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Navigating Global Uncertainties: The Financial Soundness of the Turkish Banking Sector in The Post-Reform Era*

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ABSTRACT

The Turkish banking sector experienced structural reforms in the early 2000s, ranging from increasing transparency in the processes to supporting macroeconomic stability, which later enabled it to be less vulnerable to financial turmoil in the subsequent years. Yet, since than many transformations which gave rise to regional or global uncertainties have occurred, and caused destabilizing effects on financial markets. This study aims to reveal how the banking sector reacts to different shocks in global uncertainty factors. Understanding potential risk factors that may affect the banking sector is necessary to maintain financial soundness. In this context, the overall banking sector, deposit banks, and bank groups according to their capital ownership are considered. The global uncertainty factors considered are financial uncertainty, global economic policy uncertainty, trade policy uncertainty, and geopolitical risk. As the financial soundness indicator, the Z-score is considered. The annual data obtained for the period 2002-2023 were analyzed using the nonlinear autoregressive distributed lag approach. The findings indicate that "Global Economic Policy Uncertainty-GEPU" has the strongest negative effect, while" Trade Policy Uncertainty-TPU" has the weakest. The study contributes in the existing literature by investigating the effects of global uncertainties on different bank groups in Türkiye using a nonlinear method.

Keywords: *Financial Markets and Institutions, Turkish Banking Sector, Global Uncertainty Factors, Asymmetric Shocks, NARDL.*

JEL Classification: *G21, G32, E44, C22.*

Küresel Belirsizliklerle Başa Çıkmak: Türk Bankacılık Sektörünün Reform Sonrası Dönemdeki Finansal Sağlamlığı

ÖZET

Türk bankacılık sektörü, 2000'li yılların başında, süreçlerde şeffaflığın artırılmasından makroekonomik istikrarın desteklenmesine kadar uzanan yapısal reformlar geçirmiştir. Bu reformlar, sektörün finansal çalkantılar karşısında daha az savunmasız hale gelmesini sağlamıştır. Bununla beraber, o zamandan bugüne kadar bölgesel veya küresel düzeyde belirsizliklere yol açıp finansal piyasalarda istikrarsızlık yaratan birçok dönüşüm de gerçekleşmiştir. Bu çalışma, bankacılık sisteminin küresel belirsizlik faktörlerinden kaynaklanan farklı şoklara nasıl tepki verdiğini ortaya koymayı amaçlamaktadır. Çünkü, bankacılık sistemini etkileyebilecek potansiyel risk faktörlerini anlamak, finansal sağlamlığı korumak için bir gerekliliktir. Bu bağlamda, araştırmada genel bankacılık sistemi, mevduat bankaları ve sermaye sahipliğine göre banka grupları dikkate alınmıştır. İncelenen küresel belirsizlik faktörleri; finansal belirsizlik, ekonomi politikası belirsizliği, ticaret politikası belirsizliği ve jeopolitik risktir. Finansal sağlamlık göstergesi olarak Z-skoru kullanılmıştır. 2002-2023 dönemi için elde edilen yıllık veriler, "Doğrusal Olmayan Otoregresif Dağıtılmış Gecikme" yaklaşımı ile analiz edilmiştir. Bulgular, en fazla etkiye sahip belirsizlik faktörünün küresel ekonomi politikası belirsizliği, en az etkiye sahip faktörün ise ticaret politikası belirsizliği olduğunu göstermektedir. Çalışma Türkiye'de farklı banka grupları üzerinde küresel belirsizliklerin etkilerini doğrusal olmayan yöntemlerle inceleyerek mevcut literature katkı sağlamaktadır.

Anahtar Kelimeler*: Finansal Piyasa ve Kurumlar, Türk Bankacılık Sektörü, Küresel Belirsizlik Faktörleri, Asimetrik Şoklar, NARDL.*

JEL Sınıflandırması: *G21, G32, E44, C22.*

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1. INTRODUCTION

The Turkish banking sector underwent structural reforms after experiencing challenges in the 90s and early 2000s. During this period, Türkiye also tried to comply with international regulations such as the Basel regulations, although they are advisory for Türkiye.

Among the restructuring reforms implemented were the adoption of a floating exchange rate model, restructuring of the banking sector by the Savings Deposit Insurance Fund (SDIF), ensuring financing balance in public finance, developing public revenue strategies that support the inflation target, and making legal arrangements to ensure that the restructuring process is transparent and effective (Kesebir, 2018: 9). The rationale and necessity of these reforms can be better understood considering the vital importance of the banking sector in the transfer of funds for a developing country like Türkiye. As of September 2023, the Turkish banking sector covers nearly 80% of the entire financial system in terms of asset size. Among the banking sector, deposit banks account for nearly 85% of the sector's assets, with 37% for state-owned, 28% for privately-owned, and 20% for foreign deposit banks (Türkiye Bankalar Birliği, 2024). As of June 2025, there are 67 banks in the Turkish Banking sector, including 38 deposit banks, 20 development and investment banks, and 9 participation banks (Türkiye Bankalar Birliği, 2025).

The importance of the sector for Türkiye becomes even more evident when it is taken into account that deposit banks in particular have functions such as financial intermediation in the economy, ensuring the flow of resources and efficiency in resource utilization, adjusting the maturity and amount of funds, creating bank money, ensuring efficiency in the implementation of monetary policy, and developing international trade (Akgüç, 2012: 27-29).

Indeed, since the Turkish banking sector suffered less from the adverse effects of the global mortgage crisis, it shows how effective the reforms were. Whereas, when the Basel II regulations had just been implemented, many international financial institutions suffered serious losses and even went bankrupt. These cases led to the questioning and reconsideration of the regulations.

Undoubtedly, behind such effects are the globalization trends that accelerated in the 80s with the liberalization of capital movements, increased liberal tendencies, and

developments in communication technologies. Globalization has also had an impact on banks in terms of the structure of funding sources and transactions, the uniformization of the rules to be followed by banks, and the increase in competition and risks. With this process, banks have been exposed to short-term speculative hot money movements, increased exchange rate and interest rate risks, while the country risk factor has also gained importance. These increasing uncertainties, on the other hand, contributed to the fact that fund management became a profit-loss center and banks used hedging techniques more widely (Akgüç, 2012: 39-40). Among financial innovations for hedging purposes, the most important instruments can be said to be financial derivatives. Especially in the early 2000s, credit derivatives and structured financial products were developed for such purposes by global banks and financial institutions to solve credit crunch and liquidity problems in banks (Yıldıran, 2010: 32).

The world is currently undergoing a new transformation process. Social events, such as the Covid-19 pandemic have led to economic, commercial, technological, and social impacts on countries. For example, while this process accelerated digitalization practices, it slowed commercial activities, and countries exhibited more inward-looking policies. While this process was also negatively priced in stock markets, attention in the stock market increased again during the lockdown period. Moreover, the recent political turmoil in many countries that Türkiye has ties with, such as the Russian-Ukrainian War, Syria, Iran, and Palestine issues, may have different effects on financial markets and the economy. So, is the Turkish banking sector resilient to the uncertainties that have emerged during this transformation process?

IMF emphasizes that financial stability is the resilience of financial systems to stress. Banks would be reluctant to finance profitable projects, asset prices deviate excessively from their intrinsic values, and payments may not arrive on time in the periods of financial instability. If instability increases, bank runs, hyperinflation, or a stock market crash can be experienced (World Bank, 2016). Even if there are different views and findings regarding the effect of uncertainties on financial institutions, Baum et al. (2021) states that uncertainty causes prices to be unpredictable and thus an effective fund allocation would not be realized. This outcome stems from the reluctant behavior of managers to bear risks or changes in their risk preferences. Therefore, the availability and efficiency of credit would be affected as well

as the stability of the sector. According to Mishkin and Eakins (2018), bank managers might want to hold more capital to protect the equity holders in more uncertain times. On the other hand, they reduce the amount of bank capital, have more assets compared to equity capital, and thereby increase the return on equity, if they have confidence that loan losses will not occur. Alessandri and Mumtaz (2019) also claims that while uncertainties mostly affect the real economy through financial markets, their impact can vary significantly throughout fluctuations (real business cycle fluctuations) under the influence of balance sheet conditions and asset price volatility. Especially weak balance sheets and financial markets can amplify the transmission mechanism and leave the economy vulnerable in the face of increased economic uncertainty.

Therefore, this study aims to reveal the impact of global uncertainty factors on the financial soundness of the banking sector in Türkiye. The analysis process of the study was conducted for the period 2002-2023 using nonlinear econometric time series approaches. In the context of the research topic, four different global uncertainty factors are considered: financial, economic, geopolitical, and trade uncertainty. The findings of this research are expected to make meaningful contributions to the literature by revealing the level of soundness of the Turkish banking sector against global shocks in the post-reform period.

2. LITERATURE REVIEW

Owing to the increasing uncertainty caused by recent developments worldwide, there has been a rise in studies in the literature on the effects of uncertainty factors on the financial system as well. Although there are studies such as Golkhandan and Mansour (2024), Seçme (2024), Banerjee et al. (2024), Camgöz (2022), and Zanjani and Mehregan (2018), they mostly examine capital markets and report mixed findings. Moreover, the responses of geopolitically fragile economies to risk shocks are much more salient.

Regarding studies focusing on uncertainties and banks in Türkiye, there are few studies as well. However none of these studies consider asymmetrical interaction between global uncertainty factors and bank soundness. For example, Uzuner (2003) found that monetary policy uncertainty has negative effects on return on assets and return on equity ratios of banks in Türkiye. Çalış and Kaya (2021) investigated the effect of world uncertainty

index on selected financial ratios of Turkish banks. They found that there is long run cointegration relationship between the variables. Akyol (2020) searched for risk taking behavior of Turkish banks under political uncertainties, and found that economic policy uncertainty causes risk taking behavior and systemic risks to decrease. Arslantürk Çöllü (2021) investigated bank specific risks such as liquidity risk, credit risk and funding risk on bank soundness which was calculated by z-score. Research findings indicated that risk factors have significant but different effects on bank soundness. Gürsoy and Kılıç (2021) investigated the volatility spillovers of the global economic policy uncertainty to BIST Banking Index besides 5-year CDS spread, and found a two-way strong volatility interaction between the variables. Aytaç Emin (2025) revealed that economic policy uncertainty in USA increases banking sector fragility in Türkiye. Banking sector fragility is calculated using the average of standardized values for bank deposits, the conversion rate to non-performing loans, and banks' foreign liabilities.

There are also various studies on the determinants of financial performance and/or financial soundness. However, few studies have examined the impact of uncertainty factors on bank soundness. Some of these are summarized below.

Aledeimat et al. (2025) analyzed the effect of uncertainty on non-performing loans of banks in the MENA region from 2005 to 2022. They compared 50 conventional and 42 Islamic banks from 13 MENA countries. The methods adopted in the analysis are augmented mean group (AMG) and two-step generalized method of moments (GMM). The uncertainty factors investigated in the analysis are world pandemic uncertainty, US trade policy uncertainty, US sovereign debt risk uncertainty, and oil price uncertainty. In consequence, all the risk factors but US sovereign debt risk uncertainty have negative effects on conventional banks. On the other hand, it is found that all the risk factors but oil price uncertainty have positive effects on Islamic banks.

Ali et al. (2025) investigated the relationship between uncertainty and banking instability from the global perspective. Their sample comprises 773 banks from 34 countries for the period 2000 and 2022. The panel quantile regression analysis findings indicate a negative interaction between the variables. In addition, it was revealed that the smaller banks have relatively lower vulnerability against uncertainty factors.

Dang et al. (2025) studied the effect of economic uncertainty factors and the role of institutional quality on bank profitability for the period 2000 and 2021 by the two-step generalized method of moments approach. They obtained the data from 165 countries, and considered the world uncertainty index, world trade policy uncertainty index, and global economic policy uncertainty index as the uncertainty factors. Bank profitability is considered by return on equity and net interest income. Their findings indicate that both uncertainty factors and institutional quality negatively affect bank profitability.

Mursalov et al. (2025) aimed to reveal the determinants of financial stability, considering the effect of regulatory financial indicators in Ukraine from 2018 to 2024 through multiple regression analysis. They found that financial stability of banks is affected by internal capital structure dynamics.

Bin Kamal et al. (2024) investigated the effect of economic uncertainty on the asset quality of banking sector in Bangladesh in the period of 1990-2018 by the autoregressive distributed lag (ARDL) model. They set forth a positive relationship between non-performing loans and economic uncertainty in the long run.

Luo et al. (2024) aimed to reveal the interaction between economic uncertainty and bank efficiency, comparing Islamic banks and conventional banks for the period 2006 and 2021 by the panel data analysis. The study sample covers 3,980 conventional banks and 1,228 Islamic banks from 14 countries. According to their findings, economic uncertainty enhances bank efficiency.

Zuhroh and Rofik (2024) analyzed the interaction between global economic policy uncertainty and the performance of Islamic banks in Indonesia, Nigeria, and the United Arab Emirates from 2014 to 2022. Financial performance is measured by non-performing financing and return on assets. Conducting a panel autoregressive distributed lag (ARDL) model analysis, they found that while global economic policy uncertainty does not have a statistically significant effect on non-performing financing, it has a negative effect on return on assets in the short run and a positive effect in the long run.

Tran et al. (2022) studied how financial soundness of banks was affected in the Covid-19 period. They considered quarterly data of 1,953 bank in the 2020-2021 period, and used

the Z-score as the indicator of financial soundness. In addition to bank specific financial ratios, macroeconomic indicators such as GDP are considered. Their findings indicate that an increase in Covid-19 cases causes a decrease in financial soundness. It is also found that economic support, stringency, and containment from governments are important in banking risks and stability during the Covid-19 period.

Dunbar (2022) also examined the effect of Covid-19 on the financial soundness of banks in the USA. The study highlighted that the pandemic posed considerable risks to the financial soundness of banks. Monthly and quarterly data for the period January 2009 and July 2020 is considered. The findings reveal that the net hedging factor can set forth the causal relationship between the financial soundness indicators and capital buffer requirement of the Federal Reserve significantly.

Wu et al. (2021) conducted a noteworthy study in which they investigate the impact of economic uncertainty on bank soundness in emerging Asian economies. The findings show that increased economic uncertainty negatively affects banks.

Salina et al. (2021) investigated the determinants of financial soundness of banks in Kazakhstan between 2008 and 2014 using principal component analysis. They emphasize the importance of financial soundness was understood after the financial crisis of 2007/08. Considering 15 different financial ratios, the findings indicate that capital adequacy, return on assets, profitability, asset quality, liquidity, and leverage affect financial soundness. They concluded that these can be utilized as early warning signals regarding the financial health of banks.

Athari (2020) studied the interaction between domestic political risk, global economic policy uncertainty, and bank profitability for the Ukranian banks for the 2005-2015 period. According to the findings, domestic political stability and global economic policy uncertainty have significant positive and negative effects.

As can be seen from the literature focusing on banks, while the effects of uncertainty factors on variables such as bank profitability and non-performing loans are investigated more, factors such as bank soundness or instability are less examined. Furthermore, it was observed that these effects were researched more extensively during the pandemic period. It is

also seen that conventional and Islamic banks were given more consideration in comparative research rather than their ownership structure. However, the most frequently examined factor is found to be economic policy uncertainty, leaving other global uncertainty factors less explored. In addition, regarding the interaction between global uncertainties and bank soundness, no research focusing on Türkiye was found.

On the other hand, neglecting financial soundness in banks which are the key component of the overall financial system may limit understanding of how current uncertainties affect banks and, consequently, the financial system. To fill these gaps this study contributes to the literature in four unique points as stated below:

1. Four different global uncertainty factors were considered ranging from political to financial perspective.

2. Unlike most studies, it focuses on the financial soundness of banks instead of certain profitability measures.

3. The research was conducted specifically on the Turkish banking sector, with a general-to-specific approach by considering their ownership structures.

4. Unlike similar studies, this study adopted methods that sought to reveal the effects of both positive and negative shocks on the financial soundness of banks separately.

3. METHODOLOGY

This study aims to reveal whether the financial soundness level of deposit banks is sensitive to global uncertainty factors following the reform period in the banking sector after the 2000-2001 financial crises in Türkiye. To answer this research question, a general-to-specific perspective was adopted. In other words, the financial soundness of the overall Turkish banking sector (LNZTUM), overall deposit banks (LNZMEVD), state-owned deposit banks (LNZKAMU), privately-owned deposit banks (LNZOZEL), and foreign deposit banks (LNZYAB) are analyzed. The global uncertainty variables taken into account are the CBOE VIX volatility index, the global economic policy uncertainty index, the geopolitical risk index, and the trade policy uncertainty index as the indicators of global financial (LNVIX),

economic (LNGEPU), geopolitical (LNGPR), and trade policy (LNTPU) uncertainties, respectively. The annual series regarding the group of banks are obtained from the databank of Türkiye Bankalar Birliği (TBB - The Banks Association of Türkiye) for the period 2002-2023, which is the longest span of time for which the dataset could be obtained consistently. In order to provide data integrity, observations for 2024 have been excluded from the analysis, as they have not yet been published for all bank groups during the analysis period. This constitutes one of the main limitations of the study. All monthly series of global uncertainty factors, except the VIX data are obtained from matteoiacoviello.com and policyuncertainty.com. Data regarding the VIX index were obtained from tr.investing.com. Annual series of global uncertainty factors were calculated by taking the annual arithmetic averages of the monthly series. All the series in the analysis were transformed into natural logarithms to normalize them by stabilizing variance and reducing skewness, and thereby making the estimations more reliable (Table 1).

Table 1. Variables in the Analysis

Code	Type	Definition	Source
LNVIX	Independent	Chicago Board Options Exchange (CBOE) Volatility Index (VIX)	tr.investing.com
LNGEPU	Independent	Global Economic Policy Uncertainty Index	policyuncertainty.com
LNGPR	Independent	Geopolitical Risk Index	matteoiacoviello.com
LNTPU	Independent	Trade Policy Uncertainty Index	policyuncertainty.com
LNZTUM	Dependent	Financial soundness of overall Turkish Banking sector	Calculated by the author using data from the TBB
LNZMEVD	Dependent	Financial soundness of overall deposit banks	Calculated by the author using data from the TBB
LNZKAMU	Dependent	Financial soundness of state-owned deposit banks	Calculated by the author using data from the TBB
LNZOZEL	Dependent	Financial soundness of privately owned deposit banks	Calculated by the author using data from the TBB
LNZYAB	Dependent	Financial soundness of foreign deposit banks	Calculated by the author using data from the TBB

Unlike profitability-based measures, this study focuses on the financial soundness of the banking sector. Because financial soundness integrates profitability, leverage, and volatility, and therefore, may reflect solvency risk of banks. To measure banks' financial

soundness, the Z-score is used. World Bank defines bank Z-score as the probability of default of a country's banking system. This score compares the buffer of a country's banking system with the volatility of those returns which is estimated by standard deviation (World Bank, 2025). This index is inversely related to the probability of a bank's bankruptcy. A higher Z-score, which is used as a measure of banks' distance from default, indicates that the bank is more robust, stable and less risk-bearing. As shown in Equation (1), the Z-score for unit i at time t can be calculated as the sum of the capital adequacy ratio (CAR) and the return on assets (ROA) divided by the standard deviation of the return on assets (ROA) (Boyd and Runkle, 1993; Boyd et al., 1993; Čihák and Hesse, 2008).

$$Z - score_{i,t} = [ROA_i + CAR_i]_t / [stddeviation(ROA_i)] \quad (1)$$

For equation (1), the CAR and ROA indicators are obtained from the officially reported ratios of bank groups which were published by The Banks Association of Türkiye. Here, ROA was calculated as net income after tax divided by average total assets of last two years for each bank group. The CAR was calculated by dividing the owners' equity to risk-weighted assets.

After calculating the Z-scores, the analysis was conducted in a few steps. First, a logarithmic transformation was performed so as to linearize the series, and then descriptive statistics were examined. In the next step, the level at which the series is stationary was detected. In the third step, the Nonlinear Autoregressive Distributed Lag (NARDL) method is applied to the series. This method is adopted because it can reveal the relationships between series with different unit root levels, allowing for the investigation of asymmetric interactions since it is revealed in the literature that uncertainty factors can have asymmetric effects, so it can detect non-linear relationships, and finally, it can reveal both short-term and long-term effects separately.

The NARDL approach is a convenient method for revealing the effects of positive and negative shocks separately. That is to say, it presents whether bank groups react differently when uncertainty increases and decreases. In the last step, the assumptions for the models were tested. In the NARDL method, as in the ARDL bounds test approach, the stationarity levels of the variables should not be I(2) and should only be I(0) or I(1) (Durgun Kaygısız,

2022: 632-633). The final representation of the nonlinear ARDL (p,q) model developed by Shin et al. (2013) can be expressed as in equation (2).

$$y_t = \sum_{j=1}^{p} \phi_j y_{t-j} + \sum_{j=0}^{q} (\theta_j^{+\prime} x_{t-j}^{+} + \theta_j^{-\prime} x_{t-j}^{-}) + \varepsilon_t, \quad (2)$$

Here, x_t, represents a multivariable k x 1 vector which is defined as $x_t = x_0 + x_t^+ + x_t^-$. ϕ_j, indicates the autoregressive parameter. θ_j^+ and θ_j^- indicate asymmetrically distributed lagged parameters, and finally ε_t represents an independent and uniformly distributed process having zero mean and constant variance (σ_ε^2). Thus, within the scope of the NARDL model and the research questions of the study, the null hypothesis for the uncertainty factor related to the financial soundness of each bank group is designed as follows:

H_0: Asymmetric shocks of the selected uncertainty factor (x) have no statistically significant effect on the financial soundness (y) of the relevant bank group.

4. FINDINGS

The descriptive statistics regarding the variables are presented in Table 2. For bank groups, the mean and median values are found to be close to each other. Therefore, it can be inferred that the distribution of the series is rather symmetrical. Among the bank groups according to their capital ownership, the financial soundness is the highest in the publicly owned banks (3.494853) on average, while it is the lowest for the private capital banks (3.115285). However, the standard deviation is the highest for the public capital banks (0.416373), indicating that these bank groups have more volatile values in terms of financial soundness. Regarding the global uncertainty factors, the highest mean value is calculated for LNGEPU (4.905956). This is followed by LNGPR (4.623548), LNTPU (3.708095), and LNVIX (2.935669). Hence, it is seen that global economic policy uncertainty and geopolitical risk are the highest risk factors compared to other risk factors included during the analysis period. The Jarque-Bera normality test statistics indicate that all series except LNZKAMU, LNZYAB, and LNTPU are normally distributed.

Table 2. Descriptive Statistics

	LNZTUM	**LNZMEVD**	**LNZKAMU**	**LNZOZEL**	**LNZYAB**
Mean	3.561894	3.490651	3.494853	3.115285	3.201054
Median	3.503428	3.447590	3.288244	3.100805	3.164265
Maximum	4.015461	3.906680	4.500026	3.458138	3.830822
Minimum	3.332094	3.269243	3.148725	2.887748	2.945171
Std. Dev.	0.184832	0.168558	0.416373	0.157405	0.226485
Skewness	0.917092	0.880140	1.348756	0.479038	1.494546
Kurtosis	3.272858	3.320316	3.358579	2.407796	4.589773
Jarque-Bera	3.152124	2.934423	6.788056	1.162895	10.50688
Probability	0.206788	0.230568	0.033573	0.559088	0.005230
Sum	78.36166	76.79432	76.88677	68.53628	70.42318
Sum Sq. Dev.	0.717419	0.596650	3.640692	0.520303	1.077203
Obs.	22	22	22	22	22
	LNVIX	**LNGEPU**	**LNGPR**	**LNTPU**	
Mean	2.935669	4.905956	4.623548	3.708095	
Median	2.870393	4.866876	4.591231	3.423799	
Maximum	3.459257	5.732585	5.172196	5.132304	
Minimum	2.402053	4.149007	4.347614	3.160124	
Std. Dev.	0.310392	0.449422	0.233794	0.574379	
Skewness	0.248474	-0.013188	1.006059	1.275723	
Kurtosis	1.994528	2.167874	3.049090	3.642880	
Jarque-Bera	1.153103	0.635368	3.713443	6.346242	
Probability	0.561832	0.727833	0.156184	0.041873	
Sum	64.58471	107.9310	101.7181	81.57810	
Sum Sq. Dev.	2.023207	4.241591	1.147849	6.928142	
Obs.	22	22	22	22	

Graphical illustration of the series are given in Figure 1. It is seen that financial soundness of bank groups has a volatile structure during the analysis period with a smoothly increasing pattern after 2016. Especially the financial soundness of privately owned bank groups increases rapidly yet having lower levels compared to other bank groups. LNVIX increases sharply in 2008 and 2020, indicating that perception of risk responds dramatically to periods such as the global financial crisis and the pandemic. LNGEPU is continuously having an increasing pattern after 2008, which reflects the global economic policy uncertainty. LNGPR also has a volatile structure with sharp increases in the 2002-2003, 2013-2014, and

2020-2022 periods, which may indicate that acts like war, diplomatic crises, and terrorism cause an increase in the geopolitical risk index. Finally, LNTPU also increases sharply during 2014-2018 and after 2020. Although this factor may indirectly affect the banking sector, it is still worth investigating, especially following the trade policies of countries like the USA.

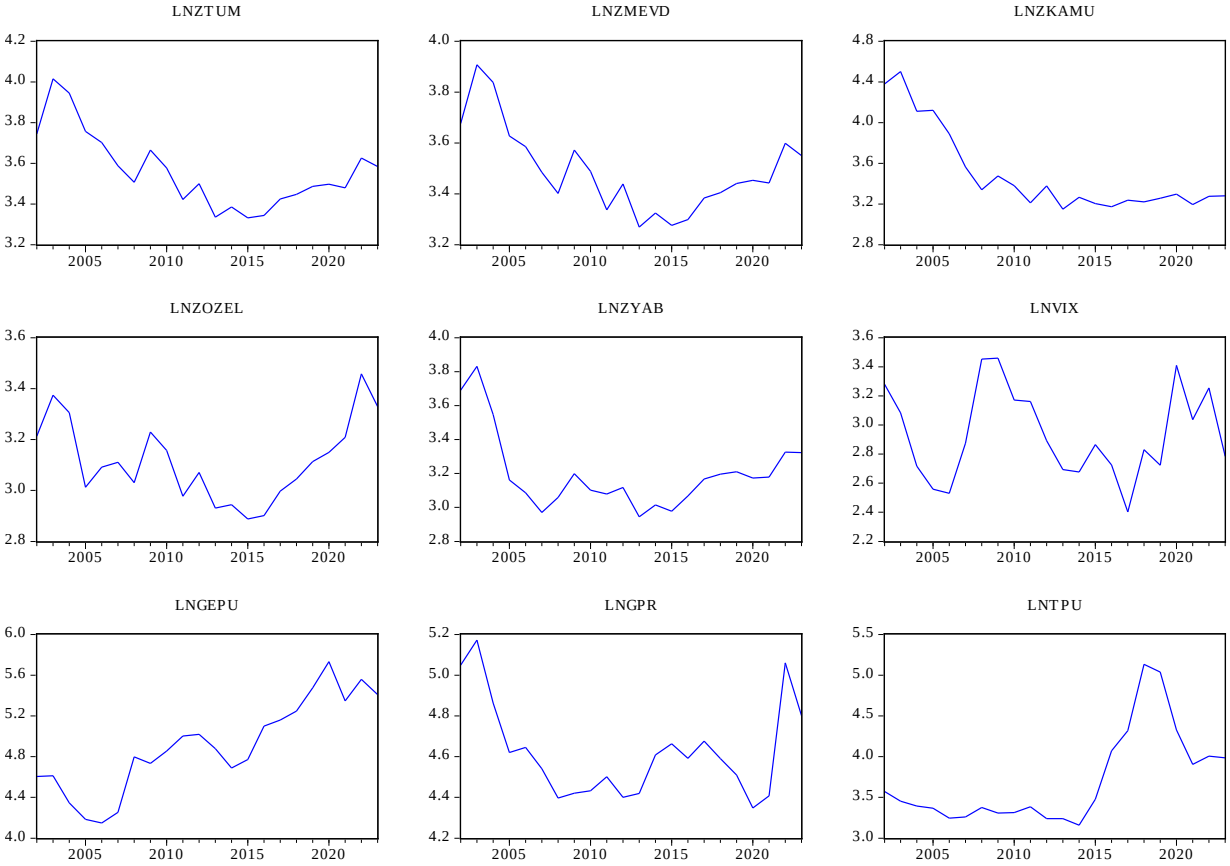

Figure 1. Graphical Illustration of the Series in the Analysis

Correlation coefficients between the whole series are given in Table 3. The correlation between the financial soundness of bank groups and risk factors LNVIX and LNGPR is positive with higher levels of LNGPR. The correlation between financial soundness and factors of LNTPU and LNGEPU is seen to be emerging at different levels and in different directions. However, this interaction cannot reveal a cause-and-effect relationship. Therefore, after investigating unit root levels, the effect of uncertainty factors on financial soundness is investigated via appropriate methods.

Table 3. Correlation Coefficients

	LNZTUM	LNZMEVD	LNZKAMU	LNZOZEL	LNZYAB	LNVIX	LNGEPU	LNGPR	LNTPU
LNZTUM	1.0000								
LNZMEVD	0.9889*	1.0000							
LNZKAMU	0.8934*	0.8612*	1.0000						
LNZOZEL	0.7140*	0.7863*	0.4164***	1.0000					
LNZYAB	0.7921*	0.8504*	0.7468*	0.7233*	1.0000				
LNVIX	0.1297	0.1411	0.0099	0.3893***	0.2134	1.0000			
LNGEPU	-0.4697**	-0.3562	-0.6415*	0.1547	-0.0491	0.2600	1.0000		
LNGPR	0.6146*	0.6696*	0.6264*	0.5654*	0.7881*	-0.0642	-0.1652	1.0000	
LNTPU	-0.2518	-0.1583	-0.3344	0.0635	0.0944	-0.1063	0.6981*	0.0056	1.0000

Note: *, ** and *** represent 1%, 5% and 10% statistical significance levels, respectively.

Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests are applied on the series in order to determine the stationary level of the data. The null hypothesis for each test is that the series has a unit root. According to both of the tests' findings, all the series do not contain a unit root at I(1) level (Appendix 1). Since none of the series are stationary at I(2), the data is found to be eligible to conduct NARDL method. Moreover, as the number of observations is not big, this method is also chosen because ARDL-type methods can tolerate and provide more robust findings for smaller samples.

Following the NARDL analyses between the series, assumption tests for normality, serial correlation and heteroskedasticity for the model findings were examined by Jarque-Bera (JB), Breusch-Godfrey Serial Correlation LM Test (BG LM), and Breusch-Pagan-Godfrey (BPG) tests, respectively. Ramsey's Reset test and CUSUM tests are also applied in order to check for model specification error and stability of the parameters, respectively. According to the findings, there are no problems of non-normal distribution, and heteroscedasticity in the models. All of the models but LNZKAMU and LNVIX, LNZKAMU and LNGPR are correctly specified, according to Ramsey's Reset tests. All of the models but LNZKAMU and LANTPU are indicating that the model coefficients remained stable over the sample period

according to the CUSUM tests. However, it is found that there is serial correlation for the models of LNZKAMU, LNZOZEL, LNZYAB, and LNVIX; LNZTUM, LNZMEVD and LNGEPU; LNZOZEL and LNGPR; and LNZKAMU, LNZYAB, and LNTPU (Appendix 2). Therefore, these models are investigated by robust estimator of HAC (Newey-West). Final robust estimations are presented in Table 4 and Table 5 respectively.

Long-run coefficients and test findings regarding the NARDL models are given in Table 4. There is an asymmetrically cointegration relationship between LNVIX and LNZTUM, LNZMEVD and LNZKAMU. However, none of the coefficients calculated are statistically significant. For LNGEPU, there is an asymmetrically cointegration relationship between all the bank groups but LNZOZEL. Considering the effects of positive and negative shocks from this factor, it is seen that despite their changing effects, none of the positive shocks are statistically significant. Negative shocks of LNGEPU has a statistically significant effect on LNZTUM (-1.638437), LNZMEVD (-1.354056), and LNZOZEL (2.123919). Considering LNGPR, it is revealed that there is an asymmetrically cointegration relationship between this risk factor and LNZKAMU, LNZOZEL, and LNZYAB. On the other hand, the coefficients obtained for LNZOZEL are not statistically significant. However, it is seen that negative shocks from LNGPR have significant positive effects on LNZKAMU (0.472301), while positive shocks from LNGPR have statistically significant positive effects on LNZYAB (0.256687). Finally, it is found that there is an asymmetrically cointegration relationship between LNTPU and LNZKAMU and LNZYAB. Both positive and negative shocks have statistically significant and positive effects on LNZKAMU. A 1% increase in the positive shocks causes a 0.133107% increase in the financial soundness of LNZKAMU, while a %1 decrease in the negative shocks causes a 1.105060% decrease in LNZKAMU. The different effect in positive and negative shocks is also found to be statistically significant according to the Wald statistics.

Table 4. NARDL Long-Run Effects

	LNZTUM	**LNZMEVD**	**LNZKAMU**	**LNZOZEL**	**LNZYAB**
LNVIX +	-0.47498	-0.40925	-0.23022	0.56417	-0.36988
LNVIX-	-0.76126	-0.70411	-0.06914	0.68014	0.04276
F-bound /LNVIX	5.93160**	5.39510**	11.2177*	2.33372	2.38582
Wald /LNVIX	1.07240	10.15966**	1.88703	-	-

LNGEPU+	-0.09969	-0.03469	0.38425	0.54768	-0.12053
LNGEPU-	-1.63844**	-1.35406*	0.35169	2.12392***	-0.78113
F-bound /LNGEPU	9.68737*	12.1449*	7.90723*	2.45344	7.40450*
Wald / LNGEPU	16.8923*	19.3004*	0.26510	-	16.6124*
LNGPR+	5.91428	3.22367	0.22213	0.67160	0.25669***
LNGPR-	9.46877	5.09605	0.47230***	1.10468	0.22241
F-bound /LNGPR	2.12197	2.07253	11.7004*	4.22464***	4.28015***
Wald / LNGPR	-	-	2.16414	0.67297	4.73681**
LNTPU+	0.17123***	0.15451***	0.13311*	-2.92410	-1.47145
LNTPU-	1.01239**	0.83031**	1.10506*	0.30771	0.87601
F-bound /LNTPU	3.16977	3.32341	9.98695*	1.46740	13.1486*
Wald /LNTPU	-	-	8.22112**	-	19.1311**

Note1: *, ** and *** represent 1%, 5% and 10% statistical significance levels, respectively.

Note2: +, and - represent the positive and negative shocks of the uncertainty factor, respectively.

Note3: Test statistics for the F-bounds test are as follows for the sample: For the 1% significance level, 5.155 (I(0)) and 6.265 (I(1)); for the 5% significance level, 3.538 (I(0)) and 4.428 (I(1)); and for the 10% significance level, 2.915 (I(0)) and 3.695 (I(1)).

Short-run coefficients and test findings regarding the NARDL models are given in Table 5. Of all the uncertainty factors, only positive and lagged shocks from LNGEPU have statistically significant effects on LNZTUM. For LNZMEVD, both LNVIX and LNGEPU have statistically significant effects. For LNZKAMU, all of the uncertainty factors have significant effects in the short run. For LNZOZEL, only lagged values of positive and negative shocks of LNGPR have significant effects. And finally, both LNGEPU and LNTPU have significant effects on LZYAB.

Table 5. NARDL Short-Run Effects

	LNZTUM	**LNZMEVD**	**LNZKAMU**	**LNZOZEL**	**LNZYAB**
D(LNVIX+)	1.30E-13	-	-0.19179	-	-
D(LNVIX+(-1))	4.56E-14	0.11012	-	-	-
D(LNVIX+(-2))	2.93E-14	0.28665*	0.29982***	-	-
D(LNVIX-)	-1.04E-13	-	-	-	-
D(LNVIX-(-1))	-2.08E-13	0.15330	-	-	-
D(LNVIX-(-2))	-2.20E-13	-	-0.25741	-	-
D(LNVIX-(-3))	-1.74E-13	0.38692**	-	-	-
D(LNGEPU+)	-	-	-0.28773**	-	-

D(LNGEPU+(-1))	0.33046*	0.33194*	-	-	0.47847*
D(LNGEPU+(-2))	0.36760*	0.38733*	-	-	0.28123**
D(LNGEPU+(-3))	-	-	-0.16228	-	-
D(LNGEPU-)	0.20299	0.21574	0.53300**	-	0.25584
D(LNGPR+)	-	-	-	0.44274**	-
D(LNGPR-(-1))	-	-	-0.56127	-1.20040**	-
D(LNGPR-(-2))	-	-	-1.21774*	-0.91351**	-
D(LNGPR- (-3))				0.54736	
D(LNTPU+)	-	-	-	-	0.23050***
D(LNTPU+(-1))	-	-	-	-	0.94888***
D(LNTPU+(-2))	-	-	-	-	0.51748
D(LNTPU+(-3))	-	-	-	-	0.67195
D(LNTPU-)	-	-	-5.07E-15	-	-1.05598***
D(LNTPU-(-1))	-	-	4.29E-14**	-	-0.70616
D(LNTPU-(-2))	-	-	4.12E-14**	-	-2.15248**
D(LNTPU-(-3))	-	-	4.30E-14**	-	-1.13252***
CointEq(-1) (LNVIX)	-0.254472*	-0.279988*	-0.577924*	0.744039**	0.593845**
Wald /LNVIX	0.70121	0.46500	19.9029*	-	-
CointEq(-1) (LNGEPU)	-0.195852*	-0.233224*	-0.621874*	0.550364*	-0.569142*
Wald / LNGEPU	24.8783*	7.02473**	12.9566*	-	5.05712**
CointEq(-1) (LNGPR)	-0.077196**	-0.137059**	-1.083765*	-0.517451*	-1.260651*
Wald / LNGPR	-	-	12.5421*	4.64281***	-
CointEq(-1) (LNTPU)	-0.745955*	-0.840489*	-0.966876*	-0.266304***	-0.358392*
Wald /LNTPU	-	-	7.96766**	-	27.8448**

Note1: *, ** and *** represent 1%, 5% and 10% statistical significance levels, respectively.

Note2: "+" and "-" represent the positive and negative shocks of the uncertainty factor, respectively.

In conclusion, the salient global uncertainty factors having significant effects on the Turkish banking sector can be summarized as shown in Table 6. While the most sensitive bank group is the state-owned deposit banks (LNZKAMU), the least sensitive bank group is the privately-owned deposit banks (LNZOZEL).

Table 6. Main Global Uncertainty Factors Affecting Turkish Deposit Banks

Bank Group	Long-Run	Short-run
LNZTUM	LNGEPU-	LNGEPU+
LNZMEVD	LNGEPU-	LNGEPU+
LNZKAMU	LNTPU+, LNTPU-, LNGPR-	LNVIX+, LNGEPU+, LNGEPU-, LNGPR-, LNTPU-
LNZOZEL	-	LNGPR+, LNGPR-
LNZYAB	LNGPR+	LNGEPU+, LNTPU+, LNTPU-
Note: "+" and "-" represent the positive and negative shocks of the uncertainty factor, respectively.		

5. CONCLUSIONS

This study investigates the effect of asymmetrical shocks from selected global uncertainty factors on the Turkish banking sector after the reformatory regulations conducted in the early 2000s. The main limitation of this study is analyzing the short time period. Unlike prior panel-based or profitability-focused studies, this paper uses the Z-score measure to focus on financial soundness of banks, and a NARDL method instead of traditional models on a 2002–2023 sample in order to reveal ownership-specific, asymmetric responses to four different types of global uncertainty factors (VIX, GEPU, GPR, TPU) for the Turkish banking sector. Remarkable findings can be summarized as follows:

*Uncertainty factors that have an asymmetric long-run cointegration relationship with the whole banking sector are financial uncertainty and economic policy uncertainty. Positive and negative shocks of both factors have negative effects on the system, even if they are mostly statistically insignificant.

*Uncertainty factors that have an impact on the overall deposit banks are financial

uncertainty and economic policy uncertainty as well, and their effects are mostly insignificant and negative.

*Grouping deposit banks by their capital ownership type, it is found that there are asymmetric cointegration relationships between the financial soundness of state-owned deposit banks and all risk factors in the long run. On the other hand, only negative shocks of geopolitical uncertainty and positive and negative shocks of trade policy uncertainty have statistically significant effects. All of these effects are positive. Negative shocks from uncertainty factors have a larger effect as well.

*There is only one long-run asymmetric cointegration relationship between privately-owned deposit banks and geopolitical uncertainty. None of the risk factors has a statistically significant effect.

*There is a long-run asymmetric cointegration relationship between foreign deposit banks and all risk factors except the financial uncertainty factor. However, only positive shocks from geopolitical uncertainty have a statistically significant and positive effect.

*Considering short-run effects, it is seen that only the positive and lagged shocks of global economic policy uncertainty have an effect on the overall banking sector. In deposit banks, both financial uncertainty and global economic policy uncertainty have significant effects.

*On the other hand, state-owned deposit banks are the bank group being most affected by risk factors in the short run. The lagged values of all risk factors have significant effects. The bank group least affected by risk factors is privately-owned deposit banks, and these effects only stem from geopolitical risks. Finally, it has been found that the lagged values of both global economic policy uncertainty and trade policy uncertainty have significant effects on foreign banks in the short run.

These findings reveal that the effect of global uncertainty factors on the financial soundness of Turkish banks varies according to their capital ownership structure. Key implication recommendations can be drawn for policy makers and practitioners. First, although it is found that the financial soundness of the Turkish financial system is rather

robust to global uncertainty factors, these findings indicate that macroprudential policy should still consider having stronger capital buffers and liquidity coverage ratios, especially during this period. For state-owned deposit banks, which are the most sensitive group to uncertainty factors, especially in the short run, this group may be subject to regular stress tests based on possible scenarios during periods of increased uncertainty, and adopting higher transparency in reporting processes may also be effective in reducing risks. For privately-owned deposit banks, which are the least sensitive group to uncertainty factors, this insensitivity can be taken as a competitive advantage, and it can allow for more strategic risk-taking implications. The relatively higher soundness can also be highlighted for international investors and creditors. These bank groups, in particular, can adopt a more aggressive strategic position to get higher returns in relatively riskier areas such as asset management. Finally, for foreign banks, as it is seen that they are more sensitive to global economic and trade policy uncertainty factors, especially in the short run, challenges during this period can be managed by increasing parent company support and global portfolio diversification. These bank groups can provide more effective risk management by developing strategies to balance the risk of their assets within a global portfolio, working in coordination with their home country branches and global risk management teams.

Findings of this study are compatible with the studies in the literature from various perspectives. Regarding the positive findings of trade policy uncertainty, findings are compatible with Aledeimat et al. (2025), while negative findings related to trade policy uncertainty are in line with Dang et al. (2025). It is seen that global economic policy uncertainty is the most investigated risk factor in the related literature. Regarding negative findings of this risk factor, Dang et al. (2025), Wu et al. (2021), and Athari (2020) have found similar interactions. On the other hand, it is seen that Luo et al. (2024), Zuhroh and Rofik (2024), and also Athari (2020) have found positive findings similar to this research. This disparity can be attributed to the fact that besides sample heterogeneity, regional, political, and temporal factors can have an effect on the interaction between the variables.

Taken together, these findings suggest that the financial soundness of Turkish financial system is quite resilient to global uncertainty factors. Because despite having significant effects in the short run, it is seen that they are not common for all bank groups;

only idiosyncratic effects may arise. However, in the long run, the impact of risk factors can diminish or become non-significant. Also these effects are still not common for the whole bank groups. However, especially state-owned deposit banks develop risk management strategies against geopolitical and trade policy factors uncertainties. Of all the bank groups, financial soundness of the privately-owned deposit banks is the most insensitive to global uncertainty factors. Therefore, future studies may examine and compare the different risk management strategies of bank groups, considering the findings of this research. Nevertheless, the fact that the analysis was conducted for a relatively shorter time period, the study should better be repeated for a longer span of time in the future. Also, future studies may investigate symmetric relationships for banks where asymmetric relationships could not be detected. Finally, analyzing the impact of uncertainties for shorter frequencies may make the impact of risk factors more visible.

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APPENDICES

Appendix 1. Unit Root Test Findings

Variable	Level	Deterministic Chosen	ADF	PP
LNZTUM	I(0)	Constant	-1.5879	-1.4867
		Trend	-1.4521	-1.4191
	I(1)	Constant	-5.9062*	-5.9181*
		Trend	-7.1040*	-19.5832*
LNZMEVD	I(0)	Constant	-1.7489	-1.6515
		Trend	-1.4722	-1.2769
	I(1)	Constant	-5.8098*	-5.8313*
		Trend	-3.7614**	-18.9121*
LNZKAMU	I(0)	Constant	-3.2987**	-2.7697***
		Trend	-1.8769	-1.0816
	I(1)	Constant	-5.4948*	-5.3658*
		Trend	-8.1174*	-8.7659*
LNZOZEL	I(0)	Constant	-1.7657	-1.7472
		Trend	-1.6333	-1.4953
	I(1)	Constant	-5.3204*	-5.3204*
		Trend	-6.1944*	-7.6029*
LNZYAB	I(0)	Constant	-2.4182	-2.4184
		Trend	-1.2620	-1.7193
	I(1)	Constant	-3.5933**	-3.6512**
		Trend	-4.3485**	-4.7117*
LNVIX	I(0)	Constant	-3.7635**	-2.8777***
		Trend	-3.6926**	-2.8038
	I(1)	Constant	-4.7447*	-4.7449*
		Trend	-4.5576*	-4.5578*
LNGEPU	I(0)	Constant	-0.8805	-0.8805
		Trend	-2.8263	-2.8263
	I(1)	Constant	-4.3158*	-4.3144*
		Trend	-4.2059**	-4.2059**
LNGPR	I(0)	Constant	-3.6351**	-2.4483
		Trend	-2.7679	-1.7919
	I(1)	Constant	-3.9075*	-4.6556*
		Trend	-4.5854*	-5.7267*
LNTPU	I(0)	Constant	-1.9013	-1.3946
		Trend	-2.7089	-1.9637
	I(1)	Constant	-2.8627***	-2.8650***
		Trend	-4.5257**	-2.7746

Note: *, ** and *** represent 1%, 5% and 10% statistical significance levels, respectively.

Appendix 2. Model Diagnostics

	Normality (JB)	Serial Correlation (BG LM)	Heteroskedasticity (BPG)	Ramsey's Reset	CUSUM
Uncertainty Factor: LNVIX					
LNZTUM	1.274262	4.417906	11.91133	0.418862	yes
LNZMEVD	1.194219	3.749198	11.82398	0.258774	yes
LNZKAMU	1.319260	14.73275*	12.78070	3.391985**	yes
LNZOZEL	0.045499	15.12666*	16.94135	3.245451	yes
LNZYAB	0.568263	6.775051*	16.33536	0.035465	yes
Uncertainty Factor: LNGEPU					
LNZTUM	2.808793	7.126392**	8.890410	1.062452	yes
LNZMEVD	2.721835	4.910189***	7.362114	0.412947	yes
LNZKAMU	0.564700	3.584340	12.77457	0.229496	yes
LNZOZEL	0.589661	0.162555	8.138312	0.077504	yes
LNZYAB	0.858023	4.196962	13.18685	0.182573	yes
Uncertainty Factor: LNGPR					
LNZTUM	0.758924	2.215809	13.28463	0.092412	yes
LNZMEVD	0.291087	1.862004	14.57351	0.048912	yes
LNZKAMU	1.235815	0.666055	6.355757	3.350974**	yes
LNZOZEL	0.850740	7.429244**	12.81977	0.197634	yes
LNZYAB	0.609312	1.297478	6.870388	0.242551	yes
Uncertainty Factor: LNTPU					
LNZTUM	1.083923	1.759752	7.291367	1.479983	yes
LNZMEVD	0.839905	1.795772	7.148993	0.998184	yes
LNZKAMU	0.438886	10.40552*	8.569356	0.015648	no
LNZOZEL	2.158820	9.177544*	12.14919	2.914703	yes
LNZYAB	1.370078	1.441770	10.95322	0.638884	yes

Note1: *, ** and *** represent 1%, 5% and 10% statistical significance levels, respectively.

Note2: JB = Jarque–Bera Normality Test; BG LM = Breusch–Godfrey Serial Correlation LM Test; BPG = Breusch–Pagan–Godfrey Heteroskedasticity Test; CUSUM = Cumulative Sum Control.