

Testing the asymmetric effect of financial development and capital formation on growth in Türkiye

Türkiye’de finansal gelişme ve sermaye oluşumunun büyüme üzerindeki asimetrik etkisinin test edilmesi

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Abstract

Building on the question of whether financial development and capital formation have asymmetric effects on economic growth, this study aims to test the asymmetric impact of broad money supply, private-sector loans, and gross capital formation on economic growth in Türkiye. The study covers the period from 1970 to 2023. The non-linear autoregressive distributed lag (NARDL) method was used in the study to identify asymmetric effects. The study found a long-run cointegration relationship between the variables. Accordingly, estimates of the long-run and short-run coefficients were derived by separating positive and negative shocks. In the short term, both positive and negative shocks to private-sector loans, as well as positive shocks to monetary expansion, negatively affect economic growth. However, negative shocks to capital formation have a positive impact on economic growth. In the long run, however, positive and negative shocks to monetary expansion, along with positive shocks to private-sector loans, hurt economic growth, whilst positive shocks to capital formation have a positive impact on economic growth. Ultimately, it has been concluded that, in Türkiye between 1970 and 2023, financial development hurt growth in both the short and long term, whilst capital accumulation had a positive impact. Based on these findings, it is necessary not only to channel financial development instruments in Türkiye towards productive sectors and capital formation, but also to increase and diversify the incentives that support capital formation.

Keywords: Growth, Financial Development, Capital, NARDL

Jel Codes: C32, E22, E51, O47

Öz

Finansal gelişme ve sermaye oluşumu ekonomik büyüme üzerinde asimetrik bir etkiye sahip mi sorusunda hareketle, bu araştırmanın amacı Türkiye’de geniş para arzı, özel sektöre verilen krediler ve brüt sermaye oluşumunun ekonomik büyüme üzerindeki asimetrik etkisini test etmektir. Araştırmanın dönemi 1970-2023 yılları arasını kapsamaktadır. Araştırmada asimetrik etkileri ortaya koymak için doğrusal olmayan gecikmesi dağıtılmış otoregresif sınır (NARDL) yöntemi kullanılmıştır. Araştırmada değişkenler arasında uzun dönemli eşbütünleşme ilişkisinin olduğu gözlemlenmiştir. Bu doğrultuda uzun ve kısa dönem katsayı tahminleri pozitif ve negatif şoklara ayrıştırılarak yapılmıştır. Kısa dönemde özel sektöre verilen kredilere yönelik pozitif ve negatif şoklar ile parasal genişlemeye yönelik pozitif şoklar ekonomik büyümeyi negatif yönde etkilemektedir. Fakat sermaye oluşumuna yönelik negatif şoklar ekonomik büyümeyi pozitif yönde etkilemektedir. Uzun dönemde ise parasal genişlemeye yönelik pozitif ve negatif şoklar ile özel sektöre verilen kredilere yönelik pozitif şoklar ekonomik büyümeyi negatif yönde etkilerken, sermaye oluşumuna yönelik pozitif şoklar ekonomik büyümeyi pozitif yönde etkilemektedir. Nihayetinde Türkiye’de 1970-2023 yılları arasında kısa ve uzun dönemde finansal gelişmenin büyümeyi negatif yönde, sermaye birikiminin ise pozitif yönde etkilediği sonucuna varılmıştır. Bu bulgulardan hareketle, Türkiye’de finansal gelişme araçlarının daha çok üretken sektörler ile sermaye oluşumunu destekleyici kanallara yönlendirilmesinin yanı sıra sermaye oluşumunu destekleyici teşviklerin artırılıp çeşitlendirilmesi gerekmektedir.

Anahtar Kelimeler: Büyüme, Finansal Gelişme, Sermaye, NARDL

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Introduction

Historically, Mercantilism based economic growth on attracting precious metals to the country through trade surpluses, while Physiocratic thought held that the fundamental basis of economic growth was agricultural production and the natural order. According to classical economists, the fundamental basis of economic growth is a free-market economy, whereas, according to Keynesian thought, it is aggregate demand (Kütükçü and Günay, 2025, p. 39). In the Neoclassical (Solow) and Endogenous Growth theories, the fundamental pillars of economic growth are technological progress, physical capital, and human capital (Tiryaki, 2021, p. 56).

Economic growth is one of the foremost economic issues that nearly all countries must take seriously. This is because economic growth is not only a long-term, wide-ranging phenomenon that affects the economy, but also one that shapes many other variables, including social, political, cultural, and similar factors. Therefore, a country needs to achieve stability and sustainability in economic growth and development to improve its citizens' living conditions across economic, political, health, education, cultural, and other aspects that enhance prosperity. Economic growth, which is considered an important driving force of prosperity, is influenced by the economic, political, and social developments of the period in which it occurs. For example, one obstacle to economic growth in underdeveloped and developing countries is underdeveloped financial markets. However, it has not been easy to determine the exact role of this situation on economic growth (Helhel, 2017, p. 10).

Financial expansion can be defined as the diversification of financial services across various sectors and the increase in the number of financial institutions. The financial system can be decisive for economic growth by providing capital for capital formation and supporting technological innovation. Liberalisation policies, which gained momentum worldwide after 1980, removed trade barriers, increased international trade, and accelerated financial flows. Thus, the financial system has become increasingly complex (Ebghaei, 2025, p. 2). During this process, two ways in which well-functioning financial systems could affect the savings mechanism and resource allocation decisions were identified. According to the first of these, the capital accumulation mechanism, one of the fundamental tasks of financial intermediation is to mobilise savings. These mobilised savings can then be transferred to entrepreneurs in need of funds, thereby supporting investment. The second channel, total factor productivity, addresses various methods to reduce the negative effects of asymmetric information on financial intermediaries, facilitate transactions by allocating funds, and minimise transaction costs through corporate governance (Arestis et al., 2015, p. 550).

Debates regarding the relationship between financial development and economic growth began with Schumpeter's (1911) research, and these debates remain relevant to this day (Aydın et al., 2014: p. 150). In this context, developments have centred the debates on the relationship between financial development and economic growth around four perspectives: the 'supply-led view', the 'demand-led view', the 'view that the two variables influence each other reciprocally', and the 'view that there is no interaction between the two variables' (Al-Yousif, 2002, p. 132).

The first hypothesis, in line with the supply-side perspective, states that 'financial development has a positive impact on economic growth'. This positive effect manifests itself in two ways. The first is through an increase in the marginal productivity of capital, thereby supporting economic growth, whilst the second is through an increase in savings, thereby supporting investment (Al-Yousif, 2002, p. 132). According to the second, demand-led perspective, however, 'there is an interaction from economic growth towards financial development'. Economic growth opens new areas for entrepreneurs to invest in and produce. Entrepreneurs seeking to capitalise on this opportunity require external resources, thereby increasing their demand for financial instruments. According to Patrick (1966), this situation can be observed in countries with underdeveloped or less developed financial systems. As the financial system improves, the direction of this relationship may change (Çeştepe and Yıldırım, 2016, p. 15).

The third view, which examines the relationship between financial development and economic growth, posits that 'the interaction between financial development and economic growth is reciprocal'. Finally, the fourth view, put forward by Lucas (1988), is based on the premise that 'there is no interaction between financial development and growth'. According to Lucas (1988), economic growth has only two sources: physical and human capital. (Kandır et al., 2007, pp. 313–314).

Although the increasing liberalisation of the global economy since the 1980s has significantly diversified the financial sector and accelerated capital flows (Ebghaei, 2025), studies in the literature have concluded that financial development and capital accumulation have both positive and negative effects on growth. In this context, some recent studies—including those by Pasara and Garidzirai (2020), Abbasa et al. (2022), Uslu (2022), Kesar et al. (2023), Dinçer (2025), Yıldız (2025), Sotiropoulou (2025), Ko

et al. (2025), Yeboah et al. (2025), and Yusoff et al. (2025) have reached conclusions indicating that financial development has a positive impact on capital growth. In contrast, studies by Helhel (2017), Dinh et al. (2019), Tutgun (2019), Ebghaei (2025), and Günbegi (2025) suggest that financial development has a negative or insignificant effect on capital growth. Furthermore, studies such as those by Abbas et al. (2022), Ebghaei (2025), and Sotiropoulou (2025) have failed to reach a consensus on the causal relationship between financial development and economic growth.

There is still no consensus in either the theoretical or empirical literature regarding the role of the financial system in the economic growth process (Arestis et al., 2015). Drawing on the literature on this contentious issue, this study employs a new-generation method that accounts for non-linear relationships, in contrast to the methods predominantly used in the literature, which focus on linear relationships. By enabling the determination of whether the trajectory of economic growth diverges in response to positive and negative shocks to financial development and capital formation, this method contributes to the literature by offering a different perspective on the conflicting findings. Furthermore, by drawing on the effects generated by positive and negative shocks, it positions itself within the literature as a means of ensuring that policy recommendations are more accurate, dynamic, and consistent.

Stable macroeconomic policies are of great importance to both global and national economies, helping improve investment and develop financial systems. These positive developments in investment and the financial system are also of great importance for economic growth. In this context, emerging economies are prioritising reforms to their financial systems to attract foreign capital and ensure stable, regular capital flows. In striving to achieve these objectives, the primary aim is to boost market confidence through monetary policy, fiscal discipline, and various regulations targeting the financial sector (Canbay, 2025, p. 174). Accordingly, this study aims to test the asymmetric relationship between financial development (broad monetary growth and credit extended to the private sector) and gross capital formation on economic growth in Türkiye, a developing economy, between 1970 and 2023. Based on the existing literature and theoretical framework, the hypotheses for this study are presented below.

H₁: Positive shocks to private sector loans – a key source of funding for investment channels – support investment and have a positive impact on economic growth.

H₂: Negative shocks to private-sector loans – a key source of funding for investment channels – reduce investment and harm economic growth.

H₃: Positive shocks to monetary growth increase demand and consumption. As rising demand and consumption are likely to increase inflation expectations, this may prompt central banks to raise interest rates. This situation leads to a decline in investment, thereby adversely affecting economic growth.

H₄: Negative shocks to monetary growth reduce demand and consumption. In turn, falling demand and consumption lead to a decline in investment and output, thereby adversely affecting economic growth.

H₅: Positive shocks to capital formation increase capital accumulation, which translates into investment, thereby positively affecting economic growth.

H₆: Negative shocks to capital formation reduce capital accumulation, leading to a fall in investment and, in turn, negatively affecting economic growth.

To test the hypotheses put forward in the study, the new-generation distributed autoregressive boundary test (NARDL), which is based on the ARDL boundary test, was employed. The most significant features of this test are that it yields better results than the ARDL model even with small data sets, and that it can distinguish between positive and negative shocks to the dependent variable, thereby testing their effects. Furthermore, another distinctive feature of this model is its accounting for asymmetric effects (Mert and Çağlar, 2023; Tiryaki, 2026).

The study is structured in six sections. The first section presents the theoretical framework, methodology, and proposed hypotheses. The second section reviews the relevant literature and provides the necessary analyses. The third section introduces the data set and evaluates the descriptive statistics. The fourth section addresses the model and methodology. The fifth section evaluates the research findings and presents the necessary discussions. In the sixth and final section, the results are discussed, and policy recommendations are made.

Literature review

The relationship between financial development and economic growth

A review of the literature examining the relationship between financial development and economic growth reveals that studies focusing on specific countries and groups of countries have yielded differing results. Indeed, the findings of some studies, such as those by Helhel (2017), Tutgun (2019), and Canbay (2025), suggest a negative relationship between these variables. Conversely, studies such as those by Dinh et al. (2019), Uslu (2022), Abbas et al. (2022), and Obradović and Grubišić (2024) suggest a positive relationship between these variables. Furthermore, studies such as those by Abbas et al. (2022), Ebghaer (2025), and Sotiropoulou (2025) have not reached consensus on the causal relationship in this context. Consequently, the current literature indicates that no consensus has yet been reached on this matter. In this context, the results of some selected recent studies on this topic are presented in detail in Table 1.

Table 1: Literature Summary

Author Year	Country Period	Method	Result
Helhel (2017)	E-7 Countries 2001-2013	Pedroni and Fisher Cointegration	The present study hypothesises that the effect of M2 money supply on growth is negative. The correlation between private-sector credit provision and economic growth is not statistically significant.
Asteriou and Spanos (2019)	26 EU countries 1990-2016	FEM	Financial development supported growth before the 2008 crisis but has not since.
Dinh et al. (2019)	Low and Middle- Income Developing Countries 2000-2014	VECM, FMOLS	Direct foreign investment has a positive effect on long-term growth but a negative effect on short-term growth. Furthermore, in the short term, money supply has a positive effect on growth, while total credit extended to the private sector has a negative effect.
Tutgun (2019)	Türkiye 1961-2014	ARDL	In the short and long term, energy consumption and loans provided to the private sector have a positive effect on growth, while increases in the broad money supply harm growth.
Abbas et al. (2022)	44 countries and 42 Middle-Income Countries 1995-2018	Panel ARDL	In both country groups, financial development supports long-term growth. Furthermore, there is a two-way causal relationship between financial development and growth.
Coşkun and Kandemir-Kuloğlu (2022)	Türkiye 1980-2019	Johansen Cointegration and Toda-Yamamoto Causality	In the short term, it is evident that private-sector loans do not have a significant effect on economic growth. Nonetheless, capital has been shown to have a positive and significant effect on short-term growth. The existence of a two-way causal relationship between growth and the private sector has been demonstrated, as well as a one-way causal relationship from capital to growth.
Taşseven and Yılmaz (2022)	Türkiye 2005-2020	Johansen Cointegration and Granger Causality	There is a cointegration relationship among economic growth, the BIST 100, inflation, exports, imports, credit volume, and M2. There is a unidirectional causal relationship from economic growth to the BIST 100 and M2. Bank credit volume is not a cause of economic growth.
Uslu (2022)	Türkiye 1960-2019	FMOLS, DOLS, and CCR	The money supply, private-sector loans, and energy consumption are positively affecting growth.
Demir-Kale and Ebghaei (2023)	Türkiye 2008-2022	NARDL	Positive shocks from bank loans to the private sector are boosting growth.
Obradović and Grubišić (2024)	Southeastern Europe 2007-2024	FE, FGLS, PCSE	While broad money supply growth (M3) positively affects economic growth, the effects of lending rates and official exchange rates on growth are insignificant.
Şeyranlıoğlu (2024)	Türkiye 1998-2022	DOLS and Hacker-Hatemi J Causality	Economic growth positively affects financial development. Financial development, in turn, is a Granger cause of economic growth.
Ebghaei (2025)	Developing Countries 1990-2022	Canning and Pedroni Panel Causality	There is no causal relationship between financial development and economic growth for the panel as a whole.
Canbay (2025)	ASEAN 1980-2021	Panel Causality	In Indonesia and Malaysia, direct foreign investment has a positive effect on growth, while financial development has a negative effect. In the Philippines, the opposite is true; in Singapore and Thailand, however, direct foreign investment and financial development harm growth.
Günbegi (2025)	Türkiye 1990-2024	ARDL	The volume of credit affects growth positively in the short term and negatively in the long term.
Yıldız (2025)	Türkiye 1985-2021	ARDL	The financial markets and institutions index, energy production, and commercial openness have a positive effect on growth, whereas direct foreign investment has a negative effect.
Sotiropoulou (2025)	13 Central and Eastern European Countries 2000-2020	Toda-Yamamoto Causality	Special loans and liquid liabilities provided by the financial sector are the Granger cause of growth.
Yusoff et al. (2025)	Selected Developing Countries 2000-2022	GMM	Monetary growth and private-sector loans both positively affect growth. However, this effect is stronger for private loans.
Tiryaki (2026)	Türkiye 2005-2023	NARDL and Toda-Yamamoto Causality	Positive shocks to financial development boost growth, while negative shocks reduce it. In addition, there is a unidirectional causal relationship from growth to financial development and foreign direct investment. A unidirectional causal relationship from trade openness to growth has been identified.

The relationship between capital formation and economic growth

When we examine the literature on the relationship between capital formation and economic growth, studies of individual countries and groups of countries generally indicate a positive association. Pasara and Garidzirai (2020), Kılıç and Kızılkay (2023), Dinçer (2025), Žarković et al. (2025), and Rikhotso and Zhanje (2026) are among the studies that have found a positive relationship between these variables. Indeed, whilst Aslan and Altınöz (2021) concluded that capital hurts growth in developing countries across Europe, Asia, and the Americas, this effect is positive in Africa. Similarly, in their study covering 124 countries, Topcu et al. (2020) found that capital formation negatively affects growth in low-income countries. Eşsiz and Durucan (2023) found that capital formation negatively affects short-term growth in Türkiye. Looking at the results of these studies, the prevailing view in the current literature is that there is a positive relationship between capital formation and economic growth. The results of some selected recent studies on this topic are presented in detail in Table 2.

Table 2: Literature Summary

Author Year	Country Period	Method	Result
Pasara and Garidzirai (2020)	South Africa 1980-2018	VAR	A long-term positive relationship has been found between capital formation and economic growth.
Topcu et al. (2020)	124 Countries 1980-2018	PVAR	In high-income countries, capital formation, urbanisation, and energy consumption positively affect growth. In low-income countries, however, capital formation hurts growth. Furthermore, there is a unidirectional causal relationship between capital formation, energy consumption, and GDP.
Aslan and Altınöz (2021)	Developing Countries 1980-2018	PVAR	In countries across Europe, Asia, and America, natural resources and globalisation have a positive effect on growth, while capital accumulation has a negative effect. In countries across Africa, capital accumulation and globalisation have a positive effect on growth, while natural resources have a negative effect.
Eşsiz and Durucan (2023)	Türkiye 1974-2021	ARDL	In the short term, capital has been shown to have a detrimental effect on growth, whereas in the long term, it is positively correlated with economic growth. Conversely, direct foreign investment has been shown to exert a positive impact in the short term, yet a negative impact in the long term.
Kesar et al. (2023)	BRICS 2002-2019	DOLS	The governance index, population, control of corruption, effective governance, and capital formation positively affect growth.
Kılıç and Kızılkaya (2023)	Türkiye 1990-2020	ARDL	Whilst foreign direct investment and capital formation have a positive impact on growth in both the short and long term, this effect on inflation applies only in the long term.
Dinçer (2025)	10 MENA Countries 1990-2023	Panel ARDL	Commercial openness, capital formation, and direct foreign investment positively affect long-term growth, while commercial openness and direct foreign investment negatively affect short-term growth.
Ko et al. (2025)	ASEAN 2000-2023	Panel ARDL	Direct foreign investment, capital formation, and trade openness positively affect growth. However, the effect of capital formation on economic growth is very weak.
Yeboah et al. (2025)	9 European Countries 1995-2021	Panel ARDL	Direct foreign investment and trade openness have a positive effect on short-term growth and a negative effect on long-term growth. Capital formation has a positive effect on growth in the long term.
Ramadhani et al. (2025)	ASEAN-5 2000-2023	FEM	Capital formation, public expenditure, and the labour force all influence growth.
Žarković et al. (2025).	28 EU Countries 2000-2020	Regression	In both old and new EU Member States, capital formation, trade openness, and public expenditure positively affect growth.
Kasap (2025)	BRICS-T 2003-2021 EU Countries 2001-2022	The Fixed Effects	In both EU countries and BRICS-T countries, internet usage, fixed broadband access, mobile phone subscriptions, and capital formation all positively impact growth.
Kadiroğlu and Ayhan (2025)	Türkiye 1970-2020	ARDL	While gross capital formation and trade openness have a positive impact on growth, economic globalisation hurts growth.
Rikhotso and Zhanje (2026)	SADC Countries 1994-2023	FGLS, CS-ARDL	Capital formation has a positive impact on growth in both the short and long term.
Albayrak (2026)	Türkiye 1968-2024	FMOLS, DOLS, and CCR	Indirect taxes, openness to the outside world, and capital investments all positively impact economic growth.
Özbek and Turgut (2026)	Türkiye 1990-2023	FMOLS, DOLS, CCR, and Hacker-Hatemi-J Causality	Exports of high-tech products, foreign direct investment, labour, and capital all positively impact economic growth. Furthermore, there are both symmetric and asymmetric causal relationships between these variables and economic growth.

Data set and descriptive statistics

The data set for this study, covering the period from 1970 to 2023 in Türkiye, includes variables such as growth (GDP), financial development (broad money supply and credit to the private sector), and gross capital formation. The main reason the data set covers these years is data limitations. In compiling this data set, the literature was consulted, including Helhel (2017), Tutgun (2019), Pasara and Garidzirai (2020), Abbasa et al. (2022), Uslu (2022), Coşkun and Kandemir-Kuloğlu (2022), Sotiropoulou (2025), and Yusoff et al. (2025). Detailed information about the dataset is provided in Table 3.

Table 3: Data Set

Variables	Abbreviations	Description	Database
Gross Domestic Production	LNGDP	Gross Domestic Product (GDP: constant 2015 US\$)	The World Bank
Broad Money Growth	BMG	Broad money growth (annual %)	The World Bank
Credit to the Private Sector	CPS	Domestic credit to the private sector by banks (% of GDP)	The World Bank
Gross Capital Formation	GCF	Gross capital formation (% of GDP)	The World Bank

Descriptive statistics

Descriptive statistics include the mean, maximum, minimum, and number of observations for the data set used in the analysis. In this context, the descriptive statistics for the dataset used in this study are presented in Table 4.

Table 4: Descriptive Statistics

Variables	Observation	Min	Max	Average	Median	Std. Deviation
LNGDP	54	23.506	27.742	26.018	25.946	1.228
BMG	54	10.422	144.796	47.254	35.105	31.588
CPS	54	13.588	70.896	29.259	20.607	17.750
GCF	54	13.731	35.039	23.367	23.799	5.396

Looking at Table 4, the lowest GDP value in logarithmic form is 23,506, the highest is 27,742, and the average is 26,018. Looking at monetary expansion, the lowest value is 10.422%, the highest value is 144.796%, and the annual average is 47.254%. It is understood that the lowest value of loans granted to the private sector was 13.588%, the highest value was 70.896%, and the average was 29.259%. During this period, the variable with the lowest standard deviation was growth, while the variable with the highest standard deviation was broad money supply.

Model and methodology

Model

In Türkiye, the fundamental equation of the data set used to examine the asymmetric effects of monetary expansion, loans to the private sector, and capital formation on economic growth is given in Equation (1).

$$\text{LNGDP}_{it} = f(\text{BMG}, \text{CPS}, \text{GCF}) \quad (1)$$

When Equality (1) is expanded, it becomes the equation given in Equality (2).

$$\text{LNGDP}_{it} = \beta_0 + \beta_1 \text{BMG}_{it} + \beta_2 \text{CPS}_{it} + \beta_3 \text{GCF}_{it} + e_{it} \quad (2)$$

In Equality (2), LNGDP is the control variable, while BMG, CPS, and GCF are the independent variables, and e is the error term.

Methodology

In the time-series analyses conducted in this study, the Non-linear Autoregressive Distributed Lag (NARDL) model was used alongside unit root tests.

Unit root tests

Unit root tests hold an important place in time series analysis. These tests, used to determine whether a series is stationary, are indispensable for analysis. Accordingly, the PP (Phillips-Perron, 1988), ERS (Elliott-Rothenberg-Stok, 1996), and NG Perron (2001) unit root tests were used in this study.

Non-linear ARDL (NARDL) test

The NARDL test, developed by Shin et al. (2014), is an extended version of the symmetric ARDL test developed by Pesaran et al. (2001). As with the ARDL test, this test can be applied even when the variables are stationary at the $I(0)$ or $I(1)$ level (Neog and Yadava, 2020, p. 44475; Ahmed et al., 2021, p. 4). The NARDL test allows for symmetric and asymmetric cointegration (Mert and Çağlar, 2023, p. 341) and also provides short- and long-term coefficient estimates (Zhang et al., 2022, p. 2). This test not only yields good results with a small sample group, but also estimates the short- and long-term positive and negative effects of the independent variables on the dependent variable (Chen, 2023, p. 19333). Positive shocks estimated in the model can affect the dependent variable in either a positive or negative direction. In contrast, negative shocks can affect it in either a positive or negative direction (Mert and Çağlar, 2023, p. 345). In addition to these characteristics, this model was chosen for this study because

it is current. In addition to these characteristics, this model was chosen for this study because it is current. Accordingly, the NARDL prediction equation for the dataset used in this study is given in Equation (3) (Khurshid and Abid, 2024, p. 5):

$$\begin{aligned} \text{LNGDP}_t = & m_0 + \sum_{i=1}^p m_1(\text{LNGDP})_{t-1} + \sum_{i=0}^q m_2(\text{BMG}^+)_{t-i} + \sum_{i=0}^q m_2(\text{BMG}^-)_{t-i} \\ & + \sum_{i=0}^q m_3(\text{CPS}^+)_{t-i} + \sum_{i=0}^q m_3(\text{CPS}^-)_{t-i} \\ & + \sum_{i=0}^q m_4(\text{GCF}^+)_{t-i} + \sum_{i=0}^q m_4(\text{GCF}^-)_{t-i} + \lambda_1(\text{LNGDP})_t + \lambda_2(\text{BMG}^+)_t + \lambda_2(\text{BMG}^-)_t \\ & + \lambda_3(\text{CPS}^+)_t + \lambda_3(\text{CPS}^-)_t + \lambda_4(\text{GCF}^+)_t + \lambda_4(\text{GCF}^-)_t + e_{i,t} \end{aligned} \quad (3)$$

Empirical findings and discussion

Unit root findings

This section presents the results of the stationarity tests, which constitute the first stage of the empirical analysis. Accordingly, the results of the PP unit root test are presented in Table 5.

Table 5: PP Unit Root Test Results

Variables	Model	Level		First Difference	
		t-Stat	Result	t-Stat	Result
LNGDP	Cons.	-1.549	Unit Rooted	-7.057*	I(1)
	Cons. and Trend	-2.439	Unit Rooted	-7.2082*	I(1)
BMG	Cons.	-2.641***	I(0)	-11.671*	I(1)
	Cons. and Trend	-2.687	Unit Rooted	-11.553*	I(1)
CPS	Cons.	-0.941	Unit Rooted	-4.764*	I(1)
	Cons. and Trend	-1.691	Unit Rooted	-4.689*	I(1)
GCF	Cons.	-1.926	Unit Rooted	-14.286*	I(1)
	Cons. and Trend	-4.696*	I(0)	-	I(0)

Note: *** and * are statistically significant at the 10% and 1% levels, respectively. I(0): Stationary at the level, I(1): Stationary at the first difference.

The PP results in Table 4 indicate that the LNGDP and CPS variables are stationary at the first difference for both models. The fixed model for BMG shows that BMG is stationary at the 10% significance level, but that the first difference is stationary at the 1% significance level. The fixed- and trending-model tests for BMG indicate that it is stationary at the first difference at the 1% significance level. Finally, according to the fixed- and trending-models for GCF, GCF is stationary at the level, whereas under the fixed model, GCF is stationary at the first difference.

Table 6: ERS Unit Root Test Results

Variables	Model	Level		First Difference	
		t-Stat	Result	t-Stat	Result
LNGDP	Cons.	210.944	Unit Rooted	1.704*	I(1)
	Cons. and Trend	15.585	Unit Rooted	4.481**	I(1)
BMG	Cons.	6.585	Unit Rooted	1.194*	I(1)
	Cons. and Trend	19.157	Unit Rooted	4.356**	I(1)
CPS	Cons.	0.006*	I(0)	-	-
	Cons. and Trend	0.009*	I(0)	-	-
GCF	Cons.	9.328	Unit Rooted	1.874*	I(1)
	Cons. and Trend	4.223*	I(0)	-	-

Note: ***, **, and * are statistically significant at the 10%, 5%, and 1% levels, respectively. I(0): Stationary at the level,

I(1): Stationary at the first difference.

According to the ERS unit root results in Table 5, the LNGDP and BMG variables are stationary at the first difference for both models. In contrast, the CPS variable is stationary at the level for both models. Finally, GCF is stationary at the level under the fixed and trending model, whereas it is stationary at the first difference under the fixed model. These results indicate that the variables are stationary at different orders, as shown by the PP unit root test.

Table 7: NG-Perron Unit Root Test Results

Variables	Model	MZa	MZt	MSB	MPT	Result
LNGDP	Cons.	1.227	1.522	1.240	108.206	Unit Rooted
	Cons. and Trend	-6.719	-1.751	0.260	13.618	Unit Rooted
Δ LNGDP	Cons.	-24.778*	-3.469*	0.140*	1.154*	I(1)
	Cons. and Trend	-25.391*	-3.550*	0.139*	3.664*	I(1)
BMG	Cons.	-4.347	-1.396	0.321	5.762	Unit Rooted
	Cons. and Trend	-4.834	-1.524	0.315	18.671	Unit Rooted
Δ BMG	Cons.	-21.087*	-3.244*	0.153*	1.170*	I(1)
	Cons. and Trend	-20.576**	-3.202**	0.155**	4.460**	I(1)
CPS	Cons.	-7899.90*	-62.846*	0.007*	0.004*	I(0)
	Cons. and Trend	-363.317*	-13.476*	0.037*	0.253*	I(0)
GCF	Cons.	-1.878	-0.746	0.397	10.533	Unit Rooted
	Cons. and Trend	-22.503**	-3.345**	0.148**	4.101**	I(0)
Δ GCF	Cons.	-25.057*	-3.463*	0.138*	1.227*	I(1)
	Cons. and Trend	-23.973*	-3.374**	0.140*	4.322**	I(0)

Note: ***, **, and * are statistically significant at the 10%, 5%, and 1% levels, respectively. I(0): Stationary at the level, I(1): Stationary at the first difference. Δ The first difference is stated.

Looking at Table 7, which presents the results of our final unit root test (Ng-Perron), we see that the LNGDP and BMG variables are stationary at first differences for both models. In contrast, the CPS variable is stationary at the level for both models. The GCF variable is stationary at the first difference under the fixed model, whereas it is stationary at the level under the fixed and trend model. These results show that the variables are stationary at different orders, as indicated by the PP and ERS unit root tests, and are more similar to the ERS results. Thus, the results of all unit root tests indicate that the dependent variable LNGDP is I(1) across all models. In contrast, the independent variables are stationary at different orders, including I(0) and I(1).

BDS linearity test

Based on the unit root test results, it was determined that the asymmetric ARDL (NARDL) test proposed by Shin et al. (2014) could be applied to the data set. However, before applying NARDL, the BDS test was used to determine whether the data set and the established model had a linear structure, and the results are presented in Table 8.

Table 8: BDS Results

Statistic	Dimension	Model General	LNGDP	BMG	CPS	GCF
BDS	2	0.053*	0.194*	0.072*	0.184*	0.109*
BDS	3	0.084*	0.330*	0.147*	0.300*	0.179*
BDS	4	0.105*	0.422*	0.190*	0.365*	0.224*
BDS	5	0.104*	0.485*	0.200*	0.400*	0.246*
BDS	6	0.089*	0.529*	0.196*	0.416*	0.272*

Note: *: Significant at the 1% level.

Table 8 presents the linearity test results for the model established in Equation 2 and the variables included in the model. The BDS test statistics in Table 8 indicate that the model established in Equation 2 does not have a linear structure. Furthermore, the BDS test statistics provided for each variable in Table 8 also indicate that the variables do not exhibit linear behaviour. Consequently, the non-linear behaviour observed in the dataset analysed demonstrates the applicability of the NARDL test for predictive purposes (Wani et al., 2024, pp. 9-10).

NARDL prediction results and discussion

Following confirmation of the applicability of the linearity test for NARDL, the NARDL (2,3,2,3) model was estimated based on the AIC (Akaike information criterion) and 3 lags. Subsequently, all tests were performed using this estimated model, and the results are reported sequentially under this heading.

Table 9: Diagnostic and Asymmetric Tests

Diagnostic Tests	Statistics	Prob.
R ²	0.86	-
Serial Correlation (Breusch-Godfrey LM) Test	1.137	0.355
Heteroskedasticity (Breusch-Pagan-Godfrey) Test	0.881	0.620
Specification (Ramsey Reset) Test	0.250	0.621
Normality (Jarque-Bera) Test	2.016	0.364
Cusum	Stable	
Cusum Squar	Stable	
Asymmetry Wald Tests	Statistics	Prob.
W _{SR} (Short-Run Wald test)	6.939	0.000*
W _{LR} (Long-Run Wald test)	8.283	0.000*

Cusum and Cusum Squar

Note: *: Significant at the 1% level.

According to Table 9, the R² value of the NARDL (2,3,2,3) estimation model was calculated as 0.86, while the critical values of the other four test statistics were found to be statistically insignificant. This result indicates that the model was constructed flawlessly. Another test included in Table 9 is the CUSUM and CUSUM square tests. According to these tests, the data set fluctuates steadily within the confidence interval limits. In other words, the data set moves steadily.

According to the asymmetric Wald tests presented in Table 9, the variables exhibit asymmetric structures in both the short- and long-term. Thus, the asymmetric test results support the BDS test results presented in Table 8, which indicate that the variables are not linear. Thus, the NARDL (2,3,2,3) estimation model has successfully passed the test and allows us to proceed to the next stage of the analysis.

Table 10: Cointegration Results

Model	Test Statistics	Asymptotic Value	LB	UB
NARDL (2,3,2,3)	F-statistic = 7.579*	%1	3.656	5.331*
		%5	2.726	4.057
		%10	2.309	3.507
	t-statistic = -5.816*	%1	-3.430	-4.990*
		%5	-2.860	-4.380
		%10	-2.570	-4.040

Note: *: Significant at the 1% level. LB: Lower bound = I(0), UB: Upper bound = I(1)

After the test analyses, examining the cointegration test results presented in Table 10 reveals that the F-statistic for the NARDL (2,3,2,3) model, estimated at 7.579, exceeds all upper critical values. Similarly, the estimated t-statistic value of -5.816 is also above the upper limit of all critical values in terms of absolute value. Thus, the t- and F-test statistics indicate that the data set is cointegrated. In other words, according to the NARDL (2,3,2,3) estimation model, there is a cointegration relationship between the variables. After detecting the cointegration relationship between the variables, short- and long-term coefficient estimates were obtained and are presented in Table 11.

Table 11: Short-term Results

Variable	Coefficient	t-statistic	Prob.
$\Delta \text{LNGD} (-1)$	-0.154	-1.388	0.175
ΔBMG^+	-0.004	-4.277	0.000*
ΔBMG^-	0.001	1.377	0.178
ΔCPS^+	-0.020	-2.847	0.007*
ΔCPS^-	-0.008	-2.019	0.052***
ΔGCF^+	0.010	1.193	0.241
ΔGCF^-	0.019	2.329	0.026*
C	12.346	8.154	0.000*
Cointeq (ECT)	-0.502	-8.111	0.000*

Note: ***, **, and * are statistically significant at the 10%, 5%, and 1% levels, respectively.

The error correction model coefficient presented in Table 11 was -0.502 and was found to be significant based on both the t-statistic and the probability value. The fact that the error correction coefficient is negative and statistically significant confirms that the model operates without error and indicates that short-term deviations will revert to the long-term equilibrium (Wani et al., 2024, p. 10).

Looking at the short-term coefficient estimates in Table 11, we observe that positive shocks supporting monetary expansion in the short term hurt growth. These results support the studies by Helhel (2017), Tutgun (2019), and Canbay (2025). No significant relationship was found between short-term negative shocks to monetary expansion and growth. Another result in Table 11 indicates that positive and negative shocks to bank loans to the private sector in the short term negatively affect growth. These results support the findings of Dinh et al. (2019), Canbay (2025), and Günbegi (2025) in the literature. Finally, according to Table 10, negative short-term shocks to capital formation are positively associated with growth. This result supports the findings of studies conducted by Pasara and Garidzirai (2020), Coşkun and Kandemir-Kuloğlu (2022), Kesar et al. (2023), Kılıç and Kızılkay (2023), and Ko et al. (2025) on Türkiye and other countries. On the other hand, no significant relationship was found between positive shocks to capital formation and growth.

Table 12: Long-term Results

Variable	Coefficient	F-statistic	Prob.
BMG^+	-0.004	-1.837	0.073***
BMG^-	-0.005	-2.838	0.006*
ΔCPS^+	-0.045	-3.811	0.0004*
ΔCPS^-	0.015	0.899	0.373
GCF^+	0.119	4.904	0.000*
GCF^-	0.002	0.045	0.963

Note: ***, **, and * are statistically significant at the 10%, 5%, and 1% levels, respectively.

Looking at Table 12, which contains long-term coefficient estimates, we observe that both positive and negative shocks to monetary growth negatively affect long-term growth. This result supports the findings of Helhel (2017), Tutgun (2019), and Canbay (2025) in the literature. Indeed, according to Table 12, positive shocks to private-sector lending in Türkiye negatively affect long-term growth. This result supports the findings of Dinh et al. (2019), Canbay (2025), and Günbegi (2025) in the literature. No significant relationship was found between negative shocks to long-term loans to the private sector in Türkiye and growth. Finally, another result in Table 12 indicates that long-term positive shocks to capital formation in Türkiye positively affect growth. This finding is consistent with the literature, including Pasara and Garidzirai (2020), Eşsiz and Durucan (2023), Kesar et al. (2023), Kılıç and Kızılkay (2023), Dinçer (2025), Ko et al. (2025), Yeboah et al. (2025), Kasap (2025), Kadiroğlu and Ayhan (2025), Albayrak (2026), Özbek and Turgut (2026), and Rikhotso and Zhanje (2026) in the literature, specifically regarding Türkiye and other countries. On the other hand, no significant relationship was found between negative shocks to capital formation and growth. Consequently, this serves as proof that capital accumulation, or, in other words, savings, is invested in long-term projects in Türkiye. In the final stage of the empirical analysis, Figure 1 presents graphs of the cumulative effects of the independent variables on the dependent variable.

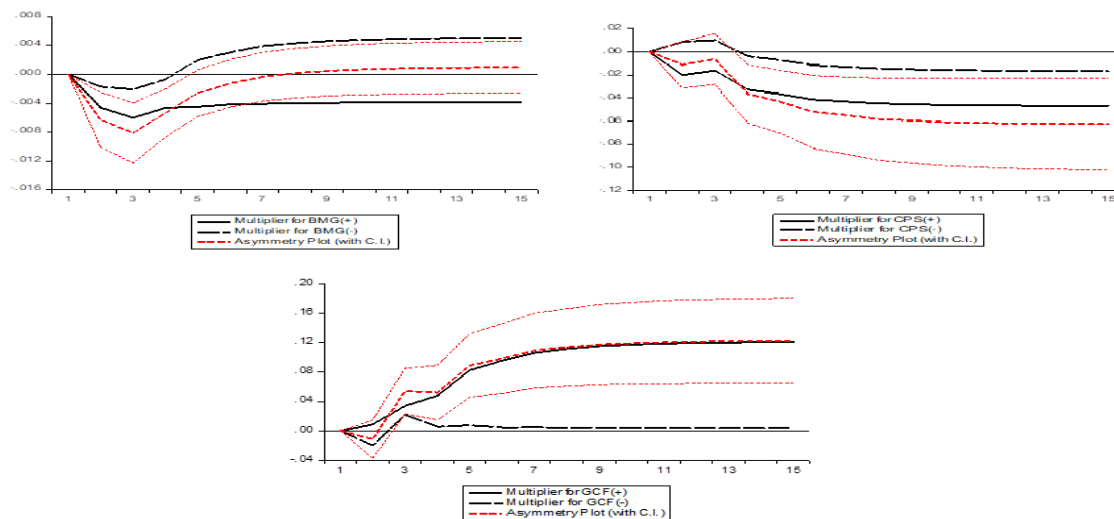


Figure 1: Cumulative Effects

The thick red dashed line in Figure 1, which indicates an asymmetric relationship for all three graphs, shows the difference between the positive and negative multipliers that are significant within the 95% confidence interval represented by the thin red dashed lines (Ahmed et al. 2021, pp. 9-10). Consequently, when examining Figure 1, it can be observed that the thick red dashed line fluctuates between the thin red dashed lines in all three graphs.

The first graph in Figure 1 (top left), which shows the cumulative effect of monetary expansion on economic growth, depicts the thick red dotted line between the short red dotted lines, representing the asymmetric relationship, as positive and negative multipliers that are statistically significant at the 5% level. Within this framework, Figure 1 shows that monetary growth has a greater impact on economic growth than negative and positive shocks.

In the second graph of Figure 1 (top right), which shows the cumulative effect of loans to the private sector on economic growth, the thick red dashed line, which lies between the red and thin dashed lines and indicates an asymmetric relationship, shows that positive and negative shocks are significant at the 5% significance level. Within this framework, Figure 1 shows that negative shocks to economic growth from private-sector lending exceed the positive shocks. Thus, according to the two cumulative graphs at the top, which represent financial development, negative growth shocks in Türkiye exceed positive ones.

Finally, in the graph at the bottom of Figure 1, which shows the cumulative effect of capital formation on economic growth, positive and negative shocks are significant at the 5% level of significance, as indicated by the thick red dashed line between the red and thin dashed lines, which represents an asymmetric relationship. Within this framework, Figure 1 shows that the positive shocks to capital formation on economic growth exceed the negative shocks. Consequently, growth in Türkiye derives its most significant share from capital accumulation. In other words, it is possible to state that the shocks of savings towards growth are more positive. This result is the exact opposite of what financial development would predict.

Conclusions and recommendations

Financial development and capital formation are important economic policy instruments for countries. Accordingly, this study examines the asymmetric effects of financial development and capital formation as economic policy instruments on economic growth, specifically in Türkiye. While cointegration was found among the variables in the analysis, the short- and long-term coefficient estimates were separated into positive and negative responses to the independent variables. Furthermore, it was determined that the model did not exhibit a linear structure and showed an asymmetric pattern in both the short- and long-term.

Looking at short-term coefficient estimates for monetary expansion, positive shocks that support it hurt growth. This result supports our proposed H3 hypothesis regarding positive shocks. This is because, in a country such as Türkiye, where the vast majority of production is supported by imported inputs, economic policies that support monetary expansion can lead to depreciation of the national currency and, consequently, cost-push inflation. Similarly, increases in consumption expenditure supported by

monetary expansion can also lead to demand-pull inflation. In an inflationary environment, households may face a loss of welfare. This loss of welfare can pave the way for a decline in consumer spending, thereby contracting production. Furthermore, potential central bank interest rate hikes in response to inflation rising alongside monetary expansion may also increase investment costs, thereby curbing growth. Ultimately, the emergence of an inflationary environment in Türkiye—even if only in the short term—can lead to a loss of welfare, a contraction in demand, and a decline in investment; this contraction in demand and loss of welfare, in turn, can reduce the volume of production and adversely affect economic growth. No significant relationship was found between negative shocks to monetary expansion and growth. Consequently, as this result does not provide an answer to our proposed Hypothesis H4 regarding negative shocks, it cannot be interpreted.

Long-run coefficient estimates for monetary expansion, however, differ from those for the short run in terms of negative shocks. This is because in Türkiye, both positive and negative shocks to monetary expansion have a negative impact on long-run growth. This result supports our proposed hypotheses H3 and H4 regarding positive and negative shocks. Consequently, in the short term, demand- and cost-driven inflation, macroeconomic instability, welfare losses, and interest rate rises resulting from economic policies supporting monetary expansion in Türkiye may adversely affect economic growth in the long run by reducing output and investment. On the other hand, negative shocks to economic policies supporting monetary expansion in Türkiye over the long term may hinder access to financial resources, leading to a contraction in consumption expenditure; this, in turn, may reduce production volume and pave the way for economic contraction. Another aspect of this issue is that long-term high-interest-rate policies can negatively affect economic growth by increasing investment costs in the real sector.

Drawing on the short- and long-term consequences of monetary expansion, the following recommendations are worth making to policymakers. Economic policy instruments aimed at monetary tightening or easing should not be used in ways that lead to high costs, high inflation, welfare losses, or excessive consumption. In other words, monetary tightening and easing policies must be used in moderation to allow other macroeconomic dynamics to come into play. That is to say, in an inflationary environment where inflation exceeds the target in Türkiye, the prolonged application of a tight or expansionary monetary policy on its own does not yield results that support economic growth. In particular, in the long term, it is crucial for economic growth that these tools are used in a stable and measured manner, whilst other macroeconomic dynamics are brought into play to implement corrective policies.

Another finding of this study is that, in the short term, both positive and negative shocks to bank loans to the private sector have, unfortunately, a negative impact on growth. Whilst these results do not support our H1 hypothesis, they do support our H2 hypothesis. This suggests that loans to the private sector in Türkiye do not translate into short-term investment. Whilst it is common in theory for shocks that restrict access to credit and financing instruments to harm investment, the fact that, during periods of positive shocks that facilitate access to credit and financing, these instruments do not support investment—or, in other words, economic growth—constitutes a significant problem for Türkiye. Consequently, it can be said that loans granted to the private sector in Türkiye are not channelled into short-term investment but instead directed to other areas.

Long-term coefficient estimates for bank loans to the private sector, however, differ from those in the short term in response to negative shocks. Indeed, whilst no significant relationship is found in Türkiye between negative shocks to bank loans to the private sector and long-term growth, positive shocks have a negative impact on long-term growth. This result contradicts our proposed H1 hypothesis regarding positive shocks. The main reason for this is that, as in the short term, credit and financing instruments provided to the private sector in Türkiye are channelled into expenditure items other than investment and into debt, even in the long term. Thus, it appears that policies aimed at increasing the volume of credit to the private sector in Türkiye do not support economic growth in the long term, nor do they in the short term. In conclusion, it appears that loans granted to the private sector in Türkiye do not support investment; therefore, in addition to loans, other incentives and support policies designed to encourage investment must be improved or introduced. Furthermore, recommendations that such support be structured around regional development and specialisation, and that strict monitoring and oversight be implemented to ensure their sustainability, may serve as a guide for policymakers.

In the final stage of the research findings, whilst negative shocks to capital formation in Türkiye had a positive impact on growth in the short term, no significant relationship was found between positive shocks to capital formation and growth. This result does not support our H6 hypothesis. This indicates that the negative spillover effect on economic growth resulting from an adverse development affecting

capital formation in Türkiye is not immediately reflected in the short term. Consequently, it must be concluded that, specifically regarding capital formation in Türkiye, the spillover effect on economic growth is predominantly long-term. In other words, short-term negative shocks to capital formation in Türkiye do not hinder economic growth.

When we look at the long term from a capital perspective, however, the situation is the exact opposite of that in the short term. That is, in Türkiye, positive shocks to long-term capital accumulation boost growth. This result supports our H5 hypothesis. This result demonstrates that long-term positive developments supporting capital accumulation in Türkiye have a favourable impact on growth. This, in turn, indicates that, in the long run, savings in Türkiye are being channelled into investment, thereby increasing production and output, and consequently shows that these policies are being well managed. In this context, it should be noted that policymakers would benefit not only from continuing positive policies aimed at capital accumulation but also from making improvements and developments to ensure their more effective utilisation. No significant relationship was found between negative shocks to capital accumulation and growth. This result does not provide an answer to our proposed H6 hypothesis.

The findings of this study on the impact of financial development on economic growth are consistent with those of Helhel (2017), Tutgun (2019), Canbay (2025), Dinh et al. (2019), and Günbegi (2025) in the literature. However, they do not support the findings of studies by Abbas et al. (2022), Uslu (2022), Obradović and Grubišić (2024), Yusoff et al. (2025), and Demir-Kale and Ebghaei (2023). The findings indicating that financial development instruments (broad money supply and credit provided to the private sector) have a negative impact on economic growth in Türkiye suggest that these instruments are being used ineffectively and inefficiently; this may be attributable to factors such as the presence of financial vulnerabilities, excessive financialisation and the channelling of financial resources towards unproductive sectors.

The findings of this study on the impact of capital formation on economic growth are consistent with those in the literature, including Pasara and Garidzirai (2020), Topcu, Altınöz and Aslan (2020), Eşsiz and Durucan (2023), Kesar et al. (2023), Kılıç and Kızılkay (2023), Dinçer (2025), Ko et al. (2025), Yeboah et al. (2025), Kasap (2025), Kadiroğlu and Ayhan (2025), Albayrak (2026), Özbek and Turgut (2026), and Rikhotso and Zhanje (2026); however, it does not support the findings of the study by Aslan and Altınöz (2021). The positive impact of capital on growth – one of the topics examined in this study – is consistent with the general expectations and findings in the literature. It is therefore possible to state that, in Türkiye, capital formation has consistently exhibited behaviour that supports production and output, despite macroeconomic vulnerabilities and shocks.

Based on the findings of this research, which suggest that financial development in Türkiye has a negative impact on economic growth, policymakers are advised to it is recommended that policies regarding the use of financial instruments in Türkiye be reviewed to ensure their more effective and efficient utilisation; that macroeconomic and financial vulnerabilities be identified and the necessary policy and economic measures taken; that measures be implemented to address excessive financialisation, where applicable; and, in particular, that financial instruments be channelled more towards productive sectors and channels that support capital formation. Furthermore, based on this study's findings that capital has a positive impact on growth, policymakers are advised to provide greater support for policies that encourage capital formation; in particular, by channelling financial instruments into channels that support capital formation, the growth losses attributable to financial instruments can be offset. Furthermore, increasing supportive policies for capital formation will not only boost production and output but will also support policies to combat unemployment by creating new employment opportunities. In future research, this study could be expanded by including variables such as interest rates, taxation, corporate quality, education expenditure and public expenditure, in addition to the dataset used in this study.

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