Available online at www.sciencedirect.com

Borsa İstanbul Review

Borsa İstanbul Review 23-6 (2023) 1303–1321
http://www.elsevier.com/journals/borsa-istanbul-review/2214-8450

The role of institutional quality in the relationship between financial development and economic growth: Emerging markets and middle-income economies

Yuksel Bayraktar [a], Ayfer Ozyilmaz [b,*], Metin Toprak [c], Mehmet Firat Olgun [d], Esme Isik [e]

[a] *Department of Economics, Ankara University, Ankara, 34452, Türkiye*
[b] *Department of Foreign Trade, Kocaeli University, Kocaeli 41650, Türkiye*
[c] *Department of Economics, Istanbul Sabahattin Zaim University, Istanbul 34303, Türkiye*
[d] *Technology Transfer Office, Kastamonu University, Kastamonu 37150, Türkiye*
[e] *Department of Optician, Malatya Turgut Ozal University, Malatya 44090, Türkiye*

Received 9 June 2023; revised 5 October 2023; accepted 5 October 2023
Available online 12 October 2023

Abstract

In this study, the relationship between economic growth and financial development was analyzed for emerging markets and middle-income economies. The effect of financial development on growth, whether there is institutional quality or not, has also been investigated. In addition, which financial development indicator is more effective for growth has been examined. Six institutional quality indicators and seven financial development indicators were used. According to the Dumitrescu–Hurlin causality test results, there is a causality relationship between all financial development indicators and growth. According to the estimation results, financial development indicators have a positive effect on growth in the presence of institutional quality. However, if institutionalization is not included in the model, the effect of financial development indicators on economic growth is statistically insignificant.

Keywords: Financial development; Growth; Institutional quality; Causality; Machine learning; Random forest

1. Introduction

The financial system has critical importance in macroeconomic indicators. In this context, financial sector development can cause important investments that can contribute to poverty and economic growth (Guru & Yadav, 2019; Redmond & Nasir, 2020; Shahbaz et al., 2020). Financial systems direct small savings to major investments, decreasing risk, and accessing accurate information with institutional quality. In this way, financial structures that respond to the market's demand for funds lead to the realization of capital accumulation, which is the basis of growth (Tunali & Onuk, 2017). Increasing capital accumulation in the financial system depends on the existence of a developed financial system. Financial system development not only causes a quantitative increase in some financial indicators but also causes a qualitative improvement in financial instruments and service quality (Kandır et al., 2007; Song et al., 2021).

Financial instruments that have diversified and strengthened with the development of the financial system can facilitate trading and hedging. In this way, financial systems can affect the allocation of resources and thus economic growth by enabling risk diversification between industries and firms. In addition, the financial system can ensure economic stability

* Corresponding author.
E-mail addresses: yuksel.bayraktar@ankara.edu.tr (Y. Bayraktar), ayfer.ozyilmaz@kocaeli.edu.tr (A. Ozyilmaz), metin.toprak@izu.edu.tr (M. Toprak), mfolgun@kastamonu.edu.tr (M.F. Olgun), esme.isik@ozal.edu.tr (E. Isik).

Peer review under responsibility of Borsa İstanbul Anonim Şirketi.

https://doi.org/10.1016/j.bir.2023.10.002

through financial stability. At this point, the financial system has a critical role in encouraging innovation that will strengthen competition and support productivity (Estrada et al., 2010; Nasir et al., 2015).

Financial inclusion, in another context, covers certain components of monetary and fiscal policies. Financial inclusion nourishes existing tools in the financial system to ensure economic and social benefits. Therefore, the simultaneous use of monetary and fiscal policies within the scope of financial inclusion may strengthen the main components of the financial system, such as stocks and bonds (see Nasir & Soliman, 2014), which may ultimately lead to a higher benefit from financial inclusion.

Financial development can improve efficiency in capital allocation by providing optimal information for profitable investments. In other words, an advanced financial system helps reduce information costs and can enable the effective execution of contracts. In addition, the financial system can make the framework of the concept of risk safer by providing access to accurate information. Individuals are generally risk averse, but high-yield investment opportunities generally tend to be high-risk. Financial intermediaries and markets allow individuals to diversify their risks, channeling more capital into high-return investment projects, high-risk investments, and thus capital productivity increases (Estrada et al., 2010; Guru & Yadav, 2019).

Some of the prominent channels in the financial system's positive impact on economic growth are as follows: i) information costs, which begin to decrease with financial development, may lead household savings to turn to corporate sector investments, and this can bring about efficiency in resource allocation; ii) developed financial systems can positively affect capital accumulation by providing flexibility to savings; iii) the development of financial systems can positively affect corporate governance, and as a result, productivity in investment projects can reach a more optimal level; iv) financial development can positively affect asset diversification through risk minimization and transparency channels, and this can support long-term investments; and v) financial development can feed the real sector and cause productivity and specialization (Levine, 2005).

One of the important parameters in the positive effect of the financial system on economic growth is the balanced growth of the real and financial sectors. Financial development that is not reflected in the real sector can sometimes negatively affect the economy (Ductor & Grechyna, 2015). In addition, the level of development can also be determinative (Song et al., 2021). For example, Magazzino, Mele, & Santeramo (2021) found that the effect of access to credit on growth is weaker in countries with lower levels of economic development. In this context, while access to credit for the agricultural sector positively affects production in developing countries, these credits also affect productivity in developed countries (Magazzino et al., 2021). According to Oro and Alagidede (2019), who have a similar view, the effect of financial development on growth is stronger in developed countries than in developing countries. Because financial markets in developed countries are relatively stronger and have institutional quality, but in developing countries, deficiencies and vulnerabilities in the financial system are greater.

Institutional quality is a topic that should be discussed in the relationship between financial development and growth. Instability and anti-institutional structures such as corruption may cause ineffective loans on the economy, and sometimes even deterioration in institutional quality can lead to financial fragility and adversely affect economic growth. In addition, deterioration in institutionalization can lead to inefficiency by reducing the success of financial intermediaries in integrating resources with national economies (Kassie, 2021; Kutan et al., 2017; Law et al., 2013). In this context, many studies have investigated the importance of institutional quality in the relationship between financial development and growth and have found that this effect can be strengthened by financial development (see Compton & Giedeman, 2011; Demetriades & Hook Law, 2006; Kutan et al., 2017; Sulemana et al., 2022).

Although the importance of the financial system is emphasized in the literature, there are also studies concluding that financial development has a negative effect on economic growth. For example, bank loans can positively affect economic growth by financing the economic activities of companies, and further expansion of bank loans can cause higher use of loans; thus, the impact of the financial system on growth is reversed (Ho & Saadaoui, 2022). Therefore, the financial system, which can lead to problematic debts, can negatively affect economic growth by bringing financial crises with it, or as a reverse feed effect, financial crises that occur due to disruptions in the financial system can negatively affect the financial system and can be decisive in economic growth (Moyo et al., 2018; Nasir & Du, 2018).

In addition, the bidirectional relationship between finance and growth is an important debate in the literature. In this context, the financial system can be a determinant in the transformation of savings into investments, thus positively affecting economic growth. Increasing economic growth, on the other hand, can lead to an increase in per capita income and, accordingly, an increase in savings. This process, which also feeds the financial system, leads to the finance-growth spiral and may ultimately cause both variables to feed each other (Tripathy & Mishra, 2021).

The theoretical foundations of the relationship between economic growth and financial development are based on the supply-leading work of Schumpeter (1911), Gurley and Shaw (1955), Goldsmith (1969), and more recently Mckinnon (1973) and Shaw (1973). According to the supply-leading hypothesis, there is a causal relationship between financial development and economic growth. In this framework, the development of financial institutions and markets increases the supply of financial services, and thus the financial system causes growth. For example, according to the McKinnon–Shaw School, real interest rates are too low to reduce savings. As a result, the supply of loanable funds for investment decreases, which hurts economic growth. Therefore, the McKinnon– Shaw model emphasizes that financial liberalization will increase competition and raise interest rates, resulting in an increase in savings, thereby stimulating investment and ultimately supporting economic growth (Abu-Bader & Abu-Qarn, 2008; Ang, 2008; Calderón & Liu, 2003; Khan & Senhadji, 2000).

The demand-following approach argues that economic growth causes financial development. Robinson (1952), a pioneer of the theory, opposed the view that the financial sector positively affects economic growth. According to the study, the financial system responds to the demand arising from the real sector. Economic growth causes domestic financial development. In other words, as per capita income increases, the demand for financial services increases, and this causes economic growth to affect financial development (Opoku et al., 2019; Robinson, 1952; Tran et al., 2020).

Contrary to demand-following and supply-leading theories, Patrick (1966) argues that the financial system and economic growth feed each other. According to the theory, because of economic growth, financial markets grow, which increases liquidity opportunities and minimizes risks, leading to a feedback effect for growth. In this context, national income increases, which positively affects the external resource demand of the enterprises, and accordingly, the financial intermediaries increase. Because generally, firms tend to finance expansion from the financial system. In addition, the financial system allows resources to be directed toward faster-growing sectors. Thus, the financial system can support growing sectors and positively affect sustainable growth through this channel.

Despite studies concluding a relationship between financial development and growth from different perspectives, Lucas (1988) emphasized that the determinant parameters in growth are physical capital and human capital. Contrary to the approaches that foresee that financial development leads to economic growth, Lucas (1988) argued that the role of the financial system in economic growth has been overstated.

In this study, the growth effect of financial development was examined in four stages for emerging market and middle-income economies. In the first stage, the causal relationship between financial development and growth was investigated. In the second stage, the relationship between financial development and growth was examined using 9 different financial development indicators. In the third stage, the effect of financial development on growth and institutional quality is discussed. Thus, in the case of institutional quality, the effect of financial development on growth has been investigated using many indicators. In this framework, 42 different models were estimated using 7 different financial development indicators and 6 different institutional quality indicators. In addition, which of the financial development and institutional quality indicators have a stronger effect on growth has been examined with the Random Forest model, which is a machine learning method.

Many studies have examined the relationship between financial development and growth. However, the main hypothesis of this research is how institutionalization affects growth and financial development. To the best of our knowledge, the literature investigating the relationship between so many institutionalization indicators and financial development growth is quite limited.

The plan of the study is as follows: In section 2, the literature is discussed. In section 3, methods and dataset are given, and in section 4, the analysis findings are presented.

2. Literature

Extensive literature has investigated the financial development– growth relationship. The general tendency in studies that mostly reveal that financial development is a determinant of economic growth is that financial development plays a supportive role in economic growth. In some studies, the direction of this relationship was investigated, and in others, the causal relationship between these variables was examined. In this context, there are four different approaches that discuss the causal relationship between financial development and economic growth. The first view is the supply-leading approach, which argues that the financial system leads to economic growth. According to this approach, financial system development accelerates the acquisition of savings; thus, the financial system positively affects growth. The second approach is the demand-following approach, which argues that economic growth leads to financial development. Accordingly, economic growth increases supply and demand, leading to financial development. According to the third approach, economic growth and financial development feed each other. The last view argues that there is no significant relationship between economic growth and financial development.

Looking at demand-leading studies, Ak et al. (2016) revealed a unidirectional causality relationship between growth to financial development in Turkiye. According to this study, there is a demand-following causality relationship between variables. In this context, the growth of the real sector, which is a determinant of economic growth, increases financial demands. Individuals and companies that are unable to afford their financing needs with their own resources have to use external financing; thus, the demand for financial services is increasing. This contributes to financial sector development by causing both expansion and deepening of financial markets. Ozcan and Ari (2011), Kandır et al. (2007), Tunali and Onuk (2017), and Kar et al. (2014) found similar findings for Turkiye. Helhel (2017) found that the causality relationship is from growth to financial development in the E7 countries and that the demand-following hypothesis is valid. Zang and Kim (2007) found a unidirectional causality relationship from economic growth to financial development in a large panel dataset. Similarly, Liang and Jian-Zhou (2006) found that there is unidirectional causality from economic growth to financial development in China.

Bozoklu and Yılancı (2013), one of the supply-leading studies, investigated the financial development growth relationship for Brazil, China, Indonesia, the Philippines, South Korea, India, Hungary, Malaysia, Mexico, Egypt, Peru, Chile, Thailand, and Turkiye. In the study, they found a causal relationship between financial development and economic growth.

According to Pata & Ağca (2018), financial development positively affects economic growth both in the short and long run in Turkiye. On the other hand, there is unidirectional causality from financial development to economic growth in the short run. However, there is no contribution from growth to financial development. Aslan and Küçükaksoy (2006) and Atamtürk (2004) reached similar findings for Turkiye. Ağayev (2012) for 20 transition economies, Sağlam and Sönmez (2017) for 13 developing countries in Asia concluded that there is a unidirectional causality relationship from financial development to economic growth in the long run In addition, Habibullah and Eng (2006) found that the financial system supports economic growth.

Çeştepe and Yıldırım (2016), one of the studies on the Patrick (1966) hypothesis, concluded that there is a bidirectional causality relationship between financial development and economic growth in Turkiye. Calderón and Liu (2003) found bidirectional causality between economic growth and financial development in 109 developing and industrialized countries. According to the study, financial deepening contributes more to economic growth in developing countries than in industrialized countries. Abu-Bader and Abu-Qarn (2008) revealed that the causality between economic growth and financial development in Egypt is bidirectional, and financial development increases investment and productivity.

In addition, Contuk and Güngör (2016) analyzed the relationship between financial development and economic growth in Turkiye using Granger and asymmetric causality analyzes Granger causality analysis results support both the demand-following and supply-leading hypotheses. However, according to the asymmetric causality analysis findings, the relationship is mostly from economic growth to financial development. For 69 countries, Chow and Fung (2013) concluded that there is a causality from growth to financial development and a bidirectional causality relationship between financial development and growth in developed economies. Shan et al. (2001) found a relationship between financial development and growth in 9 OECD countries. Hassan et al. (2011) analyzed this relationship for high-income and low-middle-income countries. According to the study, there is a positive relationship between financial development and economic growth in developing countries. In addition, a bidirectional causality relationship was found between financial development and growth in most regions, and a unidirectional causality relationship from growth to financial development was found for the two poorest regions. Işık and Bilgin (2016) investigated the relationship between financial development and economic growth in Turkiye for different periods. According to the results of the analysis, while there was no causal relationship between financial development and economic growth in the pre-crisis period, a causal relationship was found between the variables in the post-crisis period. Song et al. (2021) found that the findings differ according to country, and they investigated the relationship between corruption, economic growth, and financial development in 142 countries. Countries are grouped into developed and developing countries, and a long-run cointegration relationship was found between financial development and growth in the general panel and developing countries. However, for developed countries, there is no causal relationship between financial development and economic growth.

Contrary to the large literature findings that there is a causal relationship between economic growth and financial development, according to Karamelikli and Kesgingöz (2017), there is no relationship between variables in Turkiye. In addition, Williams (2018) found that financial development is not a determinant of economic growth in Latin America and the Caribbean (LAC).

There are many studies suggesting that financial development positively affects growth. For instance, Orji et al. (2022) found that financial development positively affects growth in ECOWAS countries. Because access to credit is difficult in these countries, it is expected that the credits obtained will positively affect economic growth by increasing economic investments and activities. According to Nguyen et al. (2022), financial development has a positive effect on economic growth in 22 developing countries. On the other hand, there is both a bidirectional Granger causality relationship and a long-term relationship between financial development and economic growth. Hunjra et al. (2022) revealed that financial development positively affects sustainable economic development in 50 low-middle-income countries. Tripathy and Mishra (2021) found that financial development positively affects growth and that there is unidirectional causality between financial development and economic growth in India. Hussain et al. (2021) revealed a long-term positive relationship between financial development and economic growth in Pakistan. Botev et al. (2019) investigated the relationship between financial development and economic growth in developing and developed countries. According to the study, financial development positively affects growth through channels such as financial innovation, minimization of transaction costs, and investment, and this effect is stronger in stock markets with financial depth. Doumbia (2016) found that financial development is a determinant of investment and savings decisions in 43 developed and developing countries, and this effect is positive in low-middle-income and low-income countries. However, this effect is slight in more developed countries. According to Ang (2008), financial development increases growth with private savings and private investment channels in Malaysia. İnançlı et al. (2016), Hayaloğlu (2015), and Estrada et al. (2010) found that financial development positively affects economic growth in D-8 economies, fragile five countries, and 125 countries, respectively.

However, some studies claim that financial development has a negative effect on economic growth. Cheng et al. (2021) found that financial development negatively affects economic growth in 72 countries, and this effect was stronger in high-income countries. A bad financial system can waste resources, negatively affect investments, and cause speculation. Cheng and Hou (2021) argued that private loans in 17 developed European countries negatively affect real economic growth in both the short and long run. According to the study, this result may be due to over-financing in European countries, or financial crises may be decisive in obtaining these findings. However, they found that life insurance has a positive effect on growth. Because life insurance plays an important role in minimizing long-run real growth volatility.

Many studies examine the relationship between financial and economic growth using nonlinear models and focus on the threshold effect. For example, according to Ho and Saadaoui (2022), financial development positively affects growth when the credit/GDP ratio is below a certain threshold in ASEAN countries. If this threshold is exceeded, the effect of financial development on growth weakens. Shahbaz et al. (2022) investigated the relationship between financial development and growth in 10 financially developed countries using a three-regime threshold autoregressive distributed lag model. According to the study, the upper regime affects economic growth positively in Singapore and negatively in Finland. In the middle regime, financial development positively affects economic growth in Singapore and Australia. In the lower regime, this effect is negative in Malaysia, the United States, and Singapore. Bui (2020) focused on the nonlinear relationship between domestic credit and growth in the ASEAN countries. According to the study, domestic loans positively affect economic growth up to a certain threshold, but this effect is reversed after this optimal threshold level is exceeded. In this context, loans exceeding this threshold lead to an abundance of loans, thus negatively affecting economic growth. Oro and Alagidede (2019) found the opposite of this study in Nigeria. Accordingly, financial development first affects growth negatively, and after a certain threshold level, it affects growth positively. However, according to Aryestya and Marta (2022), in Southeast Asian countries, domestic loans have a positive effect on economic growth up to a certain threshold level, but after this threshold level is exceeded, this effect becomes statistically insignificant. Therefore, there is no nonlinear relationship between financial development and economic growth.

Using different financial development indicators, Sotiropoulou et al. (2022) investigated the relationship between financial development and growth in 23 European Union countries. According to the study, when stock market capitalization, private loans, Z-scores, and net margin interest rates are used as financial development indicators, there is a unidirectional causality from financial development to economic growth. There is a bidirectional causality between economic growth and liquid liabilities, non-performing loans, and bank assets, and a unidirectional causality between economic growth and turnover and traded value. On the other hand, there is no causality between economic growth and stock price volatility. In Brazil, Moyo et al. (2018) found that financial development, including financial development and banking sector indicators, negatively affects economic growth, but financial development, including stock market development indicators, positively affects economic growth. Nguyen et al. (2019) investigated the relationship between financial development and growth in 90 countries using 4 different indicators. These are the stock, banking, insurance, and bond markets. The relationship between banking and growth is negative, and this result is based on the fact that most bank loans are used mostly for expenditures that do not affect growth, such as personal expenditures. Stock markets positively affect growth in middle-income countries, but in high-income countries, this effect was positive only before the crisis. Insurance is the strongest variable on economic growth at all levels of development.

In addition to these studies, Ductor and Grechyna (2015) argued that the effect of financial development on economic growth in 101 developed and developing countries depends on real output-private credit growth. In this context, if growth in private loans and real output are not simultaneous, the effect of financial development on growth is negative. Therefore, balanced growth in the real and financial sectors is necessary for economic growth. According to Keyghobadi et al. (2021), financial development in Iranian provinces positively affects the economic growth of regions; but does not have a spillover effect on the growth of neighboring provinces and regions. Ali et al. (2021) argued that both financial development and the interaction between financial development and FDI positively affect economic growth in Pakistan.

In some studies, the relationship between financial growth was investigated in the context of institutional quality. Institutionalization can affect economic growth both directly and through indirect channels such as financial development (Redmond and Nasir; 2020). In these studies, it is generally seen that the effect of financial development on growth is stronger or more significant if institutionalization exists. Suleman et al. (2022) investigated the financial sector development and growth relationship between the Economic Community of West African States (ECOWAS) and the Southern African Development Community (SADC). Accordingly, financial development positively affects growth in SADC countries, but it is not statistically significant in ECOWAS. Institutional quality strengthens the existence of this effect through its complementary role. Kassie (2021) found that financial development is statistically insignificant in terms of economic growth in 35 African countries. However, financial development interacting with the institutional quality index positively affects economic growth. Therefore, when countries have higher institutional quality, the effect of financial development on economic growth will be stronger. Haini (2020) investigated the relationship among financial development, financial markets, financial institutions, and growth in ASEAN economies. According to Haini, financial development affects economic growth. In addition, the effect of financial markets on growth is insignificant, but the effect of financial institutions on growth is positive. In this context, institutional quality positively affects financial markets, and institutionalization is a determinant of the finance– growth relationship. Kutan et al. (2017) focused on the role of institutional quality in the relationship between financial development and economics in 21 MENA countries. According to the study, financial development, which is not effective on growth in the absence of institutional quality, positively affects economic growth with institutional quality. Similarly, Demetriades and Hook Law (2006) found that financial development affects economic growth more strongly in the presence of a more institutionalized financial system in 72 countries. In MENA countries, Gazdar and Cherif (2015) used different financial development indicators and found that most of them affect economic growth negatively, but the interaction variable with financial development and institutional quality affects growth positively. Therefore, institutional quality reduces the negative effect of financial development on growth. Law et al. (2013) investigated how financial development affects growth based on institutional quality in 85 countries. According to the study, the effect of financial development on growth becomes positive after institutional development exceeds a certain threshold level. However, until the determined threshold point is reached, financial development has no effect on growth. In contrast to this study, Compton and Giedeman (2011) investigated the role of institutional development between financial development and economic growth in nearly 90 countries. According to the study, the findings differ according to the financial development indicators. For example, as institutional quality increases, the positive effect of banking development on growth decreases. However, institutional development does not contribute to the effect of stock markets on growth.

In literature, the effects of shocks, which are indirectly effective components such as institutionalization in the financial development–growth relationship, have been investigated. For instance, Samargandi and Kutan (2016) investigated the effects of private credit shocks on economic growth in BRICS countries. The authors analyzed the impact of a specific credit shock in each BRICS country on the economic growth of other BRICS countries. According to the study, positive shocks to private sector loans positively affect the economy in all BRICS countries. Giri et al. (2021) found a co-integration relationship between financial development and economic growth eventually in India. A long-term positive shock to financial development positively affects economic performance, but negative shocks negatively affect economic growth.

3. Dataset and method

3.1. Dataset and models

In this study, the relationship between economic growth and financial development was analyzed. The IMF has defined emerging markets and middle-income economies in consultation with other international institutions through a common approach. An important aspect of emerging market economies is that they try to ensure the structural conditions in developed countries over time and, within this framework, attach importance to reforms and institutional infrastructure. (Scott and Munichello, 2022). At this point, it is important to understand how the financial development of these countries will affect growth. In particular, in these economies where institutionalization is particularly weak, one of the questions seeking an answer is how financial development will affect growth without institutionalization or in the presence of different institutionalization indicators. Therefore, the main purpose of this study is to determine how financial development affects growth along with institutionalization. Because of the availability of data, different periods were used. The variables are listed in Table 1.

Table 1
Data description.

Variables	Description	Source
Growth	GDP growth (annual %)	World Bank Open Data
LTRADE	Trade (% of GDP)	World Bank Open Data
LGOV	General government total expenditure (% of GDP)	World Bank and IMF
LFDI	Financial Development Index	IMF
INF	Inflation, consumer prices (annual %)	World Bank Open Data
LBM	Broad money (% of GDP)	World Bank Open Data
LPCDMB	Private credit by deposit money banks to GDP (%)	World Bank: Global Financial Development Database
LDMBA	Deposit money bank assets to GDP (%)	World Bank: Global Financial Development Database
LLL	Liquid liabilities to GDP (%)	World Bank: Global Financial Development Database
LFSD	Financial system deposits to GDP (%)	World Bank: Global Financial Development Database
LSMC	Stock market capitalization to GDP (%)	World Bank: Global Financial Development Database
LSMTVT	Stock market total value traded to GDP (%)	World Bank: Global Financial Development Database
LSMTR	Stock market turnover ratio (%)	World Bank: Global Financial Development Database
LCC	Control of corruption (percentile rank)	World Bank-Worldwide Governance Indicators
LGE	Government effectiveness (Percentile Rank)	World Bank-Worldwide Governance Indicators
LPSAV	Political stability and absence of violence/terrorism (percentile rank)	World Bank-Worldwide Governance Indicators
LRQ	Regulatory quality (Percentile Rank)	World Bank-Worldwide Governance Indicators
LRL	Rule of law (Percentile Rank)	World Bank-Worldwide Governance Indicators
LVA	Voice and accountability (Percentile Rank)	World Bank-Worldwide Governance Indicators
DUM	Dummy variable for the 2008 economic crisis	

L indicates the logarithm of the variables.

First, the causal relationship between financial development indicators and growth was investigated. The causality relationship between financial development indicators and growth was examined using the Dumitrescu– Hurlin causality test. After the causality relationship, the effect of financial development is discussed. The semi-logarithmic model was used in this study. In the main model, in which the effect of financial development on growth is discussed, the dependent variable is used at the level. Independent variables were used in logarithmic form, except inflation.

$$Growth_{i,t} = aGrowth_{it-1} + \beta_1 LFD_{i,t} + \beta_2 LTRADE_{i,t} + \beta_3 LGOV_{i,t} + \beta_4 INF_{i,t} + \beta_5 DUM_{i,t} + \varepsilon_{i,t} \quad (1)$$

In the System GMM forecast, the 2008 global financial crisis is included in the model. Therefore, the DUM variable, which was used as a dummy variable, was used to determine the effect of the crisis. Although this crisis emerged in 2008, its clear impact was evident in many countries in 2009. Therefore, 2009 was determined as the year in which the dummy variable was included.

In equation (1) and (9) different variables were used as indicators of financial development. FD in the main model is the financial development indicator. Financial Development Index for Model I, Broad Money (% of GDP) for Model II, Private Credit by Deposit Money Banks to GDP (%) for Model III, Deposit Money Banks' Assets to GDP (%) for Model IV, Liquid Liabilities to GDP (%) for Model V, Financial System Deposits to GDP (%) for Model VI, Stock Market Capitalization to GDP (%) for Model VII, Stock Market Total Value Traded to GDP (%) for Model VIII, and Stock Market Turnover Ratio (%) for Model IX are used as indicators of financial development.

Institutional quality was included in the model, and the effect of financial development on growth was examined. The financial development and institutional quality interaction variables are also included in the model. The effect of the interaction between institutional quality and financial development on growth is also discussed using six different institutional quality indicators. The model is given below.

Institutionalization Model

$$\begin{aligned} Growth_{i,t} = aGrowth_{it-1} + \beta_1 LFD_{i,t} + \beta_2 LINST_{i,t} \\ + \beta_3 LFD_{i,t} xLINST_{i,t} + \beta_4 LTRADE_{i,t} + \beta_5 LGOV_{i,t} \\ + \beta_6\, INF_{i,t} + \beta_7 DUM_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{2}$$

Here, LINST represents the institutional quality indicator and the LFDxLINST variable represents the financial development – institutionalization interaction variable. Estimates were made using 6 different indicators of institutional quality, 7 different indicators of financial development, and the interaction variable of institutional quality – financial development. Valickova et al. (2015) showed that it is important to control endogeneity when estimating the effect of financial development on growth. Studies using OLS find, on average, larger effects than studies that somehow explain internality (instrumental variables, panel data methods, or other more advanced techniques). Therefore, the system GMM method, which considers endogeneity, was used in the estimation of the models in the study.

3.2. Methods

3.2.1. Cross-section dependency and unit root test

In this study, the Breusch and Pagan (1980) test was used to determine the cross-sectional dependence in cases with T > N. In cases with N > T, the CD test developed by Pesaran (2004) was used. In cases where N and T are both large, the LM_Adj test was developed by Pesaran et al. (2008).

In case of cross-sectional dependence in the series, unit root tests were used, taking this into account. Since the number of years is greater than the number of countries for different periods considered in the causality analysis, the stationarity of the series was examined with the Multivariate Augmented Dickey-Fuller (MADF) unit root test developed by Taylor and Sarno (1998), which considered cross-section dependency. Because of the differentiation of the period considered for model estimation, the unit root test was applied to the variables again. The stationary of the variables used for model estimation was examined using the CIPS unit root test developed by Pesaran (2007), which takes into account cross-sectional dependency.

3.2.2. Homogeneity test

In determining homogeneity, the S test developed by Swamy (1970) and the homogeneity test developed by Pesaran and Yamagata (2008) were used. The test developed by Swamy requires N to be small and T to be large. The standardized Swamy's test ($\tilde{\Delta}$) developed by Pesaran and Yamagata (2008) is more effective when T, N→∞.

3.2.3. Co-integration test

The Durbin–Hausman co-integration test developed by Westerlund (2008) was used to determine the co-integration relationship between the series. This test considers heterogeneity and allows a series to be stationary of different orders. Statistical values were calculated for both the panel and the groups. DH_g shows the statistical value for the group, while DH_p shows the statistical value for the panel. The basic hypothesis is that there is no co-integration. If the calculated test statistic is greater than the table critical value, the basic hypothesis is rejected.

3.2.4. Dumitrescu– Hurlin panel causality test

The panel causality test developed by Dumitrescu and Hurlin (2012) is an extended version of the Granger causality test. This test takes heterogeneity into account. The basic equation of the causality relationship is as follows (Dumitrescu & Hurlin, 2012):

$$y_{i,t} = a_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \tag{3}$$

In the equation, $y_{i,t}$ shows dependent variables, $x_{i,t}$ independent variables, a_i individual specific effects, k lag length, $\gamma_i^{(k)}$ autoaggressive parameter and $\beta_i^{(k)}$ slope parameters. In the investigation of Granger causality from x to y, the basic hypothesis states that all slope parameters are equal to 0, i.e., there is no causality (Dumitrescu & Hurlin, 2012).

$$H_0 : \beta_i = 0 \forall i = 1, \ldots\ldots., N \tag{4}$$

where $\beta_i = (\beta_i^{(1)}, \ldots\ldots.., \beta_i^{(k)})'$. The alternative hypothesis is that causality exists in some units (Dumitrescu & Hurlin, 2012).

$$H_1 : \beta_i = 0 \forall i = 1, \ldots\ldots., N_1 \tag{5}$$

$$\beta_i \neq 0 \forall i = N_1 + 1, N_1 + 2, \ldots\ldots., N \tag{6}$$

where N_1 is unknown but must satisfy the condition $0 \leq N_1/N \leq 1$. N_1/N ratio must be less than 1. If $N_1 = N$, there will be no causality in all units in the panel, and the alternative hypothesis will be the same as the basic hypothesis. The variables examined in the panel causality test should be stationary. To test the hypotheses, the Wald statistics of the units ($W_{N,T}^{Hnc}$) is calculated by the following equation (1) (Dumitrescu & Hurlin, 2012).

$$W_{N,T}^{Hnc} = \left(\frac{1}{N}\right)\sum_{i=1}^{N} W_{i,T} \quad (7)$$

The aim of calculating the $W_{N,T}^{Hnc}$ test is to calculate the appropriate test statistic when T, N →∞ and N → ∞ and T are fixed. It is appropriate to use $Z_{N,T}^{Hnc}$ with asymptotic distribution in cases T and $N\rightarrow\infty$ (Dumitrescu & Hurlin, 2012).

$$Z_{N,T}^{Hnc} = \sqrt{\frac{N}{2K}}\left(W_{N,T}^{Hnc} - K\right) \underset{N,T\rightarrow\infty}{\overset{d}{\rightarrow}} N(0,1) \quad (8)$$

When N →∞ and T are fixed (N > T), it is more appropriate to use the Z_{N}^{Hnc} test with semi-asymptotic distribution (Dumitrescu & Hurlin, 2012).

$$Z_{N}^{Hnc} = \frac{\sqrt{N}\left[W_{N,T}^{Hnc} - N^{-1}\sum_{i=1}^{N} E(W_{i,T})\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} Var(W_{i,T})}} \underset{N\rightarrow\infty}{\overset{d}{\rightarrow}} N(0,1) \quad (9)$$

3.2.5. System generalized method of moments (GMM)

The system GMM method was used in model estimations. This method was developed by Arellano and Bover (1995) and Blundell and Bond (1998). The general form of the System GMM is as follows.

$$y_{i,t} = a y_{i,t-1} + \beta X'_{i,t} + \varepsilon_{i,t} \quad (10)$$

$$\varepsilon_{i,t} = \mu_i + v_{it} \quad (11)$$

$$E(\mu_i) = E(v_{it}) = E(\mu_i v_{it}) = 0 \quad (12)$$

In the above equations $y_{i,t}$ is dependent variable, $y_{i,t-1}$ is lagged of dependent variable, $X_{i,t}$ is independent variable vector and $\varepsilon_{i,t}$ is distribution term. Here, the distribution term has two orthogonal components. These are μ_i and v_{it}. μ_i is fixed effects. v_{it} indicate shocks in term (Roodman, 2009).

The System GMM method considers endogeneity and is used in the case of small T and large N. The Arellano and Bond (1991) test is used to test autocorrelation. There should be no second-order autocorrelation. On the other hand, instrumental variables must be unrelated to the error term. The validity of the instrumental variables was tested with Hansen and Difference-Hansen tests. The main hypothesis for these tests is that the instrumental variables are valid (Roodman, 2009).

3.2.6. Random forest model

One of the supervised classification algorithms is the random forest. It is applied to both classification and regression issues. By creating many decision trees, the method seeks to boost the classification value during the classification phase. The random forest method selects the decision tree with the best score out of numerous trees that operate independently of one another. This incident is well seen in Fig. 1. The rate of obtaining a precise result rises with the number of trees. The root node is determined randomly, which is the major distinction between the decision tree algorithm and the random forest algorithm.

Boosting and Bagging (Breiman, 1996; Breiman&Friedman, 1984) are two well-known approaches for collective learning in tree classification. In Bagging, each tree is constructed using the training data. Repeated trees are separate from each other, and the tree with the most votes is chosen for prediction. Consecutive trees in boosting are dependent on the previous tree. Extra weight is given for points incorrectly predicted by the previous premises. Weighted votes are then taken for prediction (Boulesteix et al., 2012; Cutler, 2006).

The primary goal of Breiman (1996) was to use the Bagging technique to generate each tree independently of the others

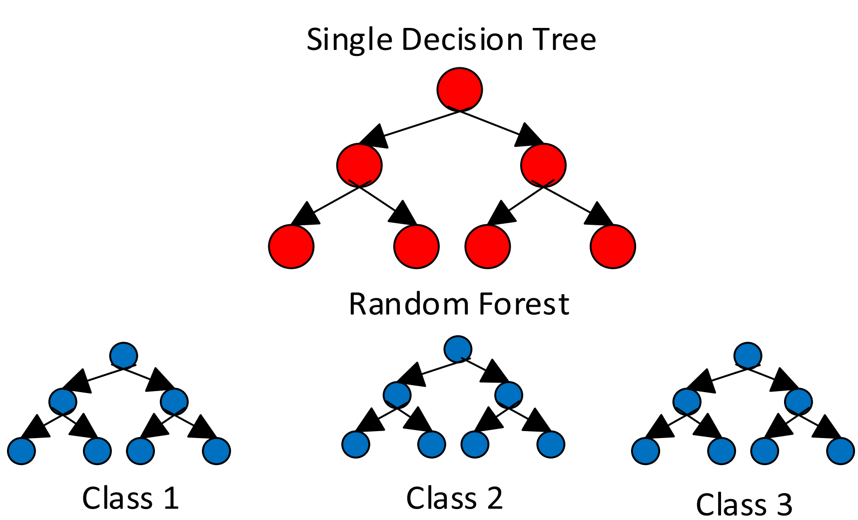

Fig. 1. General structure of random forest algorithm.

using training data. In addition, the predictions are random. The selection method produces it (Ho, 1998). In addition, for the estimation of new data, the degree of importance of each parameter is assessed from the data created during the method of communal learning. When there are many predictors, this model can be particularly beneficial for reduction. Random forest is a collective learning method that generates many trees through iterative segmentation (Svetnik et al., 2003).

In collective learning, the vectors of the random forest are generated to construct each tree. For example, the Bagging method developed by Breiman (1996) is based on the principle of developing a tree by randomly selecting samples from the training data. Random split choices is another example (Breiman, 2001). The splits at each node are randomly selected from among the K best splits. Breiman created new training data in 1999 by randomizing the original training data. In all of these approaches, a random vector θK is created for k trees. The θK s created are separate from one another. θK and training data with the same distribution are used to create a tree. In the training data, there are N samples. N boxes are randomly filled with random vectors. Then, a split selection is made at random. Split selection at random θ is an integer number between 1 and K that is independent and random. The size and structure of θ are determined by the nature and intended function of the tree. After a huge number of trees have been produced, the most popular class is voted on. Random forest classifier

$$\{h\,(x, \theta_K\,)\; k = 1, \ldots\} \tag{13}$$

where x represents the input data; θ_K is the random vector. The most popular class receives a vote from each tree. Random Forest is the name of these processing phases.

In Breiman 's (2001) the Random Forest method, bagging is handled with random feature selection. A new training dataset is created by displacement from the original dataset. The new training set is then used to build a tree using random feature selection. These mature trees have not been pruned. There are two important reasons why the bagging method is preferred. First, because random features are used in the bagging process, the accuracy is increased; the second is the calculation of generalized errors. These errors are out-of-bag (OOB) errors (Breiman, 2001).

Many classed trees grow in random forests. It sorts the incoming data into each tree in the forest to create a new object from it. Each tree represents a different classification. For that class, tree votes are calculated. The classification with the most votes is chosen by the forest.

i. N numbers of random training data were collected by substituting N numbers of original data.
ii. For each node, M is randomly $m \leq M$ from the total input variables selected. This m value remains constant as the forest increases.
iii. Each tree is cultivated to its full potential (Boulesteix et al., 2012).

Correlation and power drop as m decreases, but correlation and power rise as m increases. This m value can be adjusted according to the OOB errors (Breiman & Cutler, 2008). Two user-defined parameters are required to create a tree using the RO classifier. To identify the appropriate split, these factors are the number of variables used at each node (m) and the number of trees to be generated (N) (Segal, 2004). Random forest develops trees of maximal size without pruning using the classification and regression tree algorithm (Breiman, 2001). A node is divided into the CART algorithm by applying a criterion. To do so, first consider the values for which all the qualities exist, and then add all the matches to obtain two divisions. These divisions are subject to selection. In division operations, nodes with a homogeneous class distribution are favored. Node homogeneity is measured using criteria such as the Gini Index, entropy, misclassification error, and gain ratio criteria. The Gini index is used in the random forest approach. Gini index for a given node t;

$$GINI(t) = 1 - \sum_j [p(j \backslash t)]^2 \tag{14}$$

In Equation (14), $p(j\backslash t)$, t represents the concerned probability of class j at node t. It is determined which cleavage position has the minimum Gini index. The nodes are separated into splits, as shown in Fig. 1, and tree structures are built on the basis of the division criteria calculated using the training data.

4. Empirical results

The results of the cross-section dependence, unit root, homogeneity, and co-integration tests are given in the appendix. The causality analysis results are presented in Table 2.

Since the T and N values are large, it is more appropriate to look at the results of $Z_{N,T}^{Hnc}$ statistical results in Dumitrescu and Hurlin (2012) Causality test. Considering the $Z_{N,T}^{Hnc}$ test statistic,

Table 2
Dumitrescu and Hurlin (2012) Causality test results.

Causality	$W_{N,T}^{Hnc}$	$Z_{N,T}^{Hnc}$	Z_{N}^{Hnc}	Countries
LFDI→ Growth	21.365[a]	14.149[a] (0.000)	2.929[a] (0.0034)	31
Growth→LFDI	12.112[a]	2.629[a] (0.008)	−0.750 (0.4528)	31
LBM→Growth	19.693[a]	9.980[a] (0.000)	0.250 (0.8023)	29
Growth→LBM	22.564[a]	13.277[a] (0.000)	0.7789 (0.4360)	29
LPCDMB→Growth	35.915[a]	27.601[a] (0.000)	3.123[a] (0.0018)	27
Growth→ LPCDMB	70.718[a]	66.157[a] (0.000)	9.306[a] (0.000)	27
LDMBA →Growth	40.548[a]	32.734[a] (0.000)	3.946[a] (0.0001)	27
Growth→ LDMBA	24.697[a]	15.173[a] (0.000	1.130 (0.2583)	27
LLL →Growth	19.293[a]	9.355[a] (0.000)	0.173 (0.862)	28
Growth→ LLL	14.306[a]	3.730[a] (0.000)	−0.728 (0.4663)	28
LFSD →Growth	15.102[a]	7.611[a] (0.000)	1.032 (0.3021)	28
Growth→LFSD	13.430[a]	5.529[a] (0.000)	0.343 (0.7312)	28
LSMC →Growth	6.844[a]	21.473[a] (0.000)	10.103[a] (0.000)	27
Growth→ LSMC	1.639	2.349[b] (0.018)	0.444 (0.656)	27
LSMTVT →Growth	2.020[b]	3.748[a] (0.000)	1.848[c] (0.064)	27
Growth→ LSMTVT	1.360	1.324 (0.185)	0.264 (0.791)	27
Growth→ LSMTR	1.479	1.588 (0.112)	0.496 (0.619)	23

[a,b,c] indicate causality at the 99%, 95%, 90% confidence levels.

Table 3
Financial development– growth model estimation results.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
	Financial Development Index	Broad money (% of GDP)	Private credit by deposit money banks to GDP (%)	Deposit money banks' assets to GDP (%)	Liquid liabilities to GDP (%)	Financial system deposits to GDP (%)	Stock market capitalization to GDP (%)	Stock market total value traded to GDP (%)	Stock market turnover ratio (%)
L.Growth	0.482[a] (0.052)	0.476[a] (0.055)	0.476[a] (0.056)	0.484[a] (0.054)	0.494[a] (0.054)	0.481[a] (0.053)	0.258[a] (0.085)	0.342[a] (0.085)	0.316[a] (0.093)
LFD	0.214 (0.368)	0.149 (0.538)	−0.644 (0.549)	−0.424 (0.514)	−0.019 (0.482)	−0.464 (0.379)	0.288 (0.188)	0.373[b] (0.158)	0.483[b] (0.210)
LGOV	−0.448 (0.359)	−0.380 (0.464)	−0.058 (0.336)	−0.033 (0.418)	−0.295 (0.405)	−0.111 (0.306)	−0.409 (0.434)	−0.432 (0.469)	−0.645 (0.519)
INF	−0.039[c] (0.020)	−0.039[c] (0.021)	−0.057[b] (0.026)	−0.051[b] (0.024)	−0.043[b] (0.021)	−0.048[b] (0.023)	−0.010 (0.043)	0.002 (0.031)	−0.037 (0.024)
LTRADE	0.806[a] (0.288)	0.803[b] (0.352)	1.264[a] (0.442)	1.069[a] (0.356)	0.873[a] (0.330)	1.145[a] (0.348)	0.757[b] (0.369)	0.772[b] (0.388)	0.869[b] (0.408)
DUM	−4.714[a] (0.815)	−4.971[a] (0.786)	−4.716[a] (0.795)	−4.737[a] (0.804)	−4.747[a] (0.804)	−4.734[a] (0.807)	−2.902[a] (0.947)	−2.831[a] (0.874)	−3.629[a] (0.904)
Number of Groups	35	34	35	35	35	35	24	26	22
Period	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2007–2019**	**2006–2019**	**2006–2019**
Observations	595	578	595	595	595	595	288	337	286
AR (1) (p-value)	−3.02 (0.003)	−2.91 (0.004)	−3.06 (0.002)	−3.04 (0.002)	−3.02 (0.003)	−3.02 (0.003)	−3.50 (0.000)	−3.67 (0.000)	−3.43 (0.001)
AR (2) (p-value)	0.06 (0.954)	0.12 (0.906)	0.08 (0.939)	0.07 (0.945)	0.07 (0.944)	0.06 (0.956)	−1.16 (0.246)	−2.21 (0.027)	−1.81 (0.070)
Hansen Test (p-value)	27.65 (1.000)	29.19 (1.000)	29.76 (1.000)	32.45 (1.000)	28.78 (1.000)	30.32 (1.000)	21.80 (1.000)	24.17 (1.000)	20.21 (1.000)
Diff-Hansen (p-value)	33.22 (1.000)	32.70 (1.000)	32.15 (1.000)	32.20 (0.993)	32.95 (1.000)	32.12 (1.000)	19.48 (0.677)	19.01 (1.000)	16.03 (0.360)

a,b, and c indicate statistical significance at 99%, 95%, 90% confidence levels.

there is a causal relationship between all financial development indicators and growth. However, while the causality relationship from growth to financial development was in 7 indicators, no relationship was found in 2 indicators. Financial Development Index, Broad Money (% of GDP), Private Credit by Deposit Money Banks to GDP (%), Deposit Money Banks' Assets to GDP (%), Liquid Liabilities to GDP (%), Financial System Deposits to GDP (%), Stock Market Capitalization to GDP (%), and financial development indicators have a bidirectional causality relationship with growth. The existence of bidirectional causality between financial development and growth is similar to Calderón and Liu (2003), Abu-Bader and Abu-Qarn (2008), Chow and Fung (2013), Shan et al. (2001), Hassan et al. (2011), and Nguyen et al. (2022) studies. On the other hand, there is a unidirectional causality relationship between stock market total value traded to GDP (%) and stock market turnover ratio (%) as financial development indicators of growth. The causality results differ according to the financial development indicator used. According to Sotiropoulou et al. (2022), Naceur et al. (2017), Moyo et al. (2018), and Nguyen et al. (2019), different causality relationships were found for different financial development indicators.

After revealing the causality relationship, the effect of financial development indicators on growth is examined. The estimation results are given in Table 3. According to the estimation results, financial development indicators in Models 1–7 were found to be statistically insignificant. In Models 8 and 9, although financial development indicators are statistically significant for growth. However, System GMM diagnostic tests show second-degree autocorrelation. Therefore, the results obtained in Models 8 and 9 are invalid. Therefore, 9 financial development indicators do not have a statistically significant effect on growth. Considering the significance of other control variables, the lagged growth value has a statistically significant and positive effect on growth in all models. ltrade, which is the share of trade in GDP, was also found to be statistically significant in all models. According to Model 1, there is a 1% increase in trade economic growth by 0.008 units. In model 3, the effect of trade is quite strong. Accordingly, if the share of foreign trade in GDP increases by 1%, economic growth increases by 0.012 (ceteris paribus). The lgov variable, which represents the share of public expenditures in GDP, is statistically insignificant. Inflation has a statistically significant and negative effect on growth in some models. The dummy variable used to represent the 2008 global financial crisis is statistically significant in all models and has a negative effect on growth. This indicates that the global crisis negatively affected growth in the emerging market and middle-income economies. When the diagnostic tests are examined, there is a first- order autocorrelation but no second-order autocorrelation in. These results are consistent with expectations and indicate that there is no autocorrelation in the models. Models 8 and 9 have second-degree autocorrelation; therefore, these model results are invalid. Considering the Hansen and Dif-Hansen test results, the basic hypothesis cannot be rejected in all models. Therefore, the instrumental variables are valid. Diagnostic tests show that the results obtained are effective and consistent.

Table 4
Institutional quality Model Estimation Results.

Variables	LFDI	LFDI	LFDI	LFDI	LFDI	LFDI	LBM	LBM	LBM	LBM	LBM	LBM
L.Growth	0.451^{a} (0.066)	0.450^{a} (0.067)	0.446^{a} (0.073)	0.453^{a} (0.071)	0.458^{a} (0.069)	0.466^{a} (0.067)	0.437^{a} (0.067)	0.433^{a} (0.068)	0.422^{b} (0.071)	0.435^{a} (0.071)	0.442^{a} (0.070)	0.432^{a} (0.070)
LFD	1.600^{c} (0.919)	2.067^{b} (1.036)	1.973^{b} (0.776)	2.179^{b} (0.912)	2.047^{b} (0.801)	2.240^{a} (0.694)	1.664^{c} (0.876)	1.985^{b} (0.931)	2.015^{a} (0.774)	1.930^{b} (0.827)	1.952^{b} (0.837)	2.045^{a} (0.648)
LGOV	−1.620^{a} (0.606)	−1.664^{a} (0.577)	−1.635^{a} (0.568)	−1.626^{a} (0.532)	−1.471^{b} (0.575)	−1.421^{a} (0.482)	−1.689^{a} (0.624)	−1.726^{a} (0.594)	−1.863^{a} (0.633)	−1.731^{a} (0.578)	−1.598^{b} (0.618)	−1.603^{a} (0.574)
INF	−0.044^{c} (0.022)	−0.052^{b} (0.022)	−0.054^{b} (0.023)	−0.054^{b} (0.022)	−0.052^{b} (0.022)	−0.051^{b} (0.021)	−0.052^{b} (0.021)	−0.060^{a} (0.023)	−0.065^{a} (0.022)	−0.059^{a} (0.022)	−0.059^{a} (0.022)	−0.063^{a} (0.023)
LTRADE	0.461 (0.326)	0.409 (0.322)	0.275 (0.312)	0.356 (0.297)	0.445 (0.313)	0.237 (0.273)	0.471 (0.415)	0.463 (0.405)	0.242 (0.461)	0.456 (0.398)	0.486 (0.395)	0.475 (0.316)
DUM	−4.578^{a} (0.792)	−4.645^{a} (0.798)	−4.633^{a} (0.794)	−4.640^{a} (0.792)	−4.638^{a} (0.802)	−4.701^{a} (0.796)	−4.906^{a} (0.764)	−4.910^{a} (0.766)	−4.878^{a} (0.757)	−4.900^{a} (0.762)	−4.923^{a} (0.771)	−4.970^{a} (0.758)
LCC	2.306^{a} (0.850)						2.472^{a} (0.786)					
LFDxLCC	−0.592^{b} (0.249)						−0.609^{a} (0.179)					
LGE		2.165^{b} (0.849)						2.342^{a} (0.758)				
LFDxLGE		−0.643^{b} (0.259)						−0.645^{a} (0.196)				
LPSAV			2.581^{a} (0.931)						3.174^{a} (0.773)			
LFDx LPSAV			−0.699^{a} (0.265)						−0.766^{a} (0.176)			
LRQ				2.279^{a} (0.759)						2.462^{a} (0.726)		
LFDxLRQ				−0.697^{a} (0.237)						−0.660^{a} (0.184)		
LRL					1.907^{b} (0.972)						2.260^{a} (0.866)	
LFDxLRL					−0.629^{a} (0.230)						−0.656^{a} (0.179)	
LVA						2.246^{a} (0.702)						3.060^{a} (0.712)
LFDxLVA						−0.738^{a} (0.207)						−0.884^{a} (0.192)
Number of Groups	35	35	35	35	35	35	34	34	34	34	34	34
Period	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**
AR (1) (p-value)	0.004	0.004	0.005	0.005	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.006
AR (2) (p-value)	0.954	0.946	0.930	0.937	0.939	0.933	0.929	0.905	0.908	0.914	0.909	0.910
Hansen Test (p-value)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Diff-Hansen (p-value)	0.997	0.999	0.985	0.932	0.999	0.789	0.938	1.000	1.000	1.000	1.000	0.827

^{a,b,c} indicates statistical significance at 99%, 95%, 90% confidence levels.

Table 5
Institutional quality model estimation results.

Variables	LPCDMB	LPCDMB	LPCDMB	LPCDMB	LPCDMB	LPCDMB	LDMBA	LDMBA	LDMBA	LDMBA	LDMBA	LDMBA
L.Growth	0.430[a] (0.063)	0.429[a] (0.063)	0.431[a] (0.067)	0.433[a] (0.068)	0.436[a] (0.067)	0.437[a] (0.068)	0.442[a] (0.062)	0.440[a] (0.063)	0.435[a] (0.069)	0.444[a] (0.068)	0.449[a] (0.066)	0.445[a] (0.068)
LFD	0.660 (1.141)	0.787 (1.230)	1.281 (0.868)	1.103 (1.257)	0.969 (1.158)	1.608[b] (0.763)	0.833 (0.947)	1.058 (1.020)	1.392[c] (0.828)	1.310 (0.968)	1.147 (0.944)	1.607[b] (0.693)
LGOV	−1.474[b] (0.647)	−1.489b (0.647)	−1.453[a] (0.542)	−1.439[b] (0.572)	−1.406[b] (0.638)	−1.141[a] (0.539)	−1.310[c] (0.682)	−1.376[b] (0.665)	−1.450[b] (0.656)	−1.359[b] (0.618)	−1.259[c] (0.655)	−1.196[b] (0.589)
INF	−0.058b (0.023)	−0.065[a] (0.024)	−0.076[a] (0.024)	−0.066[a] (0.022)	−0.064[a] (0.023)	−0.072[a] (0.023)	−0.056[b] (0.022)	−0.064[a] (0.023)	−0.073[a] (0.022)	−0.065[a] (0.022)	−0.062[a] (0.022)	−0.069[a] (0.023)
LTRADE	0.980[c] (0.566)	0.861 (0.547)	0.749 (0.486)	0.774[c] (0.469)	0.902[c] (0.531)	0.820[b] (0.385)	0.724 (0.451)	0.642 (0.444)	0.507 (0.444)	0.582 (0.393)	0.676 (0.430)	0.579[c] (0.340)
DUM	−4.569[a] (0.774)	−4.622[a] (0.782)	−4.571[a] (0.768)	−4.615[a] (0.767)	−4.610[a] (0.780)	−4.680[a] (0.767)	−4.627[a] (0.787)	−4.656[a] (0.789)	−4.593[a] (0.775)	−4.647[a] (0.779)	−4.655[a] (0.791)	−4.710[a] (0.775)
LCC	2.132[a] (0.774)						2.195[a] (0.716)					
LFDxLCC	−0.469[b] (0.205)						−0.478a (0.172)					
LGE		2.186[a] (0.746)						2.278[a] (0.674)				
LFDxLGE		−0.480[b] (0.223)						−0.519[a] (0.191)				
LPSAV			2.534[a] (0.657)						2.749[a] (0.733)			
LFDx LPSAV			−0.669[a] (0.176)						−0.665[a] (0.167)			
LRQ				2.262[a] (0.659)						2.326[a] (0.626)		
LFDxLRQ				−0.567[a] (0.216)						−0.584[a] (0.175)		
LRL					2.136[b] (0.844)						2.180[a] (0.764)	
LFDxLRL					−0.544[a] (0.207)						−0.554[a] (0.173)	
LVA						2.468[a] (0.599)						2.560[a] (0.602)
LFDxLVA						−0.788[a] (0.181)						−0.769[a] (0.168)
Number of Groups	35	35	35	35	35							

Table 6
Institutional quality model estimation results).

Variables	LLL	LLL	LLL	LLL	LLL	LLL	LFSD	LFSD	LFSD	LFSD	LFSD	LFSD
L.Growth	0.461^{a} (0.064)	0.461^{a} (0.064)	0.455^{a} (0.067)	0.463^{a} (0.067)	0.469^{a} (0.067)	0.460^{a} (0.066)	0.439^{a} (0.063)	0.439^{a} (0.064)	0.433^{a} (0.069)	0.443^{a} (0.067)	0.448^{a} (0.066)	0.457^{a} (0.067)
LFD	1.248 (0.860)	1.621^{c} (0.962)	1.495^{b} (0.749)	1.691^{b} (0.829)	1.602^{c} (0.848)	1.753^{a} (0.639)	1.006 (0.863)	1.336 (0.963)	1.386^{c} (0.737)	1.511^{c} (0.885)	1.320 (0.839)	1.749^{b} (0.788)
LGOV	−1.448^{b} (0.647)	−1.512^{b} (0.617)	−1.434^{b} (0.595)	−1.528^{a} (0.858)	−1.367^{b} (0.621)	−1.335^{b} (0.549)	−1.536^{b} (0.640)	−1.593^{b} (0.627)	−1.504^{a} (0.561)	−1.563^{a} (0.580)	−1.444^{b} (0.627)	−1.340^{b} (0.533)
INF	−0.049^{b} (0.020)	−0.056^{b} (0.021)	−0.061^{a} (0.020)	−0.056^{a} (0.020)	−0.056^{a} (0.021)	−0.058^{a} (0.021)	−0.054^{b} (0.022)	−0.061^{a} (0.023)	−0.073^{a} (0.022)	−0.061^{a} (0.022)	−0.059^{a} (0.022)	−0.062^{a} (0.022)
LTRADE	0.536 (0.405)	0.492 (0.402)	0.356 (0.424)	0.484 (0.395)	0.533 (0.393)	0.489^{c} (0.298)	0.832^{c} (0.428)	0.758^{c} (0.424)	0.657 (0.425)	0.720^{c} (0.401)	0.785^{c} (0.419)	0.634^{c} (0.346)
DUM	−4.674^{a} (0.801)	−4.686^{a} (0.797)	−4.675^{a} (0.789)	−4.683^{a} (0.794)	−4.701^{a} (0.803)	−4.757^{a} (0.795)	−4.629^{a} (0.797)	−4.649^{a} (0.797)	−4.639^{a} (0.785)	−4.653^{a} (0.793)	−4.665^{a} (0.802)	−4.728^{a} (0.788)
LCC	1.961a (0.719)						2.286^{a} (0.786)					
LFDxLCC	−0.458^{a} (0.176)						−0.541^{a} (0.203)					
LGE		1.906^{a} (0.646)						2.247^{a} (0.740)				
LFDxLGE		−0.512^{a} (0.195)						−0.581^{a} (0.223)				
LPSAV			2.445^{a} (0.680)						2.882^{a} (0.793)			
LFDx LPSAV			−0.592^{a} (0.160)						−0.747^{a} (0.198)			
LRQ				1.969^{a} (0.606)						2.235^{a} (0.703)		
LFDxLRQ				−0.542^{a} (0.163)						−0.620^{a} (0.203)		
LRL					1.826^{a} (0.168)						2.150^{a} (0.801)	
LFDxLRL					−0.534^{a} (0.168)						−0.596^{a} (0.202)	
LVA						2.253^{a} (0.582)						2.299^{a} (0.653)
LFDxLVA						−0.687^{a} (0.157)						−0.742^{a} (0.205)
Number of Groups	35	35	35	35	35	35	35	35	35	35	35	35
Period	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**	**2002–2019**
AR (1) (p-value)	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
AR (2) (p-value)	0.964	0.944	0.955	0.948	0.947	0.949	0.9888	0.971	0.973	0.969	0.970	0.941
Hansen Test (p-value)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Diff-Hansen (p-value)	1.000	1.000	1.000	1.000	0.956	1.000	0.876	0.963	0.912	0.976	1.000	1.000

^{a,b,c} indicates statistical significance at 99%, 95%, 90% confidence levels.

With the inclusion of institutional quality in the model, the effect of financial development on growth was examined. 6 different financial development indicators and 6 different institutional quality indicators were used. The estimation results showing all institutional quality indicators and all financial development indicators are included in the model as interaction variables, and their effect on growth is given in Tables 4–7.

In the financial development–growth relationship, the findings differ when institutional quality is included in the model. In Tablo 4, the financial development index (LFDI) is used as an indicator of financial development, and according to model findings, financial development and institutional quality have a statistically significant and positive effect on growth. However, the interaction variable of financial development and institutional quality has a negative effect. The negative effect of institutional quality on financial development interaction coefficients may be due to the negative effect of institutional quality on financial development in the short run. Khan et al. (2019) state that institutional development negatively affects financial development in the short run, whereas Law and Saini (2012) and Law et al. (2014) argue that institutional development positively affects financial development after a certain threshold level. Therefore, the negative impact of institutional quality on financial development in the short run may have caused the interaction variable to be negative. The model in which the final effect of the financial development index on growth is highest is the model in which voice and accountability are used as indicators of institutional quality. According to the results of this model, a 1% increase in broad money increases growth by 0.015. All institutionalization indicators also appear to have a positive effect on growth. The institutional quality indicator with the highest impact on growth is the Political Stability and Absence of Violence/Terrorism (LPSAV) variable with 2.408 in the broad money financial development model. A 1% increase in political stability and the absence of violence/terrorism increases growth by 0.024. LTRADE and LGOV also have a statistically significant effect on the growth of some models. While an increase in trade has a positive effect on growth, an increase in government expenditure reduces growth. Government spending has a stronger effect on growth than trade. The dummy variable used to represent the 2008 financial crisis is statistically significant in all models and has a negative effect on growth.

In Table 5, the effect of financial development on growth is analyzed using institutional quality indicators. Private Credit by Deposit Money Banks to GDP (%) and Deposit Money Banks' Assets to GDP (%) are used as indicators of financial development. Control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory

Table 7
Important parameters of economic growth, financial development, and institutional quality -economic growth.

Institutional quality -Economic Growth							Financial Development and Economic Growth					
Country	CC	GE	PSAV	RQ	RL	VA	FD	BM	PCDM	DMBA	LL	FSD
Algeria	0.042	0.000	0.632	0.045	−0.011	0.000	0.101	0.000	0.619	0.000	−0.068	0.249
Angola	0.000	0.000	0.350	−0.045	0.125	0.000	0.028	0.000	0.214	0.000	−0.045	1.144
Argentina	0.007	0.000	−0.199	0.025	−0.041	0.000	−0.089	0.000	0.721	0.000	−0.053	0.044
Brazil	0.045	0.000	0.001	0.045	0.079	0.000	0.000	0.000	0.560	0.000	0.060	0.061
Bulgaria	−0.067	0.000	−0.181	0.000	−0.063	0.000	0.057	0.000	0.305	0.000	0.091	0.397
Chile	0.045	0.000	−0.207	−0.045	0.009	0.000	0.000	0.000	0.658	0.000	0.050	−0.130
China	0.045	0.000	0.209	−0.045	−0.045	0.000	0.079	0.000	1.422	0.000	0.000	0.085
Colombia	0.000	0.000	0.111	0.000	0.045	0.000	0.058	0.000	0.383	0.000	0.068	0.076
Croatia	0.071	0.000	−0.134	−0.045	0.129	0.000	−0.045	0.000	1.441	0.045	0.000	0.262
Dominican Republic	−0.040	0.000	−0.389	0.000	0.106	0.000	0.058	0.000	−0.076	0.000	0.028	0.000
Ecuador	0.045	0.000	0.117	−0.022	0.062	0.000	0.055	0.000	0.509	0.000	0.000	0.072
Egypt	0.063	0.000	0.755	0.000	0.045	0.000	0.057	0.000	−0.022	0.000	−0.077	0.624
Hungary	−0.045	0.000	0.584	0.045	0.039	0.000	0.070	0.000	0.496	0.000	−0.045	0.741
India	0.000	0.000	−0.238	0.005	−0.049	0.000	0.045	0.000	−0.247	0.000	0.056	0.150
Indonesia	0.038	0.000	0.176	0.000	0.080	0.000	0.052	0.000	0.358	0.000	−0.023	0.093
Kazakhstan	0.104	0.000	0.086	0.029	0.059	0.000	−0.051	0.000	−0.110	0.000	0.037	0.671
Kuwait	0.000	0.000	−0.117	−0.028	−0.069	0.000	−0.009	0.000	0.573	0.000	−0.004	0.565
Malaysia	−0.012	0.000	0.264	−0.046	0.038	0.000	0.000	0.000	−0.213	0.000	0.000	0.022
Mexico	0.055	0.000	0.178	−0.051	0.055	0.000	−0.022	0.000	−0.069	0.000	0.047	−0.234
Morocco	−0.049	0.000	0.347	0.040	0.072	0.000	−0.043	0.000	0.161	0.000	0.045	−0.364
Oman	0.028	0.000	0.004	0.004	0.077	0.000	−0.103	0.000	−0.085	0.000	0.048	−0.222
Pakistan	0.083	0.000	0.509	−0.025	0.071	0.000	0.000	0.000	−0.196	0.000	0.061	0.615
Peru	0.065	0.000	0.430	0.000	0.045	0.000	−0.045	0.000	0.489	0.000	0.045	0.295
Philippines	0.000	0.000	−0.181	0.045	−0.016	0.000	0.093	0.000	0.508	0.000	−0.037	0.260
Poland	0.050	0.000	0.409	0.045	0.044	0.000	−0.035	0.000	0.514	0.000	0.000	0.200
Qatar	0.045	0.000	−0.115	0.000	0.000	0.000	0.045	0.000	−0.112	0.000	0.070	0.940
Romania	0.000	0.000	0.891	0.026	0.036	0.000	0.045	0.000	0.167	0.000	0.045	0.160
Saudi Arabia	0.045	0.000	0.106	−0.018	0.045	0.000	−0.063	0.000	0.197	0.000	0.077	−0.030
South Africa	−0.048	0.000	0.220	0.095	−0.104	0.000	0.052	0.000	−0.230	0.000	0.035	0.793
Thailand	0.025	0.000	−0.198	−0.066	0.045	0.000	0.062	0.000	0.164	0.000	−0.045	0.046
Turkiye	−0.045	0.000	0.098	−0.045	0.050	0.000	−0.059	0.000	−0.240	0.000	0.044	0.013
Ukraine	0.000	0.000	0.208	0.032	0.063	0.000	0.038	0.000	0.131	0.000	0.052	0.405
United Arab Emirates	−0.036	0.000	−0.162	−0.043	−0.006	0.000	0.000	0.000	0.601	0.000	0.000	0.359
Uruguay	0.000	0.000	0.237	0.039	0.010	0.000	0.000	0.000	0.359	0.000	0.062	0.688

quality, rule of law, voice, and accountability were used as indicators of institutional quality. The statistical significance of LPCDMB (Private Credit by Deposit Money Banks to GDP) and LDMBA (Deposit Money Banks' Assets to GDP) differ according to the institutional quality indicator. In models where political stability, absence of violence/terrorism, voice, and accountability variables are used as indicators of institutional quality, financial development has a statistically significant and positive effect on growth. All institutional quality indicators are statistically significant for growth. In the model in which LPCDMB is a financial development indicator and a voice and accountability institutionalization indicator, only financial development is statistically significant for growth. A 1% increase in private credit by deposit money banks to GDP (LPCDMB) increases growth by 0.008. In the model using LDMBA (Deposit Money Banks' Assets to GDP), the strong institutional quality indicator on growth is political stability and absence of violence/terrorism. This is the model with the highest net effect of institutionalization on growth. A 1% increase in political stability and the absence of violence/terrorism increases growth by 0.022. LGOV, another control variable, also has a statistically significant effect on growth. Government expenditure has a negative effect on growth. The dummy variable representing the financial crisis is statistically significant in all models and has a negative effect on growth.

Table 6 shows the effects of the other 2 financial development indicators on growth along with institutional quality indicators. These financial development indicators are liquid liabilities to GDP (LLL) and financial system deposits to GDP (LFSD). The financial development indicator with the strongest final impact on growth is LSMC (stock market capitalization to GDP). It is seen that other financial development indicators are statistically significant in most cases, and the general effect on growth is positive. The model in which the financial development indicator is LLL and the institutional quality indicator is LPSAV has a strong effect on growth. In this model, a 1% increase in LLL increases economic growth by 0.0185. In the model in which LFSD is used as a financial development indicator, the variable in which the institutional quality indicator has the strongest effect on growth is LPSAV. A 1% increase in LVA increases economic growth by 0.021. When the other control variables are examined, the lagged value of growth has a statistically significant and positive effect on growth in all models. It can be said that lgov and ltrade have a statistically significant effect on growth in general. In addition, the financial crisis negatively affects growth.

After the causality relationship and estimation results, it has been researched which financial development indicators and institutional quality indicators on the basis of country are the most effective for growth. The random forest model was used to determine the effect values of the variables. The important parameters are given in Table 7. The random forest model provides a measure of variable importance. This is particularly useful in this study to determine which financial development and institutional quality indicators have the most significant impact on economic growth. By using the Random Forest model in this study, researchers can overcome the limitations of traditional linear models, capture non-linear relationships, assess variable importance, and gain a more comprehensive understanding of the complex relationship between financial development, institutional quality, and economic growth. By ranking the importance of variables, researchers can gain insights into the factors that are most influential in driving economic growth within the context of financial development and institutional quality. This information can inform policy decisions and guide future research.

For institutionalization and financial development, CC, GE, PSAV, RQ, RL, and VA and FD, BM, PCDM, DMBA, LL, and FSD are used as inputs, respectively, and economic growth is used as output. The importance of each input parameter is given in Table 7 for each country used in this study. The high values obtained because of the method used indicate that the parameter is more important. The proposed model is analyzed on a country-by-country basis to examine the impact of institutionalization and financial development on economic growth. The importance of financial development and institutionalization on economic growth differs among countries. In general, when examining institutionalization control variables, it is found that PSAV was the largest factor influencing economic growth, and RL had the most negative impact. GE and RL are factors that had no impact on economic growth across all nations. According to the financial development results, PCDM has the most impact and DM and DMBA are the null variables. FD was minimal and had a mixed impact on economic growth in different nations. In all nations, it is not possible to conclude that both factors affect the variables completely negatively or positively on economic growth.

5. Conclusions

There is a large body of literature discussing the relationship between financial development and growth. These studies are generally divided into four categories. The first is demand-following studies, which concluded that there is a causal relationship between economic growth and financial development. The second is the supply-leading approach, which argues that there is a causal relationship between financial development and economic growth. The third is the feedback hypothesis, which emphasizes that there is a bidirectional causality relationship between both variables. The fourth view found that the relationship between the two variables is insignificant.

In this study, the relationship between economic growth and financial development was analyzed in emerging markets and middle-income economies. In addition, the effect of financial development on growth in the case of institutional quality was also investigated, and the financial development and institutional quality indicators most effective on growth were analyzed using the random forest method. The existence of a relationship between financial development and growth was examined using the Dumitrescu– Hurlin causality test. The system GMM method was used for model estimations. In the analysis, 9 different financial development indicators were used to determine the relationship between financial development and growth. According to the Dumitrescu– Hurlin causality test results, there is a causal relationship between economic growth and financial development for 7 financial development indicators, but there is no causality for 2 indicators. There is a bidirectional causality relationship between the 7 financial development indexes and growth. The existence of bidirectional causality between financial development and growth supports studies by Calderón and Liu (2003), Abu-Bader and Abu-Qarn (2008), Chow and Fung (2013), Shan et al. (2001), Hassan et al. (2011), and Nguyen et al. (2022) On the other hand, there is a unidirectional causality relationship between 2 financial development indicators and economic growth. The causality results differ according to the financial development indicators. Similarly, Sotiropoulou et al. (2022), Naceur et al. (2017), Moyo et al. (2018), and Nguyen et al. (2019) also found different causality relationships for different financial development indicators. According to the System GMM estimation results, if institutional quality variables are not included in the model, the effect of all financial development indicators on growth is statistically insignificant. Considering the other control variables, inflation, financial crisis, and public expenditures have a negative effect.

According to the estimation results of the institutional quality model, in which 6 different institutional quality indicators and 6 different financial development indicators are used, the financial development index, broad money, and liquid assets have a positive effect on growth in all models. Financial system deposits, private credit by deposit money banks, and deposit money banks' assets have a positive effect on growth in some models but are statistically insignificant in others. 6 financial development indicators, which were not significant with the inclusion of institutional quality in the model, showed a statistically significant effect on growth. This indicates that institutional quality is crucial in financial development and economic growth relationships. Similar findings were reached by Suleman et al. (2022), Kutan et al. (2017), and Law et al. (2013).

Control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law, voice, and accountability institutional quality indicators were found to have a positive effect on growth in all models.

By using the random forest model and analyzing the importance of various input parameters, important insights were obtained. The results demonstrated that the impact of financial development and institutionalization on economic growth varies among countries. Institutionalization control variables, such as Political Stability and Absence of Violence/ Terrorism, were found to have significant positive effects on economic growth, whereas Rule of Law had a negative impact. Among the financial development indicators, Private Credit by Deposit Money Banks emerged as the most influential, while Broad Money and Deposit Money Banks' Assets had negligible effects.

This study indicates that financial development can have an impact on economic growth if institutionalization is present. The existence of institutionalization weakens the mentality that will lead to waste of resources, such as corruption and bribery, and therefore enables the efficient use of financial resources. In addition, the asymmetric information problem in financial markets can be minimized through institutionalization, allowing the financial system to be used more effectively. In addition, the control mechanisms for the financial system that will be provided through institutionalization will contribute to the improvement of the financial system, especially financial stability. Therefore, supporting the financial system through institutionalization can play a stronger role in growth by ensuring efficiency in resource use. At this point, it is important that policy makers also prioritize policies aimed at institutionalization to increase the power of financial development in economic growth.

Funding

This study received no specific funding from any funding agency in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

There are no conflicts of interest.

Appendix.

Table A1
CIPS Unit Root Test Results for GMM and Cointegration

Variables	Constant	Constant + Trend	First Dif.	Period	CD Test
Growth	−2.999[a]	−3.073[a]	−4.719[a]	2002–2019	29.40[a]
LFDI	−2.609[a]	−3.234[a]	−4.556[a]	2002–2019	43.64[a]
LBM	−1.910	−1.805	−3.246[a]	2002–2019	35.73[a]
LPCDMB	−1.609	−1.770	−2.811[a]	2002–2019	34.49[a]
LDMBA	−1.680	−1.750	−2.801[a]	2002–2019	39.15[a]
LLL	−2.028	−2.029	−3.611[a]	2002–2019	36.43[a]
LFSD	−1.834	−1.512	−2.883[a]	2002–2019	41.95[a]
LSMC	−1.600	−1.880	−2.837[a]	2007–2019	20.73[a]
LTRADE	−1.605	−2.390	−3.633[a]	2002–2019	15.50[a]
INF	−2.628[a]	−2.848[a]	−3.970[a]	2002–2019	18.01[a]
LGOV	−2.345[a]	−2.686[b]	−4.387[a]	2002–2019	13.10[a]

[a,b] indicate that the basic hypothesis is rejected at 99% and 95% confidence levels.

Table A2
MADF Unit Root Test Results for Causality and Cross-Sectional Dependecy Test Results

Variables	Constant	First Dif.	Period	Countries	BP	LM_Adj
Growth	811.786[a]	1384.706[a]	1982–2019	31	845.76[a]	510.29[a]
Growth	790.031[a]	1265.322[a]	1981–2019	29	713.26[a]	491.08[a]
Growth	572.305[a]	1061.572[a]	1981–2019	27	656.85[a]	456.61[a]
Growth	758.402[a]	1139.402[a]	1981–2019	28	689.04[a]	473.84[a]
Growth	948.596[a]	2071.370[a]	1985–2019	28	740.24[a]	373.80[a]
LFDI	980.973[a]	878.087[a]	1982–2019	31	591.04[a]	462.83[a]
LBM	474.999[a]	664.087[a]	1981–2019	29	735.16[a]	409.61[a]
LPCDMB	180.533[a]	544.903[a]	1981–2019	27	621.10[a]	383.43[a]
LDMBA	270.872[a]	627.510[a]	1981–2019	27	670.78[a]	380.46[a]
LLL	478.414[a]	598.190[a]	1981–2019	28	663.10[a]	391.90[a]
LFSD	909.571[a]	2219.802[a]	1985–2019	28	620.43[a]	319.43[a]

[a] indicates that the basic hypothesis is rejected at 99% confidence levels.

Table A3
Homogeneity and Cointegration Test Results

Test	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Homogeneity Test									
Swamy Shat	359.44[a]	396.26[a]	461.88[a]	473.09[a]	443.01[a]	413.91[a]	152.64[a]	121.44[a]	131.72[a]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Detla tilde1	116.78[a]	45.07[a]	92.30[a]	13.30[a]	73.63[a]	260.89[a]	2233.43[a]	14.96[a]	72.04[a]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Delta_tilde_adj1	146.94[a]	56.72[a]	116.15[a]	16.74[a]	92.66[a]	328.28[a]	3158.55[a]	20.49[a]	98.65[a]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Delta_hat1	13.11[a]	15.78[a]	19.23[a]	19.90[a]	18.10[a]	16.36[a]	4.08[a]	1.20	3.29[a]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.113)	(0.000)
Delta_hat_adj1	0.84	1.04	1.29[c]	1.33[c]	1.20	1.08	0.21	−0.08	0.14
	(0.199)	(0.149)	(0.098)	(0.090)	(0.113)	(0.139)	(0.416)	(0.535)	(0.441)
Westerlund (2008) Cointegration Test									
Dh-g	9.79[a]	14.69[a]	3.79[a]	5.04[a]	13.86[a]	7.14[a]	142.01[a]	24.82[a]	766.35[a]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dh-p	2.379[a]	3.21[a]	1.72[b]	1.91[b]	3.52[a]	3.48[a]	1.63[c]	7.06[a]	4.26[a]
	(0.009)	(0.001)	(0.042)	(0.028)	(0.000)	(0.000)	(0.052)	(0.000)	(0.000)

[a,b,c] show that the basic hypothesis is rejected at 99%, 95%, and 90% confidence levels.

References

Abu-Bader, S., & Abu-Qarn, A. S. (2008). Financial development and economic growth: The Egyptian experience. *Journal of Policy Modeling, 30*(5), 887–898.

Ağayev, S. (2012). Geçiş ekonomilerinde finansal gelişme ve ekonomik büyüme ilişkisi. *Marmara Üniversitesi İktisadi ve İdari Bilimler Dergisi, 32*(1), 155–164.

Ak, M. Z., Altıntaş, N., & Şimşek, A. S. (2016). Türkiye'de finansal gelişme ve ekonomik büyüme ilişkisinin nedensellik analizi. *Doğuş Üniversitesi Dergisi, 17*(2), 151–160.

Ali, M. S., Khan, U. U., & Parveen, S. (2021). The relationship between financial development and foreign direct investment and its impact on economic growth of Pakistan. *iRASD Journal of Economics, 3*(1), 27–37.

Ang, J. B. (2008). What are the mechanisms linking financial development and economic growth in Malaysia? *Economic Modelling, 25*(1), 38–53.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies, 58*(2), 277–297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics, 68*(1), 29–51.

Aryestya, R., & Marta, J. (2022). Non-linear impact of domestic credit on economic growth in Southeast Asia countries. In *Eighth padang international conference on economics education, economics, business and management, accounting and entrepreneurship (PICEEBA-8 2021)* (pp. 511–520). Atlantis Press.

Aslan, A. G.Ö., & Küçükaksoy, İ. (2006). Finansal gelişme ve ekonomik büyüme ilişkisi: Türkiye ekonomisi üzerine ekonometrik bir uygulama. *Istanbul University Econometrics and Statistics e-Journal, 4*, 25–38.

Atamtürk, B. (2004). Türkiye'de finansal gelişme ve ekonomik büyümenin nedensellik yönü üzerine bir inceleme (1975-2003). *Maliye Araştırma Merkezi Konferansları, 46*, 99–105.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics, 87*(1), 115–143.

Botev, J., Égert, B., & Jawadi, F. (2019). The nonlinear relationship between economic growth and financial development: Evidence from developing, emerging and advanced economies. *International Economics, 160*, 3–13.

Boulesteix, A. L., Janitza, S., Kruppa, J., & König, I. R. (2012). Overview of random forest methodology and practical guidance with emphasis on computational biology and bioinformatics. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 2*(6), 493–507.

Bozoklu, Ş., & Yılancı, V. (2013). Finansal gelişme ve iktisadi büyüme arasındaki nedensellik ilişkisi: Gelişmekte olan ekonomiler için analiz. *Dokuz Eylül Üniversitesi İktisadi İdari Bilimler Fakültesi Dergisi, 28*(2), 161–187.

Breiman, L. (1996). Bagging predictors. *Machine Learning, 24*(2), 123–140.

Breiman, L. (2001). Random forest. *Machine Learning, 45*(1), 5–32.

Breiman, L., & Cutler, A. (2008). *Random forests—classification manual.* Available online: http://www.math.usu.edu/%7Eadele/forests. (Accessed 12 March 2022).

Breiman, L., Friedman, J., Olshen, R., & Stone, C. (1984). Classification and regression trees. *Wadsworth Int. Group, 432*, 151–166.

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies, 47*(1), 239–253.

Bui, T. N. (2020). Domestic credit and economic growth in ASEAN countries: A nonlinear approach. International *transaction. Journal of engineering, management, & Applied Sciences & Technologies, 11*(2), 1–9.

Calderón, C., & Liu, L. (2003). The direction of causality between financial development and economic growth. *Journal of Development Economics, 72*(1), 321–334.

Çeştepe, H., & Yıldırım, E. (2016). Türkiye'de finansal gelişme ve ekonomik büyüme ilişkisi. *Uluslararası Yönetim İktisat ve İşletme Dergisi, 12*(12), 12–26.

Cheng, C. Y., Chien, M. S., & Lee, C. C. (2021). ICT diffusion, financial development, and economic growth: An international cross-country analysis. *Economic Modelling, 94*, 662–671.

Cheng, S. Y., & Hou, H. (2021). Financial development, life insurance and growth: Evidence from 17 European countries. *The Geneva Papers on Risk and Insurance - Issues and Practice, 47*, 835–860.

Chow, W. W., & Fung, M. K. (2013). Financial development and growth: A clustering and causality analysis. *Journal of International Trade & Economic Development, 22*(3), 430–453.

Compton, R. A., & Giedeman, D. C. (2011). Panel evidence on finance, institutions and economic growth. *Applied Economics, 43*(25), 3523–3547.

Contuk, F. Y., & Güngör, B. (2016). Asimetrik nedensellik testi ile finansal gelişme ekonomik büyüme ilişkisinin analizi. *Muhasebe ve Finansman Dergisi, 71*, 89–108.

Cutler, A., & Stevens, J. R. (2006). Random forests for microarrays. *Methods in Enzymology, 411*, 422–432.

Demetriades, P., & Hook Law, S. (2006). Finance, institutions, and economic development. *International Journal of Finance & Economics, 11*(3), 245–260.

Doumbia, D. (2016). Financial development and economic growth in 43 advanced and developing economies over the period 1975–2009: Evidence of non-linearity. *Applied Econometrics and International Development, 16*(1), 13–22.

Ductor, L., & Grechyna, D. (2015). Financial development, real sector, and economic growth. *International Review of Economics & Finance, 37*, 393–405.

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling, 29*(4), 1450–1460.

Estrada, G. B., Park, D., & Ramayandi, A. (2010). *Financial development and economic growth in developing Asia. Asian development bank economics working paper*. No. 233. Available at: https://www.adb.org/sites/default/files/publication/28277/economics-wp233.pdf.

Gazdar, K., & Cherif, M. (2015). Institutions and the finance–growth nexus: Empirical evidence from MENA countries. *Borsa Istanbul Review, 15*(3), 137–160.

Giri, A. K., Mohapatra, G., & Debata, B. (2021). Technological development, financial development, and economic growth in India: Is there a non-linear and asymmetric relationship? *Journal of Economic and Administrative Sciences, 39*(1), 117–133.

Goldsmith, R. W. (1969). *Financial structure and development*. New Haven, CT: Yale University Press.

Gurley, J. G., & Shaw, E. S. (1955). Financial aspects of economic development. *The American Economic Review, 45*(4), 515–538.

Guru, B. K., & Yadav, I. S. (2019). Financial development and economic growth: Panel evidence from BRICS. *Journal of Economics, Finance and Administrative Science, 24*(47), 113–126.

Habibullah, M. S., & Eng, Y. K. (2006). Does financial development cause economic growth? A panel data dynamic analysis for the asian developing countries. *Journal of the Asia Pacific Economy, 11*(4), 377–393.

Haini, H. (2020). Examining the relationship between finance, institutions and economic growth: Evidence from the ASEAN economies. *Economic Change and Restructuring, 53*(4), 519–542.

Hassan, M. K., Sanchez, B., & Yu, J. S. (2011). Financial development and economic growth: New evidence from panel data. *The Quarterly Review of Economics and Finance, 51*(1), 88–104.

Hayaloğlu, P. (2015). Kırılgan beşli ülkelerinde finansal gelişme ve ekonomik büyüme ilişkisi: Dinamik panel veri analizi. *Ekonomik ve Sosyal Araştırmalar Dergisi, 11*(1), 131–144.

Helhel, Y. (2017). E7 ülkelerinde finansal gelişme ve ekonomik büyüme arasında nedensellik analizi. *Finans Politik ve Ekonomik Yorumlar, 54*(628), 9–18.

Ho, T. K. (1998). C4. 5 decision forests. In *Proceedings. Fourteenth international conference on pattern recognition (cat. No. 98EX170)* (Vol. 1, pp. 545–549). IEEE.

Ho, S. H., & Saadaoui, J. (2022). Bank credit and economic growth: A dynamic threshold panel model for ASEAN countries. *International Economics, 170*, 115–128.

Hunjra, A. I., Azam, M., Bruna, M. G., & Taskin, D. (2022). Role of financial development for sustainable economic development in low middle income countries. *Finance Research Letters, 47*, Article 102793.

Hussain, A., Oad, A., Ahmad, M., Irfan, M., & Saqib, F. (2021). Do financial development and economic openness matter for economic progress in an emerging country? Seeking a sustainable development path. *Journal of Risk and Financial Management, 14*(6), 237.

İnançlı, S., Altintaş, N., & İnal, V. (2016). Finansal gelişme ve ekonomik büyüme ilişkisi: D-8 örneği. *Kastamonu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 14*(4), 36–49.

Işık, H. B., & Bilgin, O. (2016). Finansal gelişme ve ekonomik büyüme ilişkisi: Türkiye örneği. *İnsan Ve Toplum Bilimleri Araştırmaları Dergisi, 5*(7), 1757–1765.

Kandır, S. Y., & İskenderoğlu, A. G.Ö. (2007). Finansal gelişme ve ekonomik büyüme arasındaki ilişkinin araştırılması. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 16*(2), 311–326.

Karamelikli, H., & Kesgingöz, H. (2017). Finansal gelişme bileşenlerinin ekonomik büyüme üzerindeki etkisi: Türkiye Örneği. *Itobiad: Journal of the Human and Social Science Researches, 6*(1), 683–701.

Kar, M., Nazlıoğlu, Ş., & Ağır, H. (2014). Trade openness, financial development and economic growth in Turkey: Linear and nonlinear causality analysis. *BDDK Bankacılık ve Finansal Piyasalar Dergisi, 8*(1), 63–86.

Kassie, N. M. (2021). The effects of financial development on economic growth in africa: Does the quality of institutions matter? *Journal of Business Economics and Finance, 10*(4), 166–177.

Keyghobadi, M., Pahlavani, M., & Hosseinzadeh, R. (2021). Spillover impacts of financial development on regional economic growth: A spatial econometric approach. *Journal of Development and Capital, 6*(1), 19–32.

Khan, M. A., Khan, M. A., Abdulahi, M. E., Liaqat, I., & Shah, S. S. H. (2019). Institutional quality and financial development: The United States perspective. *Journal of Multinational Financial Management, 49*, 67–80.

Khan, M. S., & Senhadji, A. (2000). Financial development and economic growth: An overview. In *IMF Working Paper* (pp. 3–14). No: WP/00/209.

Kutan, A. M., Samargandi, N., & Sohag, K. (2017). Does institutional quality matter for financial development and growth? Further evidence from MENA countries. *Australian Economic Papers, 56*(3), 228–248.

Law, S. H., & Azman-Saini, W. N. W. (2012). Institutional quality, governance, and financial development. *Economics of Governance, 13*, 217–236.

Law, S. H., Azman-Saini, W., & Ibrahim, M. H. (2013). Institutional quality thresholds and the finance–growth nexus. *Journal of Banking & Finance, 37*(12), 5373–5381.

Law, S. H., Tan, H. B., & Azman-Saini, W. N. W. (2014). Financial development and income inequality at different levels of institutional quality. *Emerging Markets Finance and Trade, 50*(1), 21–33.

Levine, R. (2005). Finance and growth: theory and evidence. *Handbook of economic growth,, 1*, 865–934.

Liang, Q., & Jian-Zhou, T. (2006). Financial development and economic growth: Evidence from China. *China Economic Review, 17*(4), 395–411.

Lucas, R. E., Jr. (1988). On the mechanics of economic development. *Journal of Monetary Economics, 22*(1), 3–42.

Magazzino, C., Mele, M., & Santeramo, F. G. (2021). Using an artificial neural networks experiment to assess the links among financial development and growth in agriculture. *Sustainability, 13*(5), 2828.

Mckinnon, R. I. (1973). *Money, capital and banking*. Washington D. C.: Brooklyn Institution.

Moyo, C., Khobai, H., Kolisi, N., & Mbeki, Z. (2018). *Financial development and economic growth in Brazil: A non-linear ARDL approach. MPRA paper No. 85252*. https://mpra.ub.uni-muenchen.de/85252/.

Naceur, M. S. B., Blotevogel, M. R., Fischer, M. M., & Shi, H. (2017). *Financial development and source of growth: New evidence. International monetary fund*. https://doi.org/10.5089/9781484302637.001

Nasir, M. A., Ahmad, M., Ahmad, F., & Wu, J. (2015). Financial and economic stability as 'two sides of a coin' Non-crisis regime evidence from the UK based on VECM. *Journal of Financial Economic Policy, 7*(4), 327–353.

Nasir, M. A., & Du, M. (2018). Integration of financial markets in post-global financial crises and implications for British financial sector: Analysis based on a panel VAR model. *Journal of Quantitative Economics, 16*, 363–388.

Nasir, M. A., & Soliman, A. M. (2014). Aspects of macroeconomic policy combinations and their effects on financial markets. *Economic Issues, 19*(1), 95–118.

Nguyen, Y. N., Brown, K., & Skully, M. (2019). Impact of finance on growth: Does it vary with development levels or cyclical conditions? *Journal of Policy Modeling, 41*(6), 1195–1209.

Nguyen, H. M., Le, Q. T. T., Ho, C. M., Nguyen, T. C., & Vo, D. H. (2022). Does financial development matter for economic growth in the emerging markets? *Borsa Istanbul Review, 22*(4), 688–698.

Opoku, E. E. O., Ibrahim, M., & Sare, Y. A. (2019). The causal relationship between financial development and economic growth in Africa. *International Review of Applied Economics, 33*(6), 789–812.

Orji, A., Ogbuabor, J. E., Okolomike, C. F., & Anthony-Orji, O. I. (2022). Capital inflows, financial development and growth in ecowas countries: A new empirical insight. *Applied Econometrics and International Development, 22*(1), 61–80.

Oro, O. U., & Alagidede, I. P. (2019). The non-linear relationship between financial development, economic growth and growth volatility: Evidence from Nigeria. *African Review of Economics and Finance, 11*(2), 67–97.

Ozcan, B., & Ari, A. (2011). Finansal gelisme ve ekonomik büyüme arasindaki iliskinin ampirik bir analizi: Türkiye örnegi. *Business and Economics Research Journal, 2*(1), 121–142.

Pata, U. K., & Ağca, A. (2018). Finansal gelişme ve ekonomik büyüme arasındaki eşbütünleşme ve nedensellik ilişkisi: Türkiye Örneği. Osmaniye Korkut Ata Üniversitesi İktisadi ve İdari Bilimler Fakültesi. *Dergisi, 2*(2), 115–128.

Patrick, H. T. (1966). Financial development and economic growth in underdeveloped countries. *Economic Development and Cultural Change, 14*(2), 174–189.

Pesaran, M. H. (2004). *General diagnostic tests for cross section dependence in panels. IZA discussion paper*. No. 1240 https://docs.iza.org/dp1240.pdf.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics, 22*(2), 265–312.

Pesaran, M. H., Ullah, A., & Yamagata, T. (2008). A bias-adjusted LM test of error cross-section independence. *The Econometrics Journal, 11*(1), 105–127.

Pesaran, M. H., & Yamagata, T. (2008). Testing slopehomogeneity in large panels. *Journal of Econometrics, 142*(1), 50–93.

Redmond, T., & Nasir, M. A. (2020). Role of natural resource abundance, international trade and financial development in the economic development of selected countries. *Resources Policy, 66*, Article 101591.

Robinson, J. C. (1952). *The generalisation of the general theory in the rate of interest and other essays*. London: Macmillan Press.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *STATA Journal, 9*(1), 86–136.

Sağlam, Y., & Sönmez, F. E. (2017). Finansal gelişme ve ekonomik büyüme arasındaki ilişki: Avrupa geçiş ekonomileri örneği. *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi, 12*(1), 121–140.

Samargandi, N., & Kutan, A. M. (2016). Private credit spillovers and economic growth: Evidence from BRICS countries. *Journal of International Financial Markets, Institutions and Money, 44*, 56–84.

Schumpeter, J. A. (1911). *Theory of economic development*. Cambridge: Harvard University Press.

Scott, G., & Münihiello, K. (2022). *Emerging market economy definition, how it works, and examples*. Available Online: https://www.investopedia.com/terms/e/emergingmarketeconomy.asp.

Segal, M. R. (2004), 1-14. Available online:. *Machine learning benchmarks and random forest regression*. UCSF: Center for Bioinformatics and Molecular Biostatistics https://escholarship.org/uc/item/35x3v9t4. (Accessed 16 March 2022).

Shahbaz, M., Nasir, M. A., Hille, E., & Mahalik, M. K. (2020). UK's net-zero carbon emissions target: Investigating the potential role of economic growth, financial development, and R&D expenditures based on historical data (1870–2017). *Technological Forecasting and Social Change, 161*, Article 120255.

Shahbaz, M., Nasir, M. A., & Lahiani, A. (2022). Role of financial development in economic growth in the light of asymmetric effects and financial efficiency. *International Journal of Finance & Economics, 27*(1), 361–383.

Shan, J. Z., Morris, A. G., & Sun, F. (2001). Financial development and economic growth: An egg-and-chicken problem? *Review of International Economics, 9*(3), 443–454.

Shaw, E. (1973). *Financial deepening in economic development*. New York: Oxford University Press.

Song, C. Q., Chang, C. P., & Gong, Q. (2021). Economic growth, corruption, and financial development: Global evidence. *Economic Modelling, 94*, 822–830.

Sotiropoulou, T., Georgopoulos, A., & Giakoumatos, S. (2022). Causality between financial development, economic growth, and income inequality in EU countries. *International Journal of Applied Research in Management and Economics, 5*(1), 1–13.

Sulemana, M., & Dramani, J. B. (2022). Effect of financial sector development and institutions on economic growth in SSA. Does the peculiarities of regional blocs matter? *Journal of Sustainable Finance & Investment, 12*(4), 1102–1124.

Svetnik, V., Liaw, A., Tong, C., Culberson, J. C., Sheridan, R. P., & Feuston, B. P. (2003). Random forest: A classification and regression tool for compound classification and QSAR modeling. *Journal of Chemical Information and Computer Sciences, 43*(6), 1947–1958.

Swamy, P. A. V. B. (1970). Efficient inference in a random coefficient regression model. *Econometrica, 38*(2), 311–323.

Taylor, M. P., & Sarno, L. (1998). The behavior of real exchange rates during the post-Bretton Woods period. *Journal of International Economics, 46*(2), 281–312.

Tran, V. T., Walle, Y. M., & Herwartz, H. (2020). The impact of local financial development on firm growth in Vietnam: Does the level of corruption matter? *European Journal of Political Economy, 62*, Article 101858.

Tripathy, N., & Mishra, S. (2021). The dynamics of cointegration between economic growth and financial development in emerging Asian Economy: Evidence from India. *Vision*, 1–13. https://doi.org/10.1177/09722629211011811

Tunali, H., & Onuk, P. (2017). Finansal gelisme ve ekonomik buyume arasindaki nedensellik īliskisi: Turkiye ornegi. *Journal of Economic Policy Researches, 4*(1), 1–15.

Valickova, P., Havranek, T., & Horvath, R. (2015). Financial development and economic growth: A meta-analysis. *Journal of Economic Surveys, 29*(3), 506–526.

Westerlund, J. (2008). Panel cointegration tests of the Fisher effect. *Journal of Applied Econometrics, 23*(2), 193–233. https://doi.org/10.1002/jae.967

Williams, K. (2018). Has the finance–growth link been broken? Panel data evidence from Latin America and the caribbean. *Economia, 19*(3), 404–423.

Zang, H., & Kim, Y. C. (2007). Does financial development precede growth? Robinson and Lucas might be right. *Applied Economics Letters, 14*(1), 15–19.