effect of the competition variable $COMP$ on the dependent variable GROWTH. c is the threshold parameter that determines the value of $COMP$ at which the transition occurs. q is a parameter that controls the smoothness of the transition. $G(COMP_{i,t};c,q)$ represents the transition function, which is a logistic function in the PSTR model and $\epsilon_{i,t}$ is the error term for bank i at time t.

1.6 Data

The dataset employed for the estimation of the competition indices and panel regression is a panel data which consists of banks, including Commercial banks, Savings banks, Cooperative banks, Investment banks and Real estate and mortgage finance institutions within 19 eurozone countries for the period from 2015 to 2020.

After cleaning the dataset by removing banks with missing data, we have 1867 banks over a 6-year period from 2015 to 2020, which results in an unbalanced panel data with 6858 bank-year observations. The source of the banks' data is BankFocus database, while the data for the macroeconomic variables for each country are drawn from the World Development Indicators which is managed by the World Bank.

Once we obtain the values of the Lerner index and Boone indicator, we include them in the regression model specified in eq. (7) and (8) as regressors together with the control variables to estimate the impacts of competition on economic growth. All the independent variables are standardized and the set of control variables in their standardized form which are included in the models as regressors consist of:

- Trade (Trade) sums up the exports and imports of goods and services measured as a fraction of GDP;
- Investment (Investment) measures the investment of the economy to GDP ratio which includes an acquisition of fixed assets plus net changes in the level of inventories;
- Government expenditure (GovExp) measures the general government

final consumption expenditure as a fraction of GDP;

- The inflation rate (Inflation), measured by the average annual variation of the consumer price index;
- Population (Population) measures the total annual population;
- Bank credit (BankCredit) measures the domestic credit provided to the private sector by banks;

Over the last two decades, numerous empirical studies have been conducted with the aim of identifying the factors that influence economic growth using various models (Moral-Benito, 2009). Regarding the choice of the control variables in the growth regression, Levine and Renelt (1992) analyze specific issue regarding the selection of appropriate variables to include in the linear growth regression and they conclude that very few variables included in the growth regression are robustly correlated with growth and this is contrary to the findings of Sala-i-Martin (1997) who opines that some variables included in the growth regression are fairly stable across specifications.

Strictly following the findings of studies by Solow (1956), Lucas (1988), Levine and Renelt (1992), Mankiw et al. (1992), Easterly (1994), Barro and Sala-i-Martin (1995), Sala-i-Martin (1997), Levine and Zervos (1998), Beck et al. (2000), Beck and Levine (2004), Coccorese (2009) and Moral-Benito (2009), they all customarily employed the control variables above in their analysis concerning the determinants of economic growth and their data on control variables were drawn from the World Bank Development Indicators database.

1.7 Empirical Estimations and Analysis

Table 1.1 provides some descriptive statistics of the variables, while Table 1.2 displays the list of countries and their average Lerner and Boone indices. Table 1.3 illustrates the annual Lerner and Boone indices and Table 1.4 shows the correlation matrix and the Variance Inflation Factor (VIF) of the variables. Tables 1.5, 1.6 and 1.7 provide the results of the regression models. Table 1.8 presents the proxies and measurement of the variables.

1.7.1 Summary Statistics

In Table 1.1, Lerner Index has a mean of 0.18 which indicates less market power and greater competition on average in the banking industry. The minimum value of -0.99 for Boone indicator highlights the presence of negative values in Boone indices which is an indicative of higher competition among some banks within the banking industry. The Boone indicator has a mean of 1.33, which signals lower level of banking competition on average. Regarding the macroeconomic variables, an average inflation of 0.96 which is approximately 1% is generally considered acceptable. Population has relatively low mean of 0.39, while the rest of the macroeconomic indicators have positive mean, indicating the overall positive macroeconomic trend.

1.7.2 Analysis of Annual Lerner and Boone indices

Pruteanu-Podpiera et al. (2007) argue that the Lerner index is an inverse measure of competition such that a higher Lerner index connotes less competition while a lower Lerner index implies high competition. In Table

1.2, it can be observed that, the Lerner Index values range from a minimum of 0.1730 in 2016, indicating the highest competition level and to a maximum of 0.1881 in 2015, suggesting the lowest level of competition over the years. The Lerner Index decreases from 0.1881 in 2015 to 0.1730 in 2016, then increase and stabilize around 0.18 from 2017 to 2020 and this fluctuation over the period from 2015 to 2020 suggests varying degrees of market power, hence different competition levels over the years.

Concerning Boone indicator in Table 1.2, there was a marginal increase in Boone indicator from 2015 to 2017, demonstrating a trend towards less competitive banking industry during this period, while from 2017 to 2020 exhibited a "U-shaped" pattern, where the index decreases notably from 2017 to 2018 and then increases substantially from 2018 to 2020, signalling fluctuations in the level of competition from 2017 to 2020.

Overall, both the Lerner and Boone indices recorded from 2015 to 2020 are low values signalling less market power and more competitive banking industry in the euro area countries.

1.7.3 Analysis of Average Lerner and Boone indices

Regarding the analysis of Lerner indices in Table 1.3 which shows the list of countries and their average Lerner and Boone indices, it can be observed that, Germany has the least Lerner index (0.1453), indicating the minimum market power and maximum competition level, while Lithuania records the largest Lerner index (0.3574), indicating the maximum market power and minimum competition level, within the eurozone. Although the Lerner indices in Table 1.3 obviously show lower market power and higher banking competition

within the countries, some countries such as Ireland and Lithuania, have Lerner indices of approximately 0.30 and 0.36 respectively, comparatively demonstrating that, the degree of competition in these two countries from 2015 to 2020 was lower than the competition level in the rest of the countries that have Lerner indices close to zero.

Additionally, concerning the analysis of Boone indices in Table 1.3, we can observe that countries such as Cyprus, Finland, Latvia, Slovenia and Spain have Boone indices close to zero, implying greater banking competition, while Greece and Malta record Boone indices of approximately 3.5 and 3.4 respectively, an indicative of weak competition as compared to the remaining euro area countries.

1.7.4 Correlation Matrix and VIF Test

Prior to the regression models, we perform some statistical tests. Firstly, we estimate the correlation coefficients among the variables using Pearson correlation matrix to test for multicollinearity. Additionally, we also compute the Variance Inflation Factor (VIF) values to test for multicollinearity and Table 1.4 discloses the results of the correlation matrix and VIF test.

Gujarati (2007) and Gujarati and Porter (2009) argue that the problem of multicollinearity exists if the correlation between independent variables is above 0.8. From Table 1.4, there is a perfect positive correlation between Investment and GovExp variables since they have a correlation coefficient of 1 which may potentially cause multicollinearity problem in the regression models. Aside the correlation coefficient of 1, the next highest correlation coefficient between the variables is 0.7 which is below the 0.8 threshold

(Gujarati, 2007; Gujarati and Porter, 2009).

Moreover, the highest VIF values, 6.03 and 4.82 for Investment and GovExp respectively are less than the threshold of 10 above which multicollinearity is an issue (Gujarati and Porter, 2009).

Considering these two tests, we can conclude that multicollinearity may exist and pose problem in our estimations as a result of the high correlation between Investment and GovExp, hence including both variables in the same regression model may lead to multicollinearity issues.

1.7.5 Panel Regression Analysis

Before estimating regression models, specifically the random effects models, we standardize the independent variables to ensure that they are on the same scale, which helps in interpreting coefficients, comparing their relative importance, and improving the numerical stability of regression estimations.

To address the multicollinearity issues, we include Investment variable and exclude GovExp variable in the regression models. The analysis of the panel regression and the Panel Smooth Transition Regression (PSTR) models in Tables 1.5, 1.6 and 1.7 are as follows:

With regards to the competition measures in Table 1.5, although the Lerner index shows a negative coefficient in both the regression and correlation matrix, this negative relationship is not statistically significant in explaining growth in the model, therefore the Lerner index as a competition measure do not demonstrate a significant impact on economic growth.

Conversely, the Boone indicator is positive and highly significant at 1% as expected, implying that an increase in Boone indicator (less competition)

in the banking industry may stimulate economic growth. Thus, in a less competitive banking industry (higher Boone Indicator) banks achieve higher profits which may lead to higher investments and expansion, fostering economic growth.

Several empirical studies confirm the positive relationship between competition and economic growth. Nickell (1996) argues that most competitive firms experienced productivity growth rates from 3.8% - 4.6% higher than the less competitive firms. Aghion et al (2008) find that greater competition (e.g. resulting in a 10% reduction in mark-ups) could increase productivity growth in South Africa by 2-2.5% per year. The study by Hyung (2022) reveals a positive impacts of competition on economic growth which allows firms and industries to produce more and quality goods and services at lower costs.

Concerning investment, gross capital formation plays a crucial role in driving economic growth. Investment is positive and significant in both the regression model and the correlation matrix as expected and this confirms that higher levels of gross capital formation are associated with increased levels of economic growth. Empirical studies support this positive relationship that Investment drives economic growth, suggesting that significant increase in investments promotes economic growth (World Bank, 2019; UNCTAD, 2021).

With respect to trade, trade is a key driver of economic growth. In a competitive environment, trade improves efficiency which increases productivity leading to a rise in output, an increase in market expansion, higher employment opportunities and eventually economic growth. The

positive coefficient exhibited in both the regression model and the correlation matrix supports the traditional belief that international trade can have several positive effects on economic growth.

Pertaining to inflation, the main driving force of economic growth is inflation. The results disclose a positive coefficient for inflation in the regression model and the correlation matrix, indicating that inflation can boost investment especially when businesses anticipate a rise in inflation and higher revenues in future, they intend to invest in expanding production capacity which can increase productivity and create jobs, contributing to economic growth.

Regarding population, the results show a positive coefficient in both the regression model and the correlation matrix as expected to prove that a rise in population allows for an expansion of labor force which will lead to higher productivity with positive effects on economic growth (Fengler, 2010; Peter and Bakari, 2018; Tartiyus et el, 2015).

In connection with bank credit, excessive bank credit to individuals, businesses, and even government can contribute to high levels of indebtedness and financial instability which can have a negative impact on the economy. As expected, bank credit exhibited negative regression and correlation coefficients and is statistically significant in all regressions, a signal that excessive credits by banks and reckless borrowing by firms can lead to financial instability, with references to the global financial crisis in 2007 and 2008 and this may have adverse impact on economic growth (Carlos, 2012; Tahir et al., 2015; Rajan, 2010).

1.7.6 Panel Smooth Transition Regression Analysis

For robustness checks, we estimate Panel Smooth Transition Regression (PSTR) to test the nonlinear relationship between the competition measures and economic growth while controlling for macroeconomic factors. Tables 1.6 and 1.7 present the results of the panel threshold regression analysis using PSTR models. We use Lerner index and Boone indicator as transition variables in Table 1.6 and Table 1.7 respectively to estimate the impacts of banking competition on economic growth.

The significant level of threshold is 0.4779 in Table 1.6 with Lerner index as transition variable and 0.9938 in Table 1.7 with Boone indicator as transition variable. Since lower values of Lerner index suggest greater competition and higher values indicate lesser competition, then Lerner index less than the threshold value of 0.4779 signifies higher competition and Lerner index greater than or equal to the threshold value of 0.4779 indicates lesser competition. Similarly, based on Boone et al. (2013) assumption that, higher negative value of the estimated Boone indicator coefficient indicates stronger competition, therefore Boone indicator less than the threshold value of 0.9938 implies higher competition and Boone indicator greater than or equal to the threshold value of 0.9938 suggests lesser competition.

In Table 1.6, Lerner index has a positive and significant impact on economic growth in the first regime (higher competition) and this could be interpreted as in a more competitive market, banks become more innovative and offer high-quality services, including lower fees on transactions, reduced lending rates on loans, and higher deposit rates on deposits to attract customers and gain market share, which can lead to increased savings and investments,

thereby promoting economic growth. On the other hand, the impact becomes negative and significant in the second regime (lower competition), signalling that in a less competitive market, banks with high market power (less competition) may have more control to manipulate the prices of banking services by offering higher transaction fees, increased interest rates and poor quality services which could lead to decreased savings and investments, hindering economic growth.

From Table 1.7, Boone indicator is negative and non-significant in the first regime, suggesting that higher competition among banks do not have a statistically significant effect on economic growth and this could be caused by factors such as regulatory constraints or market conditions that limit the impact of competition on economic growth. On the contrary, the relationship becomes positive and significant in the second regime, signifying that lower competition within the banking industry fosters economic growth and this could be interpreted as, in a less competitive banking industry, banks with more market power have the ability to influence the prices of banking services by charging higher prices and higher interest rates so as to earn higher profits which can be used to expand the market and create more jobs, contributing to economic growth.

Overall, from Tables 1.6 and 1.7, in both the first regime (higher competition) and second regime (lower competition), the results indicate that the relationship between the competition measures and economic growth in the banking industry is non-linear, complex and varies depending on the degree of market power that banks have.

Our results confirm the findings of the empirical evidence that support the

positive relationship between banking competition and economic growth such that higher banking competition strengthens economic growth. (Coccorese, 2017; Rakshit and Bardhan, 2019). Conversely, the results also confirm the findings of the empirical studies that support the negative connection between banking competition and economic growth such that lower competition and higher market power can slow down economic growth (Coccorese, 2017). Additionally, our results further confirm the findings of some empirical studies that support the idea that the relationship between banking competition and economic growth is complex and non-linear (Coccorese, 2017; Banya and Biekpe, 2017; Arshad, 2020).

From Tables 1.6 and 1.7, Investment is positive and significant in both models and regimes, an indication that in a more or less competitive environment, investment plays a critical role in promoting economic growth. Research on foreign direct investment (FDI) has shown that FDI has a positive influence on economic growth by way of increasing financial resources, new innovation and technology, skills development, and job creation. The result confirms the findings of Binder and Bröck (2011), Mahembe and Odhiambo (2014), World Bank (2019), UNCTAD (2021), and Ocolișanu et al. (2022) about the positive relationship between investment and economic growth, reinforcing the idea that investment plays a crucial role in promoting economic growth.

Trade is significant and positively associated with economic growth in both models, and this result confirms the traditional belief that international trade tend to increase innovation and technology, expand market, improve productivity and create jobs through exports which consequently boosts

economic growth. (Esther et al., 2017; Brian, 2019; Bardi and Hfaiedh, 2021; Ekanayake et al., 2023).

Inflation has a positive significant impacts on economic growth in both models which suggests a statistically meaningful relationship between inflation and economic growth. The result supports the findings of Yilmazkuday (2022), Becha, Kalai and Helali (2023) and Anthony and Oluwabunmi (2020) that inflation can stimulate spending, encourage businesses to invest, leading to job creation which potentially contributes to increased economic growth.

Population is significant and positively connected to economic growth in both regimes and models as expected, an indication that population growth contributes to economic growth. Population growth leads to greater human capital as more people produce more goods and services resulting in higher tax revenues and increased innovation where exceptional individuals with expertise can contribute significantly to technological advancements which foster economic growth (Furuoka, 2018; Brander and Dowrick, 1994; Darrat and Al-Yousif, 1999; Mamingi and Perch, 2013).

Bank credit has a statistically meaningful relationship with economic growth under different market conditions. In both models, the relationship between bank credit and economic growth is both negative and positive in regime 1 and regime 2 respectively, depending on the competitiveness of the market. Particularly, it shows that in a highly competitive market (regime 1), bank credit has a negative impact on economic growth, while in a less competitive market (regime 2), bank credit has a positive impact on economic growth. The results confirm that credit misallocation, overextension of credit and default in repayment of bank loans can lead to financial crises, which

can have a detrimental effect on economic growth. On the other hand, by extending credit to most productive sectors of the economy has a positive impact on the income of businesses and individuals, leading to increased investment, market expansion and job creation which potentially contribute to economic growth (Izz, 2016; Prochniak and Wasiak, 2017; Davis and Ngozi, 2019; Vasconcelos et al., 2021; Ho and Saadaoui, 2022).

1.8 Conclusion

The analysis of banking competition is a complex and multifaceted topic. The level of competition in the banking industry can have significant implications for banking efficiency, stability, performance, customer welfare, and overall economic growth.

The impacts of banking competition can vary across different contexts and time periods and therefore in any assessment of banking competition, researchers and policymakers should make a continuous efforts to monitor and evaluate the dynamics of banking competition, taking into consideration the evolving dynamics of financial markets.

As the literature reveals, in a perfect market, competition has a positive impacts on efficiency and performance in the banking industry while in an imperfect market, higher levels of market power and market concentration have negative effects on efficiency and performance in the banking industry.

A deregulatory policy has a significant influence on market power and market concentration. For instance, a reduction in entry barriers may lead to a less concentrated and more competitive industry.

As reported in the literature, there is no clear consensus on the impacts of banking competition on economic outcomes. There is lack of clarity surrounding the relationship between banking competition and economic performance. Researchers have differing views and opinions on whether competition has positive, negative or mixed effect on economic outcomes and therefore there is the need for further investigation and analysis to provide clarity on the relationship between banking competition and economic dynamics and to reconcile any conflicting viewpoints in the literature.

From the study results, it is obvious that macroeconomic factors such as investment, trade, inflation, and population are key determinant of economic growth.

The main findings of this study show that banking competition promotes economic growth. This is particularly evident in a more competitive market, when banks become more innovative and offer high-quality services, including lower fees on transactions, reduced lending rates on loans, and higher deposit rates on deposits to attract customers and gain market share, leading to increased savings and investments, thereby fostering economic growth.

On the contrary, the findings also disclose that, banking competition stifles economic growth. This mostly occurs in a less competitive market, where banks with high market power may have more control to manipulate the prices of banking services by offering higher transaction fees, increased interest rates and poor quality services which could lead to decreased savings and investments, hindering economic growth.

Overall, the relationship between banking competition and economic growth is non-linear, complex and varies depending on the degree of market

power that banks have.

References 1

Adelman, Morris A. (1969) "Comment on the 'H' concentration measure as a numbers equivalent," Review of Economics and Statistics 51 February 1969, pp. 99—101.

Albaity M, Mallek R. S., Noman A. H. (2019). Competition and bank stability in the MENA region: The moderating effect of Islamic versus conventional banks. Emerging Markets Review. Volume 38, March 2019, Pages 310-325.

Anochiwa L.I. and Maduka, A. (2015) Inflation and Economic Growth in Nigeria: Empirical Evidence?

Anthony Olugbenga Adaramola and Oluwabunmi Dada (2020). Impact of inflation on economic growth: evidence from Nigeria. Investment Management and Financial Innovations, 17(2), 1-13.

Arshad Hassan (2020). Linking Bank Competition, Financial Stability, and Economic Growth. Journal of Business Economics and Management

Bailey, Elizabeth E., Daniel P. Kaplan, and David S. Sibley (1983). "On the contestability of airline markets: some further evidence," in Jörg Finsinger, editor, Economic Analysis of Regulated Markets. New York: St. Martin's Press, 1983, pp. 48—64.

Bailey, Elizabeth E., David R. Graham and Daniel P. Kaplan (1985). Deregulating the Airlines. Cambridge, Massachusetts: MIT Press.

Bain, J. (1951).The Relation of profit Rate to Industry Concentration, American Manufacturing, 1936-1940, Quarterly Journal of Economics, vol.65 (3), pp.293-324.

Bain, J. (1956). Barriers to New Competition,Harvard University Press, Cambridge, MA.

Banya, R.M. and Biekpe, N. (2017), "Bank competition and economic growth: Empirical evidence from selected frontier African countries", Journal of Economic Studies, Vol. 44 No. 2, pp. 245-265. https://doi.org/10.1108/JES-09-2015-0169

Bardi, W. and Hfaiedh, M.A. (2021). International trade and economic growth: evidence from a panel ARDL-PMG approach. International Economics and Economic Policy, 18, 847–868.

Barro R. and X. Sala-i-Martin (1995), Economic Growth, New York: McGraw-Hill.

Baumol et al. (1982). Contestable markets and the theory of industry structure. Harcourt Brace Jovanovich.

Binder, M. and Bröck, S. (2011), "Chapter 4 On the Relation Between Investment and Economic Growth: New Cross-Country Empirical Evidence", de La Grandville, O. (Ed.) Economic Growth and Development (Frontiers of Economics and Globalization, Vol. 11), Emerald Group Publishing Limited, Leeds, pp. 43-86. https://doi.org/10.1108/S1574-8715(2011)0000011009

Brander, J.A., Dowrick, S. (1994). The role of fertility and population in economic growth. J Popul Econ 7, 1–25. https://doi.org/10.1007/BF00160435

Brian C. Albrecht (2019). Freer Trade and Economic Growth: Evidence of the Relationship.

Becha, H., Kalai, M., and Helali, K. (2023). Smooth transition regression model relating inflation to economic growth in Tunisia. Journal of Economic Structures, 12, Article number: 14.

Beck T., R. Levine and N. Loayza (2000), 'Finance and the sources of growth', Journal of Financial Economics, 58(1-2), 261-300.

Beck T. and R. Levine (2004), 'Stock markets, banks, and growth: Panel evidence', Journal of Banking and Finance, 28(3), 423-442.

Beck T. (2008), 'Bank competition and financial stability: friends or foes?' World Bank Policy Research Working Paper, 4656.

Berger, A. N., Hannan, T.H., (1998). The efficiency cost of market power in the banking industry: A test of the 'quiet life' and related hypotheses. Review of Economics and Statistics 8 (3), 454–465.

Berger, A. N., Klapper, L., Turk-Ariss, R. (2009), "Bank competition and financial stability", Journal of Financial Services Research, 35, 99–118.

Bikker, J., Shaffer, S., Spierdijk, L., 2012. Assessing competition with the Panzar-Rosse model: the role of scale, costs, and equilibrium. Rev. Econ. Stat. 94, 1025–1044.

Blair, R., Sokol, D., 2014. The Oxford Handbook of International Antitrust Economics, vol. 1. Oxford University Press, U.S.A.

Bonaccorsi di Patti E. and Dell'Ariccia G. (2004), 'Bank competition and firm creation', Journal of Money, Credit and Banking, 36(2), 225-252.

Boone, J., 2000, Competition, CEPR Discussion Paper Series No. 2636.

Boone, J., 2001, Intensity of competition and the incentive to innovate,

International Journal of Industrial Organization 19(5), 705–726.

Boone, J., (2004). A New Way to Measure Competition, CEPR Discussion Paper Series No. 4330.

Boone J., R. Griffith and R. Harrison, (2004). Measuring Competition, presented at the Encore Meeting 2004 'Measuring competition'

Boone Jan, Griffith Rachel and Harrison Rupert (2005). Measuring Competition. Advanced Institute of Management Research Paper No. 022, Available at SSRN: https://ssrn.com/abstract=1307004 or http://dx.doi.org/10.2139/ssrn.1307004

Boone, J. (2008), "A new way to measure competition", Economic Journal, 118, 1245-1261.

Boot, A., Thakor, A., 2000. Can relationship banking survive competition? J. Finance 55, 679–713.

Bos, J. W. B., and Schmiedel, H. (2013). Competition and innovation: Evidence from financial services. Review of Finance, 17(6), 1987-2022.

Bresnahan F. Timothy (1989) Chapter 17-Empirical studies of industries with market power, Handbook of Industrial Organization, Elsevier, Volume 2, Pages 1011-1057, ISSN 1573-448X, ISBN 9780444704351. https://doi.org/10.1016/S1573-448X(89)02005-4

Call, Gregory D. and Keeler, Theodore E.(1985) "Airline deregulation, fares, and market behavior: some empirical evidence," in Andrew F. Daughety, editor, Analytical studies in transport economics. Cambridge: Cambridge University Press, 1985, pp. 221—47.

Căpraru B, and Andrieş M. A. (2015). Nexus Between Concentration and Fragility Across EU Banking Systems, Procedia

Economics and Finance, Volume 32, Pages 1140-1147, ISSN 2212-5671, https://doi.org/10.1016/S2212-5671(15)01579-8.

Carb´o, S., Humphrey, D., Maudos, J., and Molyneux, P. (2009). Cross-country comparisons of competition and pricing power in European banking. Journal of International Money and Finance, 28(1):115–134.

Casu, B. and Girardone, C. (2006). Bank Competition, Concentration and Efficiency in the Single European Market. Manchester School, 74 (4), 441¬–468. http://dx.doi.org/10.1111/j.1467-9957.2006.00503.

Centraal Planbureau, 2000, Measuring competition; how are cost differentials mapped into profit differentials', CPB Working Document nr. 131.

Cetorelli N. and M. Gambera (2001), 'Banking market structure, financial dependence and growth: International evidence from industry data', Journal of Finance, 56(2), 617-648.

Chatterjee Sayan (1991). Gains in Vertical Acquisitions and Market Power: Theory and Evidence. Academy of Management Journal. Vol. 34, No. 2.

Clark, J. A. and Speaker, P. J. (1994). Economies of scale and scope in banking: evidence from a generalized translog cost function. Quarterly Journal of Business and Economics, pages 3–25.

Cobbinah, J., Zhongming, T., and Ntarmah, A. H. (2020). Banking competition and stability: Evidence from West Africa. National Accounting Review, 2(3), 263–284. https://doi.org/10.3934/NAR.2020015.

Coccorese, P. (2009). Market power in local banking monopolies. Journal of Banking and Finance, 33 (7), 1196-1210. http://dx.doi.org/10.1016/j.jbankfin.2008.12.013

Coccorese Paolo, (2017). "Banking competition and economic growth. Handbook of Competition in Banking and Finance, chapter 12, pages 230-263, Edward Elgar Publishing.

Coccorese, P., Pellecchia, A. (2022). Deregulation, Entry, and Competition in Local Banking Markets. Rev Ind Organ 61, 171–197. https://doi.org/10.1007/s11151-022-09867-w

Collender R.N. and S. Shaffer (2003), 'Local bank office ownership, deposit control, market structure, and economic growth', Journal of Banking and Finance, 27(1), 27-57.

Daglish et al. (2015). Translog Cost Function Estimation: Banking Efficiency.

Darrat, A. F., and Al-Yousif, Y. K. (1999). On the Long-Run Relationship between Population and Economic Growth: Some Time Series Evidence for Developing Countries. Eastern Economic Journal, 25(3), 301–313. http://www.jstor.org/stable/40325933

Das, S. K. and Drine, I. (2011). Financial liberalization and banking sector efficiency in india: a fourier flexible functional form and stochastic frontier approach. International Business and Management, 2(1):42–58.

Davis Ojima and Ngozi Ojima (2019). Credit Risk and Economic Growth in Nigeria. European Journal of Business, Economics and Accountancy. Vol. 7, No. 1, ISSN 2056-6018.

De Guevara, J., Maudos, J. (2007), "Explanatory factors of market power in the banking system", The Manchester School, 75, 275–296.

De Guevara, J., Maudos, J. (2007). The cost of market power in banking: Social welfare loss vs. cost inefficiency. Journal of Banking and Finance.

Volume 31, Issue 7, July 2007, Pages 2103-2125.

Deidda L. and B. Fattouh (2005), 'Concentration in the banking industry and economic growth', Macroeconomic Dynamics, 9(2), 198-219.

Demetriades, P. O., and Luintel, K. B. (1997). The output effects of banking sector efficiency in a developing economy. Manchester School, 65(1), 60-78.

Demirguc-Kunt, A. and Peria, M.S.M. (2010). A Framework for Analyzing Competition in the Banking Sector: An Application to the Case of Jordan. Policy Research working paper No. 5499, 1-24.

D. Masciandaro and M. Quintyn (2019) Measuring Financial Regulation Architectures and the Role of the Central Banks: The Financial Supervision Herfindahl Hirschman Index. Published in Corporate Governance and Economics eJournal.

Easterly W. (1994), 'Economic stagnation, fixed factors, and policy thresholds', Journal of Monetary Economics, 33(3), 525-557.

Ekanayake, P.N.S.P., Madsen, J.B. and Bharati, T. (2023). Trade and economic growth: Does the sophistication of traded goods matter? Journal of Economic Growth, 28, 481–524.

Eli Tartiyus, TM Dauda and Amade Peter (2015). Impact of population growth on economic growth in Nigeria.

Esther O. Lawal, Kamtochukwu Ezeuchenne (2017). International Trade and Economic Growth in Nigeria. IOSR Journals.

Ferhat Pehlivanoğlu and Erkam Tekçe (2013) Analysis of the Turkish electricity market. Published in Abant İzzet Baysal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi.

Fries, S. and Taci, A. (2005). Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. Journal of Banking and Finance, 29(1):55–81.

Furuoka, F. (2018). Is population beneficial to economic growth? An empirical study of China. Qual Quant 52, 209–225. https://doi.org/10.1007/s11135-016-0463-6

Graham, David R., Daniel P. Kaplan, and David S. Sibley (1983). "Efficiency and competition in the airline industry," Bell Journal of Economics 14 Spring 1983, pp. 118—38.

Greene, W. H. (2008a). Econometric analysis. Granite Hill Publishers.

Greene, W. H. (2008b). The econometric approach to efficiency analysis. The measurement of productive efficiency and productivity growth, pages 92–250.

Heather Boushey and Helen Knudsen (2021). The Importance of Competition for the American Economy.

Ho, Sy Hoa and Saadaoui, Jamel, (2022). Bank Credit and Economic Growth: A Dynamic Threshold Panel Model for ASEAN Countries. Updated version of the BETA working paper 2021-24 (2021). International Economics, Available at SSRN: https://doi.org/10.1016/j.inteco.2022.03.001

Homma T. Tsutsui Y. and Uchida H. (2014). Firm growth and efficiency in the banking industry: A new test of the efficient structure hypothesis. Journal of Banking and Finance. Volume 40, Pages 143-153.

Hyde, C. and Perloff, J. (1995). Can market power be estimated? Rev. Ind. Organ. 10, 465–485.

Izz ananzeh (2016). Relationship between Bank Credit and Economic

Growth: Evidence from Jordan. International Journal of Financial Research

Jayaratne, J., and Strahan, P. E. (1996). The finance-growth nexus: Evidence from bank branch deregulation. The Quarterly Journal of Economics, 111(3), 639-670.

Jiménez, G., Lopez, J. A., Saurina, J. (2007), "How Does Competition Impact Bank Risk-Taking", Federal Reserve Bank of San Francisco Working Paper Series 2007-23, September.

Kessides, Ioannis N. (1986) "Advertising, sunk costs, and barriers to entry," Review of Economics and Statistics 68(1), pp. 84—95.

Kessides, Ioannis N. (1988) "Market Structure and Sunk Costs: An Empirical Test of the Contestability Hypothesis," Working Paper No. 88-50, Department of Economics, University of Maryland.

Koetter, M. (2006). Measurement matters—alternative input price proxies for bank efficiency analyses. Journal of Financial Services Research, 30(2):199–227.

Kramarić, T. P., and Miletić, M. (2019). The Boone indicator as determinant of Croatian insurance market soundness. South East European Journal of Economics and Business, 14(2), 1–12. https://doi.org/10.2478/jeb-2019-0009

Poku K., Opoku E. and Ennin A. P. (2022). The influence of government expenditure on economic growth in Ghana: An Ardl approach, Cogent Economics and Finance, 10:1, DOI: 10.1080/23322039.2022.2160036

Lawrence J. White (2007). Market Power and Market Definition in Monopolization Cases: A Paradigm Is Missing.

Lerner A.P. (1934), 'The concept of monopoly and the measurement of

monopoly power', Review of Economic Studies, 1(3), 157-175.

Leuvensteijn Van M., Bikker, J. A., van Rixtel, A. A. R. J. M., and Sørensen, C. K. (2007). A new approach to measuring competition in the loan markets of the euro area. Applied Economics, 43(25), 3155-3167.

Leuvensteijn Van M. (2008). The Boone-indicator: Identifying different regimes of competition for the American Sugar Refining Company 1890-1914.

Levine R. and Renelt D. (1992). A Sensitivity Analysis of Cross-Country Growth Regressions. The American Economic Review. Vol. 82, No. 4. pp. 942-963 (22 pages).

Levine R. and S. Zervos (1998), 'Stock markets, banks, and economic growth', American Economic Review, 88(3), 537-558.

Lucas R.E., Jr. (1988), 'On the mechanics of economic development', Journal of Monetary Economics, 22(1), 3-42.

Mahembe, E., and Odhiambo, N. M. (2014). Foreign direct investment and economic growth: A theoretical framework. Journal of Governance and Regulation, 3(2), 63-70.

Mahmood Khan and Muhammad Hanif (2017). Measuring Competition in the Banking Sector of Pakistan: An Application of Boone Indicator.

Mamingi, N., and Perch, J. (2013). Population growth and economic growth/development: An empirical investigation for Barbados. Population, 4(4).

Mankiw N.G., D. Romer and D. Weil (1992), 'A contribution to the empirics of economic growth', Quarterly Journal of Economics, 107(2), 407-437.

Martin, Stephen (2000) "The Theory of Contestable Markets," Bulletin

of Economic Research.

Mensi Sami and Zouari Abderrazak (2010). Efficient structure versus market power: Theories and empirical evidence. International journal of Economics and Finance.

Moral-Benito, Enrique (2009). Determinants of Economic Growth: A Bayesian Panel Data Approach. World Bank Policy Research Working Paper No. 4830, Available at SSRN: https://ssrn.com/abstract=1344715

Ocolișanu, A.; Dobrotă, G.; Dobrotă, D. The Effects of Public Investment on Sustainable Economic Growth: Empirical Evidence from Emerging Countries in Central and Eastern Europe. Sustainability 2022, 14, 8721. https://doi.org/10.3390/su14148721

OECD (2010) Policy Roundtables: Competition, Concentration and Stability in the Banking Sector.

Petersen, M., Rajan, R. (1995). The effect of credit market competition on lending relationships. Q.J. Econ. 110, 407–443.

Prochniak, M., Wasiak, K. (2017). The impact of the financial system on economic growth in the context of the global crisis: empirical evidence for the EU and OECD countries. Empirical 44, 295–337 https://doi.org/10.1007/s10663-016-9323-9

Poku K., Opoku E. and Ennin A. P. (2022). The influence of government expenditure on economic growth in Ghana: An Ardl approach, Cogent Economics and Finance, 10:1, DOI: 10.1080/23322039.2022.2160036

Pruteanu-Podpiera, Anca, Weill, Laurent and Schobert, Franziska, (2007), Market Power and Efficiency in the Czech Banking Sector, Working Papers, Czech National Bank, https://EconPapers.repec.org/RePEc:cnb:wpaper:2007/6.

Rajan R.G. and L. Zingales (1998), 'Financial dependence and growth', American Economic Review, 88(3), 559-586.

Rakshit, B. and Bardhan, S. (2019). "Does bank competition promote economic growth? Empirical evidence from selected South Asian countries", South Asian Journal of Business Studies, Vol. 8 No. 2, pp. 201-223. https://doi.org/10.1108/SAJBS-07-2018-0079

Sala-i-Martin X. (1997). I Just Ran Four Million Regressions. National Bureau of Economic Research. Working paper 6252. DOI 10.3386/w6252.

Shepherd, W.G. (1986). "Tobins'q and the Structure-Performance Relationship: Comment". The American Economic Review, Vol.76, No.5, pp. 1205-1210.

Sherman, H. D. and Gold, F. (1985). Bank branch operating efficiency: Evaluation with data envelopment analysis. Journal of Banking and Finance, 9(2):297–315.

Shaffer, S., Spierdijk, L., 2015. The Panzar-Rosse revenue test and market power in banking. J. Bank. Finance 61, 340–347.

Shaffer S. and Spierdijk L. (2020). Measuring multi-product banks' market power using the Lerner index. Journal of Banking and Finance.

Solow R.M. (1956), 'A contribution to the theory of economic growth', Quarterly Journal of Economics, 70(1), 65-94.

Strahan, P. E., and Stiroh, K. J. (2003). Competitive dynamics of deregulation: Evidence from U.S. banking. Journal of Money, Credit and Banking, 35(5), 801-828.

Tan Y. (2016). Theory of Bank Efficiency and Bank Competition. Weill, L. (2013). Bank competition in the EU: How has it evolved? Journal of

International Financial Markets, Institutions and Money, 26:100–112.

Vasconcelos, Marcos and Reginato, Vitor and Cunha, Marina. (2021). An empirical analysis of the relationship between bank credit and economic growth. Textos de Economia. 24. 1-24. 10.5007/2175-8085.2021.e72868.

Weill, L. (2013). Bank competition in the EU: How has it evolved? Journal of International Financial Markets, Institutions and Money, 26:100–112.

Yang-Ming Chang, Victor J. Tremblay (1991) Oligopsony/oligopoly power and factor market performance. Published in Managerial and Decision Economics.

Yilmazkuday, H. (2022). Inflation and growth: the role of institutions. Journal of Economics and Finance, 46, 167–187.

Table 1.1: Summary statistics for the variables

Variable	**Mean**	**St.Dev**	**Min**	**Median**	**Max**
Growth	35839.2	9872.42	12425.68	37567.87	97656.78
Lerner	0.18	0.1	-0.84	0.18	0.9
Boone	1.33	1.28	-0.99	1.12	4.96
Investment	4.212e+11	2.488e+11	2413200000	5.302e+11	6.898e+11
GovExp	4.119e+11	2.447e+11	1644300000	5.380e+11	6.778e+11
Trade	90.15	42.31	55.29	86.25	377.84
Inflation	0.96	0.71	-2.1	0.97	3.72
Population	0.39	0.48	-1.4	0.36	3.93
BankCredit	85.87	16.82	32.45	82.05	243.26

Table 1.2: Annual Lerner and Boone Indices from 2015 - 2020

Year	**Lerner Index**	**Boone Indicator**
2015	0.1881	1.2690
2016	0.1730	1.2999
2017	0.1766	1.3360
2018	0.1833	1.2899
2019	0.1789	1.3926
2020	0.1808	1.3987

Table 1.3: Lerner and Boone Indices for Eurozone Countries from 2015-2020

Index	Country	Lerner Index	Boone Indicator
1	Austria	0.1804	1.9719
2	Belgium	0.1936	1.6120
3	Cyprus	0.2364	0.9854
4	Estonia	0.2619	1.4066
5	Finland	0.1919	0.5562
6	France	0.2562	1.4864
7	Germany	0.1453	1.1771
8	Greece	0.2390	3.4893
9	Ireland	0.2981	2.1119
10	Italy	0.2048	1.1821
11	Latvia	0.2908	0.9045
12	Lithuania	0.3574	1.1295
13	Luxembourg	0.2817	1.2255
14	Malta	0.2043	3.3638
15	Netherlands	0.2180	1.8289
16	Portugal	0.1939	1.4690
17	Slovakia	0.2401	1.4627
18	Slovenia	0.2267	0.9271
19	Spain	0.1771	0.9611

Table 1.4: Correlation Matrix and VIF Test

	Growth	Lerner	Boone	INV	GovExp	Trade	INF	POP	BankCredit	VIF
Growth	1									–
Lerner	−0.01	1								1.01
Boone	0.06	0.03	1							1.01
INV	0.07	−0.22	−0.12	1						6.03
GovExp	0.05	−0.2	−0.13	1	1					4.82
Trade	0.7	0.1	0.06	−0.36	−0.38	1				1.82
INF	0.27	−0.07	0.08	0.03	−0.03	0.19	1			2.46
POP	0.59	−0.03	0.07	−0.09	−0.1	0.59	0.07	1		1.51
BankCredit	−0.11	0.16	0	−0.25	−0.23	−0.02	−0.31	0.08	1	1.24

Table 1.5: Banking Competition and Economic Growth

	Dependent variable:	
	Growth	
	Model 1	Model 2
Lerner	−11.483	———
	(13.277)	
Boone	———	657.670***
		(156.114)
Investment	4,328.992***	4,361.379***
	(93.298)	(93.497)
Trade	5,711.392***	5,705.571***
	(97.060)	(96.947)
Inflation	68.006***	66.436***
	(11.677)	(11.668)
Population	91.269***	94.076***
	(15.457)	(15.443)
BankCredit	−298.033***	−299.327***
	(17.753)	(17.718)
Constant	35,984.550***	35,973.060***
	(161.066)	(160.928)
Observations	6,858	6,858
Number of Banks	1867	1867
R^2	0.676	0.677
Adjusted R^2	0.676	0.676
F Statistic	13,089.110***	13,139.420***

Note: Standard errors in parentheses, *p<0.1; **p<0.05; ***p<0.01

Table 1.6: Panel Smooth Transition Regression (PSTR) Model for Lerner Index

	Dependent variable:	
	Growth	
	Regime 1	Regime 2
	(Higher Competition)	(Lower Competition)
Lerner	0.0287^{***}	-0.0058^{***}
	(0.0001)	(0.0001)
Investment	0.2567^{***}	0.5163^{***}
	(0.0001)	(0.0008)
Trade	0.6482^{***}	0.6791^{***}
	(0.0002)	(0.0001)
Inflation	0.1324^{***}	0.0557^{***}
	(0.0001)	(0.0002)
Population	0.1375^{***}	0.3910^{***}
	(0.0000)	(0.0001)
BankCredit	-0.0418^{***}	0.0020^{***}
	(0.0005)	(0.0005)
Observations	6,858	6,858
Number of Banks	1867	1867
γ	909.5	909.5
c_1	0.4779	0.4779

Standard errors in parentheses, Threshold estimates=0.4779, *p<0.1; **p<0.05; ***p<0.01

Table 1.7: Panel Smooth Transition Regression Model for Boone Indicator

	Dependent variable:	
	Growth	
	Regime 1	Regime 2
	(Higher Competition)	(Lower Competition)
Boone	-0.0010	0.0471^{***}
	(0.0013)	(0.0002)
Investment	0.3773^{***}	0.3063^{***}
	(0.0021)	(0.0007)
Trade	0.7733^{***}	0.5961^{***}
	(0.0013)	(0.0033)
Inflation	0.0660^{***}	0.1530^{***}
	(0.0016)	(0.0002)
Population	0.1677^{***}	0.2314^{***}
	(0.0021)	(0.0007)
BankCredit	-0.0470^{***}	0.0668^{***}
	(0.0017)	(0.0000)
Observations	6,858	6,858
Number of Banks	1867	1867
γ	8.828	8.828
c_1	0.9938	0.9938

Standard errors in parentheses, Threshold estimates=0.9938, *p<0.1; **p<0.05; ***p<0.01

Table 1.8: Proxy and Measurement of Variables

Variable	**Proxy**	**Measurement**
Price	Total revenues	Interest revenue plus operating revenue
Quantity	Total assets	Total assets
Total cost	Total cost	Operating expenses plus interest expense
Marginal cost	Average cost	Ratio of total cost to quantity
Lerner index	Lerner	Difference between price and marginal cost, divided by price
Profit	ROA	Ratio of profit after tax to total assets
Boone indicator	Boone	Estimated coefficient of average cost

Chapter 2

Banking Regulation and Economic Growth: A Friend or Foe?

Abstract - Chapter 2

Although regulations may be unpopular among many firms, it plays a crucial role in promoting a level playing field for all participants. Regulations ensure that firms and individuals operate in a manner that is safe and fair, ultimately fostering market efficiency and stability.

This paper examines the impacts of banking regulations on economic growth using a panel regression analysis while controlling for bank-specific characteristics and macroeconomic factors for 2,248 banks within 19 eurozone countries over the period from 2015 - 2020.

The main findings of the study show that countries with robust regulatory policies tend to experience favourable economic growth. Countries that deny a higher fraction of applications for bank entry licensing tend to have

adverse effects on economic growth. Countries that restrict banks from engaging in activities such as securities, insurance, and real estate slow down the economy. Countries that hold reserves or liquidity requirements tend to experience favourable economic growth. Countries with higher banking freedom and minimal government interference are associated with positive economic growth.

KEYWORDS: Bank regulations; Capital adequacy; Liquidity requirement; Macroeconomic dynamics; Economic growth.

2.1 Introduction

This paper assesses the relationship between banking regulations and economic growth while controlling for bank specific and macroeconomic factors. Banking regulations are a set of rules and guidelines established by government and financial regulatory agencies to supervise and control the activities of banks and the financial institutions. Banking regulation aims at protecting customers, while ensuring the stability of the financial system of banks and other financial institutions. The regulation of banking is pivotal for maintaining the stability and the functioning of the financial system, and this has a significant impact on economic growth.

The functioning of the financial system exerts substantial influence over economic growth and the overall stability of the economy. It affects long-term economic growth through its effect on the efficiency of intermediation between the savers and final borrowers of funds; through the degree to which it allows for monitoring of the users of external funds, thereby impacting capital

productivity, and its role in determining the volume of savings, which in turn influences the future income-generating capacity of the economy (Serres et al, 2006). The financial system operates with a high level of borrowing and lending, which can be risky within the economy, if any part of it experiences a failure or disruption, it can have a cascading effect on the entire economy, potentially leading to instability. This emphasizes the crucial role the financial system plays in ensuring the smooth functioning and security of the overall economy.

Although there are several research on bank regulations and its impacts on bank-specific traits and macroeconomic dynamics. While empirical studies have extensively explored the impacts of bank regulations on bank specific factors such as financial stability, financial fragility, bank efficiency, performance, profitability, credit availability, net interest margin, cost and profit efficiency, and deposits and investments, very few research have been carried out on the relationship between bank regulations and various macroeconomic outcomes such as inflation rate, interest rate, macroeconomic shocks.

Naceur and Omran (2010) examine the nexus between bank regulations and bank performance across a broad selection of Middle East and North Africa (MENA) countries and the empirical results suggest that regulatory and institutional variables have significant impacts on bank performance. Pasiouras, Tanna, and Zopounidis (2009) investigate the impact of regulations related to capital adequacy requirements, supervisory power, and market discipline mechanisms, as well as bank activity restrictions, on cost and profit efficiency of banks and their study finds evidence that bank regulations have

significant influence on cost and profit efficiency of banks. Bilin and Nergiz (2014) analyse the relationship between bank regulation and supervision and banking-sector performance and their results indicate that bank regulation and supervision has significant positive impacts on bank deposits and investment rate as well as significant negative impacts on non-performing loans. Riccetti et al. (2017) explore the effects of banking regulation on financial stability and macroeconomic dynamics in an agent-based computational model and the authors show that overly tight regulation reduces credit availability, while overly loose regulations increase financial fragility which in turn, damage the real economy. Ayadi and Mouley (2014), assess the connection between bank regulations, bank performance and macroeconomic conditions and their findings suggest that a well-functioning regulatory system improves bank performance measures when they are complemented by other macroeconomic conditions.

However, their studies differ from this particular study in the following aspects: Firstly, none of the studies actually analysed the impacts of bank regulations on economic growth within the euro area using banking regulatory and supervisory data. Moreover, there is limited empirical literature on the impacts of bank regulations on macroeconomic dynamics within the euro zone.

This particular study fills the gap by examining the impacts of banking regulations on economic growth using panel data regression techniques, while controlling for bank specific traits and cross-country differences in macroeconomic factors for 9912 banks across 19 euro countries over the period from 2015-2020.

The main findings of the study show that higher liquidity regulations enhance bank stability and improve risk management, fostering economic growth. Countries with robust regulatory policies tend to experience favourable economic growth. Countries that deny a higher fraction of applications for bank entry licensing tend to have adverse effects on economic growth. Countries that restrict banks from engaging in activities such as securities, insurance, and real estate, as well as from owning non-financial firms, can stifle customers' access to a comprehensive suite of financial services, potentially slowing down the economy. Countries that hold reserves or liquidity requirements tend to experience favourable economic growth. Many countries including Finland, Luxembourg, and Netherlands with higher banking freedom and minimal government interference are associated with positive economic growth.

The rest of the paper is organised as follows: Section 2 reviews the existing literature on evolving regulatory frameworks, the role of bank regulation, and bank regulatory and supervisory measures. Section 3 discusses the methodology. Section 4 provides data description. Section 5 presents the empirical estimation and the analysis of the results, whiles Section 6 draws some conclusions on the findings.

2.2 Analysis of the Basel accords in global banking regulation

The Basel Committee on Banking Supervision (BCBS) which consists of the various central banks and regulatory authorities from different countries across

the globe has the oversight responsibility on the regulation and supervision of the banking sector. BCBS sets and effectively enforces Basel accords which is a set of international banking rules, standards and regulations. Several bank crises and bank failures motivate the Basel Committee on Banking Supervision to provide a comprehensive guideline in managing bank capital (Siddika and Haron, 2020).

Basel I framework

In response to the series of international banking and financial crises in 1970s and 1980s, including the Latin American debt crisis and the collapse of several major banks, Basel I was introduced in 1988 as the first set of international banking regulations aimed at ensuring stability and promoting financial soundness of the banking system.

Basel I was enforced by law in 1992 among the G-10 countries, which include Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom, and United States. The Basel I accord required banks to hold at least 8% of risk-weighted assets (RWA) as capital of which 50% must be Tier 1 or core capital, which includes shareholders' equity and disclosed reserves (Basel Committee on Banking Supervision, 1988).

The rationale behind Basel I measurement was to assess and assign weights to both on-balance sheet and off-balance sheet assets based on the level of risk they posed to banks. The primary objective of the Basel I framework was to ensure that banks had sufficient capital buffer to cover potential losses and enhance financial stability.

Basel II framework

Subsequently, Basel I encountered challenges in addressing specific risks, leading to the development of Basel II in 2004, which was a refinement and modification of the Basel I framework. The Basel II framework was developed in response to the need for enhanced banking regulations and advanced risk management practices in the financial sector, as well as to address the Asian financial crisis of 1997-1998 and the Enron scandal.

The second Basel accord was introduced to focus on three main pillars, namely, Minimum Capital Requirement (MCR), Supervisory Review Process (SRP) and Market Discipline (MD). Under the Basel II accord, banks were required to maintain regulatory capital of at least 8% of risk-weighted assets as capital for which at least 50% of the total capital base of the bank should be Tier 1 or core capital, which primarily includes common equity (ownership interest by shareholders) and approved reserves from retained earnings, while the remaining portion of the capital (up to 100% of the core capital or Tier 1 capital) can be classified as Tier 2 capital, which also includes other forms of subordinated debt and financial instruments. (Basel Committee on Banking Supervision, 2004).

Tier 1 capital is for banks' financial stability, while Tier 2 is deemed less secure than Tier 1 capital. The primary objective of the Basel II framework is to ensure that banks maintain a solid capital base to improve financial stability and safeguard the interests of depositors and other stakeholders.

Basel III framework

Following the global financial crisis of 2007-2008 which had financial and economic repercussions worldwide, Basel III was introduced in 2010, an increased global banking regulatory supervision which ushered in more

stringent capital requirements, tighter liquidity requirements, and improved risk management standards for banks and other financial institutions, aimed at ensuring their resilience during financial crises (See Basel Committee on Banking Supervision, 2021 report on Basel III reform).

Banking laws and regulations should focus on ensuring sufficient capitalization of banks, as exemplified by regulatory measures such as capital conservation buffer under the Basel III reform. The minimum amount of common equity to be maintained under the third Basel accord is increased from 2% to 4.5% and capital conservation buffer of 2.5% of the risk-weighted assets of the bank (Basel Committee on Banking Supervision, 2011).

By introducing more robust regulatory standards, Basel III aimed to establish a more resilient and stable banking system, better equipped to withstand financial shocks and economic downturns.

Basel IV framework

In an effort to strengthen the regulatory framework and promote a more resilient and stable banking system in response to the evolving global banking challenges, the Basel Committee on Banking Supervision introduced Basel IV. Essentially, Basel IV is a revision and a final amendment of the Basel III accord. It seems to improve upon the weaknesses of the Basel accords, especially the Basel III. Basel IV was implemented on 1st January 2023 to enhance capital and liquidity standards while addressing systemic risks posed by banks and financial institutions.

With the implementation of Basel IV which adds an extra layer of liquidity requirement, banks keep adequate reserves to strengthen their resilience to economic shocks and maintain financial stability. While the

fourth Basel accord significantly increases the capital buffer of banks, it potentially threatens their profitability as banks would have to hold more than twice as much credit-risk capital under the Basel IV than they would hold under Basel III.

Several reforms in various categories were incorporated in Basel IV, including reforms in the standardised approach for credit risk, the Internal Ratings-Based (IRB) approach, the quantification of Credit Valuation Adjustment (CVA) risk and operational risk approaches, an enhancements to leverage ratio framework and finalization of output floor which sets a minimum level for the capital requirements calculated. In light of these reforms, Basel IV introduces adjustments to improve the accuracy, consistency, and resilience of the regulatory framework in respect of the evolving risks.

To summarize, the Basel frameworks are significant accords that seek to address the evolving financial environments and enhance risk management practices.

2.2.1 The role of banking regulation

Banking laws and regulations encompass the private commercial law developed through banking customs, established standards of good practice, and the common law, which collectively played a significant role over time in shaping and enhancing the rights and obligations of banks and their customers (Chiu and Wilson, 2019). According to Sriono et al. (2021), banking laws and regulations provide legal protection for customers, including deposit insurance, standard clauses, and banking mediation forums for dispute resolution.

Regulations within the banking industry is essential to foster bank stability,

efficiency, and performance. Regulatory and supervisory strategies that promote private sector forces work. Countries with regulatory policies that promote private monitoring of banks have better bank performance and more stability, and countries with more generous deposit insurance schemes tend to have poorer bank performance and greater bank fragility (Barth, Caprio, and Levine, 2001; Cull, Senbet, and Sorge, 2000; Demirgüç-Kunt and Detragiache, 2000).

Over the last three decades, the global banking and financial crises had far reaching financial and economic consequences worldwide, including financial instability, bank failures and economic recession which propelled the world bank and other policy makers to construct an appropriate regulatory and supervisory framework (Levine, 2005a; Barth et al. 2003a, 2004a).

Barth, Levine, and Caprio (2001) highlight the absence of a systematically compiled database on how countries regulate and supervise their banking systems, hence no comprehensive analysis of which regulatory and supervisory practices of banks are most appropriate. Dermiguc-Kunt et al. (2008) also confirm that numerous countries are currently improving their bank regulatory and supervisory frameworks and this however, proves to be a complex and challenging process because there is no clear answer regarding what constitutes effective regulation and supervision. Economic theory produces contradictory predictions regarding the impact of regulatory and supervisory practices on banks, but it also offers subtle insights into the specific circumstances under which regulations and supervisory practices can accomplish the intended results (Barth et al., 2004a). According to Barth et al. (2004a), there is limited cross-country empirical evidence available to determine which among

the various regulatory and supervisory practices implemented worldwide can effectively foster bank stability and development. It is only in recent times that scholars have undertaken research on international comparisons of bank regulation and supervision (Barth et al., 2003a).

2.2.2 Banking regulatory and supervisory measures

Aside the evolution of Basel III reform, the global financial crisis had profound and widespread impacts on the European Union banking sector, which facilitated for stronger banking regulatory and supervisory measures including Banking Union which seeks to strengthen European banking supervision and regulatory governance, aimed at building a single market in financial services and implementing capital mobility (See Chiu and Wilson, 2019) and EU's comprehensive bank regulatory framework on Capital Requirements Regulation (CRR), Capital Requirements Directive (CRD), Bank Recovery and Resolution Directive (BRRD), Deposit Guarantee Schemes (DGS), and Single Rulebook. These are component of a larger initiative aimed at establishing a single market for financial services within the European Union, while ensuring the safety and stability of banks and safeguarding the interests of customers and investors.

Basel Committee on Banking Supervision (BCBS) and the central banks have the oversight responsibility of setting and enforcing bank regulations as well as supervising the activities of the banking and financial sector. A well-crafted and strictly enforced bank regulations promote security, soundness and stability of the financial sector while ensuring the protection of the interests of customers and shareholders. There are a number of ways in which

banks and financial institutions are regulated and the following discusses some of the key regulatory and supervisory measures within the banking sector:

Capital adequacy regulation

Capital adequacy regulation is a statutory capital requirement in which banks are mandated to hold a percentage of their risk-weighted assets. According to Siddika and Haron (2020), the capital adequacy regulation is an international standard to safeguard the banks through setting a risk-sensitive minimum capital requirement for operating banks to maintain.

This minimum capital requirement of banks serves as a financial buffer to absorb financial losses, enhancing banks' ability to withstand financial shocks and economic downturns, thereby increasing stability. Capital adequacy is a regulatory tool designed to strengthen banks against financial uncertainties, ensuring they remain stable and capable of fulfilling their roles even during challenging financial and economic conditions.

Regarding the capital adequacy regulation, Basel III monitoring report (2022) suggests that there was a decline in the capital adequacy ratios of banks at the end of June 2022, indicating a decrease in their financial strength. However, at the end of December 2022, capital adequacy ratios increased which is an improvement over the first part of the year, an indicative of how well banks can meet their obligations during financial crises and economic downturns.

While capital adequacy is widely recognized as a crucial tool for risk management and financial stability, it may have negative impacts on risk management. Theoretical and empirical studies on the relationship between capital adequacy regulations and risk management of banks find contrasting

results. While several studies report positive relationship, others also claim that, capital adequacy regulation has negative impacts on risk management.

Adequate capital serves as a financial cushion that increases the capital base. Having a strong capital base enables banks to absorb potential losses from various risk exposures, such as credit risk, market risk, and operational risk, hence improving risk management. Conversely, a high capital adequacy can reduce profitability, raise the cost of capital, reduce credit availability which in turn decreases lending and can consequently lead to risk-taking behaviour that might not align with the banks' long-term risk management objectives.

According to Siddika and Haron (2020), tight capital regulation raises the cost of capital, decreases expected profit and the rate of return, and induces the bank to invest in a risky sector that is more risky in the long run. Blum and Hellwig (1995) indicate that regulations on capital adequacy in the banking sector can potentially reinforce macroeconomic fluctuations. When adverse shocks to aggregate demand decrease the ability of firms to service their debts to banks, this reduction in debt service lowers bank equity, and due to capital adequacy requirements, this in turn reduces bank lending and industry investment, hence support the view that capital adequacy leads to a reduction in credit availability, lending and investments. Karim et al. (2014) analyze the relationship between capital requirements, deposit and lending behaviours using 52 Islamic banks and 186 conventional banks in 14 OIC countries from 1999 to 2009 and the empirical evidence suggests that capital requirement has significant positive impacts on deposit and lending for both Islamic and conventional banks, and their finding therefore does

not supports the idea that capital adequacy leads to a reduction in credit availability, lending and investments.

Chorafas (2009) identifies two catastrophic risks, namely insolvency, and illiquidity that banks often suffer from and therefore capital adequacy regulations should ensure banks' survival during crisis by addressing insolvency and illiquidity risks, while maintaining competitiveness. Blum (1999) contends that under binding capital requirements, capital adequacy regulations may increase the riskiness of banks, as banks may choose risky strategies to increase their equity in the future, especially if raising equity is costly.

To recapitulate, capital adequacy regulation is essential to mitigate potential financial losses during financial crises. However, when it's not properly set, it may be a recipe for banks' financial disaster which can contribute to risky investments, declined bank equity, and reduced bank lending and investment, thereby stimulating risks.

Liquidity regulation

Banks and other financial institutions are required to have sufficient liquid assets to cover their short-term financial obligations during financial stress. Basel Committee on Banking Supervision, central banks and other bank regulators are responsible to enforce the liquidity regulation aimed at preventing liquidity crises and maintaining the stability of the financial system.

The Great Financial Crisis of 2007 and 2008 was significantly caused by the failure of banks and other financial institutions to effectively monitor and manage liquidity risk, which placed numerous banks and financial institutions in distress. Liquidity requirement acts as banks' life support in the face of

financial crises and economic downturns. Based on recent academic research, liquidity regulations may limit pressure on central banks for liquidity injections during crises periods (Rochet, 2008). The brain behind liquidity requirements is to ensure that banks and other financial institutions have enough readily available funds to cover their liquidity needs, especially in times of financial stress.

According to Rochet (2008), liquidity regulation of banks was introduced during the recent subprime crisis as a complement to solvency regulations but König (2015) argues that Bank liquidity regulation may be a "double-edged sword" that can mitigate illiquidity risks and at the same time raise insolvency risks, depending on the bank's specific circumstances. König (2015) points out that liquidity regulation comes with two opposing effects notably, a liquidity effect which arises when a bank increases its liquidity buffer to mitigate its risk of illiquidity, and a solvency effect which also occurs when the increased liquidity buffer reduces the bank's returns and therefore raises its insolvency risk.

The key aspects of liquidity requirements include Liquidity Coverage Ratio, Current Ratio, Cash Ratio, Reserve Requirements, Working Capital Ratio and Quick Ratio (Acid-Test Ratio). Among these liquidity regulatory measures, the Liquidity Coverage Ratio (LCR) is a key regulatory measure that is part of the Basel III framework in which the Basel Committee on Banking Supervision enforces it to ensure that banks hold sufficient amount of high-quality liquid assets to cover their short-term liquidity needs during stressed conditions.

According to Basel III monitoring report (2022), liquidity coverage ratio

experienced a decline in 2022. This however means that the banks might have a slightly lower capacity to meet their short-term funding needs. An improved levels of liquidity positions is generally a positive sign for financial stability and growth within the banking industry.

While all other ratios play a crucial role in evaluating a bank's liquidity position, the liquidity coverage ratio stands out as a distinct regulatory requirement designed to strengthen the resilience of banks' liquidity risk profile. Central banks and regulatory authorities employ the liquidity coverage ratio as a liquidity regulation to evaluate and monitor the liquidity risk management practices of banks.

To sum up, capital adequacy and liquidity regulations are bank regulatory measures that address distinct aspects of banks' operations aimed at ensuring the stability and soundness of financial institutions and improve risk management practices.

2.2.3 Banking regulations and macroeconomic performance

Both theoretical and empirical studies have extensively explored the impacts of bank regulations on various economic outcomes. Different empirical studies have shown mixed effects of banking regulations on macroeconomic factors.

Empirical studies indicate that banking regulations have cascade effects on macroeconomic performance. Regulations in the banking industry influence macroeconomic factors through their impacts on bank stability, efficiency and performance. Macroeconomic indicators such as GDP growth, inflation rates, interest rates and exchange rates are key determinants of banks' stability and

performance.

The following empirical studies analyze the impacts of bank regulations on a range of macroeconomic outcomes. Riccetti et al. (2017) explore the effects of banking regulation on financial stability and macroeconomic dynamics in an agent-based computational model and the authors show that overly tight regulation is dangerous because it reduces credit availability, while overly loose constraints, associated with a high payout ratio, increase financial fragility which in turn, damage the real economy. Bank regulations can either be too stringent or too lax and each extreme comes with its own set of risks and consequences. The authors argue that overly tight regulations within the banking industry can limit the ability of banks and other financial institutions to extend credit to businesses and individuals which may stifle economic growth. Conversely, when there are overly loose banking regulations, there may be low or no liquidity requirement which can undermine bank stability, leading to fragility which in turn, can have adverse spillover effects on economic growth, supporting the view that bank regulations may slow down economic growth through their effects on reduced credit availability and bank fragility.

In examining the connection between bank regulations, macroeconomic conditions and stability, Ayadi and Mouley (2014), analyze the impact of monetary policy and bank regulations on efficiency and their findings suggest that an adequate and well-functioning regulatory system improve various bank performance or stability measures as long as they are complemented by other institutional and macroeconomic conditions. A well-designed regulatory policy is essential, but its effects on bank performance and stability is contingent on a

range of other macroeconomic conditions and institutional factors (Kaufinan, Kraay, and Zoido-Loboton, 2001), an indication that the effectiveness of regulatory policies is interconnected with broader economic and institutional factors.

Baltensperger and Dermine (1987) conduct a study on deregulation of financial services in many European countries with a focus on liberalization of the banking system and their results portray that banking deregulation in Europe may increase vulnerability to macroeconomic shocks. The authors opine that deregulation of financial services can make the entire economy more susceptible to macroeconomic shocks. Bank deregulation measures such as the abolition of reserve requirements, removal of minimum liquidity requirements and reduction of capital adequacy requirements can increase banks' susceptibility to financial shocks, leaving them without sufficient reserves and capital buffers to cover liquidity needs, during liquidity crises which consequently makes banks less resilient in times of economic downturns and could lead to financial instability and pose systemic risks to the economy at large. This study result confirms the views that deregulation in the banking sector can trigger bank fragility which has negative impact on economic growth.

Using 23 industrial countries from 1975 to 1999, Copelovitch and Singer (2008) conducts an econometric analysis of inflation and their empirical results reveal that inflation is significantly higher in those countries with central banks that are vested with bank regulatory responsibility. The authors argue that the central banks with dual responsibilities of implementing monetary policy and regulating banks concurrently have a significant influence on inflation

outcomes such that they are not likely to enact tighter monetary policies aimed at maintaining price stability since they may be equally more sensitive to the profitability and stability of the banking sector, which may possibly lead to a rise in inflation. Their findings suggest a potential conflict of interest arises between central banks' maintenance of price stability through tighter monetary policies and their sensitivity to the profitability and stability of the banking sector, which could lead to a rise in inflation.

To recap, the effectiveness of regulatory framework doesn't operate in isolation, it is influenced by a complex interplay of various external factors, including macroeconomic factors.

2.2.4 Banking regulations and banking outcomes

The relationship between bank regulations and bank specific factors are mostly touted in theoretical and empirical studies as having significant positive relationships. Strong regulatory policies in the banking sector ensure that banks and financial institutions maintain adequate capital, operate prudently, and manage risks effectively, and these promote significant banking outcomes.

Bilin and Nergiz (2014) offer an empirical exploration of the relationship between bank regulation and supervision and banking-sector performance using data on legal quality of bank regulation and supervision for 53 countries and their results indicate that bank regulation and supervision has significant positive effects on bank deposits and investment rate as well as significant negative effects on non-performing loans. Essentially the findings of the study reveal that robust bank regulatory frameworks have positive effects on various aspects of the banking system. A well-crafted and effectively enforced

bank regulation boosts confidence among depositors, fosters investments, and reduces the rate of non-performing loans, potentially, contributing to the stability and efficiency of the banking system.

Using a dataset consisting of 2853 observations from 615 commercial banks operating in 74 countries during the period 2000–2004. Pasiouras, Tanna, and Zopounidis (2009) investigate the impact of regulations related to capital adequacy requirements, supervisory power, and market discipline mechanisms, as well as bank activity restrictions, on cost and profit efficiency of banks and their study finds three main evidence. Firstly, bank regulations that promote market discipline and empower the regulatory authorities tend to increase both cost and profit efficiency. Secondly, bank regulations that impose stricter capital requirements are associated with improved cost efficiency but reduce profit efficiency. Finally, bank regulations that restrict the activities of banks tend to reduce cost efficiency but improve profit efficiency. Overall, these results indicate that the link between bank regulations and cost and profit efficiency is multifaceted such that different regulations have different impacts, and the trade-offs between cost and profit efficiency are contingent on the specific regulatory framework.

In testing the nexus between bank regulation and bank performance, Naceur and Omran (2010) examine the influence of bank regulation, concentration, and financial and institutional development on commercial bank margins and profitability across a broad selection of Middle East and North Africa (MENA) countries and the empirical results suggest that bank-specific characteristics, particularly bank capitalization and credit risk, have a significant positive impact on banks' net interest margin, cost efficiency,

and profitability. The authors also find that regulatory and institutional variables have significant impacts on bank performance. The findings indicate that banks and other financial institutions with strong capitalization and lower credit risk tend to have better bank outcomes such as net interest margin, cost efficiency, and profitability. The study seems to suggest that a relationship exists between bank regulations and bank outcomes such that variations in the bank regulations can have a significant influence on a range of bank outcomes.

To summarize, banking regulations have a significant impact on bank outcomes, including stability, efficiency, and performance, which are contributory factors to increased economic growth.

2.3 Methodology

This study employs a panel data technique to examine the impacts of bank regulations on economic growth using regression analysis while controlling for bank-specific and macroeconomic factors.

In the first step, we calculate the bank-specific variables which are included in the analysis, while the macroeconomic and the regulatory variables are drawn from World Bank database and Barth et al.(2001b) survey on bank regulation and supervision respectively to estimate the impacts of bank regulations on economic growth in the second step.

We include Profitability, Liquidity, Bank size and Bank credit in the analysis as bank-specific variables because they are considered influential in shaping the banking sector's stability and performance which in turn have

significant impacts on economic growth.

Profitability is calculated as the ratio of profit-after-tax to total assets and is given as follows:

$$\text{Profitability}_{it} = \frac{\text{Profit-After-Tax}}{\text{Total Assets}} \tag{1}$$

Liquidity is measured as the ratio of current assets to current liabilities which is shown below:

$$\text{Liquidity}_{it} = \frac{\text{Current Assets}}{\text{Current Liabilities}} \tag{2}$$

Bank size is computed as the logarithm of the total assets which is specified as follows:

$$\text{Bank size}_{it} = \ln(\text{Total Assets}) \tag{3}$$

Bank credit is a measure of the domestic credit provided to the private sector by banks. The data is drawn from the World Development Indicators which is managed by the World Bank.

To quantify the impacts of bank regulations, bank-specific factors and macroeconomic factors (i.e. except GDP growth) on economic growth, both fixed effects and random effects regression models are employed to account for country-specific effects and unobserved heterogeneity, providing a

comprehensive analysis of the impacts of bank regulations, bank-specific factors, and macroeconomic factors on economic growth across diverse countries.

The correlation matrix discloses a high degree of correlation among the regulatory variables, which are the variables of interest in this study. The high multicollinearity among the regulatory variables could be problematic especially when trying to assess the individual impacts of the regulatory variables on economic growth in a regression model which potentially can lead to unstable and non-significant coefficient estimates.

To effectively assess the individual impact of each of the regulatory variable on economic growth variable, we use separate regression models in the analysis where in each regression model, we include the regulatory variables one-at-a-time while mitigating the multicollinearity issues.

First, we estimate the impact of banking regulations on economic growth while controlling for bank-specific factors. The regression model is given in the following form:

$$\text{GROWTH}_{ct} = \alpha \ + \beta_1 \text{BANK}_{ct} + \beta_2 \text{REG}_{ct} + \varepsilon_{ct} \tag{4}$$

Next, we estimate the impact of banking regulations on economic growth while controlling for macroeconomic factors. The regression model is shown below:

$$\text{GROWTH}_{ct} = \alpha \ + \beta_1 \text{BANK}_{ct} + \beta_2 \text{MACRO}_{ct} + \varepsilon_{ct} \qquad (5)$$

Finally, we evaluate the impact of banking regulations on economic growth while controlling for bank-specific and macroeconomic factors. The regression model is specified as follows:

$$\text{GROWTH}_{ct} = \alpha \ + \beta_1 \text{BANK}_{ct} + \beta_2 \text{MACRO}_{ct} + \beta_3 \text{REG}_{ct} + \varepsilon_{ct} \qquad (6)$$

Where c indexes country c, and t indexes time t, GROWTHct, is the average annual growth rate of GDP per capita for country c at time t, BANKct, is a vector of bank-specific variables for country c at time t, MACROct is a vector of macroeconomic variables for country c at time t, REGct is a vector of regulatory restrictions on banks, and εct is the error term.

In the above regression models, we estimate the impacts of banking regulations on economic growth while controlling for bank specific and macroeconomic factors. The sample includes bank specific characteristics, bank regulatory factors and macroeconomic dynamics. The dependent variable is Growth which is the average annual growth rate of GDP per capita of country while the main independent variables are the regulatory variables which consists of bank entry denied, reserve requirements of banks, restrictions on bank activities, banking freedom and government regulatory index. Bank specific variables (i.e. profitability, liquidity, bank size and bank credit) as well as macroeconomic variables (i.e. investment, government expenditure,

trade, inflation and population) are the control variables in the model.

Over the past two decades, numerous empirical studies have been carried out to identify the factors that impact economic growth, employing a range of models (Moral-Benito, 2009). Following closely the empirical studies of Solow (1956), Lucas (1988), Levine and Renelt (1992), Mankiw et al. (1992), Easterly (1994), Barro and Sala-i-Martin (1995), Sala-i-Martin (1997), Levine and Zervos (1998), Beck et al. (2000), Beck and Levine (2004), Coccorese (2009), Moral-Benito (2009), Chirwa and Odhiambo (2016), and Próchniak and Wasiak (2017) they consistently employed the aforementioned macroeconomic variables in their analysis related to the determinants of economic growth. Since economic growth is also influenced by a number of factors, we include bank specific and macroeconomic factors as control variables in the regression model.

2.4 Data

We have 2248 banks within 19 euro area countries over a 6-year period from 2015 to 2020 after cleaning the dataset by removing banks with missing data, which results in an unbalanced panel data with 9894 bank-year observations.

The study relied on four sources of data. The bank-level data is from the BankFocus database. The data for the macroeconomic variables for each country are drawn from the World Development Indicators which is managed by the World Bank. The data on commercial banks' regulations is obtained from Barth, Caprio and Levine (2001b) database. The data on banking freedom variable is drawn from the Heritage Foundation. Overall,

the variables included in the analysis consist of:

For bank specific variables

- Profitability – It is calculated as profit-after-tax divided by total assets over the period from 2015-2020.
- Liquidity - It is calculated as current assets divided by current liabilities over the period from 2015-2020.
- Bank size – It is calculated as the logarithm of the total assets over the period from 2015-2020.
- Bank credit - A measure of the domestic credit provided to the private sector by banks.

For macroeconomic variables

- Growth – A measure of the gross domestic products by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.
- Investment - A measure of the investment of the economy to GDP ratio which includes an acquisition of fixed assets plus net changes in the level of inventories.
- Government expenditure - A measure of the general government final consumption expenditure as a fraction of GDP.
- Trade - Sums up the exports and imports of goods and services measured as a fraction of GDP.

- The inflation rate - A measure of the average annual variation of the consumer price index.

- Population - A measures of the total annual population.

  For Regulatory variables

- Entry denied - A measure of the number of entry applications denied as a fraction of the number of applications received from domestic and foreign entities (ratio of Survey of Bank Regulation and Supervision questions 1.9.1 and 1.10.1 to 1.9 and 1.10).

- Activity restrictions - A measure of a bank's ability to engage in the businesses of securities underwriting, insurance and real estate, and of the regulatory restrictiveness of banks to own shares in non-financial firms (sum of Survey of Bank Regulation and Supervision questions 4.1 through 4.4).

- Reserve requirements – It takes the value of one if banks are required to hold liquidity reserves or zero if banks are not required to hold liquidity reserves (Based on question 7.3 of Survey of Bank Regulation and Supervision).

- Banking freedom - An indicator of banking freedom (ranging from 0 to 1), averaged over 2015-2020 period. Greater values signify more freedom. It's the banking freedom index of the Heritage Foundation.

- Government Regulatory quality index - A measure of the perceptions about the ability of the government to formulate and implement sound

policies and regulations that promote private sector development, its score ranges from -2.5 to 2.5, with higher values corresponding to a better regulatory system.

Construction of quantitative indices for regulatory variables

The study mainly relies on Barth, Caprio, and Levine's (200lb) database for the regulatory variables. The authors designed and then implemented a survey funded by the World Bank to collect detailed and comprehensive information on the regulation and supervision of commercial banks in many countries.

The detailed survey on banking regulation and supervision was conducted in 2000-2003 in a large number of countries. The survey consist of twelve separate parts, with about 175 questions, covering different aspects of a country's banking system (See Barth et al., 200lb for detailed description of the survey, the questionnaire and the construction of the quantitative indices). Regarding this regulation and supervision database, we only focus on some selected regulations concerning bank entry, reserve requirements of banks, and restrictions on bank activities, as well as the state and foreign ownership of banks.

For better understanding of the meaning and interpretation of the regulatory variables indicated, the Barth et al.(2001b) explain more fully the construction, quantification and importance of specific variables. The quantitative indices are essential to allow for systematic and numerical measurements and comparisons of specific characteristics of variables.

The following highlights the construction and the quantification of the regulatory variables according to Barth et al.(2001b) in the order in which

the variables are listed in the analysis.

Entry denied

The entry denied records the fraction of entry applications for banking licenses denied. The figure for entry denied of each country is computed as the ratio of the sum of the total number denied to the sum of the total number of domestic and foreign applications for banking licenses of each country.

Activity restrictions

Activity restrictions measure the degree to which banks are restricted on their activities in securities, insurance, real estate, and owning shares in non-financial firms. Activity restrictions may also have an important impact on bank efficiency by reducing competition and limiting economies of scope (Barth, Caprio and Levine, 2001a; 2001b; 2003). Barth et al. (2001b) specifically measure the degree to which the national regulatory authorities in countries allow banks to engage in the following four activities:

(a) Securities: the ability of banks to engage in the business of securities underwriting, brokering, dealing, and all aspects of the mutual fund industry.

(b) Insurance: the ability of banks to engage in insurance underwriting and selling.

(c) Real Estate: the ability of banks to engage in real estate investment, development, and management.

(d) Banks Ownership of Non-financial Firms: the ability of banks to own and control non-financial firms.

The indicator ranges on a scale from 0 to 4, where higher values indicate greater restrictions. The quantitative indices assigned to the bank activity restrictions are as follows:

(1) Unrestricted – A full range of activities in the given category can be conducted directly in the bank.

(2) Permitted – A full range of activities can be conducted, but all or some must be conducted in subsidiaries.

(3) Restricted – Less than a full range of activities can be conducted in the bank or subsidiaries.

(4) Prohibited – The activity cannot be conducted in either the bank or subsidiaries.

Reserve requirements

Reserve requirement measures the minimum liquidity or reserve requirements that banks are mandated to maintain. It ranges from 0 to 1 and it takes on the value 0 if there are no reserve or liquidity requirements and 1 if there are reserve or liquidity requirements.

Banking freedom

The banking freedom is an indicator drawn from the financial freedom index of the Heritage Foundation and is designed to provide an overall measure of independence from government control and interference in the banking industry and the extent to which banks are free to operate their businesses.

Banks should exercise financial freedom devoid of government intervention in its internal management. During economic crisis, most governments exert pressure on their independent central banks to aid finance public debts. This government intervention of the internal management of the central banks may affects the degree of independence granted to central banks. Independent central banks are well resourced to resist political pressure to finance excessive government fiscal deficits, budget deficits and debt management.

Mazbouri and Schaufelbuehl (2015) analyze how banking regulation was introduced in Switzerland and they find that, during the period from 1910 to 1934, Swiss banking regulation appears to have been influenced by banking circles, featured limited state intervention, focused on codifying industry practices, which aimed to reassure the public. By limiting government intervention in the banking sector can instil confidence in the banking system and promote banking freedom, efficiency, and competition, fostering a more dynamic and responsive financial sector.

The banking freedom indicator ranges from 0 to 1, with larger values signifying more banking freedom. The banking freedom indices of the Heritage Foundation are expressed in percentages but for simplicity, we convert the percentages to decimals, hence it ranges from 0 to 1.

The choice for the inclusion of these regulatory and supervisory variables in our analysis is motivated by their use in a few recent but very influential studies by Barth et al. (2002, 2003a, 2004a), Demirguc-Kunt et al. (2004) and Levine (2004).

Data Sources

1. Bank-specific variables from BankFocus Database

2. Banking Freedom Index from Heritage Foundation

3. Macroeconomic variables from World Development Indicators, World Bank

4. Regulatory variables from Barth, Caprio, and Levine (2001b). Data available at: https://datacatalog.worldbank.org/search/dataset/0038632/Bank-Regulation-and-Supe

2.5 Empirical estimations and analysis

This section provides the empirical estimations and the analysis of the results. Table 2.1 presents the summary statistics of the variables. Table 2.2 shows the profitability and liquidity ratios. Table 2.3 displays the data on the regulatory restrictions employed in the analysis. Table 2.4 provides the correlation matrix of the variables while Tables 2.5, 2.6 and 2.7 present the panel regression results.

2.5.1 Summary Statistics Results

From Table 2.1, an average profitability (ROA) of 0.003 suggests that, on average, the banking industry is generating a profit of 0.3% which is less than 1% of its total assets, an indication that the industry is not very efficient in using its assets to generate profit.

An average liquidity (current ratio) of 1.860 indicates that, on average the banks within the industry have more current assets than current liabilities, which is generally considered as financially healthy, as it suggests that the banks have excess liquidity to cover their short-term liabilities over the period from 2015-2020.

An average inflation of 0.950 which is approximately 1% is generally considered acceptable.

An average value of 0.06 for EntryDenied suggests that 6% of the applications for banking licensing were denied and this however means that 94% of the application for bank entry licensing were approved.

Considering the minimum value of 1.25 and maximum value of 2.5 of

ActivityRestrictions variable, we can infer from the mean value of 1.69 that large number of banking activities are restricted.

An average reserve requirements of 0.73 implies that on average 73% of the banks have minimum liquidity requirements, an indication that few banks within the banking industry do not hold minimum liquidity requirements to cover their liquidity needs during financial stress.

An average banking freedom of 0.67 suggests a significant government interference on banking freedom, an indication that about 67% of the central banks are not fully independent.

2.5.2 Analysis of Profitability and Liquidity ratios

From Table 2.2, Greece, Latvia and Portugal have negative profitability ratios their banks are making losses where their expenses exceed revenue. This however could mean that, the banks may be experiencing significant financial challenges.

Estonia France and Spain have high liquidity which suggests that the banks in these countries have a healthy liquidity level and they will be able to meet their short-term obligations. Spain has a liquidity ratio of 9.7 which signifies an exceptionally high level of liquidity, indicating 9.70 in current assets for every 1 of current liabilities.

2.5.3 Analysis of regulatory restrictions from 2015-2020

Table 2.3 shows the data on the regulatory restrictions that are employed in the analysis and the following points highlight the some relationships among the variables;

Austria denies a smaller fraction (7%) of the banking license applications, Lithuania and Slovakia deny 50% and 60% of the banking license applications respectively, while the rest of the countries in the study grants banking licenses to all applicants.

Austria and Germany impose less restrictions on banking activities, while Italy and Malta impose severe restrictions on banking activities.

Cyprus, Estonia, Greece, Italy, Netherlands, Portugal and Spain which do not hold reserves or liquidity requirements, the rest of the countries hold reserves or liquidity requirements.

Finland, Luxembourg, and Netherlands have high banking freedom index, indicating less government interference. On the contrary, Greece has a low banking freedom index of 45%, which indicates less banking freedom and high government interference.

Greece records the lowest government regulations index which indicates minimal government regulations.

2.5.4 Correlation matrix

Table 2.4 shows the correlation matrix of the variables and the following are highlights of the key relationships among the variables.

- For bank specific variables, liquidity ratio and bank credit have weak negative correlation with economic growth while profitability ratio and bank size are positively correlated with economic growth.

- All the macroeconomic variables are positively correlated with economic growth.

- Investment, Trade and population have moderate positive correlation with economic growth.
- Investment and government expenditure are perfectly correlated.
- All the regulatory variables have strong correlation coefficients.

2.5.5 Panel regression results

All the independent variables were standardized before employing them in regression models, this is to ensure that they are within the same range for easy interpretation and comparison of their coefficients.

We include Investment variable and exclude government expenditure (GovExp) variable in the regression models to address the potential multicollinearity issues revealed in the correlation matrix and we use the estimation results of the panel regressions in Tables 2.5, 2.6 and 2.7 for assessing the impacts of the regulatory restrictions on economic growth.

Banking regulations and economic growth - controlling for bank-specific factors

In estimating the effect of the regulatory restrictions on economic growth, we include bank-specific variables in the models in Tables 2.5 and 2.7 and the analysis of the results is as follows;

All the bank-specific variables have a statistically significant relationship with economic growth except liquidity which is non-significant in all regressions.

Higher profitability tends to increase economic growth. This is consistent with models that emphasize that profitable banks typically have more capital available for lending and this can however result in greater credit accessibility for both businesses and individuals, thereby stimulating investment and consumption, which are drivers of economic growth. The results of our study confirm the findings of Klein and Weill (2018), who investigate the impact of bank profitability on economic growth and their results show that a high level of bank profitability contributes positively to economic growth. Our findings also align with the results of Walid et al. (2022), who analyze how bank profitability affects economic growth and the authors conclude that, profitability of banks has a positive short-term and long-term impacts on economic growth.

Liquidity is not significant and therefore has no relationship with economic growth. This confirms that while bank liquidity is essential for bank stability and efficiency, it does not directly drive economic growth. Although liquidity is generally associated with economic growth but the connection may not be significant in all circumstances. Our research provides further evidence for the conclusions drawn by Beck et al. (2020) and Beck et al. (2023), who find that liquidity creation by banks promotes economic growth in countries that rely on tangible assets and does not contribute to economic growth in countries with a high share of industries reliant on intangible assets. From Tables 2.5 and 2.7, we observe that Liquidity has both positive and negative coefficients, this is in line with the study by Van Dijk et al. (2020), who opine that Liquidity has an important non-linear relationship with economic growth.

Bank size in Table 2.5 is significant and positively associated with economic growth, while in Table 2.7, the relationship becomes negative, highlighting the dual relationship between the size of banks and growth. Larger banks are highly resilient, well equipped and more capable of managing liquidity risk which encourages investment, enhance performance, potentially contributing to economic growth than small banks. The results of our study corroborate the findings of Gržeta et al. (2023), who emphasize that large and medium-sized banks positively affects growth through efficiency and profitability, whereas, small banks negatively affects growth through performance.

Bank credit is negative and significant in Tables 2.5 and 2.7, which indicates that higher bank credit tends to decrease economic growth, a signal that excessive credits by banks and imprudent borrowing by firms can result in overextension of loans, non-performing loans and financial instability, potentially causing detrimental effects on economic growth. (Carlos, 2012; Tahir et al., 2015; Rajan, 2010; Prochniak and Wasiak, 2017). The outcomes of our investigation echo the results presented in the study by Prochniak and Wasiak (2017), who provide evidence that an excessively large size of the financial system may not lead to more rapid economic growth and may even negatively affect GDP dynamics.

Banking regulations and economic growth - controlling for macroeconomic factors

We also include macroeconomic variables in the models in Tables 2.6 and 2.7 while estimating the effect of the regulatory restrictions on economic growth and the results are discussed below;

Investment is positive and significant in all regressions in Tables 2.6 and 2.7 as expected, underscoring the significant role that investment plays in fostering economic growth and this is consistent with the theoretical models that emphasize on the positive effects of investment on economic growth. Since investment is a component of aggregate demand, a rise in investment increases the capital stock which thereby contributes to economic growth. Our study reinforce the findings of Du, Hengming and Yawen (2022), who observe that new infrastructure investment can significantly improve economic growth quality. Our results further lend credence to the conclusions of Fournier (2016), who estimate the long-term effect of human capital and physical investment on potential output and the results show that public investment has a positive effect on long-term growth and labour productivity.

Trade enters the models in Table 2.6 as positive and significant, indicating that higher levels of trade contribute to economic growth. Trade facilitates faster productivity growth through division of labour and specialization. According to World Bank (2023), trade is a powerful driver of economic development and poverty reduction. Our study findings are consistent with the results of World Bank (2018) and Silajdzic and Mehic (2018), who report that countries that are open to international trade tend to grow faster, innovate, improve productivity and provide higher income and more opportunities to their citizens which can promote economic growth.

Inflation is positive and significant in all regressions in Table 2.6 and 2.7 which indicates a statistically meaningful relationship between inflation and economic growth. The positive nexus between inflation and economic growth can be interpreted as inflation stimulates spending, encourages businesses to

invest, which leads to job creation, potentially contributing to an increase in economic growth. Our results support the findings of Anthony and Oluwabunmi (2020), Yilmazkuday (2022), and Becha, Kalai and Helali (2023) that emphasizes on the positive influence of inflation on economic growth.

Population enters the regression in Table 2.6 as positive and significant, signifying that, population growth can contribute to economic growth. This may be construed as population growth can induce larger workforce who are able to work to produce more goods and services that increase productivity, leading to a higher increase in demand, which expands the market, spurs innovation, and promotes economic growth. Our results support the models that emphasize on the positive link between population and economic growth. The evidence from our study supports the conclusions of Alemayehu et al. (2022), who analyzed the effect of population growth on economic growth in Ethiopia, and conclude that the impact of population growth on economic growth is positive and significant.

Banking regulations and economic growth - controlling for bank-specific and macroeconomic factors

Both the bank-specific and macroeconomic variables are included in the models in Tables 2.5, 2.6 and 2.7 while estimating the effect of the regulatory restrictions on economic growth and the results are analyzed as follows;

For regulatory restrictions, we include the regulatory variables one by one while controlling for bank-specific and macroeconomic factors.

Entry denied measures the number of applications for bank entry licensing that are denied. From Tables 2.5, 2.6 and 2.7, the EntryDenied variable is

associated with a negative economic growth in all regressions, an indication that, countries that deny a higher fraction of applications for bank entry licensing tend to have adverse effects on economic growth. This confirms the theoretical models that high entry barriers increase market power and reduce banking competition which can result in higher interest rates on loans and lower interest rates on deposits, potentially signalling an increase in the cost of borrowing for firms and individuals, making it more expensive to invest and expand businesses which consequently decreases economic growth. The findings of our study complement the results of Fetene (2017) and Hunegnaw and Bedhaso (2021), who analyze the link between foreign bank entry and economic growth in Sub-Sahara African countries and the study result shows that liberalization restrictions on foreign banks reduce economic growth indirectly through increasing banking instability in Sub-Sahara African Countries.

Activity restrictions measures the regulatory restrictiveness of banks to engage in certain banking activities. According to Tables 2.5, 2.6 and 2.7, ActivityRestrictions variable is negative and significant in all the regression models, a signal that countries that restrict banks from engaging in activities such as securities, insurance and real estate, as well as from owning non-financial firms, are associated with lower economic growth. Activity restrictions on banks can stifle customers' access to a comprehensive suite of financial services which may potentially slow down the economy. Our findings align with the empirical evidence of Li (2021) and Thamae and Odhiambo (2022), who argue that banking systems with activity restrictions and bank entry barriers are detrimental to economic growth.

Reserve requirements measure whether banks are required to hold liquidity reserves or not. In Tables 2.5, 2.6 and 2.7, we observe a positive and significant coefficients in all regressions, a sign that higher minimum reserve requirement is connected to higher economic growth and this is consistent with the view that a rise in reserve or liquidity requirements enables banks to maintain a significant proportion of their deposits as reserves, which improves risk management and enhances bank stability, thereby promoting economic growth. The results of our study corroborate the findings of Stewart et al. (2021), who investigate the direct relationship between bank stability and economic growth, particularly, the authors examine the effect that regulatory capital and institutional quality have on this relationship and their findings reveal a positive effects of regulatory capital on economic growth.

Banking freedom measures the overall financial or banking freedom to operate without any interference. According to Tables 2.5, 2.6 and 2.7, we observe that greater banking freedom has a significant positive impacts on economic growth, an indication that countries with higher banking freedom and less government interference, lead to bank stability, which is a recipe for economic growth. Our research provides evidence for the conclusions drawn by Djebali (2023), who investigate the effects of economic freedom and financial freedom on bank stability in 12 Middle-East and North African countries during the period 2005–2020 and their results reveal that a high degree of economic freedom, financial freedom, investment freedom, and business freedom promote innovation and entrepreneurship and, hence, leads to economic growth and better banking stability.

Government regulations measure the ability of government to formulate

and implement sound policies and regulations. GovReg enters the regressions as significant, having a positive impact on economic growth, a signal that countries with robust regulatory policies tend to experience favourable economic growth. Our results reinforce the findings of Nayak (2021), who highlights the significance of banking regulations for the determination of bank performance using regulatory factors including entry barriers, capital requirement, supervision and the empirical findings indicate a positive impact of stringent regulations regarding permissibility of activities and supervision on the financial performance of banks, which in turn can contribute to economic growth.

Considering the significant coefficient of GovReg (1129.3) in Table 2.7 and its mean value (1.37) in Table 2.1, an increase in GovReg by 10% from the mean value (i.e. from 1.37 to 1.507) would enable a country to grow its economy at $1129.3 \times [\ln(1.507) - \ln(1.37)] \times 100 = 10.8$ percentage point faster per year. Thus an increase in government regulations by 10% will lead to 10.8 percentage point higher annual growth and this highlights the significant relationship between banking regulations and economic growth and indicates that moderating banking regulation can have an economically sizable effects on economic growth.

In summary, the regression results in Tables 2.5, 2.6 and 2.7 suggest that the regulatory restrictions are statistically significant and often contribute to enhancing economic growth.

2.6 Conclusion

Regulatory policies within the banking industry that enable effective monitoring and control of banks lead to better financial performance, bank efficiency, and stability which consequently have significant impacts on economic growth.

A well-crafted and strictly enforced bank regulations promote security, soundness and stability of the financial sector while ensuring the protection of the interests of customers and shareholders.

Regarding the bank-specific traits in all regressions, there is no evidence in the study that bank liquidity has a relationship with economic growth. Profitable banks (Profitability) and highly larger banks (bank size) are associated with increased economic growth, while higher bank credit has adverse effect on economic growth. The bank specific factors contribute to enhancing economic growth through bank stability and efficiency.

Concerning the macroeconomic factors, as expected, all the macroeconomic dynamics have significant positive relationship with economic growth. Higher levels of investments and trade stimulate economic growth, while the analysis reveals a significant positive impact of inflation on economic growth. The macroeconomic factors promote a stable and conducive economic environment.

The main findings of the study on the impact of banking regulations on economic growth reveal that countries that deny a higher fraction of applications for bank entry licensing tend to have adverse effects on economic growth. Countries that restrict banks from engaging in activities such as securities, insurance, and real estate, as well as from owning non-financial firms, can stifle customers' access to a comprehensive suite of financial services,

potentially slowing down the economy. Countries that hold reserves or liquidity requirements tend to experience favourable economic growth through bank stability. Countries with higher banking freedom and minimal government interference are associated with positive economic growth. Countries with robust regulatory policies tend to experience favourable economic growth.

References 2

Alemayehu Temesgen Befikadu and Berhanu Alemu Tafa (2022). An Empirical Analysis of the Effects of Population Growth on Economic Growth in Ethiopia Using an Autoregressive Distributive Lag (ARDL) Model Approach

Ayadi, R., and Mouley, S. (2014). Impact of Monetary Policy and Bank Regulations on Efficiency. , 181-199.

Baltensperger, E., and Dermine, J. (1987). Banking deregulation in Europe. Economic Policy, 2, 63-95.

Barth, James R., Gerard Caprio Jr., and Ross Levine, 2001. "Bank Regulation and Supervision: What Matters Most," World Bank Policy Research Working Paper, forthcoming.

Barth J.R, Caprio Jr. G, Levine R (2001a) Banking systems around the globe: Do regulations and ownership affect performance and stability? In: Mishkin F.S (Ed), Prudential Supervision: What works and What Doesn't, University of Chicago Press, 31-88.

Barth, J., Caprio, G. and R. Levine (2001b). "The Regulation and Supervision of Banks Around the World: A new Database," in Robert E. Litan and Richard Herring, Editors, Integrating Emerging Market Countries into the Global Financial System Brookings-Wharton Papers on Financial

Services, Brookings Institution Press (Washington, DC), pp. 1.83-241.

Barth, J.R, Nolle, D.E, Phumiwasana, T., Yago G., (2003a). A Cross-Country Analysis of the Bank Supervisory Framework and Bank Performance. Financial Markets, Institutions and Instruments 12, 67-120.

Barth, J.R., Caprio, Jr.G., Levine R. (2003b). Bank Regulation and Supervision: Lessons from a New Database. In: Jose Antonio Murillo Garza (Ed), Macroeconomic Stability, Financial Markets, and Economic Development. Mexico, City: Banco de Mexico.

Barth, James R., Gerard Caprio Jr., and Ross Levine (2004). Bank regulation and supervision: what works best? Journal of Financial Intermediation. Volume 13, Issue 2, April 2004, Pages 205-248

Basel Committee on Banking Supervision (1988). International Convergence of Capital Measurement and Capital Standards. Bank for International Settlements. https://www.bis.org/publ/bcbs04.pdf

Basel Committee on Banking Supervision (2004). International Convergence of Capital Measurement and Capital Standards: A Revised Framework (Basel II Framework). Bank for International Settlements. https://www.bis.org/publ/bcbs107.pdf

Basel Committee on Banking Supervision. (2011). Basel III: A global regulatory framework for more resilient banks and banking systems. Bank for International Settlements. https://www.bis.org/publ/bcbs189.pdf

Basel Committee on Banking Supervision (2023) Basel III Monitoring Report.

Beck, T., Döttling, R., Lambert, T. et al. Liquidity creation, investment, and growth. J Econ Growth 28, 297–336 (2023).

https://doi.org/10.1007/s10887-022-09217-1

Bilin Neyapti and N. Nergiz Dincer (2014) Macroeconomic Impact of Bank Regulation and Supervision: A Cross-Country Investigation, Emerging Markets Finance and Trade, 50:1, 52-70, DOI: 10.2753/REE1540-496X500103

Blum, J., and Hellwig, M. (1995). The macroeconomic implications of capital adequacy requirements for banks. European Economic Review, 39, 739-749.

Blum, J. (1999). Do capital adequacy requirements reduce risks in banking. Journal of Banking and Finance, 23, 755-771.

Chirwa, T., and Odhiambo, N. (2016). Macroeconomic Determinants of Economic Growth: A Review of International Literature. South East European Journal of Economics and Business, 11, 33 - 47.

Chiu, I., and Wilson, J. (2019). Introduction to banking law and regulation. Banking Law and Regulation.

Chiu, I., and Wilson, J. (2019). European banking supervision and regulatory architecture. Banking Law and Regulation.

Chorafas, D. (2009). Solvency, Liquidity, Asset-Backed Paper, and the Carry Trade. 209-234

Copelovitch, M. S., and Singer, D. A. (2008). Financial regulation, monetary policy, and inflation in the industrialized world. The Journal of Politics, 70(3), 663-680.

Demirguc-Kunt, A., Laeven, L., and Levine, R. (2003). "The Impact of Bank Regulations, Concentration, and Institutions on Bank Margins"

Demirguc-Kunt, A., Detragiach, E., Tressel, T. (2008). Banking on the Principles: Compliance with Basel Core Principles and Bank Soundness.

Journal of Financial Intermediation (In press), available at Sciencedirect.com.

De Serres, A., Kobayakawa, S., Sløk, T., and Vartia, L. (2006). Regulation of financial systems and economic growth in OECD countries: An empirical analysis.

Djebali, N. (2023). Assessing the determinants of banking stability in the MENA region: what role for economic and financial freedom? J Bank Regul. https://doi.org/10.1057/s41261-023-00220-z

Du, Xin, Hengming Zhang, and Yawen Han. (2022). "How Does New Infrastructure Investment Affect Economic Growth Quality? Empirical Evidence from China" Sustainability 14, no. 6: 3511. https://doi.org/10.3390/su14063511

Fetene Bogale (2017). Foreign Bank Entry and Issues Efficiency, Stability and Economic Growth: Implication for Ethiopia from Sub-Sahara African Countries Panel Data

Fournier, J. (2016), "The Positive Effect of Public Investment on Potential Growth", OECD Economics Department Working Papers, No. 1347, OECD Publishing, Paris, https://doi.org/10.1787/15e400d4-en.

Gržeta, I., Žiković, S. and Tomas Žiković, I. Size matters: analyzing bank profitability and efficiency under the Basel III framework. Financ Innov 9, 43 (2023). https://doi.org/10.1186/s40854-022-00412-y

Hunegnaw and Bedhaso (2021). A dynamic analysis on foreign bank entry Nexus economic growth in Sub-Sahara African countries. Cogent Economics and Finance.

Karim, M., Hassan, M., Hassan, T., and Mohamad, S. (2014). Capital adequacy and lending and deposit behaviors of conventional and Islamic

banks. Pacific-basin Finance Journal, 28, 58-75.

Klein, Paul-Olivier and Weill, Laurent, Bank Profitability and Economic Growth (July 2, 2018). BOFIT Discussion Paper No. 15/2018, Available at SSRN: https://ssrn.com/abstract=3207171 or http://dx.doi.org/10.2139/ssrn.3207171

König, P. (2015). Liquidity Requirements: A Double-Edged Sword. International Journal of Central Banking, 11, 129-168.

La Porta, R., F. Lopez-de-Silanes, A. Shleifer, and R. W. Vishny (1999). "The Quality of Government," Journal of Law. Economics, and Organization 15, pp. 222-279.

Li, S. (2021). The Impact of Bank Regulation and Supervision on Competition. Contributions to Finance and Accounting.

Mazbouri, M., and Schaufelbuehl, J. (2015). A Legislator under Surveillance: The Creation and Implementation of Swiss Banking Legislation 1910–1934. European History Quarterly, 45, 662 - 688.

Naceur, S., and Omran, M. (2010). The Effects of Bank Regulations, Competition, and Financial Reforms on Banks' Performance. Emerging Markets: Regional Perspective eJournal.

Nayak, R. (2021). Banking regulations: do they matter for performance? J Bank Regul 22, 261–274. https://doi.org/10.1057/s41261-021-00145-5

Pasiouras, F., Tanna, S., and Zopounidis, C. (2009). The impact of banking regulations on banks' cost and profit efficiency: Cross-country evidence. International review of financial analysis, 18(5), 294-302.

Próchniak, M., and Wasiak, K. (2017). The impact of the financial system on economic growth in the context of the global crisis: empirical

evidence for the EU and OECD countries. Empirica, 44, 295-337. https://doi.org/10.1007/s10663-016-9323-9

Riccetti, L., Russo, A., and Gallegati, M. (2017). Financial Regulation and Endogenous Macroeconomic Crises. Macroeconomic Dynamics, 22, 896 - 930.

Rochet, J. (2008). Liquidity regulation and the lender of last resort. Financial Stability Review, 45-52.

Siddika, A., and Haron, R. (2020). Capital Adequacy Regulation. Banking and Finance.

Silajdzic, S., and Mehic, E. (2018). Trade Openness and Economic Growth: Empirical Evidence from Transition Economies. InTech. doi: 10.5772/intechopen.75812

Sriono, S., Dewi, S., Hulzannah, M., Panggabean, M., and Rizki, R. (2021). Legal Protection Against Bank Customers in Review of Banking Laws. , 1, 1-6. https://doi.org/10.51601/IJERSC.V1I1.7.

Stewart, R., Chowdhury, M. and Arjoon, V. (2021). Bank stability and economic growth: trade-offs or opportunities? Empir Econ 61, 827–853.https://doi.org/10.1007/s00181-020-01886-4

Thamae, R.I., and Odhiambo, N.M. (2022). The impact of bank regulation on bank lending: a review of international literature. Journal of Banking Regulation1.

Van Dijk, M., Döttling, R., Lambert, T. and Beck, T. (2020). How banks affect investment and growth: New evidence.

Walid Ali, Wissem Ben Ali and Amel Salah, (2022). "The Relationship Between Bank Profitability And Economic Growth For Conventional Banks

In Gcc Countries," Journal of Smart Economic Growth, , vol. 7(2), pages 67-92, September.

World Bank. (2018). Stronger Open Trade Policies Enable Economic Growth for All.

Table 2.1: Summary statistics for the variables

Variable	**Mean**	**St.Dev**	**Min**	**Median**	**Max**
Growth	35511.3	10397.08	12425.68	37539.38	97656.78
Profitability	0.003	0.015	-0.399	0.003	0.491
Liquidity	1.860	26.513	0.050	1.116	2161.568
BankSize	14.212	1.920	8.166	14.073	21.635
BankCredit	85.674	16.844	32.445	82.846	243.260
Investment	383761947782	250814943866	2413200000	321943600000	689823850000
GovExp	375499639639	247384730290	1644300000	318519000000	677845350000
Trade	90.869	44.700	55.286	86.246	377.843
Inflation	0.950	0.724	-2.097	0.939	3.723
Population	0.360	0.526	-1.398	0.358	3.931
EntryDenied	0.06	0.10	0	0	0.6
ActivityRestrictions	1.59	0.48	1.25	1.25	2.5
ReserveRequirements	0.7	0.4	0	1	1
BankingFreedom	0.67	0.07	0.45	0.7	0.08
GovReg	1.37	0.40	0.14	1.44	2.05

Table 2.2: Profitability and Liquidity ratios

Country	**Profitability**	**Liquidity**	**No. of Banks**
Austria	0.0068	1.2460	1785
Belgium	0.0043	1.1460	112
Cyprus	0.0067	1.1870	134
Estonia	0.0135	2.3035	37
Finland	0.0053	1.3198	111
France	0.0052	2.7247	884
Germany	0.0019	1.1415	3852
Greece	-0.0055	1.1334	35
Ireland	0.0025	1.7940	65
Italy	0.0015	1.2138	1557
Latvia	-0.0018	1.1694	56
Lithuania	0.0121	1.1163	23
Luxembourg	0.0054	1.2292	156
Malta	0.0078	1.1399	38
Netherlands	0.0051	1.7076	94
Portugal	-0.0009	1.1353	236
Slovakia	0.0068	1.3344	47
Slovenia	0.0078	1.1661	63
Spain	0.0040	9.7114	609

Table 2.3: Regulatory restrictions from 2015 - 2020

Country	Entry **Denied**	Activity **Restrictions**	Reserve **Requirements**	Banking **Freedom**	Government **Regulations**
Austria	0.07	1.25	1	0.70	1.44
Belgium	0.00	2.25	1	0.70	1.30
Cyprus	0.00	2.00	0	0.55	1.00
Estonia	0.00	2.00	0	0.77	1.60
Finland	0.00	1.75	1	0.80	1.83
France	0.00	1.50	1	0.70	1.19
Germany	0.00	1.25	1	0.70	1.74
Greece	0.00	2.25	0	0.45	0.42
Ireland	0.00	2.00	1	0.70	1.62
Italy	0.26	2.50	0	0.53	0.72
Latvia	0.00	2.00	1	0.58	1.14
Lithuania	0.50	2.25	1	0.73	1.15
Luxembourg	0.00	1.50	1	0.80	1.73
Malta	0.00	2.50	1	0.60	1.16
Netherlands	0.00	1.50	0	0.80	1.90
Portugal	0.00	2.25	0	0.60	0.90
Slovakia	0.60	2.25	1	0.70	0.85
Slovenia	0.00	2.25	1	0.50	0.74
Spain	0.00	1.75	0	0.70	0.92

Table 2.4: Correlation Matrix A

	Growth	Profit	Liquidity	BankSize	Credit	Investment	Exp	Trade	Inflation	Pop
Growth	1									
Profit	0.04	1								
Liquidity	-0.02	-0.01	1							
BankSize	0.07	-0.03	-0.03	1						
Credit	-0.09	0.03	0.03	0.048	1					
Investment	0.060	-0.08	-0.01	0.18	-0.22	1				
Exp	0.03	-0.09	-0.01	0.19	-0.20	1.00	1			
Trade	0.69	0.06	-0.01	0.06	-0.02	-0.36	-0.38	1		
Inflation	0.29	0.06	-0.02	-0.09	-0.28	0.03	-0.03	0.19	1	
Pop	0.60	0.07	-0.004	0.001	0.10	-0.07	-0.10	0.62	0.13	1

Table 2.4: Correlation Matrix B (Cont.)

	EntryDenied	ActivityRestrictions	ReserveReq	BankingFreedom	GovReg
EntryDenied	1				
ActivityRestrictions	0.72	1			
ReserveReq	-0.55	-0.83	1		
BankingFreedom	-0.70	-0.83	0.71	1	
GovReg	-0.66	-0.86	0.79	0.78	1

Table 2.5: Regulatory restrictions controlling for bank-specific factors

	Dependent variable:				
			Growth		
	(M1)	(M2)	(M3)	(M4)	(M5)
Profitability	45.503**	42.892**	44.511**	42.186**	35.860*
	(20.653)	(20.527)	(20.879)	(20.615)	(19.653)
Liquidity	−0.567	−1.144	−0.495	−0.512	−12.081
	(16.299)	(16.233)	(16.526)	(16.326)	(15.541)
BankSize	599.031***	750.570***	675.441***	520.944***	1,059.928***
	(95.942)	(93.574)	(94.429)	(92.914)	(90.121)
BankCredit	−914.120***	−907.588***	−881.839***	−925.330***	−771.720***
	(22.282)	(22.175)	(22.596)	(22.297)	(21.483)
EntryDenied	−3,249.425***				
	(214.677)				
ActivityRestrictions		−5,372.021***			
		(190.227)			
ReserveRequirements			4,203.439***		
			(168.552)		
BankingFreedom				5,042.311***	
				(158.493)	
GovReg					1,855.125***
					(44.453)
Constant	35,811.310***	35,683.440***	35,764.800***	35,740.110***	35,880.300***
	(206.171)	(188.030)	(185.070)	(179.153)	(180.705)
Observations	9,894	9,894	9,894	9,894	9,894
Number of Banks	2,248	2,248	2,248	2,248	2,248
R^2	0.294	0.342	0.335	0.361	0.395
Adjusted R^2	0.293	0.341	0.335	0.361	0.395
F Statistic	1,929.241***	2,516.216***	2,282.282***	2,714.701***	3,617.082***
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 2.6: Regulatory restrictions controlling for macroeconomic factors

	Dependent variable:				
			Growth		
	(M1)	(M2)	(M3)	(M4)	(M5)
Investment	4,256.783***	3,745.738***	3,941.674***	4,041.656***	4,074.244***
	(90.621)	(89.475)	(88.650)	(87.742)	(87.422)
Trade	6,714.395***	6,540.217***	6,523.222***	6,359.233***	6,256.464***
	(87.599)	(85.189)	(85.941)	(88.180)	(88.772)
Inflation	105.730***	135.898***	128.370***	131.279***	94.368***
	(11.255)	(11.006)	(11.011)	(11.079)	(10.891)
Population	146.612***	92.678***	116.460***	116.130***	125.081***
	(15.646)	(15.409)	(15.304)	(15.367)	(15.201)
EntryDenied	−302.808**				
	(144.939)				
ActivityRestrictions		−2,884.411***			
		(137.989)			
ReserveRequirements			2,227.512***		
			(123.489)		
BankingFreedom				2,038.135***	
				(120.410)	
GovReg					635.339***
					(34.622)
Constant	35,697.600***	35,568.190***	35,622.660***	35,649.850***	35,678.930***
	(133.129)	(129.460)	(131.940)	(131.621)	(133.201)
Observations	9,894	9,894	9,894	9,894	9,894
Number of Banks	2,248	2,248	2,248	2,248	2,248
R^2	0.666	0.680	0.676	0.675	0.675
Adjusted R^2	0.666	0.680	0.675	0.675	0.675
F Statistic	14,512.470***	15,562.670***	15,320.060***	15,214.990***	15,372.350***
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 2.7: Regulatory restrictions controlling for bank-specific and macroeconomic factors

	Dependent variable:				
			Growth		
	(M1)	(M2)	(M3)	(M4)	(M5)
Profitability	37.685**	34.465**	36.099**	35.605**	33.622**
	(15.755)	(15.773)	(15.975)	(15.663)	(15.651)
Liquidity	12.357	11.696	12.008	12.291	3.642
	(12.362)	(12.383)	(12.546)	(12.303)	(12.303)
BankSize	−509.776***	−367.125***	−413.486***	−520.710***	−83.564
	(78.974)	(78.741)	(79.366)	(77.644)	(78.037)
BankCredit	−639.405***	−632.681***	−621.442***	−648.280***	−586.039***
	(17.741)	(17.766)	(18.022)	(17.652)	(17.705)
Inflation	368.713***	386.741***	383.618***	374.749***	323.293***
	(11.191)	(11.188)	(11.307)	(11.047)	(11.147)
Investment	3,759.211***	3,441.254***	3,542.772***	3,611.190***	3,370.974***
	(96.289)	(96.241)	(96.243)	(93.217)	(92.739)
EntryDenied	−1,976.073***				
	(211.429)				
ActivityRestrictions		−3,737.596***			
		(197.852)			
ReserveRequirements			2,417.275***		
			(162.260)		
BankingFreedom				3,880.156***	
				(148.269)	
GovReg					1,129.338***
					(36.859)
Constant	35,720.270***	35,623.190***	35,702.060***	35,655.070***	35,781.260***
	(200.873)	(191.514)	(190.001)	(184.658)	(178.165)
Observations	9,894	9,894	9,894	9,894	9,894
Number of Banks	2,248	2,248	2,248	2,248	2,248
R^2	0.532	0.542	0.534	0.554	0.563
Adjusted R^2	0.532	0.541	0.534	0.554	0.563
F Statistic	8,941.987***	9,153.185***	8,779.607***	9,577.976***	9,815.475***

Note: *p<0.1; **p<0.05; ***p<0.01

Chapter 3

Navigating the Digital Landscape: Assessing the Impacts of Digital Regulations on Banking Competition

Abstract - Chapter 3

Recent advancements in digitalization have revolutionized financial services, transformed banking practices, and improved customer experiences, paving the way for a new era of digital economy. However, these improvements in financial technology have diverse effects on competition within the banking industry.

This paper explores digital and non-digital regulatory frameworks and assesses their impacts on the competitive landscape in the banking industry using a panel data for 1,331 banks within 19 eurozone countries over the period from 2015 - 2020.

The main findings of the study show that an enhancements in electronic

transactions are connected to a rise in banking competition, and an advancements in electronic payment systems can lead to a decrease in banking competition. The findings also reveal that an increase in other barriers to trade in digitally enabled services can potentially induce lower competition in the banking industry.

KEYWORDS: Digitalization; Digital banking; Traditional banking; Electronic transactions; Fintech.

3.1 Introduction

Before the conception of financial technology, customers who want to open bank account may have to visit bank in-person, fill and sign several physical documents by hand which was very frustrating, costly and time-consuming. However, as a result of the rapid acceleration in fintechs, financial services no longer require close proximity to customers; they can now be conducted online or at a distance, allowing customers to access financial markets through financial institutions at lower costs.

Currently, banking industry is increasingly becoming digitally enabled. Despite the existing empirical studies on banking and regulations in the digital space, the body of research on the link between digital regulations and banking competition is limited or unexplored, therefore the contribution of this paper is to assess the impacts of digital regulations on banking competition using a panel regression model.

The main findings of this study on the impact of digital regulations on banking competition reveal that an enhancements in electronic transactions

(E-Trans) are connected to a rise in banking competition. An advancements in electronic payment (E-Pay) systems can lead to a decrease in banking competition. An increase in other barriers to trade in digitally enabled services (DigBarr) can potentially induce lower competition in the banking industry.

The rest of the paper is organised as follows: Section 2 reviews the existing literature on the role of digital banking. Section 3 outlines some specific regulatory factors. Section 4 discusses the methodology. Section 5 provides data description. Section 6 presents the empirical estimation and the analysis of the results, while Section 7 draws some conclusions on the findings.

3.2 The role of digital banking

Digitalizing the banking industry has significant impact on the financial services the banks provide to their customers. Digital banking which also known as online banking, internet banking, virtual banking or web banking, enables banks to provide efficient and convenient financial services to customers. These financial services encompass self-service transactions, ATM deposits, online transfers, cardless withdrawals, electronic bank account management (eBAM), electronic payment, online loan, and others, allowing customers of banks to conduct a wide range of financial transactions online using computer or mobile device without visiting a traditional bank branch.

While the traditional banking centres on the conventional banking model where customers can access banking services through physical bank branches, the digital banking focuses on the delivery of banking services through online channels. The digital banking has a significant impact on traditional banking

services (Devendra, 2022). Selvi and Vilji (2024) analyze the impact of digital banking over traditional banking in India and find that customers prefer the digital banking system over traditional banking due to its convenience, as it is easy to use and saves much time. Digital banking services are cheaper than traditional banking services, and the customers of digital banking are more satisfied than traditional banking customers during COVID-19 pandemic (Rangaswamy et al., 2023).

Digital banking services can improve performance, efficiency and effectiveness of the financial services. Shifting banking activities from traditional banking to electronic banking by providing convenient and accessible digital platforms such as websites and mobile apps for customers to conduct electronic transactions, and manage online accounts enhances the productivity of the banking industry. An empirical analysis of the impact of digital finance on the efficiency of commercial banks by Zuo et al. (2023) and Wu et al. (2023) shows that digital finance significantly enhances the total factor productivity of commercial banks. Zuo et al. (2021) also find that digitalization investment has contributed to substantial production efficiency improvement for commercial banks. These studies provide empirical evidence that digital banking and finance can improve the efficiency and productivity of commercial banks.

The adoption of digital banking is influenced by a number of factors. The degree of competition among banks can significantly impact the adoption of digital banking as banks strive to offer attractive services to customers. The regulatory requirements set by the regulatory authorities can drive the adoption of digital banking. The evolution and accessibility of financial

technology significantly affect the adoption of digital banking. Customer preferences play an important role in the acceptance of digital banking. The lower transaction cost involved in conducting digital banking transactions can be a contributing factor to the choice of digital banking. The trust, security and privacy in the digital platforms can significantly influence their adoption.

An empirical study on the factors that drive the adoption of digital banking by Ananda, Devesh and Lawati (2020) reveals that awareness, web features, and perceived usefulness have significant positive influence on the adoption of digital banking. A well-designed user-friendly features on the digital banking platform and intensifying awareness of digital banking services potentially influence customers' adoption of digital banking. Another study on factors affecting the adoption of electronic banking services at the Commercial Bank of Ethiopia (CBE) by Genet (2021) also shows that awareness on e-banking service, interruption of e-banking equipment, trust and demographic factors have significant impacts on e-banking adoption. Isaac and Fengying (2022) also find that transaction cost, security and privacy, as well as facilitating conditions such as internet access and availability of digital devices that support the use of digital banking can largely affect the adoption and usage of digital financial services.

It is imperative that banks pay much attention to understand the needs and preferences of their customer base so as to enhance customer service. A good customer service is essential for harnessing excellent customer experience. Customer experience in digital banking is influenced by a variety of factors, ranging from an effectively structured service, and consistent quality to customer satisfaction. Addressing customer needs and preferences, and

providing customer supports improve the quality of customer experience and reduce fiction throughout the customer journey, thereby contributing to the success of digital banking services. Chauhan, Akhtar and Gupta (2022) explore customer experience in digital banking and the study findings show that customer experience in digital banking is determined by functional clues (functional quality, trust and convenience), mechanic clues (website attributes, website design, perceived usability) and humanic clues (customer complaint handling). The authors find that digital banking significantly influences evaluation of service experience by customers. Valsamidis et al. (2020) also identifies three main factors that affect the attitudes of customers towards the use of digital services and applications in the banking industry, specifically better service, cautiousness, and timelines/directness. Enhancing these factors can significantly boost the customer experience in online banking, contributing to improving digital banking services.

To sum up, digital banking is more convenient and cost-effective than traditional banking, and this enhances the competitive advantage of banks.

3.3 Regulatory factors

In this section, we delve into an in-depth analysis of some specific factors of regulations, both in digital and non-digital space. These factors encompass a wide range of policy measures, such as infrastructure and connectivity, electronic transactions, electronic payment systems, other barriers affecting trade in digitally enabled services, information disclosure, external monitoring, supervision, and bank governance. By discussing these factors, we aim

to present a well-rounded view of digital regulatory frameworks, thereby facilitating a better understanding of how digital regulatory environment can influence the competitive dynamics within the banking industry.

3.3.1 Digital regulatory factors

The following discusses how regulations in the digital space contribute to shaping the competitive landscape of the banking industry.

Infrastructure and Connectivity

This measures the regulatory policies on digital communication infrastructures, including internet access, regulations on internet traffic management, and restrictions on the use of communication services in a country. It measures the extent to which regulations on interconnections among network operators are implemented to facilitate smooth communication. It also captures measures that restrict or impede the use of communication services. The level of communication infrastructures, including regulations on internet access, internet traffic management, and communication services within the banking industry can significantly influence digital transformation, customer engagement, and service delivery techniques, which potentially impact the competitive dynamics of banks. Liu (2021) argues that banks in high-income economies which are likely benefiting from advanced digital infrastructure, strong legal and business environment can potentially support digital advancement of banks which can stimulate healthy competition among banks.

Electronic transactions (E-Transactions)

This measure evaluates the regulations and policies related to electronic transactions, including measures for e-commerce licenses, possibility for online tax registration, deviation from internationally accepted rules on electronic contracts, data protection and privacy laws, regulations on electronic signature and dispute settlement mechanism to resolve digital trade disputes. As a result of the advancement of digital technology, a rise in electronic transactions, including e-commerce and online tax has a significant influence on competition in the banking industry. The study results of OECD (2020) suggest that competition increases when there is a rise in FinTech and BigTech firms. The advent of digital technology in the banking industry has created a new competitive landscape where the digital commercial banks competes with traditional commercial banks based on quality and convenience of their services which may include electronic transactions (OECD, 2020; Zuo et al., 2023).

Electronic payment systems (E-Payment)

This measure assesses the regulations of electronic payment systems, which are crucial for digital trade. It captures measures that affect payments made through electronic means. The electronic payment systems encompass measures related to access to e-payment methods, restrictions on internet banking or insurance and evaluates whether domestic security standards for payment transactions align with international standards. E-payment eliminates the use of cash or cheques, making transactions more convenient, and reduces the risk of payment delays or errors. Unlike the conventional

payment, the electronic payment systems ensure security, privacy and trust which significantly influence the competitive dynamics of banks. Oyelami, Adebiyi and Adekunle (2020) indicate that electronic payment influences consumers' purchase decisions and thus increasing consumers' spending and improve aggregate demand, which can stimulate investments and economic growth, consequently enhancing the competitive position of a bank by increasing its customer base. Divya et al. (2021) evaluates the impact of digital payments on banks' performance measured by profitability and the findings show that digital payments has a positively significant relationship with the profitability of banks, which can improve financial performance and ensure stability, potentially boosting banks competitiveness.

Digital trade barriers

This measure focuses on other barriers affecting trade in digitally enabled services. It covers performance requirements affecting digital trade, limitations on downloading and streaming affecting digital trade, restrictions on online advertisement, commercial or local presence requirements, mechanisms to redress anti-competitive practices online, and other online restrictions. Too many regulatory restrictions in the banking industry can potentially influence the degree of competition among banks. The study findings of OECD (2023) reveals that, the domestic regulatory environment that underpins digital trade is becoming increasingly restrictive making it more difficult for businesses and consumers to operate effectively. The author further shows that, regulatory measures affecting the movement of data across borders, including provisions that mandate data to be stored domestically (data localisation), are also

growing and becoming increasingly restrictive. Restrictions on digital trade can impact the competitiveness of banks as excessive barriers in the banking industry will make it more difficult for banks to operate efficiently and competitively.

3.3.2 Non-Digital regulatory factors

The following elaborates the role of banking regulations in influencing the competitive dynamics of the banking industry.

Information disclosure

Information disclosure refers to the process of making information available and accessible to all interested stakeholders, including the general public. Primarily, it focuses on the preparation and auditing of financial statements, financial reporting standards, and public disclosure of financial statements. While the actions of stakeholders influence banks, the activities of banks also affect these stakeholders, and as a result, banks are mandated to disclose relevant information, including but not limited to financial performance, risk management, governance structure, and regulatory requirements with their stakeholders to ensure transparency and enhance stakeholder confidence in the banking industry. A rise in information disclosure, including press releases are associated with an increase in competition. Disclosure of information by public and private banks to their stakeholders can significantly influence the competitive dynamics of banks (Burks et al., 2018)

External monitoring

External monitoring mechanisms can have a significant impact on competition in the banking industry. External monitoring refers to the process of monitoring and assessing a company's activities, performance, and compliance with regulations by an external or private entity. This entity could be an independent auditor, external consultant, internationally recognized accounting firms such as Klynveld Peat Marwick Goerdeler (KPMG), PricewaterhouseCoopers (PwC), Ernst & Young (E&Y), and Deloitte Touche Tohmatsu Limited (DTTL) or international credit rating agencies like Moody's, Standard and Poor. External monitoring ensures objectivity, accountability and transparency of the banking industry by verifying that banks adhere to applicable standards, rules, and regulations, in order to protect the interest and enhance trust among investors, regulators, customers, and the public at large.

Empirical studies indicate that external monitoring mechanisms can significantly influence financial stability and competition in the banking industry. The role of independent external auditors is crucial as they provide high audit quality which helps in reducing financial misconduct, and malfeasance in firms. (Velte, 2022). The external auditor's responsibility of providing audit opinion ensures accurate financial reporting, which enhances transparency and trust among competitors in the banking industry. For instance, external auditors follow international auditing standards during an audit service and this provides oversight and promotes transparency which can influence banking competition. (Arda et al., 2018). An Independent audit helps to avoid or reduce the risk of providing materially inaccurate

information to stakeholders, potentially, promoting a level playing field which fosters healthy competition among banks.

Supervisors must ensure banks undergo statutory audits and obtain international ratings. Shleifer and Vishny (1994) present a model of bargaining between politicians and managers of public firms. The authors outline many stylized facts about the behaviour of state firms who mostly evade external monitoring by influencing politicians. In some cases, private and public firms influence external agencies to escape from external monitoring. The appointment of external or private entity to handle external monitoring in the banking industry ensures trust among stakeholders because of their international recognition.

Supervision

The official supervisory environment of banks can play a key role in shaping the competitive landscape of the banking industry. Generally, supervision involves the process of overseeing, monitoring, guiding, instructing, correcting, and regulating activities, operations, or behaviours to ensure compliance with established law, standards, or objectives. In the banking industry, the supervisor or management monitors the performance of banks and provide feedback, and support to ensure their adherence to banking regulations.

According to Nayak (2021), early intervention by supervisors following a breach of the law and the provision of swift corrective measures can protect banks from a significant bank run. Li (2018, 2019 and 2021) find that official supervision and greater capital strictness can enhance competition in the banking industry. The author argues that explicit guidelines on

asset diversification and deposit insurance coverage, and lower private-sector monitoring, are associated with more intensive bank competition.

This variable measures the supervisory power regarding macroprudential supervision, change of the internal organizational structure, whether or not there is an integrated financial supervisory agency, as well as holding supervisory agency personally and legally liable for damages to a bank caused by its actions.

Bank Governance structure

Bank governance structure can significantly affect the level of competition in the banking industry. Bank governance refers to the system of rules, policies, processes, structures, practices, and procedures that guide and control the decision-making process, operations, and supervision within a bank industry. It encompasses specific guidelines that address areas in the governance of banks, supervisory role in appointment of directors, and senior managers and removal of unfit stakeholders and the evaluation of remuneration or compensation system. Bank governance typically involves the supervisory agency, board of directors, senior management, shareholders, regulators, and other stakeholders working together to ensure the bank operates effectively, and in the best interests of their stakeholders.

The governance structure of banks, including the organizational structure, regulatory policies, and risk management practices can significantly influence their competitive dynamics within the banking industry. Corbae and Levine (2019) expound that regulatory policies that encourage the supervisory agency, board of directors, senior management, shareholders, regulators, and other

stakeholders to focus more on the long-run value of the bank and less on shorter-run concerns can improve bank governance. The organizational structure of a bank can shape its competitive strategy. For instance, a bank's geographical lending reach and loan pricing strategy is determined by its own and its rivals' organizational structure (Degryse, et al., 2009). A strong competition does not only increase market efficiency but it also leads to a rise in fragility of banks. However, Corbae and Levine (2019) argue that economies can mitigate the fragility costs of competition by enhancing bank governance and tightening leverage requirements. Banking competition can adversely affect the selection and evaluation process of the credit-worthiness of banks. According to Coccorese (2017), as the number of banks grows, there is a parallel increase in the probability that a given "bad" borrower will pass the screening test of at least one bank.

The variable measures the supervisory role in the appointment, removal or blacklisting of unfit shareholders, board members or senior management from holding any position in any bank.

3.4 Methodology

This study assesses the impact of digital regulations on banking competition using a panel regression analysis while controlling for non-digital regulatory factors, bank-specific factors and macroeconomic factors.

The dependent variable is Lerner index which is commonly used in measuring market power and banking competition. The independent variables are the digital regulatory variables which include infrastructure and

connectivity, electronic transactions, electronic payment systems and digital trade barriers. We also include non-digital regulatory variables (information disclosure, external monitoring, supervision, bank governance structure), bank-specific variable (Return on Asset), and macroeconomic variable (Gross Domestic Product) in the model as control variables.

3.4.1 Lerner Index

According to Lerner (1934), Lerner index is a measure of a firm's market power. It is calculated as the difference between price and marginal cost, divided by price.

$$L_{it} = \frac{P_{it} - \mathrm{MC}_{it}}{P_{it}} \tag{1}$$

Where Lit is the Lerner index for bank i at time t, Pit is the price of banks output for bank i at time t, MCit is the marginal costs for bank i at time t.

Practically, one drawback of the Lerner index is that, the available banks' financial data do not correspond to the prices and costs required to calculate the Lerner index and so proxies are used for prices and costs (Bikker et al., 2007).

To compute the Lerner index, the price (P) is calculated as the ratio of total revenues (i.e. Interest revenue plus operating revenue) to total assets whiles the marginal costs (MC) is estimated through a translog cost function.

In practice, while it is relatively easy to observe banks' prices from the financial statement, it is quite difficult to measure their marginal costs using the financial statement.

Following the studies of Bikker and Leuvensteijn (2008), Schaeck and Cihak (2010, 2014), Mirza et al. (2016) and Cummins et al. (2017), we propose to use the average costs as a proxy for the marginal costs to estimate the Lerner index. The average cost is calculated as the ratio of total cost to output which is specified below:

$$\mathrm{AC}_{it} = \frac{\mathrm{TC}}{Q} \tag{2}$$

Where AC is the average cost, TC is the total cost which is measured as the sum of operating expenses and interest expense and Q is the output which is assumed to be the total assets. The modified Lerner index is given as follows:

3.4.2 Profitability

We use the Return on Asset (ROA) as a proxy for banks' Profitability. ROA is calculated as the ratio of profit-after-tax to total assets and is given as follows:

$$\mathrm{ROA}_{it} = \frac{\text{Profit-After-Tax}}{\text{Total Assets}} \tag{3}$$

3.4.3 Panel Regression

The panel regression model to estimate the impacts of digital regulations on banking competition using fixed and random effects, while controlling for non-digital regulatory factors, bank-specific factors and macroeconomic

factors is specified below:

$$\text{LERNER}_{ct} = \alpha_1 \text{DIGREG}_{ct} + \beta \ln(X_{ct}) + \varepsilon_{ct} \tag{4}$$

Where LERNERct represents the Lerner index of the banking competition measure of country c (c = 1,...,N) at time t (t = 1,...,t), DIGREGct represents the digital regulatory variables, Xct is a vector of control variables including information disclosure, external monitoring, supervision, bank governance structure, GDP, and ROA and εct is the error term.

3.5 Data

After cleaning the dataset and removing missing data, the dataset employed for the estimation of the panel regression consists of 1331 banks within 19 euro area countries over a 6-year period from 2015 to 2020, which results in an unbalanced panel data with 6752 bank-year observations.

The study relied on four sources of data. The bank-level data is from the BankFocus database. The data on digital regulations is drawn from OECD (2022) database on Digital Services Trade Restrictiveness Index. The data on non-digital regulations is obtained from World Bank Regulation and Supervision database by BRSS (2019) and Anginer et al. (2019). The data for the macroeconomic (GDP) variable for each country is drawn from the World Development Indicators which is managed by the World Bank.

Since the variables have different units of measurement, all the independent variables are standardized to put them on a common scale. However, we

did not standardize the dependent variable (Lerner index) so as to be able to predict the actual raw value of the competition measure. The variables included in the models as regressors consist of:

• Lerner index (Lerner) – A measure of the banks' market power, commonly used for measuring competition.

• Infrastructure and Connectivity (InfraCon) – A measure of the regulatory policies on digital communication infrastructures.

• Electronic Transactions (E-Trans) – A measure of the regulations and policies related to electronic transactions.

• Electronic Payment (E-Pay) – A measure of the regulations governing electronic payment systems.

• Digital Trade Barriers (DigBarr) – A measure of the other barriers affecting trade in digitally enabled services.

• Gross Domestic Products (GDP) – A measure of the gross domestic products by all resident producers in the economy.

• Return on Asset (ROA) – A measure of the profitability of banks within the banking industry.

• Information Disclosure (InfoDisc) – A measure of the public disclosure requirements.

• External Monitoring (ExtMon) – A measure of the degree of audit of banks by internationally recognized accounting firms and rating by international credit rating agencies.

• Supervision (Supv) – A measure of the banking supervisory power.

• Bank Governance (BankGov) – A measure of the bank governance structure.

3.5.1 Construction and quantification of the regulatory variables

Essentially, it is important to state that there is no unique grouping or aggregation or quantification of the regulatory variables (Barth et al., 2004). For better understanding of the meaning and interpretation of the regulatory variables, the following explains more fully the construction and quantification of the regulatory variables.

3.5.2 Information disclosure

Information disclosure mainly focuses on the financial statements preparation, financial reporting standards, financial statements auditing and public disclosure of financial statements. The variable specifically consists of disclosure requirement regarding financial reporting, audited financial statements, off-balance sheet items, governance and risk management framework, regulatory capital and capital adequacy ratio, transactions with related party, other material information, scope of consolidation, and fines and settlements arising from non-compliance with regulations. Information disclosure variable ranges from 0 to 10, with higher values indicating more information disclosure. The quantification of the Information disclosure variable is subject to the following questions from the World Bank regulatory and supervisory survey (Questions 10.5, 10.8 and 10.10):

Are all banks operating in your country (including foreign bank branches) required to make available to the public their annual financial statements? Please select all options that apply...

a. On individual basis

b. On consolidated basis

c. None of the above

If on either individual or consolidated basis = 1, if on both individual and consolidated basis = 2, If none of the above = 0

Out of the following, how many public disclosures are mandatory?

a. Fully audited financial statements

b. Off-balance sheet items

c. Governance and risk management framework

d. Regulatory capital and capital adequacy ratio

e. Related party transactions

f. Other material information (omission / misstatement information)

g. Consolidation (state reasons if some entities are not included)

h. None of the above

Any one of the disclosures = 1, all disclosures = 7, none of the above = 0

Higher number of disclosure indicates higher stringency disclosure requirement

Do supervisors require banks to publicly disclose the following?

a. All fines arising from non-compliance with regulations

b. Not applicable

If All fines are disclosed = 1, Not applicable = 0

3.5.3 External monitoring

This variable measures the degree of audit of banks by internationally recognized accounting firms and rating by international credit rating agencies.

The variable includes the percentage of the top ten banks that are audited by any one of the accounting firms (PwC, KPMG, E&Y, and Deloitte Deloitte) as well as the percentage of rating of the top ten banks by international rating agencies (Moody's, Standard and Poor). The variable ranges from 0 to 1, with higher values indicating more percentage of external monitory. The quantification of the external monitory variable is contingent on the following questions from the World Bank regulatory and supervisory survey (Questions 5.16 and 10.12):

What percentage of the top ten banks are audited by any one of the accounting firms (PwC, KPMG, E&Y, Deloitte)? If 100% = 1, Otherwise we convert it to a decimal.

What percentage of the top ten banks are rated by international credit rating agencies (e.g., Moody's, Standard and Poor)? If 100% = 1, Otherwise we convert it to a decimal.

3.5.4 Supervision

The supervision variable measures the supervisory power regarding macroprudential supervision, change of the internal organizational structure, whether or not there is an integrated financial supervisory agency, as well as holding supervisory agency personally and legally liable for damages to a bank caused by its actions. This variable therefore ranges from 0 to 5, with higher values indicating more stringency. The variable was quantified based on the country-level responses to the following five questions in the survey (Questions 12.5, 12.12, 12.13, 12.24, and 12.25):

Can the banking supervisory authority force a bank to change its internal

organizational structure? If Yes = 1, No = 0

Can individual banking supervisory staff be held personally liable for damages to a bank caused by their actions or omissions committed in the good faith exercise of their duties? If Yes = 1, No = 0

Can the supervisory agency be held legally liable for damages to a bank caused by its actions? If Yes = 1, No = 0

Do you have an integrated financial supervisory agency covering all significant financial institutions? If Yes = 1, No = 0

Is the banking supervisor responsible for macroprudential supervision? If Yes = 1, No = 0

3.5.5 Bank Governance Structure

The variable measures the supervisory role in the appointment, removal or blacklisting of unfit shareholders, board members or senior management from holding any position in any bank. The variable ranges from 0 to 4, with higher values indicating better governance structure. The quantification of the bank governance variable is dependent on the following questions (Questions 6.4 and 6.9):

Do the supervisors have approval authority regarding appointment of the following? a. Board of directors b. Senior managers

If the supervisor has approval authority, it indicates better bank governance structure. If approval authority is for none of these two = 0, If for one of these two = 1, and for both = 2

Can the banking supervisor agency: a. Blacklist unfit/not proper shareholders, board members or senior management from holding any position

or stake in any bank. b. Remove board members and senior management from banks who are found to be unfit/not proper.

If supervisor agency can blacklist or remove unfit shareholders, board members or senior management, it indicates a better bank governance structure. If supervisor either blacklist or remove unfit stakeholders = 1, if supervisor both blacklist or remove unfit stakeholders = 2, If supervisor cannot blacklist or remove unfit stakeholders = 0

3.5.6 Data Sources

1. Bank-specific variables from BankFocus Database

2. Digital regulatory variables from OECD (2022) database on Digital Services Trade Restrictiveness Index. Data available at: `https://stats.oecd.org/viewhtml.aspx?datasetcode=STRI_DIGITAL&lang=en`.

3. Non-digital regulatory variables from BRSS (2019) and Anginer et al. (2019). Data available at: https://datacatalog.worldbank.org/search/dataset/0038632/Bank-Regulat

4. Macroeconomic variable (GDP) from World Development Indicators, World Bank

3.6 Empirical estimation and analysis

This section presents the empirical estimations and analysis of the results. Table 3.1 shows the summary statistics of the variables. Table 3.2 displays the correlation matrix and VIF values of the variables while Table 3.3 provides the panel regression results.

3.6.1 Summary statistics

From Table 3.1, electronic transaction has a mean of 0.03, a minimum value of 0, and a maximum value of 0.04, this signifies that there was a moderate level of adoption and usage of e-transactions during the observed period.

Electronic payment systems with mean of 0, minimum value of 0 and a maximum value of 0.02 indicates that, on average there were no electronic payment recorded and this could possibly be that e-payment systems were not widely adopted or frequently used within the countries during the observed period.

An average ROA (profitability) of 0 suggests that, on average, the banks are not generating any profit from their total assets, an indication that the banking industry is not efficiently using its assets to generate profit.

The mean value for GDP of 36034.58 suggests the average level of economic output or income generated within the eurozone countries from 2015 till 2020.

Information disclosure with a mean of 9.61, a minimum value of 7, and a maximum value of 10 suggests a high and consistent level of public disclosure among the euro area countries.

External monitoring has a mean of 0.98%, a minimum value of 0.5%, and a maximum value of 1%, suggesting an extremely high and consistent level of external monitoring among the banks, an indication that almost all the banks have independent auditors and international credit rating agencies.

3.6.2 Statistical tests

In Table 3.2, we perform statistical tests before the regression analysis to ensure the validity and reliability of the regression model.

Correlation matrix and VIF test

Firstly, we estimate the Pearson correlation among the variables to test for multicollinearity. Moreover, we also compute the Variance Inflation Factor (VIF) values to detect the presence of multicollinearity and Table 3.2 shows the results of the correlation matrix and VIF values.

According to Gujarati (2007), if the correlation between the independent variables is above 0.8, it indicates higher correlation, thereby suggesting the presence of multicollinearity. Several empirical studies by Menard (2001), Vittinghoff et al. (2005), Gujarati and Porter (2009), and James et al. (2013) all argue that a vector inflation factor (VIF) value above 10 suggests serious multicollinearity.

From Table 3.2, all the correlation coefficients between the variables are below the 0.8 threshold (Gujarati, 2007). Additionally, the highest VIF value of 4.27 recorded by InfoDisc is also less than the threshold of 10 above which multicollinearity is an issue (Menard, 2001; Vittinghoff et al., 2005; Gujarati and Porter 2009; James et al., 2013).

From these two tests and considering the rule of thumb that severe multicollinearity may be present if the correlation coefficient is greater than 0.8 and VIF value is above 10, we can conclude that multicollinearity problem may not exist in our regression model as a result of the low correlation coefficients among the variables.

Key correlations among the variables

• For digital regulatory variables, infrastructure and connectivity, and e-transactions have weak negative correlation with Lerner index, while e-payment and digital trade barriers are weakly positively correlated with Lerner index.

• For non-digital regulatory variables, supervision has positive correlation with Lerner index, while information disclosure, external monitoring, and bank governance structure are negatively correlated with Lerner index.

• A correlation coefficient of -0.002 for GDP indicates extremely weak negative relationship with Lerner index.

• A correlation coefficient of 0.38 for return on asset (ROA) suggests a moderate positive relationship with Lerner index.

• All the regulatory variables have weak correlation coefficients.

3.6.3 Panel regression analysis

The discussion and analysis of results of the impacts of digital regulations on banking competition in Table 3.3 are as follows;

Infrastructure and connectivity is not statistically significant in the model, signifying that there is no relationship between infrastructure and connectivity, and banking competition. While infrastructure and connectivity are important digital technologies for supporting online banking services and improving customer experiences, regulatory policy on infrastructure and connectivity do not directly impact the level of competition within the banking industry.

Electronic transactions variable shows a negative and significant coefficient

at 5% level, an indication that enhancements in electronic transactions are connected to a fall in market power (Lerner index) and a rise in banking competition. The result supports the notion that, digitalization of transactions, including electronic transactions, electronic fund transfers, online purchases, digital invoices, mobile payments, contactless payments, electronic remittances, digital wallets, and digital signatures can reduce transaction costs, increase market transparency, facilitate entry for new banks, and enhance efficiency and performance of banking services, thereby intensifying competition in the banking industry. Our findings support the results of OECD (2020), who reports that an early effect of digital disruption is the erosion of incumbents' margins and an increase in competitive pressure and contestability of banking markets. The results provide further evidence for the conclusions drawn by Liu (2021), who finds cross-country evidence that banks in high-income economies have emerged as digital leaders, likely benefiting from sound digital infrastructure, favourable legal and business environments, and healthy competition.

Electronic payment system is significant at 1% level and positively connected to Lerner index, demonstrating that, advancements in e-payment systems can lead to an increase in market power (Lerner index) which implies a decrease in banking competition. This could be interpreted as, advanced e-payment systems could give certain banks a competitive advantage, leading to less competition. This is consistent with empirical studies that emphasize that the dominance of e-payment systems by large banks could result in increased market power and decreased competition in the banking industry. Our findings align with the results of Sarkisyan (2024), who explores the

relationship between instant payment systems and competition for deposits, and the study findings suggest that universally available payment systems have significant impact on banking competition.

Digital trade barriers is statistically significant and positively associated with Lerner index, implying that, an increase in other barriers to trade in digitally enabled services can potentially induce an increase in market power (Lerner index), hence lower competition in the banking industry. This supports empirical studies on regulatory barriers in the digital economy that excessive regulatory barriers can hinder the cross-border flow of digitally-enabled services, impede innovation, limit market entry, consequently reducing competition in various sectors, including the banking industry. The result is consistent with the findings of Jiang et al. (2023), Qian and Xuerou (2023), Yinguo et al. (2022), and Duan and Yang (2023) that digital trade barriers can have negative impacts on digital services trade competitiveness, which could potentially affect competition. Digital trade barriers have negative impacts on economic growth and the range of digital services available, could potentially have adverse effect on competition (Jangam, 2023; Hao et al. 2023).

Information disclosure is not significant in the model and therefore has no relationship with banking competition. This can be interpreted as during an intense competition in the banking industry, specific competitive factors such as interest rates, fees and charges, product offerings, customer service quality, brand reputation, financial strength and stability, and technology and innovation offerings that drive market dynamics and consumer preferences dominate which may outshine information disclosure, causing it to have no

impact on competition (Altunbaş et al. 2022; Vauhkonen, 2012).

External monitoring is statistically significant and shows an adverse impact on Lerner index, indicating that an increase in external monitory reduces market power and increase banking competition. This can be interpreted as audits by independent external auditors or internationally recognized accounting firms, and ratings by international rating agencies lead to accurate disclosure of financial information, high audit quality, limit financial malfeasance by banks and increase transparency in the banking industry, leading to a more competitive market environment which potentially reduces the Lerner Index (Shleifer and Vishny, 1994; Velte, 2022). The results of our study corroborate the findings of Ghosh (2007) who examines how internal monitoring by managers and external monitoring by auditors relate to firm valuation and the study results which reveal the existence of a substitution monitoring effect between auditors and managerial group, conclude that both external and internal monitoring functions affect firm value. This highlights the significant role that intensive monitoring plays in improving the quality of financial reporting and enhancing effective banking supervision which can influence competition in the banking industry. A two-way interaction between external auditors and supervisors can improve the quality of external audits and enhance banking supervision which can contribute to a more competitive banking environment (Velte, 2023).

Supervision is significant and positively associated with Lerner index, indicating that while strong supervision and effective oversight of banks are essential for financial stability, it could lead to higher market power (Lerner index) and lower competition in the banking industry. Empirical studies

indicate that stringent regulatory oversight and supervisory requirements often impose extra costs on banks in meeting the regulatory standards and reporting obligations that are prescribed by the supervisory board, leading to an increase in operational costs for banks which can excessively affect smaller banks, reducing their ability to compete with larger banks. (Peria, 2010). A unified supervision of banks can lead to fair and consistent regulatory policies which may reduce entry barriers, making the banking industry more competitive. For instance, since the establishment of the Single Supervisory Mechanism (SSM) in 2014 by ECB, Raunig and Sigmund (2023), empirically investigate how the shift from national supervision to direct and uniform supervision under the SSM affects the competitive position of SSM banks and the authors find that the shift from national supervision to direct supervision in euro area countries that are heavily affected by the sovereign debt crisis, decreases competition for SSM banks.

Bank governance is statistically significant and positively connected to Lerner index in the model, signifying that improvement in the governance structure of banks can result in increased market power and decreased competition in the banking industry. The governance structure of banks characterized by high ownership concentration, decision-making power concentration, limit shareholder influence, prioritize long-term stability, and create barriers to entry for new banks may tend to significantly increase market power and reduce competition in the banking industry. The results of our study are in line with the findings of Yao et al. (2023) who investigate the influence of bank governance structure on green credit and the authors find a substitution effect between low board independence and low executive

incentives which can influence the strategic decisions of banks, potentially leading to an increase in market power and decrease in competition. A high ownership concentration can lead to a more strategic planning, geared towards enhancing market power, which can affect the competitive position of banks (Yao et al., 2023). The organizational structure of banks influences the type of information used and the lending technology employed. Our results lend further credence to the conclusions of Degryse, et al. (2009) who investigate how bank organization shapes banking competition and the study results suggest that an effective use of the organizational structure to adopt advanced lending technologies have effect on the level of competition.

3.7 Conclusion

Digital banking is more convenient, cost-effective and enhances the competitive advantage of banks than traditional banking.

While external monitoring is essential for financial stability and stakeholder confidence, stringent external monitoring can hinder banking competition and so the potential negative impacts of external monitory on banking competition underscores the important need for regulators to strike a balance between ensuring adequate supervision and maintaining a competitive environment within the banking industry that fosters innovation and growth.

Though information disclosure by banks is important and can have several effects on the banking industry, its influence on banking competition is insignificant.

Stringent regulatory oversight and supervisory requirements often impose

additional costs on banks, leading to an increase in operational costs for banks which can excessively affect smaller banks, reducing their ability to compete with larger banks.

The governance structure of banks including the board members, supervisory agency, senior management, shareholders and other stakeholders can contribute to increased market power and decreased banking competition as a result of maximizing profits.

Undoubtedly, infrastructure and connectivity are essential digital technologies that provide significant support for online banking services and improve customer experiences. However, improvement in infrastructure and connectivity do not directly impact the competitive dynamics within the banking industry.

The main findings of this study on the impact of digital regulations on banking competition reveal that an enhancements in electronic transactions (E-Transactions) are connected to a rise in banking competition. An advancements in electronic payment (E-Payment) systems can lead to a decrease in banking competition. An increase in other barriers to trade in digitally enabled services (Digital trade barriers) can potentially induce lower competition in the banking industry.

References 3

Akubuilo Francis and Akubuilo I. Nneoma (2022). Nigerian Banking Sector: Impact of Corporate Governance on Profitability.

Alam, N. (2013). Impact of Banking Regulation on Risk and Efficiency in Islamic Banking. Journal of Financial Reporting and Accounting 11 (1): 29–50.

Altunbaş, Y., Polizzi, S., Scannella, E. et al. (2022). European Banking Union and bank risk disclosure: the effects of the Single Supervisory Mechanism. Rev Quant Finan Acc 58, 649–683. https://doi.org/10.1007/s11156-021-01005-z

Ananda, S., Devesh, S. and Al Lawati, A.M (2020). What factors drive the adoption of digital banking? An empirical study from the perspective of Omani retail banking. J Financ Serv Mark 25, 14–24. https://doi.org/10.1057/s41264-020-00072-y

Anginer, D., Bertay, A. C., Cull, R., Demirgüç-Kunt, A., and Mare, D. S. (2019). Bank Regulation and Supervision Ten Years after the Global Financial Crisis. World Bank.

Arda, A., Gororo, M., Grochalska, J., and Mohlala, M. (2018). External Audit Arrangements at Central Banks.

Barth, J.R., G. Caprio, and R. Levine. 2004. Bank regulation and supervision: What works best? Journal of Financial Intermediation 13 (2): 205–248.

Burks, J.J., Cuny, C., Gerakos, and Granja J. (2018). Competition and voluntary disclosure: evidence from deregulation in the banking industry. Rev Account Stud 23, 1471–1511. https://doi.org/10.1007/s11142-018-9463-1

Chauhan, S., Akhtar, A. and Gupta, A. (2022), "Customer experience in digital banking: a review and future research directions", International Journal of Quality and Service Sciences, Vol. 14 No. 2, pp. 311-348. https://doi.org/10.1108/IJQSS-02-2021-0027

Coccorese, P. (2017). Banking competition and economic growth.

Corbae, D., and Levine, R. (2019). Competition, Stability, and Efficiency in the Banking Industry.

Degryse, H., Laeven, L., and Ongena, S. (2009). Impact of Organizational Structure and Lending Technology on Banking Competition.

Devendra.G.O. (2022). The Impact of Digital Banking on Traditional Banking Services. Journal of Emerging Technologies and Innovative Research (JETIR), 9(1), 2647-2654.

Divya K. Hema, Rahaman Md S., Aravind, D. and Venkatesh, P. (2021). Impact of digital payments on selected banks performance. American Institute of Physics. https://pubs.aip.org/aip/acp/article/2821/1/040018/2922627/

Duan Jie and Yang Yuchen (2023). Proceedings of the 2023 4th International Conference on Management Science and Engineering Management (ICMSEM 2023). Advances in Economics, Business and Management Research.

Genet Yitayew (2021). Factors Affecting Adoption of Electronic Banking Services at CBE.

Ghosh Saibal (2007). External Auditing, Managerial Monitoring and Firm Valuation: An Empirical Analysis for India. International Journal of Auditing Int. J. Audit. 11: 1–15

Hao, Shuang, Zhi Chen, Chien-Chih Wang, and Che-Yu Hung (2023). "Impact of Digital Service Trade Barriers and Cross-Border Digital Service Inputs on Economic Growth" Sustainability 15, no. 19: 14547. https://doi.org/10.3390/su151914547

Isaac Anane, and Fengying Nie (2022). Determinants Factors of Digital Financial Services Adoption and Usage Level: Empirical Evidence from Ghana, International Journal of Management Technology, Vol.9, No 1, pp. 26-47

James, G., Witten, D., Hastie, T., and Tibshirani, R. (2013). An introduction to statistical learning (1st ed.).

Jangam, Bhushan Praveen (2023) "Do barriers to digital services trade hamper economic growth? Evidence from a cross-country analysis" Bulletin of Monetary Economics and Banking: Vol. 26: No. 0, Article 7. DOI: https://doi.org/10.59091/1410-8046.2059

Jiang, T., Hu, Y., Haleem, F., and Zeng, S. (2023). Do Digital Trade Rules Matter? Empirical Evidence from TAPED. Sustainability, 15(11), 90741

Li, Shaofang (2018). The Impact of Bank Regulation and Supervision on Competition: Evolution in the Emerging Economies. Available at SSRN: https://ssrn.com/abstract=3176498 or http://dx.doi.org/10.2139/ssrn.3176498

Li, Shaofang (2019). The Impact of Bank Regulation and Supervision on Competition: Evidence from Emerging Economies. Emerging Markets Finance and Trade, 55(10), 2334–2364. https://doi.org/10.1080/1540496X.2018.1547191

Li, Shaofang (2021). The Impact of Bank Regulation and Supervision on Competition. In: Financial Regulation and Bank Performance. Contributions to Finance and Accounting. Springer, Singapore.

Liu Estelle X. (2021) Stay Competitive in the Digital Age: The Future of Banks.

Menard, S. (2001). Applied Logistic Regression Analysis (2nd ed.). London: Sage Publications.

Nayak Ranjeeta (2021). "Banking regulations: do they matter for performance?" Journal of Banking Regulation, Palgrave Macmillan, vol. 22(4), pages 261-274, December.

OECD (2020). Digital Disruption in Banking and its Impact on Competition. Retrieved from https://www.oecd.org/competition/digital-disruption-in-banking-and-i

OECD. (2022). Digital Services Trade Restrictiveness Index.

OECD (2023). Key Issues in Digital Trade. OECD Global Forum on Trade 2023 "Making Digital Trade Work for All".

Oyelami, L.O., Adebiyi, S.O. and Adekunle, B.S (2020). Electronic payment adoption and consumers' spending growth: empirical evidence from Nigeria. Futur Bus J 6, 14. https://doi.org/10.1186/s43093 020-00022-z

Peria Soledad Martinez Maria (2010). Measuring Bank Competition: How Should We Do It?

Qian Liao and Xuerou Yu (2023). An Empirical Study on the Impact of

Digital Trade Barriers on the Export Benefits of Cross Border E-commerce. Proceedings of the 2nd International Conference on Information Economy, Data Modeling and Cloud Computing, ICIDC 2023, June 2–4, 2023, Nanchang, China.

Raunig Burkhard and Sigmund Michael (2024). SUERF Policy Brief – The ECB Single Supervisory Mechanism: Any Effects on Bank Competition?

Sarkisyan, Sergey, Instant Payment Systems and Competition for Deposits (March 17, 2024). Jacobs Levy Equity Management Center for Quantitative Financial Research Paper, Available at SSRN: https://ssrn.com/abstract=4176990 or http://dx.doi.org/10.2139/ssrn.4176990

Shleifer Andrei and Vishny W. Robert. (1994). Politicians and Firms. The Quarterly Journal of Economics 109 (4): 995–1025.

Valsamidis, S., Tsourgiannis, L., Pappas, D., and Mosxou, E. (2020). Digital Banking in the New Era: Exploring Customers' Attitudes. In: Horobet, A., Polychronidou, P., Karasavvoglou, A. (eds) Business Performance and Financial Institutions in Europe. Contributions to Economics.

Vauhkonen, J. (2012). The Impact of Pillar 3 Disclosure Requirements on Bank Safety. J Financ Serv Res 41, 37–49. https://doi.org/10.1007/s10693-011-0107-x

Velte, P. (2022). The impact of external auditors on firms' financial restatements: a review of archival studies and implications for future research.

Velte, P. (2023). The impact of external auditors on firms' financial restatements: a review of archival studies and implications for future research. Manag Rev Q 73, 959–985 https://doi.org/10.1007/s11301-022-00264-x

Vittinghoff, E., Glidden, D. V., Shiboski, S. C., and McCulloch, C. E.

(2005). Regression methods in biostatistics: Linear, logistic, survival, and repeated measures models. Springer Publishing Co.

Wu C, Liu T, and Yang X (2023). Assessing the Impact of Digital Finance on the Total Factor Productivity of Commercial Banks: An Empirical Analysis of China. Mathematics. 11(3):665. https://doi.org/10.3390/math11030665

Yinguo Dong, Baixue Xiao, and Xiaocui Wang (2022). Research on the Impact of Barriers to Cross-Border Data Flows on Digital Services Trade Competitiveness Mediation Effect Analysis Based on FDI in the Services Industry.

Zuo L, Strauss J, Zuo L (2021). The Digitalization Transformation of Commercial Banks and Its Impact on Sustainable Efficiency Improvements through Investment in Science and Technology. Sustainability. 13(19):11028. https://doi.org/10.3390/su131911028

Zuo L, Li H, Xia X (2023). An Empirical Analysis of the Impact of Digital Finance on the Efficiency of Commercial Banks. Sustainability. 2023; 15(5):4667. https://doi.org/10.3390/su15054667

Table 3.1: Summary statistics for the variables

Variable	**Mean**	**St.Dev**	**Min**	**Median**	**Max**
Lerner	0.18	0.10	-0.84	0.18	0.90
InfraCon	0.08	0.04	0.04	0.08	0.16
E-Trans	0.03	0.01	0.00	0.04	0.04
E-Pay	0.00	0.01	0.00	0.00	0.02
DigBarr	0.02	0.01	0.00	0.02	0.04
GDP	36034.58	9821.92	12425.68	37567.87	97656.78
ROA	0.00	0.00	0.00	0.00	0.14
InfoDisc	9.61	0.78	7.00	10.00	10.00
ExtMon	0.98	0.06	0.50	1.00	1.00
Supv	3.01	0.19	2.00	3.00	5.00
BankGov	2.90	0.53	1.00	3.00	4.00

Table 3.2: Correlation Matrix and VIF Test

	Lerner	InfraCon	E-Trans	E-Pay	DigBarr	GDP	ROA	InfoDisc	ExtMon	Supv	BankGov	VIF
Lerner	1											–
InfraCon	-0.16	1										1.17
E-Trans	-0.23	-0.19	1									2.25
E-Pay	0.26	-0.40	-0.41	1								1.87
DigBarr	0.19	-0.21	-0.20	0.38	1							1.05
GDP	-0.002	0.17	-0.01	-0.17	-0.17	1						1.21
ROA	0.38	-0.04	-0.30	0.18	0.10	-0.04	1					1.08
InfoDisc	-0.08	-0.47	0.52	0.12	-0.11	-0.24	-0.23	1				4.27
ExtMon	-0.19	-0.06	0.32	-0.22	-0.13	0.12	-0.27	0.49	1			1.86
Supv	0.03	0.05	-0.13	0.05	-0.05	-0.11	0.04	0.15	0.30	1		1.30
BankGov	-0.001	-0.37	0.24	0.002	-0.13	-0.32	-0.10	0.64	0.18	-0.05	1	2.17

Table 3.3: Digital Regulations and Banking Competition

Variable	Estimate	Std. Error	z-value	p-value
(Intercept)	0.17837274	0.00187791	94.9846	$< 2.2e-16$ ***
InfraCon	-0.00023094	0.00113505	-0.2035	0.8387746
E-Trans	-0.00751868	0.00280405	-2.6814	0.0073322 **
E-Pay	0.01550568	0.00260229	5.9585	$2.546e-09$ ***
DigBarr	0.00193649	0.00096859	1.9993	0.0455787 *
GDP	0.00756289	0.00197871	3.8221	0.0001323 ***
ROA	0.01983598	0.00126148	15.7244	$< 2.2e-16$ ***
InfoDisc	0.00299000	0.00378283	0.7904	0.4292858
ExtMon	-0.01216598	0.00245319	-4.9592	$7.077e-07$ ***
Supv	0.00432078	0.00216484	1.9959	0.0459461 *
BankGov	0.00797111	0.00272946	2.9204	0.0034958 **

Significance levels: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
The dependent variable (Lerner index) is the competition measure.