

The impacts of conventional and Islamic banking sectors on real sector growth: Evidence from time-varying causality analysis for Türkiye

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Abstract

Advocates of Islamic finance claim that it contributes to the development of the real economy, rather than focusing on growth in financial assets by selling money to earn money, but no empirical evidence has been produced to support that view. Therefore, this study investigates the effects of conventional banking activities and Islamic banking activities, in particular in terms of their contribution to economic growth and development. The novelty of the study is that it treats these relationships in terms of time-varying causality supported by Fourier functions. The study also seeks evidence of the possibility that the effect of conventional and Islamic banking on the dependent variables might become U-shaped or inverted U-shaped over time. This study uses three different datasets on the real economy in Türkiye for the period January 2005 to February 2023. Our results reveal that loan volume in banking in general and Islamic banking in particular affects the sectors considered and that causality varies over time. The study shows that, in Türkiye, Islamic banking activities have a weaker impact than banking activities in general because Islamic banking is still in its early stages of development, but it still has an impact on related sectors.

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1. Introduction

The banking sector underpins the financial system by acting as an intermediary between fund providers and individuals and organizations in need of funds. To fulfill its role as a financial intermediary, banks make their own resources available to those in need through individual and corporate credit transactions. By using these resources, entrepreneurs can transform savings into new investment. In this way, new investment contributes to higher production and economic growth. Therefore, the resources provided by the banking sector to the

real sector are very important. The banking sector, whose role in the financial system is critical, has become an indispensable part of modern economies as it is a dynamic sector, and economic growth is important for every country. Banks are the main driving force in economic growth because they channel savings into productive investment. Therefore, analyzing the impact of developments in the banking sector on economic growth is of great importance.

The impact of conventional and Islamic banking on real economic growth remains a topic of great interest and relevance. The impact of the financial sector on economic growth has been discussed since Schumpeter (1911). According to Schumpeter (1911), the financial sector paves the way for creative innovation by mobilizing savings and allocating credit to productive sectors and thus plays an important role in promoting economic development. The banking system is at the core of the financial system, and the traditional banking sector

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supports economic growth by intermediating between savers and borrowers and providing liquidity and risk management services. In this intermediation activity, the banking sector serves economic growth, on the one hand, by increasing the efficiency of capital accumulation and thus the marginal productivity of capital and, on the other, by increasing the savings rate and thus the investment rate (e.g., Ali et al., 2023; Calderón & Liu, 2003; Chaiechi, 2012; Menyah et al., 2014; Obiora et al., 2022; Pradhan et al., 2017; Stewart & Chowdhury, 2021; Thornton, 1994). However, the traditional interest-based financial system has been criticized by all three Abrahamic religions, especially Islam, for its alleged exploitation and unfairness and by many scholars for its unfair resource transfer in terms of the share of wealth owners in income distribution (e.g., M. Ahmad, 2015; Azmat et al., 2021; Kazak, 2021; Naqvi, 1981; Omar Farooq, 2012). Hence, the Islamic finance and banking system has emerged as an alternative banking and finance model that operates according to the principles of shariah, which prohibits interest (*ribâ*), uncertainty (*gharar*), gambling (*maysir*), and other unethical practices (Ahmad, 1994; Alnamlah et al., 2022; Iqbal, 2004; Ismail, 2010; Ozdemir et al., 2023; Razak et al., 2019; Saiti et al., 2014; Siddique et al., 2023). In contrast to interest-bearing systems, Islamic finance emphasizes the concept of profit and loss sharing as a way of ensuring the fair distribution of income and risk among the parties involved (Iqbal & Molyneux, 2016; Siddiqi, 2000, 2006; Wajdi Dusuki, 2008; Zaher & Kabir Hassan, 2001).

In Türkiye, the banking sector has grown rapidly in recent years and various financial innovations have been introduced. As an Islamic country, Türkiye is in an important position as a country with people with Islamic sensitivities, particularly with respect to interest. In this process, conventional banks and Islamic banks have both played an important role in the country's development and have steadily increased the volume and diversity of financial services. Therefore, understanding and comparing the effects of conventional and Islamic banking sectors on real sector growth in Türkiye has become a growing research topic. Fig. 1 illustrates the volume of funds disbursed by conventional and Islamic banks in Türkiye from 2005 to 2023.

As shown in Fig. 1, over the period 2005–2023, the banking sector underwent a major transformation. The participation banking sector is developing in parallel with that the conventional banking sector. Whereas in 2005 its share of banking was 4.17 percent, in 2023 it was 8 percent. Although it nearly doubled over this period, its share of total banking remains quite small. However, this growth indicates its development potential, which enables us to predict that, in the coming years, the growth is likely to continue.

The goal of this paper is to examine the impact of conventional and Islamic banking on real sector growth in Türkiye through a time-varying causality analysis. The focus of our research is to understand the impact of these two different approaches to banking on the Turkish economy and to identify potential differences. To do so, we use Fourier function econometric analysis and statistical methods to track the causal

relationship between the conventional and Islamic banking sectors on real sector growth over time.

The results of this study are valuable for understanding the effects of the banking sector in Türkiye on real sector growth and contributing to future policy-making. In addition, the results clarify the effects of the banking sector on the Turkish economy by highlighting the differences between conventional and Islamic banking.

The paper is organized as follows. Section 2 reviews the existing literature on the impacts of conventional and Islamic banking sectors on real sector growth after this introduction Section. Section 3 describes the research methodology. Section 4 discusses the main findings of the study, and the concluding remarks are presented in Section 5.

2. Literature review

We divide the literature into three group for review. The first group of studies discusses the impact of the conventional banking sector on economic growth (e.g., Nguyen et al., 2022). The second group discusses the impact of Islamic banking activities. Finally, the third group of studies address the impact of both groups of banks on the real economy in detail, rather than analyzing economic growth in terms of GDP.

The impact of financial systems, or the financial development process, on economic development has attracted considerable attention in the literature. The overall banking sector, which has an important place in the financial system, and Islamic banking, which has developed rapidly over the past thirty years, merit this attention. One subject of extensive research is the complex causal relationship between the evolving activities of financial intermediaries and economic growth, with a focus on conventional and Islamic banks. After Schumpeter (1911), who revealed the impact of the financial sector on economic growth, the first seminal studies on the impact of finance, especially banking, are exemplified by McKinnon (1973), Shaw (1973), Bencivenga and Smith (1991), King and Levine (1993), Levine et al. (2000), and Beck and Levine (2004). Later studies continued to analyze this topic in depth, and some recent prominent studies on the subject are summarized below.

Şendeniz-Yüncü et al. (2008) prove the existence of a long-run relationship between the banking sector and GDP, as a real sector performance measure, through a cointegration test. The causality tests reveal a leading role of the banking sector in the real sector (GDP) in some countries, but no interdependence in other countries. Turgut and Ertay (2016) analyze the Granger-causality relationship between the banking sector and economic growth in Türkiye using quarterly data for the period 2003–2013. Total medium- and long-term loans are used as the banking sector indicator and GDP at constant prices as the economic growth indicator. The results obtained from the Granger-causality analysis (at the 5% significance level) reveal that medium- and long-term total loans have a causal effect on GDP.

Balcilar et al. (2018) analyze the impact of banking and insurance on economic growth with a panel of 10 African countries that are responsible for most of the financial activities

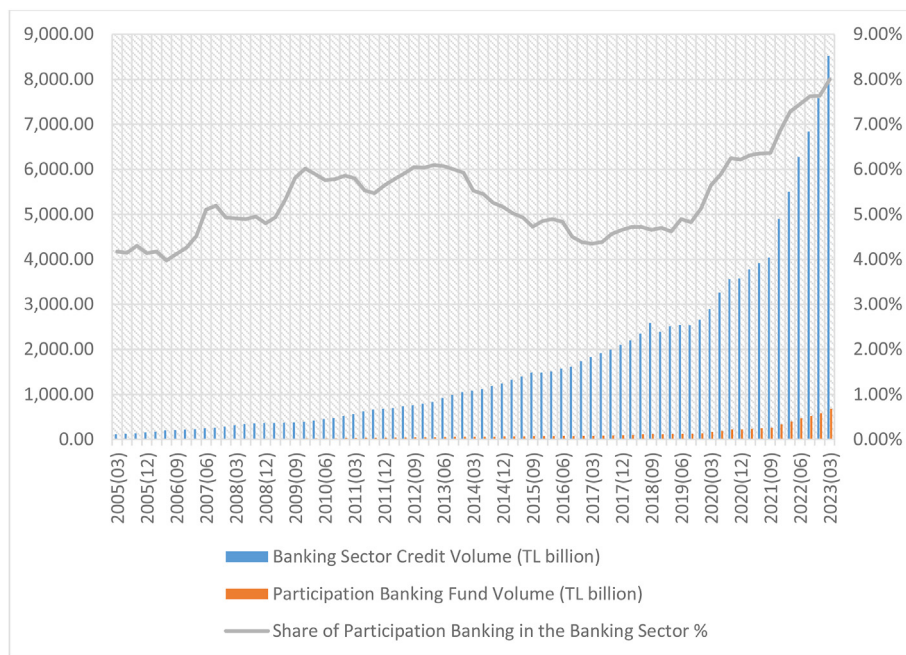


Fig. 1. Growth in the conventional and Islamic banking sectors in Türkiye, 2005–2023

in Africa. Using the dynamic panel generalized method of moments (GMM) estimation technique, they find that the insurance and banking sectors are complementary and together have a positive synergistic effect on economic growth. Kale and Eken (2018) examine the effect of the financial development level and some indicators for the banking sector on economic growth by analyzing data for the period 2003–2016. The Granger-causality relationship is evaluated with the Toda and Yamamoto (1995) approach, identifying a causal relationship not from financial development to GDP but from economic growth to financial development.

Şaşmaz and Gümüş (2018) analyze the impact of the banking sector on economic growth in Türkiye within the framework of an autoregressive distributed lag (ARDL) cointegration test and causality relationship for the period 1960–2017. The growth rate of real GDP per capita is used as an indicator of economic growth and the ratio of domestic bank loans to the private sector to GDP is used as an indicator of the banking sector. The ARDL cointegration test shows that the banking sector has a positive effect on GDP in the long run. Again, the Toda-Yamamoto causality test reveals a unidirectional causality relationship from the banking sector to GDP.

Tongurai and Vithessonthi (2018) evaluate all countries in the world in seven regions between 1960 and 2016 with a panel data analysis. They analyze the impact of the banking sector on economic growth with a panel Ordinary Least Square (OLS) regression. Their results reveal that banking sector development has a negative effect on agricultural sector development in countries with a high level of development, but no effect in other countries. They also find that banking sector development has no effect on industrial sector development. However, they determine that the sectors have an effect on the banking sector: development of the agricultural sector has a negative effect on

the banking sector, whereas development of the industrial sector has a positive effect.

Zequiraj et al. (2020) evaluate 13 southeast European countries with a panel data analysis over the period 2000–2015. Although they also examine other data, they mostly analyze the impact of the banking sector on economic growth using the GMM estimator proposed by Arellano and Bond (1991). The change in real GDP per capita is used as an indicator of economic growth. Their results reveal that banking sector performance has a positive and significant effect on economic growth (GDP).

Örs (2021) empirically analyzes the direct relationship between bank loans and economic growth in Türkiye. In order to limit the scope of analysis, quarterly data between 2003 and 2020 were obtained from the Central Bank of Republic Türkiye (CBRT) and used in a cointegration test. Based on the results on the effects of bank loans on economic growth, bidirectional causality is found between bank loans and interest rates as well as unidirectional causality from economic growth to interest rates. The empirical analysis shows that the total loan volume contributes positively to economic growth in the long and short run.

Altın and Zeren (2022) analyze the effect of the banking sector on economic growth with the panel causality test by Emirmahmutoglu and Kose (2011), in 18 G20 countries over the period 2001–2019. Economic growth is represented by GDP, and the banking sector is included in the analysis by domestic bank loans. Their results reveal bidirectional causality between economic growth and bank loans for the entire panel. On a country basis, causality is found from economic growth to bank loans in nine countries and from bank loans to economic growth in eight countries. Bidirectional causality is found only in Italy. In two countries (Australia, Saudi Arabia), no causal relationship is detected.

Coşkun and Kandemir Kuloğlu (2022) analyze the relationship between bank loans to the private sector and economic growth in Türkiye for the period 1980–2019. Real GDP is used to represent economic growth. Their empirical analyses reveals the existence of a long-run relationship between the variables. The Toda-Yamamoto causality test results show the existence of bidirectional causality between bank loans to the private sector and economic growth.

Haini (2022) analyzes the impact of banking sector development on economic growth in 30 provinces in China for the period 1990–2017, using panel data analysis. A dynamic panel GMM estimator and the U test proposed by Lind and Mehlum (2010) are used. The empirical analyses conducted reveal a nonlinear relationship between banking sector development and economic growth. The Lind-Mehlum U test reveals an inverted U-shaped relationship between the banking sector and economic growth and shows that financial development has a weaker effect on economic growth over time. Accordingly, there is a threshold level at which development of the banking sector becomes negative or insignificant.

Seyfullayev and Seyfullali (2023) analyze the effect of loans to the manufacturing sector in Azerbaijan with some indicators that represent GDP for the period 2005–2021, using the Johansen cointegration test and the Toda-Yamamoto test. Contrary to the predominant findings in the literature, they do not detect a cointegration relationship between financial development and economic growth in the long run. Toda-Yamamoto test results similarly indicate the absence of a causal relationship between the variables.

Oyadeyi (2023) analyzes the impact of banking sector innovations on economic growth in Nigeria over the period 2009–2021. Empirical analyses reveals that various innovative activities have a positive impact on economic growth. The second issue addressed in this study is the impact of Islamic banking activities on economic growth and development. (Studies on this issue are discussed below.)

Abduh and Azmi Omar (2012) analyze the impact of Islamic banking development on economic growth in Indonesia over the period 2003–2010. Their analyses show a significant and bidirectional relationship between the development of Islamic banking and economic growth in the short and long run. Jobarteh and Ergeç (2017) investigate the link between Islamic financial development and economic growth in Türkiye. They use the econometric unit-root, cointegration, and Granger-causality methods within the Vector Error-Correction Model (VECM) framework. Their findings indicate unidirectional causality from Islamic financial development to economic growth in the short and long run, and the results are significant for all measures of Islamic financial development.

Bozkurt (2019) econometrically analyzes the relationship between the development of traditional banking and the development of participation banking with economic growth in Türkiye. These relationships are analyzed using quarterly data from the Central Bank and TURKSTAT for the period April 2005 to February 2016. Their results provide evidence of a nonlinear relationship between financial development and economic growth. Accordingly, although the effect of

participation banking development on economic growth is negative in the early stages, it turns positive later. Conventional banking, however, has a positive effect on economic growth in the first period but turns negatively subsequently.

Using quarterly data covering the period 2005/Q4 to 2018/Q4 and ARDL, Sekmen (2021) examines the effects of Islamic banking on economic growth in Türkiye by comparing it with conventional banking. The model estimates confirm that in Türkiye conventional banking contributes more to economic growth than Islamic banking. However, Sekman (2021) states that “Islamic banking still constitutes a very small part of the financial system in Türkiye and the development and promotion of more Islamic financial instruments could increase the share of Islamic finance in the financial system and strengthen the relationship between Islamic finance and economic growth.”

Polyzos et al. (2022) use machine learning tools to examine how the adoption of various degrees of Islamic banking affects economic outcomes. They show that although “Islamic banking systems tend to reduce economic activity, financial stability and social happiness increase”. In addition, they conclude that a banking sector that applies Islamic principles is better equipped to deal with banking crises because it has lower expectations regarding both economic activity and social welfare than conventional banking.

Çınar and Ünsal (2022) analyze the impact of two variables of the Islamic banking sector (cash fund disbursement volume, total non-bank fund disbursement volume) on economic growth in 81 provinces in Türkiye for the period 2010–2020. The results of their analyses show that the variables are not related in the short run. Their study also argues that Islamic banking has an exclusionary rather than complementary effect on conventional banking, because conventional banking has positive coefficients whereas Islamic banking has negative coefficients in the model that includes conventional banking.

Körüklü (2022) empirically examines the impact of the main products of participation banks on GDP, which is also the main indicator of the country's economy. In the study, Johansen cointegration and Granger-causality tests are performed on the basis of quarterly data for Türkiye in 2010 and 2020. Financing, time and demand deposits, and total assets used at participation banks are compared with GDP. As a result of the tests, a long-run cointegration relationship is found between the variables. As a result of the causality tests, unidirectional causality from loans to GDP and from GDP and loans to deposits were determined.

Ledhem and Mekidiche (2022) analyze the relationship between Islamic financial development and economic growth in Türkiye over the period 2013–2019. In the study, economic growth is represented by GDP, and financial data on six participation banks in Türkiye are used to proxy for Islamic financial development. Analyses using quantile regression with Markov chain marginal bootstrap (MCMB-A) reveal that Islamic finance supports economic growth.

Naz and Gulzar (2023) analyze the impact of Islamic financial development on economic growth in Pakistan for the period 2006–2021. In the study, Islamic banking, the *sukuk*

market, and Islamic equities proxy for Islamic financial development, and economic growth is represented by real GDP. Their analyses reveal a long-run and positive relationship between Islamic banking and the Islamic equities market and GDP, but the Islamic equities market has negative cointegration in the short run. A significant but negative cointegration relationship is found in the short run in terms of *sukuk* volume. In the long run, no cointegration relationship was detected. Their study has important results in terms of showing the impact of Islamic banking on economic growth.

The majority of the literature is on financial development, banking, and economic growth (represented by GDP, i.e., the real economy). But few studies have been conducted on the effects of financial development and banking on the real economy in detail and by subdivisions.

Mitchener and Wheelock (2013) analyze the impact of the banking market structure (banking market concentration) on economic growth using the average annual growth rates in 18 industries for the period 1899–1929. Their results reveal that banking market concentration affects economic growth on a sectoral basis. Topcu and Çoban (2017) analyze the relationship between financial development and firm growth on the basis of subsectors in Turkish manufacturing for the period 1989–2010 with the Dumitrescu and Hurlin (2012) causality approach. Their analyses reveal the validity of a supply-side hypothesis across subsectors.

Ergeç and Selçuk (2020) investigate the causality relationship between six variables of Islamic and conventional banking sectors and eight industrial production indices in Türkiye for the period 2010–2020. Islamic banking has fewer causal relations with industrial production than conventional banking does. The direction of causality relationships shows that although the causality between the variables is mostly from banking to industry or bidirectional with the conventional banking sector and industrial production, the direction of these relationships in the Islamic banking sector is mostly from industrial production to the Islamic banking sector.

Tekin (2021) analyzes the effect of loans from the Islamic and conventional banks in Türkiye on the industrial production index, which represents real sector output, for the period 2008–2020. The results of this analysis show that the loans from Islamic and conventional banks and industrial production move together in the long run. Afolabi et al. (2022) analyze the effect of banks' private sector loans and manufacturing sector loans on manufacturing outputs in Nigeria for the period 1991–2020. Unlike most studies, this analyses shows that private sector loans and manufacturing sector loans have a significant but negative effect on manufacturing outputs.

Rodríguez and Chávez (2023) analyze the impact of commercial bank credit on the manufacturing sector and seven selected manufacturing industries in Mexico for the period 2009–2020. Their results provide evidence that bank credit has a positive and significant impact on output for the entire sector and for some industries (nonmetallic mineral-based products, transport equipment manufacturing, beverages and tobacco, paper, food). The study finds no evidence that credit concentration affects manufacturing output.

Few studies on banking in general address sub sectoral details, and the same is true of studies on Islamic banking. This study fills an important gap in the literature in terms of a comparative analysis of some important subsectors in conventional and Islamic banking in Türkiye. The study also makes important contributions to the literature as it uses econometric analyses that have not been used before in the field of current and addressed issues.

3. Research methodology

This study uses data on Türkiye comprising 218 observations between January 2005 and February 2023. The abbreviations of the data are shown in Table 1.

These sectors are used in the study because of their importance in manufacturing in terms of economic growth in developing countries such as Türkiye. Electricity, gas, steam, and air conditioning are important because of increasing energy needs and their positive contribution to economic growth; mining and quarrying play an important support role in the need for additional resources in economic growth. Although other sectors are also important, they are excluded from the scope of this study because the volume of the study. The descriptive statistics of these variables are listed in Table 2.

This study analyzes the time-varying causality relationships between total banking and participation banking in terms of the commercial loan and fund disbursement volume and dependent variables (mining; manufacturing; and electricity, gas, steam, and air conditioning production and distribution) in Türkiye, and the fractional frequency Fourier augmented Dickey-Fuller (FADF) unit-root test is applied to the variables. Following the unit-root test, we perform a time-varying causality test.

The unit roots are analyzed using a Fourier ADF unit-root test (Enders & Lee, 2012) and then causality tests.

$$\Delta y_t = \delta_0 + \delta_1 \sin\left(\frac{2\pi\kappa t}{T}\right) + \delta_2 \cos\left(\frac{2\pi\kappa t}{T}\right) + \delta_3 y_{t-1} + \sum_{i=1}^p \alpha_i \Delta Y_{t-i} + V_t \tag{1}$$

Next, the time-varying causality test developed by Hacker and Hatemi-J (2006) and used by Zeren and Koç (2016) is performed with the binary variables. The most important difference between the Toda-Yamamoto (1995) causality test and the Hacker and Hatemi-J (2006) causality test is that, in the latter, the critical values are obtained by Monte Carlo simulation method. Subsequently, the causality relationship between the two series is tested with the lagged vector autoregressive (VAR) model. Hacker and Hatemi-J (2006) test the causality

Table 1
Variables and variable labels.

Variable	Variable labels
Banking	BNK
Participation Banking	PBNK
Mining	MIN
Manufacturing Industry	MAN
Electricity	ELEC

Table 2
Descriptive statistics of the variables.

	BNK	KTLM	MIN	MAN	ELEC
Mean	13.5401	10.6849	4.5722	4.4876	4.5393
Median	13.6265	10.8298	4.5993	4.5028	4.5585
Maximum	15.7406	13.2996	4.9996	5.1369	5.0101
Minimum	11.3894	8.2420	4.0400	3.8709	4.0665
Std. Dev.	1.1239	1.1957	0.2125	0.2990	0.2236
Skewness	-0.0296	-0.0078	-0.4214	0.0364	-0.2000
Kurtosis	2.0042	2.5073	2.5448	2.0517	2.0681
Jarque-Bera	9.0390	2.2070	8.3344	8.2157	9.3424
Probability	0.0109	0.3317	0.0155	0.0164	0.0094
Sum	2951.74	2329.31	996.74	978.30	989.56
Sum Sq. Dev.	274.0921	310.2253	9.7983	19.3950	10.8479
Observations	218	218	218	218	218

relationship between the two series with the VAR model, given in Equation (2):

$$y_t = a + A_1 y_{t-1} + \dots + A_p y_{t-p} + u_t \tag{2}$$

The VAR model of this equation is given in Equation (3).

$$Y = DZ + \delta \tag{3}$$

in Equation (3), Y, D, Z, and δ are defined as follows:

$$\begin{aligned} Y &:= (y_1^+, y_2^+, y_3^+, \dots, y_T^+) \text{ (nxT)matrix,} \\ D &:= (a, A_1, A_2, A_3, \dots, A_p) \text{ (nX(1 + n(p + d))),} \\ Z &:= (Z_0, Z_1, Z_2, Z_3, \dots, Z_{T-1}) \text{ ((1 + n(p + d))XT)matrix,} \\ \delta &:= (u_1^+, u_2^+, u_3^+, \dots, u_T^+) \text{ (nxT)matrix,} \end{aligned} \tag{4}$$

$$Z_t := \begin{bmatrix} 1 \\ Y_1 \\ Y_{t-1} \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ Y_{t-p+1}^+ \end{bmatrix} \text{ ((1 + n(p + d))) X1 matrix for } t = 1 \text{ next } T \tag{5}$$

The main hypothesis of no Granger causality is analyzed with the Wald test statistic in Equation (6).

$$MWALD = (C\beta)' [C((Z'Z)^{-1} \otimes S_u)C]^{-1} (C\beta) \tag{6}$$

Here, \otimes is the Kronecker product, and C is the indicator function with constraints. Here $\beta = \text{vec}(D)$, where vec is the column accumulation operator. Because q is the number of lags in the VAR equilibrium, it shows that the variance-covariance matrix is calculated as $(\delta \delta)' / (T - q)$ for the unrestricted VAR model (Zeren & Koç, 2016).

The time-varying causal relationship between the variables are analyzed separately with these equations.

We also examine whether a U-shaped or inverted U-shaped relationship exists between banking and participation banking for each variable (for similar approaches, see Bastý &

Ghachem, 2023). To do so, we use the U-shape–inverted U-shape test approach developed by Lind and Mehlum (2010). The test takes into account the sign and significance of the variable and its quadratic term. According to Lind and Mehlum, U-shaped or inverted U-shaped relationships should be examined by looking at the signs and statistical significance of the original variable and its squared term. For this purpose, the following OLS equation should be estimated first.

$$\text{Ln } y_{mt} = a \text{Ln} x_{mt} + b \text{Ln} x_{mt}^2 + Z_t C + \varepsilon_t \tag{7}$$

where y is the dependent variable, and each dependent variable is represented as $(y_m: y_1, y_2, \dots, y_n)$. Independent variables are represented as $(x_m: x_1, x_2, \dots, x_n)$. We perform tests separately for each dependent variable (y_1, y_2, \dots, y_n) . The joint hypothesis test should be performed after the equations are estimated.

$$H_0 : (a + b2 \text{Ln} x_{m(\min)} \leq 0) \cup (a + b2 \text{Ln} x_{m(\max)} \geq 0) \tag{8}$$

The alternative hypothesis is presented as follows:

$$H_1 : (a + b2 \text{Ln} x_{m(\min)} > 0) \cup (a + b2 \text{Ln} x_{m(\max)} < 0) \tag{9}$$

where $\text{Ln} x_{m(\min)}$ is the minimum value of the mth independent variable, and $\text{Ln} x_{m(\max)}$ is the maximum value of the mth independent variable. If the null hypothesis is rejected, then the existence of a U-shape is confirmed. H0 and H1 can also be articulated in reverse.

4. Results and discussions

In this section, we first perform the fractional frequency Fourier ADF test of stationarity of the series. Then, we use the time-varying causality test developed by Hacker and Hatemi-J (2006) and used by Zeren and Koç (2016) to analyze the causality relationship between the variables. The fractional frequency Fourier ADF unit-root test results at level and first difference of the variables are given in Table 3.

The FADF test statistic calculated for BNK, PBNK, ELEC, MAN, and MIN is outside the critical values shows that all the variables contain a unit root at level. When we take the first difference of the variables, the unit-root problem is eliminated, and they all become stationary. Therefore, all the variables are stationary to the same degree.

At this stage, the Zeren and Koç (2016) time-varying causality test is applied. The results of the analyses conducted to investigate the course of the causality relationship between the variables over time show statistical values of more than 1, indicating a causal relationship (Zeren & Koç, 2016). Fig. 2 illustrates the time-varying causality results between the banking sector commercial loan volume (BNK) and electricity, gas, steam and air conditioning production and distribution sector production volume index (ELEC).

In the next stage, we evaluate whether a U-shaped or inverted-U-shaped relationship exists between the relevant variables with the analysis developed by Lind and Mehlum (2010). The results about the relationship are given in Table 4.

Table 3
Fractional frequency Fourier augmented Dickey-fuller unit-root test results.

Variable	k	Min KKT	F Test Statistic	App. Lag Length	FADF Test Statistic	FADF 1% Critical Value	FADF 5% Critical Value	FADF 10% Critical Value
BNK	0.1	0.1171	4.930007	1	-1.35944	-476,837	-421,683	-393,332
DBNK	0.1	0.1150	3.808686	1	-9.94758	a -476,837	-421,683	-393,332
PBNK	0.8	0.1453	11.24312	1	-1.128558	-480,277	-426,329	-398,427
DPBNK	0.1	0.1410	9.109098	1	-9.13452	a -476,837	-421,683	-393,332
ELEC	0.2	0.9456	5.709894	13	-3.52329	-474,122	-420,078	-39,215
DELEC	3.7	1.3307	5.207604	11	-5.47653	a -428,578	-367,112	-334,119
MAN	0.4	2.0942	4.201859	13	-2.93177	-478,169	-421,847	-393,958
DMAN	3.5	2.4891	5.239953	11	-6.422	a -429,185	-366,797	-334,624
MIN	0.1	1.8470	3.783997	14	-3.12926	-476,837	-421,683	-393,332
DMIN	3.8	2.1959	3.692559	13	-4.59875	a -42,462	-363,994	-332,055

^a 1% level of significance.

The results of the Lind and Mehlum (2010) test in Table 4 reveal the existence of an inverted U-shaped relationship. They show that the lower bound slope is 0.13107, but the upper bound slope turns negative. Accordingly, the marginal impact of the banking sector on the electricity sector has tended to decrease over time, and an inverted U-shaped relationship has started to form, as shown in Fig. 3.

Fig. 2 illustrates the time-varying causality results from BNK to ELEC and from ELEC to BNK, showing that—except for periodic episodes—the causality relationship is generally weak. However, on balance, more causality is found from ELEC to BNK. The causality relationship between the variables intensified in particular after the 2008 crisis. The causal relationship from ELEC to BNK began early on in the crisis. No causality from BNK to ELEC is seen until February 2010. The effects of the global financial crisis of 2008–2009 began to decrease in Türkiye in that period. At the peak of the crisis at the end of 2009, GDP (in USD) had decreased by 4.84 percent compared to the previous year. At the end of 2010, it increased by 8.59 percent compared to 2009 and 3.33 percent compared to 2008 (OECD, 2023). However, interestingly, the causality from BNK to ELEC later

disappeared, and then this directional relationship did not arise again until June 2020. This is quite remarkable. In mid-2020, the variables affect each other in a bidirectional causal relationship. The most important development in this period was the emergence of Covid-19 in Türkiye beginning on March 11, 2020 (Koca, 2020). This causal relationship emerged in the first stage due to this virus-induced crisis, later be declared to be a pandemic. In this period, developments in some indicators that directly affect the electricity market are also noteworthy. For example, gasoline and diesel prices started to increase in this period. Gasoline prices increased by 9.5 percent, 7.5 percent, 4.3 percent, 3.2 percent, 2.2 percent, 1.2 percent, 0.0 percent and 5.2 percent in the June–December 2020 period, respectively. In the same period, diesel prices increased by 2.3 percent, 6.5 percent, 4.5 percent, 2.6 percent, -2.4 percent, 2.6 percent, 3.6 percent and 4.7 percent, respectively. Domestic natural gas prices, which directly affect the energy market, did not significantly increase.

Next, the results of the time-varying causality analysis between the banking sector commercial loan volume (BNK) and the manufacturing industry production volume index (MAN) are shown in Fig. 4.

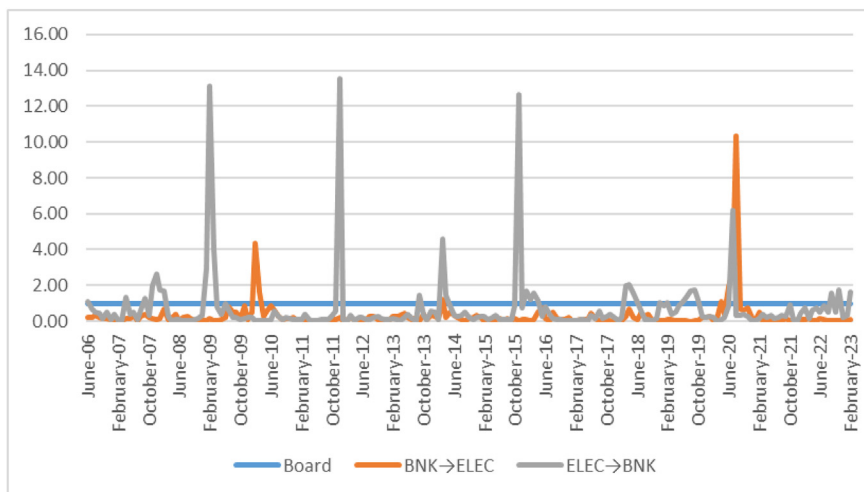


Fig. 2. BNK↔ELEC causality.

Table 4
U- or inverted U-shaped relationship between BNK ↔ ELEC.

H1: Inverted U-shape		
H0: Monotonic or U-shape		
	Lower bound	Upper bound
Interval	11.38939	15.74057
Slope	0.13107	-0.07723
t-value	2.39248	-1.36223
P> t	0.00880	0.08728
95% Fieller interval for extreme point	[11.997438; 16.774809]	
Extreme point	14.12727	
t-value	1.36000	
P> t	0.08730	
Overall test of presence of an inverted U-shape.		

Table 5
U or inverted U-shaped relationship between BNK ↔ MAN.

H1: Inverted U-shape		
H0: Monotonic or U-shape		
	Lower bound	Upper bound
Interval	11.38939	15.74057
Slope	0.87085	-0.03107
t-value	4.40632	-0.16539
P> t	0.00001	0.43440
95% Fieller interval for extreme point	[14.650131; 24.631364]	
Extreme point	15.59066	
t-value	0.17000	
P> t	0.43400	
Overall test of presence of an inverted U-shape.		

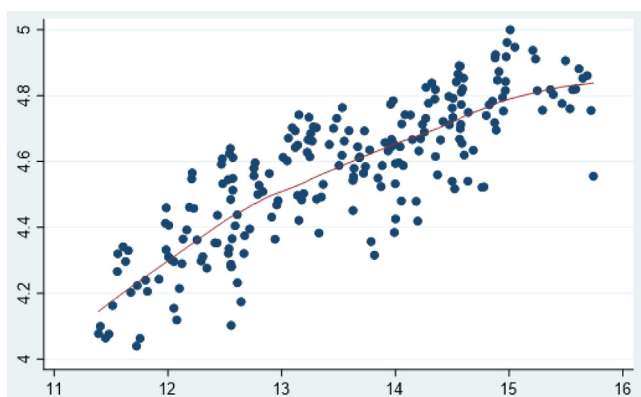


Fig. 3. Inverted U-shape in BNK ↔ ELEC

Next, we analyze whether a U-shaped or inverted-U-shaped relationship exists between the relevant variables based on the method by Lind and Mehlum (2010). The results on the relationship are given in Table 5.

The Lind and Mehlum (2010) test results in Table 5 reveal the existence of an inverted U-shaped relationship. As the results show, the lower bound slope is 0.87085, and the upper

bound slope value has turned negative. Accordingly, the marginal effect of the banking sector on the manufacturing sector has decreased over time, and an inverted U-shaped relationship has started to form. As seen in Fig. 5, the initial slight U-shaped has started to take an inverted U-shape at the end of the relevant interval.

An analysis of the time-varying causality relationship between BNK and MAN in Fig. 5 shows a more intense causal relationship from BNK to MAN. Although there is significant causality from BNK to MAN before the 2008–2009 global financial crisis, the direction of causality turned from MAN to BNK during the global financial crisis. In 2010, when the effects of the global financial crisis started to diminish in Türkiye, the relationship is predominantly from BNK to MAN, and, at the same time, a bilateral causal relationship is also observed. Until February 2015, although the causal relationship fluctuates, the causal relationship is from BNK to MAN. In the February–October 2013 period, the causal relationship is quite high. The most important development in this period is that street protests in Türkiye between May and August 2013, called the Gezi Park protests, deeply shook the economy and the country. Türkiye experienced moderate economic growth in the period January 2015–March 2016 but also faced some

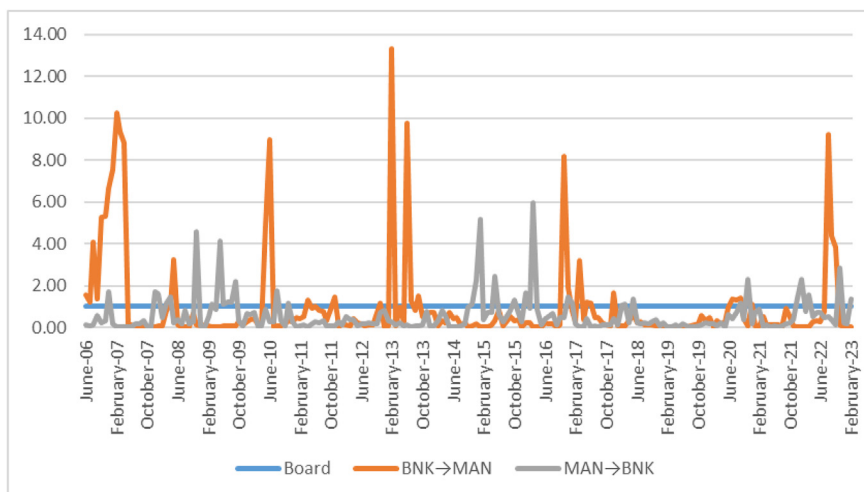


Fig. 4. BNK ↔ MAN causality.

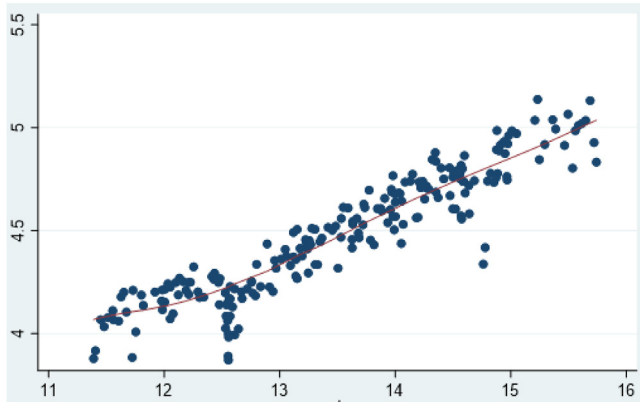


Fig. 5. Inverted U-shape in BNK \mapsto MAN

external and internal shocks that affected its stability and confidence. During this period, annual growth in US dollar terms was 5.98 percent in 2015 and 3.32 percent in 2016 (OECD, 2023). This period of economic stability is noteworthy, as a time in which manufacturing supported bank loan growth. The period between June 2018 and March 2020 again is important as a time in which the bilateral causal relationship disappeared. In this period, before the Covid-19 pandemic, Türkiye experienced a serious economic slowdown due to a combination of external and internal factors. In the last two quarters of 2018, the growth rate was -1.63 percent and -3.18 percent. As of the end of 2019, the annual growth rate was 0.81 percent. Considering that annual growth was 7.46 percent in 2017, the slowdown is significant (OECD, 2023). Because the Covid-19 pandemic emerged in mid-2020, causal relations re-emerged, and the bilateral causal relationship has continued, despite fluctuations. The banking sector is closely related to manufacturing because Türkiye is a developing country, manufacturing is one of the main driving sectors in developing countries, and this sector needs financial support because of the lack of domestic resources. But the banking sector, like other financial sectors, is one of the sectors that is most affected by micro- and macro-scale developments. For all these reasons,

Table 6

U- or inverted U-shaped relationship between BNK and MIN.

	Lower bound	Upper bound
H1: Inverted U-shape		
H0: Monotonic or U-shape		
Interval	11.38939	15.74057
Slope	0.34943	0.17224
95% Fieller interval for extreme point	[17.775232; 24.315031]	
Extreme point	19.97006	

Extremum outside interval; trivial failure to reject H0.

the strong interaction in the time-dependent causality between manufacturing and banking is seen as stronger and more noteworthy than electricity, considered in the previous example.

The next analysis is the time-varying causality analysis between the banking sector commercial loan volume (BNK) and the mining and quarrying sector production volume index (MIN) variables, and the results of the analysis are shown in Fig. 6.

In the next stage, we evaluate whether the relevant variables have a U-shaped or inverted-U-shaped relationship, using an analysis developed by Lind and Mehlum (2010). The results regarding the relationship are given in Table 6.

According to the results of the Lind and Mehlum (2010) test given in Table 6, the extremum outside interval and H0 cannot be rejected. As shown in results, the upper bound point is still below the extreme point, which shows that the relationship between the variables is still monotonic and has not yet taken a U- or inverted U-shape. Nevertheless, the fact that the slope at the upper bound is considerably smaller than the slope at the lower bound gives a clue that an inverted U-shape will emerge in the future (after the extreme point is exceeded). The reason for this situation is that Türkiye is a developing country and the related sector is not yet completely developed.

The time-varying causality results between BNK and MIN in Fig. 6 show a consistent causal relationship between the two variables most of the time, although it fluctuates temporally. In

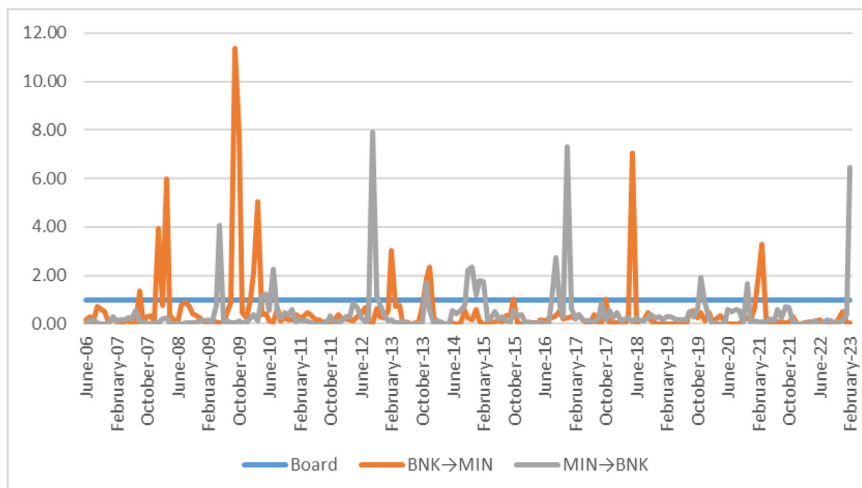


Fig. 6. BNK \leftrightarrow MIN causality.

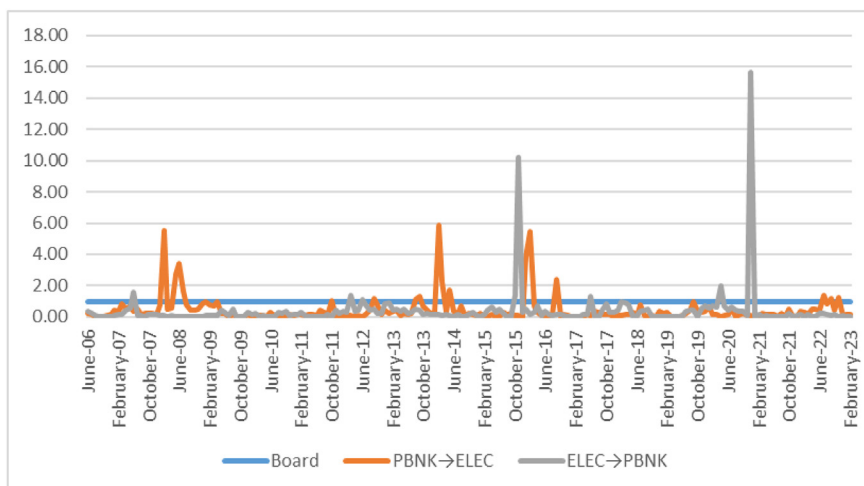


Fig. 7. PBNK↔ELEC causality.

this group, it is observed that the causal relationship between the variables emerged because of the impact of the 2008 global crisis, and the causality that first emerged was from BNK to MIN. Although causality disappeared for a while, this causal relationship continued throughout the crisis period. The causal relationship reversed in some periods during the crisis period. In 2011, the causality disappeared bilaterally, and, in the first months of 2012, causality was observed, first, from MIN to BNK and, then, from BNK to MIN at the beginning of 2013. At the end of 2013, causality was bilateral. In the following periods, causality disappears most of the time, and there is sometimes reverse causality from BNK to MIN. During the economic slowdown, before the Covid-19 pandemic, the causal relationship was almost nonexistent except in one period. During the pandemic, a causal relationship is observed, first from MIN to BNK and then the reverse. The mining and quarrying sector presents a different outlook than other economic sectors. Although it is affected by crises and economic events, it does not have a direct and obvious causal relationship, as the manufacturing sector is affected. The mining and quarrying sector has less connection to the general economy than manufacturing. Therefore, it is to be expected that the strong relationships like those in the manufacturing sector are not found here. The sector has a different structure, due to its own internal dynamics, and it differs from the other sectors analyzed.

After the impact of the banking sector on the sectors is considered, in the second stage, we analyze the time-dependent causal relationship of participation banks on related sectors. Accordingly, the next analysis is the time-varying causal analysis between participation banking in terms of PBNK and ELEC, and the results are given in Fig. 7.

In the next stage, we evaluate whether the relevant variables have a U-shaped or inverted-U-shaped relationship with an analysis based on Lind and Mehlum (2010). The results regarding the relationship are given in Table 7.

According to the Lind and Mehlum (2010) test results in Table 7, the extremum outside interval and H0 cannot be

rejected. As shown in the results, the upper bound point is still below the extreme point. This shows that the relationship between the variables is still monotonic and has not yet taken a U- or inverted U-shape. Nevertheless, the fact that the slope at the upper bound is considerably smaller than the slope at the lower bound gives a clue that an inverted U-shape will be seen in the future (after the extreme point is exceeded). The reason for this situation is that Türkiye is a developing country and participation banking is not yet completely developed.

We analyze the results of the time-varying causal relationship between PBNK and ELEC in Fig. 7, finding that the causality from PBNK to ELEC is more intense. The causality from ELEC to PBNK is limited. The previous analysis of the banking sector shows more causality from the variable to BNK. In this respect, there is a difference between the banking sector and the participation banking sector.

The next analysis is the time-varying causality analysis between PBNK and MAN, and the results are illustrated in Fig. 8.

In the next stage, we evaluate whether the relevant variables have a U-shaped or inverted-U-shaped relationship with an analysis based on Lind and Mehlum (2010). The results on the relationship are presented in Table 8.

The results of the Lind and Mehlum (2010) test in Table 8 show that the extremum outside interval and H0 cannot be

Table 7
U- or inverted U-shaped relationship between PBNK and ELEC.

	Lower bound	Upper bound
Interval	8.24200	13.29964
Slope	0.23457	0.05303
95% Fieller interval for extreme point	[13.393412; 18.783369]	
Extreme point	14.77717	
Extremum outside interval; trivial failure to reject H0.		

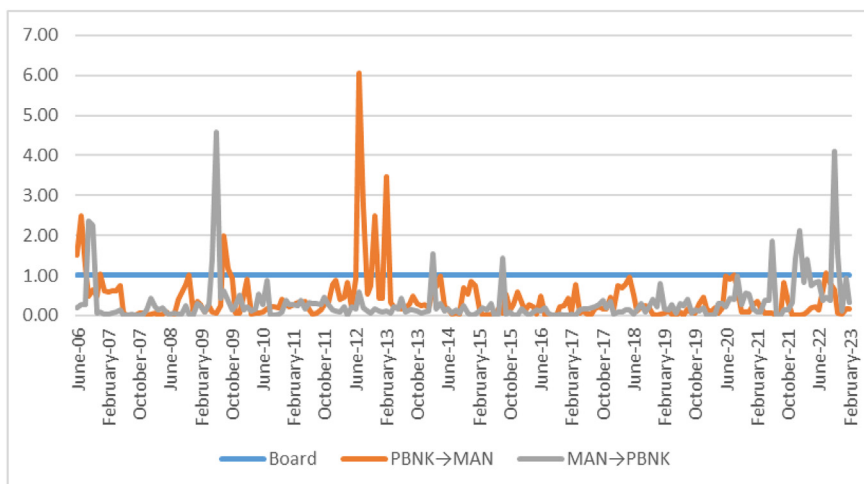


Fig. 8. PBNK↔MAN causality.

rejected. As indicated in the results, the upper bound point is still below the extreme point. This shows that the relationship between the variables is still monotonic and has not yet taken a U- or inverted U-shape. Nevertheless, the fact that the slope at the upper bound is considerably smaller than the slope at the lower bound indicates that an inverted U-shape will emerge in the future (after the extreme point is exceeded). The reason for this situation is that Türkiye is a developing country, in which participation banking and the sector analyzed are not yet completely developed.

An analysis of the time-varying causal relationships of PBNK and MAN in Fig. 8 shows that, after the financial crisis, causality ran from MAN to PBNK. Before the crisis, a bidirectional causal relationship is found in some periods. The conventional and participation banking sectors have a similar effect on manufacturing both before and after the financial crisis, for example in the period 2011–2013. In the period July 2012–June 2013, the causality relationship is quite high. Although the causal relationship fluctuates until December 2014, it ran from BNK to MAN. From 2014 until 2020, with the outbreak of the Covid-19 pandemic, the causal relationship between participation banking and manufacturing seemed to disappear. During this period, the causal relationships seen in the banking sector during the Gezi Park protests in Türkiye in May–August 2013 and the moderate economic growth between

January 2015 and March 2016 were not observed in participation banking. Short-term causality from MAN to PBNK is seen only in August 2015. In October 2020, during the Covid-19 pandemic, a causal relationship existed from BNK to MAN, and since then, a causal relationship has existed from MAN to PBNK.

These findings are quite interesting. Until the end of 2013, the conventional and participation banking sectors had similar effects on manufacturing, but afterward, they diverged. Manufacturing drives growth in participation banking. The participation banking sector in Türkiye is still in the process of development and, as of April 2023, comprises 8.34 percent of the banking sector as a whole (BDDK, 2023). Depending on the increase in this share, it can be predicted that, over time, the effect on banking as a whole will also be seen in participation banking.

Next, we analyzed time-varying causality between PBNK and MIN, and the results are shown in Fig. 9.

We evaluate whether a U-shaped or inverted-U-shaped relationship is found between the relevant variables with an analysis by Lind and Mehlum (2010). The results are shown in Table 9.

The results of the Lind and Mehlum (2010) test in Table 9 show that the extremum outside interval and H0 cannot be rejected. The results also indicate that the upper bound is still below the extreme point. This shows that the relationship between the variables is still monotonic and has not yet taken a U- or inverted U-shape. Nevertheless, the fact that the slope at the upper bound is considerably smaller than the slope at the lower bound demonstrates that an inverted U-shape will occur in the future (after the extreme point is exceeded). The reason for this situation is that Türkiye is a developing country, and participation banking and the analyzed sector are not yet completely developed.

The last model analyzing time-dependent causality between PBNK and MIN is shown in Fig. 9. The analysis indicates that the weighted causality is from participation banking (PBNK) to MIN. As with banking as a whole in the previous analyses,

Table 8
U- or inverted U-shaped relationship between PBNK and MAN.

	Lower bound	Upper bound
H1: U-shape		
H0: Monotonic or inverted U-shape		
Interval	8.24200	13.29964
Slope	-0.19731	-0.10364
95% Fieller interval for extreme point	[13.806735; 75.934066]	
Extreme point	18.89552	

Extremum outside interval; trivial failure to reject H0.

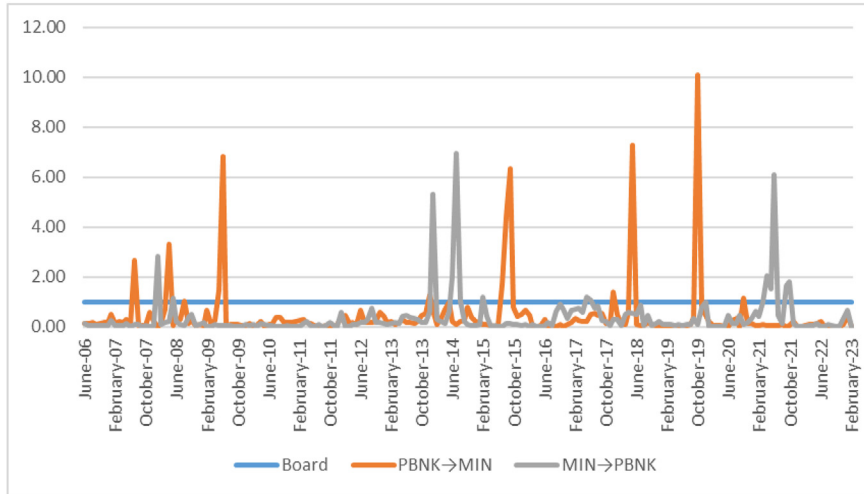


Fig. 9. PBNK↔MIN causality.

Table 9
U- or inverted U-shaped relationship between PBNK and MIN.

H1: Inverted U-shape		
H0: Monotonic or U-shape		
	Lower bound	Upper bound
Interval	8.24200	13.29964
Slope	0.25299	0.08517
95% Fieller interval for extreme point	[14.413813; 19.089462]	
Extreme point	15.86652	

Extremum outside interval; trivial failure to reject H0.

causality runs from PBNK to MIN before, during, and after the 2008 financial crisis. Increasing causality from MIN to PBNK occurs in the period January 2014–August 2014, and then the direction of causality changes. Subsequently, except in October 2021, the causal relationship is similar to that of the banking sector as a whole.

Figs. 10 and 11 give the causality point diagrams, which enable the causal relationships of the variables over time to be observed more easily.

When the causality intensities in the dot diagrams are evaluated periodically, it is seen that the causality relations between the banking sector and the related sectors in Türkiye are quite intense, whereas participation banking has fewer causal relationships in the related sectors because it is still in the process of development.

5. Conclusions

In this study, we use a time-varying bootstrap causality test to examine banking in Türkiye over the period January 2005 to February 2023, and our most important result is that the commercial loans and funds extended by banks as a whole and participation banks in particular have significant effects on the real economy. In particular, banking has a significant impact on

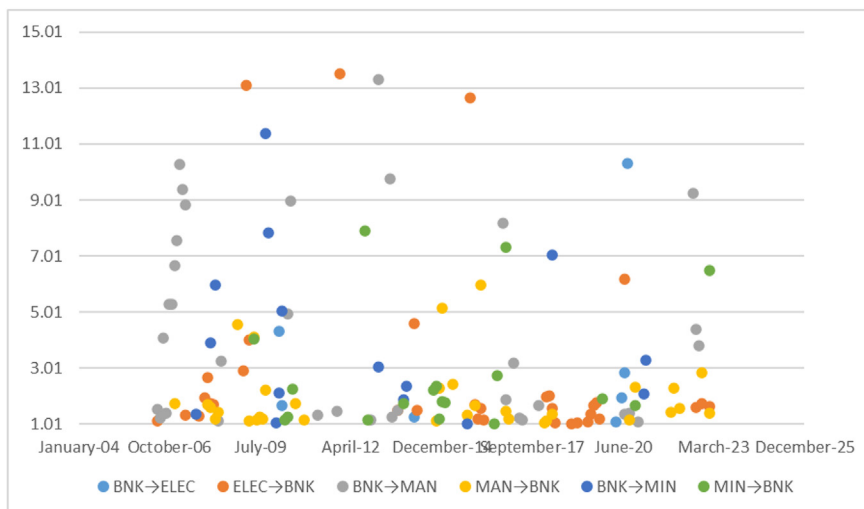


Fig. 10. Causality point diagram of the banking sector.

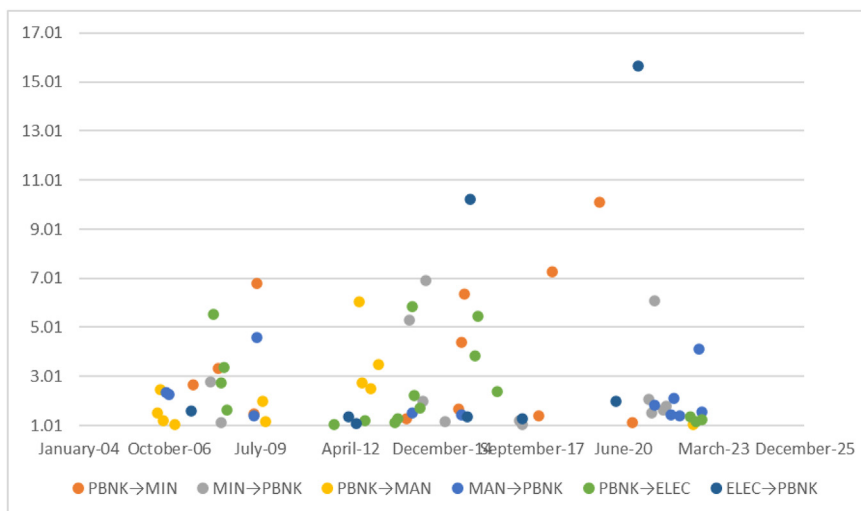


Fig. 11. Causality point diagram of the participation banking sector.

production volume in manufacturing. Banking and participation banking have an undeniable relationship with two other sectors as well. Because of its unique nature, the mining and quarrying sector has a different causal relationship. A second important result is that participation banking is supported by the sectors, rather than the reverse, because it is still in the process of development. This view is supported because less time-dependent causality is found, and the direction of the causality is predominantly from sectors to participation banking. Yet another result is that macro- and micro-scale economic developments (crises or positive economic developments) affect the relationship between the banking sector and the real economy and its direction. Manufacturing, which is an important representative of the real economy and has a weighted effect on GDP, is directly affected by economic developments and the direction and weight of its relationship with the financial sector is shaped accordingly.

Our results are in line with the general results in the literature, although they reveal causality in greater detail, depending on time. In this respect, our study supports the findings of prior studies on the relationship between the banking sector and economic growth (e.g., [Balcilar et al., 2018](#); [Coşkun & Kandemir Kuloğlu, 2022](#); [Oyadeyi, 2023](#); [Turgut & Ertay, 2016](#); [Zeğiraj et al., 2020](#); [Şendeniz-Yüncü et al., 2008](#)). Likewise, it is generally in line with prior studies that reveal the impact of the banking sector on real sectors on the basis of real sector subdivisions (e.g., [Rodríguez & Chávez, 2023](#); [Topcu & Çoban, 2017](#)).

In addition, although they support the findings in prior studies on the relationship between the participation banking sector and economic growth (e.g., [Bozkurt, 2019](#); [Jobarteh & Ergeç, 2017](#); [Körüklü, 2022](#); [Ledhem & Mekidiche, 2022](#); [Tekin, 2021](#)), they predict that the main contribution of participation banking in Türkiye will emerge over time (e.g., [Ergeç & Selçuk, 2020](#); [Sekmen, 2021](#)). The study does not support prior studies that show that Islamic banking activities have no effect on economic growth or have a negative effect (e.g., [Polyzos et al., 2022](#); [Çınar & Ünsal, 2022](#)).

Unlike prior studies on the impact of the banking sector on GDP, this study addresses the impact of the banking sector on the basis of subdivisions in the real sector. This study analyzes Türkiye, which has Islamic banking as well as conventional banking, so the impact of the two banking sectors is examined separately. Another unique aspect of the study is that it analyzes all these relationships on the basis of time-varying causality using current Fourier functions. The study investigates whether the effect of conventional and Islamic banking on the dependent variables develops a U- or inverted U-shaped relationship over time. This is an important detail, because the strength of the relationship between variables might decrease or even reverse over time. In this respect, the study reveals a difference between conventional and Islamic banks in Türkiye case. In all these respects, the study makes unique and important contributions to the literature.

The study also obtains important findings in terms of revealing the increasing impact of Islamic banking activities in particular. These findings emphasize the importance of Islamic banks in the economy. Policy makers are expected to develop policies taking into account this aspect and impact of banks and Islamic banks in particular. Taking into account as well our findings on the causal relations of changes in the economy and the direction of the relationship and developing policies accordingly will make a significant contribution to economic development. In particular, the results of the [Lind and Mehlum \(2010\)](#) test used in the study show that the marginal effect of the positive causal relationship between the banking sector and related sectors tends to decrease over time, and an inverted U-shaped relationship emerges. However, in Islamic banking, it is too early for an inverted U-shaped relationship to form, and therefore, a positive marginal effect persists. Some sectors support participation banking because it is still in the process of development, and doing so as a general policy will have positive consequences for economic development in the country. For this reason, policy makers should also follow suit. These policies can be implemented more easily in countries such as Türkiye, which has participation banks.

Finally, our suggestion for future research is to consider sectors other than the three sectors considered in this paper. In addition, replication of the study with different country samples could also make significant contributions to the literature.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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