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The Effect of Private Sector Fixed Capital Investment, External Openness and External Debt on Economic Growth: Empirical Evidence from Turkey

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ABSTRACT

Purpose- This article presents results related to the effect of private sector fixed capital investments, external debt and external openness variables on economic growth in Turkey. Whether the correlation between these variables is significant or not and what the findings mean will be important in terms of offering choice to policy-makers.

Design/methodology/approach - The research is theoretically based on the Solow growth model and the Cobb-Douglas production function. The Solow growth model, basing economic growth on labor and capital and considering a closed economy, was expanded by the addition of the external openness variable. The research considers the short- and long-term impacts of private sector fixed capital investments, external debt and external openness variables on economic growth and aims to investigate the correlations between these variables empirically. Data for the series were obtained from the World Bank and encompass the period from 1973 to 2022. The autoregressive distributed lag (ARDL) method was used linked to the stability levels of the variables. The presence of cointegration between variables was investigated with the ARDL bounds test and short- and long-term analyses were performed.

Findings - The results of the research show economic growth had a significant correlation with external debt, fixed capital investments and external openness. Fixed capital investments positively affected economic growth, in accordance with theoretical expectations. External debt had negative impacts on economic growth in the long term and positive impacts in the short term. External openness had positive impact on economic growth in the long term and negative impacts in the short term.

Discussion - The findings support the view of neoclassical economists that external debt will negatively affect economic growth. While external debt positively affects economic growth in the short term, this effect becoming negative in the long term supports the view of economists who suggest that the "Laffer curve" will be valid.

1. Introduction

Parameters affecting the economic growth of a country are explained by growth theories/models in the economy literature. These models are important in terms of showing developmental differences between countries. Fixed capital investment is an important parameter in economic growth models and this is a view accepted by many economists. In the Harrod-Domar growth model, fixed capital investments undertake an important role in increasing productive capacity of the economy. In the Solow growth model (Solow, 1956), the increase in capital amounts per capita was shown to increase economic growth. After the 1980s, though the importance of fixed capital investments for growth has relatively reduced, fixed capital investments were noted to be an important element explaining the developmental differences between countries over the years (Şahbaz, 2014). Fixed capital formation is important in terms of determining the production capacity, an important factor in increasing economic growth. In the literature, fixed capital formation was concluded to have positive impacts on economic growth (Edwards, 2001). A significant portion of empirical studies revealed that countries with high fixed capital investment rates displayed higher growth performance compared to other countries. For example, Chow (1993) researched the relationship between fixed capital investment and economic growth for the Chinese economy. It was found that a 1% increase in fixed capital investments will increase the economic growth rate by 0.045%.

In this research, the Solow growth model was taken as reference when determining the variables to be used for empirical analysis. The Solow model is one of the most common models used to explain economic growth. This model assumes a closed economy. The model was expanded by adding the openness variable in this

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study. The research aimed to determine the long- and short-term effects in the correlation between economic growth in Turkey with the fixed capital investment, external debt and external openness variables. Whether the correlation between these variables is significant or not and what the findings mean will be important in terms of offering choices to policy-makers. As the study basically focuses on the Turkish economy, it is specific to this country due to its nature. Literature investigations of the topic generally deal with the external borrowing and economic growth framework and as this is greater for developing countries, it appears that this research was more commonly performed in these countries. The aim of this research is to determine the effects of external borrowing on economic growth in Turkey for both the short and long term. Additionally, the expected positive effect of fixed capital investment on economic growth will be confirmed. It will also be possible to determine the effect of external openness on economic growth. External borrowing is preferred in developing countries, with the expectation that it will increase economic growth. Many countries do not have the necessary funds and reserves for growth. This situation may be linked partly to the low level of domestic savings. As a result, countries with a savings gap attempt to obtain external borrowing for investments they cannot finance at available savings levels. Increasing sustainable economic growth in developing countries is one of the main objectives of economic policies. To achieve this target, it is necessary to use significant amounts of capital to increase production capacity.

In situations with inadequate resources to finance investments, the expectation is that investment funding, investments, and hence gross domestic product (GDP) will increase with external borrowing. However, developing countries do not accurately and efficiently use external resources and this may cause problems to be experienced during the repayment periods of the debt. In other words, the reflection of the external debt burden of these countries, choosing the external borrowing method to resolve savings gap problems, on economic growth may not occur in a positive way as expected. Therefore, if the marginal return from external borrowing is greater than the interest costs of external debt, external borrowing will increase economic growth. However, if the marginal yield of external debt is lower than external debt interest costs, the expected positive effect on economic growth will not occur. As a result, external debt can create a higher financial imbalance if not used wisely. Additionally, excessive external borrowing will reduce the defense power of a country against shocks and crises. However, a reduction in effectiveness of monetary policies due to the limited abilities of central banks to increase interest rates and a reduction in effectiveness of financial policies with the increasing external debt burden are possible (Beetsma & Bovenberg, 2002). Additionally, it is possible that large public borrowing will create an excess increase in taxes. This will cause a reduction in output growth by leading to a reduction in investment in the economy. In short, external debt is not used as financing for investments and its use to achieve short-term targets and to finance external deficits may not provide the country with the expected contribution of external debt and hence will cause deviations in macroeconomic variables in these countries.

Another reason why developing countries care about their external debt burden compared to developed countries is the vulnerability created by their economic history. Institutional infrastructure problems rooted in the past in developing countries, and hence weaknesses, cause internal resources necessary for investment financing to remain inadequate. Excessive borrowing occurring as a result of "administrative ineffectiveness" in developing countries negatively impacts the economies of these countries. The rapid increase in private sector debt in countries during periods of economic expansion displays its effect in periods of economic tightening and shapes the economic performance of that country in a negative way (Mian & Sufi, 2010). In other words, this increase in debt burden in the private sector further deepens economic stagnation with the "spillover effect" (Bernanke & Gertler, 1989; Eggertsson & Krugman, 2012). The situation observed in examples of developing countries is that the private sector debt burden that existed before the economic recession signals that the economy may enter a slower recovery period or the recession may deepen, and therefore private sector debt burden is an important indicator that reflects the course of the economy (Bernardini & Forni, 2017). Excess external debt burden is not used for projects with high yield from economic resources or may be interpreted as overshadowing the benefits provided by projects. This situation prevents good operation of the transfer mechanism and delays recovery of the economy. In fact, there is strong probability that excessive borrowing is a trigger for banking crises and recession.

Developed and developing countries have differences in skills about managing risks created by external debt. According to Presbitero (2012), developed countries use external debt in more effective areas (in other words, use borrowing productively) compared to developing countries. Developed countries are experts in managing the crowding out effect, investment uncertainty, political changes and expectations of devaluation due to fluctuations that will be caused by external borrowing compared to developing countries. As a result, in the literature, the relationship of external borrowing with economic growth is a problem generally researched in developing countries. In this research, the focus is on developing countries and the topic is analyzed only from the perspective of the Turkish economy.

The literature shows that country-specific research has clear advantages compared to cross-sectional research. Cross-sectional studies ignore the unique features of each country. As a result, focusing on a single country will resolve this problem at least. Though proponents of cross-sectional research have the opinion that all countries have homogeneous structure, Forbes (2000) opposed the usefulness of cross-sectional research results due to the lack of any clear political implementation based on each country having some notably different features. Ignoring this situation in cross-sectional studies by studying a group of countries prevents full identification of the homogeneity of countries. In this context, the article only econometrically analyzes economic growth in the Turkish economy and the correlations with fixed capital investment, external debt and external openness. Data used in the research include annual data from the period 1973-2022. This period was identified as the aim was to reach the broadest data interval in the research -from the oldest data from 1973 to the latest data for 2022. This research is different from other studies about the same topic in terms of the variables used and the use of data encompassing the post-COVID-19 pandemic crisis.

The general framework of the article is as follows. The literature is reviewed in the second section after the introduction. The third section explains the basic hypotheses of the research within the scope of the theoretical framework forming the basis of the research model describes the dataset and methodology. The fourth section includes application and research findings. The final section of the study includes results and recommendations.

2. Literature Review

In the literature, correlations between variables like economic growth, external borrowing, fixed capital investments and external openness appear to be considered within the framework of external borrowing and economic growth. In fact, the use of foreign savings to finance investments in countries with low domestic savings reveals the importance of foreign debt for the capital of that country. In the literature, there are different approaches explaining the effect of external borrowing on economic growth. These approaches may be collected in three basic perspectives. The first group propose a positive correlation between external debt and economic growth. The Keynesian growth model reflects this approach. According to the Keynesian growth model, efficient use of external funds obtained as loans contributes to economic growth. In the external debt-growth theory, begun by Keynes and later developed by Harrod-Domar, external debts will increase national income by providing the resources necessary for investments and this will create an increase in domestic capital stock. There are several studies supporting this approach in the literature. Cline (1995) suggested that if the marginal return from foreign debt is greater than the principal and interest payments, external debt will increase economic growth. Hence, external borrowing will increase economic growth. Similarities to these findings are encountered in studies by Warner (1992) and Easterly (2003). Karagöz and Çağlar (2016) found a positive relationship between external debt and growth for 17 OECD countries. Panel analysis of 65 developed and developing countries based on data obtained from 1991-2014 by Chen et al. (2016) investigated the effect of both public investment and public debt on economic growth. They observed that debt and investment created a positive effect on economic growth until optimal levels were reached. For this reason, the economy will be negatively affected when this optimum level is reached. In this context, it is necessary for policy makers to identify this optimum level and to be careful about preserving this momentum to increase economic growth.

The approach in the second group is the neo-classical model, proposing that external debt negatively affects economic growth. Models in this group are based on the “debt overhang” theory. According to this theory, “debt overhang” occurs when a country's current debt exceeds its expected future income. This theory states that high debt burden based on state borrowing will prevent economic growth (Krugman, 1988; Sachs, 1989;

Cohen 1995). This is because the increase in borrowing will cause interest rates to rise and then both investment and consumer borrowing will become more costly. According to Diamond (1965), external debts reduce spendable income in the long term by increasing taxes used to finance these debts and this negatively affects capital accumulation and economic growth by lowering savings. Generally, the basic cause of this situation observed in developing countries may be linked to the administrative weaknesses of these countries.

In the literature, there is research which supports the approach of the second group. Research by Calderón and Fuentes (2013) in Latin America concluded that external debt negatively impacted economic growth in the period from 1970-2010. Panizza and Presbitero (2014) identified the presence of a negative correlation between external debt and economic growth in research about OECD countries. In studies based on the panel data method encompassing 30 countries, Mian, Sufi and Verner (2015) mentioned that an increase in the ratio of household debt to GDP would create lower national income and higher unemployment rates. Reinhart, Rogoff and Savastano (2003) stated that an increase in the external debt burden deepened stagnation experienced in the economies; however, the effect was further deepened in developing countries and spread over a longer term. For this reason, the recovery process in these countries occurred in the long term (Bernardini & Forni, 2017). Especially in developing economies, "safe debt levels are not the same" (Reinhart, Rogoff & Savastano, 2003). The fact that the safe debt level in these countries is not the same causes countries to have different recovery processes. The approach in the third group is based on the Laffer curve principle showing the non-linear effect of external debt on economic growth and combining the provisions of both models. The Laffer curve shows that initially external debt will increase economic growth; however, when debts begin to be repaid, this effect will reverse.

In other words, while external debt initially positively affects economic growth, later this positive effect may reverse. This situation emerges as an upside-down U relationship between external debt and economic growth. For this reason, as stated by Sachs (1989), the existence of external debts should be taken into account in cases where it is not practical to make foreign loans more attractive. Within this framework, the marginal yield of capital after a certain debt level will cause a reduction in the definite size and yield of investments and this will lead to a non-linear correlation between economic growth and external debt. Égert (2013) found some evidence in favor of a negative non-linear correlation between debt and growth using non-linear threshold models. Emerenini and Nnanna (2015) showed the presence of a non-linear effect of debt on economic growth in Nigeria using a Solow-type neoclassical growth model.

There is much research investigating the effects of both public debts and private sector debts on economic growth. Most of this research focuses on external debts, with less attention given to internal borrowing. Researchers have not focused on the effect of internal debt on growth, probably due to the lack of transparency in internal debt levels in most developing countries and the low level of internal debt to external debt. The results of empirical studies have the quality of supporting one of the three different approaches mentioned above. These results show differences according to the country or group of countries researched, the research model, period of analysis, set of control variables and even definition of debt. Due to these features, research performed about external debt and economic growth in Turkey obtained different findings. Uslu (2021) and Gövdeli (2019) identified a positive correlation between external debt and economic growth in autoregressive distributed lag (ARDL) analysis using data from 1976-2016. Uslu (2021) used fixed capital formation, population (labor force), external debt stock and education spending as independent variables and concluded that these variables positively affected economic growth. Gövdeli (2019) chose external debt stock, external openness and consumer price index as independent variables. They identified a positive impact of external debt on economic growth, while external openness and consumer price index (CPI) variables affected economic growth in a negative way. However, in both studies, channels encouraging external debt were not clearly shown. Öztürk and Çınar (2018) used external debt, variable interest external debt stock/GDP, gross savings/GDP and consumer price index as independent variables and applied the Engle-Granger cointegration test and DOLS prediction technique. They identified that from 1975 to 2016, public external borrowing increased economic growth. Ağır (2016) used GDP as the dependent variable with the ratio of gross external debt stock to GPD, CPI rates, foreign trade volume and the ratio of fixed capital formation to GDP as independent variables in research using data from 1970 to 2014. Based on not identifying a linear model, they performed the Diks-Panchenko non-linear causality test; however, they did not identify a causality correlation

between the variables. With the Hatemi-J causality test, they found one-way causality from external borrowing toward GDP.

It appears there is a broad literature for developing countries, especially about external borrowing and economic growth. The research studies mentioned above are just some of these. When research investigating the correlation between external debt and economic growth in Turkey is examined, the majority appear to be different in terms of the period of analysis and the methods used. Some of this research supports a positive correlation between economic growth and external debt, while some found this correlation was negative and some identified one-way causality from economic growth toward external debt or from external debt toward economic growth in research where only the causality test was performed.

3. Method

3.1. The purpose of the study

This article presents results related to the effect of private sector fixed capital investments, external debt and external openness variables on economic growth in Turkey. Whether the correlation between these variables is significant or not and what the findings mean will be important in terms of offering choice to policy-makers.

3.2. Determination of Hypotheses Within the Scope of the Theoretical Framework

This section explains the Solow growth model, taken as reference to determine parameters to be used in the econometric analysis. This model will assist in evaluating the empirical findings. When researching the effects of macroeconomic variables on economic growth, one of the best models that can be taken as reference is the Solow growth model. As in several economy models, the Solow growth model is constructed on assumptions (Dereje, 2013):

a) Countries produce and consume a single product,

b) Technology is exogenous in the short run.

The Solow growth model is based on the closed economy assumption. The following was taken as model reference according to the Cobb-Douglas production function:

$$Y = F(K, L) = K^{\alpha} L^{1-\alpha} \quad (1)$$

In Equation 1, Y is production; K is capital; L is amount of labor; and α represents the share of capital in outputs. With the addition of the technology variable to Equation 1 (shown by A), the equation transforms as follows:

$$Y = K^{\alpha} (AL)^{1-\alpha} \quad (2)$$

α and 1- α show the capital and labor output flexibility, respectively. α has a value between 0 and 1.

In the above production function, if the output per worker is y=Y/L and the capital per worker is k=K/L, the mathematical use of the equation can be shown as follows:

$$y = k^{\alpha} \quad (3)$$

Equation (3) shows that as capital per worker increases, more output will be produced. The capital accumulation equation in the Solow growth model shows that the change in capital per worker is a function of investment per worker, depreciation per worker and population growth:

The capital accumulation per worker equation in the Solow growth model is as follows:

$$\acute{K} = sy - dK \quad (4)$$

(Ḱ) indicates the change in capital stock, (sy) indicates gross investment, and (dK) indicates depreciation.

The capital accumulation equation per worker is as follows:

$$\acute{k} = sy - (n+d)k \quad (5)$$

According to Equation 5, the variation in capital per worker is a function of the investment per worker, depreciation per worker and population increase. Of these three variables, only investment per worker has a positive correlation with the variation in capital per worker. Solow reached the following conclusion; if other things are assumed to be fixed, countries with high savings and investment rates will become richer because large amounts of capital can be accumulated per worker and this allows the possibility of more output

productivity per worker. However, countries with high population increase rates will have a tendency to become poorer (Jones, 2002:32).

In this case, the effect of the investment rate in the Solow growth model on variation in investment rates and variation in population growth rate will be as follows. If the investment rate increases in an economy at stable level, sy will increase and thus economic growth will increase. In this case, the economy will reach a more stable state in terms of capital stock per worker. If the population growth rate increases, the capital stock per worker will decrease. According to Equations 1 and 2 including technology, technological progress is required to ensure sustainable economic growth with falling income per person. In other words, if "A" increases with time, technological progress will occur; when technology levels are higher, a unit of labor will be more productive (Jones, 2002: 36).

Returning to Equation 2, if it is assumed that the L and A variables in this equation grow externally at fixed rate (n and g rates), a predictable long-term correlation can be derived (Mankiw et al., 1992):

$$\ln\left(\frac{Y}{L}\right) = \alpha + \left[\frac{\alpha}{1-\alpha}\right] lns - \left[\frac{\alpha}{1-\alpha}\right] \ln(n + g + \delta) + \varepsilon \qquad (6)$$

The δ symbol in Equation 6 shows the depreciation rate, while s shows the fixed savings rate. The equation is based on the prediction that savings rate positively impacts production per capital, while the population growth rate negatively impacts production per capital. The increase in capital stock will continuously increase economic growth. In an externally closed economy, the main source of capital accumulation comprises domestic savings. As a result, savings increases will increase economic growth by causing an increase in capital stock. However, if investments are not met by internal savings, external savings or external borrowing will be used in situations with inadequate savings. External debt creating a sustainable positive effect on economic growth is directly related to directing external savings into productive investments. In this scenario, the effect of external debt on growth may be observed through the effect on domestic savings used as investment in the closed model. When a variable representing external openness is added to the model, the model converts to an externally open economy model.

Additionally, if the Cobb-Douglas production function is expressed as a logarithmic function, it allows the opportunity to establish a regression model. Within this framework, the growth function can be expressed as follows:

$$lnY = \alpha + \beta_1 lnx_1 + \beta_2 lnx_2 + \beta_3 lnx_3 + \cdots + \beta_n lnx_n + \varepsilon \qquad (7)$$

Y is the economic growth rate, $X1, X2, X3,\ldots, Xn$ are explanatory variables and ε represents the error term.

The general effect of external debt on economic growth may be explained based on the "debt overhang" theory. According to this theory, "debt overhang" emerges when the current value of the income expected in a country in the future is less than the accumulated debt (Krugman, 1988). In other words, economic growth is prevented as the higher debt burden and interest payments due to state borrowing lead to increases in tax rates. These effects will increase with multiplier and accelerating mechanisms and will increase external debt reliance while negatively affecting the growth of the country's economy (Yücel, 2009). The government will increase tax rates for the private sector with the aim of amortizing accumulated debts (as resource transfer tool to the public sector). This will deter private sector investments and at the same time instead of using resources in the best way possible, it will reduce government infrastructure spending due to use for large debt repayments. This will reduce total investment in the economy and in the Solow growth model, this will cause both the investment and production function curves to dip downwards. As the use of external debt for investment spending increases fixed capital stock, it will positively affect economic growth in both the short and long term by contributing to the increase in reel production. However, the use of external debt for private consumer spending will cause an nominal increase in economic growth in the short term, while increasing current account deficit and external debt stock in the long term.

Within the framework of the information given above the basic hypotheses for the research were developed:

H1: Fixed capital investment positively affects economic growth.

As stated in Equation 3, savings rates positively affect production per capital; based on the prediction that the population growth rate will negatively affect production per capital, it is expected that the increase in capital stock will continuously increase output, while the increase in population will reduce economic growth after a certain point. However, in the model including the population variable, as the population variable coefficient and standard error values are high, the population variable was removed from the model and an income per capita model was added calculating the economic growth variable according to population. Within this scope, private sector fixed capital investments are assumed to positively affect economic growth (per capita).
The increase in fixed capital investments increases economic growth, but it is difficult to determine the effect of external debts on economic growth beforehand; in other words, this effect may be positive or negative. If used to improve welfare, there may be a positive effect or they may negatively affect economic growth through increased debt burden by encouraging capital flight and discouraging investment. This study is based on the assumption that a large amount of accumulated external debt (as predicted in the debt overhang theory) will reduce economic growth after a certain period of time. However, as both short-term and long-term analyses can be performed in the ARDL model used in the research, the second and third hypotheses were developed considering the views of economists proposing that the Laffer curve is valid and that the effect of external debt on economic growth will be positive in the short term and negative in the long term.

H2: External debt negatively affects economic growth in the long term.

H3: External debt positively affects economic growth in the short term.

With the increase that will be created in economic growth by exports, especially, the external openness variable is expected to have positive impact in the long term. However, as imports will increase linked to the increase in exports in countries that are externally dependent, it may be difficult to estimate the magnitude of this effect. It is known that more economic growth may be provided in countries transitioning from a closed economy to an externally-open economy model. Based on this, at least in the long term, the external openness variable is assumed to affect economic growth positively.

H4: External openness positively affects economic growth in the long term.

To research the presence of cointegration between the variables investigated in the research, the autoregressive distributed lag model (ARDL) was used, one of the modern time series analyses developed by Pesaran, Shin and Smith (2001). ARDL is used for series that are stationary at zero level I(0) and first level I(1). The basic determinant element in applying this model is determining the stationarity levels of the variables. For this the unit root tests are used. Thus, whether the data are I(2) or not is tested.

As stated by Pesaran, Shin and Smith (2001), the most important advantage of the ARDL bounds test is that it may be applied without regard to whether the analyzed variables are I(0) or I(1). Another important advantage of the model is that it provides good and reliable results for small samples (Ghatak & Siddiki, 2001; Narayan & Narayan, 2005:429). Additionally, the bounds test approach provides more reliable results compared to the Engle-Granger and Johansen cointegration tests in situations with low numbers of observations (Narayan & Smyth, 2005:103). The ARDL method deals with endogeneity of specific variable regressions by providing long-term estimates and significant t-statistics (Odhiambo, 2009) and at the same time allows simultaneous determination of short- and long-term effects of a variable (Bentzen & Engster, 2001). Additionally, different to other traditional cointegration procedures, it calculates optimal lags (Bekhet & Matar, 2013).

3.3. Data and Variables

In this study, a data set comprising time series data was used. The model was created with this data set. With this model, the effect of private sector fixed capital investments, external debts and external openness on per

capita income will be determined. The method section of the study explains the research model and hypotheses.

For empirical analyses, annual data for 1973-2022 will be used. The reason for choosing this period is due to it being the largest time interval that can be accessed with a normal data set. Based on variables included in the Solow growth model, dependent and independent variables to be used in the analysis were determined[1]. Within this framework, the dependent variable was gross domestic product (GDP, per capita); the explanatory variables were variables representing fixed capital investments with private sector investment (INV), external openness (OPENN) and external debt (DEBT).

Gross Domestic Product

GDP shows the growth rate of national income per person obtained by dividing the total GDP by population. Data for this variable were obtained from the World Bank database.

Fixed capital investments/GDP ratio

Investments have positive and direct effect on economic growth. The capital accumulation equation is used to show this. According to this equation, investment per worker, or "sy" (as explained in the literature section), increases capital accumulation and then economic growth. This variable includes private sector fixed capital investments/GDP data. In Turkey, total investment series follow parallel to the private sector investment series (sbb.gov.tr/yatırım). As this study is theoretically based on the Solow growth model, a positive correlation is expected between investment and economic growth. Data for this variable were obtained from the World Bank database.

External debt/GDP ratio

Generally high external debt ratio shows high debt burden. This ratio was added to the model based on the "debt overhang" theory. In Turkey, in the period from 1973 to the current day, determining how external borrowing affects economic growth performance constitutes the research problem for this study. The effects of the total external debt/GDP ratio on economic growth can be positive or negative. Data for this variable were obtained from the World Bank database.

External Openness

The external openness of an economy is calculated as the proportion of exports and imports to GDP (Bahmani-Oskooee & Niromand, 1999). This variable was used as control variable in this study. Data for this variable were obtained from the World Bank database. Variables included in the model and definitions of these variables are included in Table 1.

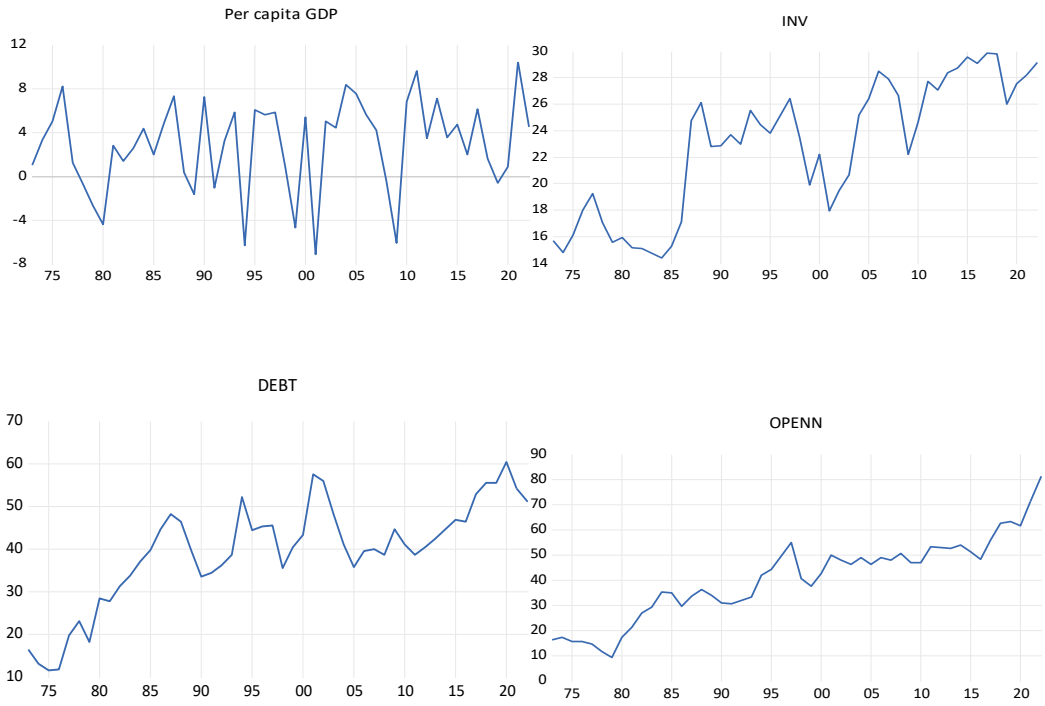
Table 1: Variables

Variable name	Symbol	Explanation
Economic growth	*GDP_per_capita*	Shows annual percentage increases in GDP (per capita)
Investment	*INV*	Shows ratio of private sector fixed capital investments to GDP
External openness	*OPENN*	Shows the total for percentage variation in exports/GDP and percentage variation imports/GDP
External debt	*DEBT*	Shows the ratio of total external debt to GDP

[1] Economic growth, investments and population are variables included in the Solow growth model. However, due to high standard error in the population series in this research, this variable was removed from the model. Based on the Cobb-Douglas production function; the number of independent variables included in the model can be increased. As the Solow growth model was used according to the closed economy assumption, the external openness variable was added to the model. Additionally, in addition to the selection of the above variables, dummy variables were included as some external opening decisions were taken and crises experienced during the analysis period. One of these is the transition of Turkey from a closed economic system to an externally open economic system and dummy variables were used for the year 1980, which represents the effects of the decisions about this taken on January 24, 1980, and for the year 1989, when freedom of capital movements was permitted (Decision 32, 1989). Additionally, dummy variables were used to be able to capture the effects of the 1994 and 2001 crises, the 2008 global crisis and the 2020 COVID-19 pandemic crisis. When creating dummy variables, the value 1 was given to year of decision and continuously after that, with 0 value given to the other years; for crisis periods the value 1 was given to the year of crisis, with 0 given to the other periods. However, as the coefficients for dummy variables were statistically insignificant, they were removed from the model.

Graphic 1 shows the time series graphics for the variables.

Graphic 1:Time series graphics for the variables



3.4. Model

In this study, the ARDL model was used as the dependent variable was stationary at I(0) level, while the independent variables were stationary at I(1) level. UECM, comprising the first stage of the ARDL bounds test approach, is given in Equation 8. The ARDL model is stated in the form adapted to our study. When determining data selection and the econometric model, studies by Dereje (2013), Gövdeli (2019) and Uslu (2021) were considered and the following model was created:

$$LNGDP\_per\_capita = \alpha + \beta_1 LNINV + \beta_2 LNOPENN + \beta_3 LNDEBT + \varepsilon_t \quad (8)$$

In Equation 8, β_1, β_2 and β_3 show the coefficients. The variables used in the model are as follows: *LNGDP_per-capita* is the GDP per capita; *LNINV* is the ratio of private sector fixed capital investments to GDP; *LNOPENN* is the ratio of total for the percentage variation in export/GPD and percentage variation in exports/GDP to GPD; *LNDEBT* is the ratio of external debt to GPD; and ε_t is the error term.

4. Analysis and Findings

4.1. Unit Root Test

The use of the ARDL model is linked to the stationarity of series to a large degree. As a result, the unit root tests are applied to determine the stationarity of logarithmic series. The ADF and PP unit root tests are used to determine the stationarity of series. When determining the optimal lag length, the Schwartz criteria were used for ADF and Newey-West band width was used for PP. The economic growth series level value was stable at I(0). The fixed capital investment, external openness and external debt series contained unit roots. Apart from economic growth, when the first differences in the other series are taken, they were determined to be stationary at I(1) (see Table 2).

Table 2: Unit Root Tests

Variables	Test st.	Level		1st difference		Result
		Stationary	Stationary and trending	Stationary	Stationary and trending	
LNGDP(per-capita)	ADF st.	-6.78*	-6.80*			I(0)
	PP st.	-6.67*	-7.04*			I(0)
LNINV	ADF st.	-1.61	-2.93	-6.51*	-6.45*	I(1)
	PP st.	-1.59	-3.11	-6.74*	-6.65*	I(1)
LNOPENN	ADF st.	-0.08	-3.01	-5.68*	-5.68*	I(1)
	PP st.	-0.53	-2.49	-5.58*	5.62*	I(1)
LNDEBT	ADF st.	2.00	-2.86	-5.49*	-5.56*	I(1)
	PP st.	-1.91	-2.61	-6.88*	-6.96*	I(1)

Note: * unit root hypothesis rejected according to 1% significance level

The dependent variable being stationary at I(0) and the independent variables being stationary at I(1) shows the suitability for use of the ARDL model.

4.2. Cointegration analysis

As the series were I(0) and I(1), the cointegration relationship between the series was investigated with the bounds test. The version of the Pesaran, Shin and Smith (2001) model adapted in line with the aims of this study is given below:

$$lnGDP\_per\_capita_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{1i}\, \Delta lnGDP\_per\_capita_{t-1} + \sum_{i=1}^{m} \alpha_{2i}\, \Delta lnINV_{t-1} + \sum_{i=1}^{m} \alpha_{3i}\, \Delta lnDEBT_{t-1} + \sum_{i=1}^{m} \alpha_{4i}\, \Delta lnOPENN_{t-1} + \gamma_1 lnGDP_{per} - capita_{t-1} + \gamma_2 lnINV_{t-1} + \gamma_3 lnDEBT_{t-1} + \gamma_4 lnOPENN_{t-1} + \varepsilon_t \quad (9)$$

Here, Δ is the first level difference, m is the lag length, α are the parameters to be predicted, and ε_t represents the white noise error term. In the bounds test, when determining whether there is a long-term relationship between variables, a zero constraint is imposed on the coefficients of the variables included in Equation 9 and they are tested to see whether they are simultaneously different to zero or not. According to the Wald constraint test, the null hypothesis states that there is no cointegration, while the alternative hypothesis states that there is cointegration and this is shown below:

$H_0: \gamma_1 = \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0$ (no cointegration)

$H_1: \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq 0$ (cointegration)

The hypotheses above are tested with the F test. If the calculated F statistic exceeds a critical upper limit, the null hypothesis is rejected and a long term correlation between variables is accepted. In the opposite situation, if the F statistic is smaller than an critical lower value, the decision is made that there is no long-term relationship between variables. If the calculated F statistic is between these upper and lower limit values, the presence of a relationship between variables is uncertain. The ARDL model created for the bounds test is shown in Table 3.

Table 3: ARDL (1,0,3,2) Model

	Coefficient	t-Statistic	Std. Error	Prob
GDP(per-capita)	-0.036802	-0.340221	0.108171	0.7357
INV	1.252.351	-5.440.074	0.073545	0.0000
DEBT	-0.400092	3.167.910	0.0031	0.0031
DEBT(-1)	0.027193	0.294489	0.092339	0.7701
DEBT(-2)	0.233898	-2.999113	0.077989	0.0049
DEBT(-3)	-0.121921	-1.653144	0.073751	0.1070
OPENN	0.205628	2.300279	0.089393	0.0273
OPENN(-1)	0.068154	0.695397	0.098007	0.4913
OPENN(-2)	0.238961	2.471340	0.096693	0.0183
C	2.598485	5.310529	0.489308	0.0000

R2=0.775923 Fist=13.85104 Prob(Fist)=0.0000 Durbin Watson= 2.043936

The F statistic for the ARDL (1,0,3,2) model was 21.89, exceeding the 5% significance level upper limit of 3.67. The ARDL and error correction model results show that there is cointegration between variables; in other words, there is a significant correlation between economic growth and the macroeconomic variables.

When the results obtained from the bounds test are assessed (Table 4) H_0 hypothesis proposing there is no long-term relationship between variables is rejected. As the F statistic value is larger than the 5% significance level lower bounds I(0) and upper bounds I(1) for the unrestricted error model with the regression constant and without trend variable, there is a long-term correlation between variables. For this reason, the basic hypothesis stating there is no cointegration correlation between variables is rejected.

Table 4: Bounds Test Results

k*	F statistic	Critical values (5% significance level)	
4	21.89944	Lower limit (I0)	Upper limit (I1)
		2.79	3.67

* k shows the number of independent variables

According to the results in Table 4, there is a cointegration correlation at 5% significance level between economic growth with fixed capital investments, external debt and external openness series. In other words, series move together in the long term. For this reason, the model prediction to be made with the level values of these series will not encounter a false regression problem.

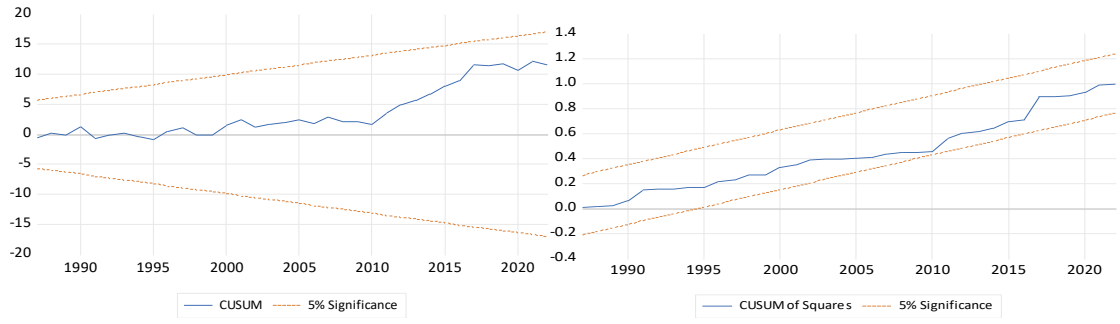
In the model, autocorrelation, the LM test (Breusch-Godfrey Lagrange multiplier) to determine whether there is a variance problem or not and the variable variance test results were examined. As the main hypothesis H_0 stating there is autocorrelation was rejected, there was no autocorrelation problem identified in the model. The heteroskedasticity test (Breusch-Godfrey) results (0.48) show there is no variable variance problem. The results (0.9626) of the Jarque-Bera normality test, to determine whether the error term of the model has normal distribution or not, show normal distribution. The Ramsey test, used to test whether the model is accurately set up or not, had significant results (0.51). The results prove there is no model specification.

Table 5: Residual Diagnostics Tests

LM Test	0.99(0.37)
Heteroscedasticity Test.	0.90(0.53)
Normality Test	0.076(0.96)
RESET Test	0.65(0.51)

The CUSUM and CUSUM-of-square tests were performed to test the stability of the predicted ARDL model; in other words whether there is structural change or not. The cumulative total (CUSUM) and cumulative squares total (CUSUMQ) graphs are shown in Figure 1. It appears the statistics for the CUSUM tests remained within the critical limits. This means the coefficients were stable.

Figure 1: CUSUM and CUSUMQ graphics



4.3. Long-term Analysis

After identifying cointegration between variables with the bounds test approach, long-term analysis was performed with the ARDL method. Findings are presented in Table 6.

According to the results in Table 6, the coefficients for all variables in the model were significant at 1% significance level. There was a positive correlation between fixed capital investments and economic growth. A 1% increase in private sector fixed capital stock from 1973-2022 in Turkey increased economic growth by 1.20%. In other words, income per person increased in parallel with capital investments. In the same period, a 1% increase in external debt stock caused a 0.70% reduction in economic growth. This result does not support the findings of Uslu (2021) and Gövdeli (2019), who identified a positive correlation between external debt and economic growth. It does support the findings of Ertaş and Başçı (2013), who found a negative correlation between external debt and economic growth.

Table 6: ARDL Model Results (Long-term Coefficients)

	Coefficient	t-Statistic	Std. Error	Prob
INV	1.207.898	6.847.878	0.0000	0.0000
DEBT	-0.702852	-4.771.506	0.0000	0.0000
OPENN	0.494543	3.167.910	0.0031	0.0031
C	2.506250	6.846910	0.0000	0.0000

A negative correlation between economic growth and external debt confirms the reality of high external debt levels being associated with low growth. This is because meeting the external debt stock leads to higher tax burden on capital. This causes lower capital returns rate and hence lower investment and lower economic growth. In conclusion, the "debt overhang" problem in Turkey is realistic and is consistent with Krugman's (1988) proposed theory that the increase in accumulated debt stock will cause higher tax on production in the future and will prevent growth. The coefficient for the external openness variable was positive. As external openness increases, the increase in export rates especially, will increase economic growth. A 1% increase in the external openness rate will cause a 0.49% increase in economic growth. Gövdeli (2019), including the external openness variable in the ARDL model, found a negative correlation between the variable and economic growth during long-term analysis. This result does not support our research findings.

4.4. ARDL-Error Correction Model (ECM) Short-Term Analysis

After determining the long-term coefficients between variables, the ARDL model proposed by Pesaran, Shin and Smith (2001) was used with the aim of identifying short-term coefficients, as with the long-term balance model. For determination of lag for variables in the model, the method determined by Kamas and Joyce (1993) was used and the lag length was identified according to AIC criteria. The short-term model prediction results are shown in Table 7. The coefficient for the error correction term shows the speed of adjustment to ensure the model regains balance. The coefficient showing the variables approach long-term balance should be negative and statistically significant. The presence of a long-term stable correlation between variables is confirmed by the significant error correction term.

The results for short-term coefficients are given in Table 7. When the short-term dynamics of the model are assessed, the error correction coefficient (ECT_{t-1}) of -1.036 was statistically significant at 5% level. The ECT_{t-1} coefficient being negative is consistent with statistical expectations. This means that the adaptation process is very rapid and deviations are rapidly corrected.

Table 7: Short-term Model Prediction Results

	Coefficient	t-Statistic	Std. Error	Prob
DEBT	-0.400092	-7.0283306	0.056926	0.0000
DEBT(-1)	-0.355820	5.362605	0.066352	0.0000
DEBT(-2)	0.121921	2.027175	0.060143	0.0501
OPENN	0.205628	3.442827	0.059727	0.0000
OPENN(-1)	-0.238961	-4.042116	0.059118	0.0003
CointEq(-1)*	-1.036802	-11.03012	0.093997	0.0000

The ECT_{t-1} coefficient being negative and significant supports the presence of a cointegration relationship. Narayan and Smith (2005) stated that if the error correction coefficient has a value between -1 and -2, the system reaches balance through fluctuations. In circumstances with any shock or with the emergence of extraordinary effects, this coefficient will resolve this effect at a rate of 1.03% per year and shows balance is reached. In other words, long-term balance is regained in a very rapid way. According to the results obtained from short-term models, there is a short-term correlation between variables shown by the variables being statistically significant.

The one and two lag values for the external debt variable are significant in the short term at 1% level and the one and two lag values for external debt stock positively affect economic growth in the short term. In the short term, a 1% increase in external debt stock will initially reduce economic growth by 0.40%, with a 0.35% increase in the first lag and 0.12% in the second lag. Though external debt stocks have positive effects on economic growth in the short term, this effect converts to a negative effect in the long term. In the short term, the external openness coefficient is negative in the first lag. Though fixed capital investments are significant explainers of GDP in the long term, it appears there is no effect when the short-term correlation is noted. One of the basic reasons for this situation is that investments are not immediately reflected in GDP figures and this takes time.

5. Results and Discussion

The basic results obtained from the econometric analysis in this research are as follows: i) the effect of private sector fixed capital investments on economic growth is positive in the long term, ii) the effect of external debt stock on economic growth is negative in the long term and both positive and negative effects were observed in the short term, and iii) the external openness variable had positive effect in the long term and negative effect in the short term (coefficients for all variables were statistically significant). This finding shows that though the effect of external debt on economic growth is positive in the short term (1st and 2nd lags) in Turkey, this effect disappears in the long term. This is compatible with Turkey not converting external debt into productive resources and mostly using borrowing for consumer spending. While external debts may create an increase in GDP in the first stage through the resource transfer route, they reduce domestic resources when the time comes for principal and interest payments. This research finding is not consistent with the findings of Uslu (2021) and Gövdeli (2019) who identified a positive correlation between external debt and economic growth.

The findings of this research generally support the approach suggesting that there will be a negative effect of external debt on economic growth. According to the "debt overhang" theory developed by Krugman (1988), higher debt burden will prevent economic growth. This is because the increase in borrowing will cause an increase in interest rates and then borrowing for both investment and consumption will be more costly. However, external debt may reduce spendable income in the long term by increasing taxes used to finance these debts and this will negatively affect capital accumulation and economic growth by lowering savings. However, when assessed in terms of short- and long-term analyses, the research findings further confirm the presence of the Laffer curve. As stated in the literature review, the Laffer curve is a curve showing that initially external debt will increase economic growth; however, when the debts begin to be repaid this effect will reverse. While external debt positively affects economic growth up to a certain point, after this point they affect it negatively. The long- and short-term coefficients for the ARDL model support this view.

The detection of a positive effect of private sector fixed capital investments on economic growth in this research once more reveals the importance of investment in terms of the economy. However, the positive effect of external openness variable, reflecting developments in exports and imports, on economic growth in the long term is compatible with the reality that orienting from a closed economy to an externally-open economy model will increase economic growth. The population variable included in the Solow growth model was removed from the model in this study due to high standard deviation; however, it is thought that per capital GDP indirectly reflects the population effect as per capita income is obtained by dividing national income by population. In conclusion, increasing population will reduce the amount of capital per labor force. Though official figures show the population increase rate has slowed in Turkey in recent years, it is known there has been a serious increase in people migrating into the country. For this reason, it is strongly probable that increasing population will create a negative effect on economic growth due to both consumption of country

resources and increasing external borrowing. To further increase economic growth in Turkey, it will be beneficial to increase fixed capital investments and the amount of skilled labor, to take precautions to reduce external dependence and to implement these. The population increasing through migration will consume the country's resources and this will slow the development rate for the country. It is possible to propose that the population increase in Turkey is a factor increasing external dependence (see Yiğitbaş & Cambazoğlu, 2019). However, external debts involve some risks. As stated by Bernanke and Gertler (1989) and Eggertsson and Krugman (2012), the increase in external debt during periods of economic stagnation will further increase the "spillover effects" of recession. Excess external debt burden will increase fragility levels in the economy as it increases the risk of exposure to foreign credit rationing in times of economic contraction. However, currently external debt has become an important component of capital in countries experiencing the resource scarcity problem. This is because there is always the probability that external debts will not be paid in time. High external debts may cause a fall in living standards of individuals and a reduction in economic growth with both increases in interest and tax rates and contraction of total spending. As a result, it is necessary to make effective plans about how external debt will be used. For external debt to create a positive effect on economic growth, it is necessary to use external debt efficiently and direct it to investments with high added value. On the other hand, increasing population will reduce the amount of capital per workforce, necessary precautions must be taken for this.

The basic suggestion for future research will be as follows; the scope of the study can be expanded by adding different variables affecting economic growth to the model used in this study. In addition, the findings obtained by including different countries in the analysis can contribute more to the literature.

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