Çelik, D., Aydın, A. / Journal of Yasar University, 2024, 19/74, 104-129

The Efficacy of Developments in Agriculture and Industry Sectors on Economic Growth in Türkiye ARDL Approach

Türkiye'de Tarım ve Sanayi Sektörlerindeki Gelişmelerin Ekonomik Büyümeye Etkisi: ARDL Yaklaşımı

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Abstract: One of the oldest economic goals of societies around the world is to increase the welfare level of the society. For this reason, the phenomenon of economic growth has been one of the most studied subjects since history. In this work, the efficacy of production in Türkiye's agricultural and industrial sectors on economic growth amongst 1980 and 2022 has been investigated. In addition, inflation and trade deficit data are included as control variables. ARDL bounds test was implemented in the work. Accordingly the outcomes of the work, in the first model, when the share of the agricultural sector in GNP increases by 1%, per capita income decreases by approximately 1.13%. A 1% increment in the inflation rate diminishes per capita income by approximately 0.18%. In the second model, the margin of the industrial sector in GNP has an affirmative efficacy on per capita income. The inflation rate, conversely, has a negatory efficacy on per capita income. When the share of the industrial sector increases by 1%, per capita income increases by approximately 4.5%. A 1% increment in the inflation rate diminishes per capita income by approximately 0.5%. The parameters related to international trade deficit are statistically insignificant.

Keywords: Agriculture, Industry, Economic Growth, Inflation, ARDL Boundary Test

JEL Classification: Q10, L60, O47, E31, C10

Öz: Dünyadaki toplumların en eski iktisadi hedeflerinden biri toplumun refah düzeyini arttırmaktır. Bu nedenle tarihten bu yana ekonomik büyüme olgusu üzerinde en fazla çalışan konulardan biri olmuştur. Bu çalışmada 1980 İle 2022 yılları arasında Türkiye'nin tarım ve sanayi sektörlerindeki üretimin ekonomik büyüme üzerindeki etkisi araştırılmıştır. Ayrıca kontrol değişkenler olarak enflasyon ve dış ticaret açığı verileri çalışmaya eklenmiştir. Çalışmada ARDL sınır testi uygulanmıştır. Çalışmanın sonucuna göre birinci modelde GSMH içindeki tarım sektörünün payı %1 arttığında kişi başına gelir yaklaşık %1,13 kadar azalmaktadır. Enflasyon oranındaki %1'lik artış ise kişi başına geliri yaklaşık %0,18 düşürmektedir. İkinci modelde ise GSMH içindeki sanayi sektörünün payının kişi başına gelir üzerindeki etkisi pozitiftir. Enflasyon oranı kişi başına gelir üzerinde negatif etkiye sahiptir. Sanayi sektörünün payı %1 arttığında kişi başına gelir yaklaşık %4,5 yükselmektedir. Buna ilaveten enflasyon oranındaki %1'lik artış ise kişi başına geliri yaklaşık %0,5 azaltmaktadır. Son olarak dış ticaret açığına ilişkin parametreler ise istatistiksel olarak anlamsız bulunmuştur.

Anahtar Kelimeler: Tarım, Sanayi, Ekonomik Büyüme, Enflasyon, ARDL Sınır Testi

JEL Sınıflandırması: Q10, L60, O47, E31, C10

1. Introduction

From past to present, one of the most fundamental goals of national economies is to increase the welfare of societies and to achieve economic growth. One of the most basic and oldest goals of

Makale Geçmişi / Article History
Başvuru Tarihi / Date of Application : 5 Temmuz / July 2023
Kabul Tarihi / Acceptance Date : 21 Şubat / February 2024

economics is to increase the welfare level of societies. Over the years, various views have been put forward to realize this goal and these views have been shaped in a wide variety of ways over time. Today, various policies are being implemented for this purpose and the function of the factors and sectors that contribute to economic growth may alter in course of time.

When analyzing the economic growth performance of countries, national income indicators are analyzed and the factors contributing to national income are the subject of studies. When we analyze the contribution to national income on a sectoral basis, agriculture and industry are the sectors that have been analyzed the most since the beginning of history. These sectors play important roles in the economic history of a country and are amongest the sectors that affect economic growth the most. The increment in production in these sectors has a prominent impress on the course of the country's national income.

In the 1980s, almost all over the world, open external policies started to be preferred significantly. This situation has led to an increment in the aggregate production levels of countries due to the increment in international trade. Since the 1980s, the abandonment of the closed economy model and the transition to an open economy model has brought about significant increases in the amount of production in the agricultural and industrial sectors. With the increase in globalization trends after the 1990s, international trade gained momentum and production acceleration started to exhibit similar trends. These developments in the global world have started to affect the main sectors, production structure and growth rates of countries.

With the development of technology over time, new transformations can be realized in production processes and this can affect the share of sectors in economic growth. By integrating technology into the goods produced in both agriculture and industry, economic growth processes can be supported quite efficiently. This work explores the influence of Türkiye's agricultural and industrial sectors on Türkiye's economic growth processes. In addition, other macroeconomic signs such as international trade variable and inflation have been added to the study as control variables. The purpose of the work is to specify the influence of Türkiye's most basic sectors like agriculture and industry on economic growth for the selected period range. Economic and political evaluations will be made based on the results obtained.

2. Theoretical Background

Although the history of economics dates back to ancient primitive times, historians of economic thought generally begin the study of economic phenomena in the mercantilist period. The

mercantilist thought that prevailed in the 1500-1700s saw the source of economic growth and prosperity in precious metals. Accordingly mercantilism, if societies wanted to prosper and increase their welfare levels, they should accumulate precious metals such as gold and silver. This view, which argued that the source of wealth at that time was the accumulation of precious metals, led to acts of colonialism, and the rich and powerful countries of the period colonized countries that were home to precious metals but were weak in order to get richer. Due to their policy of liberalizing exports and restricting imports and exporting their production as much as possible, mercantilist thought experienced high inflation and therefore fell out of favor.

Physiocrats were born as a reaction to mercantilism and stated that the policy that would create real wealth should pass through the agricultural sector and that the productive and efficient sector was the agricultural sector. The fact that the physiocrats, who had a free international trade policy, gave importance only to the agricultural sector caused this view to be discredited in a short time.

The beginning of classical economics is also seen as the beginning of modern economics. With the industrial revolution that started in England, industrial production increased rapidly, which led to a rapid increase in welfare, first in England, then in Europe, and then in industrialized countries. The productivity of industrial production was high and contributed significantly to economic growth processes. This led to the rapid spread and growth of the capitalist order, especially in European countries. Pure capitalism, which was completely opposed to state intervention and argued that market dynamics would take over and solve macroeconomic problems in the market on its own, was discredited due to its helplessness in the face of the Great Depression of 1929.

The Great Depression of 1929 was solved thanks to Keynesian economics, which argued that the state should intervene in the markets when necessary, and Keynesian economics was defended after that period. Keynesian economics, which does not differentiate amongst sectors such as agriculture or industry for economic growth, recommended government interventions in cases of insufficient demand for economic growth.

Economic growth refers to the process of increasing a country's national income and welfare level by utilising its resources more efficiently. Agricultural and industrial sectors are the determining components of the economy and developments in these sectors can affect overall economic growth. In this context, economic approaches analysing the impact of developments in

agricultural and industrial sectors on economic growth in Türkiye contribute to our understanding of the basic dynamics of the economy. The Solow growth model is a basic economic model that explains economic growth using factors such as capital accumulation, technological progress and labour force growth. Developments in the agricultural and industrial sectors can affect economic growth depending on these factors as well as productivity increases. The model can be used to analyse the effects of agricultural productivity and industrial production on growth (Solow, 1956, 65-94).

Structural transformation in the agricultural and industrial sectors is an important factor affecting economic growth. Industrial structure theories explain the industrialisation process of an economy and sectoral changes. These theories analyse the changes in the shares and importance of agriculture and industry in the economy over time and evaluate their effects on economic growth. Economic growth is generally associated with the amount of investment. Investments in agriculture and industry sectors can contribute to economic growth by increasing capital accumulation. Development models explain how investments, especially in these sectors, can affect long-term economic growth. The openness of agricultural and industrial sectors to foreign trade addresses the effects of international trade on economic growth. In particular, the impact of industrial production on exports can shape a country's economic growth. In this framework, economic models can analyse the relationship between the degree of openness and economic growth.

Understanding the impact of developments in the agricultural and industrial sectors on economic growth in Türkiye requires a comprehensive evaluation of economic theories and models. The Solow growth model, industrial structure theories, investment and development models, trade and openness analyses provide a comprehensive theoretical framework that can be used to understand the effects of developments in these sectors of the Turkish economy.

3. Literature Review

When Table 1 is perused, it will be sensed there are some other works conducted on the variables that constitute the subject of the study. Accordingly, it will be possible to reach the study subjects and findings of some other studies in the literature that will be included in the study.

Table 1. Literature Review

Author/s	**Publication year**	**Country/ies**	**Period Range**	**Conclusion**
Kopuk and MEÇİK	2020	Türkiye	1998-2020	The authors' work analyzed the efficacy of international trade in the industrial and agricultural sectors on the country's economic growth indicators. Accordingly the outcomes of the work, it was accomplished that investments in the industrial and agricultural sectors affect economic growth.
Doğan	2009	Türkiye	1980-2004	The study analyzed the additive of the agricultural sector to the country's economic development level. Accordingly the results of the study, it is emphasized that agricultural policy is inadequate, especially low agricultural taxes.
Terin, Aksoy and Güler,	2013	Türkiye	1990-2012	Factors affecting growth and the efficacy of the growth in the agricultural sector on economic growth were investigated. The findings indicate that the agricultural sector does not negatively efficacy economic growth, on the contrary, it increases it.
Yalçınkaya	2018	Türkiye	2005-2015	In this work, the efficacy of credits used in the agricultural sector on economic growth is investigated. Accordingly, changes in agricultural credits influence economic growth.
Sari Hassoun and Mouzarine	2019	MENA group of countries	1975-2014	The influence of the agricultural sector on economic growth in 8 MENA countries was investigated. Accordingly the results, the increase in value added in agriculture has an affirmative influence on economic growth.

Sertoglu, Ugural and Bekun	2017	Nigeria	1981-2013	The study examined the influence of Nigeria's agricultural sector on economic growth. A long-term affair was found amongst the variables. In addition, agriculture has a affirmative influence on economic growth.
Awan and Aslam	2015	Pakistan	1972-2012	This work investigates the influence of agricultural productivity on economic growth. The increase in value added in agriculture supports economic growth.
Idisi, Ebukiba, and Sunday	2019	Nigeria	2008-2017	The efficacy of the agricultural sector on economic growth in Nigeria is the subject of this study. Accordingly, developments in agriculture also support economic developments. The fact that agriculture is actualized in a commercial and mechanized manner is one of the facts supported in the article.
Karami, Elahinia and Karami	2019	25 European Countries	1995-2016	The efficiency of the manufacturing sector on economic growth is tested on European countries. There is a significant affirmative affair amongst economic growth and manufacturing industry.
Ou	2015	Nigeria	1973-2013	The efficiency of industrial advancement on economic growth was studied for the Nigerian economy. As a result of the study, contrary to the literature, no significant affair amongst industrial output and economic growth was found.
Banelienė	2021	OECD Countries	2014-2017	The study was conducted on 36 OECD countries and the efficiency of industry on economic growth was exemined. Accordingly the results, when the share of

				industry in gross value added increases, national income is affected at a higher level in industrialized countries with higher income levels.
Liang	2019	China	1992-2016	The study examines the affair amongst China's industrial structure and economic growth. The researcher emphasizes that the transformation of the industrial structure needs to be adjusted in order for economic development in China to be sustainable.
Yi	2021	China	2011-2019	In the study, the affair amongst industry and economic growth is analyzed and it is stated that the service industry, referred to as tertiary industry, is the major cause for the acceleration of economic growth.
Lugina, Mwakalobo and Lwesya,	2022	Tanzania	1970-2017	This study examines the affair amongst the industrial sector, agricultural sector and economic growth in Tanzania. The outcome of the work reveals that both sectors have affirmative influence on economic growth.
Qaiser	2020	Pakistan	1976-2015	The work examines the affair amongst Pakistan's industry and economic growth and finds long-run affair amongst the variables. In addition, when industrial output increases, economic growth also increases.
Kopuk and Meçik	2020	Türkiye	1998-2020	The authors' study investigated the influence of international trade in the industrial and agricultural sectors on the country's economic growth indicators. Accordingly the findings of the study, it was concluded that investments in the industrial and agricultural

				sectors affect economic growth.
Çetin & Ecevit	2010	OECD	1990-2006	In the study, the relationship between health expenditures and economic growth was analysed and no significant relationship was found between the variables.
Çetin & Seker	2012	Türkiye	1970-2009	The study analysed the relationship between energy consumption and economic growth and found a positive and strong relationship between the variables.
Çetin et.al.	2015	European Union	1984-2012	In the study, the relationship between unemployment and economic growth was analysed and there is a bi-directional causality between the variables in the short and long run.
Cetin & Ecevit	2018	Upper Middle Income Countries	1971-2014	The study analysed the relationship between energy consumption, trade openness and economic growth and found significant relationships between the variables.
Çetin	2017	Developing Countries	1990-2012	The study analysed the relationship between government size and economic growth and found significant relationships between the variables.
Beylik et. al.	2022	OECD Countries	1990-2019	In the study, the relationship between health expenditures and economic growth was analysed and significant relationships between variables were found.
Seker et. al.	2015	Türkiye	1980-2012	The study analysed the relationship between financial openness, trade openness and economic growth and found significant relationships between the variables.

4. Sectoral Distribution of Türkiye's GDP Data

Many sectors contribute to Türkiye's national income in a given period. These sectors are basic sectors such as agriculture and industry, and basic sectors can be divided into sub-sectors. Analyzing national income by sectoral distribution is one of the most preferred indicators. Figure 1 shows the sectoral distribution of GDP data calculated accordingly the production method in Türkiye. In addition to the main sectors, it is also possible to see the sub-sectors.

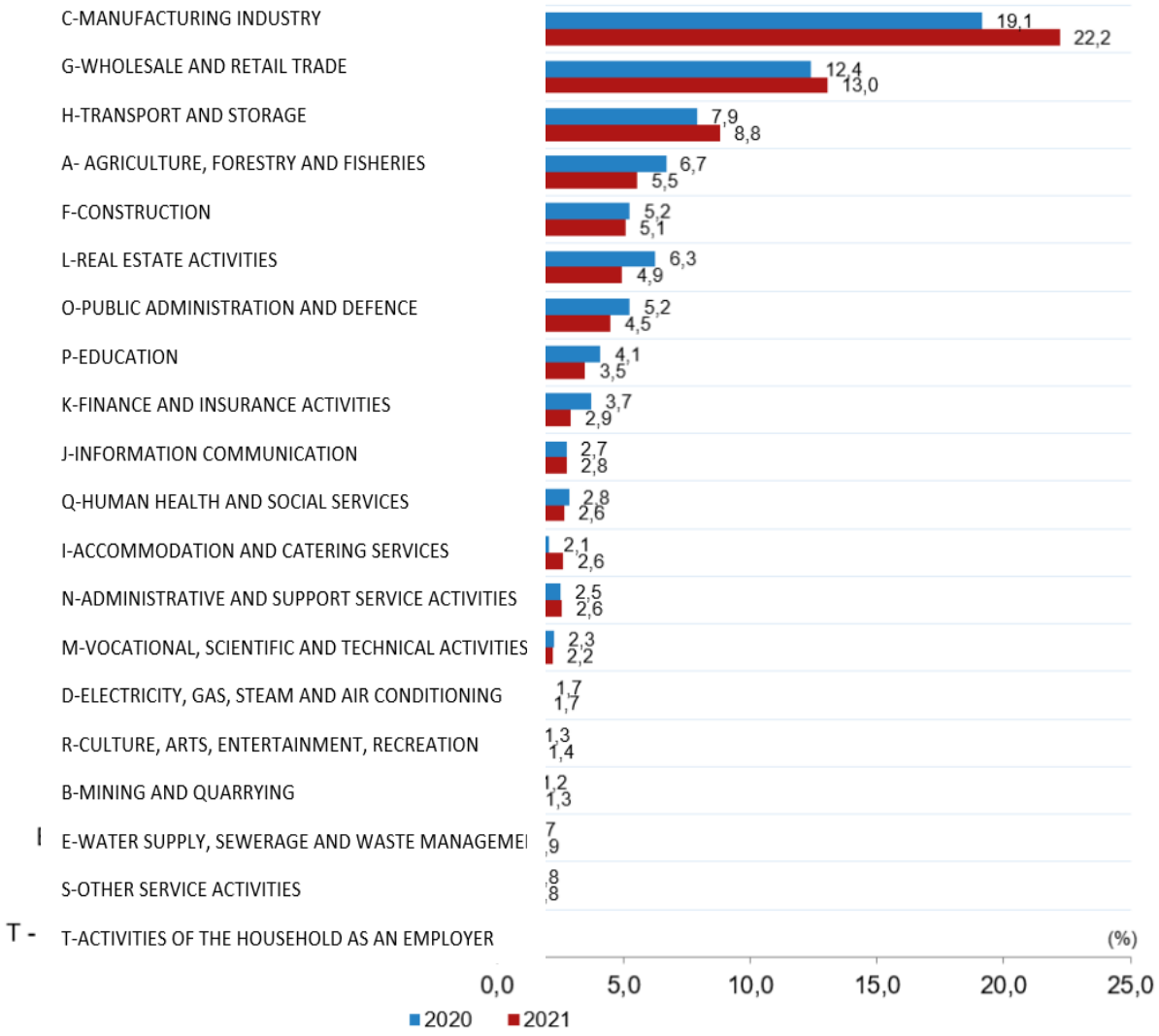

Figure 1. Shares of sectors in GDP calculation

Source: TÜİK, 2023, Access Link: https://data.tuik.gov.tr/Bulten/Index?p=Yillik-Gayrisafi-Yurt-Ici-Hasila-2021-45834

Figure 1 shows the sectors that contribute to Türkiye's national income in order. Accordingly this figure, which compares 2020 and 2021 data and observes the changes amongst these years, the manufacturing industry contributes the most to Türkiye's national income amongst these years. While the share of the manufacturing industry was 19.1% in 2020, this ratio increased to 22.2% in 2021. In this figure, which shows that agriculture is the fourth largest sector contributing to national income, the agricultural sector is seen under the heading of agriculture, forestry and fisheries. In 2020, the share of agriculture was 6.7%, while this rate decreased to 5.5% in 2021. Figure 2 shows the growth rates of these sectors.

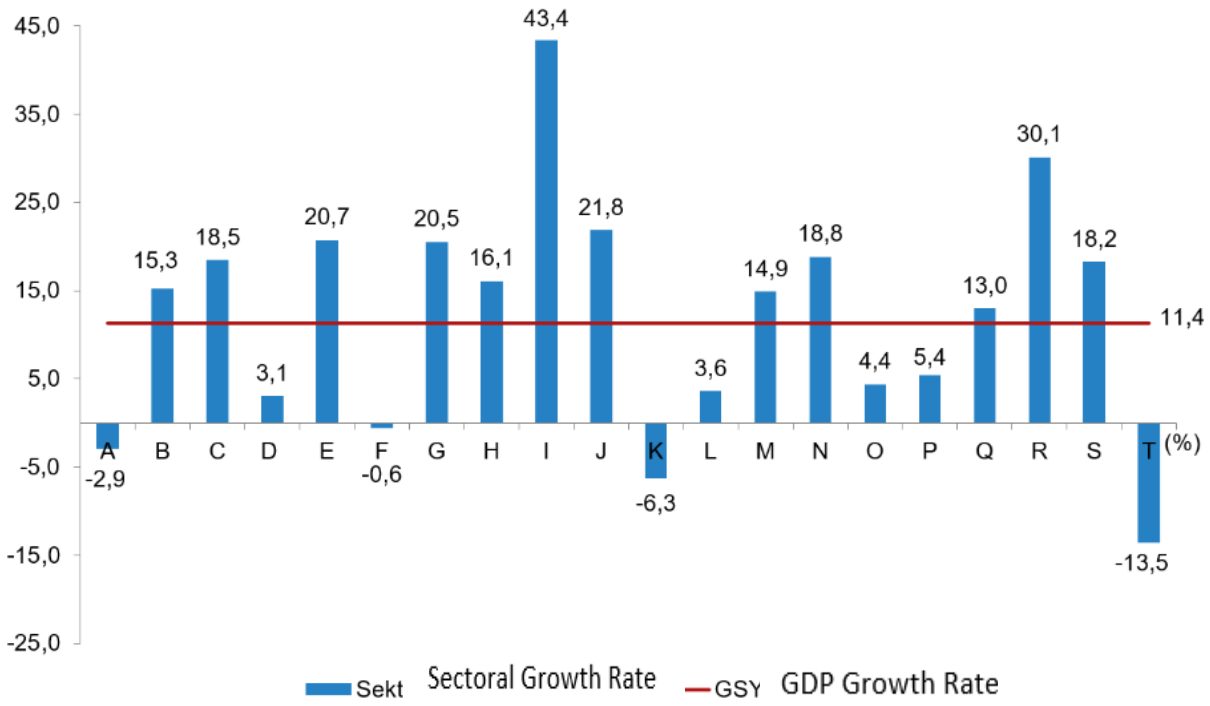

Figure 2. Sectoral Growth Rates, 2021

Source: TÜİK, 2023, Access Link: https://data.tuik.gov.tr/Bulten/Index?p=Yillik-Gayrisafi-Yurt-Ici-Hasila-2021-45834

Figure 2 shows the growth rates of the sectors that make up Türkiye's national income. Here, the sector denoted by A indicates the agricultural sector, while the sector denoted by C indicates the industrial sector. As can be seen from this figure, the agricultural sector contracted by 2.9% in this period, while the industrial sector grew by a remarkable 18.5%. In Figure 2, the sector with the highest growth rate of 43.4% and denoted by I stands for accommodation and food service activities. The sector with the largest contraction of 13.5%, denoted by T, refers to the activities

of households as employers. Figure 3 shows the development and change in the industrial and agricultural sectors in Türkiye over the years.

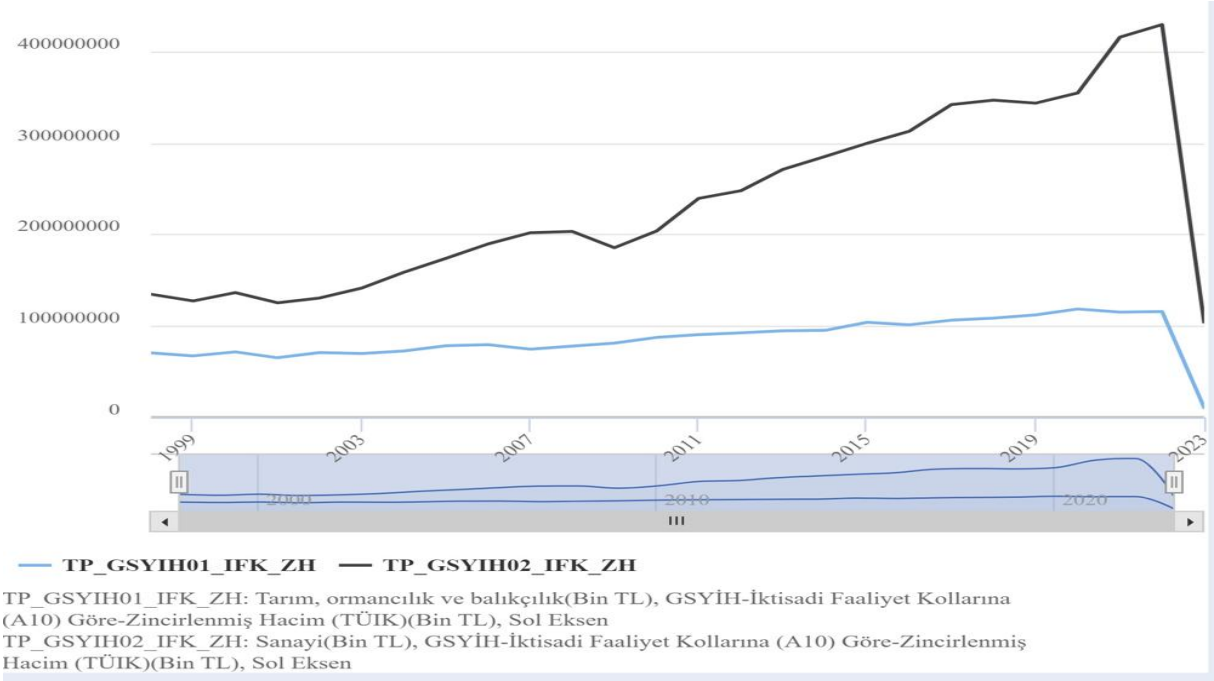

Figure 3. Industrial and Agricultural Sectors over the Years

Source: Merkez Bankası, 2023, Access Link: https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket/collapse_21/6004/DataGroup/turkish/bie_gsyhifkhe/

Figure 3 shows the course of Türkiye's agricultural and industrial sectors from 1999 to 2023. While the line shown in blue in the figure refers to the agricultural sector, the line shown in black refers to the industrial sector. It is figure out that the margin of the industrial sector is higher than the agricultural sector. Looking at the general course of the sectors over the years, it is seen that both have increased fluctuatingly.

5. Dataset and Method

In this study, economic growth, share of agriculture and industry sectors in national income, inflation and international trade deficit data are used as data set. Inflation datum is acquired from the World Bank (2023). The international trade deficit was obtained from TurkStat (2023). The share of agriculture and industry sectors is taken from Gökçen (2020) and TURKSTAT (2023).

All variables are included in the analysis with their logarithmic values. The variables are shown in the study as; LogPRO, LogIND, LogDEF, LogINF and LogGDP.

To determine the relation amongst the variables, the Autoregressive Distributed Lagged Model (ARDL) method is used. Pesaran and Shin (1995) argued that autoregressive lagged models can be used to investigate the cointegration relation. Pesaran et al. (2001) developed the bounds test method as a new cointegration analysis method. In cointegration tests such as Engle-Granger (1987) and Johansen (1988), the variables should be stationary of the same order. In the bounds test, this assumption is relaxed. In other words, in the bounds test, stationary time series at level and first order can be modelled together. In this context, the bounds test is superior to previous cointegration methods. The bounds test is performed in two stages. In the first stage, the existence of cointegration relation is investigated and if the variables are found to be cointegrated, the second stage is started. In the second stage, long-term and short-term parameters are forecasted (Çil, 2018: 408). The following model is used in the bounds test.

$$\Delta y_t = c_0 + c_1 t + \pi_{yy} y_{t-1} + \pi_{yx.x} x_{t-1} + \sum_{i=1}^{p-1} \varphi_i' \Delta z_{t-i} + \omega' \Delta x_t + \theta w_t + \varepsilon_t \quad (1)$$

In the above model, y_t is the dependent variable. z_t is the vector of independent variables. $x_t$is the vector of dependent and independent variables. π_{yy} and $\pi_{yx.x}$ are defined as the long-term multipliers of the model. The expression t in the model is the trend variable. c_0 is included in the model as a constant term. The bounds test is based on the prediction of the above regression model using the Least Squares method. Accordingly the main hypothesis of the test, there is no cointegration relation. The alternative hypothesis suggests that the variables are cointegrated. F statistic is used to test the null hypothesis. The main and alternative hypotheses are expressed as follows.

$$H_0: \pi_{yy} = 0, \pi_{yx.x} = 0 \quad (2)$$

$$H_1: \pi_{yy} \neq 0, \pi_{yx.x} \neq 0 \; veya \; \pi_{yy} \neq 0, \pi_{yx.x} = 0 \; veya \; \pi_{yy} = 0, \pi_{yx.x} \neq 0 \quad (3)$$

The critical values used in the decision process of the bounds test were developed by Pesaran et al. (2001). In this context, two different critical values are calculated. While the lower critical value presumes that the variables are stationary at the level, the upper critical value assumes that the variables are stationary at the first order. At the decision stage, if the calculated F statistic is greater than the upper critical value, the null hypothesis that the variables are not cointegrated is rejected. If the calculated F statistic remains amongst two critical values, no conclusion can be reached and the stationarity levels of the variables should be investigated. If there is a second

order stationary variable among the variables, the critical values of the F statistic become invalid. In this framework, unit root tests should be performed before the bounds test. In this study, unit root tests were conducted for the variables before the bounds test.

Firstly, the Extended Dickey-Fuller Unit Root Test (ADF) developed by Dickey & Fuller (1981) was applied. This test utilizes three different model specifications. In this study, due to the nature of the data, the model with constant and the model with constant and trend are used. These models are expressed as follows.

$$\Delta Y_t = \mu + \delta Y_{t-1} + \sum_{i=2}^{p} \delta_i \Delta Y_{t-i+1} + \varepsilon_t \quad (4)$$

$$\Delta Y_t = \mu + \beta t + \delta Y_{t-1} + \sum_{i=2}^{p} \delta_i \Delta Y_{t-i+1} + \varepsilon_t \quad (5)$$

Since only the first order autoregressive model is considered in Dickey & Fuller (1979), lagged values of the dependent variable are also included in all models in the ADF test in order to eliminate the autocorrelation problem. The main and alternative hypotheses of the ADF test are defined as follows.

$$H_0: \delta = 0 \quad (6)$$

$$H_1: \delta < 0 \quad (7)$$

If the test statistic calculated within the scope of the ADF test is greater than the critical value, the null hypothesis cannot be rejected and it is understood that the series is unit rooted.

This study also utilizes the Phillips Perron (P-P) (1988) unit root test. Unlike the ADF test, the (P-P) test does not make the assumptions of non-autocorrelation of error terms and constant variance (Enders, 2010:229). The same critical values are used as the critical values of the ADF test. In this context, if the calculated test statistic is greater than the critical value, the null hypothesis cannot be rejected and it is concluded that the series is unit rooted.

Perron (1989) showed that if there is a structural change in the time series and this change is not included in the unit root test, the test tends to accept the null hypothesis of unit root. In this framework, Perron (1989) advanced a new unit root test that takes into account one structural break. Subsequently, many unit root tests with structural breaks have been found. In this study, Lee-Strazicich (2003) unit root test is used. Model C, which takes into account two breaks in the level and slope, is used as the model specification. The main and alternative hypotheses for Model C are stated as follows.

$$Y_t = \mu_0 + d_1 B_{1t} + d_2 B_{2t} + y_{t-1} + \varepsilon_{1t} \quad (8)$$

$$Y_t = \mu_1 + \gamma t + d_1 D_{1t} + d_2 D_{2t} + \omega_1 DT_{1t} + \omega_2 DT_{2t} + \varepsilon_{2t} \quad (9)$$

Assumptions regarding the bounds test are also tested. The assumption of normality is tested with the Jarque-Bera test. The assumption of constant variance is tested with the Breusch-Pagan-Godfrey test (Godfrey, 1978:227-236 and Breusch & Pagan, 1979:1287-1294). The assumption of no autocorrelation problem is tested with the Breusch-Godfrey test (Godfrey, 1978:1293-1302, Breusch, 1978:334-355). The RESET test developed by Ramsey (1969) is used to determine whether the ARDL model contains specification error. In order to determine whether the estimated parameters satisfy the stability condition, CUSUM and CUSUM Square tests developed by Brown et al. (1975) were conducted.

6. Findings

First, conventional unit root tests were applied to the variables. For the ADF and PP unit root tests, fixed model and fixed and trended model specifications were used in accordance with the structure of the data. The test results are presented in Table 2.

Table 2. ADF and PP Unit Root Test Results at Level Values

	ADF Constant	**ADF Constant, Trending**	**PP Constant**	**PP Constant, Trending**
LogAGR	-1,130109 (-2,935001)	-2,744434 (-3,523623)	-1,200975 (-2,935001)	-2,793634 (-3,523623)
LogIND	-3,136853 (-2,935001)	-2,960227 (-3,523623)	-3,284756 (-2,935001)	-2,954667 (-3,523623)
LogDEF	-1,116459 (-2,936942)	-2,890400 (-3,523623)	-1,082031 (-2,935001)	-3,016669 (-3,523623)
LogINF	-1,864117 (-2,935001)	-1,495364 (-3,523623)	-1,854806 (-2,935001)	-1,495152 (-3,523623)
LogKBG	-0,829267 (-2,935001)	-1,649036 (-3,523623)	-0,834465 (-2,935001)	-1,956419 (-3,523623)

The values in parentheses in Table 2 indicate the critical values at the 5% significance level. It is observed that the ADF and PP test statistics for the industry variable are smaller than the critical values for the model with constants. In this framework, the series follows a stationary process accordingly the fixed model specification. In this case, the null hypothesis that the series is unit rooted cannot be rejected. When both model specifications are evaluated together, it can be said that there is evidence that the industrial series is unit rooted. For the other series, the calculated test statistics are greater than the critical values. In this context, it is concluded that these series follow a unit rooted process accordingly ADF and PP tests. As stated in the Methodology section, if there are structural breaks in a time series and these breaks are not

included in the unit root test, the test results tend to accept the null hypothesis of unit root. In this framework, the Lee-Strazicich unit root test, which takes into account two structural breaks, is applied to the series. Model C, which considers two breaks in the level and slope, is used as the model specification. The test outcomes are summed up in Table 3.

Table 3. Lee-Strazicich Unit Root Test Outcomes at Level Values

	Lag Length	**Minimum t Statistic**	**Breakage Dates**	**Critical Value (5%)**	**Conclusion**
LogAGR	6	-5,760627	1996, 2010	-6,185000	Unit Root
LogIND	5	-5,769485	1992, 2010	-6,185000	Unit Root
LogDEF	7	-6,871965	1993, 2008	-6,185000	Stationary
LogINF	7	-5,234765	1999, 2002	-6,201000	Unit Root
LogKBG	5	-5,062858	1995, 2008	-6,185000	Unit Root

As can be griped from Table 3, the null hypothesis that these series are unit rooted at level and slope under two structural breaks cannot be rejected. With this result, the unit root evidence obtained for the industry variable in conventional unit root tests has become stronger. However, the Lee-Strazicich test results for the international trade deficit series, which is found to be unit rooted accordingly the ADF and PP unit root tests, show that the calculated test statistic is smaller than the critical value. In this framework, the null hypothesis that the international trade series is unit rooted with two structural breaks is denied and it is accomplished that the series is trend stationary under two structural breaks. The order at which the series that are found to be unit rooted become stationary is important. The unit root tests were repeated by taking the first differences of these series. The results of the conventional unit root tests are given in Table 4.

Table 4. ADF and PP Unit Root Test Results with First Difference Values

	ADF Constant	**ADF Constant, Trending**	**PP Constant**	**PP Constant, Trending**
LogAGR	-7,258106 (-2,936942)	-7,244610 (-3,526609)	-7,352107 (-2,936942)	-7,347907 (-3,526609)
LogIND	-7,018387 (-2,936942)	-7,186768 (-3,526609)	-7,018387 (-2,936942)	-7,189002 (-3,526609)
LogINF	-6,846128 (-2,936942)	-6,787498 (-3,526609)	-6,968627 (-2,936942)	-6,889442 (-3,526609)
LogKBG	-6,939758 (-2,936942)	-6,883303 (-3,526609)	-6,909532 (-2,936942)	-6,857926 (-3,526609)

As seen in Table 4, the test statistics calculated for all variables within the framework of both tests are smaller than the critical values. In other words, the null hypothesis that the first

differenced series are unit rooted is denied and it is accomplished that the series are stationary. Since the conventional unit root tests are used to find stationary difference series, the unit root test with structural breaks is not applied. It is known that conventional unit root tests tend to accept the unit root.

When all unit root tests are evaluated together, it is accomplished that the international trade series is stationary at level and the other series are stationary at first order. In this context, ARDL method can be used to investigate the cointegration affair amongst the series. In this work, two different ARDL models were constructed. In the first model, the industry variable is excluded from the analysis, while in the second model, the agriculture variable is excluded. In this framework, it is aimed to decompose the effects of these two sectors on per capita income. It is also aimed to prevent the possible multicollinearity problem. In both models, the income per capita variable is taken as the dependent variable and the Schwarz information criterion is used to determine the lag lengths. The outcomes for the first model are summarized in Table 5.

Table 5. Model 1 ARDL (4,1,2,0) Results (Dependent Variable: LogKBG)

Variables	**Coefficient**	**Standard Error**	**t Statistic**	**Probability**
LogKBG (-1)	0,484392	0,158585	3,054468	0,0050
LogKBG (-2)	0,467211	0,176952	2,640329	0,0136
LogKBG (-3)	-0,098744	0,094152	-1,048772	0,3036
LogKBG (-4)	-0,216262	0,082280	-2,628361	0,0140
LogINF	-0,132981	0,032994	-4,030427	0,0004
LogINF (-1)	0,067840	0,035177	1,928548	0,0644
LogDEF	0,245452	0,029538	8,309648	0,0000
LogDEF(-1)	-0,035779	0,059335	-0,602999	0,5515
LogDEF (-2)	-0,168495	0,055762	-3,021684	0,0054
LogAGR	-0,451672	0,123638	-3,653185	0,0011
Constant	1,590834	0,391453	4,063922	0,0004
R^2	0,995095			
Adjusted R^2	0,993278			
F Statistic	547,7246			
Probability (F Statistic)	0,000000			

When we take a look at the likelihood values in Table 5, it is seen that all but two of them are less than 0.05. In other words, most of the parameters are statistically substantial. In addition, the probability value of the F statistic, which measures the significance of the model as a whole, is also less than 0.05. The R^2 value, which is evaluated as the explanatory power of the model, is

above 99%. In this context, no changes were made in the model. The consequence of the second model are presented in Table 6.

Table 6. Model 2 ARDL (1,0,2,1) Results (Dependent Variable: LogKBG)

Variables	**Coefficient**	**Standard Error**	**t Statistic**	**Probability**
LogKBG (-1)	0,760667	0,083014	9,163126	0,0000
LogINF	-0,119456	0,033513	-3,564462	0,0012
LogDEF	0,284210	0,033256	8,546193	0,0000
LogDEF(-1)	-0,167292	0,044485	-3,760656	0,0007
LogDEF(-2)	-0,079981	0,033036	-2,421003	0,0213
LogIND	-0,382180	0,491676	-0,777302	0,4427
LogIND (-1)	1,462631	0,426538	3,429074	0,0017
Constant	-0,752588	0,358135	-2,101407	0,0436
R^2	0,993446			
Adjusted R^2	0,992013			
F Statistic	692,9669			
Probability (F Statistic)	0,000000			

In accordance with the outcomes of Model 2 in Table 6, the parameter estimates are statistically expressive. In addition, accordingly the F statistic, the model as a whole is significant. The explanatory power of the model is found to be over 99% like Model 1. In order to conduct cointegration test amongst variables, some assumptions need to be met. In this context, firstly, Breusch-Godfrey test is used to investigate whether there is an autocorrelation problem for both models and the test outcomes are seen in Table 7.

Table 7. Breusch-Godfrey Test Results

	F Statistic	**Probability (F)**	**Probability (Chi-Square)**
Model 1	0,361286	0,7004	0,5864
Model 2	0,310776	0,7352	0,6653

As seen in Table 7, the probability values for both models are greater than 0.05. The null hypothesis that there is no autocorrelation problem among error terms cannot be rejected for both models. The constant variance assumption for the models is tested with the Breusch-Pagan-Godfrey test and the test results are summarized in Table 8.

Table 8. Breusch-Pagan-Godfrey Test Results

	F Statistic	**Probability (F)**	**Probability (Chi-Square)**
Model 1	0,564441	0,8278	0,7653
Model 2	0,940971	0,4894	0,4470

Table 8 shows that the probability values calculated for the models are greater than 0.05. In this framework, the null hypothesis of constant variance cannot be rejected for both models. The normality assumption, which is another assumption for the ARDL model, is analyzed with the Jarque-Bera test and the test outcomes are presented in Table 9.

Table 9. Jarque-Bera Test Results

	Jarque-Bera Statistic	**Probability**
Model 1	4,058312	0,131446
Model 2	1,063822	0,587481

As seen in Table 9, the probability values are greater than 0.05. For both models, the null hypothesis that the residuals are normally distributed cannot be rejected. The presence of specification error in the models is investigated by RESET test and the test outcomes are summed up in Table 10.

Table 10. RESET Test Results

	F Statistic	**Probability**
Model 1	0,116171	0,7360
Model 2	0,115503	0,7363

As seen in Table 10, the probability values for both models are greater than 0.05. It is concluded that there is no specification error in the models. Finally, whether the parameter estimates obtained from the ARDL model satisfy the stability condition is examined by CUSUM and CUSUM squared tests. The test outcomes are presented in Figures 4, 5, 6 and 7.

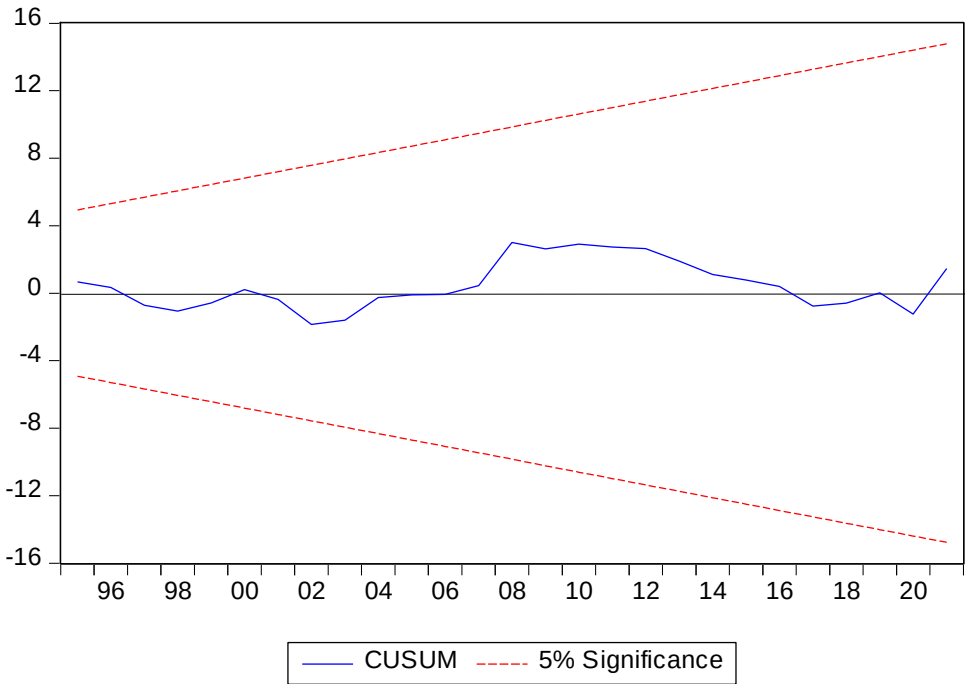

Figure 4. Model 1 CUSUM Test Result

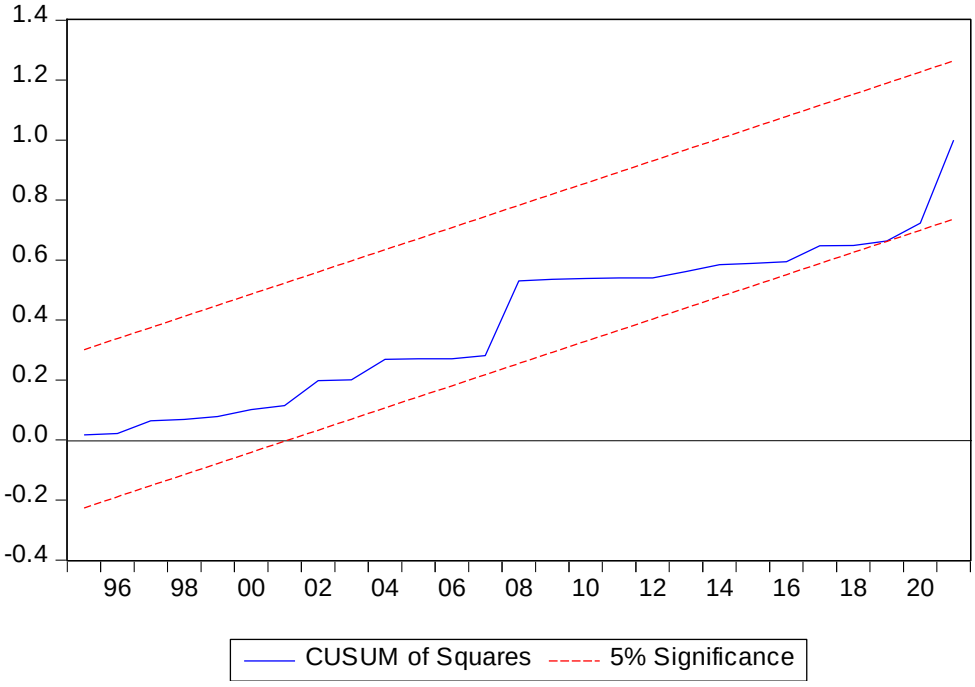

Figure 5. Model 1 CUSUM Square Test Result

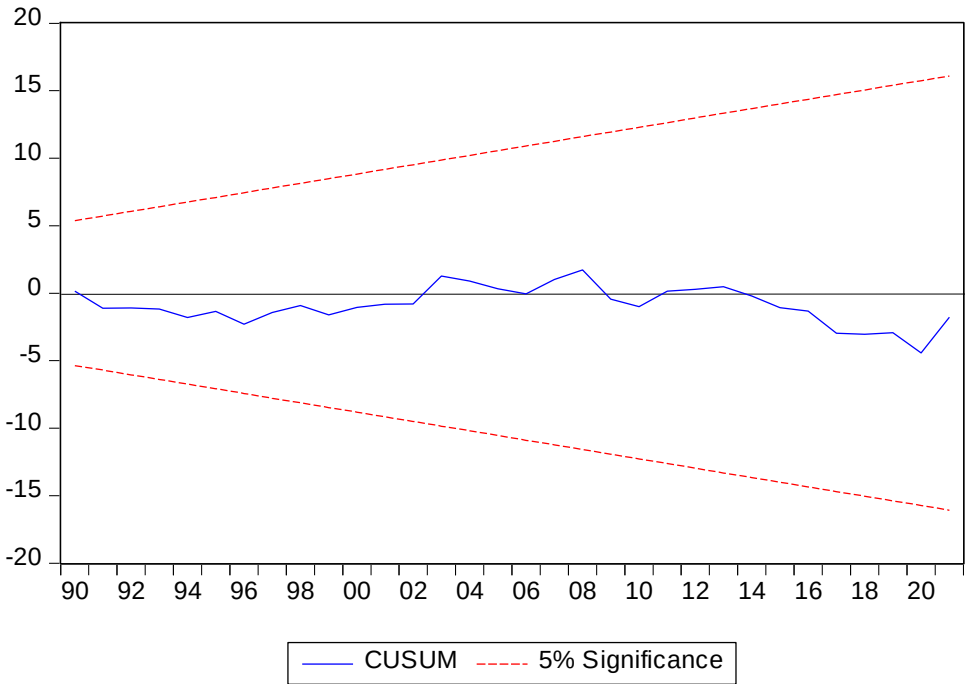

Figure 6. Model 2 CUSUM Test Result

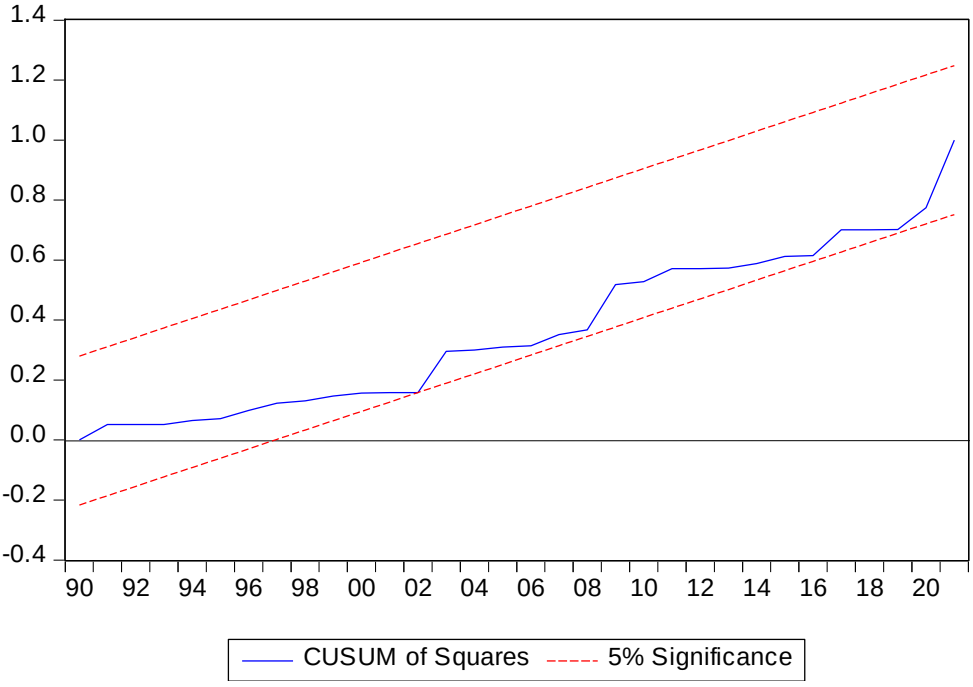

Figure 7. Model 2 CUSUM Square Test Result

The dashed lines in the figures above show the 5% confidence interval. The blue lines in the middle represent the parameter estimates. The blue lines amongst the dashed lines indicate that the parameter estimates for both models satisfy the stability condition.

It is concluded that all assumptions regarding the ARDL model are met. At this stage, the bounds test was applied to investigate the existence of cointegration affair amongst the variables and the test outcomes are presented in Table 11.

Table 11. Boundary Test Results

	Model 1	**Model 2**
F Statistic	5,032252	4,291735
Lower Bound (5%)	3,1	3,1
Upper Bound (%5)	4,088	4,088

As seen in Table 11, the test statistics calculated for both models are greater than the upper critical value. In this context, a cointegration relation amongst the variables is found for both Model 1 and Model 2. In this context, long-run parameter estimations were performed and the estimation consequence are presented in Table 12 and Table 13.

Table 12. Model 1 Long Run Parameter Predictions

Variables	**Coefficient**	**Standard Error**	**t Statistic**	**Probability**
INF	-0,179252	0,059085	-3,033825	0,0053
DEF	0,113312	0,115702	0,979340	0,3361
AGR/GDP	-1,242898	0,303039	-4,101443	0,0000
Constant	4,377611	1,163859	3,761290	0,0008

Table 13. Model 2 Long Run Parameter Predictions

Variables	**Coefficient**	**Standard Error**	**t Statistic**	**Probability**
INF	-0,499122	0,166764	-2,992983	0,0053
DEF	0,154331	0,184246	0,837633	0,4084
IND/GDP	4,514432	1,850560	2,439495	0,0204
Constant	-3,144525	1,356314	-2,318434	0,0270

As figure out in Table 12 and Table 13, the parameters for the trade deficit are statistically insignificant. However, since the models are significant, this variable is not excluded from the analysis. It is seen that the other parameters are significant. In this context, the estimated models are as follows.

LogKBG=4,37760-0,1793LogINF+0,1133LogDEF-1,1249LogAGR

LogKBG=-3,1445-0,4991LogINF+0,1543LogDEF+4,5144LogIND

In the first model, the share of agriculture in GNP is considered, while the share of industry in GNP is modeled in the second model. When the first model is analyzed, it is observed that the

share of agriculture has a negative efficacy on per capita income. Similarly, the increment in inflation has a negative influence on per capita income. Since all variables are included in the analysis with their logarithmic values, the parameters can be considered as elasticities. In this context, accordingly the first model, when the share of the agricultural sector in GNP increases by 1%, per capita income decreases by approximately 1.13%. A 1% enhancement in the inflation rate diminishes per capita income by approximately 0.18%. Accordingly, the second model, the share of the industrial sector in GNP has a affirmative efficacy on per capita income. The inflation rate, moreover, has a negative effect on per capita income. When the share of the industrial sector enhancement by 1%, per capita income rises by approximately 4.5%. A 1% enhancement in the inflation rate diminishes per capita income by approximately 0.5%.

In order for the cointegration relation to be valid, it is important that the error correction model works. Error correction models are constructed with the error terms obtained from long-run forecasts. The results of the error correction models for both models are presented in Table 14.

Table 14. Error Correction Model (ECM) Outcomes

Variable	**Coefficient**	**Standard Error**	**t Statistic**	**Probability**
Error Correction Term (Model 1)	-0,363402	0,067612	-5,764101	0,0000
Error Correction Term (Model 2)	-0,239333	0,048711	-5,374835	0,0000

As seen in Table 14, the ECM term for both models is negative and statistically revealing. In this framework, it can be said that the ECM works. For the first model, short-run deviations disappear after 2.75 (1/0363402) years, i.e. after 2 years and 9 months. For the second model, these deviations disappear after 4.18 (1/0.239333) years, i.e. after approximately 4 years and 2 months.

7. Conclusion and Policy Recommendations

When analyzing the economic growth performance of countries, national income indicators are analyzed and the factors contributing to national income are the subject of studies. When we

analyze the contribution to national income on a sectoral basis, agriculture and industry are the sectors that have been analyzed the most since the beginning of history. These sectors play important roles in the economic history of a territory and are amongst the sectors that affect economic growth the most. The increment in production in these sectors has a substantial efficacy on the course of the country's national income.

This study investigates the efficacy of production in Türkiye's agricultural and industrial sectors on economic growth amongst 1980 and 2022. In addition, inflation and international trade deficit data are included as control variables. ARDL bounds test is implemented in the work. In accordance with the outcomes of the work, in the first model, when the share of the agricultural sector in GNP increases by 1%, per capita income decreases by approximately 1.13%. A 1% increment in the inflation rate diminishes per capita income by approximately 0.18%. In the second model, the share of the industrial sector in GNP has an affirmative efficacy on per capita income. The inflation rate, moreover, has a negatory efficacy on per capita income. When the share of the industrial sector increment by 1%, per capita income enhances by approximately 4.5%. A 1% increment in the inflation rate diminishes per capita income by approximately 0.5%. The parameters related to international trade deficit are statistically insignificant.

When the findings obtained when the literature is analysed and other studies in the literature are examined, an inference can be made as follows. According to this; Studies supporting the conclusion of the study: Kopuk & MEÇİK, (2020), Yalçınkaya, (2018), Karami, Elahinia & Karami, (2019), Banelienė, (2021), Qaiser, (2020). Studies that have obtained results in the opposite direction to this study: Terin, Aksoy & Güler, (2013), Sari Hassoun & Mouzarine, (2019), Sertoglu, Ugural & Bekun (2017), Awan & Aslam (2015), Idisi, Ebukiba, & Sunday (2019), Lugina, Mwakalobo & Lwesya, (2022).

The study was started as of 1980 due to the limited access to data, and the period range selected was limited between these years since the data that could be obtained during the period of the study reached the maximum period by 2022. For this reason, it is recommended to include this issue in future studies since a different and longer period range can be selected in future studies and the results can be more reliable. In addition, while enriching the time interval with different additional variables, studies that can be more comprehensive by observing the effects of different variables are recommended for future researchers.

As a result, while increases in the agricultural sector decrease economic growth in Türkiye, increases in the industrial sector increase economic growth. In the light of all these findings, we can talk about the need to increase production in the industrial sector rather than the agricultural sector in order to increase the level of welfare in Türkiye and to increase Türkiye's national income per capita. However, at this point, it is worth noting that agricultural production can also be a national security issue for countries. In times of crisis and war, when countries' international trade may be disrupted, access to food is especially important. Therefore, it is essential for countries to produce at least self-sufficient agricultural products. Apart from this, Türkiye can support economic growth by focusing on industrial products in the product groups that it will produce and export.

In addition, policy recommendations include integrating technology into production, increasing the productivity of human capital, increasing productivity by regulating labor markets, focusing on the production of value-added products, supporting the production of value-added products with subsidies while providing tax incentives, producing policies that will increase the quality of domestic goods, and increasing the quality of domestic goods so that they can challenge the competitive structure in international trade by branding. If these processes can be realized effectively, Türkiye will be able to make progress in both the agricultural and industrial sectors, reach higher levels of national income and contribute to increasing the welfare level of the society.

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