



UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Bachelor's project within the Business and Economics Bachelor Programme

Bank Stability and Economic Growth: Panel Evidence from the Covid-19 Pandemic

Bachelor thesis 15 hp
Joel Gabrielsson
Emma Gustavsson
Supervisor: Christer Ljungwall
Spring term 2023

ABSTRACT

This study aims to investigate the relationship between bank stability and economic growth, and in particular if it changes during the early stages of the Covid-19 pandemic. This is investigated by means of a panel data study of 24 EU countries between 2006-2020, utilizing a fixed effects model. The results show that bank stability has a positive relationship with economic growth if bank stability is measured with the non-performing loans ratio. However, no such conclusion can be drawn when using bank Z-score, due to statistical insignificance. Additionally, further research is needed to say anything definite about the causality and direction of the found effect. This study adds to the existing literature concerning the relationship in recent years, as well as contributes new findings. The main new finding is that the magnitude of the relationship between non-performing loans ratio and GDP growth is larger during the early stages of the Covid-19 pandemic.

Keywords: Bank Stability; Economic Growth; European Union; Financial Sector; Financial stability; Non-performing loans; Z-score;

JEL Classifications: E44; G10; G21; O16; O40; O52

Acknowledgments

We would like to express our deepest appreciation to our supervisor, Christer Ljungwall, for the provided guidance throughout the process of completing this thesis. We also want to thank our opponents and fellow students, who dedicated their time to read this thesis and provide invaluable feedback.

Table of Contents

1	INTRODUCTION.....	4
1.1	Background	4
1.2	Problem Description and Analysis	5
1.3	Purpose	6
1.4	Structure	6
2	THEORETICAL FRAMEWORK.....	7
2.1	The Link Between Finance and Economic Growth.....	7
2.2	Financial Stability.....	8
2.3	Bank Z-score	9
2.4	Non-performing Loans to Total Loans Ratio	10
2.5	Previous Research	10
2.6	Hypotheses	12
3	DATA.....	14
3.1	Data Collection.....	14
3.2	Dependent Variable.....	14
3.3	Variables of Interest	14
3.4	Control Variables	14
3.5	Data Treatment and Transformations	15
3.6	Descriptive Statistics	16
4	METHOD.....	18
4.1	Model Selection.....	18
4.2	Statistical Tests.....	18
4.3	Model Specification	19
5	RESULTS.....	21
5.1	Expected Results	21
5.2	Empirical Results	21
6	DISCUSSION	24
6.1	Results	24
6.2	Limitations	25
7	CONCLUSION	27
	REFERENCES.....	28
	APPENDIX A – Data Description and Sources.....	34
	APPENDIX B – Summary Statistics.....	35
	APPENDIX C – Statistical Tests	36
	APPENDIX D – Robustness Test	38

1 INTRODUCTION

1.1 Background

Economic growth and financial stability are two crucial components of a healthy economy. Gross Domestic Product (GDP) is widely used as a measure of economic performance; thus, GDP growth could be said to measure economic growth. If GDP is increasing, it generally means that both businesses and workers are doing better than when it decreases (Callen, n.d.). A stable financial system can efficiently allocate resources, assess and manage financial risks, thus mitigating the effect of shocks. In other words, a stable financial system can reduce the likelihood of financial crises (World Bank, n.d.).

Recent events, such as the global financial crisis and the Covid-19 pandemic, have further highlighted the importance of financial stability. The global financial crisis was a pivotal moment that exposed weaknesses in the financial system. Following this, financial stability became a top priority for policymakers and financial regulators worldwide, with reforms of the financial system put into place (FSB, 2022).

Regulatory bodies have been established to ensure financial stability, such as the Basel Committee and the European System of Financial Supervision (ESFS). The Basel Committee oversees the Basel accords, which are a set of international standards for banking regulation. These accords have been updated over time to address new challenges and emerging risks in the financial system. The most recent update is Basel III, partly in response to the global financial crisis (BIS, n.d.). For ESFS, one main objective is ensuring that financial regulations are correctly enforced in EU member states (Parenti, 2022).

Similarly, the Covid-19 pandemic has led to economic uncertainty and increased financial instability. The pandemic's economic impact has been severe, and in the first year the global economy decreased by approximately 3%. Global poverty has also increased, which is the first time in a generation (World Bank, 2022). These events highlight the importance of financial stability to mitigate such shocks. In this context, understanding the relationship between financial stability and economic growth is more crucial than ever before.

While financial stability and economic growth are important topics globally, this study focuses specifically on the European Union (EU). The EU is an important part of the global economy, with a total GDP of approximately €14.5 trillion in 2021 (European Union, n.d.). During the initial phase of Covid-19, European institutions worked in two ways to address the

impact of the pandemic. One focused on healthcare and supporting the development of vaccines, while the other aimed to limit the economic effects of the crisis. The European Parliament quickly set in place a temporary relaxation of prudential rules for European banks (European Parliament, 2020). Additionally, the European Investment Bank devoted nearly €25 billion to a support fund for European small and medium companies (European Investment Bank, n.d.).

1.2 Problem Description and Analysis

When a financial system is unstable, it has consequences. Banks might be less likely to fund profitable projects, and prices on assets are volatile and differ from their intrinsic value. In the case of any major instability, it can shake the confidence in the financial and economic system, and lead to bank runs or stock market crashes (World Bank, n.d.). This could be argued to be a reason why policymakers see financial instability as a problem, thus why both international and EU standards have been implemented. The importance of understanding the relationship between financial stability and economic growth is crucial, especially with the increased uncertainty and instability brought by the Covid-19 pandemic (International Monetary Fund, 2020).

As a limit to the scope of the research, the full extent of the financial system will not be covered. Banks are an important part of the financial system and have been chosen as the primary focus. Therefore, this study will research the relationship between bank stability and economic growth.

Financial stability and economic growth are two well studied topics. However, less research exists that ties the two together. More specifically, the link between bank stability and economic growth still needs further exploration. The literature that does exist primarily stems from the more studied field of finance and growth.

While theory says that financial development in general should lead to increased growth, empirical research on the topic does not paint as clear of a picture. Usually, older literature is more uniform in its results. More recent empirical research on the other hand, is more inconclusive about the relationship between financial stability and economic growth. However, there are also fewer studies performed on newer datasets (Botev et al., 2019).

1.3 Purpose

There is still a need for further research to explore the relationship between financial stability and economic growth in different contexts. No study has, to the best of our knowledge, examined the relationship with regards to the Covid-19 pandemic. In addition, there is a need to cover the time period after the global financial crisis, as well as the role of bank stability in particular. Therefore, the aim of this study is:

- (1) Examine how bank stability affects GDP growth in the EU countries.
- (2) Examine if it changes during the early stages of the Covid-19 pandemic.

The goal is to provide more information and knowledge about the inconclusiveness that surrounds the relationship between bank stability and economic growth in modern times. This is important for researchers, policymakers and regulatory bodies to foster growth and help mitigate crises. Furthermore, it is meant to give a unique insight into how the relationship can be affected by an outside shock, such as Covid-19.

1.4 Structure

The structure for the rest of this paper is as follows: Chapter 2 covers the theoretical framework and previous research on the subject. Chapter 3 presents the data, the collection process, transformations, and summary statistics of the final dataset. Chapter 4 presents the methodology and model specification. Chapter 5 covers the empirical results of the report, and chapter 6 the following discussion. Finally, chapter 7 concludes.

2 THEORETICAL FRAMEWORK

2.1 The Link Between Finance and Economic Growth

The theories on finance and economic growth can be divided into two main sides. On one hand, the supply-leading hypothesis, and on the other hand, the demand-following hypothesis. The supply-leading hypothesis claims that financial development has a positive impact on economic growth. The demand-following hypothesis instead claims that the financial sector only reacts to the real economy, and grows in size as the real economy grows (Ang, 2008).

For the supply-leading hypothesis, credit to investments driving economic growth can be traced back in the literature to Schumpeter (1911/1934). Levine (2005) describes the theoretical links through which growth is achieved as five main functions of the financial sector:

- 1. Enabling pooling of savings.** This can help not only by increasing savings, but also by enabling investment in larger projects that require big amounts of capital. It can lead to technological innovation that would otherwise not have received funding.
- 2. Easing the exchange of goods and services.** Lowering transaction costs allow for further specialization in the economy, which increases productivity.
- 3. Improving diversification and risk management.** This lets investors invest in riskier projects with higher return, that they would otherwise have deemed too risky. It allows for diversification of risk over time to reduce the effect of shocks and volatility.
- 4. Monitoring investments and corporate governance.** An intermediary acting in the interest of others can monitor investments more efficiently than independent small shareholders.
- 5. Alleviating information asymmetries.** Financial intermediaries providing information increases the ability for investors to efficiently allocate capital.

Botev et al. (2019) argues that the theoretical link is established, but that the empirical estimates vary. This would be in line with other authors, who claim that the link between financial development and economic growth is weak, or at least exaggerated (Lucas, 1988; Rodrik and Subramanian, 2009). This standpoint follows the demand-following hypothesis.

Furthermore, empirical literature about the relationship between finance and economic growth can be divided into two time periods – one before, and one after the global financial crisis. The prior group seems to find a positive relationship between financial development and growth. However, when combining the pre- and post-crisis periods, that positive relationship is no longer as clear (Botev et al., 2019; Rousseau and Wachtel, 2011). Rousseau and Wachtel (2011) propose that the relationship between finance and growth is not as present during crises, and the difficulty in finding significance in recent years might be because crises have been more present.

Overall, looking at the empirical studies, Botev et al. (2019) argue that there is no clear consensus about neither sign, nor direction, on how financial development and economic growth connect today. Beck (2012) however, argues that the evidence that points to a positive relationship between finance and economic growth is more than just coincidence. There might exist non-linearities and the relationship might vary over time, but the evidence nonetheless has merit.

2.2 Financial Stability

When examining the concept of financial stability, it is essential to establish some sort of definition of the term. According to Borio (2003), one can divide financial stability into two different perspectives, macro- and microprudential. The macroprudential perspective looks at the greater picture of the economy, and as such financial stability should attempt to limit system-wide stress. The microprudential perspective on the other hand, focuses on each individual institution with the goal of limiting losses for them.

Nonetheless, it is challenging to appropriately quantify financial stability. One big drawback for many of the variables used to measure it is that they are calculated on accounting data. This means that the underlying accounting and auditing framework strongly affect how valid the measurement will be (World Bank, n.d.). However, as this study focuses on the EU, the assumption is that the accounting and auditing frameworks are somewhat harmonized (European Banking Authority, n.d.). Another drawback of many variables is that they often fail to fully represent the complex interaction and interdependence that is present in the banking sector (Gadanecz and Jayaram, 2008).

As banks are a part of the overall financial system, bank stability is a part of overall financial stability. Jokipii and Monnin (2013) researches the impact of bank stability for 18 OECD countries. They find that periods of bank sector stability are commonly followed by increased output growth. The opposite is found for bank instability where reduced growth follows. By assessing the symmetry of the impact on the real economy, they find that the real economy is primarily impacted by periods of banking instability, rather than stability.

In light of this finding, it is relevant to consider the impact that periods of instability can bring to the real economy. In a bank crisis, banks may not have the same ability to provide credit to consumers and firms. This will reduce spending and investments, which in turn means the long-run output will drop. Banking crises are estimated to reduce output by between 15-20% of annual GDP during crisis years. However, a key issue is that it is hard to identify whether reduced output follows from a bank crisis, or if it instead is a recession that causes the bank crisis in the first place (Hoggarth et al., 2002).

A complete bank sector failure is not required to adversely affect the economy. Even if only some banks fail, the remaining banks still have capital restrictions that might limit the credit they can give as substitutes (Hoggarth et al., 2002). The substituting banks might also have less knowledge and information about the new borrower, increasing the cost of credit (Leland and Pyle, 1990; Sharpe, 1990).

2.3 Bank Z-score

Bank Z-score is an indicator of financial stability, which measures how far a bank is from defaulting. The numerator consists of return on assets (ROA) plus equity capital divided by assets. This is then divided by the standard deviation of ROA:

$$\frac{ROA + \frac{Equity\ capital}{Assets}}{\sigma_{ROA}} \quad (\text{Beck et al., 2010; World Bank, n.d.})$$

Z-score is the inverse of the probability of insolvency for one institution or firm. That is, the higher the Z-score, the lower the risk of insolvency. The intuition is that it compares the capital buffer to the volatility of returns. If the volatility of the returns increases, Z-score decreases all else equal. On the other hand, if the return or capital buffer increases, then Z-score will also increase all else equal (World Bank, n.d).

As the Z-score is calculated for each individual institution (in this case, banks), it must be aggregated together to be able to be used on the country level. However, since the Z-score is measured individually and then aggregated, there is a risk that it might not capture the interconnected systematic risk in the banking sector (Čihák et al., 2012). Nonetheless, Z-score is a common measure in the banking stability literature, for example of usage see Creel et al. (2015), Ijaz et al. (2020), Uhde and Heimeshoff (2009).

2.4 Non-performing Loans to Total Loans Ratio

To better capture systematic risk, this paper will also look at another measure of financial soundness: non-performing loans to total loans ratio (NPR). It aims to measure the asset quality of the loan portfolio. A loan is defined as non-performing if the payments of principals or interest is due by 90 or more days. This share is then compared to the total value of the loan portfolio:

$$\frac{\textit{Non performing loans}}{\textit{Total loan portfolio}} \quad (\text{International Monetary Fund. Statistics Dept., 2019}).$$

According to Čihák and Schaeck (2010), NPR does carry merit as a sign of systematic risk and increased vulnerabilities in the banking sector. It is generally expected that NPR will start rising ahead of a banking crisis and reach its peak when the crisis has fully broken out. As the banks then contract their loan portfolio and some time passes after the start of the crisis, the levels will start dropping. Costa Navajas and Thegeya (2013) also study the financial soundness indicators with logit models and find evidence for NPR as a predictor of banking crises. However, compared to Čihák and Schaeck (2010), they find NPR significant with a negative sign, which they speculate can be an indication of refinanced or restructured loans.

2.5 Previous Research

Previous research can be divided into two parts: literature focusing on the link between economic growth and finance in general; as well as literature focusing more specifically on connecting financial stability and economic growth.

The relationship between finance and economic growth is a well-studied subject, with contrasting views and perspectives. Nonetheless, the literature review by Ang (2008) details

that for panel data studies a positive relationship between finance and economic growth is generally found. However, while the research is leaning towards finance being causal and driving growth, it is hard to establish the direction of the causality for certain.

This is backed up by a meta-analysis done on 67 studies concerning finance and economic growth by Valickova et al. (2015). They find heterogeneity between studies in the reported estimates, and approximately 50% report a statistically significant positive effect. Overall, the literature does document a statistically significant positive link between financial development and economic growth.

One of the seminal papers using panel data estimation is Beck and Levine (2004). They apply at the time newer econometric techniques, namely the Generalized Method-of-Moments-estimator (GMM) developed by Arellano and Bond (1991). Beck and Levine (2004) apply this on more recent data to re-examine the relationship between finance and economic growth. As a measure of bank development and size of the financial sector, bank credit to private sector is used. This represents a progression from earlier studies where M3, or the aggregate measure of money supply, typically has been present. However, the use of bank credit instead of M3 isolates it to the private sector. Their findings include that banks have a positive influence on economic growth.

Creel et al. (2015) utilize the seminal econometric framework established by Beck and Levine (2004), but shift the primary focus to the effects and impact of financial stability. This is done by adding in several variables that aim to capture financial stability on a macro- and microeconomic level. They study EU countries during the period of 1998-2011, using both a GMM-estimator as used by Beck and Levine (2004), as well as fixed- and random effects models. They find that financial instability has a negative impact on economic growth for the EU countries. This is while controlling for the overall level of financial development, reducing the risk of the stability measures capturing that effect due to omitted variable bias. The result remains consistent for several different proxies of growth, such as consumption per capita growth rate or investment growth rate. It is worth noting that significance is found for NPR, but not for bank Z-score.

Ijaz et al. (2020) study bank concentration, bank stability and economic growth for 38 countries in and around Europe from 2001 to 2017. They employ the use of both fixed effects- and GMM-models. The findings include that bank stability, measured by Z-score and NPR, contributes positively to economic growth. Additionally, they find significance for

interaction terms when accounting for the global financial crisis and local banking crises. They argue that the result shows that increased financial stability helped with counteracting the negative effects of the crises. They find significance for both NPR and bank Z-score with both econometric methods.

A clear positive relationship between bank stability and economic growth is supported by both Jayakumar et al. (2018) and Bayar et al. (2021). Additionally, these papers investigate the causality between bank stability and economic growth and find partly contradictory findings. Both papers find evidence for both supply-leading hypothesis and demand-following hypothesis, depending on model specifications. Jayakumar et al. (2018) hypothesize that the effect is not unidirectional, but instead has a feedback-effect where both variables affect one another. They find evidence of the feedback-hypothesis for NPR, and mixed evidence of feedback- and supply-leading hypothesis for bank Z-score. Bayar et al. (2021) argue that the contradictory findings support the idea that the financial sector, and the banking sector in specific, should be recognized as complex and multidimensional. Therefore, conclusions about causality become less straightforward.

2.6 Hypotheses

Four null hypotheses are presented, two for each variable of interest. First, the hypotheses for NPR are presented, followed by bank Z-score. From studying previous literature and theory, namely Creel et al. (2015) and Ijaz et al. (2020), the expectation is that bank stability has a positive impact on economic growth.

Since NPR has a negative relationship to bank stability (Čihák and Schaeck, 2010), the first null hypothesis is:

$$H_{01}: \text{NPR has a positive or no effect on GDP growth.} \quad (1)$$

$$H_{A1}: \text{NPR has a negative effect on GDP growth.}$$

In addition, this study wants to examine if the impact of bank stability on economic growth changes during Covid-19. There are no studies done on this subject yet, however Ijaz et al. (2020) find that in other crises, financial stability has an additional effect on economic growth.

To test if the effect changes during the early stages of the Covid-19 pandemic, the second null hypothesis is:

H₀₂: NPR has no changed effect during Covid-19. (2)

H_{A2}: NPR has a changed effect during Covid-19.

As Z-score is positively related to bank stability, the expectation is that an increased Z-score has a positive relationship to economic growth (World Bank, n.d).

Corresponding hypotheses for bank Z-score:

H₀₃: Bank Z-score has a negative or no effect on GDP growth. (3)

H_{A3}: Bank Z-score has a positive effect on GDP growth.

H₀₄: Bank Z-score has no changed effect during Covid-19. (4)

H_{A4}: Bank Z-score has a changed effect during Covid-19.

3 DATA

3.1 Data Collection

The initial sample dataset consists of the 27 countries currently in the European Union. Due to constraints in availability of the bank stability measures, Z-score and NPR, the dataset starts in the year 2006. It ends with the latest available data, the year 2020. The data sources are World Bank World Development Indicators, the Global Financial Development Database, UNESCO Institute for Statistics, and Eurostat. The panel is not balanced as there are some missing observations. Three countries are dropped from the dataset (Croatia, Czech Republic, Slovak Republic) due to completely missing data for at least one variable for the whole time period. This leaves 24 countries for the analysis, and it is assumed to still be a representative sample. Appendix A displays descriptive metadata and data source for each variable.

3.2 Dependent Variable

GDP growth is used as dependent variable. GDP is one of the most widely used measures of economic performance, and measures the output from within a country. Since the measurement is so widely used, there are established international standards for how it should be computed by each country. The aim is to make the measurement more comparable (Callen, n.d.).

3.3 Variables of Interest

The variables of interest that measure bank stability are, as presented in chapter 2, bank Z-score and NPR. The idea is that Z-score has a negative relationship with the probability of default (World Bank, n.d.). NPR measures how big the share is of defaulting loans (International Monetary Fund. Statistics Dept., 2019). As such, Z-score is positively related to bank stability, while the opposite is true for NPR.

3.4 Control Variables

As control variables, this paper uses initial economic performance (lagged real GDP), average years of school, government expenditure as share of GDP, trade openness, and inflation. These are the seminal variables used by Beck and Levine (2004), which were then also

utilized by Creel et al. (2015). From the theoretical framework established in the previous literature, education, trade openness, and inflation are expected to have a positive relationship with GDP growth. Initial economic performance and government expenditure on the other hand, are expected to have a negative relationship with GDP growth.

To measure and control for the size of the financial sector, this paper partly follows the methodology by Creel et al. (2015). They proxy the size by total credit to the private sector from banks and other financial institutions, divided by GDP. This variable is expected to have a positive effect on GDP growth. However, there are studies in more recent times that show conflicting results. Arcand et al. (2015) propose that there is a threshold limit, where increasing credits no longer promote growth.

Creel et al. (2015) also use stock turnover ratio to measure the size of the stock market. However, for the chosen time period 2006-2020, almost half of the observations are missing data about stock turnover ratio. As such, the variable will not be used.

3.5 Data Treatment and Transformations

To address missing data points for the variable average years of school, we have decided to use linear extrapolation in Stata to increase the number of observations available for the regressions. In general, one needs to exercise great care when making changes to the dataset. However, in this case we consider it justified and relatively safe as the variable is not volatile and remains quite steady over the whole period with clear trends, for all the countries.

Summary statistics for the variable before and after extrapolation can be found in appendix **B**.

The control variables initial economic performance, average years of school, government expenditure, and trade openness are log-transformed before use in the regressions. This is in line with previous literature (Beck and Levine, 2004; Creel et al., 2015). To address non-positive inflation rates, this variable is instead transformed using inverse hyperbolic sine transformation ($\bar{x} = \ln(x + \sqrt{x^2 + 1})$), as done by Arcand et al. (2015) and Creel et al. (2015).

While outliers could potentially impact the analysis, this paper opts to not winsorize or remove any observations from the dataset. With crises and instability, extreme values of low bank stability or economic growth may still be of interest for the research question. The

decision not to remove or transform outliers is also in line with prior literature (Beck and Levine, 2004; Creel et al., 2015; Ijaz et al., 2020).

3.6 Descriptive Statistics

Table A presents descriptive statistics for the dataset after data treatment and transformations. After data treatment the variables have a similar number of observations, with NPR having slightly fewer. The mean and standard deviation indicate that the data is quite spread out, especially for the non-transformed variables.

TABLE A – Descriptive Statistics					
Variables	N	mean	sd	min	max
<u>Dependent variables:</u>					
GDP Growth rate %	360	1.580	4.083	-14.84	24.37
<u>Bank stability variables:</u>					
Non-performing loans %	325	6.992	8.130	0.0818	47.75
Bank Z-score	358	14.14	9.826	-0.326	57.44
<u>Control variables:</u>					
Private credit to GDP %	352	92.62	44.56	24.62	254.7
Transformed Inflation rate	360	1.123	0.895	-1.301	3.422
Log (Initial economic performance)	360	25.97	1.567	22.71	28.91
Log (Government expenditures)	360	2.977	0.163	2.486	3.330
Log (Trade openness)	360	4.706	0.474	3.816	5.934
Log (Average years of school)	360	2.452	0.118	2.030	2.657
Number of countries	24	24	24	24	24

The table displays statistics after transformations and data treatment. Data source: Eurostat, UIS & World Bank.

The correlation matrix for the non-transformed variables is presented in table B. It does not show any large correlations, indicating that multicollinearity should not be a concern. Additionally, Variance Inflation Factor (VIF) tests are conducted, and the reported values are consistently low, further strengthening the assumption regarding multicollinearity. Output for the VIF test can be found in appendix C.

TABLE B – Correlation Matrix

	GDP Growth	NPR	Bank Z-score	Private credit	Inflation rate	Average years of school	Trade openness	Initial econ. performance	Government expenditures
GDP Growth	1.0000								
NPR	-0.0327	1.0000							
Bank Z-score	0.0877	-0.3380	1.0000						
Private credit	-0.2248	0.1684	0.1723	1.0000					
Inflation rate	0.0876	-0.2432	-0.0844	-0.1342	1.0000				
Average years of school	0.1130	-0.2175	-0.0928	-0.2600	-0.0128	1.0000			
Trade openness	0.2704	-0.0657	0.3318	-0.1155	-0.0011	0.0833	1.0000		
Initial econ. performance	-0.1055	-0.1705	0.0851	0.0591	-0.0743	0.0517	-0.4101	1.0000	
Government expenditures	-0.3571	-0.3025	0.1203	0.2975	-0.0712	0.1403	-0.3007	0.2132	1.0000

The correlations displayed are between the non-transformed variables. Data source: Eurostat, UIS & World Bank.

4 METHOD

4.1 Model Selection

Fixed effects regression is a well-established tool for regression analysis of panel data. It extends the standard multiple regression model to account for time-invariant individual-specific factors. In this study, this would be the assumption that different countries might have different prerequisites for economic growth that are not controlled specifically in the model. For example, this could be cultural views or political conditions. Furthermore, it is possible to expand the model and include time fixed effects to control for possible time-variant factors as well (Stock and Watson, 2020).

Prior research tends to use a GMM model to test the effect of financial stability on economic growth. However, GMM is generally used on data with either fewer time periods, more countries, or both. Roodman (2009) concludes that with a large time period, dynamic panel bias becomes insignificant, and there is no need to use a complicated model such as GMM. In fact, it might be better to use a less complicated model, since it leaves less room for errors.

Because of the above mentioned reasons, this study does not utilize GMM. Instead, a fixed effects panel data model is used to examine the relationship between GDP growth and the set of independent variables.

The regressions are performed separately for the variables of interest with NPR first, followed by bank Z-score. First, the regression is done with the base set of variables. Second, an interaction effect is introduced, between the variable of interest and a dummy variable capturing the Covid-19 pandemic. Finally, to ensure robustness, an additional interaction between the variable of interest and a dummy variable capturing the global financial crisis is introduced.

4.2 Statistical Tests

To ensure the validity of the panel data analysis, several statistical tests are conducted. The first test stems from how the regression error might correlate over time within the same country in panel data. The presence of autocorrelation is confirmed by performing a Wooldridge test (Wooldridge, 2010). Furthermore, the command `xttest2` in Stata is used to

perform a Breusch-Pagan LM test of independence, which confirms the presence of heteroscedasticity (Baum, 2000).

This paper mitigates the effect of both autocorrelation and heteroscedasticity by clustering the standard errors. Clustering is a technique that accounts for correlation within a group of observations (Stock and Watson, 2020). In this case, the errors are clustered on the country level.

To strengthen the choice of using a fixed effects model over a random effects model, the command `xtoverid` in Stata is used. The command allows performing a Hausman test when using clustered standard errors (Hausman, 1978; Schaffer and Stillman, 2016). The test confirms that a fixed-effects model is appropriate for both variables of interest.

Additionally, a test to confirm the use of yearly fixed effect dummies is performed with the command `testparm` in Stata. The test result confirms the use of yearly fixed effect dummies.

Overall, the tests conducted strengthen the validity of the model specification and reliability of the regression results. For test results, see appendix C.

4.3 Model Specification

The model specification to test the first hypothesis H_{01} , that NPR has a positive or no effect on GDP growth, is:

$$y_{i,t} = \beta_1 NPR_{i,t} + \beta_2' CV_{i,t} + \lambda_t + \alpha_i + \varepsilon_{i,t} \quad (1)$$

- Subscripts:
 - $i = \text{country } 1, \dots, 24$
 - $t = \text{time period } 2006, \dots, 2020$.
- y : Dependent variable, GDP growth.
- NPR : Variable of interest, non-performing loans to total loans ratio.
- $'CV$: Vector of control variables.
- λ : Time-fixed effect.
- α : Country-fixed effect.
- ε : Error term.

To test the second hypothesis H_{02} , that NPR has no changed effect during Covid-19, an interaction term is introduced. The model specification is:

$$y_{i,t} = \beta_1 NPR_{i,t} + \beta_2' CV_{i,t} + \beta_3 (NPR_{i,t} * CovCr) + \lambda_t + \alpha_i + \varepsilon_{i,t} \quad (2)$$

- $CovCr$: Dummy variable that takes the value 1 for the year 2020, 0 otherwise.

Following the model specifications above, the corresponding models to test the third H_{03} and fourth H_{04} hypothesis, substituting bank Z-score for NPR:

$$y_{i,t} = \beta_1 BZS_{i,t} + \beta_2' CV_{i,t} + \lambda_t + \alpha_i + \varepsilon_{i,t} \quad (3)$$

$$y_{i,t} = \beta_1 BZS_{i,t} + \beta_2' CV_{i,t} + \beta_3 (BZS_{i,t} * CovCr) + \lambda_t + \alpha_i + \varepsilon_{i,t} \quad (4)$$

- BZS : Variable of interest, bank Z-score.

Outside of these four models that are specified to test against the null hypotheses, robustness checks are performed including a new interaction. This is done to see if the results change if controlling for the global financial crisis. The global financial crisis started in 2007 in the US, however there was a delay before the effects were seen in the EU. Therefore, the interaction will be specified between the variable of interest and the year 2009. The model specification for this test is:

$$y_{i,t} = \beta_1 NPR_{i,t} + \beta_2' CV_{i,t} + \beta_3 (NPR_{i,t} * CovCr) + \beta_4 (NPR_{i,t} * BankCr) + \lambda_t + \alpha_i + \varepsilon_{i,t} \quad (5)$$

$$y_{i,t} = \beta_1 BZS_{i,t} + \beta_2' CV_{i,t} + \beta_3 (BZS_{i,t} * CovCr) + \beta_4 (BZS_{i,t} * BankCr) + \lambda_t + \alpha_i + \varepsilon_{i,t} \quad (6)$$

- $BankCr$: Dummy variable that takes the value 1 for the year 2009, 0 otherwise.

5 RESULTS

5.1 Expected Results

Based on previous research and the underlying theoretical framework of this study, the expectation is that bank stability has a positive relationship with economic growth.

Consequently, it is expected to see a negative sign for the variable of interest in model 1 and 2 (NPR), and correspondingly a positive sign in model 3 and 4 (BZS). If this is the case, and the coefficient is statistically significant, the null hypotheses can be rejected. Furthermore, the robustness checks are expected to show the same results, thus strengthening the findings.

5.2 Empirical Results

The results are interpreted under the assumption that the effect is following the supply-leading hypothesis. This means that the effect is entirely causal from independent variables to growth. Causality concerns are addressed separately in chapter 6.2. The results are presented in table C below. The significance level for rejecting the null hypotheses is 5% in all tests.

TABLE C – Regression Results on GDP Growth

Variables	(1)	(2)	(3)	(4)
Private credit	-0.0371*** (0.0126)	-0.0406*** (0.0134)	-0.0450*** (0.00928)	-0.0448*** (0.00965)
Average years of school	-10.17** (4.500)	-9.274* (4.508)	-8.818** (3.641)	-9.142* (5.072)
Government expenditure	-15.72*** (5.475)	-14.71** (5.576)	-13.50*** (4.707)	-13.60** (4.878)
Inflation	0.311 (0.273)	0.263 (0.278)	0.514 (0.302)	0.515 (0.303)
Trade openness	1.339 (2.119)	2.046 (2.302)	-0.699 (2.017)	-0.736 (1.986)
Initial economic performance	-11.03*** (3.918)	-11.49*** (4.092)	-6.854** (2.467)	-6.884** (2.521)
NPR	-0.0943** (0.0446)	-0.0972** (0.0430)		
NPR*CovCr		-0.181** (0.0848)		
BZS			0.0375 (0.0383)	0.0376 (0.0382)
BZS*CovCr				-0.0107 (0.0563)
Year fixed effect	YES	YES	YES	YES
Constant	357.5*** (115.4)	361.4*** (116.9)	249.0*** (76.10)	251.0*** (80.17)
Observations	321	321	350	350
R-squared				
Within	0.665	0.670	0.674	0.674
Between	0.168	0.173	0.281	0.280
Overall	0.076	0.076	0.138	0.137
Number of countries	24	24	24	24
F-test	238.5	636.4	136.2	354.6
Prob > F	0	0	0	0

Fixed effects regressions on the dependent variable GDP growth. Robust standard errors in parentheses. Data source: Eurostat, UIS & World Bank.

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

NPR has a statistically and economically significant impact on economic growth in models 1 and 2. The sign is negative, which implies that an increase in NPR leads to a decrease in GDP growth. In model 1 the coefficient is -0.0943. It means that a 10 percentage points increase in NPR would imply a reduction in GDP growth by approximately 0.94 percentage points, *ceteris paribus*. There is enough evidence to reject H_{01} at 5% significance level.

Model 2 introduces the interaction effect between NPR and the early stages of the Covid-19 pandemic. The interaction term shows both statistical and economic significance, in addition to the original variable remaining significant. The interaction also has a negative sign, which means that the effect NPR has on GDP growth increases during the pandemic. In model 2 the coefficient for NPR is -0.0972, while the coefficient for the interaction is -0.181. It means that a 10 percentage points increase in NPR would imply a reduction in GDP growth by approximately 0.97 percentage points outside of Covid-19. The interaction increases the total effect to a reduction of approximately 2.78 percentage points during the initial stages of the pandemic, *ceteris paribus*. There is enough evidence to reject H_{02} at 5% significance level.

The other variable of interest, bank Z-score, is statistically insignificant in models 3 and 4. This result means that there is not enough evidence to reject H_{03} or H_{04} neither at 5%, nor 10%, significance level.

The control variables with statistical significance in the models are private credit, government expenditures and initial economic performance. They are significant at 5% level in all models and are all impacting GDP growth negatively. Average years of school is significant at 5% level in model 1 and 3 with a negative sign.

R-squared is low in all models, this is specifically notable for the overall R-squared. However, when conducting an F-test for joint significance, it confirms that the variables are jointly significant in all models.

Finally, as a robustness check, another regression is performed that adds an interaction effect between the variable of interest and a dummy variable capturing the global financial crisis, for output see appendix **D**. The statistical and economical significance still holds true for the model with NPR when adding this interaction term. In the model with bank Z-score, Z-score is still not significant. Notably, the added interaction effect is not significant in either model.

6 DISCUSSION

6.1 Results

The aim of this study is to research the effect of bank stability on economic growth, and if that effect changes during the early stages of the Covid-19 pandemic.

There are some inconclusive results in this study. The models specified with NPR show a negative relationship between NPR and GDP growth. This is consistent with the results presented by Creel et al. (2015) and Ijaz et al. (2020). When compared to theory, the NPR models behave as expected. Worsened bank stability should lead to reduced credit from banks, which in turn means that resources are not allocated efficiently, reducing output and crippling economic growth (Hoggarth et al., 2002).

The Z-score models, however, do not have statistical significance, neither at 5% nor 10% levels. This differs from the expectation that bank Z-score should have a positive impact on GDP growth. However, it is consistent with the findings of Creel et al. (2015) who also find no significance. Since the model specifications of this paper are built from the models by Creel et al. (2015), this result is not out of line. Contradictory, Ijaz et al. (2020) find significance for the variable.

There could be various reasons why different results are obtained. Some of the critique towards bank Z-score is that it is a measure calculated from accounting data only, and that it does not really take financial integration into account (Čihák et al., 2012). Determining the exact reason why bank Z-score is insignificant is outside the scope of this paper. However, further research could be beneficial in establishing if the insignificance stems from not accounting for systematic interconnectedness. This could help determine if bank Z-score simply is a better predictor on an institutional level, compared to aggregated together for the entire bank sector in a country.

When evaluating the effect of bank stability during the Covid-19 pandemic, new results about the impact of NPR on economic growth are presented. The interaction term added in model 2 has a statistically significant negative coefficient, indicating that bank stability is more important in the event of an outside shock. The size of the coefficient indicates that during the initial stages of Covid-19, the total effect of NPR is almost tripled. The results support the findings presented by Jokipii and Monnin (2013), which suggest that the effect on economic growth primarily comes from periods of instability.

As the pandemic subsided relatively recently in the EU, there is not yet any research capturing this period, making it difficult to draw comparisons. One of the more appropriate comparisons is Ijaz et al. (2020) which find significance for interaction effects for other crises, namely the global financial crisis, as well as local banking crises. The sign is comparable to the results of this paper, indicating that the effect is stronger during the crises. If one considers it reasonable to equate these types of crises with the Covid-19 pandemic, then it is reasonable that the findings are similar. The results further strengthen the idea that financial stability is important and something that regulatory bodies should continue to focus on.

Regarding the control variables, initial economic performance and government expenditure are statistically significant in all regressions, with the expected sign. However, the variables average years of school and private credit have the opposite sign of what is expected.

Variables with coefficients and signs differing from what is expected can be problematic. Either the theory does not match reality, or the model is misspecified, rendering the results biased.

The variable average years of school is meant to proxy for the accumulated human capital. In theory it has a positive relationship to GDP growth. However, in previous research, the empirical results vary, with both positive and negative signs, as well as insignificant results (Arcand et al., 2015; Beck and Levine, 2004; Creel et al., 2015).

The variable private credit is meant to capture the size of the financial sector. It should theoretically, as outlined in chapter 2, have a positive relationship to economic growth. However, empirical studies have found weak or even negative relationships for this control variable, including Arcand et al. (2015) and Creel et al. (2015). One explanation could be the threshold effect that Arcand et al. (2015) suggest exists, where finance no longer has a positive effect on growth after reaching a certain level. It is also possible that since the financial sector has grown a lot in recent years, increased private credit has other implications than it did 20 years ago (Arcand et al., 2015). Nonetheless, discrepancies in the coefficient signs are important to note as a concern regarding the validity of the specified models.

6.2 Limitations

Although this paper provides new results, it still has some important limitations. The most notable limitations concern data availability and endogeneity.

The regressions and results can only factor in the initial blow of the pandemic, due to data on bank stability only being available until 2020. While the economy did start to recover in the subsequent years, many of the EU countries still maintained restrictions. Additionally, the lack of data led to the exclusion of the variable stock turnover ratio, compared to the reference model specification by Creel et al. (2015). The omitted variable could lead to bias in the models since the variable proxies for the market side of the finance sector. While the exclusion of the variable could introduce bias, the specified model still captures the banking sector side with the variable private credit.

To address endogeneity issues, prior literature regularly uses GMM models. The use of instrumental variables in a GMM is what deals with endogeneity. However, the GMM model is complex, and an incorrect model specification risk leading to biased and incorrect results. The exact specifications for the GMM models are rarely disclosed in the literature. For that reason, it is difficult for a reader to assess the validity of the model specification. Theoretically, a fixed effects model should suffice if studying enough time periods (Roodman, 2009).

Then the question becomes - what can be said for certain in the presence of endogeneity? It creates difficulties in drawing definitive conclusions. One could argue that it is not clear if an increase in NPR leads to a decrease in economic growth, or if bad economic times make it so that more loans default. Finding the causality and direction for certain is a large topic, and it is outside the scope of this paper. It is not yet completely established in which direction the causality goes (Bayar et al., 2021; Jayakumar et al., 2018).

Even though the direction of causality is not yet proven empirically, previous research has seen similar results as this paper, while addressing endogeneity with GMM models (Creel et al., 2015; Ijaz et al., 2020). Additionally, there are theoretical links of NPR having merit as an indicator of bank instability (Čihák and Schaeck, 2010). This could be argued to strengthen the validity of the interpreted results.

7 CONCLUSION

This study analyzes the relationship between bank stability and economic growth in the EU between 2006 and 2020. It partly extends the work of Creel et al. (2015), but shifts the time frame to before and during the early stages of the Covid-19 pandemic. With means of a fixed effects panel data regression, the relationship is analyzed using two different measures of bank stability, non-performing loans ratio (NPR) and bank Z-score.

Mixed results are found regarding the relationship. There is enough evidence to conclude that NPR does have a significant negative relationship to GDP growth, and that the magnitude changes during the early Covid-19 pandemic. However, there is not enough evidence to draw any conclusions about the relationship between bank Z-score and GDP growth. This holds true regardless of whether accounting for the early Covid-19 pandemic or not.

This study contributes new findings, namely that the magnitude of the relationship NPR has with GDP growth is larger during the early Covid-19 pandemic. To the best of our knowledge, these results have not been presented before.

The relationship between bank stability and economic growth is complex, and determining causality is one of the major limitations in this paper. Prior research on causality has seen mixed findings on the direction of the relationship. Despite this, other studies that do address endogeneity concerns using GMM models show results similar to ours. That could be an argument for NPR having a causal effect on GDP growth. However, more research about the causality is needed to draw any definitive conclusions about the direction. Nonetheless, this paper strengthens the empirical evidence of a positive relationship between bank stability and economic growth.

Expanding on the ideas for future research, an area to examine more extensively becomes available as more data releases, that is, the effects during the Covid-19 pandemic. It also opens the possibility to compare the Covid-19 pandemic to other types of crises. As of writing this paper, it is not yet concluded that the full impact of the pandemic has been seen.

Altogether, continued research in these areas would help policymakers and regulatory bodies, supporting them in their decision-making toward increased economic growth.

REFERENCES

- Ang, J. B. (2008). A Survey of Recent Developments in the Literature of Finance and Growth. *Journal of Economic Surveys*, 22(3), 536–576. <https://doi.org/10.1111/j.1467-6419.2007.00542.x>
- Arcand, J. L., Berkes, E., & Panizza, U. (2015). Too much finance? *Journal of Economic Growth*, 20(2), 105–148. <https://doi.org/10.1007/s10887-015-9115-2>
- Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, 58(2), 277. <https://doi.org/10.2307/2297968>
- Baum, C. F. (2000). XTTEST2: Stata module to perform Breusch-Pagan LM test for cross-sectional correlation in panel data model. *Statistical Software Components*. <https://ideas.repec.org/c/boc/bocode/s415702.html> (Revised 09 Jan 2023)
- Bayar, Y., Borozan, D., & Gavriletea, M. D. (2021). Banking sector stability and economic growth in post-transition European Union countries. *International Journal of Finance & Economics*, 26(1), 949–961. <https://doi.org/10.1002/ijfe.1829>
- Beck, T. (2012). The role of finance in economic development: benefits, risks, and politics. In D.C. Mueller (Eds.), *The Oxford Handbook of Capitalism*. Oxford University Press.
- Beck, T., Demirgüç-Kunt, A., & Levine, R. (2010). Financial Institutions and Markets across Countries and over Time: The Updated Financial Development and Structure Database. *The World Bank Economic Review*, 24(1), 77–92. JSTOR.
- Beck, T., & Levine, R. (2004). Stock markets, banks, and growth: Panel evidence. *Journal of Banking & Finance*, 28(3), 423–442. [https://doi.org/10.1016/S0378-4266\(02\)00408-9](https://doi.org/10.1016/S0378-4266(02)00408-9)

BIS. (n.d.). *History of the Basel Committee*. Retrieved May 8, 2023, from

<https://www.bis.org/bcbs/history.htm>

Borio, C. (2003). Towards a Macroprudential Framework for Financial Supervision and

Regulation? *CESifo Economic Studies*, 49(2), 181–215.

<https://doi.org/10.1093/cesifo/49.2.181>

Botev, J., Égert, B., & Jawadi, F. (2019). The nonlinear relationship between economic growth and financial development: Evidence from developing, emerging and advanced economies.

International Economics, 160, 3–13. <https://doi.org/10.1016/j.inteco.2019.06.004>

Callen, T. (n.d.). *Gross Domestic Product: An Economy's All*. IMF. Retrieved May 10, 2023, from

<https://www.imf.org/en/Publications/fandd/issues/Series/Back-to-Basics/gross-domestic-product-GDP>

Čihák, M., Demirgüç-Kunt, A., Feyen, E., & Levine, R. (2012). Benchmarking Financial Systems around the World. *World Bank Policy Research Working Paper No. 6175*, Available at

SSRN: <https://ssrn.com/abstract=2152254>

Čihák, M., & Schaeck, K. (2010). How well do aggregate prudential ratios identify banking system problems? *Journal of Financial Stability*, 6(3), 130–144.

<https://doi.org/10.1016/j.jfs.2010.03.001>

Costa Navajas, M., & Thegeya, A. (2013). Financial Soundness Indicators and Banking Crises.

IMF Working Papers, 13(263), 1. <https://doi.org/10.5089/9781484327616.001>

Creel, J., Hubert, P., & Labondance, F. (2015). Financial stability and economic performance.

Economic Modelling, 48, 25–40. <https://doi.org/10.1016/j.econmod.2014.10.025>

- European Banking Authority. (n.d.). *Accounting and auditing*. European Banking Authority.
Retrieved May 15, 2023, from <https://www.eba.europa.eu/regulation-and-policy/accounting-and-auditing>
- European Investment Bank. (n.d.). *Coronavirus outbreak: EIB Group's response*. EIB.Org.
Retrieved May 15, 2023, from <https://www.eib.org/en/about/initiatives/covid-19-response/index.htm>
- European Parliament. (2020). *COVID-19: Easing rules to encourage banks to lend to companies and households* | News | European Parliament.
<https://www.europarl.europa.eu/news/en/press-room/20200615IPR81234/covid-19-easing-rules-to-encourage-banks-to-lend-to-companies-and-households>
- European Union. (n.d.). *Facts and figures, EU economy* | European Union. Retrieved May 10, 2023, from https://european-union.europa.eu/principles-countries-history/key-facts-and-figures/economy_en
- FSB. (2022). *Post-2008 financial crisis reforms*. <https://www.fsb.org/work-of-the-fsb/market-and-institutional-resilience/post-2008-financial-crisis-reforms/>
- Gadanecz, B., & Jayaram, K. (2008). Measures of financial stability—A review. *Irving Fisher Committee Bulletin*, 31(1), 365–383.
- Hausman, J. A. (1978). Specification Tests in Econometrics. *Econometrica*, 46(6), 1251.
<https://doi.org/10.2307/1913827>
- Hoggarth, G., Reis, R., & Saporta, V. (2002). Costs of banking system instability: Some empirical evidence. *Journal of Banking & Finance*, 26(5), 825–855. [https://doi.org/10.1016/S0378-4266\(01\)00268-0](https://doi.org/10.1016/S0378-4266(01)00268-0)

- Ijaz, S., Hassan, A., Tarazi, A., & Fraz, A. (2020). Linking Bank Competition, Financial Stability, and Economic Growth. *Journal of Business Economics and Management*, 21(1), 200–221.
<https://doi.org/10.3846/jbem.2020.11761>
- International Monetary Fund. (2020). *Global financial stability report: Markets in the time of COVID-19*. <https://www.imf.org/en/Publications/GFSR/Issues/2020/04/14/global-financial-stability-report-april-2020>
- International Monetary Fund. Statistics Dept. (2019). *Financial Soundness Indicators Compilation Guide 2019*. International Monetary Fund. <https://doi.org/10.5089/9781484396209.069>
- Jayakumar, M., Pradhan, R. P., Dash, S., Maradana, R. P., & Gaurav, K. (2018). Banking competition, banking stability, and economic growth: Are feedback effects at work? *Journal of Economics and Business*, 96, 15–41. <https://doi.org/10.1016/j.jeconbus.2017.12.004>
- Jokipii, T., & Monnin, P. (2013). The impact of banking sector stability on the real economy. *Journal of International Money and Finance*, 32, 1–16.
<https://doi.org/10.1016/j.jimonfin.2012.02.008>
- Leland, H. E., & Pyle, D. H. (1977). Informational Asymmetries, Financial Structure, and Financial Intermediation. *The Journal of Finance*, 32(2), 371.
<https://doi.org/10.2307/2326770>
- Levine, R. (2005). Finance and growth: Theory and evidence. In A. Aghion & S. N. Durlauf (Eds.), *Handbook of economic growth* (Vol. 1A, 865– 934). Elsevier Science & Technology.
- Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22(1), 3–42. [https://doi.org/10.1016/0304-3932\(88\)90168-7](https://doi.org/10.1016/0304-3932(88)90168-7)

- Parenti, R. (2022). *European System of Financial Supervision (ESFS) | Fact Sheets on the European Union | European Parliament*. European Parliament.
<https://www.europarl.europa.eu/factsheets/en/sheet/84/european-system-of-financial-supervision-esfs->
- Rodrik, D., & Subramanian, A. (2009). Why Did Financial Globalization Disappoint? *IMF Staff Papers*, 56(1), 112–138. <https://doi.org/10.1057/imfsp.2008.29>
- Roodman, D. (2009). How to do Xtabond2: An Introduction to Difference and System GMM in Stata. *The Stata Journal: Promoting Communications on Statistics and Stata*, 9(1), 86–136.
<https://doi.org/10.1177/1536867X0900900106>
- Rousseau, P. L., & Wachtel, P. (2011). What is Happening to the Impact of Financial Deepening on Economic Growth? *Economic Inquiry*, 49(1), 276–288. <https://doi.org/10.1111/j.1465-7295.2009.00197.x>
- Schaffer, M. E., & Stillman, S. (2016). XTOVERID: Stata module to calculate tests of overidentifying restrictions after xtreg, xtivreg, xtivreg2, xthtaylor. *Statistical Software Components*. <https://ideas.repec.org/c/boc/bocode/s456779.html>
- Schumpeter, J. A. (1934). *The theory of economic development; an inquiry into profits, capital, credit, interest, and the business cycle* (R. Opie, Trans.). Harvard University Press. (Original work published 1911)
- Sharpe, S. A. (1990). Asymmetric Information, Bank Lending, and Implicit Contracts: A Stylized Model of Customer Relationships. *The Journal of Finance*, 45(4), 1069–1087.
<https://doi.org/10.1111/j.1540-6261.1990.tb02427.x>
- Stock, J. H., & Watson, M. W. (2020). *Introduction to econometrics* (Fourth edition, global edition). Pearson Education Limited.

Uhde, A., & Heimeshoff, U. (2009). Consolidation in banking and financial stability in Europe: Empirical evidence. *Journal of Banking & Finance*, 33(7), 1299–1311.

<https://doi.org/10.1016/j.jbankfin.2009.01.006>

Valickova, P., Havranek, T., & Horvath, R. (2015). Financial Development and Economic Growth: A Meta-analysis. *Journal of Economic Surveys*, 29(3), 506–526.

<https://doi.org/10.1111/joes.12068>

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed). MIT Press.

World Bank. (n.d.). *Financial Stability*. World Bank. Retrieved May 10, 2023, from

<https://www.worldbank.org/en/publication/gfdr/gfdr-2016/background/financial-stability>

World Bank. (2022). *World Development Report 2022: Finance for an equitable recovery*. World Bank. <https://doi.org/10.1596/978-1-4648-1730-4>

APPENDIX A – Data Description and Sources

Variable:	Metadata description:	Data Source:
GDP Growth	Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2015 prices, expressed in U.S. dollars.	World Development indicators - World Bank
Non-performing loans	Ratio of defaulting loans (payments of interest and principal past due by 90 days or more) to total gross loans (total value of loan portfolio). The loan amount recorded as nonperforming includes the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue.	Global Financial Development Database – World Bank
Bank Z-score	It captures the probability of default of a country's commercial banking system. Z-score compares the buffer of a country's commercial banking system (capitalization and returns) with the volatility of those returns.	Global Financial Development Database – World Bank
Private credit	Private credit by deposit money banks and other financial institutions to GDP.	Global Financial Development Database – World Bank
Inflation rate (Harmonized Indices of Consumer Prices)	The Harmonised Index of Consumer Prices (HICP) gives comparable measures of inflation for the countries and country groups for which it is produced. It is an economic indicator that measures the change over time of the prices of consumer goods and services acquired by households. In other words, it is a set of consumer price indices (CPIs) calculated according to a harmonised approach and a set of definitions as laid down in Regulations and Recommendations.	Eurostat
Average years of school	Average number of completed years of education of a country's population aged 25 years and older, excluding years spent repeating individual grades.	UNESCO Institute for Statistics (UIS)
Trade openness	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	World Development indicators - World Bank
Initial Econ. Perf.	First lag of GDP (in constant 2015 USD).	World Development indicators - World Bank
Government expenditure	General government final consumption expenditure (formerly general government consumption) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation.	World Development indicators - World Bank

APPENDIX B – Summary Statistics

Variables	N	mean	sd	min	max	p1	p5	p95	p99
Average years of school	274	11.72	1.331	7.617	14.26	7.782	9.145	13.60	14.08
Average years of school, extrapolated	360	11.69	1.301	7.614	14.26	7.782	9.235	13.55	14.10
Average years of school, logged	274	2.454	0.121	2.030	2.657	2.052	2.213	2.610	2.645
Average years of school, extrapolated and logged	360	2.452	0.118	2.030	2.657	2.052	2.223	2.607	2.647

Summary of Average Years of School, without and with extrapolation, before and after log-transformation. Data source: UIS.

APPENDIX C – Statistical Tests

Variance Inflation Factor (VIF) – with NPR

Variable	VIF	1/VIF
Initial economic performance	2.04	0.490100
Trade openness	1.95	0.511797
Government expenditures	1.58	0.632787
NPR	1.45	0.690748
Private Credit	1.32	0.758500
Average Years of School	1.25	0.799035
Inflation	1.14	0.874990
	Mean VIF	1.53

Variance Inflation Factor (VIF) – with BZS

Variable	VIF	1/VIF
Trade openness	2.28	0.439080
Initial economic performance	2.14	0.467009
Government expenditures	1.49	0.672568
Private Credit	1.30	0.771867
Bank Z-score	1.29	0.772869
Average Years of School	1.26	0.795714
Inflation	1.02	0.976859
	Mean VIF	1.54

Wooldridge Test for Autocorrelation

<i>H₀: No first-order autocorrelation</i>		
Variable of Interest	F-test	Prob > F
NPR	11.432	0.0026
BZS	16.352	0.0005

Breusch-Pagan LM Test of Independence

<i>H₀: No heteroscedasticity</i>		
Variable of Interest	Chi2	Prob > Chi2
NPR	609.076	0
BZS	521.042	0

Test for Fixed- or Random effect

H₀: Random effect model is preferred

Variable of Interest	Sargan-Hansen	P-value
NPR	337.636	0
BZS	182.631	0

Test for Year Fixed Effects

H₀: All year fixed effects are jointly significant

Variable of Interest	F-test	Prob > F
NPR	66.34	0
BZS	37.64	0

APPENDIX D – Robustness Test

Regression Results on GDP Growth		
Variables	(5)	(6)
Private credit	-0.0402*** (0.0133)	-0.0448*** (0.00963)
Average years of school	-9.302** (4.454)	-9.277* (5.056)
Government expenditure	-14.64** (5.682)	-13.49** (4.887)
Inflation	0.266 (0.270)	0.517* (0.300)
Trade openness	2.084 (2.349)	-0.820 (1.960)
Initial economic performance	-11.49** (4.098)	-6.794** (2.504)
NPR	-0.0974** (0.0433)	
NPR*CovCr	-0.180** (0.0847)	
NPR*BankCr	-0.0698 (0.230)	
BZS		0.0350 (0.0408)
BZS*CovCr		-0.00912 (0.0548)
BZS*BankCr		0.0377 (0.0631)
Year fixed effect	YES	YES
Constant	360.9*** (117.0)	249.1*** (79.15)
Observations	321	350
R-squared		
Within	0.670	0.674
Between	0.173	0.278
Overall	0.076	0.139
Number of countries	24	24
F-test	772.5	16982
Prob > F	0	0

Robust standard errors in parentheses. Data source: Eurostat, UIS & World Bank.

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