WHAT IS THE IMPACT OF BANK COMPETITION ON BANK STABILITY? AN EMPIRICAL STUDY OF THE ARMENIAN BANKING SYSTEM FROM 2004 TO 2021

By

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Submitted to Central European University - Private University

Department of Economics and Business

In partial fulfilment of the requirements for the degree of Master of Arts in Economic Policy in Global Markets

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Vienna, Austria

2023

Abstract

The relationship between bank competition and bank stability is a widely discussed topic in economic literature. This research aims to examine the impact of bank competition on bank stability in the Armenian financial market during the period from 2004 to 2021. I conduct fixed effects panel data analysis to investigate the relationship between bank concentration, measured by Herfindahl-Hirschman Index (HHI) for loan and deposit markets separately, and bank risk, measured by non-performing loan (NPL) ratio (proxy for credit risk) or Z-index (proxy for overall bank risk). I control for bank specific variables, including number of branches, bank size, asset composition, bank capital, return on assets, as well as the Central Bank refinancing rate. The regression analyses conducted for both loan and deposit markets provide contrasting results, supporting my initial hypothesis. More specifically, for the loan market, I find a positive and significant relationship between the bank concentration index and credit risk. Additionally, I find a negative and significant relationship between the bank concentration index and Z-index, which is also consistent with the "competition-stability" view. On the other hand, in line with "competition-fragility" view, in the deposit market, I find a negative and significant relationship between the concentration index and credit risk, as well as a positive and significant relationship between the concentration index and Z-index. My findings suggest that policymakers should adopt tailored approaches for loan and deposit markets because of the divergent impacts of competition on bank stability.

Author's Declaration

I, the undersigned, Gohar MKRTCHYAN, candidate for MA degree in Economic Policy in Global Markets, declare herewith that the present thesis is exclusively my own work, based on my research and only such external information as properly cited in bibliography. I declare that no unidentified and illegitimate use was made of the work of others, and no part of the thesis infringes on any person's or institution's copyright. I also declare that no part of the thesis has been submitted in any form to any other institution of higher education for an academic degree.

Gohar MKRTCHYAN

Acknowledgments

I would like to express my deepest gratitude to my thesis supervisor, Professor Ibolya Schindele. Your guidance, expertise and support throughout the thesis project have been truly important for me and shaped the outcome of this research. Your mentorship has been instrumental for my academic growth and I am honored to have the opportunity to learn from you.

I am deeply grateful to Hayk Voskanyan for sparking my interest in the topic that formed the foundation of this thesis. Your vision and expertise in the field provided me an opportunity to expand my knowledge and to contribute meaningfully to the field. I am grateful for your efforts to guide me despite your busy schedule. I truly appreciate your remarkable support.

I am incredibly thankful to Anna Alikhanyan for her insightful feedback and contribution to my research study. Your expertise and critical analysis have significantly enhanced the quality of this thesis. Your guidance and encouragement have been invaluable and I am sincerely grateful for the opportunity to know you. Your support made a positive impact on my personal and professional growth. Thank you for being an inspiring mentor and for your continued belief in me.

I am indebted to my team at Inecobank cjsc for their support. Thank you for being an extraordinary group of individuals. I feel fortunate to have had the opportunity to work alongside each and every one of you, and I look forward to the continued collaboration and success that lies ahead.

I would like to express my deepest appreciation to my mother, Zara. Your unwavering love, encouragement and sacrifices have always been the driving force for my academic and career pursuits. Your belief in me is my greatest motivation. I am forever grateful for your endless support – thank you for being the extraordinary mother that you are.

I am grateful to my fiancé, Karen, who has been an incredible source of support and encouragement throughout my academic journey. Your belief in my abilities, even during the moments of self-doubt, has been a constant reminder of my potential and has fueled my determination to succeed.

Lastly, I would like to acknowledge my family, all the friends and individuals who supported me during my academic journey. Your encouragement was very important and I am deeply grateful for your presence in my life.

Table of Contents

Table of Figures

Introduction

The 2008 financial crisis was a global event that had far-reaching consequences for the world economy, causing long lasting economic and social effects. The lack of effective regulation in the financial system contributed to major financial institutions collapsing, which in turn threatened the overall stability of the entire financial system. In order to recover from the crisis, policymakers and regulators around the world began to focus more closely on issues of bank stability, seeking to prevent another repeat of the events of 2008. This included the introduction of new regulations, such as the Dodd-Frank Act in the United States and the Basel III framework internationally, aimed at improving the resilience of the financial system and mitigating the risk of systemic failure.

With ongoing improvements in financial stability regulations, there is an active debate about the extent to which competition should be regulated in the banking sector. While competition may be considered beneficial in other sectors, as it can lead to lower prices, improve product/service quality, drive innovation, offer greater variety to consumers and increase their satisfaction, banking sector represents unique situation, where the real effect of competition is debated.

The debate over the relationship between bank competition and financial stability centers on two contradicting views. The "competition-fragility" view suggests that competition cuts profit margins resulting in a reduced franchise value, which encourages banks to take on more risk endangering financial stability. On the other hand, the "competition-stability" view argues that competition reduces interest rates of loans, therefore minimizes the probability of asset portfolio default and borrower risk, which in turn promotes the system stability. In other words, while both views agree that competition has a positive effect on interest rates, "competition-fragility" view suggests that reduction of interest rates will generate risk-taking behavior of shareholders and they

1

will gamble using depositor's money to have higher returns. On the other hand, "competition-stability" view suggests that as a result of interest rate decrease, the value of non-performing loans, meaning the likelihood of borrower default will decrease, the asset quality of banks will improve contributing to the overall stability of the financial system. In fact, Berger et al. (2008) provide an evidence that can be described as "mixed" suggesting that the relationship cannot be solely categorized into either the "competition-fragility" or "competition-stability" view. The authors argue that banks with higher market power, despite being more likely to bear higher loan portfolio risk, also may enjoy less overall risk exposure. This is attributed to their ability to employ various risk-mitigating techniques, such as maintaining higher equity capital to protect their franchise value, which in turn results in more stable banking system. (Berger et al., 2008)

In this research, the primary objective is to analyze the relationship between bank competition and bank stability in Armenia during the period from 2004 to 2021. The research question addressed is: "What is the impact of bank competition on bank risk exposure in Armenia during the years 2004 - 2021?". To answer this question, I conduct an empirical analysis of the existing theories using Herfindahl-Hirschman Index (HHI) as a measure of market structure for both deposit and loan markets, as well as different indicators of bank stability, such as Z-index and the ratio of non-performing loans (NPL) by controlling for bank specific variables, including number of bank branches, log assets, loan-to-asset ratio, bank return on asset ratio, equity-to-asset ratio, as well as the refinancing rate provided by the Central Bank of Armenia (CBA[1]).

This study aims to make a valuable contribution to the existing literature by examining the relationship between bank competition and bank stability within the unique context of the

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[1] For more information: https://www.cba.am/en/SitePages/statmonetaryfinancial.aspx

Armenian financial system. This context is particularly interesting because, although Armenia is not officially a part of the Basel Committee on Banking Supervision, the Central Bank of Armenia uses Basel regulations and guidelines to oversee and regulate the banking sector. To my knowledge, no similar study has been previously applied for analyzing the effect of bank competition on bank stability in Armenian financial market during the period from 2004 to 2021.

The findings of this study can have implications for policymakers, regulators, and banking market participants in Armenia. They can contribute to the development and use of regulatory frameworks that successfully balance competition and the stability and the resilience of the financial system of Armenia.

It is important to acknowledge the limitations of this research, such as data constraints, including availability of quarterly financial statements of all the banks for the period analyzed under the study, as well as the specific choice of variables and measures. Further research and analysis are encouraged to validate and strengthen the findings of this study.

Chapter 1: Literature Review

The relationship between bank competition and bank stability is a widely discussed topic in economic literature. If we analyze the history of bank runs in the United States, after the establishment of Federal Deposit Insurance Corporation (FDIC) the period from 1933 to 1980 can be considered as a "quiet" one, with no bank runs. It is important to observe that during these 50 years the banking system was strictly regulated. However, major problems started to occur around three decades before the 2007-2009 financial crisis, when the intense process of banking system deregulation started to take place.

"Competition – fragility" view

Keeley (1990) suggests that liberalization of bank competition laws, including deposit rate and state branching deregulation, as well as changes in technology, eroded banks' charter value. The author tests the hypothesis, according to which increased competition in the banking industry caused decline in banks' charter value, which in turn led banks to increase their default risk, particularly through increasing asset risk and lowering capital. In other words, the hypothesis is that liberalization of competition laws encouraged banks to take on more risk and resulted in bank failures endangering financial stability. While the most important driver of increased bank competition may not necessarily be the liberalization of laws, the liberalization itself serves as a readily observable exogenous factor. Thus, to test the theory, in the empirical analysis the author analyzes changes in liberalization laws over time to explore their impact on market power within banks and whether exogenous variations in market power are associated with variations in bank risk-taking. The results of the analysis are consistent with the hypothesis and indicate a statistically significant relationship (at the 1-percent level) between the liberalization of branching/multibank

holding company expansion laws in a prior period and a lower market-to-book asset ratio, suggesting that the restrictions of laws related to branching and multibank holding company expansion provide banks with some shelter of protection from competition, therefore liberalization of laws endangers financial stability. Additionally, Keeley (1990) tests the theory, according to which the reduction in a bank's market power was the primary factor behind the decline in the bank's capital to asset ratio. The author's empirical finding is consistent with the theory: there is a strong, positive, and statistically significant relationship between market-to-book asset ratio (the proxy for market power) and the market-value capital-to-asset ratio, according to the OLS results. This means that banks enjoying market power also hold more capital relative to their assets, therefore they have less incentive to increase their asset risk. The author suggests that even if the overall risk in the economy does not increase, holding asset risk constant, low capital provides less protection against failure. (Keeley, 1990).

Some theoretical studies also suggest examining volatility in earnings when measuring bank stability. Couto (2002) suggests that it is important to consider earnings volatility because higher levels of volatility in a bank's earnings can lead to uncertainty about the level of equity capital, which can ultimately contribute to a decline in the bank's overall financial stability (Couto, 2002). Based on Couto (2002), Haan and Poghosyan (2011) contribute to the existing literature on bank competition and bank stability by conducting an empirical analysis on US banking system, including commercial, savings and cooperative banks, using quarterly financial data for the period from 2004 to 2009. Haan and Poghosyan (2011) analyze whether the bank size and market concentration affect earnings volatility controlling for potential other bank characteristics that may affect earnings volatility, including efficiency, leverage, and the level of asset-side diversification of the bank. The authors assume that large banks can be more diversified than small banks, as well

as that it is possible that large banks, due to their size and importance, could be considered "too big to fail," which may lead them to take on greater risks. Haan and Poghosyan (2011) also examine whether the relationship between bank size, market concentration, and earnings volatility has been impacted by the financial crisis that occurred in 2008. Their empirical findings suggest that larger banks tend to have lower return volatility, indicating that their earnings are relatively stable. However, the negative effect of bank size on earnings volatility diminishes when market concentration increases. This means that when banks are operating in more concentrated markets, the impact of their size on earnings volatility is less pronounced. The findings also demonstrate that during times of 2008 financial crisis, larger banks operating in more concentrated markets experienced higher volatility compared to pre-crisis periods, although their earnings volatility remained lower than that of smaller banks. The empirical results suggest no support for the competition-stability view, as the coefficient of the market concentration is not statistically significant. The authors conclude that market power creates "larger" banks, and the latter can better diversify their portfolios: the more diversified are portfolios, the lower the earnings volatility, meaning more "stable" earnings, which contributes to financial stability. (Haan and Poghosyan, 2011).

Jimenez, Lopez and Saurina (2010) provide an empirical analysis of the Spanish banking system to test the theory according to which "franchise value plays a key role in limiting bank risk-raking". When banks enjoy market power, their franchise values increase, thus policies that limit competition in banking sector have been seen as fostering stability. The empirical results support the franchise/charter value paradigm, which means that market power measured by Lerner Index in the loan market has a negative relationship with bank risk, which in turn is measured by the ratio of non-performing loans. Meaning that, the authors suggest that in the Spanish banking

system, as the market power increases, bank NPL ratios decrease. Similar, although weaker results are observed for the deposit market. Moreover, in the context of the Spanish banking system, HHI and C5 indexes of market power failed to affect bank risk variable. (Jimenez, Lopez and Saurina, 2010)

"Competition – stability" view

Boyd and De Nicolo (2005) review the existing theoretical literature, according to which when there is an increased market competition, the moral hazard problem arising from profit-seeking equity holders' limited liability leads banks to take on more risk. The authors suggest that the way competition can impact stability depends on the net effect of deposit and loan markets, therefore they introduce a model which allows competition in both deposit and loan markets. They argue that in the loan market in the absence of market competition, banks increase interest rates. This leads to an increased portfolio of non-performing loans; therefore, market concentration leads to bank fragility, and the probability of systemic distress is high. Additionally, Boyd and De Nicolo (2005) suggest that at the same time in the deposit market less competition means that deposit interest rates are low, which in turn means that banks have higher profits, and they seek less risk. The authors claim that the effect of loan market dominates, and "*increased competition unambiguously results in lower bank risk*" (Boyd and De Nicolo, 2005).

Boyd, De Nicolo and Jalal (2006) provide two theoretical models in which banks face asset allocation problem and are allowed to invest in riskless assets, such as bonds. In Model 1, banks compete only in deposit markets and do not have contracting problem with borrowers. In Model 2, banks compete in both deposit and loan markets and they have to solve the "optimal contracting problem". By "*optimal contracting problem*", the authors mean "*a situation in which there is private information and borrowers' actions will depend on loan rates and other lending terms*".

7

Model 1 predicts that the likelihood of bank failure rises as the number of banks increases, meaning that there is a trade-off between competition and stability, while the Model 2 predicts a positive relationship between competition and stability. However, both models predict that as the number of banks increase, loan/asset ratio of the banks also increases. The empirical analysis that tests the theoretical models using two different data sets (US banks vs banks in 134 non-industrialized countries) provide identical qualitative results for both samples. The analysis reveals that, after controlling for other factors, there is a positive and statistically significant relationship between market concentration and banks' probability of failure, supporting the prediction of Model 2. Furthermore, the loan to asset ratio shows a negative and significant relationship with concentration, which is in line with the predictions of both models. Lastly, bank profits are positively and significantly related to bank concentration. (Boyd, De Nicolo and Jalal, 2006)

"Mixed evidence"

Berger et al. (2008) use Bankscope data on 8235 banks in 23 developed countries to test whether the two opposing views may be operative simultaneously. Their results suggest that consistent with "competition-stability" theory, in those countries banks with a higher degree of market power have significantly higher loan portfolio risk, measured by non-performing loan (NPL) ratio. However, consistent to "competition-fragility" theory, these banks also enjoy lower exposure to overall bank risk, measured by Z-index (inverse proxy for bank's probability to fail), as they can protect their franchise values through different risk-mitigating techniques, including holding smaller loan portfolio or higher equity capital. The authors suggest that even if banks have higher exposure to loan risk, they can still choose to have lower exposure to overall bank risk. Therefore, the results are best described as "mixed", meaning consistent with both "competition-stability", as well as "competition-fragility" views. (Berger et al., 2008)

Chapter 2: Banking system overview

This chapter serves as a background for my research on financial stability and bank competition in Armenia. Understanding the financial sector's structure and performance from 2004 to 2021 is essential to gain insights into the current state of Armenia's financial market, which has undergone significant changes during the period analyzed in this study. From 2004 to 2021, there have been numerous developments in the banking sector, including changes in market structure, the emergence of new players, mergers, and shifts in regulatory policies.

Figure 1 represents the number of banks and total number of bank branches operating from 2004 to 2021. From 2005 to 2015 the number of banks operating in the system is higher than in the year 2004 and after the year 2016. The total number of bank branches in the system has grown significantly from 2004 to 2021 apart from the periods between 2008 to 2009 and 2015 to 2016, which are characterized by decrease of total number of branches.

Figure 1: Number of banks, total number of branches by year in Armenia
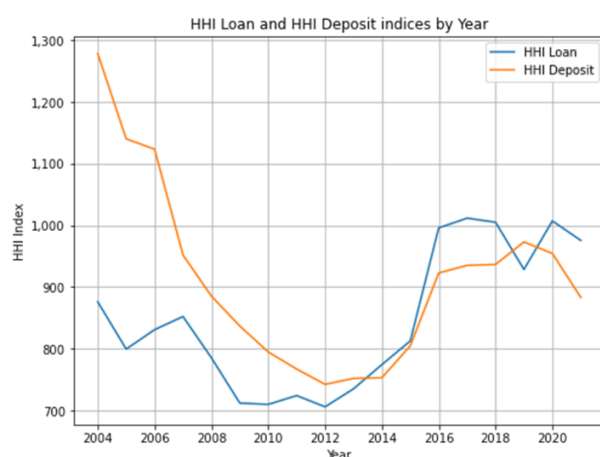

Source: Annual financial statements of individual banks

In December 2014, the Central Bank of Armenia made a decision to increase the minimum amount of total capital required for banks to operate. This minimum amount was raised from AMD 5

billion to AMD 30 billion, and the change went into effect on January 1, 2017. The purpose of this decision was to improve the stability and efficiency of the banking sector in Armenia. As a result of it, the number of banks, as well as the number of branches decreased reaching their level of 17 commercial banks with their 561 branches operating in the country as of December 2021.

In the analysis of market structure in the banking system, I differentiate between Loan and Deposit Markets. As a measure of market structure, I use Herfindahl-Hirschman Index (HHI) indices for those two markets. In Figure 2 the market structure trend from 2004-2021 is shown. Note that higher HHI index means higher concentration in the market, therefore less competition. For both of the indices, the same sample of banks is observed.

Figure 2: HHI Loan and HHI Deposit indices from 2004 to 2021

Source: Financial statements of individual banks, based on own calculations

As Figure 2 shows, from 2004 to 2013 the deposit market is more concentrated than the loan market. However, from 2013 to 2021 the competitive structure changes, and the loan market becomes slightly more concentrated compared to the deposit market (with the exception of the year 2019).

10

The overall trend of the deposit market concentration is decreasing from 2004 to 2021. To be more specific, in 2004 the HHI Deposit index was approximately 1279, however in 2021 it was 883. On the other hand, from 2004 to 2021 the HHI Loan index has increased. In 2004, the HHI Loan index was approximately 876, whereas in 2021 it is around 976. The banking system had the lowest HHI index in both loan and deposit markets in the year 2012.

It is also important to note that when analyzing the market concentration index, according to the US Justice Department[2], an HHI value of less than 1,500 is generally considered to indicate a competitive market. An HHI value falling between 1,500 and 2,500 is viewed as moderately concentrated, while an HHI of 2,500 or more suggests a highly concentrated market. During the periods from 2004 to 2021, the indices for both loan and deposit markets in Armenia are lower than 1500, implying that, according to the standard of judgment suggested by the US Justice Department, the market is competitive during all years discussed in the study.

In order to examine the relationship between the average interest rates and the market concentration indices, I analyze the data provided by Central Bank of Armenia on average deposit and lending interest rates. I used up to 1-year deposit and lending rates, excluding demand deposits and loans averaged for each year.

The results are shown in the Figure 3 below.

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[2] U.S. Justice Department. "Horizontal Merger Guidelines," Select "5.3 Market Concentration."
For more information: Horizontal Merger Guidelines (08/19/2010) (justice.gov)

Figure 3: Avg. deposit / lending rates vs HHI index for deposit or loan markets, respectively
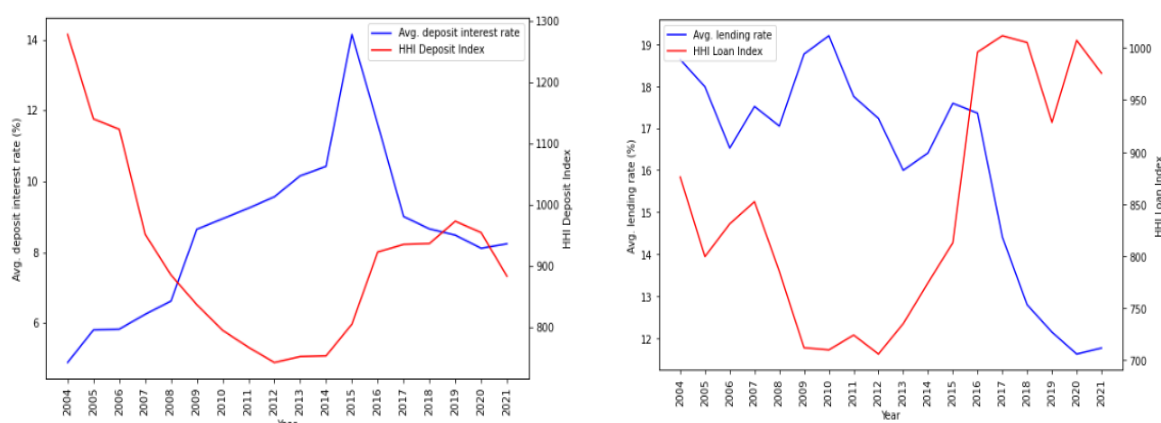
Source: Financial statements of individual banks and CB report, based on own calculations

Figure 3 shows that HHI deposit and average deposit interest rates are generally inversely related, meaning when there is an increasing trend in competition in the deposit market (decreasing HHI deposit index), average deposit interest rate is rising. On the other hand, decreasing trend of HHI Loan index is associated with decreasing lending rates, and vice versa, meaning increase in competition in the loan market is associated with decrease of average lending rates.

The health of financial system in Armenia is largely dependent on the overall health of the banking system, mostly because as of December 2021, approximately 84 percent of assets in the financial system are the assets of commercial banks, according to the Central Bank of Armenia[3]. From 2004 to 2021 there is a substantial growth in assets in the banking sector. In 2021 the ratio of loans provided to customers and total assets is approximately 56.6 percent, having a decreasing trend from 2019. As of December 2021, non-performing loans in the banking sector account for approximately 3.7 percent of total loans and have decreased after 2020, however they are still

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[3] For more information: https://www.cba.am/am/SitePages/fscintroduction.aspx

higher than the pre Covid-19 level. The equity side of the balance sheet has also significantly increased over the years.

*Figure 4: Balance sheet trends of the banking system 2004-2021*

Source: Financial statements of individual banks, based on own calculations

As of December 2021, the Armenian banking system continues to face a significant obstacle in the form of low profitability, which is limiting its ability to have investments and expand its

development capacity. According to the data provided by the Central Bank of Armenia[4] (represented in Figure 5), in 2021, the Armenian banking system experienced a decline in its return on assets (ROA) and return on equity (ROE) compared to the previous year. Specifically, ROA and ROE dropped by 0.1 and 0.3 percentage points, totaling 0.9% and 7.1%, respectively.

Figure 5: ROA, ROE, Net interest margin of the banking system in Armenia
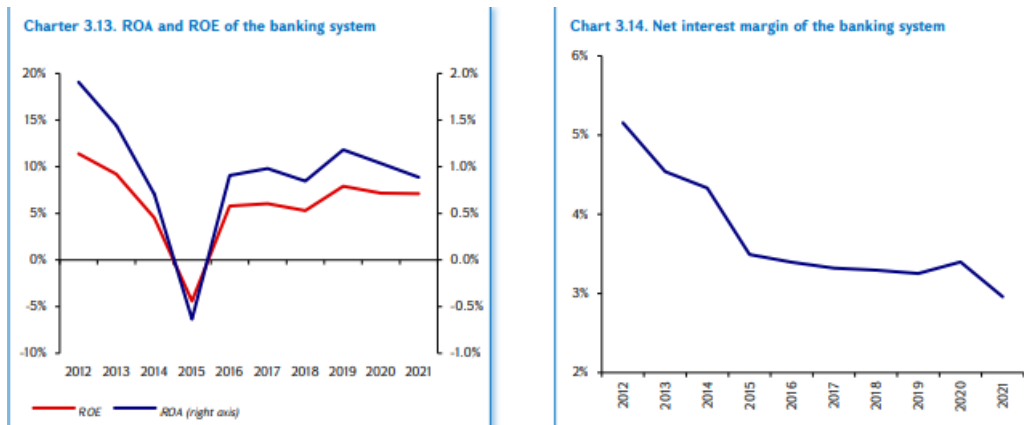
Source: Central Bank of Armenia

As my model does not incorporate macroeconomic variables, I will proceed with the analysis by focusing on important dates (years) to provide context for the analysis and understand their potential implications.

- 2008-2009: Financial crisis had a significant impact on the global economy, as well as the Armenian economy. This event led to widespread economic downturns, banking crises, and a decline in international trade and investment.

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[4] For more information: https://www.cba.am/en/SitePages/fsreport_annual_2021.aspx

- 2016: Changes in regulatory requirement of the minimum total capital of commercial banks. As a result of it, bank mergers in Armenia occurred, which played an important role in market structure changes.

- 2020-2021: the Nagorno-Karabakh war and the COVID-19 pandemic emerged as crucial factors affecting the economy of Armenia. These events resulted in several significant consequences, including the closure of bank branches operating in Nagorno-Karabakh and a potential increase in non-performing loans due to the combined effects of the war and the COVID-19 pandemic.

Chapter 3: Data

The purpose of this research is to examine the effect of bank competition on bank stability in Armenia during the period from 2004 to 2021. I use bank-level financial data for the years 2004 to 2021 from the published fourth quarter financial statements of the banks included in the sample. I also use reports available in the official website of the Central Bank of Armenia (CBA) on financial stability, as well as CBA statistics on average deposit, lending and refinancing interest rates available in the official website of CBA. My primary goal is to examine the banking system, which accounts for approximately 83.5% of assets of the financial system as of December 2021. My research sample includes all the banks operating during the years under the study. It is also important to note that in Armenia as an alternative source of credit, consumers can also borrow from credit organizations, which I do not include in my analysis, because they bear significantly lower portion of the assets of financial system and my primary research interest is the banking sector. In future, further research can be done to analyze the effect of competition on financial system stability including banks, as well as credit organizations.

The independent variables refer to Herfindahl-Hirschman Index (HHI), which measures the degree of market concentration. The formula is provided below:

$$HHI_i = (S_{1i})^2 + (S_{2i})^2 + ... + (S_{ni})^2$$

where;
S_{ni} represents market share of individual bank n in the year i.

HHI is calculated separately for loan and deposit markets. For the loan market, an individual bank's market share is calculated based on the loans and advances provided to customers

(corporate and retail). For the deposit market, an individual bank's market share is calculated based on the deposits attracted by customers (corporate and retail).

The dependent variables include the ratio of non-performing loans (NPL Ratio) and Z-index, which serve as proxies for bank stability. Particularly, I use NPL ratio as a measure of credit or loan portfolio risk, as it measures the percentage of a bank's loans that are not being repaid according to the contractual terms and conditions agreed with the customer. Delinquency for more than 90 days is considered the threshold for categorizing a loan as a "non-performing" in my study. The higher the ratio of non-performing loans, the higher the credit risk of a bank, meaning the probability of loan portfolio default is also high. While the NPL ratio is indeed a good measure of credit risk, it is only one aspect of a bank's overall risk profile. A bank's overall risk is a function of various factors, including its funding structure, capital adequacy, volatility of earnings, etc. Even though a bank may have a high credit risk, it does not necessarily mean that bank's overall risk profile is also high. This can be explained by the fact that banks can use various risk-mitigating techniques, including holding higher capital, which allow them to decrease overall risk exposure of the bank and still be stable. In other words, high credit risk does not always imply high overall bank risk. (Berger et al., 2008)

Therefore, in my research, I make a clear distinction between loan portfolio risk, measured by NPL ratio, and overall bank risk, measured by Z-index, as another proxy for bank stability that is used to assess insolvency risk. By comparing a bank's profitability with its equity, the Z-index measures "*the distance to insolvency*". The higher the Z-index, the more resistant the bank is to shocks in profitability; therefore, bank stability is higher (lower overall bank risk). I use the methodology used by Berger et al., (2008) to calculate Z-index.

17

$$Z_{it} = (ROA_{it} + CAR_{it})/SD(ROA)_i$$

where;

ROA represents return on assets (Net income / Total assets) for individual bank i in the year t;

CAR is the capital ratio (Equity/Total assets) for individual bank i in the year t;

SD(ROA) is the standard deviation in return on assets during the 18 years (2004-2021) analyzed

under the study for each individual bank i;

Simply put, Z-index increase is associated with higher capitalization (higher CAR) or higher

profitability (higher ROA), and the decrease is associated with higher volatility of earning (higher

sd of ROA).

In addition to this, I also control for bank level variables, such as *Bank Size* (logarithm of Total

Assets), *Asset Composition* (Loan-to-Asset ratio), *Bank Capital* (Equity-to-Asset ratio), *Number

of branches*, and *Return on Assets* (ROA) for each individual bank i in the year t. More specifically,

I want to study whether bigger banks are more exposed to credit or overall bank risk, as well as

the effect of asset composition on bank risk. I control for bank capital, measured by Equity to Asset

ratio, as the latter serves as a buffer and provides a measure of a bank's ability to absorb risks. I

also control for number of branches of individual banks in Armenia, because the concentration

measure used in the study does not consider the geographic spread/presence of the banks. I use

ROA to control for bank profitability when analyzing the risk exposure of the banks. Additionally,

I use yearly averaged refinancing rate provided by the Central Bank of Armenia. Refinancing rate

is the interest rate at which the Central Bank of Armenia lends money to commercial banks.

Refinancing rate serves as a benchmark for determining the cost of borrowing in the economy and

influences overall interest rates. Lower refinancing rates stimulate borrowing and trigger economic

growth. Lower refinancing rate can also be interpreted as the Central Bank's response to an

overheated economy, meaning that if the refinancing rate is lower, risks in the economy may be also low.

To investigate the effect of bank competition on bank stability in Armenia during the period from 2004 to 2021, I formulate the following hypothesis:

- *Hypothesis 1A*: Concentration in loan market has a positive relationship with loan portfolio risk, measured by NPL ratio.
- *Hypothesis 1B*: Concentration in loan market has a negative relationship with Z-index; higher values indicate higher bank stability.
- *Hypothesis 2A*: Concentration in deposit market has a negative relationship with loan portfolio risk, measured by NPL ratio.
- *Hypothesis 2B*: Concentration in deposit market has a positive relationship with Z-index; higher values indicate higher bank stability.

Simply put, I hypothesize that competition in loan and deposit markets affects differently the bank risk. More specifically, I assume that competition is loan market leads to bank stability; however, competition in the deposit market leads to bank fragility. Additionally, in contrast to Berger et al. (2008), I assume that if banks are exposed to higher credit risk measured by NPL ratio, their overall risk portfolio is also high. I do not anticipate an outcome where credit risk is high while the overall bank risk remains low, because I assume that financial market in Armenia is very small, and risk-mitigating techniques are not as diverse, as in other more developed financial markets that analyzed by Berger et al. (2008).

Table 1 in Appendices provides the descriptive statistics of the variables. Table 2 in Appendices represents the comprehensive list of variables used in the study, categorized as independent, dependent, and control variables. Each variable is defined along with the base of analysis.

Chapter 4: Methodology

The methodology adopted for this study is mainly based on the approach used by Berger et al. (2008), although in my research I analyze the relationship between the bank competition and bank stability using panel data fixed effects analysis model to account for unobserved heterogeneity across different units (bank, year). I control for both bank-specific and year-specific factors that could influence the relationship between bank competition and bank stability, so I can better isolate the effect of bank competition on bank stability, holding all other factors constant. These factors can include differences in management quality, efficiency and risk management practices among different banks, as well as macroeconomic factors and regulatory environment, including, but not limited to different macroeconomic indicators, legal rights, entry and activity restrictions, etc.

The basic equation for regression is mentioned below:

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + ... + \beta_7 X_{7it} + \varepsilon_{it}$$

; where i represents an individual bank, t represents the year. ε is the error term

The outcome variable Y is the NPL ratio or Z-index of individual banks, which is explained by independent variable X_1 (HHI Loan or HHI Deposit), and controlled by set of variables, including:

X_2 – Number of branches

X_3 – Log of Bank Assets (Lagged)

X_4 – Bank Loan-to-Asset ratio (Lagged)

X_5 – Bank Equity-to-Total Asset ratio (Lagged) (not included when Y is the Z-index)

X_6 – Bank ROA (Lagged) (not included when Y is the Z-index)

X_7 – Refinancing rate (Lagged)

I do not include Bank Equity-to-Total Assets ratio, as well as Bank ROA as a control variable when the outcome variable Y is the Z-index, because these two variables are already included in the formula of Z-index. Recall, $Z_{it} = (ROA_{it} + CAR_{it})/SD(ROA)_i$,

where $CAR_{it} = Equity_{it} / Total\ Assets_{it}$

To avoid endogeneity problems, I lag by one period (year) bank-level explanatory variables, such as Log Bank assets, Bank Loan-to-Asset ratio, Bank Equity-to-Total Asset ratio, Bank ROA, as well as the Central Bank refinancing rate.

Chapter 5: Discussion of the results

The regression analyses conducted for loan and deposit markets are very consistent with Figure 3 and provide contrasting results on the effect of bank competition on bank risk for loan and deposit markets. Recall that according to Figure 3, increasing competition in the loan market is associated with lower average lending rates, while increasing competition in the deposit market is associated with higher average deposit interest rates. This statement is crucial for analyzing the findings of this study.

In the loan market, the results indicate a positive relationship between the market concentration index and the non-performing loan (NPL) ratio, consistent with the empirical finding of Berger et al. (2008). Specifically, the higher the concentration in the loan market, the higher the ratio of non-performing loans, which indicates higher risk in loan portfolio of banks at a 1 percent significance level. The results also indicate that if log total assets of individual banks are lagged by 1-year, banks with larger asset portfolio are less exposed to loan portfolio risk. In other words, bigger banks are less exposed to credit risk, which is consistent to the finding of Haan and Poghosyan (2011). I assume that the reason behind is that big banks can afford better risk mitigating techniques, and enjoy higher efficiency in their business model, which allows them to decrease their credit risk exposure. In addition, the results also indicate that higher loan-to-asset ratio lagged by 1 year is associated with lower loan portfolio risk. This relationship can be explained by the fact, that usually bigger banks in Armenia are more specialized in financing bigger companies, such as utility companies, telecom, mining companies, which in turn have inherently lower risk exposure. Furthermore, I find that bank equity-to-asset ratio is negatively related to bank credit risk, meaning that consistent with Keeley (1990) low capital provides less protection against failure. The results also indicate that bank profitability measured by ROA (lagged by 1 year) is

negatively related to loan portfolio risk, meaning that higher profitability is associated with lower credit risk. I assume that this is explained by the fact that banks having higher ROA ratios enjoy higher efficiency in utilizing their assets to generate higher profits. In other words, these banks effectively manage their resources. One example of it can be using adequate risk mitigating techniques to control for credit risk, including exercising more effective loan screening procedures.

However, inconsistent with Berger et al. (2008) the results show negative relationship between the bank concentration in the loan market and bank stability measured by Z-index at 1 percent significance level, meaning the higher the concentration in the loan market, the lower the overall bank stability. The results are not consistent with Berger et al. (2008), because I assume that financial market in Armenia is very small compared to the other more developed financial markets analyzed by Berger et al. (2008), and in case of higher risk in loan portfolio, the overall risk of banks is also high due to their limited ability to use differentiated or sophisticated risk mitigating techniques. In other words, this finding can be attributed to various factors, including less developed financial infrastructure, narrower range of investment opportunities, fewer market participants, limited access to specialized risk management tools, and a less diversified pool of financial instruments.

My regression results for the loan market support "competition-stability" hypothesis, implying that as competition increases, the average interest rates charged by the banks decrease, decreasing the probability of loan portfolio default and borrower risk.

In the deposit market, on the other hand, consistent with empirical findings of Jimenez, Lopez and Saurina (2010), the results indicate negative relationship between market concentration index and non-performing loan (NPL) ratio, meaning that increased concentration (higher HHI index) in the deposit market is associated with lower bank loan portfolio risk (lower NPL ratio), as well as lower

23

overall bank stability (lower Z-index). These findings contribute to the franchise-value hypothesis being in line with the theory, according to which competition in the deposit market increases the moral hazard incentives of bank shareholders. This means that consistent with Boyd and De Nicolo (2005), when the competition for deposits among banks increases, deposit interest rates also increase, therefore banks' profitability decreases and reduces franchise value. Increased competition incentivizes bank shareholders to take on more risk and engage in riskier activities with depositors' funds (gambling with depositors' money). Moreover, as the results indicate lower Central Bank refinancing rate lagged by 1-year decreases credit risk and increases overall bank stability. Recall that the refinancing rate serves as a benchmark for determining the cost of borrowing in the economy and influences overall interest rates. Lower refinancing rate can also be interpreted as the Central Bank's response to an overheated economy, meaning that if refinancing rate is lower, risks in the economy may be also low. Table 3 and Table 4 in Appendices show the main regression results.

Chapter 6: Limitations

This chapter aims to explore limitations of the current research, and provides a roadmap for future research.

First, as mentioned in Chapter 3, in this research I use data from the fourth quarter (year-end) financial statements of each bank analyzed in the sample. The availability of bank-level quarterly data, as well as the use of quarterly macroeconomic indicators would significantly enhance the quality and the depth of the results of this research, and would provide conclusions that are more accurate. In addition, a limitation of this study is the inability to calculate the Lerner Index, another measure of market power that has been widely used by other authors, including Berger et al. (2008). For further research, it is recommended to use alternative measures of market power, including Lerner index, to have more robust results. Additionally, as I do not include credit organizations in the sample, it may be important to analyze them as well in future research, especially if their market share increases in the financial system.

Recognizing the constraints of this research, such as limited data availability regarding quarterly financial statements for the analyzed period, as well as the specific selection of variables and measures, it is important to encourage further research to validate the findings of this study.

Chapter 7: Conclusion and policy implications

Based on the findings presented in Chapter 5, it can be concluded that the relationship between bank competition and bank stability in Armenian banking sector is complex and varies depending on the market (loan vs deposit) analyzed. The results may be the best characterized as "mixed", supporting my initial hypothesis.

Hypothesis	Approved/Rejected
H1A: Concentration in loan market has a positive relationship with loan portfolio risk, measured by NPL ratio.	Approved
H1B: Concentration in loan market has a negative relationship with Z-index; higher values indicate higher bank stability.	Approved
H2A: Concentration in deposit market has a negative relationship with loan portfolio risk, measured by NPL ratio.	Approved
H2B: Concentration in deposit market has a positive relationship with Z-index; higher values indicate higher stability.	Approved

In line with "competition-stability" view, in the loan market the results suggest that increased competition may lead to lower credit risk of banks, as measured by the non-performing loan ratio, and higher overall bank stability, as measured by Z-index. In other words, increased concentration in the loan market results borrower defaults because of higher interest rates, and reduces overall bank stability in the system.

In line with "competition-fragility" view, in the deposit market increased competition leads to a higher credit risk of banks and lower overall bank stability, as measured by the NPL ratio and Z-index, respectively. In other words, increased competition in the deposit market results in reduction of profits, therefore increases the moral hazard incentives of bank shareholders to gamble with depositors' money and engage in riskier deals to gain more profit. Deposit insurance system provides another incentive for banks to engage in such practices.

Based on the mixed findings on the relationship between bank competition and bank stability in the Armenian banking sector, it is important to implement differentiated policies for loan and deposit markets. Recognizing the divergent impact of competition on stability in loan and deposit markets, policymakers should consider tailored approaches for each market. More specifically, in the loan market, promoting healthy competition can contribute to lower loan portfolio risk and increase the overall stability of the financial system. However, in the deposit market, measures should be taken to address the potential moral hazard incentives of bank shareholders associated with decrease of profits as a result of intense competition.

Specific policies that can address the challenges of promoting healthy competition in the loan market while addressing moral hazard incentives in the deposit market may include:

Loan Market:

- Implementing regulations to promote transparency in contracts with consumers, enabling borrowers to make informed decisions and encouraging competition based on provided service quality, which includes terms and conditions of the services, as well as the risk assessment.
- Improving credit information sharing system to facilitate better risk assessment by banks and reduce information asymmetry in the financial market.
- Encouraging the entry of new lenders, such as fintech companies, through regulatory frameworks provided by the CBA that ensure fair competition and promote innovation in lending practices while mitigating the risks associated with it.

Deposit Market:

- Implementing measures to prevent shareholders' moral hazard incentives, such as stricter supervision and monitoring of banks' risk-taking behavior conducted by the CBA

27

- Protecting consumers by improving their financial literacy, so they can make better and most importantly informed decisions.
- Reviewing minimum capital requirements and implementing stress testing frameworks to ensure banks maintain adequate financial buffers.

It is important to highlight that based on the analysis conducted in this research, the main policy implication is to implement differentiated policies for the loan and deposit markets. However, it is important to emphasize that further research has to be done to provide specific policy recommendations tailored to each market. Additional studies can provide deeper analysis for each market to develop more targeted policies addressing specific challenges within each market and promote stability.

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"VTB Bank Armenia" cjsc: https://www.vtb.am/

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"ID Bank" cjsc: https://idbank.am/en/

Appendices
Table 1: Descriptive statistics

Variable	Obs.	Mean	Std. dev.	Min	Max
NPL_ratio	352	0.0300416	0.0337766	0.0007213	0.2782435
Z_index	352	1.144105	1.257342	-2.789906	5.300017
HHI_Loan	352	836.3191	108.5584	705.8884	1011.717
HHI_Deposit	352	907.2374	143.7743	742.3092	1278.46
Branch_number	352	22.59943	22.65073	0	101
LogA	352	7.888015	0.5438686	6.598883	9.039964
LtoA	352	0.5397271	0.1408694	0.0787426	0.80848
EtoA	352	0.2322395	0.1358721	0.0274806	0.8164757
Bank_ROA	352	0.0162186	0.0281386	-0.2682	0.1829
Ref_rate	352	0.0646128	0.0152993	0.0375	0.0978

Table 2: Variable definitions

Variable name	Definition	Analysis
Independent variables:		
HHI_Loan	Country level indicator of bank concentration in loan market	Higher value means higher concentration
HHI_Deposit	Country level indicator of bank concentration in deposit market	Higher value means higher concentration
Dependent variables:		
NPLratio	Bank level ratio of non-performing loans to total loans	Proxy for bank stability: Higher value means higher risk in loan portfolio
Z_index	$Z_{it} = (ROA_{it} + CAR_{it)/}SD(ROA)_i$ *i-individual bank, t-year*	Proxy for bank stability: Higher value means higher bank stability and less overall bank risk
Control variables:		
Branch_number	Number of branches of individual banks as of year-end during the period studied	
LogA (Lagged)	Log value of Total Assets	To control for Bank size
LtoA (Lagged)	Loan-to-Assets ratio	To control for Asset composition
EtoA (Lagged)	Total Equity to Total Asset ratio	To control for Capital
Bank_ROA (Lagged)	Return on Assets	To control for Profitability
Ref_rate (Lagged)	Central Bank refinancing rate	Macroeconomic indicator

Table 3: Loan market regression results

	Dependent variable	
	NPL ratio	**Z-index**
	R1	**R2**
HHI Loan	.0004***	-.0064**
	(3.14)	(-2.62)
Number of branches	-.0005	-.0156
	(-1.21)	(-1.60)
Log Bank assets (Lagged)	-.0312*	.1320
	(-1.91)	(0.31)
Loan-to-asset ratio (Lagged)	-0437*	.1097
	(-1.99)	(0.16)
Equity-to-asset ratio (Lagged)	-.0844**	N/A
	(-2.14)	
Bank ROA (Lagged)	-0.1650*	N/A
	(-1.75)	
Refinancing rate (Lagged)	-0.4902	23.9114
	(-0.50)	(0.82)
Bank Fixed effects	YES	YES
Year Fixed effects	YES	YES
R-Squared	Within = 0.2761	Within = 0.3300
	Overall = 0.0900	Overall = 0.2003
No of observations	330	330
No of groups	22	22

NOTE. The table reports estimates obtained from panel data regressions. The dependent variables are NPL ratio (Non-performing loans/Total Loans) as proxy for bank's loan portfolio risk, as well as Z-index, inverse indicator of bank fragility; a higher value indicates higher bank stability. Bank Concentration is measured by HHI Loan index; higher values mean higher concentration. Control variables are defined in Table 2. "Lagged" subsequent to a variable name indicates that these variables are lagged by 1 year. Coefficients are listed in the first row, t-statistics based on robust standard errors is reported in the row below in parentheses, and the corresponding significance levels are in the adjacent column.

"Yes" indicates that the set of fixed effects is included.

*** Significant at 1%, ** significant at 5%, * significant at 10%

Table 4: Deposit market regression results

	Dependent variable	
	NPL ratio	**Z-index**
	R1	**R2**
HHI Deposit	-.0004***	.0067**
	-3.14	2.62
Number of branches	-.0005	-.0156
	-1.21	-1.60
Log Bank assets (Lagged)	-.0312*	.1320
	-1.91	0.31
Loan-to-Asset ratio (Lagged)	-.0437*	.1096
	-1.99	0.16
Equity-to-asset ratio (Lagged)	-.0844**	N/A
	-2.14	
Bank ROA (Lagged)	-.1650*	N/A
	-1.75	
Refinancing rate (Lagged)	4.1137**	-55.9560*
	2.69	-1.80
Bank Fixed effects	YES	YES
Year Fixed effects	YES	YES
R-Squared	Within = 0.2761	Within = 0.3300
	Overall = 0.0900	Overall = 0.2003
No of observations	330	330
No of groups	22	22

NOTE. The table reports estimates obtained from panel data regressions. The dependent variables are NPL ratio (Non-performing loans/Total Loans) as proxy for bank's loan portfolio risk, as well as Z-index, inverse indicator of bank fragility; a higher value indicates higher bank stability. Bank Concentration is measured by HHI Deposit index; higher values mean higher concentration. Control variables are defined in Table 2. "Lagged" subsequent to a variable name indicates that these variables are lagged by 1 year. Coefficients are listed in the first row, t-statistics based on robust standard errors is reported in the row below in parentheses, and the corresponding significance levels are in the adjacent column.

"Yes" indicates that the set of fixed effects is included.

*** Significant at 1%, ** significant at 5%, * significant at 10%