ESSAYS ON FINANCIAL DEVELOPMENT

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THESIS SUMMARY

The impact of financial development on economic growth has been studied in the past few decades. However, the empirical findings range from having a positive effect on economic growth in early studies to no impact or even negative effect in the last decade. Therefore, this thesis contributes to the finance-growth nexus by re-examining the relationship using different dimensions of financial development, namely financial stability, financial crises, and financial structure. This thesis is comprised of three empirical chapters.

The first empirical study examines the impact of natural disasters on banking stability. Given that the effects of natural disasters on banking stability differ across the level of economic development, this study focuses on these heterogeneous effects. We combine two different datasets. The first utilises bank-level data comprising 1,242 banks across 72 countries, and the second uses the natural disasters dataset provided by the Centre for Research on the Epidemiology of Disasters (CRED). We estimate our models by employing a panel regression estimator with the bank and year-fixed effects. The results suggest that natural disasters significantly affect the distance-to-default (Z-score), which is our measure of banks' stability, especially for middle-and low-income countries. The results also indicate that natural disasters adversely affect non-performing loans, return on assets, and capital ratios of banks.

The second empirical study examines the impact of banking, currency and debt crises on economic growth and its volatility. Financial crises often have a devastating impact on living standards. However, there needs to be more evidence about their effects in Africa, a vastly underdeveloped region. We empirically estimate a growth equation using both fixed effects and System GMM estimations. Using data from 1970 to 2017 for 52 African countries, we find that only currency and debt crises affect economic growth negatively in Africa. On the other hand, banking crises are shown to have a statistically insignificant effect on growth in Africa. Currency crises may reduce economic growth in the long run by 1.19 percentage points, and debt crises are the most harmful, reducing long-run growth by three percentage points.

The third empirical study investigates the relationship between financial structure and economic growth. There is inconclusive empirical evidence regarding the importance of financial structure and whether a market or bank-based financial system contributes to economic growth. Consequently, we contribute to the literature by re-examining the relationship based on a broader sample and more recent data. Our sample includes 84 countries and covers the period from 1960 to 2019. The results of our study indicate that the banking sector is no longer an essential source of growth promotion in the last two decades. Moreover, according to some of our analyses, economic growth is negatively impacted by the increased development of the banking sector. In contrast, from 2000 to 2019, the stock market consistently and significantly contributed to economic growth.

Key words: financial development, economic growth, banking stability, natural disasters, financial crises, financial structure

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LIST OF ABBREVIATIONS

CRED	Centre for Research on the Epidemiology of Disasters
UNDRR	United Nations Office for Disaster Risk Reduction
GDP	Gross Domestic Product
EM-DAT	Emergency Events Database
GNI	Gross National Income
ODA	Official Development Assistance
HIC	High Income Countries
L&M	Low- and Middle-Income Countries
NPL	Non-Performing Loans ratio
GFC	Global Financial Crisis
U.S.	United States
FS	Financial Structure

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CHAPTER 1: INTRODUCTION

This thesis aims to empirically investigate the various dimensions of financial development and their impact on the economy. Specifically, it examines the relationship between financial development and economic growth, while also considering the influence of other key variables. Previous literature has emphasised the significance of financial development in fostering economic growth. However, recent studies suggest a more complex relationship, necessitating further exploration. Thus, this thesis seeks to contribute to the existing body of knowledge by delving into the complexities of the relationship between financial development and economic growth. To provide a comprehensive foundation for the subsequent empirical chapters, this chapter offers a concise overview of the main theories and empirical studies in the finance-growth nexus, establishing a connection to the subsequent empirical chapters.

In the field of development economics, there is a widely held belief that finance plays a pivotal role in driving economic growth, as initially put forth by Shaw (1973) and McKinnon (1974) in their research on financial liberalisation and the impact of financial intermediaries on economic growth. According to this perspective, the presence of a well-designed financial system, sophisticated financial services, and a high level of financial institution and market development are crucial for fostering positive economic growth in developing nations. However, there has been an ongoing and vigorous debate concerning the significance of the relationship between financial development and economic growth over the past few decades. Lucas (1988) argues that financial development is inconsequential for growth and has been " very badly over-stressed," while Miller (1998) contends that the link between finance and growth is "painfully obvious" and requires no further examination. Conversely, Bagehot (1873) and Schumpeter (1911) assert that the connection between economic growth and financial development is non-trivial and fundamental to comprehending the economic landscape of any country. Consequently, it is imperative to review the existing literature to gain a deeper

understanding of the complexities involved in the relationship between financial development and economic growth.

Several influential studies have demonstrated the positive relationship between financial development and economic growth. Goldsmith (1969) posits that a strong connection and interplay exist between financial outcomes or growth, based on the size of the financial industry, and long-term economic growth. He argues that intermediation channels savings towards productive investments, thus explaining the association between finance and growth. Similarly, King and Levine (1993a) conducted one of the pioneering empirical studies demonstrating the positive role of the financial system in fostering economic growth. Their findings indicate a robust correlation between financial development indicators and economic growth, with a significant ability to predict future growth rates. Expanding on this perspective, King and Levine (1993b) contend that a more developed financial system is more likely to facilitate productivity improvements by effectively selecting high-quality entrepreneurs and projects, mobilizing external financing, providing mechanisms for risk diversification in innovative activities, and fostering a greater understanding of the potential profits associated with uncertain business ventures. Moreover, Rajan and Zingales (1998) contribute to this body of evidence by uncovering a similar relationship, highlighting that the development of financial markets and intermediaries disproportionately affects sectors that rely more heavily on external financing.

Continuing the examination of the finance-growth nexus, additional empirical studies offer further evidence to strengthen this relationship. Levine, Loayza, and Beck (2000) employ instrumental variable procedures, utilizing the legal and accounting systems as instruments, to provide additional support for the finance-growth nexus. Their findings reinforce the argument that financial intermediaries have a significant impact on factors that contribute to productivity growth. Similarly, Beck et al. (2000) incorporate dynamic panel procedures, such as difference

and system GMM indicators, to substantiate the notion that financial intermediaries play a crucial role in fostering productivity growth. Furthermore, Levine and Zervos (1998) explore the contributions of financial market development to economic growth. Their research reveals that, even after controlling for economic and political factors, the development of financial institutions and markets promotes capital accumulation and higher productivity. Similarly, recent empirical studies have found similar results. Nguyen et al. (2022) re-examine the growth-finance nexus using contemporary data. Their results suggest that there is a positive relationship between financial development and economic growth, and they argue that the relationship is linear and there is a bidirectional causality between finance and growth. in addition, Ahmed et al. (2022) find that financial development is essential for growth. however, they argue that the information and communication technology have a direct and noteworthy influence on the relationship between finance and growth.

The mechanisms through which financial development promotes economic growth are multifaceted and encompass vital roles played by developed financial institutions and markets. According to Levine (1997), the significance of developed financial institutions and markets in driving economic growth cannot be overstated, as they serve as the backbone of economies worldwide. These institutions and markets perform crucial roles in the growth process, particularly in providing loans and credit facilities that facilitate productive activities. The essential functions of the financial system can be categorised into five key areas. Firstly, trade facilitation encompasses activities such as risk diversification, pooling, hedging, resource allocation, savings mobilisation, managerial oversight, corporate control, and facilitation of the exchange of goods and services. These functions directly support economic growth by enabling efficient trade and fostering business operations. Moreover, these functions indirectly influence economic growth by impacting capital accumulation and fostering technological advancements within financial institutions.

The role of the financial sector in promoting economic growth is a subject of debate among economists, with contrasting perspectives on its significance. While the previous paragraphs emphasised the positive impact of financial development on economic growth, it is important to recognise that economists hold differing views on the role of the financial sector. Lucas (1988), for instance, downplays the significance of finance as a determining factor in economic growth. Robinson (1952) suggests that finance simply follows the lead of enterprise, implying that it does not actively drive economic growth but rather responds to demand from the non-financial sector. Critics such as Bagehot (1873) and other economists challenge the notion that the finance-growth nexus can be dismissed without severely limiting our understanding of economic growth. They emphasise the need to carefully study and interpret the specific impact of financial development on growth, as this relationship may vary among countries. Furthermore, Demetriades and Hussein (1996) argue that the relationship between financial development and economic growth may evolve over time, influenced by various factors. Some contemporary studies using more recent data have found contrasting results. Rousseau and Wachtel (2011) and Arcand, Berkes, and Panizza (2015) indicate that the previously observed positive impact of the banking sector on economic growth may be diminishing or even adversely affecting growth. In addition, Aluko and Ibrahim (2020) argue that the relationship is complex, and it depends on the institutional quality in the country. They find that financial development does not promote economic growth in countries where institutional quality is under a certain threshold. Likewise, Zhang and Zhou (2021) claim that financial development could spur growth in the short run; however, in the long run, they find that financial development does not have a significant impact on growth. Similarly, Shahbaz, Nasir and Lahiani (2022) find that increased financial development levels in some countries actually hampers economic growth.

In order to comprehensively understand the impact of financial development, it is crucial to consider how we measure a country's level of financial development. Traditional empirical research often relies on the size, or depth, of the financial sector as a proxy for financial development (Goldsmith, 1969; King and Levine, 1993b). However, it is important to acknowledge that financial depth alone may not capture the full extent of financial development, as highlighted by Arcand, Berkes and Panizza (2015). They argue that financial depth is an imperfect proxy for the broader concept of financial development. Recognising the need for a more comprehensive approach, Čihák et al. (2012) have identified four significant features or attributes of financial institutions and markets that provide a useful framework for measuring the roles of financial systems. These four broad traits include: the size of financial institutions and markets (financial depth), the accessibility of financial institutions and markets to individuals and their actual usage (access), the efficiency of financial institutions and markets in delivering financial services (efficiency), and the stability of financial institutions and markets (stability). By considering these four dimensions, researchers can obtain a more nuanced understanding of a country's financial development. This multifaceted measurement approach allows for a comprehensive assessment of the various components of financial systems, enabling a more accurate evaluation of their impact on economic growth. In the subsequent empirical chapters of this thesis, these measures will be utilised to provide a robust analysis of the relationship between financial development and economic growth.

To gain a comprehensive understanding of the relationship between finance and economic growth, it is imperative to employ contemporary data and consider multiple dimensions of financial development. While traditional measures often focus on the size of the financial sector as a proxy for financial development, recent research highlights the significance of exploring additional dimensions. One such dimension, highlighted by Čihák et al. (2012), is financial stability, which serves as a proxy for financial development. Empirical studies demonstrate that

a stable banking sector positively affects the real economy by enhancing output growth certainty (Jokipii and Monnin, 2013; Creel, Hubert, and Labondance, 2015; Wang, Chen, and Xiong, 2019). However, the stability of the banking sector can be influenced by various factors. In the aftermath of the global financial crisis in 2008, financial regulators played a pivotal role in mitigating excessive risks taken by banks, which significantly affected banking sector stability (Alexander, 2014). Several factors are known to impact the stability of the banking system. These include financial liberalisation, banking sector concentration, and interest rate volatility (Calvo, Leiderman and Reinhart, 1993; Detragiache and Demirgüç-Kunt, 1998; Boyd and De Nicoló, 2005; Beck, Demirgüç-Kunt and Levine, 2006; Laeven and Valencia, 2013). However, it is important to recognise that factors beyond the financial sector can also exert influence, such as political uncertainty, crises, and natural disasters. Surprisingly, the impact of natural disasters on banking sector stability remains understudied in the existing literature. Alexander (2014) emphasises the need for banking sector regulators to consider natural disasters as a genuine threat, urging them to maintain adequate capital reserves. Nevertheless, current research primarily focuses on the broader economic output effects of natural disasters, neglecting their specific implications for bank stability (Albala-Bertrand, 1993; Skidmore and Toya, 2002; Noy, 2009; Felbermayr and Gröschl, 2014; Klomp and Valckx, 2014). In the first empirical chapter, we aim to bridge this gap by examining the relationship between natural disasters and bank stability. By addressing this understudied aspect, our research intends to provide valuable insights for banking sector regulators and policymakers. This exploration not only contributes to the broader understanding of the finance-growth nexus but also promotes resilience and stability in the face of natural disasters.

Financial crises serve as another compelling topic in the literature. Numerous studies have established a positive association between financial development, particularly when measured by depth, and economic growth (King and Levine, 1993a; King and Levine, 1993b;

Demetriades and Hussein, 1996; Rousseau and Wachtel, 1998; Demetriades and Andrianova, 2004; Valickova, Havranek, and Horvath, 2015). However, it is crucial to recognize that such development can also give rise to financial crises (Wachtel, 2018). Extensive evidence drawn from diverse economies, both developed and developing, highlights the vulnerability and destabilizing effects associated with financial liberalisation, which can lead to severe financial crises (Demirgüç-Kunt and Detragiache, 1998; Arestis and Demetriades, 1999; Kaminsky and Schmukler, 2003). In addition, financial crises can be triggered by various factors, with underdeveloped financial systems being particularly susceptible to such events. Countries characterised by poorly defined legal and regulatory frameworks within their financial sectors are at a heightened risk of experiencing increasing financial crises that exert disruptive effects on the economy and society (Reinhart and Reinhart, 2015). Consequently, as economic activity declines and the intermediation capacity of the banking system becomes compromised, credit rationing becomes prevalent, hindering investment in growth-stimulating opportunities. It is worth noting that financial crises have been found to have detrimental effects on economic growth (Summers, 2000; Barro, 2001). Given the complex relationship between finance and growth, it is essential to comprehensively examine the effects of financial crises on both financial development and economic growth to navigate the challenges associated with promoting financial stability and sustainable economic growth. Hence, in Chapter 3, we empirically examine the impact of financial crises on economic growth.

Moreover, it is evident that both financial markets and institutions play a pivotal role in fostering economic growth. However, divergent theories exist concerning which system, whether financial institutions or financial markets, exerts a more substantial influence on growth. The market-based theory emphasises the significance of financial markets in promoting economic growth. Financial markets facilitate diversification and the efficient dissemination of information, thereby enabling investments and facilitating the mobilisation of

savings (Arestis, Demetriades and Luintel, 2001). Conversely, the bank-based view posits that banks can address certain weaknesses inherent in stock markets. Specifically, a well-developed stock market swiftly reveals information, making it challenging for investors to access and analyse such information. Consequently, a well-developed stock market may reduce individuals' incentives to identify innovative projects, impeding resource allocation and limiting economic growth (Stiglitz, 1985). Overall, there remains limited consensus on which system—bank-based or market-based—is more preferable for fostering growth (Luintel et al., 2008; Mathenge and Nikolaidou, 2018; Chu, 2020). Therefore, in Chapter 4, we re-examine the relationship between financial structure and economic growth by utilising contemporary data and a broader sample to gain a deeper understanding of the relationship between finance and growth.

Given the extensive literature reviewed regarding the diverse effects of financial development measures, a significant gap in empirical research on financial development becomes apparent. This gap calls for further investigation to address the changing nature of the finance-growth nexus Therefore, the primary objective of this thesis is to fill this gap by conducting three distinct empirical studies that contribute to our understanding of financial development and its implications. The studies included in this thesis are as follows:

1- This thesis empirically examines the impact of natural disasters on bank stability, an essential measure of financial development. By exploring various factors that may influence bank stability in the face of natural disasters, this study aims to enhance our understanding of the vulnerabilities and resilience of financial institutions in the context of these catastrophic events.
2- The thesis analyses the effects of different types of financial crises on economic growth. Building on the existing literature that highlights the importance of avoiding financial crises for financial development to positively impact economic growth, this study seeks

to provide insights into the specific dynamics and consequences of financial crises on overall economic performance.

3- The thesis investigates the impact of financial development on economic growth by comparing the effects of stock markets and banks on the economy. Recognising that countries exhibit different financial structures, with some relying more heavily on the banking sector while others emphasise the stock market, this study aims to examine the role of financial structure in shaping the relationship between financial development and economic growth.

By conducting these three empirical studies, this thesis aims to contribute to the existing literature on financial development and its complex effects on economic growth. The findings from these studies will provide valuable insights for policymakers, regulators, and researchers, enabling them to make informed decisions and formulate effective strategies to promote sustainable financial systems and foster long-term economic growth.

This thesis is structured into five chapters as follows:

Chapter 2 provides empirical evidence of the impact of natural disasters on banking stability. Chapter 3 examines the effects of different types of financial crises on economic growth and its volatility in Africa. Chapter 4 investigates the importance and significance of banks and markets for economic growth and which financial structure works best for countries. Finally, chapter 5 concludes and offers several policy-related implications based on the empirical results of the thesis. References are provided at the end of the thesis.

CHAPTER 2: THE IMPACT OF NATURAL DISASTERS ON BANKING STABILITY

2.1 Introduction

Natural disasters possess a remarkable capacity to inflict tremendous losses on human lives and economies. According to the UNDRR's 2019 report, disasters associated with extensive risk accounted for 68.5% of all economic losses between 2005 and 2017. As these catastrophes strike, they can dramatically impact various sectors, including the financial industry. The banking sector, which plays a vital role in the economy and society by providing essential intermediation services, is not immune to the disruptive forces of natural disasters. Recognising their potential influence on banking stability becomes imperative to ensure the sector's resilience and continued effectiveness.

Studies have consistently demonstrated the positive contribution of banking stability to the real economy, fostering increased certainty in real output growth (Jokipii and Monnin, 2013; Creel, Hubert, and Labondance, 2015; Wang, Chen, and Xiong, 2019). However, the stability of the banking sector remains vulnerable to a variety of factors. For instance, financial liberalisation (Detragiache and Demirgüç-Kunt, 1998; Laeven and Valencia, 2013), banking sector concentration (Boyd and De Nicoló, 2005; Beck, Demirgüç-Kunt, and Levine, 2006), and interest rate volatility (Demirgüç-Kunt and Detragiache, 1998; Calvo, Leiderman, and Reinhart, 1993), have been identified as determinants of banking stability. However, among these factors, the potential influence of natural disasters on banking stability remains relatively understudied.

Disasters can significantly impact the stability of the banking sector by increasing the share of non-performing loans or raising the likelihood of bank runs, particularly in the immediate aftermath of the events. Notably, large-scale natural disasters exert adverse effects on the

financial sector within the affected regions. Consequently, banking regulators require banks to maintain adequate capital reserves and acknowledge the systematic environmental risks that pose threats to banking stability (Alexander, 2014). The examination of the effect of natural disasters on financial stability has yielded inconclusive findings. Klomp (2014) stands as the pioneering study to directly explore this effect, revealing the significant impact of large-scale disasters on financial stability. However, only a handful of subsequent studies have followed Klomp (2014), investigating the relationship using different samples and methodological approaches (Noth and Schüwer, 2018; Albuquerque and Rajhi, 2019; Brei, Mohan, and Strobl, 2019).

Therefore, in this chapter, we aim to answer the question of whether there is a direct impact of natural disasters on the stability of the banks. Moreover, natural disaster shocks may differ in high-income and low-income countries. It is expected that natural disasters have a relatively lower effect on high-income countries since they may have a strong infrastructure in place, good credit ratings that permit sovereign borrowing, and a developed insurance industry that helps alleviate losses. Therefore, we also aim to answer the question of whether the effect of natural disasters has a different impact on low-income countries. Finally, economies have different characteristics, which means that even if two different low-income countries face similar disasters in terms of their magnitude, the effect of that damage on the economy may differ. Therefore, we test if the banking sectors in countries with relatively higher agriculture share in their GDP are affected more than other countries. As the agriculture sector is likely to be affected more by natural disasters as compared with other sectors, we seek to consider this factor in our study to see if it has any significant effect on banking stability during disasters.

To answer the research questions, we utilise the total number of people affected by disasters as a measure of the exogenous shock of natural disasters. Additionally, our main dependent

variable is the distance-to-default measure, or Z-score, commonly used in the literature to measure the stability of banks. We find that, by using a fixed effects estimator, the natural disaster variable has a significantly negative impact on the Z-score bank values, especially in middle- and low-income countries. Furthermore, we perform different robustness tests to consider other situations. Due to the over-representation of banks from high-income countries, we split our sample into two groups: high-income countries and middle- and low-income countries. We produce different results that show that the impact is only significant for middle- and low-income economies. Additionally, we utilise a different binary variable of natural disasters, and the results support our main findings. Lastly, we employ additional measures for the stability of banks and find that natural disasters affect non-performing loans, return on assets ratios, and capital ratios.

This study contributes to the existing literature in four ways. First, it examines the direct impact of natural disasters on banking stability. The previous literature studying the same effect of natural disasters on banks has focused only on large-scale disasters in terms of the total damages caused by the events (Klomp, 2014). Thus, our study expands this scope by including more disasters and using the total number of people affected as a main proxy for natural disasters as the total cost of disasters can be manipulated or miscalculated (Noy, 2009; Keerthiratne and Tol, 2017). While total monetary damages directly measure the financial losses caused by natural disasters, they may not capture the full extent of their impact on the banking sector. The total monetary damage may be gathered by inexperienced individuals who attend to the affected areas to provide medical assistance; therefore, they may lack the expertise to evaluate the economic losses correctly, especially in poorer countries (Noy, 2009; Keerthiratne and Tol, 2017; McDermott, Barry and Tol, 2014). Though both measures of natural disasters may have a similar limitation when it comes to the accuracy of reported data, the total number of people affected is a more straight-forward measure even for low-income

countries as they can still estimate the number of people affected with surveys, census or population data, and reports from relief agencies. In addition, natural disasters can have indirect financial consequences, such as increased loan defaults, higher credit risk, reduced economic growth, and increased operational costs for banks. These indirect effects may not be fully reflected in the monetary damages alone. By considering the number of people affected, we are accounting for the broader socioeconomic impact, which can indirectly influence the stability of the banking sector. Therefore, the total number of people affected is more suitable for this study as it reflects the scale of social and economic disruptions caused by natural disasters. When a large number of people are affected, it indicates significant disruptions in various sectors, including housing, transportation, healthcare, education, and commerce. Such disruptions can have tumbling effects on the stability and functioning of the banking sector. For example, if a substantial portion of the population is displaced or faces financial hardships due to a disaster, it may lead to increased loan provisions, reduced consumer spending, and a decline in economic activity, all of which can affect the stability of banks.

Second, this chapter provides bank-level evidence of the effect of natural disasters on banking stability. Most natural disaster studies use country-level data (Noy, 2009; McDermott, Barry and Tol, 2014; Klomp, 2014; Keerthiratne and Tol, 2017; Albuquerque and Rajhi, 2019). Though the use of macro-level variables can be expected when studying the effect on the economy, it is imperative to examine the bank-level variations and the impact on banks directly. Bank-level data allows for analysis of disaster effects on individual banks' stability indicators like non-performing loans, profitability, and liquidity ratios which provides more nuanced evidence than aggregate system-wide data. It allows for an assessment of risk management practices and preparedness measures implemented by individual banks in response to natural disasters. Keerthiratne and Tol (2017) suggest that using micro-level data to study the effect of natural disasters can be more helpful, as macro-level data are open to misinterpretation, which

may disguise the actual mechanisms. Therefore, bank-level data helps to isolate variations in banking stability arising from (unobserved) heterogeneity of banks and ensures that individual banks' reactions to natural disasters are not confounded by aggregate variation in the stability of the banking sector (Skidmore, 2001; Kellenberg and Mobarak, 2008; Fosu, 2014).

Third, this chapter contributes to the natural disasters and banking stability literature by including the agricultural share in the economy in the analysis. A country's dependence on certain sectors that are more vulnerable to disasters is an essential factor to consider when examining the relationship. In the natural disaster literature, the agricultural share of the economy has been considered when measuring the impact of disasters on loan portfolio performance (Collier, Katchova and Skees, 2011), economic growth (Klomp and Valckx, 2014; McDermott, Barryy and Tol, 2014), and financial development (Keerthiratne and Tol, 2017). While other studies have examined the impact of disasters on banking stability, they do not consider the agriculture factor in their research. None of these studies has attempted to take the agricultural share in the economy into account when measuring the impact of natural disasters on banking stability. The agricultural sector is often highly vulnerable to natural disasters due to its dependence on weather conditions and natural resources, and disruptions in agricultural production can have spillover effects on banks. For instance, a decline in agricultural output can lead to reduced incomes for farmers, affecting their ability to repay agricultural loans. This, in turn, can impact banks' loan portfolios and credit risk. Shala and Schumacher (2022) find that natural disasters affect banks' loan repayments, and the impairments were mostly driven by corporate loans concentrated in specific sectors, such as agriculture and manufacturing. Therefore, this reveals a demanding gap in the literature, as previous studies have focused only on distinguishing developed and developing countries; however, that does not count for the reliance on agriculture in the economy.

Finally, we contribute to the literature by introducing a new threshold that determines the natural disasters magnitude that affect banks' stability. McDermott, Barry, and Tol (2014) have constructed a binary variable of natural disasters with a threshold of the total people affected to the population is 0.5%. However, as the threshold is somewhat arbitrary, we expand our scope by testing different thresholds. In particular, we test for different thresholds of the ratio of total number of people affected to the total population, namely, 0.5%, 1%, 2.5%, 5%, 7%, and 10%. By setting a threshold based on the share of the population affected by disasters we provide a clear criterion for determining when natural disasters are considered to have a significant impact on the banking stability. This threshold can help identify situations where the severity or scale of the disaster is substantial enough to potentially affect the stability of the banking sector. It allows for a more nuanced analysis by distinguishing between low-impact and high-impact events. Additionally, it can help policymakers and stakeholders identify critical thresholds at which interventions and policy responses may be necessary to safeguard banking stability.

The remainder of this chapter consists of five sections. In section 2.2, we present the literature review and the primary studies that have examined the relationship between natural disasters and banking stability. Section 2.3 shows the data we use in this study, while section 2.4 outlines the methodology. Section 2.5 then presents the results, main findings, and discussion. Finally, section 2.6 offers our conclusion and a discussion of our recommendations and limitations.

2.2 Literature Review

There are various factors that play essential roles in increasing the banking sector's fragility. For example, financial liberalisation can cause markets to become more unstable, and banking crises occur more frequently in liberalised economies. However, a robust institutional environment can limit the adverse effects of liberalisation on the financial system (Detragiache

and Demirgüç-Kunt, 1998). Likewise, Ranciere, Tornell and Westermann (2006) find that financial liberalisation leads to financial instability and crises; however, they argue that financial liberalisation is also beneficial for faster average long-run growth. Additionally, Laeven and Valencia (2013) highlight recent data showing that costly banking crises occur in advanced economies and not only in emerging economies. A possible explanation is that financial deregulation or innovation has led to increased financial fragility in developed economies.

Moreover, numerous studies have examined the effects of bank concentration and competition on financial stability. For example, Boyd and De Nicoló (2005) assert that concentrated banking systems increase bank market power and increase interest rates, which may lead firms to take additional risks as a result. Thus, they argue that there is a positive relationship between concentration and banks' fragility. Similarly, Caminal and Matutes (2002) argue that while there is no clear relationship between bank concentration and exposure to risks, a lack of competition may result in less credit rationing, larger loans, and an increased likelihood of failure. In contrast to the above findings, Beck, Demirgüç-Kunt and Levine (2006) suggest that relatively concentrated banking systems are less prone to banking crises after controlling for different regulatory policies and macroeconomic conditions. Their analyses indicate that bank concentration tends to reduce banking fragility.

Furthermore, central banks determine the interest rates in the economy, which has serious consequences for banks. For instance, In the event that banks are unable to increase their lending rates quickly, they can be negatively affected by high interest rates (Demirgüç-Kunt and Detragiache, 1997). Moreover, Calvo, Leiderman and Reinhart (1993) argue that the volatility of interest rates plays a vital role in capital flows, which impacts the financial industry's stability. Similarly, Frankel (1999, cited in Klomp 2014) states that the increased capital flows since 1990 have led to the financial sector's vulnerability and financial crises.

Nevertheless, an increased lending rate for banks is not always beneficial. In recent studies, the effect of having increased finance in the economy has been proven to harm economic growth. For example, Arcand, Berkes, and Panizza (2015) and Law and Singh (2014) argue that financial deepening can be beneficial up to a certain threshold; beyond this threshold, however, increased finance hurts the economy. However, the income level of countries is a crucial factor, as Beck, Degryse and Kneer (2014) find that increased finance in high-income countries increases volatility over the short and medium terms. Similarly, Berger et al. (2019) argue that a bank's liquidity creation level is associated with financial crises and negative financial stability. They also differentiate between Islamic and commercial banks to find that the latter's liquidity creation negatively affects financial stability in high-income countries, while the former's liquidity creation promotes financial stability in low-income countries.

The above-mentioned factors that might affect banks' stability have been well-studied in the literature. However, a potential exogenous factor that may influence the banking sector's stability is natural disasters. Natural disasters result in a tremendous loss not only in terms of human lives but also to the economy. There are around 350 million people affected by natural disasters each year, which can affect a country's plans for development, especially for poorer nations (United Nations, 2019). Furthermore, the economic damage from disasters can be catastrophic; in the past three decades, the estimated damages of natural disasters have been over $2 trillion (Klomp, 2014). Additionally, 68.5% of all economic losses over the period from 2005 to 2017 were caused by disasters associated with extensive risk (UNDRR, 2019). Lastly, according to Alexander (2014), natural disasters can significantly increase the instability of banks unless sufficient precautions are taken, and they argue that banking regulations must recognise systemic environmental risks because they pose a potential threat to banking stability.

The literature on the effect of natural disasters on the economy has been growing in the past two decades (Klomp and Valckx, 2014). One of the first attempts to empirically examine the impact was made by Albala-Bertrand (1993). In this study, he discusses the pre- and post-disaster effects using data from 28 disasters in 26 countries during 1960-1979. The results show that the GDP, capital formation, and agricultural output increased, while there was no effect on inflation and exchange rates. However, Skidmore and Toya (2002) argue that the short-term increase in the GDP is due to how disasters destroy the capital stock, and the capital stock is not measured in the GDP. Therefore, replacing them with investing in disaster mitigation and recovery efforts increase the GDP in the periods immediately following the disasters. Consequently, they extend their study to measure the long-term impact of disasters on economic growth. Their cross-country analysis for the period of 1960-1990 shows that higher frequencies of natural disasters positively affect human capital accumulation, total factor productivity, and economic growth.

Moreover, further research has been done to investigate the effect by examining the differences between developed and developing countries. Raddatz (2007) argues that external shocks, including natural disasters, have an adverse short-term impact on the GDP of low-income countries. However, the results suggest that other internal factors play an essential role in the economic instability experienced by these countries. This claim is supported by Noy's (2009) findings, through which they conclude that developing countries are more vulnerable to disasters. In particular, Noy (2009) finds that developing countries face much larger shocks to their macro economies than developed economies for relatively similar disaster magnitudes. Additionally, while the effects of natural disasters hurt the GDP per capita for developing countries in the short term, the growth returns to its original path in the long term (Klomp and Valckx, 2014). However, natural disaster events do not necessarily have a damaging effect on the economy of all developing countries. Cavallo et al. (2013) state that there must be a radical

political revolution that severely affects the institutional organisation of society for a disaster to harm the growth of the countries in their sample. Therefore, they argue that disasters have no significant effect on economic growth unless they are combined with political distress. In addition, according to Felbermayr and Gröschl (2014), the empirical literature does not provide conclusive evidence of the effects of natural disasters on the economy because most studies use disaster data from insurance company records or news stories. In response, the authors build a comprehensive database of disaster events from primary geophysical and meteorological information instead. They have found a significant and negative impact of natural disasters on growth; more specifically, low-income countries are more affected by geophysical disasters and high-income countries by meteorological events.

Furthermore, it is expected for disasters to both affect the abilities of individuals and small firms to pay back loans and increase the cash demand sharply to cover unexpected losses, especially in developing countries. As Alexander (2014) reviews, natural disasters can then lead to the instability of the banking sector, as they increase the share of non-performing loans and bank runs. Therefore, it is possible for banks to become insolvent following a catastrophe as a result of one of the following mechanisms: bank run or immediate withdrawals to replace losses, excessive provisions for loan losses, increased borrowing demand and lower creditworthiness (Do, Phan and Nguyen, 2023)

However, an early attempt to examine the effects of disasters on banks liquidity was made by Steindl and Weinrobe (1983). They study the deposit experiences of individual savings, loan associations, and commercial banks in the US following a sizable natural disaster. Their findings suggest no evidence of significant changes or bank runs; conversely, there is a substantial increase in deposits. They believe that the rise in deposits can be explained by different factors such as direct government support to facilitate the issues arising from disasters, insurance claims, or individual deposits to insure themselves against any further disruption.

Similarly, Skidmore (2001) examines the savings behaviours in case of natural catastrophes, and he finds that there is an increase in savings rates in cases where the chances of natural disasters are higher. His argues that households tend to self-insure against catastrophic events, especially when insurance claims and government policies do not provide enough protection against possible losses. Ultimately, he argues that natural disasters increase household saving rates. Additionally, Skoufias (2003) argues that many of the informal mechanisms to cope with risk become less effective during economic crises and natural disasters, which leads households to rely on self-insurance strategies. However, these strategies would be costly in terms of current as well as future welfare. Similarly, recent study using contemporary data made by Chamberlain, Vijayaraghavan and Zheng (2019) to examine the impact of natural disasters on bank liquidity. They find that banks face a significant decline in deposits following a disaster which can affect the supply of fund available to support loan growth.

Natural disasters can also affect the banking sector in terms of loans and access to credit. Collier, Katchova and Skees (2011) survey the effect of El Niño events on microfinance institutions in Northern Peru, where they face severe flooding disasters. They have found that the events significantly increased the proportion of restructured loans by 3.6% of the total value of the loan portfolio. Moreover, Berg and Schrader (2012) analyse the impact of natural disaster events in Ecuador on loan demand and access to credit. They find that, during the period following a disaster, the demand for loans increases. However, there is a considerable decrease in the probability for individual clients to be approved for a loan. In addition, Yang (2008) argues that there is a decline in commercial lending after disasters, which can be explained by declines in rates of return or increased risk perceptions on the part of international lenders and investors. Furthermore, Dafermos, Nikolaidi and Galanis (2018) analyse the effect of climate change on financial stability using global data and simulations conducted for the period 2016–2120. They argue that due to climate change events, the liquidity and profitability of firms

would decrease. As a result, the default rate of corporate loans would increase, which can harm the stability of the banking system. Moreover, catastrophic events might affect credit expansion, which would aggravate the adverse impact of disasters on the economy.

Therefore, Dal Maso et al. (2022) argue that banks need to recognise natural disasters risk and one of the effective ways for banks to do that is to enhance their credit risk management through loan loss provisions. They claim that A higher level of loan loss provisions is required by banks in the current period in order to build reserves in anticipation of future write-offs. Moreover, they empirically demonstrate that natural disasters positively affect loan loss provisions, with a one standard deviation change in disaster risk resulting in a 5.4% to 7% increase in loan loss provisions, resulting in a 1.2% to 1.6% reduction in earnings. Likewise, Lambert, Noth and Schüwer (2012) study how banks react to natural disasters by comparing banks in affected locations to other banks. They find that loan loss provisions for banks in locations affected by natural disaster increased sharply following disaster events with comparison to unaffected banks. Similarly, Chamberlain, Vijayaraghavan and Zheng (2019) argue that banks need to have more conservative policies when it comes to loan loss provisions especially in regions that are more vulnerable to natural disasters. They find that, in the period preceding disasters, banks that make prudent or timely provisioning decisions are able to respond more quickly to the new loan demands that are created by disasters and experience greater growth in their loan portfolios. Furthermore, Do, Phan and Nguyen (2023) state that banks become vulnerable when disasters occur due to the volatility of total deposits and liquidity and that banks are prone to increased provisions of loan loss which may lead to loss of their competitiveness. However, they strongly suggest that appropriate loan loss provision levels prior to disasters help mitigate climate risks without impairing capital during disasters.

One of the first attempts to directly study the effect of natural disasters on bank stability was developed by Klomp (2014). He uses data consisting of 170 natural disasters in 160 countries

from 1997 to 2010. The findings suggest that large-scale disasters increase the likelihood of bank defaults and adversely affect financial stability, especially geophysical and meteorological disasters due to their high damage costs. Additionally, Klomp (2014) argues that while natural disasters may be a substantial threat to liquidity, there is no evidence of their impact on the solvency of the banking sector. However, in contrast to Klomp (2014), Noth and Schhwer (2018) have found that disasters have a significant negative impact on banks in the US. They use a sample of more than 6,000 banks in the US for the period of 1994-2012 and prove that natural disasters result in the reduction of banks' Z-score values and other performance ratios. Moreover, Albuquerque and Rajhi (2019) have examined the effect of natural disasters and state fragility on banking stability. They use a sample of 66 developing countries from 1995 to 2011, finding that the effects of natural disasters are temporary and detrimental only to non-performing loans. Similarly, Brei, Mohan, and Strobl (2019) test this same relationship by using a sample of seven Eastern Caribbean countries over the period of 2001–2012. They have found that there is a decrease in deposits after disasters, which results in a reduction in credit and other investments by banks. Furthermore, they note that disasters lower the Z-scores, which they assume is due to the relatively lower bank profitability.

Therefore, based on the literature presented in this section, it is clear that there is a demanding gap in the natural disasters and banking stability literature, which we aim to fulfil by testing the research hypotheses addressed in the next section.

2.2.1 Research hypotheses

Based on the literature review, it is clear that natural disasters have different effects on the economy and financial sector, and these effects differ depending on the development level of countries. Hence, we discuss the relative literature to build our four research hypotheses for this study.

Natural disasters cause massive losses to the economy and, more importantly, to human lives. The natural disaster literature has shown differing results regarding the effect of these disasters on the economy both before and after the events themselves. Scholars argue that when disasters happen in a country, there is an increase in the economic output immediately after the event due to the increase in mitigation and recovery investment (Albala-Bertrand, 1993; Skidmore and Toya, 2002). In contrast, more recent studies argue that disasters harm the economy, especially in the periods immediately after the event (Noy, 2009; Klomp and Valckx, 2014; Felbermayr and Gröschl, 2014). Therefore, natural disasters have a direct impact on the economy, which in turn would have some effect on the banking sector and the profitability of firms in general. In the case of a major disaster, there would be an effect on local firms and households, which would increase the probability of corporate loan defaults (Dafermos, Nikolaidi and Galanis, 2018). This can then affect the stability of the banking sector, as it threatens the liquidity of banks and increases the likelihood of bank defaults (Klomp, 2014; Noth and Schhwer, 2018; Brei, Mohan and Strobl, 2019). Thus, we test for the following hypotheses:

H_1: Natural disasters have a significant negative impact on the Z-scores of banks.

H_2: Natural disasters increase the shares of non-performing loans.

Moreover, natural disasters affect the bank performance. Even though it is assumed that natural disasters increase banks deposits (e.g., Steindl and Weinrobe, 1983; Skidmore, 2001), there is some evidence suggesting that disasters lead to an increase in the non-performing loans, thereby harming the profitability of banks and potentially leading to bank runs (Alexander, 2014). Additionally, large-scale disasters cause massive losses to firms and individuals, which increases the demand for credit. However, due to the decline in rates of return or increased risk,

access for credit declines (Yang, 2008). Consequently, banks face adverse selection issues, which can affect bank performance. Thus, we test for the following hypothesis:

H_3: There is a significant effect of natural disasters on banks' Return on Assets Ratio (ROA).

Furthermore, as previously discussed, natural disasters have a direct impact on economic output and the profitability of firms. However, the effect differs depending on the characteristics of countries. It is evident that natural disasters can have a more substantial effect on developing rather than developed countries (e.g., Raddatz, 2007; Noy, 2009; Klomp and Valckx, 2014; Felbermayr and Gröschl, 2014). Therefore, the impact can lead to broader economic crises in certain countries where their economic output heavily relies on specific sectors. For example, countries that mainly rely on agriculture can be expected to be more vulnerable to natural disasters. In this case, the destruction of their output can affect credit demand and credit worthiness. Keerthiratne and Tol (2017) note that natural disasters have a significant impact on financial development, especially in countries where they rely heavily on agriculture. Similarly, Li, Blake and Cooper (2010) argue that natural disasters adversely affect the tourism industry in China and have a negative impact on economic output. Thus, while Klomp (2014) argues that there is no evidence of the effect of natural disasters on bank insolvency, it is crucial to account for the different characteristics of different economies. This leads to the following, final hypothesis:

H_4: Natural disasters have a significant negative impact on banks in countries with high agricultural output reliance.

2.3 Data

In this study, we utilise DataStream as a primary source of banks' data. We use a panel dataset from 1999 to 2018 for 1,242 banks. The study focuses on bank-level data to measure the effect of natural disasters on banks' stability. Hence, our sample comprises 19,733 bank-year

observations, which is all the available banks' data on DataStream for the countries with natural disaster data. There are other country-level factors to be considered in the study since the banks come from different levels of economic development. The number of countries represented in the sample is 72, where the majority of the sample, 67% of banks, belong to high-income economies due to the availability of the data. The United States banks represent the vast majority of the sample, with 41% (513 banks) of the total number of banks. Additionally, Japan and China come after the United States in terms of the number of banks, with respectively 7% (83 banks) and 3% (37 banks) of the total number of banks. The rest of the sample countries represent between 0.08% to 2.72%. This type of distribution is common in the banking literature (Mollah and Liljeblom, 2016). However, we try to overcome this issue by splitting the sample into different categories so that the results are not only driven by those countries. The full distribution of banks among countries is available in **Table 2.9 (Appendix A)**.

The data on natural disasters are gathered from the International Disaster Database, EM-DAT, provided by the Centre for Research on the Epidemiology of Disasters (CRED) at the Université Catholique de Louvain in Brussels, Belgium (EM-DAT, 2020). The database is gathered from various sources, including UN agencies, non-governmental organisations, insurance companies, research institutions, and press agencies. The EM-DAT database contains essential data on natural disasters and the occurrences and effects of more than 14,000 events from 1900 to 2020 worldwide. Moreover, at least one of the following criteria must be fulfilled for a disaster to be entered into the EM-DAT database: (1) 10 or more people reported killed; (2) 100 people reported affected; (3) declaration of a state of emergency; or (4) call for international assistance. However, according to Cavallo and Noy (2009), these requirements are quite low, which increases the number of small disasters in the sample. Still, the EM-DAT database has been used the most in recent investigations on the effect of natural disasters (Yang,

2008; Gassebner, Keck and Teh, 2010; Klomp, 2014; Miao and Popp, 2014; Keerthiratne and Tol, 2017).

For the period of this study, from 1999 to 2018, the database contains data on about 8,000 natural disaster events that have occurred in 215 countries. However, due to the availability of banks' data on DataStream, the natural disaster sample for this study contains information about 4,935 disaster events that have occurred in the 72 countries from 1999 to 2018 that have at least one person affected.

EM-DAT categorises natural disasters into sub-groups; geophysical, meteorological, hydrological, climatological, biological, and extra-terrestrial disasters, and each sub-group has different types and sub-types of the event. However, this chapter excludes biological disasters as their economic effects differ systematically from other natural disasters (Gassebner, Keck and Teh, 2010). Hydrological and meteorological disasters are the most common natural disasters, with 46.22% and 37.37% of total disaster events, respectively. Even though Hydrological and meteorological disasters are more likely to occur, they don't affect as many people as climatological disasters or cause as many deaths as geophysical hazards. Additionally, the impact of disasters differs among regions. Asia has more people affected by disasters than the global average in the sample, followed by Africa and both Americas. Although Europe has a meagre average of people affected by disasters, the average of total deaths from disasters is higher than the sample average and higher than the average of Africa, the Americas, and Oceania combined. Details of the distribution of disasters among continents are in **Table 2.1**. The high number of people affected in Asia specifically could be explained by the population density in the region and the sizeable geographical landscape. Therefore, we can assume that the location and the magnitude of natural disaster events have some randomness associated with them.

Table 2.1 Natural disasters' distribution

	Total affected		Total deaths	
Continent	Mean	Freq.	Mean	Freq.
Africa	259,025.14	273	32.04	199
Americas	230,078.02	896	65.01	845
Asia	1,670,903.00	2,060	308.12	1,980
Europe	28,083.80	487	253.22	576
Oceania	5,473.33	81	16.94	49
Total	983,156.23	3,797	224.19	3,649

2.3.1 Measures for dependent variables

The primary dependent variable for this study is the Z-score values of banks. The Z-score is a commonly used measure of banks' stability as it accounts for bank's probability of insolvency (Lepetit and Strobel, 2013). The Z-score measure captures the distance to a default of banks. A higher Z-score indicates a lower likelihood of a bank failing, as it has enough capital to withstand adverse shocks. Low Z-score values suggest undercapitalized, risky banks. In addition, a Z-score value of 0 means a bank is insolvent, and the Z-score measures the number of standard deviations ROA needs to fall to wipe out all bank capital. According to Laeven and Levine (2009), insolvency is the state where losses overcome equity (E<- π), where E is equity and π is profits. Therefore, insolvency can be expressed as the probability of (-ROA<CAR), where ROA (= π /A) is the return on assets and CAR (= E/A) is the capital assets ratio. Thus, the Z-score can be measured by the following equation:

$$Z_{i,t} = \frac{(ROA_{i,t}+CAR_{i,t})}{\sigma(ROA_i)} \qquad (eq.1)$$

Where σ (ROA) is the standard deviation of ROA for bank i.

Moreover, to test the robustness of our estimations, we introduce other measures of banks' stability as dependent variables. We use (ROA) return on assets as a proxy for the banks'

performance and profitability. The ROA measure is widely used in the literature to evaluate the performance of banks (Mollah and Liljeblom, 2016). Return on assets measures how well a bank uses its assets to generate profits. Higher ROAs indicate more efficient asset use. Therefore, the annual ROA values are collected from DataStream for all banks in the sample. In addition, we test the impact of natural disasters on the non-performing loan ratio (NPL). We aim to identify if the disasters events increase the ratio of loan repayment defaults and, therefore, increase the instability of banks. Finally, we include the capital ratio (Cap ratio) of banks as our dependent variable as a robustness check. Capital ratio is a key measure of banks' financial strength and their ability to absorb losses during catastrophes, hence, we examine how natural disasters affect capital ratio of banks.

2.3.2 Measures for independent variables

The primary independent variable is natural disasters. The EM-DAT provides data on natural disasters based on the total monetary damages, number total of deaths, and the total number of people affected (injured, became homeless, displaced or affected otherwise) by the disasters.

The total monetary damage may be gathered by inexperienced individuals who attend to the affected areas to provide assistance; also, some developing countries may inflate the reported damages in order to receive higher support from international organisations and governments (Noy, 2009; Keerthiratne and Tol, 2017; McDermott, Barry and Tol, 2014). Additionally, the total number of deaths does not measure the effect of natural disasters directly, as many disasters may not kill any individuals, especially in wealthier countries, which would create a selection bias in the data (Gassebner, Keck and Teh, 2010; McDermott, Barry and Tol, 2014). Therefore, in this study, the total number of people affected is the primary indicator of the impact of natural disasters.

The effects of disasters, in terms of the number of people killed or affected, depend on other factors, such as socioeconomic status, which may lead to endogeneity in the models (Kellenberg and Mobarak, 2008). Therefore, McDermott, Barry and Tol (2014) construct a binary variable of disasters where it takes one if the ratio of people affected by a disaster to the population exceeds the 0.5% threshold. However, they acknowledge that using a binary variable reduces the variation in the data and the explanatory power of the data. Nevertheless, using a binary variable would equalise more minor disasters affecting fewer people and large-scale disasters involving hundreds of thousands of people. However, the binary variable is used in this analysis as a robustness test. Also, we test different thresholds to examine the effect of large disasters on high-income and middle and low-income economies.

Therefore, a continuous measure of the number of people affected is employed for this study. However, to avoid the differences in population density in some regions, as we can see from **Table 2.1**, we follow Noy (2009) and Keerthiratne and Tol (2017) by taking the percentage of people affected to the population, using the population of the year before the disasters' events as the current year's population has been affected by the disaster already (Dis%).

2.3.3 Measures for control variables

To improve the model, we use the control variables employed by previous studies in the banking stability literature. The variables are utilised to control for bank-specific characteristics, macroeconomic indicators, and financial development variables.

Adverse shocks affect financial stability by affecting the solvency of borrowers; also, there are difference between the level of development among countries. Therefore, we control for that notion by employing GDP per capita using the *World Development Indicators* database. It helps account for cross-country differences in development levels and productivity. GDP per capita measures the average income per person in a country and helps control for differences

in economic development. Moreover, it is expected that countries that rely heavily on agriculture to be more vulnerable to natural disasters (Keerthiratne and Tol, 2017). The destruction of livestock and the disruption of transportation and trade may affect financial stability. Therefore, the share of agriculture to GDP (Agri%) is employed. Additionally, the level of financial development plays a vital role in financial stability (Loayza and Ranciere, 2006). Well-developed financial systems channel more credit to productive uses and support economic growth. Thus, private credit to GDP (credit) is used to count for the country's financial development level. Credit to GDP measures financial development and it is commonly used in the literature (Rewilak, 2013).

Furthermore, Cavallo et al. (2013) argue that natural disasters only affect financial development or economic growth if there is political turmoil. Similarly, Demirgüç-Kunt and Detragiache (1998) state that financial fragility is positively related to weaker institutions. Moreover, political institutions are vital in the mitigation process after disasters occur. To capture the different country effects that might affect the banking stability, we construct a binary variable that takes 1 if a significant event happens in the relative country during that year. Major events comprise different political and economic factors. Political factors include civil wars (Marshall, 2019) and coups (Marshall and Elzinga-Marshall, 2019). In addition, the country effect variable takes 1 if a country faces a banking crisis, liquidity crisis, or sovereign debt crisis that year and the crisis data is provided by Laeven and Valencia (2020). We name the binary variable (country effect) for simplicity.

Moreover, some developing countries receive financial assistance from different countries or organisations, especially during crises. Financial aid can be crucial for the banking sector's stability since it can help maintain certain economic development, enhancing banking stability by reducing credit risk. Thus, we control for that by including the percentage of the official development assistance (ODA) to Gross National Income (GNI). Official Development

Assistance (ODA) consists of grants or loans to developing countries, from both bilateral and multilateral sources, that are undertaken by the official sector with the purpose of promoting economic development and welfare.

One of the main risks that banks face is liquidity risk; therefore, we include a binary variable of whether a country has deposit insurance as it prevents bank runs and ensures stability (Diamond and Dybvig, 1983). Additionally, banking sector concentration as it affects banking sector fragility (Beck, Demirgüç-Kunt and Levine, 2006). High concentration may hinder competition but also facilitate risk monitoring in banking. Trade-offs exist between concentration and stability. The data is collected from the financial development and structure dataset (Beck et al., 2019).

Finally, our data comprise mainly bank-level data, and therefore, we need to control for bank-specific factors commonly used in the stability literature. For example, we control for capital adequacy by including the capital ratio (cap ratio), The capital adequacy ratio aims to protect depositors by ensuring banks have sufficient capital buffers. Also, we control for asset quality by looking into the non-performing loans (NPLs), high NPLs erode bank capital and signify weak underwriting and risk management practices. Sustainable NPLs are important for banking system stability. In addition, we count for management quality via cost-to-income ratio (cost-income), this ratio benchmarks a bank's operational efficiency, lower ratios indicate greater efficiency. Finally, we control for profitability by using the return on assets ratio (ROA), and bank size by including total assets (assets). Larger banks may benefit from economies of scale but also pose greater systemic risk. All the variable definitions, sources, and how they are calculated are presented in **Table 2.2.**

Table 2.3 presents the descriptive statistics of the main and control variables. Due to the availability of data, there is inconsistency in the number of observations for different variables.

The total number affected variable shows the number of people affected by disasters during a year. It offers huge variations ranging from 1 to 347 million people affected by disasters in a single year, which happened in India in 2015. Moreover, our main dependent variable, the percentage of the total number of people affected to the total population, shows similar variation from a very small percentage to about 45% of the population. However, most of the sample experienced disasters that affected a small portion of their population as expected. In addition, the top 1% of the observations come from different geographical locations and development levels. For example, Malawi experienced disasters in 2015 and 2005 that affected about 45% and 41% of its population, respectively. Also, South Africa faced events in 2004 that affected 32% of the population, India in 2004 with around 32%, and the United States in 2016 when natural disasters affected about 27% of its population. That shows that even though disasters might occur more frequently in some areas of the world, when and where they occur and the magnitude of the events have some randomness associated with them.

The primary dependent variable in this study is Z-scores. The values of Z-score of banks vary in the sample, from a minimum of -30.39 to 245; the variation of the values is expected since the data contains bank-level observations from various countries. Therefore, we take the logarithm of the Z-scores, as explained earlier, and it ranges between -0.36 to 1.24, with a mean of 0.36.

Table 2.2 Variable definitions and sources

Variable name	Definition	Source
Z-score	A measure of bank solvency calculated based on return on assets, equity/assets ratio, and standard deviation of return on assets. $Z_{i,t} = \frac{(ROA_{i,t}+CAR_{i,t})}{\sigma(ROA_i)}$	DataStream
Dis%	Percentage of the total number of people affected by disasters to total population.	(EM-DAT, 2020)
ROA	Return on assets, measured as net income divided by total assets. Indicates bank profitability.	DataStream
Cap ratio	Capital ratio, measured as equity divided by total assets. Indicates bank capital adequacy.	DataStream
Ln (Assets)	Natural log of total assets. Used to control for bank size.	DataStream
Ln (NPL)	Natural log of ratio of nonperforming loans to total loans. Indicates asset quality.	DataStream
Ln (Cost-income)	Natural log of ratio of total costs to total income. Indicates operational efficiency.	DataStream
Ln (GDP)	Natural log of gross domestic product per capita. Controls for macroeconomic environment.	World Development Indicators database
Concentration	Asset concentration ratio of the 3 largest banks as a share of assets of all commercial banks. Indicates market structure.	Financial development and structure dataset (Beck et al., 2019)
Ln (Credit)	Natural log of domestic credit provided by financial sector as % of GDP. Indicates financial depth.	World Development Indicators database
Deposit Insurance	Dummy variable for existence of explicit deposit insurance scheme	Financial development and financial structure dataset (Beck et al., 2019)
Country effect	Dummy variables for each country. Control for unobserved heterogeneity. It takes 1 if a country faced systematic risks such as financial crises or political instability.	(Marshall, 2019), (Marshall and Elzinga-Marshall, 2019) and (Laeven and Valencia, 2020)
ODA	Comprises disbursement of concessional finance from both bilateral and multilateral sources.	World Development Indicators database

Table 2.3 Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Total affected	9,029	7,486,101	30,367,493	1.00	346,600,000*
Dis%	9,029	0.02	0.05	0.00	0.32
Dis-binary	9,029	0.26	0.44	0	1
Z-score	9,029	50.27	38.75	-0.31	244.87
Ln(Z-score)	9,029	0.38	0.23	0.00	1.24
Agri%	9,027	0.04	0.05	0.00	0.27
ROA	9,029	1.25	1.07	-14.80	44.48
Cap ratio	9,029	0.16	0.09	-0.04	0.98
Ln (Assets)	9,029	15.23	2.10	10.70	22.13
Ln (NPL)	9,029	10.39	2.78	0.00	20.17
Ln (Cost-income)	9,029	1.47	0.80	-0.83	8.14
Ln (GDP)	9,029	10.10	1.22	6.09	11.13
Interest rates	9,029	0.04	0.05	0.00	0.67
Concentration	9,029	0.38	0.14	0.21	1.00
Ln (Credit)	9,029	4.03	0.43	2.31	5.25
Deposit insurance	9,029	0.93	0.26	0	1
Country effect	9,029	0.20	0.40	0	1
ODA	9,029	0.00	0.00	0	0.07

*The maximum number of people affected occurred in India in 2015, India experienced a drought that affected more than 346 million people that year.

2.4 Methodology

We estimate our models using a panel regression estimator with bank and year fixed effects. Fixed effects estimator is chosen to prevent any selection biases in the data due to the over-representation of disaster data in developing countries as a result of vulnerability to disasters (Keerthiratne and Tol, 2017). Additionally, we perform the Hausman test to check whether the random effects estimator is preferable; however, the results reject the null hypothesis, and the fixed effects estimator is preferable. Moreover, we estimate the year-fixed effects to control for common shocks across all banks, such as global warming, the increasing number of disasters, and global financial crises. Standard errors are clustered at the bank level.

Therefore, the baseline model of the panel regression is as follows:

$$ln\ Z\_score_{i,t} = \alpha_i + \beta_1 Dis\%_{i,t} + \beta_2\ ROA_{i,t} + \beta_3 Cap\ ratio_{i,t} + \beta_4\ assets_{i,t} + \beta_6 NPL_{i,t} + \beta_7 cost_{i,t} + \beta_8 GDP_{i,t} + \beta_9\ Interest\ rates_{i,t} + \beta_{10}\ Concentration_{i,t} + \beta_{11} Credit_{i,t} + \beta_{12} Deposit\_insurance_{i,t} + \beta_{13} Country\_effect_{i,t} + \beta_{14} ODA_{i,t} + \tau_t + \varepsilon_{i,t} \quad (1)$$

Ln Zscore is the distance to default taken in natural logarithms for bank i for year t. The Z-score values were divided by 100, then added by 1 before taking the logarithm to prevent losing any negative values and smoothing out higher values (Klomp, 2014).

Moreover, *Dis%* is our primary independent variable in this study. This natural disaster variable is the total number of people affected divided by the previous year's population. Disaster events occur randomly, especially since we might know the geographic locations of more vulnerable areas; however, the timing of the events is random. Additionally, as the share of the population affected by disasters increases, we would expect that there would be some defaults in loan repayments, especially from businesses that were hurt because of the disasters. Also, individuals and small firms may lose income during that period, which could decrease banks' stability in terms of their z-scores.

Bank-level control variables are added to the baseline model is capture the differences across banks. Therefore, we include $ROA_{i,t}$ which is the return on asset ratio. Additionally, $Cap\ ratio_{i,t}$ is the capital to assets ratio of bank i for year t. The ratio is important to control for as it shows the level of capital at the banks, and if they have enough liquidity to absorb losses during crises before they become insolvent. Also, $assets_{i,t}$ is the log of total assets of bank i at time t to control for the bank size. $NPL_{i,t}$ is the logged non-performing loans of bank i at time t. Finally, to control for the management differences, we add $cost_{i,t}$, which is the cost to income ratio of bank i at time t.

Furthermore, countries have different characteristics and levels of development and income. Therefore, we capture those differences by including macro-level control variables. $GDP_{i,t}$ is the logarithm of the GDP per capita for in country i at time t in constant 2010 US$. It is essential to control for the levels of income as it is expected for banks in countries where the GDP per capita is relatively higher than other countries not to be as affected because they would have a stronger financial position to cope with the consequences of the disasters. $Interest\ rates_{i,t}$ captures the interest rates since that can affect the banking stability through their lending rates and capital flows. $Concentration_{i,t}$ controls for the concentration of the banking system, it is calculated as the assets of three largest banks as a share of assets of all commercial banks (Beck et al., 2019). $Credit_{i,t}$ captures the different levels of financial development, which is the ratio of credit to private sector to GDP taken into logarithm. Additionally, $Deposit\ Insurance_{i,t}$ is a binary variable to capture whether the country has a deposit insurance scheme. $Country\_effect_{i,t}$ is a binary variable to capture time-varying effects that may impact bank stability within a country; it takes 1 if a country experience banking crisis, liquidity crisis, sovereign debt crisis, coups, or civil wars. Lastly, the official development assistance (ODA) is important during disasters especially for low-income

countries as it helps to alleviate the disasters' consequences; therefore, it is captured by including the variable $ODA_{i,t}$ which is the percentage of the ODA to GNI.

In our estimation, we split the sample into two groups, High-income countries (HIC) and Middle and Low-income countries (L&M). The banks from high-income countries are over-represented in the sample; therefore, we estimate the models for the full sample and for the two groups to overcome this issue.

Moreover, we use other metrics of banking stability. As robustness tests, we use the non-performing loans ratio (NPL) as the dependent variable to test the effects of natural disasters on loan repayments and if that affects banks' liquidity. We include the ratio of non-performing loans to net loans as our measure of impaired loans. Also, we include the return on assets ratio (ROA) as the primary dependent variable to check the effects of disasters on the banks' performance. Finally, following McDermott, Barry and Tol (2014) and Keerthiratne and Tol (2017), we use a binary variable of the natural disasters with different thresholds. McDermott, Barry and Tol (2014) suggest that the threshold is 0.5% of the total population. However, following Keerthiratne and Tol (2017), we use different thresholds of the number of people affected by disasters to the total population to reduce any endogeneity problems and to avoid the possibility of results being driven by outliers. Time dummies (τ_t

2.5 Results and discussion

The results of our baseline model are presented in **Table 2.4**. In column 1, we estimate our model using all control variables on the full sample. In columns 2 and 3, we split our sample into two groups, one includes only high-income countries (HIC), and the other consists of middle and low-income countries (L&M). We include middle- and low-income countries in the same category since low-income countries have minimal bank data availability on DataStream. However, as mentioned earlier, due to the availability of banks' data, the majority

of our sample comprises high-income countries. Therefore, to avoid the results being driven by high-income countries, we estimate the models using the full sample and the split of the two groups.

The results in column 1 show that the disaster variable has a statistically significant negative impact on the Z-scores. It is significant at the confidence level of 1%, and the result suggests that an increase in the share of people affected by natural disasters to the total population leads to a decrease in the z-scores of banks, therefore, a reduction in the banking system stability. The results support the findings of Klomp (2014), where he examines only large-scale disasters based on the total monetary damages. However, Klomp (2014) finds that there is no significant effect of disasters when considering all disasters during the period of his study and assumes that there is a certain threshold of the monetary damage to GDP for disasters to affect the distance to default measure. Therefore, we expand on his findings using contemporary data, and different measures of natural disasters, by finding that natural disasters have a significant negative impact on z-scores. In addition, given that the U.S. banks are the majority in our sample, about 41% of banks, we exclude banks from the U.S. in our baseline estimation to ensure that our results are not driven solely by one country. We present the results in column 4, finding that the results remain consistent and unchanged even after removing U.S. banks.

Nevertheless, the effect differs when we split our sample. Even though it shows a negative sign, the impact of natural disasters on z-scores is insignificant in high-income countries. High-income countries might be better prepared for such events than middle- and low-income countries in terms of infrastructure and financial strength, enabling them to alleviate the consequences of disasters.

In column 3, we split the sample and present the results considering only middle-and low-income countries (L&M). The results indicate that natural disasters have a statistically

significant negative effect on Z-scores. Moreover, by splitting the sample, we are able to see that an increase in the share of people affected by disasters to population decreases the Z-scores of banks in that category. The coefficient is even higher than when we estimated the model on the full sample. The results suggest that banks in middle-and low- income countries are more vulnerable to natural disasters.

Endogeneity is one of the main issues when using a continuous variable of natural disasters. According to Kellenberg and Mobarak (2008), the consequences of natural disasters might depend on different socioeconomic aspects. Therefore, following McDermott, Barry and Tol (2014), we use a binary variable of disasters where it takes 1 if the percentage of the total people affected by disasters to the population is greater than 0.5% and 0 otherwise. The binary variable limits the variation of the data and focuses only on large disasters. In **Table 2.4**, columns 4-6 show our estimation results using a binary disasters variable for the entire sample and the split based on income. The results indicate that natural disasters have an insignificant impact on banks' stability when applying that to the whole sample. However, when we split the sample between high-income and middle- and low-income countries, the results are consistent with our findings using the continuous variable. It appears that, even when we focus on disasters that affect more than 0.5% of the population, natural disasters do not affect the stability of banks in high-income countries. Conversely, middle- and low-income countries appear to be more vulnerable to disasters. The results indicate that natural disasters have a significant negative impact on banks' stability at a 1% confidence level.

In addition, in column 1, the coefficients' signs of the control variables are as expected. The non-performing loans ratio shows a significant negative impact on banks' stability. Furthermore, the bank's size, as indicated by the logarithm of total assets, has a significant and positive effect on the Z-score values; however, only in the full-sample estimation and L&M sample, and insignificant in HIC. Moreover, the interest rate has a steady significant and

negative impact on banks' stability in all our estimations, which is expected based on the findings of the earlier literature (Demirgüç-Kunt and Detragiache, 1997; Calvo, Leiderman and Reinhart, 1993). Finally, the private credit to GDP ratio shows an insignificant impact on the stability of banks. The result indicates that the level of financial development does not affect banks' stability in all our samples except for our sample that excludes the U.S. banks where it is significant and negative at a 5% confidence level. That negative or insignificant effect of the credit variable is similar to the recent findings that the generally positive impact of financial development is changing or even vanishing in recent years (Arcand, Berkes, and Panizza, 2015; Law and Singh, 2014; Berger et al., 2019).

Table 2.4 Benchmark results

	Dependent Variable: Ln (Z-score)						
	Independent variable: %affected				Independent variable: Binary 0.5%		
Variables	(1) Full sample	(2) HIC	(3) L&M	(4) Excluding U.S. Banks	(5) Full sample	(6) HIC	(7) L&M
Dis%	-0.045***	-0.012	-0.044**	-0.027*			
	(0.012)	(0.014)	(0.017)	(0.016)			
Dis-binary					-0.002	-0.002	-0.006***
					(0.001)	(0.001)	(0.002)
Bank characteristics							
ROA	0.002	-0.001	0.007***	0.005**	0.002	-0.001	0.006***
	(0.003)	(0.006)	(0.002)	(0.002)	(0.003)	(0.006)	(0.002)
Cap ratio	1.275***	1.498***	0.852***	1.043***	1.283***	1.499***	0.863***
	(0.067)	(0.093)	(0.057)	(0.070)	(0.068)	(0.093)	(0.056)
Ln (Assets)	0.014*	0.012	0.019*	0.025***	0.013*	0.012	0.017*
	(0.008)	(0.010)	(0.010)	(0.007)	(0.007)	(0.010)	(0.009)
Ln (NPL)	-0.003**	-0.004**	-0.002	-0.002	-0.004***	-0.004**	-0.002
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Ln (Cost-income)	-0.002	-0.005**	0.002	-0.003	-0.002	-0.005**	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Macroeconomic indicators							
Ln (GDP)	0.011	-0.046*	0.034**	-0.004	-0.006	-0.047*	0.010
	(0.011)	(0.025)	(0.016)	(0.011)	(0.013)	(0.027)	(0.012)
Ln (Interest rates)	-0.007***	-0.003**	-0.007***	-0.009***	-0.004***	-0.003**	-0.008***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Concentration	-0.014	0.056***	-0.027*	0.005	-0.021	0.057***	-0.012
	(0.011)	(0.018)	(0.014)	(0.012)	(0.013)	(0.018)	(0.014)
Ln (Credit)	-0.010	0.009	-0.012	-0.017**	0.006	0.010	-0.014
	(0.009)	(0.009)	(0.012)	(0.008)	(0.009)	(0.010)	(0.011)
Deposit insurance	0.009	0.039***	0.001	-0.001	0.011	0.040***	-0.004
	(0.009)	(0.014)	(0.008)	(0.008)	(0.010)	(0.015)	(0.008)
Country effect	0.004	0.003	0.007**	0.002	0.006***	0.003	0.005
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)

ODA	0.065	6.119	1.060**	0.497	0.022	4.999	0.976*
	(0.650)	(12.273)	(0.526)	(0.580)	(0.650)	(12.118)	(0.532)
Constant	-0.100	0.424***	-0.398***	-0.166***	0.038	0.439***	-0.202***
	(0.084)	(0.145)	(0.125)	(0.052)	(0.059)	(0.155)	(0.060)
Observations	9,029	7,072	1,957	3,374	9,029	7,072	1,957
R-squared	0.713	0.755	0.726	0.662	0.707	0.755	0.717
Number of ID	907	652	255	422	907	652	255

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity.

Nevertheless, McDermott, Barry and Tol (2014) argue that the 0.5% threshold of the total population might be somewhat arbitrary. Therefore, we run our fixed effects model using the binary variable, but with different thresholds of the share of the total number of people affected by natural disasters to the population. We present our estimation results using different thresholds of 1%, 2.5%, 5%, 7%, and 10% of the disasters variable in **Table 2.5**. The coefficients' signs of the binary variable are all negative under different thresholds. However, the effect becomes significant when the event affects 5% or higher of the population. The results are similar to Keerthiratne and Tol's (2017) findings, where they find that disasters have a significant impact on financial development when the percentage of people affected by natural disasters is 5.5% or higher of the population.

Table 2.5 Different thresholds of the disasters' binary variable

	Dependent Variable: Ln (Z-score)					
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	0.5%	1%	2.5%	5%	7%	10%
Dis-binary	-0.002	-0.001	-0.001	-0.008***	-0.008***	-0.006**
	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Bank characteristics						
ROA	0.002	0.002	0.002	0.002	0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Cap ratio	1.283***	1.283***	1.283***	1.275***	1.275***	1.282***
	(0.068)	(0.069)	(0.068)	(0.068)	(0.067)	(0.069)
Ln (Assets)	0.013*	0.013*	0.013*	0.014*	0.014*	0.013*
	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.007)
Ln (NPL)	-0.004***	-0.004***	-0.004***	-0.003**	-0.003**	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln (Cost-income)	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Macroeconomic indicators						
Ln (GDP)	-0.006	-0.006	-0.006	0.010	0.011	-0.006
	(0.013)	(0.013)	(0.013)	(0.011)	(0.011)	(0.012)
Ln(Interest rates)	-0.004***	-0.004***	-0.004***	-0.007***	-0.007***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Concentration	-0.021	-0.021	-0.021	-0.016	-0.015	-0.019
	(0.013)	(0.013)	(0.013)	(0.012)	(0.011)	(0.013)
Ln (Credit)	0.006	0.006	0.006	-0.009	-0.010	0.006
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Deposit insurance	0.011	0.010	0.010	0.009	0.009	0.011
	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)
Country effect	0.006***	0.006***	0.006***	0.004	0.004	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ODA	0.022	0.024	0.004	0.007	0.069	0.019
	(0.650)	(0.653)	(0.656)	(0.655)	(0.652)	(0.650)
Constant	0.038	0.036	0.036	-0.097	-0.101	0.032
	(0.059)	(0.059)	(0.058)	(0.084)	(0.084)	(0.058)
Observations	9,029	9,029	9,029	9,029	9,029	9,029
R-squared	0.707	0.707	0.707	0.712	0.712	0.708
Number of ID	907	907	907	907	907	907

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity.

Natural disasters can affect countries in various ways based on their different characteristics. Keerthiratne and Tol (2017) find that the agricultural share in the economy significantly impacts financial development during disasters. Moreover, Collier, Katchova and Skees (2011) argue that disasters affect access to credit and other agricultural input markets. Therefore, we include an interaction term of the agriculture share in the economy with our disasters variable to control for the differences among countries. In **Table 2.8**, we can see the main results of our regression model, including the interaction term. We find that the disasters variable shows a significant and negative effect on the distance to default measure. However, the agriculture

variable and the interaction term with our disaster variable are insignificant. It appears that the agricultural share of GDP has no significant role when disasters hit a country to affect its banking system. Though, Shala and Schumacher (2022) find that natural disasters affect banks' loan repayments in Germany, and the impairments were mostly driven by corporate loans concentrated in specific sectors, such as agriculture and manufacturing, it appears that our results yield different findings. The results can be attributed to several factors. For instance, countries that heavily rely on agriculture often implement robust government support and insurance mechanisms to mitigate the impact of natural disasters on the agricultural sector. These proactive measures help cushion the adverse effects of such disasters on agricultural activities, subsequently contributing to the overall stability of the banking sector. Additionally, banks operating in these economies may have developed effective risk management strategies that specifically address the challenges posed by natural disasters. This enables them to absorb shocks more efficiently and maintain a stable operational environment.

2.5.1 Robustness tests

Another measure of banks' performance is their non-performing loans ratio (NPL). Non-performing loans can be used as a measure of the overall quality of the bank's credit portfolio. We calculate the NPL by dividing the non-performing loans by net loans. An increase in the NPL indicates a lower asset quality of the bank and increases the probability of bank failure (Chiaramonte *et al*., 2016). Hence, we aim to test not only the distance to default of banks but also whether they are affected in terms of their loan repayment by natural disasters. **Table 2.6**, in columns 1-3, we present the results of the regression models where the non-performing loans ratio is the dependent variable. The results in column 1 show that natural disasters have a statistically significant impact on the repayment of loans. Although it is only significant at the 5% confidence level, we can see that an increase in the percentage of the total people affected by disasters would lead to a rise in the non-performing loans ratio. The results support Noth

and Schhwer's (2018) findings, where they test the effects of natural disasters on banks' performance using a sample of U.S. banks only, and they find that natural disasters have a significant positive impact on non-performing loan ratios.

However, the effects differ when we split the sample. In column 2, we can see that natural disasters do not significantly impact non-performing loans in high-income countries. On the contrary, in column 3, middle- and low- income countries appear to be affected by disasters in terms of loan repayments. Our disasters' variable shows a significant positive effect on the non-performing loans ratio. Moreover, similar to the whole sample, it is only significant at a 5% confidence level, but the coefficient is higher than that of the full sample.

Additionally, the return on assets ratio (ROA) is a commonly used variable in the banking literature to count for banks' performance. By definition, the Z-score is sensitive to the standard deviation of ROA, and hence, it has a role in the stability of the banks (Chiaramonte *et al*., 2016). We present the results of our main independent and control variables estimations while using the ROA ratio as the dependent variable in columns 4-6 in **Table 2.6**. The results yield some interesting findings. Our disasters' variable significantly and negatively impacts ROA in the full sample model and the other two split samples. They are all statically significant at a 1% confidence level except for middle- and low- income countries, which is at a 5% level. However, the coefficient of middle- and low-income countries is higher than high-income countries. Additionally, the R-squared of all the models is lower than the R-squared values of the models where the Z-score is the main dependent variable. The results support our main findings in our benchmark model that natural disasters negatively affect banks' stability.

Table 2.6 Different measures of banks' stability

	Dependent Variable: NPL			Dependent Variable: ROA		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Full sample	HIC	L&M	Full sample	HIC	L&M
Dis%	0.523**	0.090	0.730*	-0.541***	-0.521***	-0.582*
	(0.224)	(0.181)	(0.418)	(0.108)	(0.074)	(0.341)
Bank Characteristics						
ROA	-0.012	-0.071	0.022			
	(0.028)	(0.043)	(0.043)			
Ln (NPL)				-0.018	-0.018*	0.024
				(0.012)	(0.010)	(0.046)
Cap ratio	0.004	0.306	-1.046	2.929***	2.602***	3.530***
	(0.772)	(0.882)	(1.445)	(0.555)	(0.652)	(1.065)
Ln (Assets)	1.100***	1.140***	0.858***	-0.157***	-0.109	-0.103
	(0.094)	(0.099)	(0.192)	(0.059)	(0.077)	(0.123)
Ln (Cost-income)	0.307***	0.366***	0.234***	-0.352***	-0.299***	-0.556***
	(0.026)	(0.030)	(0.064)	(0.020)	(0.020)	(0.051)
Macroeconomic indicators						
Ln (GDP)	-0.774***	1.013***	-0.239	-0.161	-0.305	-0.077
	(0.183)	(0.310)	(0.277)	(0.127)	(0.208)	(0.209)
Ln(Interest rates)	-0.074***	-0.271***	0.002	0.070***	0.096***	-0.001
	(0.027)	(0.035)	(0.027)	(0.011)	(0.012)	(0.020)
Concentration	1.249***	0.709	0.462*	-0.751***	-0.687***	-0.169
	(0.314)	(0.712)	(0.239)	(0.168)	(0.221)	(0.287)
Ln (Credit)	-0.682***	-2.393***	0.249	0.047	0.252***	-0.523***
	(0.195)	(0.223)	(0.273)	(0.110)	(0.076)	(0.201)
Deposit insurance	-0.032	0.161	-0.216	-0.026	-0.034	-0.089
	(0.249)	(0.495)	(0.228)	(0.122)	(0.141)	(0.150)
Country effect	0.513***	0.614***	0.172***	-0.026	-0.082***	0.112
	(0.052)	(0.047)	(0.065)	(0.027)	(0.022)	(0.133)
ODA	5.178	-230.629	5.744	-0.571	274.260	-1.788
	(12.449)	(232.635)	(11.421)	(8.232)	(249.202)	(7.799)
Constant	2.472*	-10.214***	-1.134	5.882***	5.761***	6.411***
	(1.402)	(2.168)	(1.415)	(0.770)	(1.217)	(1.045)
Observations	9,073	7,112	1,961	9,073	7,112	1,961
R-squared	0.445	0.465	0.273	0.224	0.269	0.208
Number of ID	911	654	257	911	654	257

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity

We can see from our benchmark results that natural disaster events affect banks' stability and performance. However, we want to explore whether the relationship between the disasters variable and the distance to default varies with the different levels of z-scores of banks. Therefore, we divide our z-score values into five quantiles. We present the results of the quantile regression in **Table 2.7**. We can see that natural disasters have a significant negative impact on z-scores in the first three quantiles, up to the Z-score value of 45, and higher than that, it gets insignificant. However, in the final quantile where the z-score values are higher than 73, disasters negatively and significantly affect their values, but only at a confidence level

of 10%. An explanation for that result could be that banks with very high z-scores are more willing to lend and take risks during turbulent time.

Table 2.7 Quantile regression

Dependent Variable: Ln (Z-score)					
	(1)	(2)	(3)	(3)	(3)
Variables	1st Quantile	2nd Quantile	3rd Quantile	4th Quantile	5th Quantile
Dis%	-.012**	-.015**	-.014**	-.005	-.018*
	(.005)	(.006)	(.006)	(.006)	(.009)
Bank characteristics					
ROA	.379***	.823***	1.350***	1.750***	2.276***
	(.031)	(.063)	(.054)	(.090)	(.075)
Cap ratio	.003	.001	.002	.001	.002
	(.002)	(.002)	(.002)	(.003)	(.006)
Ln (Assets)	.023***	.015*	.002	-.005	.026
	(.008)	(.008)	(.007)	(.009)	(.016)
Ln (NPL)	-.000	-.002***	-.001*	-.003***	-.001
	(.000)	(.001)	(.000)	(.001)	(.001)
Ln (Cost-income)	-.002***	-.004***	-.006***	-.006***	-.003
	(.001)	(.001)	(.001)	(.001)	(.002)
Macroeconomic indicators					
Ln (GDP)	-.003	.005	-.005	-.002	-.011
	(.004)	(.005)	(.005)	(.009)	(.018)
Ln(Interest rates)	-.001***	.000	-.000	.001	-.003
	(.000)	(.000)	(.001)	(.001)	(.002)
Concentration	.003	-.003	-.017**	.003	-.011
	(.008)	(.006)	(.007)	(.011)	(.021)
Ln (Credit)	.007*	-.006*	-.006	-.001	-.005
	(.004)	(.004)	(.005)	(.009)	(.023)
Deposit insurance	-.004	.005	.010**	-.001	.020*
	(.003)	(.003)	(.005)	(.012)	(.013)
Country effect	-.004***	.001	.002	.004***	.002
	(.001)	(.001)	(.001)	(.001)	(.002)
ODA	.129	.586	.447	-1.760	.235
	(.203)	(.469)	(.442)	(1.142)	(2.043)
Constant	-.019	.048	.171***	.209***	.359**
	(.023)	(.031)	(.038)	(.051)	(.143)
Observations	1202	1611	1707	1976	1859
R-squared	.674	.764	.818	.823	.902
Number of ID					

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity

Moreover, we include the first lag of all our independent and explanatory variables. Including lags is a common practice in the literature. The results are in column 2 in **Table 2.8**. We find that, even with including a first lag of all right-hand-side variables, our disasters variable has a significant negative impact on banks' stability. Although the R-squared value is smaller with lags than our benchmark estimation, the coefficient is slightly higher, and it is overall consistent with our benchmark results.

Furthermore, we use other metrics of how healthy banks are after natural disasters' events. Therefore, we estimate our model using the capital ratio as the dependent variable. The capital ratio is calculated by dividing the total equity by the total assets. It is also used in constructing the Z-score values of banks. Therefore, it is an essential predictor of the healthiness of banks and how far they are from failure (Chiaramonte *et al*., 2016; Noth and Schüwer, 2018). We find that natural disasters affect the capital ratio. The effect is significant at the 1% confidence level, and it shows that natural disasters significantly negatively impact banks' capital ratio. The results support our main findings that natural disasters have an adverse effect on the stability of banks. The results of our estimation are in column 3.

Table 2.8 Agriculture share and capital ratio

	Dependent Variable: Ln (Z-score)		Dependent Variable: Capital ratio
	(1)	(2)	(3)
Variables	Agri*interaction	First Lag	Cap ratio
Dis%	-0.031**	-0.050***	-0.031**
	(0.013)	(0.012)	(0.016)
Agri%	-0.343		
	(0.209)		
Dis%*Agri%	0.104		
	(0.125)		
Bank Characteristics			
Cap ratio	1.281***	0.840***	
	(0.068)	(0.044)	
ROA	0.002	0.003	0.019***
	(0.003)	(0.002)	(0.003)
Ln (Assets)	0.013*	0.013***	0.001
	(0.007)	(0.005)	(0.008)
Ln (NPL)	-0.004**	-0.006***	0.000
	(0.001)	(0.001)	(0.002)
Ln (Cost-income)	-0.002	-0.000	0.004**
	(0.001)	(0.002)	(0.002)
Macroeconomic indicators			
Ln (GDP)	-0.010	-0.002	-0.004
	(0.012)	(0.010)	(0.011)
Ln (Interest rates)	-0.004***	0.000	-0.000
	(0.001)	(0.002)	(0.001)
Concentration	-0.014	-0.043**	-0.040***
	(0.013)	(0.017)	(0.013)
Ln (Credit)	0.004	0.020***	0.042***
	(0.009)	(0.007)	(0.010)
Deposit insurance	0.012	0.001	-0.008
	(0.009)	(0.010)	(0.012)
Country effect	0.005***	-0.002	0.008***
	(0.002)	(0.002)	(0.003)
ODA	0.042	0.599	1.407*
	(0.638)	(0.583)	(0.725)
Constant	0.089	0.065	-0.009
	(0.067)	(0.063)	(0.091)
Observations	9,027	8,642	9,073
R-squared	0.708	0.335	0.088
Number of ID	907	891	911

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity

2.6 Conclusion

This study shows that natural disasters significantly negatively impact banking stability, specifically in the middle- and low-income countries. The examination of the effect of natural disasters on banking stability is limited but growing (Klomp, 2014; Noth and Schüwer, 2018; Albuquerque and Rajhi, 2019; Brei, Mohan and Strobl, 2019). The literature on natural disasters centres mainly on their macroeconomic consequences. Thus, this study adds to natural disasters and banking stability literature, primarily by using bank-level data of 1,248 banks from 72 countries for the period from 1999 to 2018. Moreover, we employ a commonly used measure of natural disasters, the number of people affected, in our models to examine the effect of disaster events that distress people rather than using the cost of damages. Additionally, we use the commonly used measure of banking stability, which is the distance-to-default measure, also known as the Z-score.

Our findings suggest that natural disasters affect the distance-to-default values negatively. We split our sample into two groups for two reasons: the vast majority of the banks in our sample represent high-income countries due to the data availability. The second is to test whether the effects differ among countries based on income levels. After splitting the data, we find that natural disasters have no significant impact on banking stability in high-income countries. However, the effect is significant and negative for middle- and low-income countries.

We use other measures to test the relationship and ensure our results are robust. Therefore, we use a binary variable of the disaster's variable introduced by McDermott, Barry and Tol (2014) but with different thresholds. The results show similar effects to our primary variable of natural disasters. Moreover, the findings indicate that the threshold of the ratio of the total number of people affected by natural disasters to population needs to be at least 5% of the total population to affect banks' stability.

Moreover, we test other measures of banks' performance. We find that natural disasters decrease the ROA and capitalisation ratios and increase the percentage of non-performing loans. These effects are significant mainly in middle- and low-income countries. That supports our main findings that natural disasters adversely impact the banking system's stability. Additionally, we find that a country's agricultural share of GDP has no significant impact in harming or mitigating banking stability.

The outcome of this study provides valuable insights into the effects of natural disasters on banking stability to policymakers, academics, and other parties who may be interested in the factors that may affect financial stability or the direct impact of natural disasters.

There are a number of limitations of this study that need to be addressed for future research. First, the availability of bank-level data is minimal, particularly for low-income countries. Second, we need to consider the time and location of each disaster. For example, an event that occurs in January has a different impact on the annual Z-scores than another event that occurs in the last quarter of the year, mainly because we use annual data. Finally, we need to understand the reasons behind the impact of disasters on banking stability and what drives that negative effect to understand if the impact is because of no access to credit, bank runs, or loss of property.

APPENDIX A

Table 2.9: Country distribution

Number	Country	Number of Banks	Percent	Number	Country	Number of Banks	Percent
1	Argentina	7	0.56	37	Korea (the Republic of)	9	0.72
2	Australia	8	0.64	38	Lebanon	6	0.48
3	Austria	7	0.56	39	Malawi	4	0.32
4	Bangladesh	28	2.25	40	Malaysia	10	0.8
5	Belgium	2	0.16	41	Mexico	4	0.32
6	Bolivia (Plurinational State of)	2	0.16	42	Morocco	6	0.48
7	Bosnia and Herzegovina	9	0.72	43	Netherlands	4	0.32
8	Botswana	3	0.24	44	Nigeria	12	0.96
9	Brazil	18	1.44	45	Norway	23	1.85
10	Bulgaria	4	0.32	46	Oman	6	0.48
11	Canada	9	0.72	47	Pakistan	20	1.61
12	Chile	5	0.4	48	Peru	7	0.56
13	China	36	2.89	49	Philippines (the)	16	1.28
14	Colombia	8	0.64	50	Poland	12	0.96
15	Costa Rica	2	0.16	51	Portugal	1	0.08
16	Croatia	8	0.64	52	Romania	1	0.08
17	Cyprus	2	0.16	53	Russian Federation (the)	17	1.36
18	Czech Republic (the)	2	0.16	54	Saudi Arabia	11	0.88
19	Denmark	19	1.52	55	Serbia	2	0.16
20	Ecuador	4	0.32	56	Singapore	3	0.24
21	Egypt	12	0.96	57	Slovakia	3	0.24
22	Estonia	1	0.08	58	South Africa	8	0.64
23	France	18	1.44	59	Spain	8	0.64
24	Germany	10	0.8	60	Sri Lanka	13	1.04
25	Ghana	6	0.48	61	Sweden	4	0.32
26	Greece	6	0.48	62	Taiwan	19	1.52
27	Hong Kong	7	0.56	63	Tanzania, United Republic of	4	0.32
28	Hungary	1	0.08	64	Thailand	11	0.88
29	India	33	2.65	65	Turkey	13	1.04
30	Indonesia	34	2.73	66	Uganda	2	0.16
31	Ireland	3	0.24	67	Ukraine	7	0.56

32	Israel	8	0.64	68	United Kingdom of Great Britain and Northern Ireland (the)	13	1.04
33	Italy	14	1.12	69	United States of America (the)	513	41.17
34	Japan	83	6.66	70	Venezuela (Bolivarian Republic of)	6	0.48
35	Jordan	11	0.88	71	Viet Nam	8	0.64
36	Kazakhstan	7	0.56	72	Zambia	3	0.24
					Total	1,246	100

CHAPTER 3: FINANCIAL CRISES, ECONOMIC GROWTH AND AFRICA

3.1 Introduction

It is claimed that financial deepening may lead to economic prosperity (King and Levine, 1993a; Demetriades and Hussein, 1996; Rousseau and Wachtel, 1998; Demetriades and Andrianova, 2004; Valickova, Havranek and Horvath, 2015). Financial crises on the other hand have detrimental effects on economic growth (Summers, 2000; Barro, 2001), where contemporary evidence from the Global Financial Crisis (GFC) and Eurozone crisis have demonstrated this fact (Claessens *et al*., 2010). As Wachtel (2018) points out, at times financial deepening may lead to economic growth, but in other cases it could lead to a financial crisis. This exemplifies the statement by Andrianova and Demetriades (2018) who state financial fragility - of which one feature may be a full-blown financial crisis - and financial deepening are two sides of the same coin.

When a financial crises hits, it does not discriminate by income-level or geographic region. For example, the recent GFC and Eurozone crisis occurred in both wealthy and poor countries, whereas the Tequila crisis was located in Latin America, and in 1997, financial crisis hit many East Asian economies (Barro, 2001; Hong and Tornell, 2005). These crises have been extensively studied, however, despite numerous crises striking the continent of Africa, scholars have typically overlooked examining their impact in this region.

Given that Sub-Saharan Africa contains many of the poorest countries in the world, there is a pressing need to promote economic growth. Increasing the understanding of the finance-growth nexus in this location is highly important if the goal of enhancing living standards is to be achieved. Despite claims that Africa's financial systems are dysfunctional in comparison to others globally (Demetriades and James, 2011), Rousseau and D'Onofrio (2013) show that monetization can play a role in enhancing growth in the region.

For African economies to have a sustainable economic growth rate, they need to reduce and control the volatility of growth (Ramey and Ramey, 1995). Similarly, Pescatori, Sandri and Simon (2014) argue that a volatile growth can be damaging to economic welfare. In addition, Easterly, Islam and Stiglitz (2000) find that developing countries face higher volatility on their economic growth, and that is due to the structure of the economy, policy regime of the government, and trade openness. Given how African economies are structured and their lack of well-established policies and institutions (Aizenman *et al*., 2018), they are prone to financial crises and growth volatility. According to Rodrik (1999), weak institutions and latent social conflict are the primary causes of volatility's negative effect on economic growth. Likewise, Pindyck and Solimano (1993) find that higher output growth volatility is associated with reduced investment levels, espicially in developing countries. Their findings suggest that economic volatilty creates a risky environment that discourages firms from making long-term investment commitments, leading to lower overall investment levels in the economy.

Therefore, this paper addresses the finance-growth nexus in Africa, specifically focusing on the detrimental impact a financial crisis may have on growth and its volatility. This is important, due to the unique features of African economies, where the consequences of financial crises could be far more devastating in this region than elsewhere. As Rousseau and Wachtel (2011) find, once accounting for financial crises, the finance-growth nexus that is claimed to have weakened, may be recovered. Thus, this study places further scrutiny on financial deepening to see if these findings transcend to the continent of Africa.

This study makes several important contributions to literature. First, it examines the impact of financial crises on economic growth and its volatility, of which the latter has been largely neglected in empirical work. Whereas existing research does examine the role of financial deepening on growth volatility (Ferreira da Silva, 2002; Mallick, 2014; Silva *et al.*, 2017), to

our knowledge no work has been carried out examining the impact of financial crises on growth volatility. Economic growth volatility can have profound implications for macroeconomic stability, investment decisions, and social welfare. Understanding how financial crises contribute to increased volatility in economic growth is essential for policymakers and other stakeholders in formulating appropriate strategies to mitigate risks and promote sustainable economic growth. For instance, in response to financial crises, fiscal and monetary policy responses can lead to a more volatile output, such as the acceleration of fiscal consolidation or temporary spikes in inflation (Pescatori, Sandri and Simon, 2014).

Second, this study focuses on the impact of financial crises in African economies. While there have been studies on the impact of financial crises on other regions, such as Asia and Latin America, there is a lack of research on the impact of financial crises on African economies. Africa contains many under-developed economies and is largely different to other regions. Under-developed economies are far more susceptible to volatile growth rates and financial crises, given how their economies are structured and their lack of well-established policies and institutions (Easterly, Islam and Stiglitz, 2000; Aizenman et al., 2018). Therefore, a specific study for this continent is imperative in order to provide relevant policy advice. As (Rewilak, 2013b) shows that the impact of financial deepening differs worldwide, where a one-size fits all policy is not necessarily optimal. As it is anticipated that this finding may transcend when examining financial crises, given the close relationship between financial deepening and fragility (Andrianova and Demetriades, 2018), this work provides a further valuable contribution to the literature.

A third contribution is that this paper considers the heterogenous impact of short versus long-term financial crises, and the financial crises that coincide with one another. While some studies have examined the impact of financial crises as singular events, our study recognises

the heterogeneity of financial crises in terms of duration and concurrent occurrence. Naturally, crises of a longer duration should harm economic growth to a greater degree than short-term crises. Specifically, this paper attempts to quantify that extent. Additionally, the simultaneous occurrence of multiple crises can create complex dynamics and compounding effects on economic growth. By explicitly considering the heterogeneous impact of short versus long-term financial crises and overlapping crises, this study provides a more nuanced and realistic analysis of the complex nature of financial crises, as opposed to solely focusing on banking crises.

To answer the research question, we empirically estimate a growth equation using both fixed effects and System GMM estimations. This follows the academic literature (Rousseau and Wachtel, 2011a; Demetriades and Rewilak, 2020). Using data from 1970 to 2017 for 52 African countries, we find that only currency and debt crises affect economic growth negatively in Africa. On the other hand, banking crises are shown to have a statistically insignificant effect on growth in Africa. Currency crises may reduce economic growth in the long run by 1.19 percentage points and debt crises are most harmful, reducing long run growth by 3 percentage points.

The results show no causally definitive evidence that increases in financial deepening may increase economic growth in Africa. However, there appears to be a correlation between the two variables, further propagating the symbiotic relationship outlined by Demetriades and Rewilak (2020).

In addition, we show that financial crises have limited effects on the volatility of economic growth in Africa. Yet, there is some evidence that debt crises increase growth volatility by approximately 1.8 standard deviations. When examining crisis duration, both short-term and long-term banking crises impact economic growth; whereas banking crises that last longer than

one year adversely affect the growth rate by 2.6 percentage points, over double the effect of short-term crisis.

This finding is important and informs policymakers to take swift and decisive action when a crisis presents itself to prevent damaging effects occurring in the economy. This time-sensitive decision, if suitably applied, may then reset the financial system to be growth promoting.[1] This finding appears to support a similar experience during the East Asian crisis in 1997/98 where many economies swiftly rebounded.

The remainder of this chapter consists of four sections. Section 3.2 presents the literature review and the hypotheses of this study. Section 3.3 shows the data and methodology. Section 3.4 discusses the results and main findings. Finally, section 3.5 offers our conclusion and a discussion of our recommendations and limitations.

3.2 Literature review

The literature on the finance-growth nexus is extensive (King and Levine, 1993a; Arestis and Demetriades, 1997; Rousseau and Wachtel, 2002, 2011; Arcand, Berkes and Panizza, 2015; Demetriades, Rewilak and Rousseau, 2023), yet there is still an incomplete understanding of the subject matter. This is well documented, given the policy advice to repeatedly deepen financial sectors, in the quest for more economic growth appears to have been ill-advised as it results in the global crisis (GFC) that occurred in 2007.

After the fallout of the GFC, research abandoned the view that "more finance equals more growth" and turned its attention to perhaps identify the optimal level of financial deepening. Arcand, Berkes and Panizza (2015) in their seminal study found that this turning point, and thus the optimal amount of financial deepening was close to 100% of GDP. However, research

[1] Strategies that may be adopted include recapitalising viable banks and closing down unviable banks and incorporating new regulations and changes in policies to further safeguard the financial system.

suggests that this threshold differs based upon sample composition. For example, for middle-income countries this turning point is 90% of GDP but falls for lower middle-income countries to 43% (Samargandi, Fidrmuc and Ghosh, 2015).

In terms of the finance-growth literature, regional variation has been shown to be important, where a one size-fits all policy prescription is not necessarily beneficial. For example, African financial systems are typically underdeveloped relative to those in other regions, and they lack adequate regulations (Murinde, 2012; Andrianova *et al*., 2015). Indeed, the finance-growth nexus is claimed to be extremely complex in Africa, where Demetriades and James (2011) argue that there is a 'broken' link between the real economy and bank credit.

Despite these deficiencies, Murinde (2012) finds that financial institutions and markets are important drivers of economic growth in Africa. With poverty widely prevalent in the region, Mullineux and Murinde (2014) further show that the financial sector is a tool that may be used to improve living standards in the continent.

There are caveats to these findings. For example, Demetriades and Fielding (2012) outline, in order for finance to enhance growth, there must be high levels of governance in the banking system, including a control of corruption and a high rule of law. Furthermore, for finance to be successful in Africa, Kedir et al. (2018) state that governments in Africa need to enhance banking supervision and regulation to ensure financial stability and avoid disruption in the financial system caused by external macroeconomic factors.

In the absence of strong financial regulation and supervision, where financial instability may flourish, the probability that a financial crisis occurs increases (Fielding and Rewilak, 2015). Given that many African economies exhibit traits that suggest their financial systems are weak, they have a high-risk of encountering a financial crisis. This would have disastrous repercussions for the region, where Akinsola and Odhiambo (2017) show that when examining

financial liberalisation in Africa, that financial crises are negatively associated with economic growth in Africa. In addition, despite financial crises occurring in both developed and developing countries, their impact may differ by income level, where Willem et al. (2010) show, the effect of the GFC was particularly harmful for developing countries such as those in Africa.

It is not just banking crises that may depress growth. Currency crises, defined as a depreciation of at least 30% against the U.S. dollar, and at least a 10-percentage point depreciation from the previous period (Laeven and Valencia, 2020), may also be harmful to economic prosperity. Currency crises may result in capital flight (Kant, 2002; Moghadam, Samavati and Dilts, 2003), as witnessed in East Asia during the turn of millennium. Here, valuable funds for investment purposes were withdrawn from the region, leading to fruitful ventures becoming unfulfilled, harming long-run growth.

Currency crises may also drive resources away from productive economic activity to speculative activities. Speculators may further harm the growth rate, as those bet on a devaluation in order to profit further harming the economy. As overvalued currencies make nations uncompetitive abroad, countries often try to defend their currencies (Yaghmaian, 1994; Tang, Lai and Ozturk, 2015). One option available is to increase domestic interest rates to incentivise investors to keep their funds within an economy. This action comes with consequences, as it leads to a higher cost of borrowing, which may slow down economic output. Furthermore, when bank-balance sheets are weak, this interest increase may have detrimental impacts on the financial sector, as witnessed during the East Asian crisis.

Public debt has shown to increase economic growth (Reinhart and Rogoff, 2010), but there are limits to sovereign indebtedness. Empirical evidence shows that a debt to GDP ratio up to 90% has positive growth effects in advanced economies, but this threshold is lower for emerging economies. For low-income countries, Clements, Bhattacharya and Nguyen (2003) find this

threshold to equal 50% of GDP, where in both cases, a ratio beyond this threshold adversely affects economic growth.

A high to debt to GDP ratio may have further consequences on a country's economy. When servicing public debt becomes unmanageable, it results in a sovereign default, a third type of financial crisis. This too would depress economic growth and limit the state's ability to promote growth via public investment. Unsurprisingly, Korinek (2011) states that developing countries are more vulnerable to sovereign debt crises, as collecting tax revenue is far more difficult in such nations. In addition, the macroeconomic volatility that poor nations experience, increases the probability of such a crisis.

Similar to the linkages between currency and banking crises, debt crises and banking crises may also be connected. During a banking crisis, the government may guarantee debt and act as a lender of last resort. Thus, to prevent bank failures, it may increase their sovereign debt, in order to bailout financial institutions. When multiple crises occur within the same time period, often referred as twin crises, their impact on economic growth is often more severe than if they occur individually (Hutchison and Noy, 2005; Lee and Lin, 2018).

As well as impacting the level of economic growth, financial crises may impact growth volatility. Low-income countries are far more susceptible to volatile growth rates (Easterly, Islam and Stiglitz, 2000), given how their economies are structured and their lack of well-established policies and institutions (Aizenman *et al*., 2018). Empirically, Ferreira da Silva (2002) and Mallick (2014) confirm this finding and showcase that when studying growth volatility, specific attention should be paid to under-developed nations. Focusing on sovereign debt, Hassan and Wu (2015) show that good sovereign debt credit ratings reduce growth volatility, where Pescatori, Sandri and Simon (2014) find that high levels of sovereign debt are associated with more volatile growth.

Despite the extensive studies on the finance-growth nexus, the majority focuses on the impact of financial deepening on growth, as opposed to the impact of financial crises. Moreover, the limited crisis literature tends to focus on banking crises, whereas both currency and debt crisis may have severe repercussions on economic growth. This is either in isolation, or via their spill-over effects onto the banking sector. With the lack of empirical evidence in Africa, one of the world's poorest regions, where the likelihood that a financial crisis may occur exceeds that of other regions, this paper fulfils several existing gaps in knowledge.

3.2.1 Research hypotheses

In this section, we present our research hypotheses based on the literature review. We have a number of hypotheses, and we provide the explanations and justifications for each one of them in this section.

Banking crises can be very disruptive to the economy and the welfare of the society. They distress the intermediation role of the banking system, and they also affect the economic activity. Laeven and Valencia (2020) define systematic banking crises as the episodes where there are significant bank runs, bank liquidations, and significant banking policy intervention measures. During banking crisis, access to credit is very limited and expensive, which hinders long-run economic growth due to lower levels of investment. Moreover, there will be a large number of banks' closures and bank runs. That require a significant government intervention, which might be harmful in the long run for the economy as it may lead to high inflation rates.

After the financial crises in 2008-2009, there have been many studies that examine the effects and causes of crises. It is very difficult to predict financial crises as they can occur in any country with different income levels. However, the impact of crises on the economy could be different between high-income and middle- and low- income countries since their fiscal and monetary capabilities differ. Willem et al. (2010) study the effects of the global financial crises

in 2008-2009 in developing countries. They find that there have been devastating spill-over effects in developing countries especially in Africa that affected countries' reserves, banks liquidity, and very low growth rates compared to what was forecasted.

Well-functioning and sound banking system can help economic growth and recovery after crises. However, increased financial deepening could lead to long-run growth in some cases, but it can end up with financial crises and deep contractions (Wachtel, 2018). Therefore, there must be high levels of governance including control of corruption, the rule of law, and financial regulation and supervision for the banking system to recover after financial crises and bolster economic growth (Demetriades and Fielding, 2012; Andrianova and Demetriades, 2018). Additionally, Asteriou and Spanos (2019) argue that capital adequacy of banks ensures the stability of the financial system after crises; however, a large liquid liability to GDP ratio hinders economic growth.

However, that relationship might not hold in some developing countries. Demetriades and James (2011) argue that there is a 'broken' link between the real economy and bank credit in some Sub-Saharan African countries, and that their ability to extend credit to households and firms does not follow economic growth. However, Murinde (2012) finds that financial institution and markets matter to economic growth in Africa, and they are essential for the economic stability. Furthermore, Demetriades and Rewilak (2020) find that financial development in Africa leads to growth as long as banks use sound lending practices.

Banking crises can cause a reduction in income and instability in the financial sector. Demetriades, Rewilak and Rousseau (2023) find that financial crises have an adverse impact on economic growth. Additionally, Akinsola and Odhiambo (2017) argue that the financial development help economic growth; however, banking crises affect the economic growth negatively in Africa. Thus, we test:

H_1: Banking crises have a significant and negative impact on economic growth in Africa.

Sovereign debt can be essential in promoting economic growth through the increase in public investment. However, high levels of sovereign debt may drag the economy into a harmful crisis. The repayment of debt can slow down the economic output level as it may require a decrease in government expenditure and increase in taxes. Moreover, debt crises can coincide with banking crises. During a banking crisis, government tend to increase their sovereign debts to help bailout banks, or there might be a spill-over effect from the public sector to banks through banks' sovereign exposures (Laeven and Valencia, 2020).

Although sovereign debt can be a useful tool for the economy during contractions, excessive debt accumulation can trigger crises. Thus, the debt to GDP ratio has a positive impact on economic growth, but up to a certain level. Reinhart and Rogoff (2010) examine the relationship between high public debt levels and growth using a sample of 44 countries. They find that debt to GDP ratio has a positive impact on economic growth up to a threshold of 90%, and after that it affects the growth negatively. However, that finding is applicable for advanced economies, and the threshold is lower than that for emerging economies at 60% of GDP. However, Clements, Bhattacharya and Nguyen (2003) find that the threshold differs for low-income countries. They find that the threshold is 50% of GDP, and beyond that, it adversely affects the economic growth. Additionally, they argue that the negative impact is due to the efficiency of resource use rather than the reduction in public investment. However, other studies find that there is no universally simple threshold effect in the relationship between sovereign debt and economic growth, and that the debt trajectory can have more consequences for growth than the level of debt to GDP (Pescatori, Sandri and Simon, 2014; Chudik et al., 2017).

Furthermore, Albu and Albu (2021) argue that public debt can stimulate the economic output in the short-run; however, higher debt levels will impact the economic growth negatively in the long-run, and countries need to keep their debt levels within sustainable limits. Moreover, Korinek (2011) states that developing countries are more vulnerable to sovereign debt crises due to macroeconomic volatility which increases the probability of default and crisis. Additionally, Ali and Imai (2015) examine the impact of sovereign debt crisis on economic growth in a large sample of African countries. They find that debt crises are detrimental to economic growth; however, they suggest that the negative effect is lower in countries that are more integrated with the rest of the world compared to countries that have low levels of trade openness. Therefore, this leads to hypothesis 2.

H_2: Sovereign debt crises have a significant and negative impact on economic growth in Africa.

Currency crisis occurs when a country's currency faces a sharp depreciation in the nominal value. Low- and middle- income economies are more vulnerable to currency crises than high-income economies, a reason could be that high-income currencies are used as reserve for other countries. A large depreciation of the currency means that imported goods become very expensive for individuals in a country where they depend on imports for their basic needs, and that may lead to a large increase in the inflation rate which is harmful for the economy in the long run. Moreover, countries take some measures to defend their currency (Yaghmaian, 1994; Tang, Lai and Ozturk, 2015). They may increase interest rates; however, that could harm economic growth since borrowing is expensive, and that could slow down the economic output. Therefore, we hypothesis that:

H_3: Currency crises have a significant and negative impact on economic growth in Africa.

Different types of financial crises can occur at the same period or caused by other types of crises. Kaminsky and Reinhart (1999) argue that banking and currency crises are closely linked in the aftermath of financial liberalisation, with banking crises precede currency crashes. They find that when banking and currency crises occur jointly, they are far more severe than if they occur individually. Additionally, banking crises could be accompanied by sovereign debt crises. When banking crises occur, governments tend to bail-out and help failing banks to stabilize the economy. Therefore, it is expected to increase the levels of sovereign debt or even the probability of defaults. Hutchison and Noy (2005) study the effects of twin crises (banking and currency crises) on economic output for 24 countries. They argue that the consequences of banking and currency crises are harmful for the economy when they occur individually; however, when a country experiences both crises in the same period, they effects are devastating for the economy. Similarly, Lee and Lin (2018) examine the effect of twin crises on economic growth using a sample of 50 countries over the period from 1984 to 2014. They find a significant negative impact of twin crises on economic growth. Thus, we test the following:

H_4: The negative impact of two crises occurring at the same time is stronger than when crises occur individually in Africa.

Finally, financial crises could affect the volatility of economic growth especially in low-income countries. Easterly, Islam and Stiglitz (2000) find that developing countries face higher volatility on their economic growth, and that is due to the structure of the economy, policy regime of the government, and trade openness. Moreover, Hassan and Wu (2015) argue that growth volatility is reduced through improvement in sovereign credit rating; however, they find that the global financial crises contributed to an increase in the macroeconomic volatility. Additionally, high levels of sovereign debt can cause different fiscal and monetary policies that could lead to an increase in the volatility of output. Therefore, Pescatori, Sandri and Simon

(2014) claim that higher debt levels are associated with an increased volatility of growth, and a volatile growth can be damaging to economic welfare. Therefore, we test:

H_5: Financial crises have a significant and negative impact on economic growth volatility in Africa.

3.3 Methodology

In this section, we present the data we use in this study and the model specifications of our analysis. First, we introduce our data and present our sample and the variables that we use in our study. Then, we explain the estimation process and the models that we employ in order to test our hypotheses.

3.3.1 Data

Using data from the *World Development Indicators* and the (Laeven and Valencia, 2020) dataset, the sample contains all African countries over the period 1970-2017. Based upon data availability, the sample contains a maximum of 54 African countries. In some regressions the country number falls to 51, and the sample includes new nations that have been formed during the sample period. The full list of the African countries in the sample is available in **Table 3.8** (**Appendix B)**. Nevertheless, there is strong cross-country coverage for the African continent and over time. To ensure that the sample is not dominated by countries with richer reporting data, and following the cross-country growth literature, the data is averaged into non-overlapping five-year periods. As the crisis data ends in 2017, the final cross section contains data from 2015 up to and including 2017.

There are two dependent variables. The first dependent variable is GDP growth. High, stable GDP growth indicates a productive, growing economy. Low or negative GDP growth can signal a recession. The GDP growth rate is a key indicator of overall economic performance.

The GDP growth values in our sample range from -11% to 57%. However, 99% of the sample ranges between -6% to 16%. The second dependent variable is GDP growth volatility, measured as the standard deviation of economic growth within each five-year period. Large fluctuations in growth from year to year create uncertainty for businesses and consumers, undermining investment and spending decisions. Low GDP volatility supports stability and confidence.

The variables of interest are the three different types of financial crises. These include banking, currency and sovereign debt crises. The variables are binary and take a value of 1 if a crisis occurs, and 0 otherwise. Following Rousseau and Wachtel (2011), if a financial crisis occurs during a five-year period, it is coded as 1 for that respective country.

Additionally, we study the effects of twin crises. Here we construct a further binary variable equal to 1 if two different types of crises occur during the five-year period, and 0 otherwise.[2] Furthermore, we create two further binary variables that separate short-term and long-term banking crises. A short crisis lasts up to one year, and longer-term crises last longer than one year. We only focus on banking crises, as they are the only type of crisis that are allocated a duration by Laeven and Valencia (2020).

We control for different macroeconomic variables that are commonly used in the growth literature (Rousseau and Wachtel, 2011; Rewilak, 2018). These are all available from the *World Development Indicators* provided by the World Bank. From this set of variables, the variable of most interest is financial deepening. This is measured as private credit to GDP and is shown to be the best proxy of financial deepening, as it captures the intermediation ability of the financial sector (Demetriades and Rewilak, 2020).

[2] There were no instances when all three crises occurred in the same period in the sample.

The control variable selection follows the literature (King and Levine, 1993a; Rousseau and Wachtel, 2011; Samargandi, Fidrmuc and Ghosh, 2015; Demetriades, Rewilak and Rousseau, 2023). We proxy for dynamics by including initial GDP per capita in the specification, to capture any catching up effects, and then use the lag of economic growth. Further control variables include trade openness, measured by the sum of imports and exports to GDP, which indicates integration into global markets. Also, we control for government spending to GDP, which reflects the resource costs of providing public infrastructure, services, social protection and other public goods. In addition, we include the inflation rate in our explanatory variables. High inflation reduces purchasing power and distorts price signals. Low, stable inflation supports commerce and consumer spending. Finally, we control for labour supply by including population growth in percent.[3] Credit to GDP, government spending and trade openness all enter the empirical specification in their natural logarithms. The summary statistics are presented in **Table 3.1**, **Table 3.2** presents the correlation matrix between the variables, and **Table 3.3** presents the variable definitions, sources, and how they are measured.

Table 3.1 Summary statistics

Variables	(1) Observations	(2) Mean	(3) Standard deviation	(4) Minimum	(5) Maximum
Crises	540	0.25	0.43	0	1
Debt Crises	540	0.05	0.21	0	1
Banking Crises	540	0.08	0.28	0	1
Currency Crises	540	0.17	0.37	0	1
Twin Crises	540	0.02	0.13	0	1
Short-term Crises	540	0.21	0.41	0	1
Med-term Crises	540	0.03	0.18	0	1
GDP Growth	474	4.01	4.49	-11.48	56.70
Pop. growth	539	2.53	1.12	-4.07	9.87
(Ln) GDP	460	7.05	0.98	5.13	9.76
(Ln) Credit	430	2.59	0.93	-4.86	4.99
(Ln) Trade	444	4.10	0.48	2.55	5.78
Inflation	472	11.13	10.60	-11.83	43.45
(Ln) G'ment Spend	426	2.65	0.45	0.14	3.93
Sd (Growth)	473	4.06	3.66	0.34	22.24

[3] In robustness tests, secondary schooling was included as an additional covariate. It is not included in the main specifications due to its high correlation with initial GDP per capita (0.67). In further robustness tests schooling replaced initial GDP per capita in the specifications. Switching these conditioning variables had little influence on the crisis findings.

Table 3.2 Correlation matrix

	Growth	Banking Crisis	Debt Crisis	Currency Crisis	(Ln) Credit	(Ln) GDP	(Ln) Trade	Inflation	(Ln) Gov.	Pop. growth
Growth	1									
Banking Crisis	-0.17***	1								
Debt Crisis	-0.13**	0.07	1							
Currency Crisis	-0.28***	0.10*	0.03	1						
(Ln) Credit	0.12*	-0.06	0.07	-0.07	1					
(Ln) Initial GDP	-0.03	-0.08	0.08	0.01	0.42***	1				
(Ln) Trade	0.18***	-0.11*	0.02	-0.16**	0.31***	0.46***	1			
Inflation	-0.14**	0.09	0.05	0.35***	-0.32***	-0.17***	-0.27***	1		
(Ln) G'ment Spend	0.06	-0.09	0.01	-0.11*	0.39***	0.21***	0.43***	-0.34***	1	
Pop. growth	0.24***	0.01	0.05	-0.03	-0.25***	-0.25***	-0.18***	0.09	-0.13*	1

Table 3.3 Variable definitions and sources

Variable name	Definition	Source
GDP growth	Annual percentage growth rate of GDP at market prices.	World Development Indicators database
GDP growth volatility	Standard deviation of annual GDP growth rates over past 5 years. Measures macroeconomic volatility.	Computed from World Development Indicators GDP data
Crisis	Dummy variable indicating systemic banking crisis.	(Laeven and Valencia, 2020)
Banking crisis	Dummy variable indicating systemic banking crisis.	(Laeven and Valencia, 2020)
Currency crisis	Dummy variable indicating currency crisis. A currency crisis is considered to occur when there is a nominal depreciation of the currency of at least 30 percent against the U.S. dollar that is also at least a 10 percent increase in the rate of depreciation compared to the year before.	(Laeven and Valencia, 2020)
Debt crisis	Dummy variable indicating sovereign debt crisis. include the year of sovereign default to private creditors and/or restructuring. If public debt was restructured without a suspension of payments, the sovereign crisis year is recorded as the year of the restructuring	(Laeven and Valencia, 2020)
Pop. growth	Annual population growth rate.	World Development Indicators database
Inflation	Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole.	World Development Indicators database
(Ln) Credit	Natural log of domestic credit to private sector as % of GDP. Indicates financial depth.	World Development Indicators database
(Ln) Trade	Natural log of ratio of exports plus imports to GDP. Indicates trade openness.	World Development Indicators database
(Ln) G'ment Spend	Natural log of general government final consumption expenditure as % of GDP.	World Development Indicators database
(Ln) Initial GDP	Natural log of lagged real GDP per capita. Controls for convergence effects.	World Development Indicators database

3.3.2 Model specification

To model the impact of financial crises on economic growth we use two estimation strategies. The benchmark specification is shown in Equation (1) and is estimated by the fixed effects estimator. The benchmark model follows King and Levine's (1993) version of the Barro-style growth model, which is commonly used in the growth literature (King and Levine, 1993b; Rousseau and Wachtel, 2011; Samargandi, Fidrmuc and Ghosh, 2015; Demetriades, Rewilak and Rousseau, 2023). In Equation (1) and all subsequent equations, (i) subscripts for individual countries, (t) subscripts for individual years, where (α) and (β) are parameters to be estimated and matrix (X) includes the conditioning variables. The variable of interest is (Crises). The term (α_i) represents a country specific intercept, and the random error term (ϵ) is denoted.

A fixed effects estimator is preferred to the Pooled Ordinary Least Squares (OLS), because we assume that the explanatory variables are correlated with the individual specific effect (α_i). Given this, OLS would be biased and inconsistent. Time dummies (τ_t) are included in the specification to control for shocks that may influence economic growth and its volatility, common across all countries in the sample.

$$Growth_{i,t} = \alpha_i + \beta_1 Crises_{i,t} + \beta_2 X_{i,t} + \tau_t + \epsilon_{i,t} \quad (1)$$

These benchmark estimations examine the correlations between the variables and economic growth. There may be a simultaneity concern than low growth rates lead to a financial crisis. However, assuming sequential exogeneity a causal interpretation may be assumed from initial GDP, and we also assume financial crises to be exogenous. This is because financial crises are random shocks to an economy and if they were predictable, then governments would intervene with policies to prevent them from occurring (Rewilak, 2018).

Therefore, to try overcoming simultaneity bias, the second estimation strategy uses a System GMM estimator that uses instrumental variable techniques to try ascertaining a casual

interpretation shown in Equations 2 and 3. In Equations 2 and 3, all right-hand side variables are considered to be endogenous and are instrumented using the estimator's internal instruments to identify the coefficients. Thus, a causal interpretation of all the variables may be inferred.[4] In the level equation, lagged differences of the endogenous variables are used as instruments and in the difference equation, lagged levels of the endogenous variables are used as instruments. Therefore, we hope this technique mitigates concerns of simultaneity bias. To restrict the instrument, count the estimator's collapse command is implemented. In addition, the System GMM allows the use of a lagged dependent variable to capture dynamics.[5]

$$Growth_{i,t} = \alpha_i + \gamma Growth_{i,t-1} + \beta_1 Crises_{i,t} + \beta_2 X_{i,t} + +\tau_t + \epsilon_{i,t} \quad (2)$$

$$\Delta Growth_{i,t} = \gamma \Delta Growth_{i,t-1} + \beta_1 \Delta Crises_{i,t} + \beta_2 \Delta X_{i,t} + \Delta\tau_t + \Delta\epsilon_{i,t} \quad (3)$$

The System GMM estimator requires several properties to be satisfied for it to be valid. It requires the presence of first-order serial correlation but no presence of second order serial correlation. In addition, it requires a non-rejection of the Hansen test which ensures that the estimator's instruments are valid. The Hansen test can be weakened by a high instrument count, therefore as a rule of thumb by Baltagi (2008), it is good practice to ensure the number of instruments do not exceed the number of cross sections.

3.4 Results

In this section, we present the results of our regressions. We divide this section into three sub-sections for clarity. The first sub-section shows the results of our estimations of the different effects of financial crises on economic growth. The second presents the results of the impact of financial crises on the volatility of economic growth. Finally, the third sub-section shows

[4] Following the existing literature, we assume our System GMM findings may be interpreted as causal as they reduce the risk of simultaneity bias.

[5] For comparability with the fixed effects specifications, the System GMM estimates were also run using initial GDP rather than a lagged dependent variable, as carried out by Beck et al., (2000) and Rousseau and Wachtel (2011).

the results of the different effects of the duration of banking crises on economic growth where we compare the impact of short-term to long-term banking crises on growth.

3.4.1 Impact on economic growth

Table 3.4 presents the benchmark fixed effects findings. In column 1, we examine the impact a financial crisis has on growth irrespective of its type. Financial crises have a significant and negative impact on economic growth. The magnitude of this findings suggests that a crisis may depress economic growth by approximately 1 percentage point. Moreover, population growth, private credit and trade openness are all significant and have a positive effect on economic growth as anticipated. Initial GDP per capita is negative and statistically significant showing convergence, where poorer nations are catching up to their richer counterparts.

Table 3.4 Dependent Variable: Five-Year Average GDP Growth

Variables	(1) Crises	(2) Banking Crises	(3) Currency Crises	(4) Debt Crises	(5) Twin Crises	(6) All Crises
Financial Crisis	-0.97 ***					
	(0.32)					
Banking Crisis		-0.36				-0.32
		(0.52)				(0.47)
Currency Crisis			-0.88***			-0.95***
			(0.32)			(0.30)
Debt Crisis				-1.85***		-1.78**
				(0.68)		(0.68)
Multiple Crises					-4.92***	
					(1.46)	
Pop. growth	1.56***	1.61***	1.60***	1.59***	1.63***	1.56***
	(0.37)	(0.37)	(0.36)	(0.37)	(0.37)	(0.37)
Inflation	-0.04	-0.04	-0.03	-0.04	-0.03	-0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
(Ln) Credit	0.46**	0.40*	0.45*	0.43*	0.42*	0.48**
	(0.23)	(0.23)	(0.23)	(0.23)	(0.22)	(0.23)
(Ln) Trade	3.04***	3.08***	2.98***	3.20***	3.21***	3.07***
	(0.74)	(0.76)	(0.75)	(0.77)	(0.73)	(0.75)
(Ln) G'ment Spend	-0.84	-0.86	-0.84	-0.88	-1.06	-0.81
	(0.74)	(0.75)	(0.74)	(0.73)	(0.73)	(0.73)
(Ln) Initial GDP	-4.15***	-4.20***	-4.21***	-4.10***	-3.88***	-4.06***
	(0.73)	(0.72)	(0.72)	(0.71)	(0.69)	(0.72)
Constant	19.01***	19.38***	19.44***	18.08***	16.88***	18.06***
	(4.77)	(4.89)	(4.72)	(4.93)	(4.74)	(4.75)
Observations	382	382	382	382	382	382
R-squared	0.42	0.41	0.42	0.42	0.43	0.43
Cross sections	51	51	51	51	51	51

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity.

In columns 2-4, we examine each crisis individually, before including all three crisis types into the regression specification simultaneously in the final column of the table. Column 2 shows that banking crises have no significant impact on economic growth in Africa. In column 3, currency crises are shown to depress economic growth by 0.9 percentage points. The following column examines debt crises which also have a statistically significant impact on economic growth. Indeed, the economic significance of this variable shows that it has the largest negative impact on growth which is over twice the size of currency crises. Overall, a debt crisis may reduce economic growth by over 1.8 percentage-points.

Column 5 then examines the impact crises have on growth if two of these crises occur in the same time period. The findings show that if a country suffers a twin crisis in Africa, economic growth is depressed by approximately 5 percentage points. This provides evidence that when a country faces one type of crisis, the consequences could be harmful, but when they experience two crises in the same period, the impact could be devastating. The findings are consistent with (Bordo, Meissner and Stuckler, 2010; Lee and Lin, 2018) who demonstrate the harmful effects of twin crises. Finally, in column 6, the results show that when all three types of crises are entered into the empirical equation, both currency and debt crises maintain their economic significance. The magnitudes of the variables are similar to those in prior columns when the variables were entered into the specification one at a time.

As in column 1, the coefficients for population growth, private credit and trade openness are all positive in sign and significant across the remaining columns. Initial GDP per capita is negative and statistically significant. Comparing the role of private credit and trade openness shows that the economic significance of financial deepening in Africa is much smaller than

being open to trade. A 10% increase in credit to GDP is associated with a 0.05 percentage point increase in growth, where a similar increase in trade openness is associated with a 0.3 percentage point increase. Overall, the model shows a good fit with R-Squared values ranging from 0.41-0.43.

Table 3.5 System GMM: Dependent Variable: GDP Growth

Variables	(1) Crises	(2) Banking Crises	(3) Currency Crises	(4) Debt Crises	(5) Twin Crises	(6) All Crises
Lag Growth	0.16**	0.16**	0.16**	0.19***	0.17**	0.16**
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Financial Crisis	-1.23**					
	(0.59)					
Banking Crisis		-1.09				-0.715
		(0.84)				(0.53)
Currency Crisis			-1.00*			-1.09**
			(0.61)			(0.51)
Debt Crisis				-2.45**		-1.69
				(1.17)		(1.08)
Multiple Crises					-7.96***	
					(1.85)	
Pop. growth	2.05***	2.11***	2.28***	2.14***	2.33***	2.20***
	(0.50)	(0.62)	(0.49)	(0.56)	(0.56)	(0.42)
Inflation	-0.09**	-0.08**	-0.07**	-0.09**	-0.07	-0.06***
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.02)
(Ln) Credit	-0.25	-0.51	-0.06	-0.44	-0.30	-0.17
	(0.86)	(1.03)	(0.84)	(0.59)	(0.81)	(0.66)
(Ln) Trade	3.59**	4.37**	3.75**	3.73**	4.08***	3.80**
	(1.52)	(1.72)	(1.74)	(1.71)	(1.37)	(1.68)
(Ln) G'ment Spend	-2.24	-2.50	-2.61**	-2.51*	-3.70**	-2.29*
	(1.37)	(1.84)	(1.28)	(1.37)	(1.50)	(1.25)
Instrument count	37	37	37	37	37	45
AR (1) *p*-value	0.00	0.00	0.00	0.00	0.00	0.00
AR (2) *p*-value	0.76	0.55	0.99	0.69	0.71	0.88
Hansen *p*-value	0.43	0.19	0.25	0.34	0.32	0.41
Observations	353	353	353	353	353	353
Cross sections	52	52	52	52	52	52

Notes: All estimates are using System GMM and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity.

Table 3.5 replaces initial GDP per capita in the specification with a lagged dependent variable as a different way to capture dynamics. In addition, to overcome any potential endogeneity concerns, the empirical equation is estimated using the System GMM estimator, using internal instruments to identify the coefficients.

In **Table 3.5**, controlling for persistence is shown to be important as the lagged dependent variable is statistically significant at the 1% level in all the regressions. Focusing on the variable of interest, in column 1, the results show that a financial crisis may depress economic growth by 1.5 percentage points in the long run. In column 2, as with the fixed effects regressions, banking crises have no significant impact on economic growth. Column 3 examines the impact of a currency crisis on economic growth, where the results show that it may reduce growth by approximately 1.2 percentage points in the long run. Debt crises are shown to have the largest negative impact on economic growth. The long-run impact of a debt crisis is shown to reduce economic growth by approximately 3 percentage points in column 4.

Column 5 focuses on twin crises which are shown to have devastating effects on economic growth. In comparison to **Table 3.4**, where a twin crisis reduced growth by approximately 5 percentage points, the long run impact shown in **Table 3.5** proposes that a twin crisis may harm economic growth by 9.5 percentage points, approximately double the prior estimate. In column 6, when all three crisis types are entered into the specification, banking crises still have an insignificant effect on growth. Currency crises are negative and significant with a similar magnitude in column 3, but surprisingly debt crises are insignificant in this final specification. However, they still exhibit a negative effect, and their T-Statistic falls just short of statistical significance at the 10% level.

From the control variables, population growth and trade openness retain their statistical significance and their respective signs from the previous table. However, private credit is no longer a statistically significant determinant of economic growth. Thus, whilst financial deepening is correlated with economic growth in Africa, there is limited support to state that it causes economic growth. In addition, the results show that inflation is now a statistically significant determinant of economic growth, where high inflation rates are detrimental to growth as anticipated.

The System GMM diagnostics are well satisfied. In all the specifications the AR (1) p-value is 0.00 that rejects the null hypothesis of no first-order serial correlation. The AR (2) p-value exceeds 0.05 in all six specifications, therefore, does not reject the null of no second order serial correlation. The Hansen p-value to test the instrument validity shows a non-rejection of null hypothesis with p-values ranging from 0.19-0.43. Furthermore, the instrument count does not exceed the number of cross-sections as proposed by Baltagi (2008).

3.4.2 Volatility of GDP growth

Table 3.6 and **Table 3.7** report the results when the dependent variable equals economic growth volatility. We anticipate that variables that reduce economic growth, will increase its volatility and vice versa. The results follow the same pattern as in the previous two tables.

Table 3.6 Dependent Variable: Five-Year Sd GDP Growth

Variables	(1) Crises	(2) Banking	(3) Currency	(4) Debt	(5) Twin	(6) All Crises
Financial Crisis	0.26					
	(0.47)					
Banking Crisis		0.34				0.32
		(0.67)				(0.68)
Currency Crisis			0.06			0.07
			(0.40)			(0.37)
Debt Crisis				0.81		0.78
				(0.63)		(0.61)
Multiple Crises					1.20	
					(0.72)	
Pop. growth	-0.91**	-0.91**	-0.92**	-0.91**	-0.92**	-0.90**
	(0.41)	(0.42)	(0.41)	(0.41)	(0.41)	(0.42)
Inflation	0.05***	0.06***	0.05***	0.05***	0.05***	0.05***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
(Ln) Credit	0.37*	0.38*	0.38*	0.37*	0.38*	0.37*
	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)	(0.20)
(Ln) Trade	0.06	0.06	0.05	0.00	0.02	0.02
	(0.62)	(0.61)	(0.62)	(0.64)	(0.62)	(0.64)
(Ln) G'ment Spend	-1.37*	-1.35**	-1.35*	-1.36**	-1.32*	-1.36*
	(0.69)	(0.66)	(0.68)	(0.67)	(0.68)	(0.68)
(Ln) Initial GDP	-1.01	-1.02	-0.99	-1.05	-1.08	-1.12
	(0.87)	(0.86)	(0.87)	(0.87)	(0.89)	(0.85)
Constant	16.81***	16.75***	16.67***	17.26***	17.29***	17.63***
	(6.18)	(6.13)	(6.12)	(6.22)	(6.30)	(6.14)
Observations	381	381	381	381	381	381
R-squared	0.25	0.25	0.25	0.25	0.25	0.26
Cross sections	51	51	51	51	51	51

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity.

Remarkably across all six columns, the financial crisis is statistically insignificant. Thus, neither banking, currency nor debt crises impact the volatility of economic growth in Africa. This is an interesting finding as in comparison to **Table 3.4**, when both currency and debt crises were shown to have harmful effects on economic growth. It may be possible that when a crisis hits, growth is reduced as witnessed in **Table 3.4**, but over the five-year period, there are no swift rebounds as witnessed with other crisis episodes like East Asia. In East Asia, growth fell during the crisis and then became high immediately after the end of the crisis, leading to volatile output within a short time period (Chari and Henry, 2015).

These results are worrying for African nations. This is because it may be the case that when a crisis hits, the effects are longer lasting, and economic growth is reduced, and this low growth rate is maintained for an extensive period. Whilst volatile economic climates may deter investment (Ferreira da Silva, 2002; Mallick, 2014), persistently depressed growth rates in the aftermath of a crisis, may be far more damaging to African economies. Analogous to Japan's lost decade, where financial fragility as opposed to a financial crisis, resulted in persistently low output (Fukao, 2003; Demetriades, Rewilak and Rousseau, 2023), it may partly explain why Africa remains underdeveloped.

From the remaining set of variables, the inflation rate and private credit are both found to increase growth volatility. Inflation is often used as a proxy of macroeconomic stability; therefore, unstable macroeconomic environments would surely result in deviations in economic growth. Interestingly a 10% increase in private credit leads to a 0.04 standard deviation increase in growth volatility. Economically, this is a trivial amount, although it may provide support regarding the strong connection between financial deepening and financial fragility as outlined by Andrianova and Demetriades (2018). In addition, population growth reduces growth volatility as does government spending. The latter variable shows that a 10%

increase in government spending, reduces growth volatility by approximately 0.1 standard deviations in Africa.

Table 3.7 System GMM. Dependent Variable: SD GDP Growth

VARIABLES	(1) Crises	(2) Banking	(3) Currency	(4) Debt	(5) Twin Crises	(6) All crises
Lag SD Growth	0.04	0.05	0.06	0.05	0.07	0.05
	(0.10)	(0.10)	(0.10)	(0.09)	(0.10)	(0.08)
Financial Crisis	0.41					
	(0.69)					
Banking Crisis		0.54				0.56
		(0.69)				(0.72)
Currency Crisis			-0.05			-0.14
			(0.56)			(0.62)
Debt Crisis				1.62**		1.83**
				(0.64)		(0.77)
Multiple Crises					0.61	
					(1.11)	
Pop. growth	-0.17	-0.01	0.02	-0.33	-0.23	0.01
	(1.38)	(0.71)	(0.88)	(1.03)	(0.86)	(0.92)
Inflation	0.08**	0.10***	0.10***	0.09**	0.10***	0.09*
	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.05)
(Ln) Credit	0.20	0.32	0.19	0.26	0.22	0.15
	(0.58)	(0.41)	(0.52)	(0.46)	(0.48)	(0.54)
(Ln) Trade	0.65	0.24	0.54	1.00	0.63	1.08
	(1.69)	(1.22)	(1.10)	(1.51)	(1.48)	(1.24)
(Ln) G'ment Spend	-1.28	-0.28	-0.52	-0.81	-0.03	-0.10
	(1.53)	(1.10)	(1.17)	(1.22)	(1.01)	(1.29)
Instrument count	37	37	37	37	37	45
AR (1) *p*-value	0.00	0.01	0.00	0.01	0.00	0.00
AR (2) *p*-value	0.32	0.34	0.34	0.37	0.36	0.32
Hansen *p*-value	0.11	0.42	0.45	0.41	0.52	0.36
Observations	352	352	352	352	352	352
Cross sections	52	52	52	52	52	52

Notes: All estimates are using System GMM and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The constant and time dummies are included in the specification but unreported for brevity.

In **Table 3.7**, when estimating the specification using System GMM, the findings largely confirm those in **Table 3.6** when focussing on the financial crises variable. There is one notable exception. In column 4 and 6, debt crises become positive and statistically significant. Thus, debt crises are shown not only to depress economic growth but result in large swings in economic growth. Examining the coefficients, in column 4, the long run impact of a debt crisis results in an increase in the volatility of economic growth by 1.62 standard deviations. In

column 6, this magnitude is slightly larger, where a debt crisis increases growth volatility by 1.83 standard deviations.[6]

The lagged dependent variable in **Table 3.7** is statistically insignificant indicating a lack of persistence in growth volatility. This is perhaps unsurprising as higher frequency data may better capture the dynamics of growth volatility. In addition, the inflation rate retains its statistical significance as it had previously in **Table 3.6**. The magnitude suggests that a unit increase in the inflation rate will increase growth volatility by 0.1 standard deviations.

The diagnostics show the System GMM estimator is well specified. Despite the statistical insignificance of the lagged dependent variable, the model exhibits first order serial correlation and no second order serial correlation. The Hansen p-value exceeds 0.1 in every specification; thus, it does not reject the null hypothesis that the instrument set is valid. The Hansen test is robust and given that the number of cross sections exceeds the number of instruments in the specification, there is confidence that this test is not weakened.

3.4.3 Short term versus long term Banking crises

Given the previous findings, how crises reduce growth but there is limited evidence that they impact its volatility, we follow this up by examining crisis duration. This approach also teases out more variation in the crisis data, and it is anticipated that crises that are short in duration are typically less harmful than those that last for a long time. Moreover, at times short crises may even be growth enhancing, if it encourages policymakers to repair the deficiencies in the financial system (Fukao, 2003; Ranciere, Tornell and Westermann, 2008).

In **Table 3.8**, we model banking crises as two separate variables, the first if a crisis occurred in a period but for only one year, and then a second variable for banking crises that occur in a

[6] Given that the lagged dependent is statistically insignificant (equals zero) the reported short-run coefficients will equal the long-run coefficients.

period and last for longer than one year.[7] Four regressions are reported, the first two examining the impact of a crisis duration on economic growth, and the latter two columns on growth volatility. The odd columns report the fixed effects results and the even columns the preferred System GMM estimates.

Table 3.8 Banking Crisis Durations

Variables	(1) Fixed Effects Dependent Variable: GDP Growth	(2) GMM Dependent Variable: GDP Growth	(3) Fixed Effects Dependent Variable: SD GDP Growth	(4) GMM Dependent Variable: SD GDP Growth
Lag Growth		0.17**		
		(0.08)		
Lag SD Growth				0.02
				(0.10)
ST Crises	-0.97***	-0.92*	0.17	0.66
	(0.29)	(0.49)	(0.49)	(0.70)
LT Crises	-1.36**	-2.15*	0.77	1.40
	(0.63)	(1.16)	(0.73)	(1.30)
Pop. growth	1.57***	2.23***	-0.92**	-0.28
	(0.37)	(0.55)	(0.41)	(1.35)
Inflation	-0.04	-0.07**	0.05***	0.08
	(0.03)	(0.03)	(0.02)	(0.05)
(Ln) Credit	0.47**	-0.29	0.37*	0.10
	(0.23)	(0.92)	(0.20)	(0.59)
(Ln) Trade	3.00***	3.97**	0.11	0.99
	(0.74)	(1.64)	(0.62)	(1.71)
(Ln) G'ment Spend	-0.83	-2.17	-1.39**	-1.59
	(0.74)	(1.40)	(0.68)	(1.08)
(Ln) Initial GDP	-4.11***		-1.05	
	(0.72)		(0.86)	
Instrument count		41		41
AR (1) *p*-value		0.00		0.00
AR (2) *p*-value		0.85		0.27
Hansen *p*-value		0.53		0.12
Observations	382	353	381	352
R-squared	0.42		0.27	
Cross sections	51	52	51	52

Notes: All odd columns are estimated using fixed effects and the even columns using System GMM. Each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The constant and time dummies are included in the specification but unreported for brevity.

In columns 1 and 2, both banking crisis variables are statistically significant. In column 1, a short run banking crisis depresses economic growth by approximately 1 percentage point where

[7] The Laeven and Valencia (2020) dataset only provides information on crisis duration for banking crises.

a longer crisis impairs growth by 1.4 percentage points approximately. In column 2 a short banking crisis has a magnitude similar to the previous column and shows that economic growth is reduced by 1.1 percentage points. However, a long-term crisis has a much greater impact on economic growth. A long-term crisis may reduce growth by 2.6 percentage points. This is a large economically significant effect. In columns 3 and 4, banking crises are shown to have no impact on the volatility of economic growth.

Examining the control variables in **Table 3.8**, population growth and trade openness are shown to increase economic growth with statistically significant coefficients in columns 1 and 2. In addition, the inflation rate is shown to harm economic growth. A positive correlation between credit and growth is shown in column 1 and there is strong evidence that dynamics matter as initial GDP per capita and the lagged dependent variable are statistically significant. When examining growth volatility, the inflation rate increases growth volatility and there is support that population growth and government spending are negatively associated with growth volatility. Finally, private credit is positively correlated with the volatility of economic growth.

The diagnostics of the System GMM estimator in **Table 3.8** are well satisfied as with the previous specifications. The null hypothesis of no first order serial correlation is rejected and the null of no second order serial correlation is not rejected. The Hansen p-value is 0.53 in column 2 and 0.12 in column 4, both that do not reject the null hypothesis that the instruments are valid. The model does not suffer from overfitting the instrument count as the number of cross sections exceeds the number of instruments.

3.5 Conclusion

This paper examines the impact of banking, currency and sovereign debt crises on economic growth and its volatility in Africa. In addition, it examines this impact when two different types

of financial crises occur simultaneously, and then examines the differing effects between short-term and long-term banking crises.

Using a System GMM estimator that controls for persistence, it is shown that currency and debt crises have a negative impact on economic growth. However, only when banking crises are split by duration, do they exhibit a harmful effect on growth. As anticipated the impact of long-term crises exceeds that of short-term crisis. Specifically, a currency crisis may harm long-run growth by 1.2 percentage points and debt crises reduce economic growth by 3 percentage points. Short-term banking crises reduce economic growth by 1.1 percentage points whereas long-term banking crises impair growth by 2.6 percentage points.

When examining whether financial crises impact growth volatility, there is limited evidence that crises impact the standard deviation of economic growth. Only debt crises are shown to increase growth volatility by approximately 1.7 standard deviations.

The region of Africa is challenged with widespread poverty and underdevelopment. Financial crises harm the economic growth process hindering efforts for the region to prosper. Therefore, African policymakers and government officials need to carefully monitor their economies and try ensuring they are as robust as possible to avoid a financial crisis. However, if a crisis does occur, policymakers need to take swift and decisive action, as longer lasting crises are shown to produce greater harm to the economy.

APPENDIX B

Table 3.9: List of African countries

#	Country name	#	Country name	#	Country name
1	Algeria	19	Eswatini	37	Namibia
2	Angola	20	Ethiopia	38	Niger
3	Benin	21	Gabon	39	Nigeria
4	Botswana	22	The Gambia	40	Rwanda
5	Burkina Faso	23	Ghana	41	Sao Tome and Principe
6	Burundi	24	Guinea	42	Senegal
7	Cabo Verde	25	Guinea-Bissau	43	Seychelles
8	Cameroon	26	Kenya	44	Sierra Leone
9	Central African Republic	27	Lesotho	45	Somalia
10	Chad	28	Liberia	46	South Africa
11	Comoros	29	Libya	47	South Sudan
12	Democratic Republic of the Congo	30	Madagascar	48	Sudan
13	Republic of the Congo	31	Malawi	49	Tanzania
14	Cote d'Ivoire	32	Mali	50	Togo
15	Djibouti	33	Mauritania	51	Tunisia
16	Egypt	34	Mauritius	52	Uganda
17	Equatorial Guinea	35	Morocco	53	Zambia
18	Eritrea	36	Mozambique	54	Zimbabwe

CHAPTER 4: FINANCIAL STRUCTURE IMPACT ON ECONOMIC GROWTH

4.1 Introduction

The importance of financial markets and institutions in promoting economic growth cannot be overstated, even if this relationship has weakened in recent times (King and Levine, 1993b; Demetriades and Hussein, 1996; Rousseau and Wachtel, 2011; Arcand, Berkes and Panizza, 2015; Demetriades, Rewilak and Rousseau, 2023). Indeed, the financial system has constantly evolved and is very different now in comparison to before the dotcom revolution (Rousseau and Sylla, 2003; Michie, 2016; Cheng, Chien and Lee, 2021). Along with globalisation, developments in computing power have changed how efficiently the financial system may operate and changed how firms may finance their operations (Basco, 2014; Lane and Milesi-Ferretti, 2018; Cheng, Chien and Lee, 2021). It has also had repercussions in the financial sector, where this increasing interconnectedness played a role in the Global Financial Crisis (GFC) of 2007.

Financial structure is best described as the mixture of the two main forms of financial intermediation channels in a financial system (Gambacorta, Yang and Tsatsaronis, 2014). These main forms are a bank-based or a market-based financial system, where a nation's reliance upon either method is incredibly heterogenous and may vary over time (Gambacorta, Yang and Tsatsaronis, 2014). In spite of this, there are different competing theories on which influence on growth is more significant, whether financial institutions or financial markets. According to market-based theory, markets promote economic growth and encourage information dissemination and diversification. Therefore, investments are encouraged, and savings can be easily mobilised (Arestis, Demetriades and Luintel, 2001). By contrast, the bank-based view asserts that banks can overcome certain weaknesses of stock markets. For example, it is particularly difficult for investors to acquire and analyse information on a well-

developed stock market because it releases information rapidly. Thus, well-developed stock markets can reduce individuals' incentives to identify innovative projects, thereby limiting resource allocation and economic growth (Stiglitz, 1985). Regardless of these differences between countries, it has often been claimed that the overall level of financial development mattered in enhancing economic prosperity rather than its composition (Levine and Zervos, 1998). However, it has emerged recently that this relationship is far more complex (Yeh, Huang and Lin, 2013; Gambacorta, Yang and Tsatsaronis, 2014; Demir and Hall, 2017).

Therefore, this chapter contributes to the literature in two ways. First, it re-examines the importance of the role of financial structure in economic growth using a contemporary data. Specifically, it tests whether this relationship has changed over time, comparing the classical period of financial intermediation (pre-2000) to a more modern approach (post-2000). This is carried out by adopting a horse race and comparing the two types of financial deepening on economic growth. Existing studies have yielded mixed findings regarding the nexus between financial structure and economic growth. Early literature found that financial structure was irrelevant for growth (Beck et al., 2000; Demirgüc-Kunt and Maksimovic, 2002; Levine, 2002; Ndikumana, 2005), while recent studies have suggested that it does matter (Pinno and Serletis, 2007; Cuadro-Sáez and García-Herrero, 2008; Lee, 2012; Guru and Yadav, 2019). However, Levine (2002) admits that their results might change over time based on Boyd and Smith's (1998) prediction that when countries develop, they become more dependent on markets; or that for developing countries, bank-based systems are better at promoting growth (Rajan and Zingales, 1998). Thus, there is hardly any consensus regarding the most effective system (bank-based or market-based) for promoting growth (Luintel et al., 2008; Mathenge and Nikolaidou, 2018; Chu, 2020). Second, we contribute to the literature by re-examining the relationship using a broader sample. In our sample, we study the relationship by including a sample of 84 countries from different income levels. Contemporary literature examining the relationship

limit their analysis to a specific region or a limited number of countries (e.g., Demir and Hall, 2017; Mathenge and Nikolaidou, 2018; Guru and Yadav, 2019), or a specific country (Liu and Zhang, 2020; Bu, Yu and Li, 2022). Thus, this study provides a comprehensive analysis that encompasses a diverse range of countries representing various income and development levels.

In this study, we use data from 84 countries over the period 1960-2019, averaging the data into five-year non-overlapping periods. Following the literature, we apply a pooled least square estimator, using initial values of the five-year averages to identify the coefficients (King and Levine, 1993b; Rousseau and Wachtel, 2011; Demetriades, Rewilak and Rousseau, 2023). As time-invariant country-specific effects may jointly determine increases in financial development and economic growth, we apply a fixed effects estimation strategy. Similarly, we assume sequential exogeneity to identify the coefficients.

The findings appear to contradict those from Levine and Zervos (1998) that the overall level of financial development matters for growth rather than the composition. This is because, in this study, it is evident that whilst bank-based systems did have a statistically significant impact on growth during the early periods in the sample, the effect was limited. However, over the period 1960-1999, there was no statistically significant effect from stock markets. On the other hand, the results also show that the importance of a market-based financial system has grown over time. This is because, over the period 2000-2019, stock market capitalisation is positively associated with economic growth.

The results are important to both academics and practitioners. It shows that the relationship between financial development and economic growth has changed, and that previous policy advice may have been of its time. Specifically, it would be difficult to argue that financial deepening in the banking sector is a growth-enhancing strategy. In addition, the work highlights the growing importance of stock markets in economic prosperity. As both the number and the

sophistication of stock markets are forecast to grow, ensuring that they expand at the correct speed and for their primary purposes is important to retain this positive association between them and economic growth. This is unlike the claims of how bank-based financing has become overly involved in the housing market, given that landed property has become the most attractive form of collateral and the most desired financial asset for both households and investors (Ryan-Collins, 2021).

The remainder of this chapter consists of four sections. Section 4.2 presents the literature review and the hypotheses of this study. Section 4.3 presents data and model specifications. Section 4.4 reports the results and main findings. Finally, section 4.5 concludes the chapter.

4.2 Literature review

The topic of financial structure has been widely debated in economic policy circles. Scholars and policymakers have often tried to identify the correct mix of a bank-based or market-based system that may be most beneficial to increase economic growth.

Both financial systems that make up a bank-based system and financial markets showcase distinct advantages for financing investments. Financial institutions play a key role in promoting growth by allocating resources to the most profitable ventures and then monitoring the investment (Stiglitz, 1985; Boyd and Prescott, 1986; Bhide, 1993). In comparison, financial markets provide liquidity and investment opportunities that can lead to economic growth, especially in developed countries (Levine, 1997; Boyd and Smith, 1998). An economy's financial structure is a mix of financial institutions, financial markets, and financial instruments. Countries are considered bank-based economies if they rely more on their banking system and market-based economies if the country's stock market is more prevalent. In terms of their functions, both banks and stock markets provide services that enhance the mobilisation of savings, which increases investment opportunities and technological innovation. Moreover,

they reduce transactional transaction and information costs, which are essential to ease the exchange of goods and services. Yet, despite the two different options providing similar functions, we witness wide discrepancies in financial structure across the globe. These differences vary based on the level of economic development and the importance of which system (bank-based or market-based) has different implications for different countries. To further shed light on this issue, there are four competing theories that address the importance of financial structure on economic growth, including bank-based, market-based, financial services, and legal and political views.

The bank-based theory highlights the importance of the banking system in the economy. The theory suggests that banks are imperative in mobilising resources, identifying good projects, monitoring managers, and managing risks (Levine, 1997). Moreover, the bank-based view stresses that banks overcome certain weaknesses that stock markets possess. Specifically, a well-developed stock market discloses information quickly in the market, which hinders the ability of investors to acquire and analyse this information. Consequently, a well-developed stock market may reduce the incentive for individuals to identify innovative projects, hindering resource allocation and economic growth (Stiglitz, 1985). Additionally, proponents of the bank-based view argue that, in liquid markets, the environment creates a myopic investor climate, where investors can simply sell their shares, leading to less incentive to monitor managers and insufficient allocation of resources, which hinders corporate control and national productivity (Bhide, 1993; Beck et al., 2000).

There are different channels through which the banking system can help promoting economic growth. Beck, Levine and Loayza (2000) find that financial intermediaries help promote economic growth and the total factor productivity growth. They argue that the positive effect of banking sector development on growth is due to its positive impact on both physical capital growth and private savings rates. Similarly, Rioja and Valev (2004b) claim that banks affect

economic growth positively through capital accumulation, and the banking sector development enhances productivity growth which leads to overall economic growth. Furthermore, Lee (1996) state that financial intermediaries discover good investment opportunities, and they improve their ability to evaluate risk over time. He claims that this process of learning by doing can lead to the development of more efficient financial system and greater economic growth. In addition, Demetriades and Andrianova (2004) further argue that the creation of new firms and innovation would not take place if not for financial intermediaries. They claim that, in the absence of banks, firms would not be able to finance their new projects unless they have accumulated sufficient profits from previous years. Likewise, Allen, Qian and Qian (2005) find that financial intermediaries are the most important financing channels for firms during their start-up and subsequent periods. Moreover, Beck, Demirgüç-Kunt and Levine (2007) claim that banking sector development induces the income of the poor to grow which lowers income inequality and promotes overall economic growth.

In contrast, the market-based theory emphasises the importance of markets in promoting economic development. A market-based system is said to encourage diversification and dissemination of information. Therefore, it can promote investments and reduces the cost of mobilisation of savings (Arestis, Demetriades and Luintel, 2001). Likewise, Rioja and Valev (2004a) assert that a larger and more efficient financial market facilitates the hedging, trading, and pooling of risk by economic agents, thereby boosting investment and economic growth. Therefore, stock market development provides liquidity which in turn enhance the two main channels of economic growth, physical capital accumulation and productivity growth (Levine and Zervos, 1998). Through stock markets, liquidity risks and capital costs can be reduced, resulting in increased earnings and productivity. Financial markets are argued to reduce transaction costs and information asymmetries, which leads to an improvement in capital allocation and a reduction of liquidity constraints (Levine, 1991). Liquidity risk is reduced in

stock markets because they allow investor to buy and sell quickly and cheaply when they wish to, and also firms enjoy easy access to capital through equity issues (Arestis, Demetriades and Luintel, 2001). Moreover, stock markets contribute to greater productivity gains, innovation, and technological change. Hsu, Tian and Xu (2014) find that countries with developed stock markets exhibit higher innovation levels, which is an essential channel for economic growth. Furthermore, supporters of the market-based theory often stress the weaknesses in the banking system to lay claim in their arguments. Specifically, banks can extract large information rents from firms, given the expense of evaluating investment opportunities. This can hinder the progress of innovation since it reduces the incentive for firms to take on high-risk projects because it proportionally reduces their profits (Rajan, 1992; Beck, Levine and Loayza, 2000). Additionally, large banks could affect the development cycle and innovation through the protection of firms with close bank relationships from their competition, collusion between managers and creditors, and the impediment of effective corporate control and the development of new companies (Levine, 2002; Mathenge and Nikolaidou, 2018). Therefore, the proponents of the market-based view argue that these inefficiencies are reduced in the markets, which promotes economic growth and innovation.

Other views emerged to minimise the importance of bank-based versus market-based systems. The financial services view highlights the importance of financial contracts, markets, and intermediaries to reduce market imperfections and that the sources of finance are not important as long we have efficient financial services (Levine, 2002). These services are crucial for economic growth as they reduce risk and information asymmetry, and enhance corporate control and mobilisation of savings regardless of the division between banks and markets in providing the financial services (Levine, 1997; Beck et al., 2000). Therefore, the financial services view emphasises that overall financial development is far more critical than just the

bank-based or market-based views. Creating better-functioning intermediaries and markets in a sound environment leads to economic growth (Boyd and Smith, 1998).

Finally, the law and finance view which stresses the importance of the legal system for financial markets and institutions to promote innovation and growth. The theory indicates that finance is a set of contracts, and to achieve high levels of efficiency and development; we need strong legal rights and enforcement mechanisms (Levine, 2002). La Porta et al. (1998) argue that the source of finance or the financial structure is irrelevant; it is the legal system and the rule of law of the financial markets and intermediaries that facilitate growth. Moreover, they argue that the legal system protects investors in both equity and debt markets, which leads to financial development regardless of the country's financial structure.

Empirical research on the impact of financial structure on economic growth shows different results based on the time of publication. Beck et al. (2000) investigate the competing theories of bank-based or market-based systems and their impact on overall growth. They use three methodologies and datasets: cross-country, industry-level, and firm-level data. Using 48 countries with data averaged over the period 1980-1995, they assess whether any economies grow faster under a specific financial system. When examining industry-level data, they use a panel of 34 countries and 36 industries to determine whether industries that depend on external financing grow faster in bank-based or market-based systems. Finally, their firm-level study uses a panel of firms from 33 countries from 1990 to 1995 to explore whether firms' access to external finance varies between the two systems. They find that financial structure is irrelevant to economic growth, and the bank-based or market-based systems do not affect industry growth or firms' creation. Instead, they argue that the financial services and law and finance views are the leading indicators for growth. Similarly, Demirgüc-Kunt and Maksimovic (2002) use firm-level data from 40 countries over the period 1989-1996 to examine how a country's financial system affects firms' access to external finance to fund growth. Their findings show that firms

do not use external financing differently if they are in countries classified as bank-based or market-based; instead, it is the overall development of the country's contracting environment.

Moreover, Levine (2002) conducts one of the first cross-country studies to provide empirical evidence on the competing views of the importance of financial structure for economic growth. He uses data from 48 countries from 1980 through 1995 and constructs three measurements of financial structure in terms of activity, size, and efficiency. He finds strong evidence that financial structure has no significant impact on growth, and it is the overall financial development that matters for growth. However, Levine (2002) admits that their results might change over time based on Boyd and Smith (1998) prediction that when countries develop, they become more dependent on markets; or that for developing countries, bank-based systems are better at promoting growth (Rajan and Zingales, 1998). Similarly, using data from 99 countries for the period 1965-1997, Ndikumana (2005) finds that the structure of the financial system has no independent effect on investment and, therefore, does not affect economic growth. Nevertheless, both Levine (2002) and Ndikumana (2005) data ended in 1995 and 1997, respectively, just before the massive technological advancement in finance where investors have access to high-frequency data, access to ticker information, and the ease of trading in the stock market online instead of being at the stock exchange floor.

However, Cuadro-Sáez and García-Herrero (2008) criticise the market-based or bank-based measurements and propose a new measurement of the financial structure "balancedness". They find that a more balanced financial system is associated with higher economic growth, and they argue that both banks and markets have a complementary role in fostering economic growth. Likewise, (Guru and Yadav, 2019) find the complementary role of banks and stock markets to be the primary driver of economic growth in five major emerging markets. Furthermore, Demirgüc-Kunt, Feyen and Levine (2011) argue that when economies grow, both stock markets and banks grow until they reach their optimal levels. Nevertheless, they emphasise

that there must be a good balance between banks and stock markets because when the economy deviates from its optimal balance, and the financial structure gap widens, it negatively impacts economic output.

Contrary to the early findings, recent studies find financial structure essential for growth. Pinno and Serletis (2007) re-examine the relationship by exploring the potential for heterogeneity in Levine's (2002) cross-country data set covering the period from 1980 to 1995. They find that a bank-based system is beneficial for economic growth in developing countries, and a market-based system promotes growth in developed countries. However, their findings are limited to the period up to 1995, and their results may change after that period, even for developing countries, given the technological advancement in the late 1990s onward. Similarly, Lee (2012) employs data from 1960-2002 to examine the importance of financial systems for economic growth in the United States, United Kingdom, France, South Korea, Germany, and Japan. He notes that having a bank-based system is beneficial in the early stages of economic growth; however, they find that market-based systems contribute to economic growth significantly in later stages. Moreover, Ergungor (2008) shows that financial structure matters and countries with inflexible judicial systems grow faster when they have a bank-oriented financial system, using a sample of 46 countries from 1980 to 1995. Using the Bayesian framework, examining 33 high-income countries and 36 middle- and low-income countries, Luintel et al. (2016) find that, in high-income countries, a more market-based financial system contributes to economic growth, but the financial structure is irrelevant in its role for growth in the middle- and low-income countries.

Further work by Chu (2020) finds that further development of the stock market in an underdeveloped banking system is harmful to economic growth. Lin, Wang and Xu (2022) also argue that economic development is accompanied by a gradual switching of financial structure from intermediaries to markets since investors face a trade-off between the information and

agency cost. They note that saving the information cost dominates in the early stages of development when the distance to the frontier is significant; however, investors tend to avoid agency costs as the local technology level approaches the frontier.

Thus, based on the literature review conducted in this section, the conclusion of the impact of financial structure on economic growth varies. That variation is due to different reasons, and in this study, we aim investigate that relationship by testing the research hypotheses presented in the next section.

4.2.1 Research hypotheses

Based on the literature review, we can see that both bank-based and market-based systems have different effects on economic growth. Therefore, we present the following hypotheses based on the literature:

The banking sector plays a crucial role in promoting economic growth. A robust banking system is necessary to allocate and mobilise financial resources efficiently, influence the investment decision-making process, and promote entrepreneurial activities. Studies have shown that countries with well-developed banking sectors have experienced higher economic growth rates over time. For instance, King and Levine (1993a) empirically show that financial development indicators have a significant impact on growth, and financial systems influence long-run economic growth. Rajan and Zingales (1998) contribute to the development literature by arguing that financial development has a substantial positive influence on growth by reducing the cost of external finance to firms. Furthermore, Levine and Zervos (1998) and Levine, Loayza and Beck (2000) find that the development of financial institutions promotes growth and capital accumulation even when controlling for different aspects, such as legal and accounting systems and political factors. Nevertheless, Rousseau and Wachtel (2011) argue that the finance-growth relationship is not as strong in more recent data as it was in the original

studies. Similarly, Rousseau and Wachtel (2011) and Arcand, Berkes and Panizza (2015) find that banking sector development indicator starts having a negative effect on output growth when credit to the private sector exceeds 100% of GDP. Therefore, based on these empirical findings, we test the following:

H_1: The banking sector has an insignificant impact on economic growth.

A well-functioning stock market can serve as an effective capital raising platform for firms and investment opportunity for investors, which can support economic growth by facilitating the efficient allocation of resources and capital accumulation. Empirical research provides ample evidence in support of the positive relationship between stock market development and economic growth. For instance, Demirgüç-Kunt and Levine (1996) suggest that a developed stock market enhances information flow, reduces information asymmetry between firms and investors, and increases investor confidence, leading to higher investment and economic growth. Similarly, Levine and Zervos (1998) and Bekaert, Harvey and Lundblad (2005) argue that the development of the stock market has a positive impact on economic growth by encouraging investment, innovation, economic diversification, allocation of resources, and reducing information asymmetry. This leads to increased productivity, higher output, and ultimately, stronger economic growth. In addition, the stock market also serves as an important source of financing for businesses, facilitating investments and expansion, which in turn generate employment and drive economic activity. Thus, we test:

H_2: The stock market development has a positive significant impact on economic growth.

There are numerous studies that show the importance of financial markets and institutions for promoting economic growth. La Porta et al. (1998) state that both stock market and banking sector are essential for economic growth. Similarly, Cuadro-Sáez and García-Herrero (2008) and Demirgüç-Kunt, Feyen and Levine (2011) argue that both banks and stock market have a

complementary role in fostering economic growth. However, an increasing number of studies find that the banking sector influence on economic growth is changing in recent years. Law and Singh (2014) argue that further enlargement of the financial system can reduce real growth. In addition, Rousseau and Wachtel (2011) Arcand, Berkes and Panizza (2015) and Cecchetti and Kharroubi (2012) reach a similar conclusion where they find that an additional development and enlargement of the banking sector is harmful for the economy. On the other hand, Lin, Wang and Xu (2022) argue that information and agency cost are proportional to the technological frontier and the local technology level respectively, therefore, as the technological advancement continues, economic development is accompanied by switching to the stock market rather than financial intermediaries. Therefore, we test:

H_3: The stock market development has a positive significant impact on economic growth in recent years.

H_4: The banking sector development has an insignificant impact on economic growth in recent years.

4.3 Methodology

In this section, we present the data we use in this study and the model specifications of our analysis. First, we introduce our data and present our sample and the variables that we utilise in our study. Then, we explain the estimation process and the models.

4.3.1 Data

To empirically examine the relationship between financial structure and economic growth, we extend the Rousseau and Wachtel (2011) sample to ensure the comparability of our findings. The sample contains 84 countries from different income levels over the period from 1960 to 2019, sourced from the *World Development Indicators* database. The list of the 84 countries is available in **Table 4.8 (Appendix C).** Following the literature, we average our variables into 5-year non-overlapping periods (Loayza and Ranciere, 2006; Demirguc-kunt, Feyen and

Levine, 2011; Rousseau and Wachtel, 2011) to capture the long-run impact of finance on growth and to smooth out data imperfections.

The dependent variable is the average growth rate of real GDP per capita. We use the GDP per capita growth rate to capture the country's economic growth. The values range from -8.92% to 13.25% during the period of our study. Financial development is measured using the percentage of private credit by deposit money banks to GDP to capture the banking sector development. The ratio of domestic credit provided by the financial sector to GDP serves as a useful proxy for financial depth and development. Higher levels of credit indicate greater financial intermediation, allowing households and firms easier access to financing for productive investments. Additionally, the ratio of the stock market capitalisation to GDP is utilised to measure the market aspect of financial development. The size and liquidity of stock markets provide an indication of availability and ease of equity financing for corporations. By creating alternative funding sources, deeper stock markets support business investment, expansion, and growth.

Private credit has the main advantage of excluding loans provided by governments and central banks, primarily providing information on banks' intermediation performance (Demir and Hall, 2017). The values of this measure range from 6% to 239%; however, 99% of the sample ranges from 1.5% to 160%. The market-based measure captures the size of the stock market to the overall economy. Furthermore, we include a measure of financial structure introduced by Levine (2002), which is commonly used in the literature and measured as follows:

$$FS_{i,t} = Log(\frac{Mkt\_cap_{i,t}}{Credit_{i,t}}) \qquad (1)$$

Mkt_cap is the market capitalisation ratio to GDP and ($Credit$) is the private credit to GDP ratio. An (unlogged) value greater than one indicates that a financial system is more market orientated where a value smaller than one indicates the financial system is predominantly bank

based. When we take the natural logarithm the values of our financial structure variable range from -4.26 to 5.10.

The following covariates are included in the model and are standard controls used in the growth literature whilst still following the approach of (Beck, Levine and Loayza, 2000; Pinno and Serletis, 2007; Rousseau and Wachtel, 2011a; Demetriades, Rewilak and Rousseau, 2023). We include the logarithm of the initial real GDP per capita to capture convergence. Additionally, we control for different fiscal policies in the countries in our sample by adding the government expenditure variable. The size of government, as measured by government expenditure as a share of GDP, reflects the resource costs of providing public infrastructure, services, social protection and other public goods. We include the trade openness, which indicates integration into global markets which expands consumption possibilities and allows countries to specialize based on comparative advantage. The empirical literature shows that the more open economies are associated with higher levels of economic growth, and that trade openness is essential in the finance-growth nexus (Huang and Temple, 2005; Ergungor, 2008; Shahbaz, Nasir and Lahiani, 2022). Also, we add the logarithm of the initial secondary school enrolment rate to control for the investment in human capital. More educated populations are generally more productive given their greater technical skills and capacity to innovate. Finally, we include a dummy variable that takes 1 if a country experienced a banking crisis and 0 otherwise to control for volatile periods. All the variables' values are presented in **Table 4.1**. In **Table 4.2**, we present the variable definitions, sources, and how they are measured.

Table 4.1 Descriptive statistics

	(1)	(2)	(3)	(4)	(5)
Variables	N	Mean	SD	Min	Max
Growth	784	1.89	2.55	-8.92	13.25
FS	284	1.49	9.74	0.01	164.35
(Ln) FS	284	-0.46	1.04	-4.26	5.10
Credit	784	39.83	36.63	0.01	239.56
Ln (Mkt_cap)	284	3.47	1.19	-1.18	5.65
Government	784	14.64	5.32	2.93	43.48
Trade	784	64.78	42.78	1.50	351.13
(Ln) Initial GDP	784	8.40	1.44	5.69	11.58
Crisis	784	0.09	0.29	0	1

Table 4.2 Variable definitions and sources

Variable name	Definition	Source
GDP growth	Annual percentage growth rate of GDP at market prices.	World Development Indicators database
Credit	Domestic credit provided by the financial sector as % of GDP. Measures financial depth.	World Development Indicators database
Ln (Mkt_cap)	Natural log of stock market capitalization as % of GDP. Measures stock market development.	World Development Indicators database
Crisis	Dummy variable indicating occurrence of banking, currency or debt crisis.	(Laeven and Valencia, 2020)
Ln (schooling)	Natural log of secondary school enrolment rate. Proxy for human capital.	World Development Indicators database
Government	General government final consumption as % of GDP. Measures government size.	World Development Indicators database
Trade	Sum of exports and imports as % of GDP. Measures trade openness.	World Development Indicators database

Table 4.3 Correlations matrix

Variables	Growth	(Ln) FS	Credit	(Ln) mktCap	government	Trade	(Ln) School
Growth	1						
(Ln) FS	0.05	1					
Credit	0.01	-0.08	1				
Ln (Mkt_cap)	-0.02	0.75***	0.52***	1			
Government	-0.16***	-0.08	0.35***	0.12**	1		
Trade	0.06	0.07	0.31***	0.26***	0.30***	1	
(Ln) schooling	0.08**	0.24***	0.54***	0.43***	0.28***	0.29***	1

**** p<0.01, ** p<0.05, * p<0.1*

Table 4.3 presents the correlation matrix between the variables. As we can see from the matrix table, the credit variable is positively correlated with GDP per capita growth, and the market capitalisation has a negative correlation with growth. In addition, the finance-size variable shows a slightly positive relationship with our main dependent variable (GDP growth). Finally, our control variables show expected results where they are all positively correlated with GDP growth except government spending.

4.3.2 Model specification

To examine the effect of financial structure on economic growth, we use two different estimation strategies. First, we start by employing a panel ordinary least squares (OLS) model as our baseline model. This follows the literature and exploits the between variations in the data. Also, it is particularly important when we split the sample into sub-periods where the time series is reduced, which may exhibit less within variation. Our baseline model is as follows:

$$Growth_{i,t} = \alpha_i + \beta_1 FS_{i,t} + \beta_2 X_{i,t} + \mu_i + \tau_t + \epsilon_{i,t} \qquad (2)$$

Where $Growth_{i,t}$ represents our main dependent variable (5-year average GDP per capita growth rate). FS is the main independent variable in this study which captures different measures of financial structure. We use three different variables to test for financial structure effects. Private credit to GDP ratio to capture banking sector development, and market

capitalisation to GDP ratio as a measure of stock market development. The third measure is the financial structure variable, calculated using equation 1.

Moreover, X represents the set of our explanatory variables which includes the logarithm of initial GDP per capita to control for convergence, the logarithm of the initial secondary b school enrolment rate to control for investment in human capital, government spending, and trade openness. The term $\epsilon_{i,t}$ is the error term, τ_t is the time fixed effects to control for global shocks in a time period that affect all the countries simultaneously, and i and t denote country and time periods, respectively. All the right-hand side of the model are the initial values at the beginning of the five-year period following Rousseau and Wachtel (2011). Our growth model follows the main literature examining the impact of financial structure on economic growth (Beck et al., 2000; Rioja and Valev, 2004a; Rousseau and Wachtel, 2011; Demirgüç-Kunt, Feyen and Levine, 2013).

Nevertheless, to count for any bias or inconsistency that may come with the OLS estimation, we re-estimate our model using a fixed effects estimator. The fixed effect estimator was selected as it controls for time-invariant country heterogeneity. For example, there may be time-invariant factors within countries that jointly determine increases in financial development and economic growth. Therefore, we also include time dummies in the equation.

Additionally, we include a financial crisis dummy variable in our baseline model to analyse the impact of the financial structure during turbulent periods. The literature shows that financial development's positive and significant effect on economic growth may be reduced or vanished during volatile periods of crises (Rousseau and Wachtel, 2011; Arcand, Berkes and Panizza, 2015).

Addressing the concern over endogeneity and its potential impact on the empirical results is crucial for ensuring the robustness and validity of our findings. We acknowledge two main

endogeneity concerns in our study. First, there may be time-invariant factors related to a country that may be jointly driving changes in both financial development and economic growth. To mitigate this concern, we employed fixed effects estimation in our analysis. By including country-fixed effects, we aim to control for unobserved time-invariant factors that could potentially confound the relationship between financial development and economic growth. This approach helps to isolate the within-country variation and provides a more reliable estimate of the causal impact. The second endogeneity concern we recognise is that of simultaneity bias. It is possible that changes in financial development and economic growth occur simultaneously and mutually influence each other. To address this concern, we adopted a specific strategy in the construction of our variables. The dependent variable, representing economic growth, is based on a five-year period average to reduce the impact of short-term fluctuations and capture more stable trends. On the other hand, the independent variables are based on initial values, reflecting the starting point of financial development. While this approach does not guarantee strict exogeneity, we believe it introduces a form of weak exogeneity that is sequential.

4.4 Results

The results in **Table 4.4** present the OLS estimations of Equation 1. The main dependent variable is the GDP per capita growth, and the main independent variable of interest is the private credit. The first three columns show the results of our estimations during different periods of the credit variable and the other set of control variables. Finally, in columns 4-6, we include the banking crisis variable to examine the relationship during turmoil periods.

The results from columns 1-3 indicate that private credit has a positive and significant impact only during the period from 1960 to 1999. However, when we estimated the effect over the whole period, the effect appeared to be insignificant. Similarly, the significant and positive

impact of credit on growth has disappeared during recent times (2000-2019), indicating that the banking sector development impact vanishes when only considering recent data. This result is consistent with the argument that bank-based systems are more essential during the early stages of economic development.

Moreover, we include a banking crisis variable in our estimations in columns 4-6. We find that the crisis variable has a significant and negative impact on economic growth during all the time periods in our estimates. However, even after including the crisis variable, the effect of private credit on growth remains the same, where it is only significant during the period between 1960 to 1999.

Table 4.4 Effects of banking sector on economic growth

	Dependent Variable (5-year Average % Growth of Per Capita Real GDP)					
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	1960-2019	1960-1999	2000-2019	1960-2019 (crisis)	1960-1999 (crisis)	1999-2019 (crisis)
Credit	0.003	0.011**	0.003	0.004	0.012**	0.004
	(0.003)	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)
Crisis				-1.255***	-1.067***	-1.295***
				(0.283)	(0.382)	(0.333)
(Ln) Initial GDP	-0.169	-0.076	-0.269*	-0.164	-0.107	-0.207
	(0.108)	(0.147)	(0.153)	(0.106)	(0.145)	(0.154)
(Ln) schooling	0.678***	0.617***	0.349	0.649***	0.618***	0.312
	(0.138)	(0.170)	(0.224)	(0.136)	(0.168)	(0.223)
Government	-0.092***	-0.080***	-0.112***	-0.090***	-0.078***	-0.110***
	(0.020)	(0.025)	(0.032)	(0.019)	(0.025)	(0.032)
Trade	0.007***	0.008**	0.007***	0.006***	0.007**	0.006**
	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Constant	4.443***	3.505***	4.009***	4.415***	3.746***	3.670***
	(0.814)	(1.035)	(0.951)	(0.798)	(1.023)	(0.965)
Observations	784	495	289	784	495	289
R-squared	0.158	0.197	0.106	0.176	0.210	0.126

Notes: All estimates are using OLS and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity.

Table 4.5 presents the results of our OLS estimation of our second main independent variable (the market capitalisation to GDP ratio) on the main dependent variable (5-year average of GDP per capita growth rate). The first three columns show the results of our independent and explanatory variables, and columns 4 to 6 include the same set of variables, including the banking crisis variable.

In columns 1-3, the results show that the market capitalisation variable is insignificant for all periods up to 2000. From 2000 onwards, the stock market indicator positively and significantly affects growth. The results suggest that the stock market development has become more prominent in promoting growth in recent years compared to the banking sector results in **Table 4.4**. Additionally, we include banking crises in our estimations in columns 4-6 to control for turbulent periods. We find that the banking crisis has a significant and negative impact on growth. However, the market capitalisation ratio continues to show a significant and positive effect on growth during the period from 2000 to 2019.

Table 4.5 Effects of stock market on economic growth

Dependent Variable (5-year Average % Growth of Per Capita Real GDP)						
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	1960-2019	1960-1999	2000-2019	1960-2019 (crisis)	1960-1999 (crisis)	2000-2019 (crisis)
(Ln) Mkt_Cap	0.008	-0.170	0.189*	0.021	-0.150	0.191*
	(0.101)	(0.172)	(0.101)	(0.100)	(0.173)	(0.101)
Crisis				-1.465***	-1.304***	-1.266***
				(0.298)	(0.475)	(0.376)
(Ln) Initial GDP	-0.318**	0.054	-0.376**	-0.252*	0.017	-0.303*
	(0.137)	(0.274)	(0.168)	(0.137)	(0.280)	(0.170)
(Ln) schooling	0.579**	0.623*	0.068	0.528**	0.639*	0.040
	(0.236)	(0.362)	(0.283)	(0.230)	(0.349)	(0.284)
Government	-0.122***	-0.095**	-0.152***	-0.129***	-0.108**	-0.150***
	(0.030)	(0.048)	(0.038)	(0.030)	(0.049)	(0.038)
Trade	0.006***	0.007	0.006***	0.006***	0.006	0.006***

	(0.002)	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)
Constant	4.902***	1.066	6.658***	4.606***	1.713	6.116***
	(1.194)	(2.353)	(0.969)	(1.182)	(2.414)	(1.000)
Observations	297	117	180	297	117	180
R-squared	0.195	0.139	0.305	0.244	0.189	0.332

Notes: All estimates are using OLS and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity.

4.4.1 Sensitivity tests

In this section, we perform a different set of sensitivity tests to examine the robustness of our results reported in **Table 4.4** and **Table 4.5**. First, we estimate our model using a time-fixed effects model to reduce any possible endogeneity where country-specific time-invariant factors jointly drive increases in finance and growth. Then, since stock market data from 1960 to 1999 are limited, we re-estimate our model using the same sample of countries in 1960-1999. Finally, we use the FS variable calculated in Eq (1) as a dependent variable to test further whether banks or markets have different effects than our findings.

In **Table 4.6**, we present our results from estimating our fixed effects model in Equation 2. First, columns 1-3 show the results of our estimation using the main independent variable of private credit and other control variables. Then, we include the banking crisis indicator in the estimation in columns 4-6. Additionally, we present the results of the effects of the market capitalisation ratio on economic growth in columns 7-12, wherein columns 7-9 we focus on the market capitalisation and other explanatory variables, and columns 10-12 include the crisis variable.

Unlike our results in **Table 4.4**, we find that the private credit indicator significantly and negatively impacts economic growth in the entire sample period from 1960-2019. However, when we focus on the periods prior to the year 2000, the credit variable shows a positive coefficient sign, albeit insignificant, impact on growth. Moreover, in column 3, the results highlight our estimation between 2000 and 2019. The main findings suggest that private credit

has a significant and negative impact on economic growth during that period. This result indicates that an increase in private credit and banking sector development has a detrimental effect on economic growth in recent years. The findings are consistent with recent research that indicate the positive impact of financial deepening is vanishing in recent years and that it might even be harmful after a certain threshold (Rousseau and Wachtel, 2011; Arcand, Berkes and Panizza, 2015). In columns 4-6, we include the crisis variable, and the results remain the same with the negative and significant impact of credit on growth. The banking crisis variable shows a negative and significant impact on growth for all the periods before 2000 but insignificant from 2000 to 2019.

Furthermore, we examine the impact of stock market development on economic growth in columns 7-12. We find that the market capitalisation ratio has an insignificant effect on growth during the periods prior to 2000. However, similar to our earlier findings in **Table 4.5**, the stock market capitalisation ratio has a positive and significant impact on economic growth from 2000 to 2019. The magnitude of these findings suggests that stock market development enhances economic growth by one percentage point during that period at a 1% confidence level. Finally, in columns 10-12, the results show that when the crisis variable enters into the empirical equation, the magnitude and economic significance of the market capitalisation variable remain unchanged. The results suggest that the stock market development has become more essential for economic growth in recent years.

The results of our control variables show similar results in all estimations in **Table 4.6**. The initial GDP and government spending variables significantly and negatively impact growth in all columns. In contrast, trade openness appears to have a significant positive effect, whereas the schooling variable shows no significant impact on economic growth in our estimations.

Nevertheless, we cannot establish a definitive causal claim due to the challenges of endogeneity in our study mentioned earlier. By assuming sequential exogeneity that suggests the changes in financial development precede changes in economic growth, allowing for a potential causal interpretation of the observed correlations. However, it is important to note that this assumption relies on the sequential nature of the relationship rather than strict exogeneity. Additionally, we have addressed the concern of time-invariant features that may jointly impact both financial development and economic growth by employing fixed effects estimation. By including country-fixed effects, we aim to control for unobserved time-invariant factors that could confound the relationship between the variables of interest. Given these considerations, we can cautiously interpret the observed correlations as suggestive of a potential causal relationship between financial development and economic growth.

Table 4.6 Fixed effects estimation of both banks and stock market's effects on growth

	Dependent Variable (5-year Average % Growth of Per Capita Real GDP)											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	1960-2019	1960-1999	2000-2019	1960-2019 (crisis)	1960-1999 (crisis)	2000-2019 (crisis)	1960-2019	1960-1999	2000-2019	1960-2019 (crisis)	1960-1999 (crisis)	2000-2019 (crisis)
Credit	-0.01**	0.00	-0.02**	-0.01*	0.00	-0.02*						
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)						
(Ln) Mkt_Cap							0.10	-0.48	1.04***	0.19	-0.26	1.03***
							(0.22)	(0.31)	(0.31)	(0.23)	(0.28)	(0.32)
Crisis				-1.21***	-1.05***	-0.73				-1.37***	-1.53**	-0.84*
				(0.27)	(0.36)	(0.48)				(0.42)	(0.74)	(0.44)
(Ln) Initial GDP	-1.99***	-2.70***	-4.55**	-2.00***	-2.71***	-4.33*	-2.95***	-4.50***	-2.43**	-2.56***	-3.49**	-2.07*
	(0.38)	(0.79)	(2.14)	(0.39)	(0.83)	(2.23)	(0.44)	(1.59)	(1.05)	(0.47)	(1.62)	(1.12)
(Ln) schooling	0.32	-0.51	0.44	0.28	-0.49	0.49	0.68*	0.20	0.27	0.66**	0.13	0.33
	(0.29)	(0.39)	(0.63)	(0.28)	(0.39)	(0.62)	(0.35)	(0.67)	(0.54)	(0.32)	(0.66)	(0.53)
Government	-0.11***	-0.15***	-0.21*	-0.10***	-0.14***	-0.22*	-0.30***	-0.16*	-0.34***	-0.30***	-0.17**	-0.33***
	(0.03)	(0.03)	(0.12)	(0.03)	(0.03)	(0.12)	(0.04)	(0.09)	(0.09)	(0.04)	(0.08)	(0.09)
Trade	0.02***	0.03***	0.02*	0.02***	0.03***	0.02	0.00	0.03**	0.01	0.00	0.03*	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
Constant	18.97***	24.70***	41.83**	18.95***	24.62***	40.06**	31.56***	45.76***	24.24**	28.11***	36.36**	20.90**
	(3.11)	(6.23)	(18.85)	(3.15)	(6.54)	(19.64)	(4.04)	(15.37)	(9.39)	(4.21)	(15.60)	(9.94)
Observations	784	495	289	784	495	289	297	117	180	297	117	180

R-squared	0.19	0.23	0.17	0.21	0.25	0.17	0.27	0.34	0.25	0.34	0.42	0.27
Number of ID	79	77	79	79	77	79	55	41	53	55	41	53

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity

Furthermore, due to the availability of the stock market data from 1960 to 1999, we re-estimate our model using the same sample of countries from 1960 to 1999 for all the other periods. Therefore, we use a sample of 41 countries to examine the impact of the stock market capitalisation ratio on growth. We present the results in **Table 4.7**. The results remain unaffected, and the stock market development variable shows a significant and positive effect on growth during the period from 2000 to 2019. However, the magnitude of the results dropped slightly, where an increase in the market capitalisation ratio enhances economic growth by 0.93 percentage points instead of 1.04 percentage points in the previous sample of countries.

Table 4.7 Re-examining the effects of the stock market using the sample of the period 1960-1999

Dependent Variable (5-year Average % Growth of Per Capita Real GDP)			
	(1)	(2)	(3)
Variables	1960-2019	1960-1999	2000-2019
(Ln) Mkt_Cap	-0.04	-0.48	0.93***
	(0.21)	(0.31)	(0.24)
(Ln) Initial GDP	-3.02***	-4.50***	-2.35*
	(0.48)	(1.59)	(1.22)
(Ln) schooling	0.62	0.20	0.04
	(0.37)	(0.67)	(0.58)
Government	-0.24***	-0.16*	-0.19**
	(0.04)	(0.09)	(0.08)
Trade	-0.00	0.03**	-0.00
	(0.00)	(0.02)	(0.01)
Constant	32.43***	45.76***	23.94**
	(4.69)	(15.37)	(11.69)
Observations	249	117	132
R-squared	0.29	0.34	0.18
Number of id	41	41	39

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity.

Table 4.8 presents the results of our fixed effects estimation of the main independent variable of financial structure (FS) on economic growth. A positive result suggests that a more market-based system is beneficial to economic growth. Columns 1-3 include the FS and other control variables, and columns 4-6 include the same variables in addition to the crisis indicator. We find that financial structure has no significant effect on economic growth when we use the entire sample period from 1960-2019; also, it shows an insignificant impact during the period of 1960-1999. Nevertheless, in column 3, the results indicate that the financial structure has a positive and significant impact on growth during 2000-2019 at a 1% confidence level. This finding supports the market-based view that stock markets play an essential role in promoting growth, especially in recent years. Moreover, the results show that having a more market-based system may enhance economic growth by approximately 1.30 percentage points.

In addition, columns 4-6 show the results of the fixed effect estimation of our variables, including the banking crisis. The findings support the market-based system by showing a significant and positive effect of the FS variable during the period from 2000 to 2019. The magnitude and economic significance of the financial structure variable remain the same even after controlling for crises. The results in **Table 4.8** reconfirm our initial findings. The stock market remains essential for economic growth from the year 2000 onward.

Table 4.8 Effects of financial structure variable on economic growth

Dependent Variable: 5-year Average % Growth of Per Capita Real GDP						
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	1960-2019	1960-1999	2000-2019	1960-2019 (crisis)	1960-1999 (crisis)	2000-2019 (crisis)
(Ln) FS	0.20	-0.25	1.29***	0.22	-0.14	1.29***
	(0.23)	(0.30)	(0.33)	(0.24)	(0.28)	(0.32)
Crisis				-1.32***	-1.58**	-0.72
				(0.41)	(0.75)	(0.44)
(Ln) Initial GDP	-3.00***	-4.57***	-2.33**	-2.54***	-3.50**	-1.88
	(0.42)	(1.60)	(1.10)	(0.45)	(1.62)	(1.16)
(Ln) schooling	0.60*	0.17	0.12	0.63*	0.11	0.21
	(0.34)	(0.66)	(0.54)	(0.32)	(0.64)	(0.52)
Government	-0.29***	-0.16*	-0.29***	-0.30***	-0.17**	-0.29***
	(0.04)	(0.09)	(0.08)	(0.04)	(0.08)	(0.08)
Trade	0.00	0.03*	0.01	-0.00	0.03*	0.01
	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
Constant	32.56***	45.28***	26.85**	28.61***	35.77**	22.70**
	(3.89)	(15.37)	(10.32)	(4.03)	(15.27)	(10.87)
Observations	284	117	167	284	117	167
R-squared	0.28	0.33	0.31	0.34	0.42	0.32
Number of id	55	41	52	55	41	52

Notes: All estimates are using fixed effects and each column contains a different regression. Standard errors are reported in parentheses where *** p<0.01, ** p<0.05, * p<0.1. The time dummies are included in the specification but unreported for brevity.

4.4.2 Discussion

In this section, we further discuss the policy implications of our findings and some limitations of our study.

The findings of this study indicate that the relationship between financial development and economic growth has changed, and previous policy advice may have been outdated. As a result, it would be difficult to assert that deepening the banking sector enhances economic growth and that may be due to a number of factors.

First, our findings could be influenced by the cautious lending behaviour adopted by banks following the financial crisis. This cautionary approach by banks, prompted by increased regulatory scrutiny and risk aversion, could have limited their lending activities and subsequently weakened the direct impact of the banking sector on economic growth. To an extent, we control for financial crises in our estimations to condition for fragilities in the financial sector. Also, cautious lending is captured by time-fixed effects in the regressions which may also be soaking up some variation that impacts all country financial systems simultaneously.

Additionally, the concept of "too much finance," as discussed by Arcand, Berkes and Panizza (2015), posits that an excessive expansion of the financial sector relative to the real economy can have adverse effects on economic growth. This perspective suggests that the relative importance of the banking sector for economic growth may have diminished due to an overemphasis on financial activities that do not directly contribute to productive investment.

Furthermore, banking deregulation has been found to increase the demand for skilled labour within the banking sector, potentially diverting talent away from other industries that heavily rely on skilled labour, leading to productivity declines (Kneer, 2013). This phenomenon could further explain the attenuated relationship between the banking sector and economic growth observed in our study.

Finally, it is crucial to consider the changing nature of bank lending. The allocation of bank credit has shifted significantly, with a greater emphasis on lending for housing and real estate purposes rather than business investment or consumer purchases (Jordà, Schularick and Taylor, 2016; Bezemer, Samarina and Zhang, 2017). This concentration of bank-based financing in the housing market, fuelled by the attractiveness of landed property as collateral, may have led to a divergence from the traditional model of bank lending that supports business investment and

working capital (Chakraborty, Goldstein and Mackinlay, 2016; Ryan-Collins, 2021). Empirical studies have also identified a negative relationship between the stock of bank lending to domestic real estate and economic growth, alongside positive growth effects of credit flows to non-financial businesses (Bezemer, Grydaki and Zhang, 2016). This further supports the notion that the changing composition of bank lending towards the housing market could contribute to the decreased significance of the banking sector for overall economic growth.

Based on our findings that indicate the stock markets play a more significant role in promoting economic growth compared to the banking sector, especially in recent years, it would be prudent for policymakers to consider the following implications. First, policymakers should encourage investment in the stock market. They could introduce measures aimed at promoting investment in the stock market, such as tax breaks or capital gains incentives. These incentives could attract more investors to the stock market, thus providing more liquidity and ultimately boosting economic growth. Additionally, with the growing importance of the stock market in promoting economic growth, it's essential to ensure that the market operates in an efficient and transparent manner. Policymakers could introduce measures to strengthen the regulation of the stock market, such as increased disclosure requirements or stricter penalties for market manipulation. This would create a level playing field and prevent malpractices that could hinder economic growth. Finally, policymakers need to ensure the stability of the political and economic environment. A stable political and economic environment can provide long-term investors with the certainty they need to invest in the stock market.

There are some limitations to our study that need to be addressed. For example, in our analysis, we control for the effects of banking crises; however, other indicators affect the financial sector's stability, especially banks. Demetriades, Rewilak and Rousseau (2023) find that different indicators of financial fragility, such as a large volume of impaired loans, have additional adverse effects on growth even if a banking crisis is avoided. However, our data

range from 1960 to 2019, while their data only covers the period from 1998 to 2012. Additionally, they only consider the banking sector's fragility indicators, which could raise a few issues since it is difficult to find comparable fragility indicators for the stock market. Furthermore, our study omits new methods of entrepreneurial finance that have become increasingly common to fund businesses in contemporary times. Given data availability, this is something beyond our control, but we acknowledge its importance and that it may influence the overall findings. Finally, the estimation strategy depends on the assumption of weak exogeneity. By using predetermined initial values of our covariates, we may be unable to interpret the correlations we find causally. Nevertheless, adopting such an econometric approach makes it directly comparable to the abundance of previous studies that follow this similar method.

4.5 Conclusion

In this chapter, we investigate the relationship between financial structure and economic growth. The empirical literature on the importance of financial structure and the type of financial system, whether bank-based or market-based, for economic growth, is inconclusive. Therefore, we contribute to the literature by re-examining the relationship using a broader sample and more recent data. Our sample includes 84 countries, and the period covered by our study extends from 1960 to 2019. According to our findings, the banking sector has no longer played an important role in promoting growth over the last two decades, and based on some of our estimates, the development of the banking sector negatively impacts economic growth. These findings are consistent with the contemporary empirical literature where they find that banking sector development no longer has an effect on economic growth (Rousseau and Wachtel, 2011) or even a negative impact on growth after a certain threshold (Arcand, Berkes and Panizza, 2015). In addition, between 2000 and 2019, we find that the stock market has consistently shown a significant positive effect on economic growth. Our findings provide

empirical evidence that the stock market development has become more essential for promoting economic growth with comparison to the banking sector.

As a result of our analysis and the limitations of our study, we suggest that future research should take into account a few points when examining the relationship between financial structure and economic growth. First, there are different factors that affect the stability of the banking sector and the stock markets, and we have included the banking crisis. However, it is imperative to consider different factors that may affect the stability of the banking sector and the stock market. Moreover, with the major technological advancements in recent years, new forms of finance have become more common. Future research may shed light on this by including the emerging forms in financial structure analysis. This will enable us to obtain a more comprehensive understanding of the relationship between financial structure and economic growth.

APPENDIX C

Table 4.9: List of countries

#	Country Name	#	Country Name	#	Country Name
1	Algeria	29	Guyana	57	Nigeria
2	Argentina	30	Haiti	58	Norway
3	Australia	31	Honduras	59	Pakistan
4	Austria	32	Iceland	60	Panama
5	Bangladesh	33	India	61	Papua New Guinea
6	Barbados	34	Indonesia	62	Paraguay
7	Belgium	35	Iran	63	Peru
8	Bolivia	36	Ireland	64	Philippines
9	Brazil	37	Israel	65	Portugal
10	Cameroon	38	Italy	66	Rwanda
11	Canada	39	Jamaica	67	Senegal
12	Central African Republic	40	Japan	68	Sierra Leone
13	Chile	41	Jordan	69	South Africa
14	Colombia	42	Kenya	70	Spain
15	Costa Rica	43	Korea, Rep.	71	Sri Lanka
16	Cote d'Ivoire	44	Lesotho	72	Sudan
17	Denmark	45	Luxembourg	73	Sweden
18	Dominican Republic	46	Malawi	74	Switzerland
19	Ecuador	47	Malaysia	75	Syrian Arab Republic
20	Egypt	48	Malta	76	Thailand
21	El Salvador	49	Mauritius	77	Togo
22	Fiji	50	Mexico	78	Trinidad and Tobago
23	Finland	51	Morocco	79	Turkey
24	France	52	Nepal	80	United Kingdom
25	Gambia, The	53	Netherlands	81	United States
26	Ghana	54	New Zealand	82	Uruguay
27	Greece	55	Nicaragua	83	Venezuela, RB
28	Guatemala	56	Niger	84	Zimbabwe

CHAPTER 5: CONCLUSION

This thesis was developed to examine the impact of financial development on economic growth. It reports on the conduct of several novel empirical tests concerning different aspects of financial development and their effects on the economy. This chapter summarises the main findings of the thesis, reviews implications for policymakers, and addresses the limitations of the empirical studies.

This thesis provides a novel perspective on the finance-growth nexus by reconsidering the relationship from different perspectives, namely banking stability, financial crises, and financial structure.

Financial stability is one of the four dimensions of financial development introduced by Čihák et al. (2012). Therefore, the aim of the first empirical chapter is to study an understudied factor that may affect the stability of the banking sector, which is natural disasters. The literature on natural disasters centres mainly on their macroeconomic consequences. Thus, this study adds to natural disasters and banking stability literature, primarily by using bank-level data of 1,248 banks from 72 countries for the period from 1999 to 2018. Our findings suggest that natural disasters affect distance-to-default values negatively. We split our sample into two groups for two reasons; one is because the vast majority of the sample represents high-income countries due to the data availability, and the second is to test if the effects differ among countries based on their income levels. After splitting the data, we find that natural disasters have no significant impact on banking stability in high-income countries. However, the effect is significant and negative for middle- and low-income countries. Moreover, the findings indicate that the threshold of natural disasters to affect banking stability significantly is 5% of the total population. We find that natural disasters decrease the ROA, decrease the capitalisation ratio, and increase non-performing loans.

In addition, Wachtel (2018) argues that although there is evidence that financial development in terms of the depth factor, may lead to economic growth, but in other cases, it could lead to a financial crisis. Therefore, financial crises have detrimental effects on economic growth (Summers, 2000; Barro, 2001). Hence, the second empirical study examines the impact of banking, currency and debt crises on economic growth and its volatility. However, there needs to be more evidence about their impact in Africa, a vastly underdeveloped region. We empirically estimate a growth equation using both fixed effects and System GMM estimations. Using data from 1970 to 2017 for 52 African countries, we find that only currency and debt crises affect economic growth negatively in Africa. On the other hand, banking crises are shown to have a statistically insignificant effect on growth in Africa. Currency crises may reduce economic growth in the long run by 1.19 percentage points, and debt crises are the most harmful, reducing long-run growth by 3 percentage points.

The third empirical study investigates the relationship between financial structure and economic growth. There is inconclusive empirical evidence regarding the importance of financial structure and whether a market or bank-based financial system contributes to economic growth. Consequently, we contribute to the literature by re-examining the relationship based on a broader sample and more recent data. Our sample includes 84 countries and covers the period from 1960 to 2019. The results of our study indicate that the banking sector is no longer an essential source of growth promotion in the last two decades. Moreover, according to some of our analyses, economic growth is negatively impacted by the development of the banking sector. In contrast, from 2000 to 2019, the stock market consistently and significantly contributed to economic growth.

The outcome of this thesis provides valuable insights into the different effects of financial development on economic growth. This thesis focuses mainly on banking stability, financial crises, and financial structure studies, which can be useful to policymakers, academics, and other parties who may be interested in the financial development literature.

The study on the effects of natural disasters on banking stability provides us with several policy implications. Countries where they face more frequent natural catastrophes need stricter regulation imposed on banks, especially in the middle- and low-income economies. The disaster events hit banks' liquidity and therefore affect their performance and stability. Additionally, policymakers need to ensure that the insurance industry is effective and present in all regions. They may need to consider mandating deposit insurance and other insurance policies that are related to disasters to alleviate the effects of disasters on the liquidity of the banks and possible bank runs. Furthermore, governments must improve the infrastructure in the country so the losses from natural disasters would be less. When there is a good infrastructure in place, the ease of receiving aid is bigger, access to different services is easier, and the overall losses would be less.

Moreover, underdevelopment and poverty are prevalent in the African region. The financial crisis hinders the economic growth process in the region, thus preventing it from prospering. Consequently, African policymakers and government officials should carefully monitor their economies and ensure that they are as robust as possible in order to prevent a financial crisis. It is imperative, however, that policymakers take swift and decisive action if a crisis does occur, as longer-lasting crises have been shown to adversely affect the economy more than shorter-term crises.

Finally, the results of the third empirical chapter are crucial for academics as well as practitioners. The study indicates that the relationship between financial development and

economic growth has changed, and previous advice may have been outdated. As a consequence of the findings, it is difficult to argue that financial deepening in the banking sector is a growth-enhancing strategy. Furthermore, it is evident that the significance of stock markets in economic prosperity is growing. Despite the fact that both the number and sophistication of stock exchanges is expected to increase in the near future, it is essential that they expand at the correct pace and for their primary purposes if they are to continue to be associated with economic growth in the future.

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