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DOES BANKING COMPETITION ENHANCE OR MITIGATE RISK? NEW EVIDENCE FROM OECD COUNTRIES*

Bankacılıkta Rekabet Riski Arttırır mı Yoksa Azaltır mı? OECD Ülkelerinden Yeni Kanıtlar

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Competition,
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JEL Codes:
C50, G21, G32.

Abstract

The primary aim of the study is to question the relationship between competition and risk-taking behavior in banks in recent years, when competition and risks have significantly differentiated, and to provide new evidence. In addition, it is also aimed to question the impact of the level of financial development on the relationship between competition and risk. In this context, the study is the first of its kind in the literature. A comprehensive study was conducted with the data of 6,478 banks operating in OECD (Organization for Economic Co-operation and Development) member countries for the period 2013-2021. Panel data analysis results obtained from the nexus between competition and risk-taking behavior are found to be consistent with the 'Competition-stability' view. The results are also consistent with the 'Non-linear' view, revealing a non-linear relationship between competition and risk-taking behavior, which is formed according to banks' actions by the position they have taken according to the situation of the sector.

Anahtar Kelimeler:
Rekabet,
Risk Alma Davranışı,
Finansal Gelişme,
Bankacılık Sektörü,
Panel Veri Analizi.

JEL Kodları:
C50, G21, G32.

Öz

Çalışmanın temel amacı, rekabet ve riskin önemli ölçüde farklılaştığı son yıllarda bankalarda rekabet ile risk alma davranışı arasındaki ilişkiyi sorgulamak ve yeni kanıtlar sunmaktır. Ayrıca, finansal gelişmişlik düzeyinin rekabet ve risk arasındaki ilişkiye etkisinin sorgulanması da amaçlanmaktadır. Bu bağlamda çalışma literatürde ilk olma özelliği taşımaktadır. OECD (Ekonomik İşbirliği ve Kalkınma Örgütü) üye ülkelerinde faaliyet gösteren 6,478 bankanın 2013-2021 dönemi verileri ile kapsamlı bir çalışma yürütülmüştür. Analiz sonuçlarına göre, rekabet ile risk alma davranışı arasında elde edilen bulgular, 'Rekabet-istikrar' görüşü ile tutarlıdır. Sonuçlar ayrıca 'Doğrusal olmayan' görüş ile de tutarlı olup, bankaların sektörün durumuna göre aldıkları pozisyona göre oluşan rekabet ile risk alma davranışı arasında doğrusal olmayan bir ilişki olduğunu ortaya koymaktadır.

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1. Introduction

Discussions about whether competition harms the banking system due to the increases it causes in the banks' risk propensity and fragility began after the Great Depression of the 1930s. Competition was limited to maintain stability after the crisis. After the 1970s, the liberalization and deregulation processes resulted in heightened competition in the banking sector from both inside and outside the sector, especially from non-bank financial intermediaries, market-based finance, and new competitors emerging as fintech companies (Carletti, 2008; Akande et al., 2018). To survive in this competitive environment, banks engaged in risky behavior, which caused many of them to go bankrupt in the 1980s and 1990s. Excessive competition and inadequate regulation during the 80s and 90s can be regarded as the main causes of these failures. The 2007-2009 global financial crisis raised concerns about competition policy and regulatory deficiencies, so post-crisis regulatory reforms were implemented in various countries to ensure stability in the banking sector (Danisman and Demirel, 2019). Since it contributes to increased efficiency in the production of financial services, enhanced quality of financial products, and a higher level of financial innovation, competition is a crucial element for the banking sector (Claessens and Laeven, 2004). Maintaining a competitive banking environment without jeopardizing the stability of the system is challenging (Akande et al., 2018). As in many crisis periods, banks may exhibit fragile structures and tend to take high risks. Banks play an important role as liquidity providers to depositors, intermediate between firms and borrowers, and utilize maturity transformation in asset-liability management. However, this also makes them vulnerable to sudden outflows and systemic crises. (Carletti, 2008). Although the nature of the banking system has played an important role in both academic and policy debates, the effects of competition on the stability of the system have not yet been fully appreciated. For a long time, the desirability of competition in the banking sector has been questioned.

Banks' risk-taking behavior has been a focus of public opinion and academic literature since the financial crisis of 2007-2008. To reduce excessive risk-taking and stabilize the banking system, regulators and researchers have implemented various sanctions and requirements on banks. The risk and competition relationship is more complex in the banking market because decreasing interest rates due to competition can impact bank risk in different ways through multiple channels (Hao and Zheng, 2021). Risk-taking behavior may stem from banks' competitive behavior or their market power. In this case, banks may engage in activities that promise higher returns in order to compensate for capital losses or to maintain and increase capital buffers. Moreover, banks' increased risk-taking may also be driven by their reluctance to provide liquidity to fragile competitors and to encourage interbank co-operation and assistance (Badarau and Lapteacru, 2020). Increased competition limits the amount of information available to banks, which increases the risk of credit default.

The banking literature has extensively discussed how competition affects stability, and three main views have emerged. Most of the existing studies in the literature advocate the competition-fragility view, which states that increased competition puts great pressure on profits, reduces the capital-oriented estimated value of banks, and increases risky behavior. On the other hand, a smaller body of recent research supports the competition-stability view, stating that competition reduces the risks of lending due to lower lending rates, resulting in a more stable banking sector. Recent studies, on the other hand, reveal a non-linear relationship between competition and bank risk. According to advocates of this view, increased competition may increase or decrease the riskiness of banks, depending on the market situation (Mia, 2018;

Danisman and Demirel, 2019). In general, the impact of different practices on bank stability is quite unclear and needs to be brought to light.

The primary aim of this study is to provide new evidence on this relationship using a number of data sets. This study intends to compare the risk of competition in the banking markets of OECD member countries for banks according to the development levels of the countries. Panel data analysis, which is a growingly popular method of longitudinal data analysis among researchers in the social and behavioral sciences, is employed in this study. A comprehensive study was conducted with the data of 6,478 banks operating in OECD member countries for the period 2013-2021. In addition, as the motivation of the study, it is considered whether the level of financial development has an effect on the risk, and a different perspective is used as an indicator of competition, in addition to the market competition measure, with the diversification provided in the financial statements. In this context, it is thought that it will contribute to the literature of the countries in question, as it is the first of its kind in the literature. Therefore, it is believed that the study findings will be useful for researchers, regulatory institutions, and managers.

The rest of this paper is structured in the following way: Section 2 reviews the previous studies. Section 3 presents the data, methodology, variables, descriptive statistics, hypotheses, and models. Section 4 presents the empirical findings and robustness checks. Finally, Section 5 concludes the paper.

2. Literature Review

The competition-fragility view, pioneered by Marcus (1984) and Keeley (1990), is also known as the franchise value paradigm, and the main argument of this view is that high bank competition increases banks' incentives to take risks. Marcus (1984) argues that greater competition causes a decline in the capital-focused estimated value of banks, which in turn pushes them to adopt riskier strategies. Keeley (1990) found that the decrease in capital-focused estimated value leads banks to take more risks using the choice model (Saif-Alyousfi et al., 2020). According to this view, competition reduces banks' profits and customer base, and therefore, banks undertake riskier projects to increase returns to shareholders. Therefore, there is an inverse relationship between competition and stability, meaning that a positive relationship exists between bank risk and competition (Maji and Hazarika, 2018). According to the competition-fragility view, high levels of competition in the banking sector may increase financial instability and bank fragility, implying a positive relationship between bank competition and risk-taking (Keeley, 1990; Hellmann et al., 2000; Allen and Gale, 2004). In a banking sector where competition is high, bank managers may have a motivation to undertake high-risk operations in search of rapid, large profits to achieve profit targets. This may lead them to build a riskier asset portfolio, which may result in bankruptcy in the event of financial distress (Cuestas et al., 2020). Specifically, the view assumes that the decline in banks' profits as they lose market share during competition provides an incentive to invest in high-risk portfolios to regain lost margins (Akande et al., 2018). In addition, Beck et al. (2013); Fu et al. (2014); Kasman and Kasman (2015); Kabir and Worthington (2017); Berger et al. (2017); Leroy and Lucotte (2017); Albaity et al. (2019); Danisman and Demirel (2019); Phan et al. (2019); Li (2019); Louhichi et al. (2019); Bahri and Hamza (2020); Gupta and Moudud-Ul-Huq (2020); Kočišová (2020); Nguyen and Tran (2020); Rakshit and Bardhan (2020); Saif-Alyousfi

et al. (2020); Tongurai and Vithessonthi (2020); Feghali et al. (2021); López-Penabad et al. (2021); Zoghlami and Bouchemia (2021); Nyangu et al. (2022); Abdesslem et al. (2023); Jiang et al. (2023); Khan and Ahmad (2023); Srivastava et al. (2023); Chinoda and Kapingura (2023); Wang et al. (2024); Khan and Akhtar (2024) have found evidence consistent with the competition-fragility view.

The second view, the competition-stability view, advocates a more competitive banking market because in a weak competitive environment, banks are encouraged to increase interest rates and therefore provide riskier and larger loans (Badarau and Lapteacru, 2020). According to this view, increased market competition reduces the possibility of bank risk, encourages banks to be more prudent, and this reduces banks' risk-taking (Wang et al., 2024). In addition, increased competition in the banking sector led to actions reducing the risk of loan default, like financing of safer projects with lower interest rates. Therefore, this view asserts that competition and bank risk are inversely proportional (Maji and Hazarika, 2018). The competition-stability view put forward by Boyd and De Nicolo (2005) argues that there is a positive relationship between competition and stability. They posit that reduced competition leads to higher interest rates on loans, which in turn increases the risk of default due to the moral hazard of borrowers. In this case, banks have to cope with increasing non-performing loans (Kasman and Kasman, 2015). According to the proponents of this view, high competition in the banking sector reduces interest rates, and loan servicing becomes easier for borrowers. As a result, this paves the way for a decline in default risk and bank stability (Gupta and Istiaque, 2023). Boyd and De Nicolo (2005) argue that when competition decreases, banks cannot extract higher rents by charging higher interest rates, which in turn causes borrowers to bear the cost of taking on more risks. This effect can be amplified by moral hazard among borrowers, thus increasing the likelihood of banks defaulting. In such a case, assuming that banks solve an optimal capital-oriented problem, the balance between competition and risk-taking no longer exists. In other words, banks function not only as agents for depositors but also as principals towards their borrowers. As a result, they revealed that there exists a negative relationship between risk-taking behavior and competition (Anginer et al., 2012; Bahri and Hamza, 2020). In addition, many studies, such as Fiordelisi and Mare (2014); Kasman and Carvallo (2014); Tabak et al. (2015); Soedarmono and Tarazi (2016); Goetz (2018); Maji and Hazarika (2018); Noman et al. (2018); Hassan et al. (2021); Li (2021); Moudud-Ul-Huq et al. (2022); Wahinya et al. (2023); Verma and Chakarwarty (2024), have found evidence consistent with the competition-stability view.

As a third view on this issue, some academics (Martinez-Miera and Repullo, 2010; Tabak et al., 2012; Borauzima and Muller, 2023) argue that market competition and bank risk may show a non-linear relationship under the combined effect of risk transfer effect and marginal benefit effects (Wang et al., 2024). Contrary to previous studies, Martinez-Miera and Repullo (2010) reveal that in practice, there may be two distinct effects. The authors argue that there is a non-linear relationship between competition and the risk of bank failure, where the bank's credit risk initially decreases but then begins to rise in an excessively competitive market. According to this view, on the one hand, increased competition reduces the probability of credit default, while on the other hand, it also reduces interest payments arising from problem loans, which act as a buffer to cover credit losses. Advocates of this view argue that more competition in concentrated markets reduces bank risk. Therefore, increase in the bank competition results in an initial decrease followed by an increase after a certain threshold in the probability of default after a certain point (Kasman and Kasman, 2015). In a less competitive market, banks tend to

apply higher interest rates on loans to increase profitability, which may increase the risk of bankruptcy. In a more competitive market, the lower interest rates applied by banks motivate borrowers to invest in less risky projects. Although the income from low interest is low, the safety of lending can cause a more vulnerable banking sector, which results in a non-linear competition and risk association (Saha and Dutta, 2021). High competition can reduce the default rate and improve financial stability by increasing efficiency and lowering the loan interest rates. However, when market concentration is high, competition poses a risk in the banking sector. In addition, intense competition can encourage lending in the market and endanger financial stability. Many studies have found evidence consistent with this view, including Tabak et al. (2012); Jiménez et al. (2013); Gonzalez et al. (2017); Clark et al. (2018); Ahi and Laidroo (2019); Wu et al. (2019); Cuestas et al. (2020); Moudud-Ul-Huq (2020); Albaity et al. (2021); Banyen (2021); Căpraru et al. (2021); Saha and Dutta (2021); El Moussawi and Mansour (2022); Mateev et al. (2022); Borauzima and Muller (2023); Ernaningsih et al. (2024).

What makes our study unique is the Financial Development Index (FDI) obtained from the International Monetary Fund (IMF) as an indicator that allows questioning of the competition-risk relationship in the financial development environment. Financial development refers to the development of the financial sector, encompassing both financial institutions and markets. Financial development strengthens the financial stability of countries and increases access to capital and financial services by strengthening the efficiency of financial markets and financial intermediation.

Financial development is realized by reducing imperfect information, limited enforcement, and transaction costs of financial instruments, financial markets, and financial intermediaries. For example, the establishment of credit registries has led to better information about borrowers and the dissemination of this information, thus contributing to a more efficient allocation of resources and having a positive impact on economic development. Another example is that economies with effective legal and regulatory systems support the development of equity and bond markets, allowing investors to build more diversified portfolios without the efficiency of securities markets (Čihák et al., 2012). Such developments can help increase risk diversification while at the same time accelerating growth by channeling capital towards higher-returning projects.

FDI is an indicator that reflects the efficiency, depth, and access of financial institutions and markets. Financial depth refers to the size and liquidity of financial markets. Financial accessibility refers to the ability of individuals and firms to access financial services. Financial efficiency reflects the capacity of institutions to provide quality and low-cost financial services. In this context, FDI encompasses various financial indicators, including pension fund assets, stock market capitalization, traded stocks, stock market turnover rate, insurance premiums, number of bank branches, private sector loans, and ATMs. Therefore, it is thought that this index better reflects the complex structure of financial development. Data on the FDI were obtained from the IMF (IMF, 2024). The literature evaluates this index in detail and in a multidimensional manner. FDI takes a value between 0 and 1, and as the value approaches 1, the financial development of that country increases (Svirydzenka, 2016; Uzar et al., 2023). Studies in different areas related to financial development (Svirydzenka, 2016; Hamadi and Awdeh, 2020; Abdmoulah, 2021; De Moraes et al., 2021; Abaidoo and Agyapong, 2022; Ajide and Ojeyinka, 2022; Khan, 2022) have increased in the recent period.

3. Data and Methodology

3.1. Dataset

The data set used in the study covers the period 2013-2021. The reason why 2013 is accepted as the beginning is that there is less data loss, and therefore, the number of banks is higher. The reason why the end date is 2021 is that the FDI calculated by the IMF is not calculated after that date. The analysis was conducted with a balanced panel data set by excluding missing data in the period considered. The study consists of 58,302 observations collected annually (T=9) for the period 2013-2021 for 6,478 banks (N=6,478). Since there is no data for Greek banks for the period considered, the analysis was continued with 37 OECD countries. Data specific to banks operating in OECD countries were retrieved from the BankFocus (2024) database created by Bureau Van Dijk. Sector-specific and macroeconomic variables were taken from the OECD (2024), IMF (2024), and World Bank (WB, 2024) databases. Table 1 shows the banks operating in the banking sector of the countries included in the study, grouped according to bank types taken from the BankFocus database.

Table 1. Classification of Banks According to Specialization

Bank Specialization	Number of banks
Commercial bank	4.298
Savings bank	933
Cooperative bank	879
Bank holding company	342
Private banking	26

3.2. Method

Panel data analysis, which is a growingly popular method of longitudinal data analysis among researchers in the social and behavioral sciences, is employed in this study. A panel refers to a cross-section or group of individuals who are studied periodically over a specific period (Yaffee, 2003). Panel data sets are also known as cross-sectional time series data. Observations in panel data consist of at least two dimensions, a cross-sectional dimension, represented by the subscript *i* and a time series dimension represented by the subscript *t* (Seetaram and Petit, 2012). The growth in panel data research has been phenomenal since the article by Balestra and Nerlove (1966). There are at least three factors that have influenced this phenomenal growth: (i) the availability of data, (ii) the increased ability to model the complexity of human behavior compared to a single cross-section or time series data, and (iii) challenging methodology (Hsiao, 2007). The dataset used in this study has both cross-sectional and time-series characteristics. Therefore, panel data analysis was chosen because it allows for the simultaneous modeling of these dynamics.

3.3. Variables

Dependent variables representing risk in the banks included in the study, independent variables representing bank-specific factors and competition, and macroeconomic variables are presented in Table 2, and descriptive statistics of the variables are given in Table 3.

Table 2. Definitions and Sources of Variables

Variable	Definition	Source
Dependent Variables		
Z-SCORE	Bank level stability indicator= (ROA + (Total equity/ Total assets)) / σROA (Return on assets)	Authors' calculations based on BankFocus
NPL	Non-performing loans= Loan loss provision/ Total loans	Authors' calculations based on BankFocus
Independent Variables (Competition Variables)		
CR5	The share of assets of the five largest banks	WB
HHI	Herfindahl-Hirschman Index= 1- (Net-interest income/ Operating revenues)^2 + (Non-interest income/ Operating revenues)^2	Authors' calculations based on BankFocus
Bank's Control Variables		
SIZE	Bank size is the natural logarithm of total assets value	BankFocus
ROE	Return on equity= Net profit/ Total equity	BankFocus
NIM	Net Interest Margin= (Interest income- Interest expense)/ (Total assets)	BankFocus
EA	Equity to total assets	BankFocus
Macroeconomics Variables		
FDI	Financial Development Index	IMF
GDP	Annual GDP growth rate	OECD
IT1	Interaction term	HHI*FDI
IT2	Interaction term	CR5*FDI
DUM	Dummy for Covid-19	1 for 2020-2021 years, 0 for the other years

Descriptive statistics for the variables are presented in Table 3. According to the findings, the variables with the highest mean values are Z-SCORE, $CR5^2$ and SIZE, respectively. While the NIM variable has the highest maximum value, the Z-SCORE variable has the lowest minimum value. The Z-SCORE variable has the highest standard deviation value, and the HHI^2 variable has the lowest standard deviation value.

Table 3. Descriptive Statistics

Variable	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	Observation
Z-SCORE	98.43	56.39	10400.80	-2.68	225.85	20.88	730.31	58302
NPL	7.66	7.74	18.51	-1.42	3.28	-0.33	3.61	58302
HHI	0.30	0.30	0.50	0.00	0.13	-0.19	2.26	58302
CR5	4.09	4.00	4.60	3.80	0.22	0.91	2.26	58302
SIZE	13.28	12.91	22.04	6.09	2.03	0.97	4.48	58302
ROE	8.01	7.38	898.58	-2.11	11.38	30.95	1969.77	58302
NIM	3.27	2.97	11383.00	-0.24	47.19	240.48	57986.13	58302
EA	11.46	10.29	99.98	-0.62	7.94	7.49	73.21	58302
GDP	4.01	4.05	4.92	2.58	0.22	-2.45	11.81	58302
FDI	0.85	0.91	0.98	0.19	0.12	-2.51	9.97	58302
HHI^2	0.11	0.09	1.36	0.00	0.07	0.44	2.85	58302
$CR5^2$	16.80	16.05	21.20	14.44	1.89	0.94	2.32	58302
IT1	0.25	0.26	0.48	0.00	0.10	-0.22	2.72	58302
IT2	3.48	3.59	4.34	0.90	0.42	-3.03	15.23	58302

3.4. Hypothesis and Models

The hypotheses put forward in the study are as follows:

H_1: Competition has a linear effect on risk.

H_2: Competition has a non-linear effect on risk.

H_3: There is an effect of FDI level on the effect of competition on risk.

The general model estimated for the linear relationship between risk-taking behavior and competition is established as follows:

$$Risk_{it} = \beta_0 + \beta_1 competition_{it} + \beta_2 bankcontrol_{it} + \beta_3 macrocontrol_{it} + \varepsilon_{i,t} \quad (1)$$

The general model estimated for the nonlinear relationship between competition and risk-taking behavior is established as follows:

$$Risk_{it} = \beta_0 + \beta_1 competition_{it} + \beta_2 competition^2_{it} + \beta_3 bankcontrol_{it} + \beta_4 macrocontrol_{it} + \varepsilon_{i,t} \quad (2)$$

The general model estimating the effect of the level of financial development for the linear relationship between competition and risk-taking behavior is established as follows:

$$Risk_{it} = \beta_0 + \beta_1 competition_{it} + \beta_2 (competition_{it} * dFDI_{it}) + \beta_3 bankcontrol_{it} + \beta_4 macrocontrol_{it} + \varepsilon_{i,t} \quad (3)$$

i: bank, t: time (annual), $ß_0$: constant term, ε_{it}: error term

The models created as a result of the correlation matrix of the variables are as follows.

Model 1: $Z - SCORE = f(SIZE, EA, HHI, DUM)$

Model 2: $Z - SCORE = f(SIZE, EA, HHI, HHI^2, DUM)$

Model 3: $Z - SCORE = f(SIZE, EA, ROE, NIM, GDP, IT1)$

Model 4: $Z - SCORE = f(SIZE, EA, CR5, DUM)$

Model 5: $Z - SCORE = f(SIZE, EA, CR5, CR5^2, DUM)$

Model 6: $Z - SCORE = f(SIZE, EA, ROE, NIM, GDP, IT2)$

Model 7: $NPL = f(SIZE, EA, HHI, DUM)$

Model 8: $NPL = f(SIZE, EA, HHI, HHI^2, DUM)$

Model 9: $NPL = f(SIZE, EA, ROE, NIM, GDP, IT1)$

Model 10: $NPL = f(SIZE, EA, CR5, DUM)$

Model 11: $NPL = f(SIZE, EA, CR5, CR5^2, DUM)$

Model 12: $NPL = f(SIZE, EA, ROE, NIM, GDP, IT2)$

In the study, the CD (Cross-Sectional Dependence) test developed by Pesaran (2004) was applied to the variables to test whether each panel data was independent of the cross-section. Referring to the associated probability values, the null hypothesis regarding independent cross-sections for the analyzed panel data was rejected in favor of the dependent cross-section alternative. Since T<15 was found in the study, the unit root test was not performed (Pesaran, 2012). The selection phase of the appropriate models was started for the theoretical models created through the Pearson correlation matrix. First of all, the F-test was used to decide whether it was a pooled effect model or a fixed effect model. Since the F-test results were below 0.01, H_0 was rejected, and the fixed effect model was decided. The Hausman test was applied

for the selection of the fixed effect model and random effect model, and as a result of the test, the H_0 hypothesis was rejected, and the fixed effect model was selected.

The validity of the diagnostic assumptions of the models was investigated. The problem of heteroscedasticity in the fixed effects model was investigated with the modified Wald test. Since the probability values and significance value were less than 0.01, the H_0 hypothesis was rejected, and it was concluded that there was heteroscedasticity. The problem of autocorrelation in the fixed effects model was investigated with the Locally Best Invariant (LBI) test proposed by Baltagi-Wu (1999), which is widely used in panel data models, and the modified Durbin Watson (DW) test of Bhargava et al. (1982). Since the test results in question were below the acceptable value of 2, there was an autocorrelation problem in the model (Kögel, 2004). The test results indicated that both autocorrelation and heteroscedasticity problems were present in all models. For the model results to be reliable, it is necessary to work with estimators that eliminate these problems. For this purpose, the Driscoll and Kraay estimator is used as an effective estimator in the presence of heteroscedasticity and autocorrelation in the fixed effects model that considers the cross-sectional dependence of the variables previously made (Hoechle, 2007). The analysis was continued with the Fixed Effects Driscoll and Kraay estimator, and the models were reported.

4. Empirical Results

Table 4 consists of the Driscoll-Kraay estimation results of the models that examine the relationship between the dependent variable Z-SCORE, which is the measure of risk-taking behavior, and the explanatory variables. According to the F-test results, all models were significant. According to Table 4, HHI is considered as the competition variable in Model 1, Model 2, and Model 3; CR5 variable is considered as the competition variable in Model 4, Model 5, and Model 6.

According to Model 1, examining the linear effect of competition on risk-taking behavior, a statistically positive and significant relationship was found at a 1% significance level between the diversification-induced competitiveness measured by the HHI variable and the risk-taking behavior measured by the Z-SCORE in the period 2013-2021. This finding generally indicates that the competitiveness of the bank increases with service diversification, thus strengthening its market dominance and reducing the risk of bankruptcy. Service diversification indicates that banks rely not only on interest income but also on fee and commission income and other various sources. Since the bank has a more diversified and risk-manageable financial structure, it can access more resources and power, which can increase financial solidity. In other words, it can be said that banks are more resilient to financial shocks thanks to their various sources of income, and in this case, their bankruptcy risks decrease. Therefore, in this case, an increase in the Z-SCORE may indicate that the bank manages the risk related to its financial activities better and has a more solid financial structure. An increase in the HHI may indicate that the bank operates more effectively and efficiently. A bank with a diversified service range and financial structure generally indicates more customers and more revenue. In this case, a higher Z-SCORE may indicate that the bank is managing its operations more effectively and its financial performance is improving. This finding is in line with the "Competition-stability" view of Boyd and De Nicolo (2005) and is consistent with the studies of Fiordelisi and Mare (2014); Kasman and Carvallo (2014); Goetz (2018); Maji and Hazarika (2018); Noman et al. (2018); Hassan et al.

(2021); El Moussawi and Mansour (2022); Moudud-Ul-Huq et al. (2022); Wahinya et al. (2023); Khan and Akhtar (2024). In the same period, a statistically significant and positive relationship was found between EA and Z-SCORE at the 1% significance level. The increase in the equity of banks in their total assets increases their financial strength, which may encourage banks' risk-taking behavior. This finding is consistent with the studies of Moudud-Ul-Huq (2020); Nyangu et al. (2022). It was also observed that there was no statistically significant relationship between SIZE and Z-SCORE and DUM and Z-SCORE in the period in question. According to this result, banks' management policies and strategies may determine the effect of asset size on risk-taking behavior. It may be thought that large banks may limit their risk-taking behavior by implementing more comprehensive risk management policies and stricter audit procedures. However, the pandemic process may have led banks to adopt a more stable and conservative approach instead of changing their risk-taking behavior. Banks may be more careful when faced with economic uncertainties and risks. In many countries, regulators have taken various measures to support the banking sector during the COVID-19 pandemic. The seriousness of these measures in the OECD member countries- their application to the entire market- may have minimized the possibility of banks going bankrupt. This finding is consistent with the studies of Hussain and Bashir (2020); Noman et al. (2021).

Table 4. Results of Driscoll-Kraay Fixed Effects Standard Error Estimator (Z-SCORE)

Z-SCORE	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
SIZE	3.415	3.368	-6.311**	2.743	3.751	-6.062**
	(2.142)	(2.087)	(2.753)	(2.647)	(2.025)	(2.483)
EA	3.293***	3.282***	2.922***	3.250***	3.281***	2.946***
	(0.254)	(0.257)	(0.252)	(0.219)	(0.243)	(0.260)
HHI	22.613***	-17.685***				
	(5.157)	(5.632)				
HHI^2		74.293***				
		(11.100)				
CR5				11.316*	-625.729***	
				(5.993)	(223.950)	
$CR5^2$					79.152***	
					(28.517)	
ROE			-0.026			-0.022
			(0.031)			(0.029)
NIM			0.000***			0.000***
			(0.000)			(0.000)
GDP			38.056***			38.427**
			(14.127)			(16.903)
IT1			13.416**			
			(4.342)			
IT2						20.528***
						(5.437)
DUM	-0.430	-0.598		0.215	-0.837	
	(2.138)	(2.096)		(2.283)	(2.004)	
Constant term	8.481	13.365	-7.160	-21.641	1242.218***	62.767**
	(23.780)	(22.701)	(22.456)	(22.775)	(448.272)	(25.111)
R^2	0.0620	0.0635	0.0737	0.0605	0.0639	0.0781
F-Test	213.14***	170.65***	23940.63***	440.76***	580.96***	513.67***
Prob (F)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observation	58.302	58.302	58.302	58.302	58.302	58.302

Note: (*) indicates that the relevant coefficient is statistically significant at 1%, (**) at 5%, (***) at 10%; values in parentheses indicate standard errors.

Following Martinez-Miera and Repullo (2010), the nonlinear effect of competition on risk-taking behavior was examined by adding the square of the competition measure (HHI^2) to Model 2. A nonlinear relationship was found between competition and risk-taking behavior at the 1% significance level. In other words, both the competition-fragility and competition-stability views can be applied simultaneously to banks in OECD countries. On one hand, increasing competition in countries with a high level of competition, in terms of income diversification, may increase the probability of risk. On the other hand, low competition levels may be beneficial in terms of efficiency. Increased competition may increase risk-taking behavior. However, when the competition reaches very high levels, risk-taking behavior may decrease or be balanced. The nonlinear relationship can be interpreted as an indicator that banks are trying to manage their risks in a balanced manner in a competitive environment. With increasing competition, banks may be encouraged to take more risks, but in cases where competition is extremely high, banks may tend to take fewer risks to balance their risks more carefully. This result may suggest that a certain level of competition enables banks to reach the optimal risk-taking level. Increased competition up to a certain point may allow banks to take more risks, but beyond this point, excessive competition may limit or reduce risk-taking behavior. The findings are consistent with the studies of Tabak et al. (2012); Jeon and Lim (2013); Fu et al. (2014); González et al. (2017); Gupta and Moudud-Ul-Huq (2020); Moudud-Ul-Huq (2020); Albaity et al. (2021); Banyen (2021); Mateev et al. (2022); Gupta and Istiaque (2023); Ernaningsih et al. (2024). In this model, as in Model 1, asset size and the pandemic process did not have a statistically significant effect on risk-taking behavior, and a statistically significant and positive relationship was found between the Equity/Total Assets (EA) ratio and risk-taking behavior at the 1% significance level.

In Model 3, where the interaction term between competition and financial development, IT1 (HHI*FDI), was included, and the effect of the level of financial development on the effect of competition on risk was examined, a statistically positive and significant relationship was found at the 5% significance level. This may indicate that as the level of financial development increases, banks can perform better in a more competitive environment with a higher level of financial stability and increase their risk-taking behavior. In an environment where financial development is high, a competitive environment can encourage banks to operate on more solid foundations. Encouraging competition and supporting financial development means that banks have a more solid financial stability, which may mean that banks can more easily take risks in such an environment and increase their profits and performance. A statistically significant and negative relationship was found between SIZE and Z-SCORE at the 5% significance level. This finding may suggest that small-scale banks have a more solid financial structure compared to large-scale banks and that the risk-taking behavior of small-scale banks is more balanced and sustainable. Smaller banks may generally have less complex and better-controllable risks. This may also suggest that smaller banks can implement risk management and auditing processes more effectively and control financial risks better. This finding is consistent with the study of Miklaszewska et al. (2021). A statistically significant and positive relationship was found between NIM and Z-SCORE at the 1% significance level. In other words, as the net interest margin increases, banks become more stable and less risky in terms of bankruptcy, and thus their risk-taking behavior increases. A bank can increase its net interest margin by applying higher lending rates, but this usually requires taking higher risks.

Riskier loans usually provide higher returns, but they also have a higher risk of default. Therefore, banks can invest in riskier assets to have a higher net interest margin. However, this can increase the bank's overall risk level and bring with it the risk of possible losses. Therefore, banks generally adopt a balanced approach between net interest margin and risk-taking. A balance needs to be established between optimizing the net interest margin to achieve better returns without increasing risks and managing risks to achieve a higher interest margin. An increase in net interest margin indicates that banks' income is increasing. A higher net interest margin generally means higher profitability. In this case, banks' higher profitability can increase their financial stability and reduce the risk of bankruptcy. An increase in net interest margin generally indicates that banks are implementing their risk management strategies effectively. A higher net interest margin generally reflects more robust lending and portfolio management policies. This can increase the financial soundness of banks. An increase in net interest margin usually indicates that market conditions are changing in favor of banks. For example, an increase in interest rates can increase banks' net interest margins. In this case, the change in the market conditions in favor of banks may increase their financial stability. In addition, a statistically significant and positive relationship was found between GDP and Z-SCORE at the 1% significance level. This finding asserts that economic growth has a positive effect on banks in general. Economic growth increases the income of enterprises and employment, and strengthens the financial system in general. This could result in a decline in the risky asset holdings of banks in their loan portfolios and contribute to the reduction of the bankruptcy risk and increase in the banks' risk appetite. In addition, economic growth may increase banks' income and reduce their operational risks. The findings are consistent with the studies of Moudud-Ul-Huq (2020); Noman et al. (2021); Li (2021); Miklaszewska et al. (2021). In this model, a statistically significant and positive relationship was found between EA and Z-SCORE at the 1% significance level. It was observed that there was no statistically significant relationship between ROE and Z-SCORE. Accordingly, banks' ROE levels and risk-taking strategies may differ. Some banks may be more inclined to take risks to achieve higher ROE, while others may adopt a more conservative approach.

According to Model 4, investigating the linear effect of competition on risk-taking behavior, a statistically significant and positive relationship was found between the competition measured with the CR5 variable and the risk-taking behavior measured with the Z-SCORE in the period 2013-2021 at a significance level of 10%. In other words, as CR5 increases, the Z-SCORE increases, which is the same finding for the competition measured with the HHI variable and is consistent with the study of Nyangu et al. (2022). The results in Model 1 are valid for the SIZE, EA, and DUM variables.

The square of the competition measure ($CR5^2$) was added to Model 5, which examines the nonlinear effect of competition on risk-taking behavior, and a nonlinear relationship was found between competition and risk-taking behavior at a significance level of 1%. This result is in line with the finding examined with the competition measure HHI in Model 2. The results in Model 2 are also valid for the SIZE, EA, and DUM variables.

In Model 6, where the financial development level's impact on the effect of competition on risk is examined by including the interaction term IT2 (CR5*FDI) between competition and financial development, a statistically positive and significant relationship is found at the 1% significance level, as in Model 3, where the interaction term IT1 (HHI*FDI) is examined. In addition, the results in Model 3 are valid for the variables SIZE, EA, ROE, NIM, and GDP.

4.1. Robustness Checks

We perform a robustness check of the model by changing the proxies of the variables. To check the robustness of the model, we replace the risk proxies Z-SCORE with NPL. NPL is a direct measure of credit risk, whereas Z-SCORE is an inverse proxy of credit risk and a direct measure of stability risk. Table 5 presents the robustness check of Table 4 in terms of risk.

Table 5. Results of Driscoll-Kraay Fixed Effects Standard Error Estimator (NPL)

NPL	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
SIZE	0.397***	0.397***	0.740***	0.444***	0.455***	0.744***
	(0.088)	(0.088)	(0.029)	(0.074)	(0.082)	(0.032)
EA	-0.018*	-0.018*	0.004	-0.015*	-0.015*	0.005
	(0.010)	(0.010)	(0.006)	(0.008)	(0.088)	(0.006)
HHI	0.014	0.575***				
	(0.127)	(0.195)				
HHI^2		-1.034***				
		(0.284)				
CR5				-1.276	-7.872	
				(0.721)	(7.400)	
$CR5^2$					0.819	
					(0.865)	
ROE			-0.011***			-0.011***
			(0.002)			(0.002)
NIM			0.000*			0.000*
			(0.000)			(0.000)
GDP			-2.847***			-2.845***
			(0.305)			(0.301)
IT1			-0.006			
			(0.205)			
IT2						-0.247
						(0.223)
DUM	-0.370***	-0.367***		-0.404***	-0.415***	
	(0.120)	(0.120)		(0.129)	(0.140)	
Constant term	2.677**	2.609**	9.287***	7.249	20.335	10.093***
	(1.274)	(1.278)	(1.042)	(3.011)	(15.297)	(1.131)
R^2	0.0125	0.0127	0.0312	0.0159	0.0160	0.0314
F-Test	90.15***	71.46***	298.60***	63.63***	51.53***	0.0314***
Prob (F)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observation	58302	58302	58302	58302	58302	58302

Note: (*) indicates that the relevant coefficient is statistically significant at 1%, (**) at 5%, (***) at 10%; values in parentheses indicate standard errors.

According to the F-test results, in Table 5, where all models are significant, there is no statistically significant relationship between risk-taking behavior measured by NPL and competition measured by the HHI variable. In all models where a robustness check is performed (Table 5), a statistically significant and positive relationship is found between SIZE and NPL. As the asset sizes of banks increase, they generally can provide more credit and financial services. In this case, a larger portfolio and a wider customer base may mean that banks can take more risks. Large banks usually set more aggressive growth targets. A larger asset size usually means higher profitability potential, which may mean that banks can take more risks. Competition between banks generally encourages them to increase their asset sizes. Larger banks may be inclined to take more risks to maintain or expand their market share. A

statistically significant and negative relationship is found between EA and NPL in all models except for the two models that only include FDI (Model 9 and Model 12). This finding is consistent with the models, including Z-SCORE. Although there is no statistically significant relationship between DUM and Z-SCORE in the models including Z-SCORE, there is a statistically significant and negative relationship between DUM and NPL. Economic uncertainty and volatility increased during the pandemic period. Banks may have adopted a more cautious approach to cope with these uncertainties. Investing in fewer unknown risky assets indicates a decrease in the tendency to take risks. Many businesses and individuals faced economic difficulties during the pandemic period. Banks can more carefully evaluate the situation of customers who may increase their credit risk and apply stricter credit policies. Regulators and supervisors may increase the requirements of banks regarding risk management and capital protection during the pandemic period. This may reduce the tendency of banks to take risks because they have to comply with stricter regulations. There was a general decrease in economic activity during the pandemic period, and customer demand decreased. Banks may invest in less risky assets as demand decreases. Monetary and prudential policies may have prevented excessive credit growth and limited bank risk-taking. In addition, ensuring effective supervision and regulation of banks can help create a legal environment that facilitates the resolution of non-performing loans. The square of the competition measure (HHI^2) was added to Model 8, which examines the non-linear effect of competition on risk-taking behavior. In this case, a non-linear relationship was found between competition and risk-taking behavior. This gives the same result as the findings with Z-SCORE. No statistically significant relationship was found in Model 9, where the interaction term between competition and financial development, IT1 (HHI*FDI), was included and the effect of the level of financial development on the effect of competition on risk was examined, and in Model 12, where the effect of the level of financial development on the effect of competition on risk was examined by including IT2 (CR5*FDI). However, this result was statistically significant and positive in the models with Z-SCORE. This result may indicate that the level of financial development is not a factor limiting the effect of competition on risk. In other words, the effect of competition on risk may be independent of the level of financial development. The lack of effect of financial development level on the effect of competition on risk may be related to other factors. For example, it may be thought that sectoral regulations or market conditions are more effective in determining the effect of competition on risk. In this case, the level of financial development may be an insignificant factor in determining the effect of competition on risk. While no statistically significant relationship was found between ROE and Z-SCORE, a statistically significant and negative relationship was found between ROE and NPL. In other words, the negative relationship indicates that banks with higher return on equity have lower non-performing loan ratios. This may suggest that banks apply more careful and disciplined risk management when they are more profitable. A higher return on equity generally indicates that banks have a more solid financial structure. This may cause banks to focus on less risky loans and thus reduce their non-performing loan ratios. A high return on equity is generally perceived as a sign of confidence by market participants. This may cause banks to exhibit a more solid financial stance and thus limit their risk-taking behavior. In addition, higher return on equity may indicate that banks are better regulated and supervised, and therefore implement more robust risk management. A statistically significant and negative relationship was found between GDP and NPL; this result is consistent with the models including Z-SCORE. A statistically significant and positive relationship was found between NIM and NPL. This result is not

consistent with the models, including Z-SCORE. Namely, the increase in the net interest margins of banks may generally indicate that they tend to take more risks to increase their profitability. In other words, banks may turn to riskier loans in order to earn higher profits. The increase in the net interest margin usually occurs in an environment where interest rates are high. When banks offer higher-risk credit products, they usually charge higher interest rates for these loans. This may lead to an increase in the bank's risk. Higher-risk credit products may provide larger interest margins. For example, high-interest loans may increase the interest income of banks, but they may also increase the risk of loan default. In addition, banks may manage their risks less carefully in order to achieve high profitability targets, which may lead to an increase in non-performing loan ratios. While there is a positive and significant relationship between CR5 and Z-SCORE in Model 4, no statistically significant relationship was found with CR5 in the model with NPL as a risk variable (Model 10). Similarly, there is a significant and linear relationship between $CR5^2$ and Z-SCORE in Model 5, while no statistically significant relationship was found with $CR5^2$ in the model with NPL as a risk variable (Model 11). The results contain similar findings to the study of Jimenez et al. (2007).

5. Conclusion

The relationship between competition and financial stability has been an active topic of discussion in academic and regulatory circles for the past two decades, especially following the financial crisis of 2007–2008. While competition is generally viewed as a beneficial force in most sectors, it has been mostly controversial in the banking sector. Two opposing views have emerged in the literature on the relationship between competition and stability in the banking sector. According to the competition-fragility view, which argues that there is an inverse relationship between bank competition and stability, increased competition among banks reduces banks' profit margins and market power. This would increase banks' propensity to bear more risk. However, according to the competition-stability view, there is a direct correlation between competition and stability. The reasons for this include that bank competition lowers credit default rates and interest rates, reduces moral hazard and adverse selection problems among borrowers. Recently, Martinez-Miera and Repullo (2010) synthesized these two opposing views, arguing that there is a non-linear relationship between competition and stability (Kasman and Kasman, 2015).

The bank-specific data used in the analysis were collected from the BankFocus database created by Bureau Van Dijk. Sectoral and macroeconomic variables were taken from the OECD, IMF, and WB databases. The sample of the study consists of a total of 6,478 banks in OECD member countries, including 4,298 commercial banks, 933 savings banks, 879 cooperative banks, 342 bank holding companies, and 26 private banks. The effect of competition on risk-taking behavior was estimated using panel data econometric tools with annual data of 6,478 banks operating in 2023-2021. The reason why 2013 is accepted as the beginning is that there is less data loss and therefore more banks. The reason why the end date is 2021 is that the FDI calculated by the IMF is not calculated after that date.

A comprehensive literature review was conducted to determine 2 competition variables, 4 bank control variables, 2 macroeconomic variables, and 1 dummy variable that could affect risk-taking behavior. In this study, the fixed effect model suggested by the Hausman test is applied since it is found to be the most appropriate one among the fixed and random effect

models. For the consistency of the results, diagnostic tests were performed to detect the presence of cross-sectional dependence, autocorrelation, and changing variance in the panel data set. However, since there is horizontal cross-section dependence, autocorrelation, and changing variance in the data set, the results obtained from the fixed effects model are estimated using the Driscoll-Kraay estimator. According to the analysis results of the study, the findings obtained between the competition measured with both the market-based competition indicator CR5 variable and the financial statement-based competition indicator HHI variable and the risk-taking behavior measured with the Z-SCORE variable in the 2013-2021 period, where the linear effect of competition on risk-taking behavior was examined, are consistent with the "Competition-stability" view of Boyd and De Nicolo (2005). In other words, increasing competition reduces risk-taking behavior in banks and thus increases stability.

The results are also consistent with the "non-linear" view of Martinez-Miera and Repullo (2010). According to this view, there is a non-linear relationship between competition and risk-taking behavior, and banks act according to the position they have taken according to the situation of the sector. While increasing competition may initially increase risk-taking behavior, it may reduce or balance risk-taking behavior when it reaches very high levels.

In the models examining the effect of FDI level on the effect of competition on risk, a positive relationship was found between the interaction terms IT1 (CR5*FDI) and IT2 (HHI*FDI) and Z-SCORE. In an environment where financial development is high, a competitive environment may encourage banks to operate on a more solid basis. Encouraging competition and supporting financial development means that banks have a more solid financial stability, which may mean that banks can more easily take risks and increase their profits and performance in such an environment. An increase in the level of financial development generally provides banks with access to more financial resources, better technological infrastructure, and a wider customer base. This can enable banks to provide more effective and efficient services. Therefore, the competitive advantages of banks in countries with higher levels of financial development may be more pronounced.

In addition, in all models where Z-SCORE is the dependent variable, both CR5 and HHI variables; it was observed that the pandemic dummy variable (DUM) and return on equity (ROE) variables did not have a significant effect on the risk-taking behavior of competition (Z-SCORE), while the net interest margin (NIM), equity/assets (EA) and gross domestic product (GDP) variables had a positive and significant effect.

On the other hand, in all models where NPL is the dependent variable and both CR5 and HHI variables are present, it is observed that asset size (SIZE) and NIM variables have a positive and significant effect on the risk-taking behavior of competition, while the pandemic DUM, ROE and GDP variables have a negative and significant effect on the risk-taking behavior of competition.

In the findings obtained between the competition measured with both the CR5 variable and the HHI variable and the risk-taking behavior measured with the NPL variable in the 2013-2021 period, where the linear effect of competition on risk-taking behavior is examined, a non-linear relationship between competition and risk is found only between the HHI variable and the NPL variable. Neither a linear nor a non-linear relationship was found in the risk-taking behavior of competition examined with the CR5 variable.

As a result, the relationship between competition and risk-taking behavior in banks will continue to be a subject of discussion in the literature. Competition by its very nature encourages banks to take risks to make more profits, which raises the issue of financial stability for valid reasons. Effective regulatory and supervisory mechanisms need to be developed to monitor and limit risk-taking behavior, which can vary depending on many factors such as banks' size, profitability, sectoral concentration, risk appetite, and more.

No study has been found in the literature examining the role of financial development on the risk-taking behavior of banks in OECD member countries. For this reason, the study is the first of its kind in both national and international literature. The study is of critical importance for understanding how banks perform in a competitive environment, how they maintain their financial stability, and how they shape their risk-taking tendencies. Understanding how the level of financial development plays a key role in these dynamics is crucial for the health of the banking sector and economic growth.

The importance of a strong banking sector for an economy to function effectively makes this issue a topical concern for both academics and policymakers. Accurately analyzing the degree of causality between banking competition and the risk-taking behavior of the banking sector helps institutions take the right measures to increase stability. Therefore, it is thought that the findings of the study will be useful for researchers, supervisory and regulatory authorities, and the sector.

In this context, banks should frequently review their internal audit, internal control, and risk management systems in the face of increasing risk appetite and impose limitations when necessary. Boards of directors and senior managers should adopt long-term sustainable goals instead of short-term profits. Employees' targets and, therefore, their wages should be designed in a way that does not encourage excessive risk-taking. Adequate capital buffers should be maintained even in times of high competition. Banks should regularly monitor the loans they provide with early warning systems, stress tests, and scenario analyses, and take action without delay. New regulations should be taken into consideration for the increased risk appetite with digital banking.

For future studies, it is thought that it will be useful to investigate the impact of competition on risk-taking behavior by grouping such as country, bank type, financial development level, and income level, and to examine whether there are differences in this regard, and to reveal the reasons.

Declaration of Research and Publication Ethics
This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researcher's Contribution Rate Statement
1. Author: Drafting, data collection, data interpretation, literature review, methodology, original draft preparation.
2. Author: Proofreading, and reviewing the manuscript, study concept.
3. Author: Critical revision, theoretical background and incorporation of intellectual content.

Declaration of Researcher's Conflict of Interest
There is no potential conflicts of interest in this study.

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