

A R A Ş T I R M A M A K A L E S İ / R E S E A R C H A R T I C L E

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**CO-MOVEMENT OF NON-PERFORMING LOANS AND BANK
CONCENTRATIONS IN AN EMERGING MARKET: WAVELET COHERENCE
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ABSTRACT

This study analyzes the link between non-performing loans (NPL) and bank concentrations in Turkey using the wavelet coherence approach. Corresponding to the expectation in terms of current research, there were fluctuations in NPL by 5 and 7 banking concentrations between 2000 and 2003. Moreover, NPL ratios in the long term cause 5 and 7 banking concentrations. It is concluded that NPL in the Turkish banking sector is active on the size of asset concentration ratios of the largest 5 and 7 banks. Additionally, there is a positive correlation between NPL and 5 and 7 bank concentrations during the domestic banking crisis.

Keywords: Non-Performing Loans, Bank Concentrations, Wavelet Coherence, Turkey, Emerging Market**Jel Codes:** G10, G21**GELİŞMEKTE OLAN ÜLKELERDE DONUK KREDİLER VE BANKA
YOĞUNLAŞMALARININ BİRLİKTE HAREKET ANALİZİ: DALGACIK TUTARLILIĞI
YAKLAŞIMI****ÖZ**

Bu çalışma, dalgacık tutarlılığı yaklaşımını kullanarak Türkiye'deki sorunlu krediler (TGA) ile banka yoğunlaşmaları arasındaki bağlantıyı analiz etmektedir. Bu çalışmanın beklentisi doğrultusunda, 2000-2003 yılları arasında 5 ve 7 bankacılık yoğunlaşması ile TGA'da dalgalanmalar olmuştur. Ayrıca, uzun vadede TGA oranları 5 ve 7 bankacılık yoğunlaşmasına neden olmaktadır. Türk bankacılık sektöründe TGA'nın en büyük 5 ve 7 bankanın aktif yoğunlaşma oranlarının büyüklüğü üzerinde aktif olduğu sonucuna varılmıştır. Ayrıca, yurtdışı bankacılık krizi sırasında takipteki alacaklar ile 5 ve 7 banka yoğunlaşmalarının aralarında müspet bağlantı bulunduğu tespit edilmiştir.

Anahtar Kelimeler: Takipteki Krediler, Banka Konsantrasyonları, Dalgacık Tutarlılığı, Türkiye Gelişmekte olan piyasa**Jel Kodları:** G10, G21**Geliş Tarihi/Received:** 19.04.2022**Kabul Tarihi/Accepted:** 26.05.2022**Yayın Tarihi/Printed Date:** 30.06.2023

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INTRODUCTION

Numerous studies have been investigated the role and effect of credits on economic growth and financial crises in both literature and practice, especially after the 1990s. The impact of high-risk appetite and excessive credit expansion in the 2007-2008 global crisis attracted attention to credits in general and personal indebtedness in particular. This is because the status and progress of both total credits volume and private indebtedness, notably revisions and additions in Basel Banking Organization Principles (Basel II and III), are followed closely to provide and maintain financial and macroeconomic stability (Tiryaki, 2012: 76-94).

Several empirical and theoretical studies about non-performing loans have recently been conducted in developing countries. However, we have not encountered any empirical or theoretical studies that have analyzed the dynamic linkage between bank concentration and NPL. Thus, this paper opens up a new horizon in this field besides closing the related gap in the literature. Within the context of this research, it is examined underlying linkage amid NPL and bank concentration by utilizing the wavelet coherence technique which allows us to comprehend the contributing relationship among the variables in both the long and short terms. Therefore, besides fulfilling the needs of literature, this study aims to present empirical findings to act as a guide for policymakers and bankers.

Negative repayments of credits by companies in the real sector hurt the banking sector and national economy, and this situation may drag countries into a crisis (Konstantakis et al., 2016). Serious financial credits occur as a result of non-performing loans; accordingly, banks impose restrictions on loan amounts and provisions. The revenue loss of banks arising from non-performing loans disturbs the stable structures in the sector by increasing the costs of banks' instruments that are used for customers. For this reason, determining the reasons and factors that cause non-performing loans is essential for banks to organize their policies to minimize related credits. Adverse developments are seen in cyclical issues and financial systems by increasing non-performing loans. These adverse developments trigger an increase in NPL by the effect of decreases in available revenue and problems in the repayment of debts (Vithessonthi, 2016).

Personal loans, which consist of consumer credits and individual credit cards, have become the main topic of conversation in Turkey within the scope of financial stability, macro-prudential policies, and the current deficit. Turkey is a developing country dominated by the banking sector, which has a significant share of the economy and the financial industry. As well known, the banking sector also affects the social and economic developments within this system. Thus, the crises both within and outside the country create various effects within the context of developing countries such as Turkey. Since the sector is continually improving along with structural changes in the economy, in addition to the fact that developing countries are affected more by these effects than developed countries.

In Turkey, The Banking Regulation and Supervision Agency took precautions toward boosting the banking sector after increasing the ratio of NPL to 5.4% after the impact of the 2009 global financial crisis. Amendments were made toward restructuring Credits Regulation. Related credits reached 3.7% because of the increase in credit volume in 2010 and continued on the same parallel line until 2015, whereas it was observed to be 2.7% in 2011. This ratio decreased to 2.8% in 2013 and remained at a horizontal level of 2.19%. Finally, the rate reached a level of 3% in 2015, which was the highest observed in the entire five-year period.

According to Hassan et al. (2014), there is limited information about defining the relationship between NPL and social factors specifically about the banks in Pakistan. Waqas et al. (2017) conducted a study for Pakistan, Bangladesh, and India and emphasized that documenting the factors peculiar to banks has a significant contribution to the credit risk. Moreover, they found a positive effect of macroeconomic variables on NPL.

Beck, Demirgüç-Kunt, and Levine (2006) aim to explore the connection amid bank concentration, volatility, as well as competitiveness within the milieu of the banking businesses of 69 countries, covering the period of 1980 to 1997. They identified that economic crises decrease in economies with a more powerful banking system even after controlling for differences between shocks in the marketplace, macroeconomic conditions, commercial bank regulation policies, and national institutions that affect competition. They also expressed that regulation policies and institutions have more effect on banking system fragility. Kasman and Kasman (2014) explored the impact of competition and concentration in the banking sector on bank stability. According to the results, more concentration has a positive effect on non-performing loans. Korkmaz et al. (2016) investigated the relationship between concentration in terms of the banking business and financial fragility. Korkmaz et al. (2016) indicates that there is a two-way interaction between concentration in the banking sector and financial fragility. Ali et al. (2018) analyzed the connection between banking concentration and banking stability. According to the research results, concentration has a financially positive and stabilizing effect.

1. Data and Methodology

Time-regularity dependence amid NPL and size of asset concentration ratios of the largest 5 and 7 banks in Turkey was analyzed by quarterly data between 1995 and 2017 by benefiting from the ripple consistency method. The size of asset concentration of the first five banks is shown as 5BC; the size of the assets of the first seven banks is shown as 7BC. Non-performing loans are denoted as NPL and shown by descriptive statistics in Table 1 while Figure 1 shows the pattern of the 5BC, 7BC, and NPL in Turkey

Table 1. Data And Descriptive Statistics

	5 Bank Concentration	7 Bank Concentration	Non-performing loans
Source	TBB	TBB	TBB
Code	5BC	7BC	NPL
Period	1995Q1-2017Q3		
Mean	0.556	0.691	0.046
Median	0.581	0.743	0.033
Maximum	0.630	0.787	0.198
Minimum	0.413	0.479	0.008
Std. Dev.	0.070	0.100	0.040
Skewness	-0.768	-0.929	2.431
Kurtosis	1.994	2.132	8.731
Jarque-Bera	12.799	15.841	214.206
Probability	0.001	0.000	0.000

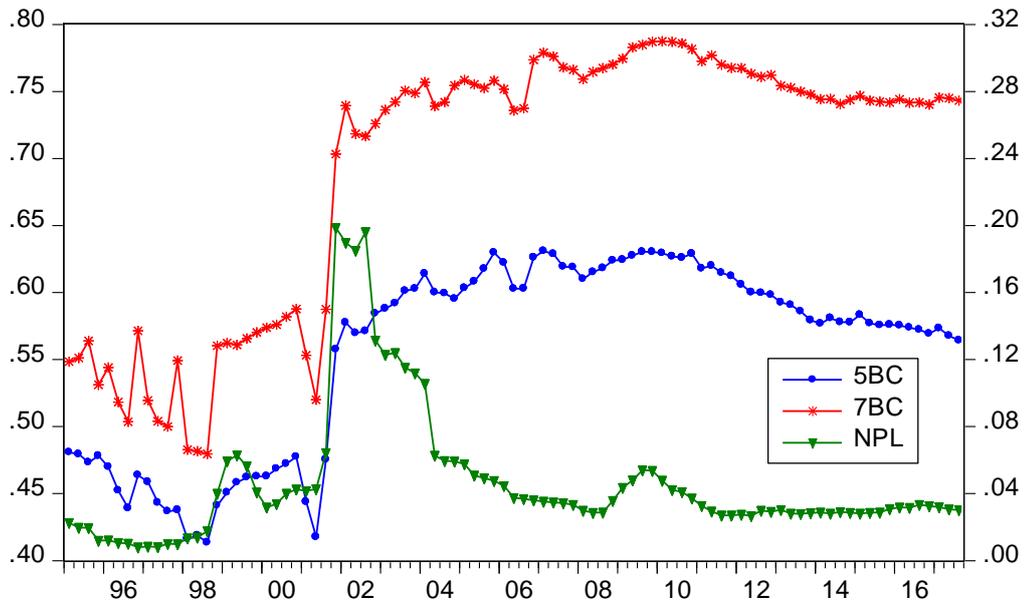


Figure 1. Five and Seven Banking Concentrations and Non-Performing Loans in Turkey

Source: The Banks Association of Turkey

We discovered the time-regularity dependency of bank concentrations and non-performing loans by using the wavelet approaches in Turkey. “The novel wavelet approach was developed by Goupillaud, Grossmann, and Morlet (1984). The core principle of wavelet consistency allows for a one-measurement period series to be disintegrated into two-breadth period-regularity areas”. Therefore, we scrutinize the long and short-term connections between banking concentrations and NPL in Turkey. A multiscale decomposition method shows an ordinary context to display frequency-based conduct and enables a relationship amid banking concentrations and NPL to be researched.

Wavelet equation (ψ), which stands a fragment of the Morlet wavelet family, as reported below:

$$\psi(t) = \pi^{-\frac{1}{4}} e^{-i\omega_0 t} e^{-\frac{1}{2}t^2}$$

Period and position are “characterized by k , and regularity that is epitomized with f are the more than one focal parameters of a wavelet” (Kirikkaleli & Gokmenoglu, 2019). There is a role to specify a specific location by controlling wavelet which is distributed for localization of various frequencies:

$$\psi_{k,f}(t) = \frac{1}{\sqrt{h}} \psi\left(\frac{t-k}{f}\right), k, f \in \mathbb{R}, f \neq 0$$

Constant wavelet stands advanced by $p(t)$ period sequences statistics as follows:

$$W_p(k, f) = \int_{-\infty}^{\infty} p(t) \frac{1}{\sqrt{f}} \psi\left(\frac{t-k}{f}\right) dt,$$

The following equation shows coefficient degenerate time of origin $p(t)$ series:

$$p(t) = \frac{1}{C_\psi} \int_0^\infty \left[\int_{-\infty}^\infty |W_p(a, b)|^2 da \right] \frac{db}{b^2}.$$

Wavelet power spectrum (WPS) enables additional data to be obtained on the magnitude of the period sequences:

$$WPS_p(k, f) = |W_p(k, f)|^2$$

The wavelet coherence approach allows for “slightly association within the context of composite period-regularity constructed causalities amid two period sequences as p (t) and q (t)” (Kirikkaleli & Gokmenoglu, 2019). this is because the related approach was preferred in this study. Two-time series are converted into cross wavelet transform (CWT) by benefiting from following equation:

$$W_{pq}(k, f) = W_p(k, f)W_q(k, f),$$

Torrence and Compo (1998) underline that, $W_p(k, f)$ and $W_q(k, f)$ define the CWT of two period sequences as p (t) and q (t). Furthermore, the equation of square wavelet that they developed can be seen below:

$$R^2(k, f) = \frac{|C(f^{-1}W_{pq}(k, f))|^2}{C(f^{-1}|W_p(k, f)|^2)C(f^{-1}|W_q(k, f)|^2)}$$

C shows time; $0 \leq R^2(k, f) \leq 1$ represents softening treatment in time. $R^2(k, f)$ value closes to 1 if time series variables are in phase. Otherwise, $R^2(k, f)$ closes to 0 if time series variables show a weak correlation.

In the wavelet approach, $R^2(k, f)$ provides information regarding the power of the dependency among the time series variables; however, there is no information about the direction (Kirikkaleli and Gokmenoglu, 2019). This is because Pal and Mitra (2017) developed an instrument to determine wavelet coherence by deferment signals within the framework of the waving of two-period sequences. The following one stays the wavelet coherence differential stage equation;

$$\phi_{pq}(k, f) = \tan^{-1} \left(\frac{L \{C(f^{-1}W_{pq}(k, f))\}}{O \{C(f^{-1}W_{pq}(k, f))\}} \right),$$

Where L represents an unrealistic operator, and O shows a tangible portion operative.

2. Experimental Conclusions

We have benefited from the wavelet power spectrum technique, which utilized in oder for specifying waving in period series data, 5BC, 7BC, and NPL. Then as a next step the wavelet coherence method was used to research the causality and the correlation between 5BC, 7BC, and NPL within the milieu of banking business of Republic of Türkiye by benefiting from quarterly data ranging from1995-2017.

As seen in Figures 2 and 3, volatility is observed at the scale of 4 and 16 quarter periods, indicating in the short and medium terms, for both 5 and 7 banks' concentrations throughout 1999 to 2003. Again, it can be seen in Figure 4 that there was volatility in periods 4-8-16 in the short, medium and long term in NPL. Therefore, we can conclude that the 2000 banking crisis and 2001 currency devaluation had significant impacts on NPL and bank concentration indicators. In the Turkish banking system, while bank concentrations increased from 50% to 80% during the 2001 crisis, NPL ratios increased from 4% to 20%.

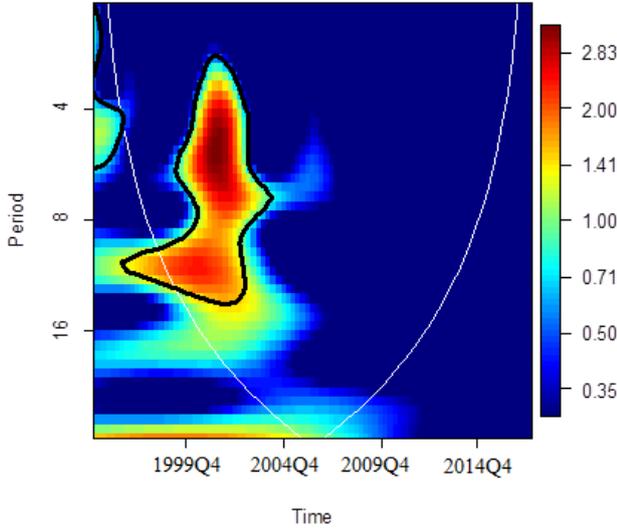


Figure 2. Power Spectrum for 7BC

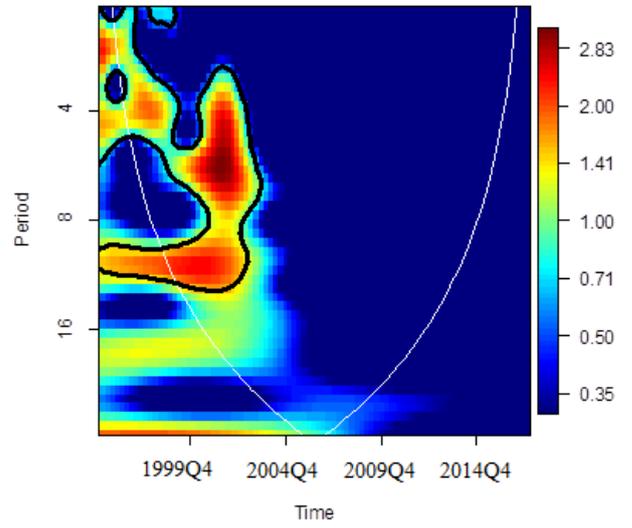


Figure 3. Power Spectrum for 5BC

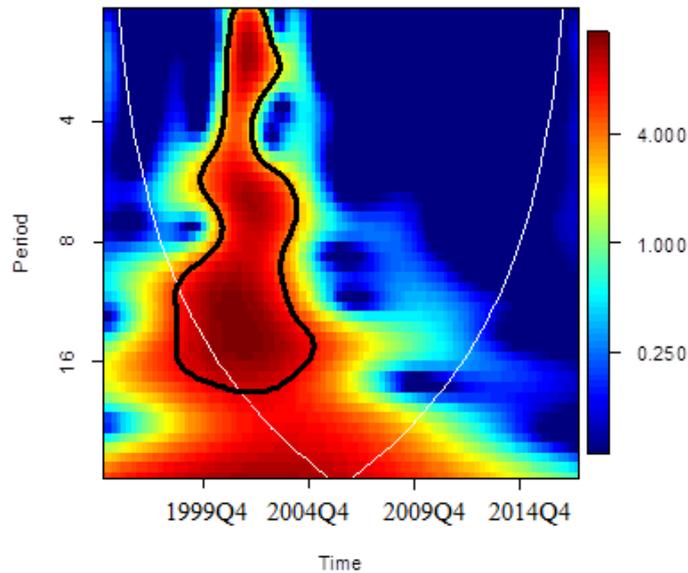


Figure 4. Power Spectrum for NPL

To identify the time-frequency connection (i) between 5BC and NPL and (ii) between 7BC and NPL in Turkey, wavelet coherence examination is implemented. The consequences of that analysis are reported in Figures 5 and 6. As seen, right-up arrows in the Figures indicate that NPL significantly causes bank concentrations, implying how NPL is a significant predictor for 5BC and 7BC in Turkey within the longer terms. The result of the existing research is rational and in agreement with the expectations since the NPL is one of the indicators of the banking sector instability. In Turkey, banks whose financial structure was damaged after the 2000 banking crisis were privatized. Some of them were sold to banks with larger volumes of capital, while others were extended by taking a partner during the crisis periods. Bank concentrations were seriously increased by the effect of NPL. Therefore, the result strongly suggests for bank managers in Turkey that banks in Turkey should control their risks to consider crisis periods. Besides, the figures clearly show that the period sequences variables stand phased since we observed that at the scale of 4-8 quarter period, the projectiles are directing to the precise between 1999 and 2003. In other words, in the medium term, NPL and bank concentrations are positively correlated during the 2000 banking and 2001 economic crisis periods.

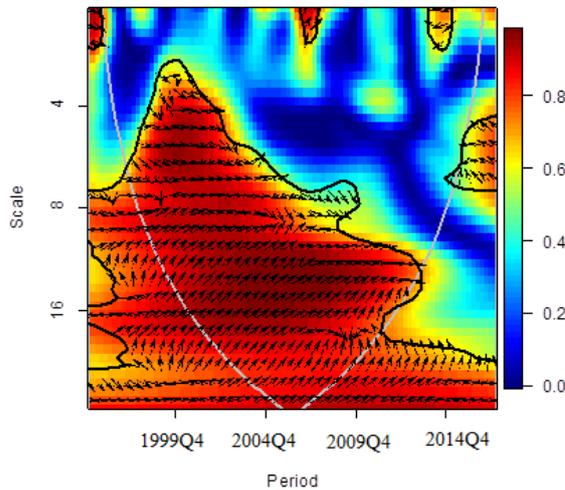


Figure 5. Wavelet Coherence between 5BC and NPL

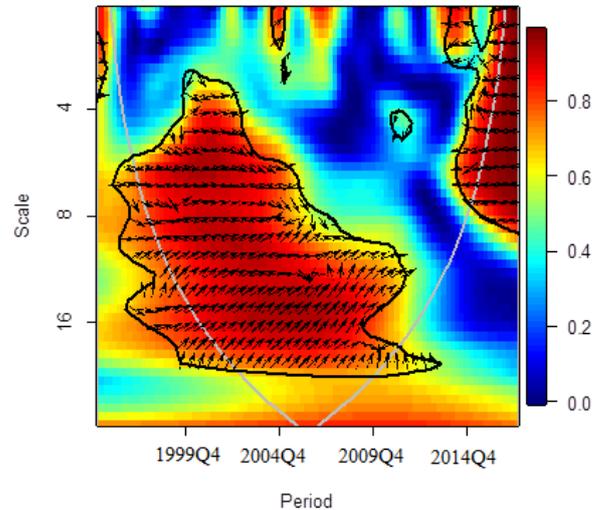


Figure 6. Wavelet Coherence between 7BC and NPL

Note: As explained by Dash et al. (2019), “despite the fact projectiles directing to the left designate damaging connection amongst the variables, projectiles pointing to the right characterize the constructive relationship.” Also, arrows pointing to the up, right-up, or left-down show that the non-performing loans cause bank concentrations in Turkey however projectiles directing to the downward, right-downward, or left-up designate that bank concentrations within Turkey cause non-performing loans.

CONCLUSION

This research has discovered the period-regularity dependency of between 5 and 7 banking concentrations and non-performing loans in Turkey. The wavelet coherence system stays practiced within the context of this research utilizing data between period 1995Q1 and 2017Q3. While the wavelet spectrum analysis permits to acquire the unstable period of the period sequences variables used within that research, the wavelet coherence analysis enables us in order for determining connection and causation amongst the period sequences variables in terms of both short and long terms. As expected, our findings indicate that 5 and 7 banking concentrations

and non-performing loans waded between 2000 and 2003. Moreover, we also observed that 5 and 7 bank concentrations are caused by NPL ratios in the long term, meaning that NPL in Turkey is one of the critical predictors of the asset size of the 5 and 7 most prominent banks in Turkey. Therefore, bank managers in the high concentration ratios should organize their credit policies effectively to minimize non-performing loans in the Turkish banking sector since we observed that NPL significantly causes bank concentration ratios of the 5 and 7 most prominent banks in Turkey. Our finding also indicates that there is a positive linkage between NPL and bank concentrations during the 2000 and 2001 crisis periods.

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EXTENDED ABSTRACT
*GENİŞLETİLMİŞ ÖZET***Co-movement of Non-performing Loans and Bank Concentrations in an Emerging Market: Wavelet Coherence Approach**

This study analyzes the link between non-performing loans (NPL) and bank concentrations in Turkey using the wavelet coherence approach. In line with the expectation of the present study, there were fluctuations in NPL by 5 and 7 banking concentrations between 2000 and 2003. Moreover, NPL ratios in the long term cause 5 and 7 banking concentrations. It is concluded that NPL in the Turkish banking sector is active on the size of asset concentration ratios of the largest 5 and 7 banks. Additionally, there is a positive correlation between NPL and 5 and 7 bank concentrations during the domestic banking crisis.

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We employed the wavelet power spectrum technique, which utilized to specify the waving in time series data, 5BC, 7BC, and NPL. Then as a next step the wavelet coherence method was used to research the causality and the correlation between 5BC, 7BC, and NPL in the Turkish banking sector by using quarterly data for the years between 1995 and 2017. 1999 to 2003. Again, it can be seen in Figure 4 that there was volatility in periods 4-8-16 in the short, medium and long term in NPL. Therefore, we can conclude that the 2000 banking crisis and 2001 currency devaluation had significant impacts on NPL and bank concentration indicators. In the Turkish banking system, while bank concentrations increased from 50% to 80% during the 2001 crisis, NPL ratios increased from 4% to 20%.

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