



## The Effect of Macroeconomic Variables on Private Savings in BRICS-T Economies

### BRICS-T Ekonomilerinde Makroekonomik Değişkenlerin Özel Tasarruflar Üzerindeki Etkisi

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DOI: <https://doi.org/10.25204/iktisad.1088177>

#### Makale Bilgileri

**Makale Türü:**  
Araştırma  
Makalesi

**Geliş Tarihi:**  
15.03.2022

**Kabul Tarihi:**  
22.08.2022

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Tüm hakları  
saklıdır.



#### Article Info

**Paper Type:**  
Research Paper

**Received:**  
15.03.2022

**Accepted:**  
22.08.2022

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#### Abstract

Considering the fact that savings are very important for developing countries and that they should be increased, in this study, the effects of macroeconomic variables consisting of economic growth rate, inflation rate, real interest rate and per capita income on private savings for BRICS-T countries, have been examined with the annual data of 1996-2019 period. For this purpose, firstly, the cross-sectional dependency and homogeneity situations between the mentioned countries have been evaluated. Then, the second-generation panel unit root test, the CADF Test, has been applied to test for stagnation. Westerlund (2008) Durbin-H method has been used to determine the long-term cointegration relationship. In the estimation of long-term cointegration coefficients, for inter-unit correlation and heterogeneity, the common correlated effects – CCE estimator proposed by Pesaran (2006) has been used. Although the findings differ for countries, they reveal that there are important relationships between macroeconomic variables and savings.

**Keywords:** Savings, economic growth, inflation, interest rate, panel data analysis.

#### Öz

Gelişmekte olan ülkeler açısından tasarrufların oldukça önemli olduğu ve artırılması gerektiği gerçeğinden hareketle bu çalışmada, ekonomik büyüme oranı, enflasyon oranı, reel faiz oranı ve kişi başına düşen gelir seviyesi makroekonomik değişkenlerinin özel tasarruflar üzerindeki etkileri 1996-2019 dönemi yıllık verileri ile BRICS-T ülkeleri için incelenmiştir. Bu amaçla öncelikle söz konusu ülkeler arasındaki yatay kesit bağımlılık ile homojenlik durumlarına bakılmıştır. Daha sonra ikinci nesil panel birim kök testi olan CADF Testi ile durağanlık sınaması yapılmıştır. Uzun dönemli eşbütünlük ilişkisinin tespiti ise Westerlund (2008) Durbin-H yöntemi ile test edilmiştir. Uzun dönemli eşbütünlük katsayılarının tahmininde ise birimler arası korelasyon ve heterojenlik durumlarında Pesaran (2006) tarafından önerilen ortak korelasyonlu etkiler – CCE tahmincisi kullanılmıştır. Elde edilen bulgular ülkeler için farklılık göstermesiyle birlikte makroekonomik değişkenlerle tasarruflar arasında önemli ilişkiler olduğunu ortaya koymaktadır.

**Anahtar Kelimeler:** Tasarruflar, ekonomik büyüme, enflasyon, faiz oranı, panel veri analizi.

**Atıf/ to Cite (APA):** Telek. C. and Miçooğulları, S.A. (2022). The effect of macroeconomic variables on private savings in BRICS-T economies. *Iktisadi İdari ve Siyasal Araştırmalar Dergisi*, 7(19), 434-447

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## 1. Introduction

Saving, which is defined as the part of income that is not allocated to consumption after the decision to postpone consumption to a future date (CBRT, 2021), has an important place for economies. Beyond its importance in all economies, it is a well-known fact that savings play an important role in increasing investments, production, and employment, especially for developing economies. When considered from the point of view of the Turkish economy, solving the problem of insufficient savings and increasing savings gains importance as in other developing countries.

When the theories focused on explaining the saving behavior and revealing the determinants of savings are examined, it can be seen that the first important contribution has been made by J.M. Keynes (1936) with the "Absolute Income Hypothesis". According to this hypothesis, Keynes has stated that the current consumption is a function of the current income, the Keynesian model states that the most important factor determining the current personal savings is the current disposable personal real income, and changes in disposable personal real income would change consumption. This relationship between consumption and disposable personal income is called the consumption function. Disposable personal income may not be used wholly for consumption purposes. At this point, the part of the income that is not used for consumption is expressed as personal savings. When evaluated from this aspect, the Keynesian model states that the most important factor determining personal savings is disposable personal real income. According to the Absolute Income Hypothesis, an increase in disposable personal real income increases consumption, but since the average propensity to consume decreases, the increase in consumption is not as much as the increase in income. Because a part of the income is allocated to savings, and therefore, when the disposable personal real income increases, the savings also increase (Ünsal, 2009: 131-139; Bulut and Karakaya, 2018: 208).

After the Absolute Income Hypothesis, which was based on the relationship of consumption and saving with disposable personal real income by Keynes, another important contribution to the saving theory has been made by J.S. Duesenberry (1949) with the "Relative Income Hypothesis". According to this hypothesis, the consumption behaviors of individuals are not independent from the consumption behaviors of other people. This hypothesis states that the factor that determines the consumption of individuals is determined by their relative income compared to other people or groups in the environment where the consumer lives, rather than their absolute income. Another important contribution was made by the "Lifetime Income Hypothesis" proposed by F. Modigliani and R. Brumberg (1954). Based on the assumption that individuals plan their consumption and saving behaviors in the long term, this hypothesis suggests that they will make their consumption and savings according to their lifetime income, unlike their current income. According to this hypothesis, individuals divide their lives into different periods. They increase their savings in periods when their income is high, and they continue their consumption expenditures by allocating these savings to consumption in periods when their incomes are low. In the "Permanent Income Hypothesis" proposed by Milton Friedman (1957), consumption is a function of not only current income but also permanent income, which includes long-term income expectations. According to this hypothesis, if individuals expect an increase in their future income, they will tend to increase their current consumption and decrease their savings. This result reveals that the most important factor affecting people's consumption and savings is their income in the long run. Many studies have been conducted by researchers in the light of these hypotheses examining the consumption and saving behavior of individuals. The reason for this is that the concepts of consumption and savings are of great importance for the economies of countries.

We have already mentioned that savings are very important for developing countries and that they need to be increased. In order for efforts to increase savings in economies to be successful, determining the factors affecting savings and revealing how they affect savings will be effective in guiding the economic policies to be implemented.

The purpose of this study is estimating the long-run relationship between savings and some selected macroeconomic variables for BRICS-T countries using annual data for the period of 1996-2019. For this purpose, firstly, the cross-sectional dependency and homogeneity situations between the mentioned countries have been evaluated. The CD Test developed by Pesaran (2004), which is the most widely used test in the literature, has been used to determine the cross-sectional dependence. For the homogeneity test, on the other hand, the Delta test developed by Pesaran and Yamagata (2008) has been used. Depending on the determination of cross-sectional dependence between units, the second-generation panel unit root test, the CADF Test, has been used to test for stagnation. The determination of the long-term cointegration relationship has been tested with the Westerlund (2008) Durbin-H method. In the estimation of long-term cointegration coefficients, the common correlated effects – CCE estimator proposed by Pesaran (2006) has been used for inter-unit correlation and heterogeneity.

## 2. Literature Review

In addition to the fact that there are many different definitions in the literature, studies examining the relationship between the concept of saving, which can be defined as the part of disposable income that is not allocated for consumption, and macroeconomic variables, are explained in this section.

There are various factors that affect the domestic savings of economies. Besides varying in terms of countries or country groups, some of these factors include; economic growth, level of per capita income, current account balance, demographic changes, interest rates, inflation, money supply, liquidity ratio etc. When the literature has been examined, studies in this context generally concentrate on explaining the relationship between some variables selected from these concepts and the saving variable.

In the literature, it is seen that there are many empirical studies on the importance of saving for countries, the factors affecting saving and the determinants of saving. Among these studies, 13 European countries have been analyzed empirically in the study conducted by Hondroyannis (2006). In the related study, it has been determined that for the whole panel, private saving was positively affected by the elderly dependency ratio, government budget constraint, real disposable income, real interest rate and inflation increase, but negatively affected by liquidity limitation. In the study conducted by Adewuyi et al. (2010), it is among the main findings that the growth in GDP has a positive but insignificant effect on saving in economies in the Economic Community of West African States (ECOWAS). In addition, when the results have been analyzed, it is seen that GDP per capita, inflation, high budget deficit and terms of trade have a significant negative effect on savings in economies in ECOWAS. In the study conducted by Ferreira (2017), in which the relationship between inflation and savings was examined for 42 countries, it is stated that the low course of inflation generally affects savings positively. Bhandari et al. (2007) examined the determinants of savings for 5 South Asian countries. The overall results indicated that government expenditures and past savings had a negative effect on private saving, while the level of financial development and per capita income growth had a positive effect. In addition, they found that the degree of urbanization, real interest rate and dependency ratio did not have a noticeable effect on private saving. Masson et al. (1998), in their study, determined that demographic changes and growth are important determinants of private savings in developing countries. On the other hand, they found that interest rates and terms of trade were positive, but their effects were weaker. Edwards (1996) made a theoretical and empirical evaluation of the determinants of savings, especially for Latin American countries. In the findings obtained for 36 economies in the relevant study, it was concluded that the increase in per capita income is the most important determinant of private and government savings, that government savings are lower in countries with high political instability, and that the increase in government savings reduces private savings. Abasimi and Martin (2018) investigated the determinants of national saving in four West African countries (Ghana, Togo, Burkina Faso and Ivory Coast) over the period

1997-2016. They applied the ARDL limit test method. The long run results reveal that gross domestic product, per capita income and real interest rate has a statistically and significant positive effect on gross savings, were as age dependency ratio has a statistical, and insignificant negative relationship with gross saving. The short run results suggest that gross domestic product and per capita income possesses positive statistically significant effects on gross national savings.

Athukorala and Sen (2004), who conducted one of the studies examining the determinants of saving for the Indian economy, found that the increase in disposable income increased the private saving rate, and real interest rates and inflation rates also had a positive effect. However, they also determined that the level of the effect was lower and that the changes in government savings and terms of trade had a negative impact. In another study conducted for the Indian economy, the relationship between saving and growth was examined by Singh (2010) and a bidirectional causality relationship was found between the variables. However, it was also stated that there is a need to accelerate domestic savings in order to finance capital accumulation and promote higher income and stable growth.

Horioka and Wan (2007), based on the fact that the savings rate is high and increasing in the Chinese economy, identified the main determinants of savings as income growth rate, real interest rate and inflation rate. However, they stated that demographic change did not affect savings and that real interest rates had a positive effect on savings. In another study on the Chinese economy, Lean and Song (2009) found a dual causality between domestic savings growth and economic growth in the short run. In the long run, on the other hand, they concluded that there is a unidirectional causality running from domestic savings growth to economic growth.

In the study conducted by Ramajo et al. (2006), one of the studies on OECD countries, which aims to determine the variables that affect private savings for 21 OECD countries, it has been determined that the rate of income growth is a positive and important variable, the rate of urbanization has a positive effect and government savings have a negative effect. Likewise, in the study conducted by De Serres and Pelgrin (2002) on 15 OECD countries, it was concluded that the decrease in private savings was mostly affected by the increase in government savings. In addition, it has been concluded that variables such as interest rates, demographic changes, and growth affect savings. Callen and Thimann (1997), in their study on 21 OECD countries, concluded that growth, demographic changes, inflation, real interest rate and unemployment rate play important roles for private and government savings. Bulut and Karakaya (2018) also investigated the relationship between savings and macroeconomic variables. According to the estimation results, it is seen that the variables of income per capita, short-term real interest rate and inflation have a negative effect on private savings, while liquidity has a positive effect. It has been observed that inflation increases government savings, while growth rate, per capita income, short-term real interest rate and liquidity decrease. It has been determined that growth rate and liquidity increase national savings, while per capita income, short-term real interest rate and inflation decrease. It is stated that macroeconomic variables are important determinants of savings for OECD countries. Another study investigating the determinants of private savings in OECD countries was conducted by Yaraşır and Yılmaz (2011). The findings obtained in the related study reveal that the previous year's savings rates, private loans, current account balance and inflation have positive effects on private savings, while government savings and elderly dependency ratios have negative effects. The effects of per capita growth rate and real interest rates on private savings were found to be insignificant for these countries. While the effect of government savings and dependency ratios on private savings is negative and significant, the positive effects of previous year savings rates, inflation and private sector loan use are also among the findings. Another finding of this empirical study is that an improvement in the current account balance increases private savings, while the increase in government savings decreases private savings.

In the study conducted by Aka and Arıcan (2019), which is one of the studies on the determinants of savings in Turkey, they found that GDP and inflation rate have significant and positive effects on saving rates, while money supply and youth dependency rates have significant and

negative effects on saving rates. In another similar study, Özcan and Günay (2012) determined that government savings have a reducing effect on private savings. However, they found that increases in income, real interest rates, and the terms of trade were statistically insignificant, although they had a positive effect on private savings. On the other hand, they determined that growth, financial depth, inflation, foreign trade deficit, increase in borrowing limits, young population and elderly population dependency ratios and urbanization also have reducing effects on private savings. On the contrary, they determined that financial liberalization, women's labor force participation rate and the increase in the number of people with university education have effects on increasing private savings. In their study, Matur et al. (2012) stated that increasing government savings can create an area to increase national savings, while per capita income level plays a very important role for savings, and indirect taxes have a negative effect on savings. In the study conducted by Düzgün (2009), it was concluded that the variables of government saving, money supply, GDP deflator and interest rate had a negative effect on private savings, while the foreign savings rate had a positive effect.

Er et al. (2014), who examined the short- and long-term relationship between savings, inflation, and growth in Turkey, found that there was a cointegration relationship between the variables and that both variables had positive effects on savings. In addition, the findings revealed that economic growth is the variable with the most explanatory power on savings in the Turkish economy among the variables and periods considered. Examining the relationship between savings and inflation, Okşak and Özen (2020) found that there is a statistically significant relationship between inflation and savings both in the short term and in the long term in the empirical results of their study. These results also reveal that an increase in inflation increases savings in the short term, while a 1-unit increase in inflation reduces savings by -0.0077 units in the long term. Another study examining the effects of inflation, interest rate and growth on domestic savings was conducted by Çağlayan (2006). In the findings, it was determined that a 1% increase in the interest rate increased domestic savings by 0.12%, a 1% increase in the growth rate increased domestic savings by 0.31%, and a 1% increase in the inflation rate decreased domestic savings by 0.27%. Barış and Uzay (2015), who examined the relationship between domestic savings and growth in their studies, state that the most important factor determining savings is economic growth. The findings show that an increase in economic growth leads to an increase in income, which in turn increases savings. In this context, it is stated that it is difficult to increase domestic savings without raising the income level above a certain level by increasing the economic growth in Turkey.

The determinants of savings other than income in Turkey were examined in the study conducted by Şengür and Taban (2016). The results of the study revealed that the ownership of the residence, second home ownership, annual disposable income of more than ten thousand liras and education level variables have a positive effect on savings. In addition, they revealed that the variables of house size, automobile ownership, temporary or seasonal employment, and living in rural areas negatively affect savings. In another similar study, the relationship between savings and housing loans in Turkey was analyzed by Tunç and Yavaş (2016). In their findings, they determined that housing and consumer loans have reducing effects on savings. When the two effects are compared, it can be said that the effect rate of housing loans is stronger. It has been determined that commercial loans have a positive effect on savings. In another study examining the effect of consumer and commercial loans on savings, Aksoy (2016) similarly found that the increase in total private sector loans is related to the decrease in private savings. However, according to the results of the analysis, it is seen that there is a negative relationship between commercial loans and savings. However, when the effects are compared, it can be said that the relationship between consumer loans and private savings is stronger, as in the study of Tunç and Yavaş (2016).

In the study conducted by Karayılmazlar and Özgün (2019), the relationship between savings and external debts was examined and it was determined that there was a negative relationship between the variables in the analyzes, and a 1% increase in savings decreased external debt by 1.4% in the long run. It can be said that policy makers should support the increase in savings in Turkey and thus

prevent possible problems in foreign debt service in the long run. The relationship between savings and external debt was examined by Öztürk Karaçor and Kartal (2016) by grouping countries according to the World Bank's country classification according to income level (low income, low-middle and upper-middle income countries). In the findings, it is seen that the increase in foreign debt in low-income countries affects savings negatively in the long run and the effect is -0.10. In the low-middle income group, this effect is positive and 0.22, while it is also positive and 0.21 in the upper-middle income group.

### 3. Empirical Analysis

In this study, in which the effects of macroeconomic variables on private savings have been examined, information about the data and the sources from which these data were obtained have been given in the first stage. Then, the estimation methods used to determine the short and long-term relationship between the variables and the findings obtained with these methods have been presented.

#### 3.1. Data and Variables

In the analysis performed in the study, annual data covering the period of 1996-2019 for the BRICS-T economies have been used. Panel data analysis methods have been used since the data have been studied with time and cross-sectional dimension. Countries within the scope of the study are Brazil, Russia, India, China, South Africa, and Turkey. The explanation of the variables and the source information from which they were obtained are presented in Table 1.

**Table 1.** Data and Variables

Variables	Abbreviation	Description	Source
<i>Saving Variable</i>			
Private Savings	S	(National Savings - Government Savings)/GDP (US Dollar)	World Bank
<i>Macroeconomic Variables</i>			
Growth Rate	GY	Annual Growth Rate of GDP %(US Dollar)	World Bank
Inflation Rate	INF	Annual Change on CPI %(US Dollar)	World Bank
Real Interest Rate	R	Inflation-adjusted Short-term Interest Rate %(US Dollar)	World Bank
Per Capita Income	Y	Income Per Capita (Fixed US Dollar)	World Bank

#### 3.2. Estimation Methods and Findings

While conducting the study, a panel cointegration technique has been used to test the short- and long-run relationships between private savings and macroeconomic variables. The analyzes outlined and the findings obtained from the analyzes carried out in four stages have been shared in the following sections.

##### 3.2.1. Cross Section Dependency and Homogeneity Tests

In panel data models, it is highly likely that the series will show inter-unit correlation, which is usually due to widespread shocks, in other words, they will show cross-sectional dependence. One of the important reasons for this possibility is that there has been a higher economic and financial integration between countries, especially in the last 50 years. Depending on this development, strong interdependencies occur between cross-sectional units. According to the studies conducted by Breitung and Pesaran (2008) and Bai and Kao (2006), the assumed independence assumption between cross-sections seems insufficient in both cointegration analysis and causality analysis. If the economic

ties between countries are relatively strong (for example, if there is strong cointegration between exchange rates), inter-unit correlation is highly likely to occur. According to Banerjee et al. (2004) and Yerdelen Tatoğlu (2020), analyzes based on implicit assumptions that such cointegration does not exist between countries in the panel may be faulty. Therefore, in panel analyzes for macroeconomic data, the commonly seen cross-section dependence needs to be taken into account and tested. Because, determining the cross-section dependency is also necessary for the determination of the following analyzes (Yerdelen Tatoğlu, 2020).

In the literature, the most widely used test for the detection of cross-sectional dependence is the CD Test developed by Pesaran (2004). The CD test attempts to detect cross-unit cross-section dependence by using residuals obtained by ADF regression estimates. For this purpose, N\*N-1 correlations with N unit size have been calculated for each unit (country) with other units (countries) other than itself. The hypotheses regarding the correlation coefficients have been set as;

$$H_0 : \rho_{ij} = 0$$

$$H_1 : \rho_{ij} \neq 0$$

and  $\rho_{ij}$  represents the correlation coefficient. In order to test the cross-sectional dependence of the balanced panel data sets, the statistic in the form of

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left( \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{\rho}_{ij} \right) \tag{1}$$

has been used (Yerdelen Tatoğlu, 2020).

On the other hand, the fact that the constant and slope parameters are homogeneous or heterogeneous according to the units is important in determining the cointegration methods to be preferred. Because most of the tests developed are based on the assumption that there is homogeneity between units. However, in the current situation where the integration between countries and markets is high, this assumption does not seem very realistic (Yapraklı and Kaplan, 2015). Therefore, homogeneity also needs to be tested. For this purpose, the homogeneity test has been performed with the Delta test developed by Pesaran and Yamagata (2008). Cross-section dependency and homogeneity test results have been given in Table 2.

**Table 2.** Results of Cross Section Dependency (Pesaran CD) and Homogeneity Tests

Cross Section Dependency Test				
Variable	CD Test	p-value	Average Coefficient of Correlation	Absolute Coefficient of Correlation
S	1.562	0.057	0.30	0.35
GY	6.725	0.000	0.35	0.40
INF	3.366	0.001	0.18	0.22
R	2.562	0.010	0.14	0.45
Y	17.143	0.000	0.90	0.90
Homogeneity Test				
$\hat{\Delta}$	6.184	0.000		
$\hat{\Delta}_{adj}$	7.094	0.000		
<b>Note:</b> Pesaran (2004) CD test has been performed in Stata 15 by using the "xtcd" command.				

In Table 2, Pesaran CD Test statistic, probability value, mean between units and absolute correlation coefficients have been given for the cross-sectional dependence of the variables. According to the results, the hypothesis of  $H_0 : \rho_{ij} = 0$  (no correlation between units) proposed for each variable has been rejected. Therefore, it has been concluded that there is inter-unit correlation, in other words, cross-section dependence in all variables. This result has also revealed that second generation panel unit root tests should be used.

### 3.2.2. Panel Unit Root Tests

The results obtained from the CD Test developed by Pesaran (2004) revealed that all of the variables had cross-section dependence. This result is important in terms of which of the panel unit root tests will be chosen. Because, in terms of whether or not the correlation between units is taken into account, unit root tests are divided into first generation and second generation unit root tests. First generation tests are built on the assumption that the cross-section units in the panel are equally affected by possible shocks. However, in current conditions where globalization and financial integration are high, the assumption that a shock to be experienced in any country will or will not affect other countries at the same level is not very realistic. Second generation unit root tests have been developed in order to eliminate this shortcoming, in other words, to consider the dependence between cross-sections and perform the stationarity analysis. The most used tests among the second generation unit root tests in the literature are; MADF developed by Taylor and Sarno (1998), SURADF developed by Breuer et al. (2002), the test developed by Moon and Perron (2004), the test developed by Bai and Ng (2004), and the CADF Test developed by Pesaran (2007) (Yerdelen Tatoğlu, 2020).

The CADF unit root test developed by Pesaran (2007), which takes into account the cross-section dependency, has been used in the study. In the CADF test, the error terms are assumed to consist of two parts. While the first one is common for all series, the other one is specific to each series. The equation for this situation is as follows:

$$Y_{it} = \beta_i Y_{i,t-1} + u_{it} \quad (2)$$

$$u_{it} = \lambda_i f_t + \varepsilon_{it} \quad (3)$$

The  $f_t$  in equation (3) above represents the unobserved common element and it is assumed to be always stationary.  $\varepsilon_{it}$  has an independent and identical distribution and represents the series-specific element. The hypotheses of the test are as follows:

$$H_0 : \beta_1 = 0 \text{ Unit root exists.}$$

$$H_1 : \beta_1 < 0 \text{ Unit root does not exist.}$$

In the test, first of all, the CADF statistics are calculated for each country. These calculated statistics are compared with the table values calculated with the help of Monte Carlo simulation. If the table value is less than the critical value, null hypothesis of “ $H_0 : \beta_1 = 0$  unit root exists” rejected, and alternative hypothesis of “ $H_1 : \beta_1 < 0$  unit root does not exist” is accepted. This means that there is no unit root in the country data analyzed and/or the shocks are temporary.

CIPS statistics are calculated by taking the average of the CADF statistics calculated for each country in the panel. The calculated CIPS statistics are tested for the unit root for the entire panel. The formula for the CIPS statistic is as follows:

$$CIPS = \frac{\sum_{i=1}^N CADF_i}{N} \quad (4)$$

The calculated CIPS statistic is compared with the table value in the study of Pesaran (2007) and it is decided whether the entire panel contains a unit root. If the table value is less than the critical value,  $H_0$  is rejected and  $H_1$  is accepted as the hypothesis that there is no unit root in the entire panel. As a result, it is concluded that there is no unit root for all countries and/or the shocks are temporary. The results for CADF and CIPS statistics are shown in Table 3.



**Table 3.** Results of CADF-CIPS Unit Root Test

COUNTRY	LEVEL									
	S		GY		INF		R		Y	
	CADF*	CADF**	CADF*	CADF**	CADF*	CADF**	CADF*	CADF**	CADF*	CADF**
BRASIL	-2.1	-1.023	-2.14	-2.057	-2.116	-3.217	-3.071	-2.944	0.028	-1.648
CHINA	-1.59	0.749	-2.311	-2.504	-3.515	-4.268	-2.805	-2.708	-2.232	-3.479
INDIA	-1.8	-1.456	-2.689	-2.448	-1.12	-1.72	-4.881	-4.68	-0.606	-2.476
RUSSIA	-2.69	-1.093	-2.238	-4.939	-3.953	-4.12	-4.361	-4.885	-2.309	-4.051
S. AFRICA	-3.5	-3.712	-1.874	-2.75	-2.152	-2.818	-3.532	-3.019	-3.556	-4.054
TURKEY	-2.09	-1.879	-4.796	-3.007	-2.527	-3.924	-1.622	-1.796	-1.099	-1.315
<b>CIPS</b>	<b>-2.295</b>	<b>-1.402</b>	<b>-2.675<sup>a</sup></b>	<b>-2.951<sup>a</sup></b>	<b>-2.564</b>	<b>-3.344<sup>a</sup></b>	<b>-3.379<sup>a</sup></b>	<b>-3.339<sup>a</sup></b>	<b>-1.629</b>	<b>-2.837<sup>a</sup></b>
COUNTRY	FIRST DIFFERENCE									
	ΔS		ΔGY		ΔINF		ΔR		ΔY	
	CADF*	CADF**	CADF*	CADF**	CADF*	CADF**	CADF*	CADF**	CADF*	CADF**
BRASIL	-4.184	-5.244	-1.048	-0.275	-4.483	-4.261	-3.774	-3.027	-2.737	-3.726
CHINA	-1.129	-1.829	-2.643	-2.648	-2.276	-2.002	-4.677	-4.555	-2.732	-2.593
INDIA	-2.042	-1.889	-2.814	-2.674	-1.838	-2.194	-3.927	-3.799	-2.566	-3.064
RUSSIA	-2.439	-4.524	-3.695	-3.191	-5.329	-5.173	-4.93	-4.676	-3.636	-5.231
S. AFRICA	-3.224	-3.027	-2.857	-2.656	-3.575	-3.506	-3.914	-4.146	-3.669	-3.622
TURKEY	-2.479	-2.413	-2.77	-1.871	-6.356	-9.223	-3.101	-3.724	-2.041	-2.178
<b>CIPS</b>	<b>-2.683<sup>a</sup></b>	<b>-3.154<sup>a</sup></b>	<b>-2.638<sup>a</sup></b>	<b>-2.619<sup>a</sup></b>	<b>-3.976<sup>a</sup></b>	<b>-4.393<sup>a</sup></b>	<b>-4.054<sup>a</sup></b>	<b>-3.988<sup>a</sup></b>	<b>-2.897<sup>a</sup></b>	<b>-3.402<sup>a</sup></b>

**Note:** Δ is the first difference operator. Critical values for CADF at Pesaran (2007) p. 276 Table Ic: \* without constant-trend: %1: -4.35; \*\* with constant-trend: %1: -4.95. Critical values for CIPS at Pesaran (2007) p. 281 Table IIc: \* without constant-trend: %1: -2.60; \*\* with constant-trend: %1: -3.15. Index a also indicates %1 significance level.

According to the results presented in Table 3, it was determined that the GY and INF variables were stationary at the equal level  $I(0)$ , and the S, R and Y variables were stationary with the  $I(1)$  value at the first variation.

### 3.2.3. Panel Cointegration Analysis

Among the variables that make up the panel, the cointegration method is the most widely used method, especially in testing the long-term relationship (Pedroni, 1999; Westerlund, 2008). At this stage of the analysis, the long-term relationship between private savings and the series representing macroeconomic variables was analyzed by cointegration. Westerlund (2008) Durbin-H method has been used when testing cointegration in panel data, since correlation between units (horizontal section dependence) has been determined both in the series and in the cointegration equation. This method allows the dependent variable to be  $I(1)$  and the independent variables to be  $I(1)$  and/or  $I(0)$  (Westerlund, 2008). Durbin-H Test hypotheses are as follows:

$H_0$  : There is no cointegration relationship.

$H_1$  : There is a cointegration relationship.

The acceptance or rejection of the hypotheses can be decided by looking at the probability value of the Durbin-H test statistic. In this sense, if the probability value is below 0.05 (5% significance level), in other words, if it is significant,  $H_0$  is rejected and the  $H_1$  hypothesis showing that there is a cointegration relationship is accepted. In addition, the presence of panel cointegration in the Durbin-H method is tested separately in panel and group dimensions. Which of the group or panel dimensions will be taken as the basis depends on whether the constant and slope parameters are homogeneous or heterogeneous according to the units. When there is homogeneity, the panel size is taken as the basis, and when there is heterogeneity, the group size is taken as a basis (Yerdelen Tatoğlu, 2020).

According to the results of the homogeneity test performed in the study, since it has been determined that the constant and slope parameters of the series were heterogeneous with respect to each other, the presence of panel cointegration has been tested with the Durbin-H method based on the group size. The results of Westerlund (2008) Durbin-H cointegration test are given in Table 4.

**Table 4.** Results of Westerlund (2008) Durbin-H Cointegration Test

	Statistic	Probability
Group Statistic of Durbin-H	4.062***	0.000
Panel Statistic of Durbin-H	-1.219	0.889

In line with the test results given above, since the probability value of Durbin-H Group Statistics, which takes into account heterogeneity, is significant at the 5% level, the hypothesis of "H<sub>0</sub>: There is no cointegration relationship" has been rejected and it has been determined that there is a long-term cointegration relationship between private savings and macroeconomic variables.

### 3.2.4. Estimation of Cointegration Coefficients

In the estimation of the long-term cointegration coefficients, the co-correlated effects – CCE estimator proposed by Pesaran (2006) has been used for inter-unit correlation and heterogeneity. CCE estimation results have been given in Table 5.

**Table 5.** Results of CCE Long-Run Coefficient Estimation

	GY	INF	R	Y
BRASIL	0.025 [0.000]	0.004 [0.000]	-0.012 [0.000]	0.278 [0.000]
CHINE	-1.029 [0.698]	0.088 [0.231]	0.281 [0.582]	2.148 [0.672]
INDIA	-0.032 [0.000]	-0.002 [0.000]	0.023 [0.000]	0.425 [0.000]
RUSSIA	0.308 [0.462]	-0.053 [0.582]	-0.236 [0.829]	5.051 [0.797]
SOUTH AFRICA	-0.151 [0.000]	0.018 [0.000]	-0.038 [0.000]	-2.843 [0.512]
TURKEY	-0.126 [0.112]	0.012 [0.035]	-0.430 [0.067]	-2.355 [0.397]

Note: Numbers in brackets are *p*-values.

When the CCE estimation results presented in Table 5 are evaluated separately for the countries that are the subject of the analysis, it is possible to make the following evaluations. Based on the coefficients estimated in Brazil, it has been seen that the growth rate, inflation rate and per capita income level have a positive effect on the determination of private savings, while the real interest rate has a negative effect, and all estimated coefficients are statistically significant. It can be seen that the growth rate has a negative effect on private savings in China, while other macroeconomic indicators have a positive effect. However, all of the estimated coefficients have been found to be statistically insignificant. The effect of growth and inflation rates on private savings in India has been detected negative, while the effect of real interest rate and per capita income has been detected positive, and all coefficients have been found to be statistically significant. While the effect of growth rate and per capita income level on private savings in Russia has been determined as positive, the effect of inflation and real interest rates has been determined as negative. However, all estimated coefficients have been found to be statistically insignificant. In the case of South Africa, the effect of the inflation rate on private savings is positive, while the effect of other macroeconomic indicators is negative. Except for the coefficient of per capita income level, other coefficients have been found to be statistically significant. The effects of macroeconomic variables on private savings in Turkey have been determined as follows. The effect of growth rate is negative and statistically insignificant, the effect of inflation rate is positive and statistically significant, the effect of real interest rate is negative and statistically significant, the effect of per capita income level is negative and statistically insignificant.

#### 4. Overall Assessment and Conclusion

Considering the fact that savings are very important for developing countries and that they should be increased, in this study, the effects of macroeconomic variables consisting of economic growth rate, inflation rate, real interest rate and per capita income on private savings for BRICS-T countries, have been examined with the annual data of 1996-2019 period. For this purpose, firstly, the cross-sectional dependency and homogeneity situations between the mentioned countries have been evaluated. The CD Test, which is the most widely used in the literature and developed by Pesaran (2004), has been used to determine the cross-sectional dependence. With the empirical results obtained, the existence of cross-sectional dependence between countries has been confirmed. This confirms that a shock in one of the selected countries can easily spread to other countries. The homogeneity test has been performed with the Delta test developed by Pesaran and Yamagata (2008). According to the homogeneity test results, it has been determined that the constant and slope parameters of the series were heterogeneous with respect to each other. Depending on the determination of cross-sectional dependence between units, the second generation panel unit root test, the CADF Test, has been used for stability. Westerlund (2008) Durbin-H method has been used to determine the long-term cointegration relationship. Thus, it has been determined that there is a long-term cointegration relationship between private savings and macroeconomic variables. In the estimation of long-term cointegration coefficients, the common correlated effects – CCE estimator proposed by Pesaran (2006) has been used in case of inter-unit correlation and heterogeneity.

When the statistically significant coefficient estimation results have been evaluated, it can be concluded that the effect of growth rate, one of the macroeconomic variables, on private savings is positive in Brazil, while it has a negative effect in India and South Africa. This positive effect of growth rate on private saving in Brazil confirms the “Lifetime Income Hypothesis” proposed by F. Modigliani and R. Brumberg (1954). Because, according to the hypothesis, savings increase during the growth periods of the economies. The negative effect of growth on private savings found for India and South Africa also confirms Milton Friedman's (1957) "Permanent Income Hypothesis". Accordingly, the vitality observed in the growth periods of the economies increases the consumption propensity and decreases the saving propensity.

It has been determined that the effect of inflation rate, which is one of the macroeconomic variables, on private savings is negative in India and positive in Brazil, South Africa, and Turkey. Inflation affects the consumption and savings tendencies of individuals through their income and wealth. Moreover, this is the basis of the differences detected between inflation and savings among countries. It is important whether the income level of individuals increases in parallel with the inflation rate during periods of increased inflation. If the level of income increases in parallel with the inflation rate or at a lower rate, the purchasing power of the people will decrease. As a result, this situation causes individuals not to postpone the expenditures they plan to make in the future, but to make them today, thus increasing consumption and decreasing savings.

It has been concluded that the real interest rate, which is another macroeconomic variable, has a negative effect on private savings in other countries except India. This relationship between the real interest rate and private savings is remarkable. There is a general belief that an increase in real interest rates will increase savings. However, the determinant of this situation is the substitution and income effects of the interest rate. The substitution effect can be expressed as the increase (or decrease) in the real interest rate, which causes savings to increase (or decrease) by increasing (or decreasing) the present cost of consumption. In this case, where the real interest rate increases, people (both borrowers and lenders) tend to save more by acting with less borrowing motive. Differences between borrowers and lenders are important in determining the income effect. If households are on the net lender side, an increase in the real interest rate increases lifetime income, leading to higher consumption and lower savings. This is the income effect of the interest rate. As a result, if saving decreases when the real interest rate increases, the income effect of interest is greater than the substitution effect. Conversely, if savings increase, it means that the substitution effect of interest is

greater than the income effect. In this case, the positive effect of the increase in the real interest rate on savings in the Indian economy indicates that the substitution effect is dominant, while the negative effect in the economies of Brazil, South Africa and Turkey indicates that the income effect is stronger.

It has been concluded that per capita income, which is the last macroeconomic variable included in the analysis, positively affects private savings in the Brazilian and Indian economies. This result reveals that the opposite result has been reached with the “Permanent Income Hypothesis” proposed by Friedman (1957).

When the results are evaluated as a whole, it is possible to determine that, macroeconomic variables have significant effects on savings, although there are differences in the findings obtained from country to country within the BRICS-T. It is seen that especially real interest and inflation variables can be effective in case the policy makers of the countries that are the subject of the analysis make macroeconomic targeting on savings. Real interest and inflation variables stand out as important alternatives in policy sets. On the other hand, only macroeconomic variables are not effective on savings. This situation lays the groundwork for future studies on the non-economic determinants of savings. For example, research can be conducted on the determination of the institutional structures and quality of countries on savings.

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