Public Expenditure on Human Capital Investment and GDP Nexus: Empirical Evidence Based on NARDL Approach

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ABSTRACT

Understanding public expenditures on human capital investment and GDP linkages is critical for countries' future. Within the scope of the reviewed literature, no study analyzes the asymmetric effects of public expenditures on human capital investments on Türkiye's GDP. Since there is no linear relationship according to the A-ARDL model using quarterly data for the period 2004-2019, the following results were documented in the analysis based on the NARDL model: (i.) Human capital investments are asymmetrically cointegrated with GDP but not linear. (ii.) A nonlinear linkage exists among GDP and social protection and health expenditure. Raises in health expenditures increase GDP more than decreases. However, there is a linear linkage between GDP and education expenditures. These findings are empirical evidence that education and health expenditures create positive externalities. (iii.) While both Keynes' hypothesis and Wagner's law are valid for health expenditures and social protection expenditures, only Wagner's law is valid for education expenditures. As a result, Türkiye, an emerging country that is not rich in natural resources, should give more importance to the efficiency of resources without ignoring the social state functions to increase its level of development.

Key Words: *Public expenditure, Human capital investment, NARDL, Keynes' hypothesis, Wagner's law*

JEL Classification: *C32, H50, O15*

Beşerî Sermaye Yatırımına Yönelik Kamu Harcamaları ve GSYİH İlişkisi: NARDL Yaklaşımına Dayalı Ampirik Kanıtlar

ÖZ

Beşerî sermaye yatırımlarına yönelik kamu harcamalarını ve GSYİH arasındaki ilişkileri anlamak ülkelerin geleceği açısından kritik öneme sahiptir. İncelenen literatür kapsamında, beşerî sermaye yatırımlarına yönelik kamu harcamalarının Türkiye'nin GSYİH'si üzerindeki asimetrik etkilerini analiz eden herhangi bir çalışma bulunmamaktadır. 2004-2019 dönemi için üç aylık veriler kullanılarak A-ARDL modeline göre doğrusal bir ilişki olmadığından NARDL modeline dayalı analizde aşağıdaki sonuçlar belgelenmiştir: (i.) Beşerî sermaye yatırımları GSYİH ile asimetrik olarak eş bütünleşiktir ancak doğrusal değildir. (ii.) GSYİH ile sosyal koruma harcamaları ve sağlık harcamaları arasında doğrusal olmayan bir ilişki vardır. Sağlık harcamalarındaki artışların GSYİH üzerindeki artırıcı etkisi azaltıcı etkisinden daha büyüktür. Ancak, GSYİH ile eğitim harcamaları arasında doğrusal bir ilişki vardır. Bu bulgular, eğitim ve sağlık harcamalarının pozitif dışsallık oluşturduğuna dair ampirik kanıtlardır. (iii.) Hem Wagner kanunu hem de Keynesyen hipotez sağlık harcamaları ve sosyal koruma harcamaları için geçerli olsa da eğitim harcamaları için yalnızca Wagner kanunu geçerlidir. Sonuç olarak doğal kaynaklar açısından zengin olmayan, gelişmekte olan

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bir ülke olan Türkiye'nin, gelişmişlik düzeyini artırmak için sosyal devlet fonksiyonlarını göz ardı etmeden kaynakların verimliliğine daha fazla önem vermesi gerekmektedir.

Anahtar Kelimeler: *Kamu harcaması, Beşerî sermaye yatırımı, NARDL, Keynesyen hipotez, Wagner kanunu*

JEL Sınıflandırması: *C32, H50, O15*

INTRODUCTION

Public expenditures (PEs) of countries are constantly increasing for various reasons. There are many approaches in the literature explaining the increase in PEs. Wagner's law (WL) is the first approach to explain this increase. According to Wagner (1883), as economies grow, PE grows more than the economy. In other words, in WL, the direction of the linkage is from economic growth (EG) to PEs. The first reason for the increase in PEs, an endogenous factor in WL, is the increase in population density in cities with economic development. As the population density in the city center increases, the demand for public services such as education, health, and housing will increase. The second reason is the need for more infrastructure with the acceleration of industrialization and urbanization. The public sector increases infrastructure investment expenditures to strengthen infrastructure in urban centers and industrial zones. Another reason for the increase in PEs is the inability of the private sector to offer goods and services that have the characteristics of a natural monopoly. When the public sector operates natural monopolies, an increase in PE is inevitable (Bird, 1971; Magazzino, 2012; Kónya and Abdullaev, 2018).

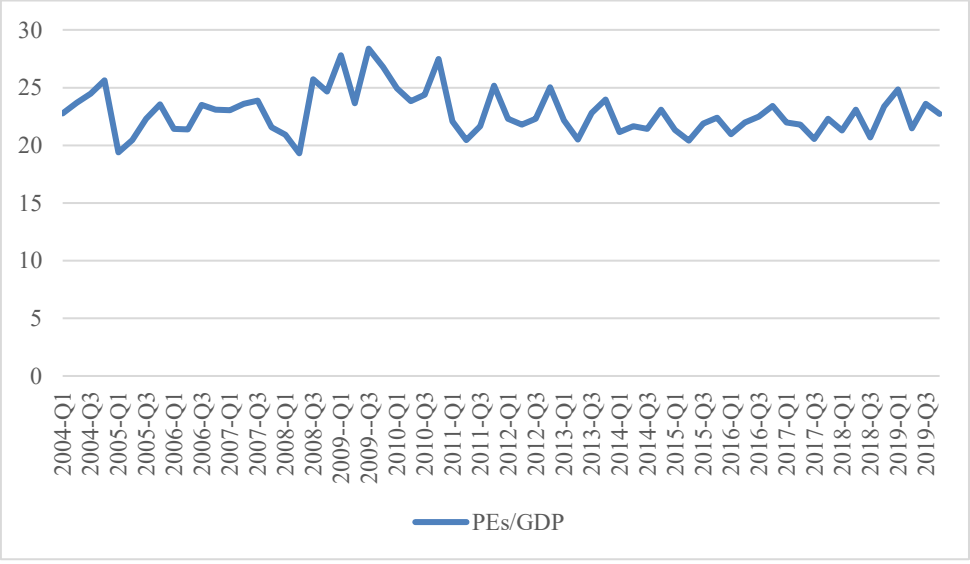
The second approach to the ever-increasing PEs is Keynes' hypothesis (KH). Unlike Wagner (1883), Keynes (1936) considers PEs as an exogenous factor. The increase in PEs, especially during recession periods, will revive aggregate demand with multiplier and accelerating mechanisms. Recovery in aggregate demand contributes to EG. According to Keynes, there is a linkage between PEs and EG (Henrekson, 1993). KH, which emerged in the Great Depression of 1929, predicts that PEs will contribute to EG in the short run. Later, studies such as Lucas (1988), Romer (1989), Barro (1990), Irmen and Kuehnel (2009) provide evidence for the validity of KH in the long run.

Most studies (Mann, 1980; Henrekson, 1993; Islam, 2001; Lamartina and Zaghini, 2010; Babatunde, 2011; Irandaust, 2019) that test the linkage between PEs and EG use total PE. However, efficient use of public resources is critical in countries like Türkiye, where natural resources are mostly scarce. For this, determining which types of expenditures cause an increase in PEs and which contribute to EG will guide policymakers. With this motivation, we used disaggregated data within the scope of the COFOG, as Balkı and Göksu (2023) suggested.

In underdeveloped or developing countries, the public sector should consider economic development and growth when making an expenditure. Some expenditures, such as education, health, and social protection, contribute to EG and increase the stock of human capital. Types of PEs that increase human capital stock and help justice in income distribution also contribute to economic development in

the long run (Sapuan and Sanusi, 2013; Shafuda and De, 2020). In this context, we use three types of expenditure (education, health, and social protection) from the disaggregated data within the scope of COFOG, which can be considered human capital investments (HCI). In the literature, some studies test the relation between education expenditures (EDU) or health expenditures (HEA) and EG using disaggregated data on PEs (Husnain, 2011; Oni, 2014; Tabar et al., 2017; Rathanasiri, 2020). Dritsakis and Adamopoulos (2004), Afonso and Alves (2017), and Arestis et al. (2021) examined the linkage between all types of expenditures under COFOG and EG. The biggest problem of these studies is that they test the linkage between each type of expenditure and EG separately. However, PEs are made simultaneously and together in a year. In other words, simultaneously testing PEs for a specific purpose (such as HCI) within the scope of a model will produce more robust results. Therefore, we used Peacock and Wiseman's (1961) model, which we modified by the inspiration of Romer (1989) and Barro (1990). In this context, we test the linkage between PEs on HCI and EG in the sample of Türkiye.

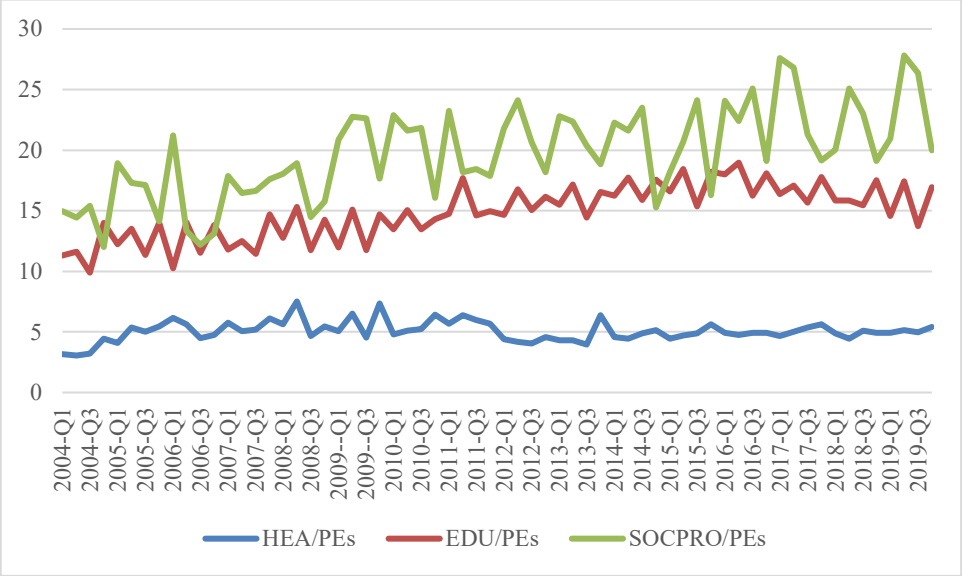
Figure 1. Share of total PEs in GDP (%)



Türkiye started to classify PEs in 2004 according to the COFOG used by the United Nations (2000) and the OECD (2021). Therefore, we examine the linkage between HCI and EG for 2004:Q1-2019:Q4. In this period, the share of PEs in GDP was the lowest in 2008:Q2 (19.30%), while the highest was in 2009:Q3 (28.37%). The first reason this rate rises from 19.30% to 28.37% is the government's increase in PEs to get rid of the recession. The second reason is the decrease in GDP because of the crisis (See Figure 1). From 2004 to 2019, social protection expenditures (SOCPRO) have the highest share in PEs among HCI (average 19.73%). SOCPRO is followed by EDU (average 14.87%) and HEA (average 5.06%), respectively. In this period, with SOCPRO, EDU tended to increase, while HEA remained flat. The share of SOCPRO in PEs was the lowest (12.01%) in 2004:Q4 and the highest (27.82%) in 2019:Q2. The share of EDU in

PEs was the lowest (9.89%) in 2004:Q3 and the highest (18.97%) in 2016:Q2. The share of HEA was lowest (3.06%) in 2004:Q2 and highest (7.52%) in 2008:Q2 (See Figure 2).

Figure 2. Share of HCI in total PEs (%)



Many studies (Chang, 2002; Aregbeyen, 2006; Babatunde, 2011; Srinivasan, 2013) examining the linkage between PEs and EG first perform a cointegration test. Then, they determine the direction of the linkage with the causality test. Cointegration and causality tests can be done linearly and nonlinearly depending on the characteristics of the data set. The critical point is that if the cointegration is linear (nonlinear), the causality test should also be linear (nonlinear). Until now, very few studies have analyzed the linkage between total PE and GDP with nonlinear cointegration (Christie, 2014; Leshoro, 2017; Akinlo and Jemiluyi, 2018; Raifu and Aminu, 2020; Dahmani et al., 2021). Among them, Akinlo and Jemiluyi (2018) tested the linkage between PEs and GDP with nonlinear ARDL (NARDL) and linear Granger causality. However, since this study did not establish nonlinear causality in the continuation of NARDL, we cannot say that the causality test results are consistent.

In accordance to the literature reviewed, we could not find any study that analyzed the disaggregated data within the scope of COFOG with nonlinear methods. Arestis et al. (2021) performed a Johansen cointegration and then a linear and nonlinear Granger causality test using the disaggregated data. However, since the Johansen cointegration is linear, we do not think that the results of the nonlinear causality test performed afterward are robust. To fill this gap in the literature, we analyze the linkage between HCI and GDP from the disaggregated data within the scope of COFOG with linear Augmented ARDL (A-ARDL) and NARDL. Afterward, we perform the T-Y (Toda-Yamamoto) Granger causality test, which

allows for both linear and nonlinear causality to determine the direction of the linkage. The reasons for testing the linkage between HCI and GDP with nonlinear methods are as follows: (i.) The government budget is affected by the preferences of the political party or party groups that make up the government. (ii.) Structural breaks we detected in the period under review. (iii.) The absence of a significant linkage due to the linear A-ARDL test. (iv.) Degenerate problems in ARDL testing. (v.) BDS (Brock-Dechert-Scheinkman) test results of the series are nonlinear. Other parts of the study are as follows: Section 1 examines the relevant empirical literature. Section 2 gives information about the dataset, model, and method. Section 3 reports the empirical findings and compares them with other studies. Section 4 evaluates the results for the Turkish sample and specifies the study's limitations. It also gives advices for politicians and future studies.

I. EMPIRICAL LITERATURE REVIEW

Many studies have examined the famous linkage between PE and GDP, beginning with Wagner (1883) and taking on a different dimension with Keynes (1936). Some studies (Abizadeh and Yousefi, 1988; Oxley, 1994; Islam, 2001; Halicioglu, 2003; Sideris, 2007; Mohammadi et al., 2008; Kumar et al., 2012; Akinlo and Jemiluyi, 2018; Dahmani et al., 2021) have found results supporting WL, some studies (Babatunde, 2011; Yilgor et al., 2012; Al-Fawwaz, 2016; Govdeli, 2019; Rasaily and Paudel, 2019) supporting the KH, and some (Iyare and Lorde, 2004; Abu-Eideh, 2015; Gurdal et al., 2021; Bazán et al., 2022) supporting both. Singh and Sahni (1984), Burney (2002), Kónya and Abdullaev (2018) did not detect any linkages.

Some studies test the linkage between PEs and GDP in terms of expenditure types within the scope of COFOG. Among these studies, which produced mixed results, we summarized the studies specific to HCI in Table 1 regarding the country they examined, the period, the method they used, and the results they obtained. Some of these studies (Iqbal and Zahid, 1998; Bose et al., 2007; Nurudeen and Usman, 2010; Colombier, 2011; Musaba et al., 2013; Oni, 2014; Lupu et al., 2018; Shafuda and De, 2020) only test KH, while others (Dritsakis and Adamopoulos, 2004; Husnain, 2011; Fedeli, 2015; Tabar et al., 2017; Sedrakyan and Varela-Candamio, 2019; Jaén-Garcia, 2020; Arestis et al., 2021) test both KH and WL. Afonso and Alves (2017) only test WL.

Table 1. Some studies testing the linkage between HCI and GDP

Study	Country	Period	Method	Education Expenditure	Health Expenditure	Social Protection Expenditure
Iqbal and Zahid (1998)	Pakistan	1960-1997	Time series (OLS regression)	KH(✓)	Ø	Ø
Dritsakis and Adamopoulos (2004)	Greece	1960-2001	Time series (OLS regression, causality)	KH(✓), WL(✓)	KH(✓), WL(✓)	KH(X), WL(✓)
Bose et al. (2007)	30 Developing Countries	1970-1990	Time series (Seemingly Unrelated Regression)	KH(✓)	KH(X)	Ø

Nurudeen and Usman (2010)	Nigeria	1970-2008	Time series (cointegration)	KH(X)	KH(✓)	Ø
Colombier (2011)	Sweden	1960-2005	Time series (ARDL bound test)	KH(✓)	KH(✓)	KH(✓)
Husnain (2011)	Pakistan, India, Sri Lanka	1975-2009	Time series (cointegration, causality)	KH(X), WL(X)	KH(X), WL(X)	Ø
Musaba et al. (2013)	Malawi	1980-2007	Time series (cointegration)	KH(X)	KH(X)	KH(X)
Sapuan and Sanusi (2013)	Malaysia	1975-2011	Time series (ARDL bound test)	KH(X)	KH(✓)	Ø
Oni (2014)	Nigeria	1970-2010	Time series (OLS regression)	Ø	KH(✓)	Ø
Fedeli (2015)	Italy	1982-2009	Time series (cointegration, causality)	Ø	KH(X), WL(✓)	Ø
Afonso and Alves (2017)	14 European Countries	1996-2013	Time series (Seemingly Unrelated Regression)	WL(X)	WL(X)	WL(X)
Tabar et al. (2017)	Iran	1981-2012	Time series (ARDL bound test)	KH(X), WL(✓)	Ø	Ø
Lupu et al. (2018)	Central and Eastern European Countries	1995-2015	Time series (ARDL bound test, causality)	KH(✓)	KH(✓)	KH(X)
Sedrakyan and Varela-Candamio (2019)	Armenia and Spain	1996-2014	Time series (IRF and FEVD Regressions, causality)	KH(X), WL(✓)	KH(✓), WL(✓)	KH(X), WL(✓)
Jaén-Garcia (2020)	Greece	1958-2015	Time series (cointegration, causality)	Ø	Ø	KH(X),WL(✓)
Shafuda and De (2020)	Namibia	1980-2015	Time series (cointegration)	KH(✓)	KH(✓)	Ø
Arestis et al. (2021)	Türkiye	2006-2019	Time series (cointegration, causality)	KH(✓), WL(✓)	KH(✓), WL(✓)	KH(✓), WL(X)

Notes: KH(✓): Keynes' hypothesis supports; KH(X): Keynes' hypothesis doesn't support; WL(✓): Wagner's law supports; WL(X): Wagner's law doesn't support; Ø: not analyzed.

So far, very few studies (Dritsakis and Adamopoulos, 2004; Colombier, 2011; Musaba et al., 2013; Afonso and Alves, 2017; Lupu et al., 2018; Sedrakyan and Varela-Candamio, 2019; Arestis et al., 2021) have tested the linkage between EDU, HEA, and SOCPRO with GDP in a single study. All these studies used linear methods in the analyses. Only Arestis et al. (2021) applied nonlinear causality. However, since the cointegration analysis is linear, the results of the nonlinear causality test performed afterward are not robust. Dritsakis and Adamopoulos (2004), Afonso and Alves (2017), Sedrakyan and Varela-Candamio (2019), and Arestis et al. (2021) tested the linkage between each type of expenditure under COFOG with GDP in separate models. However, PEs are made simultaneously and

together for a certain period. Therefore, the results from these studies may be suspicious.

Some studies analyze the linkage between PE types and GDP in a single model using disaggregated data within the scope of COFOG. Of these studies, Colombier (2011) used transport expenditures, general public service expenditures, and justice expenditures in addition to HCI in his analysis of the Swedish economy. Musaba et al. (2013) used seven types of expenditure (education, health, defense, transportation, etc.) to test the famous linkage in the Malawi economy. Also, Colombier (2011) and Musaba et al. (2013) did not complete their cointegration analysis with a causality test and determine the direction of the relations. On the other hand, Lupu et al. (2018) used all expenditure types within the scope of COFOG in the same model in their analysis for Central and Eastern European Countries. However, none of these studies tested only the linkage between HCI and GDP. At the same time, these studies ignored possible asymmetric effects. We only test the linkage between HCI and GDP. While testing this linkage, we use the NARDL method, which, unlike previous studies, can reveal asymmetric effects in addition to A-ARDL. We apply the T-Y Granger causality test to determine the direction of possible linkages.

II. METHODOLOGY

A. Data

This study examines linkages among GDP and EDU, HEA, and SOCPRO variables (human capital investments) in Türkiye. The variables within the scope of the study consist of 64 quarterly data for 2004-2019 period. Since the data is quarterly, we adjusted for seasonality using the "seasonal trend decomposition" method. We also transformed the data into logarithmic form to approximate the extreme values of the variables to the mean. Logarithmic series gives more efficient results when comparing past values with new ones. It also allows for the analysis results to be interpreted as percentages, thus making the results easier to understand. Data sources, abbreviations, expected sign values, and descriptive statistics are given in Tables 2 and 3.

Table 2. Dataset and description

	Explanation	Expected Sign
lnGDP	Gross Domestic Product, adjusted for seasonal effects and converted to natural logarithms.	Dependent Variable
lnSOCPRO	Social Protection Expenditures, adjusted for seasonal effects and converted to natural logarithms.	+
lnHEA	Health Expenditures, adjusted for seasonal effects and converted to natural logarithms.	+
lnEDU	Education Expenditures, adjusted for seasonal effects and converted to natural logarithms.	+

Source: https://www.tuik.gov.tr/, https://en.hmb.gov.tr/

According to the descriptive statistics presented in Table 3, the closeness of the mean and median values of the variables gives rise to an expectation that these variables could have a normal distribution. The variables must have a skewness value of zero (0) and a kurtosis value of three (3) to be appropriately normally distributed. Above, concerning the skewness values in Table 4, all variables, except for the GDP variable, exhibit left-skewness. Nevertheless, since

all variables have skewness values close to zero, it can be asserted that the variables are "approximately symmetric." All variables are flatter than the normal distribution because their kurtosis values are below three. In addition, whether the variables exhibit a normal distribution can also be determined by looking at the probability values of the Jarque-Bera test. Since all variables' Jarque-Bera test probabilities are greater than 0.1, the variables have a normal distribution.

Table 3. Describe statistics

	lnGDP	lnSOCPRO	lnHEA	lnEDU
Mean	26.66644	23.54336	22.19085	23.26895
Median	26.64968	23.53490	22.17537	23.30107
Maximum	27.77425	24.84319	23.42455	24.46670
Minimum	25.62552	22.24126	20.70815	22.01629
Std. Dev.	0.605161	0.733138	0.628509	0.707365
Skew.	0.141402	-0.032904	-0.193458	-0.080960
Kurt.	1.887122	2.043595	2.672690	1.854356
Jarque-Bera	3.515938	2.450779	0.684896	3.569916
Probability	0.172395	0.293643	0.710030	0.167804
Sum	1706.652	1506.775	1420.214	1489.213
Sum Sq. Dev.	23.07188	33.86191	24.88652	31.52302
Observations	64	64	64	64

B. Model

In this study, we examine the linkage between HCI and GDP by using the disaggregated data of PEs within the scope of COFOG for the Türkiye sample. For this purpose, we use Peacock and Wiseman's (1961) model, which we modified with inspiration from Romer (1989) and Barro (1990). In this context, the model we estimate is as in Equation 1.

$$\ln GDP = \beta_0 + \beta_1 \ln SOCPRO + \beta_2 \ln HEA + \beta_3 \ln EDU + \varepsilon_i \quad (1)$$

In Equation 1, the dependent variable is the GDP. We preferred to use SOCPRO, HEA, and EDU sub-items within the scope of COFOG instead of total PE as the independent variable.

C. Empirical Framework

Firstly, we applied the ARDL bounds test developed by Pesaran et al. (2001) to investigate the long run cointegration relationship between HCI and GDP variables. Since this approach is more flexible in terms of its stationarity properties (Shahbaz et al., 2013), we can say that it has become more popular among researchers in recent years compared to cointegration tests such as Engle and Granger (1987) in empirical analyses.

The ARDL procedure has become popular among researchers because it provides consistent results even for a limited number of observations and is helpful for models containing variables with different stationarity levels (Narayan and Smyth, 2005). However, Peseran et al. (2001) make some assumptions so that this test does not yield misleading results. These assumptions are that the dependent variable is I(1), the independent variables are exogeneity, and there are no degenerate cases. McNown et al. (2018) and Sam et al. (2019) also highlight similar weaknesses. The case "degenerate lagged dependent variable," which McNown et al. (2018) emphasized as degenerate case #2, refers to the situation where the lagged level of the dependent variable is insignificant, and the lagged values of the

independent variables are significant. We rule out this problem the t_{DV} test is applied. The "degenerate lagged independent variable" problem, highlighted by McNown et al. (2018) as degenerate case #1, refers to the situation where the independent variable(s)'s lagged values are insignificant. However, the dependent variable's lagged value is significant. Case #1 to rule out, the dependent variable must be I(1). In cases where the unit root test results of the dependent variable give conflicting results or the dependent variable is I(0), an approach called the bootstrap ARDL procedure by McNown et al. (2018) and later called the augment ARDL procedure by Sam et al. (2019) emerged. These researchers proposed a third test that gives more apparent results in deciding cointegration: F_{IDV}.

As a result of the analysis, if we cannot detect a linear cointegration linkage between the variables, we use the NARDL method to detect possible asymmetrical linkages. Unlike linear analyses, NARDL, an asymmetric analysis method, considers that the impact of negative and positive shocks to independent variables on the dependent variable is not the same. In this respect, unlike ARDL, the NARDL method reveals hidden cointegration between variables. Other reasons for testing the relationship between HCI and GDP using the NARDL method are: The government budget is affected by the preferences of the political party or party groups that make up the government. We detected structural breaks during the period under review—degenerate problems in ARDL testing. The series of BDS test results is nonlinear.

As a conventional application of time series analysis and to the robustness of the analysis, we perform the T-Y Granger causality test developed by Toda and Yamamoto (1995) to explore the causality direction between GDP and increases and decreases in SOCPRO, HEA, and EDU. This method allows for analyzing linkages between series without requiring stationarity and cointegration assumptions. Also, this method allows for both linear and nonlinear causality. The first step of this method involves determining an appropriate lag length (k). In the second step, we add the lag length with the highest combined degree of integration (d_{max}) to k. In the third step, we estimated a VAR model for the lag length of $k+d_{max}$.

III. RESULTS AND DISCUSSION

In the analysis part, we started with the determination of the integration level of the variables. This situation is essential for A-ARDL and NARDL analysis because none of the variables in the model should be I (2) (Akçay, 2019). To detect this situation, we applied ADF (Dickey and Fuller, 1979) unit root test, and the results are in Table 4 below.

Table 4. Conventional unit root tests

At Level		lnGDP	lnSOCPRO	lnHEA	lnEDU
C	t-Stat.	0.4770	-0.2198	-0.6517	-2.4024
	Prob.	0.9846	0.9296	0.8504	0.1460
C&T	t-Stat.	-1.5589	-5.8814***	-4.9354***	-1.8171
	Prob.	0.7980	0.0000	0.0008	0.6827
No C&T	t-Stat.	11.1395	4.5386	4.1193	2.7532
	Prob.	1.0000	1.0000	1.0000	0.9983
At First Difference		Δ(lnGDP)	Δ(lnSOCPRO)	Δ(lnHEA)	Δ(lnEDU)
C	t-Stat.	-9.0788***	-7.9894***	-8.5148***	-3.2584**
	Prob.	0.0000	0.0000	0.0000	0.0219

C&T	t-Stat.	-9.0908***	-7.9181***	-8.3985***	-4.2289***
	Prob.	0.0000	0.0000	0.0000	0.0079
No C&T	t-Stat.	-1.8656*	-10.7659***	-8.0097***	-0.4276
	Prob.	0.0596	0.0000	0.0000	0.5242

Notes: (*) 10%, (**) 5%; (***) 1%.

The ADF unit root test outcomes are displayed in Table 4, demonstrating that all the variables are I (1). To check the findings, we obtained from these conventional unit root tests, we applied the LS unit root test (Lee and Strazicich, 2003), which considers structural breaks, and the results are in Table 5 below. With this test, we aim to consider the structural breaks that Türkiye has experienced during the analysis periods discussed in the study.

Table 5. LS Unit Root Test Results

Variables	Level			First difference			Decision
	Lag	Break Years	t-stat.	Lag	Break Years	t-stat.	
lnGDP	2	2006:Q1&2016:Q3	-2.57	3	2005:Q3&2017:Q2	-5.20***	I (1)
lnSOCPRO	1	2011:Q1&2017:Q4	-4.82***				I (0)
lnHEA	1	2006:Q4&2013:Q1	-2.42	1	2012:Q3&2013:Q2	-9.52***	I (1)
lnEDU	4	2005:Q3&2007:Q1	-5.02***				I (0)

Findings from all tests (both with and without a structural break) indicate that any variable is clearly not I (2). Especially since the variables are stationary at different degrees according to the LS unit root test results and no variable is stationary I (2) at the second difference according to ADF, and LS, whether the variables move together can be investigated by the A-ARDL cointegration method.

The calculated $F_{OVERALL}$ statistics value is (1.29). At the 1% significance level for the observation values, the upper limit is less than (6.19). In addition, the t_{DV} statistical value is (-1.63), lower than the upper limit value of (-3.46) at the 1% significance level as an absolute value. According to both the $F_{OVERALL}$ and t_{DV} test results, we accept the H_0 hypothesis, which states that there is no cointegration between the variables. In order to obtain more evident results in deciding cointegration, we also applied the F_{IDV} test suggested by Sam et al. (2019) as a third test. The F_{IDV} statistical value is (1.11), and the upper limit for the observation values is less than (6.83). As a result, we detect no cointegration linkage between the variables for these three tests. We interpret this finding as that EDU, HEA, SOCPRO, and GDP variables do not move together linearly in the long run.

The absence of a linear cointegration linkage between the variables uncovers the possibility of a nonlinear cointegration linkage. Before starting the nonlinear cointegration test, we used the BDS test to determine nonlinear dependencies (Broock et al., 1996).

Table 6. BDS nonlinearity results

BDS stat.	Embedding dimensions = k				
	k=2	k=3	k=4	k=5	k=6
lnGDP	0.196172***	0.331509***	0.426557***	0.495160***	0.545283***
lnSOCPRO	0.168818***	0.286854***	0.366752***	0.427642***	0.472519***
lnHEA	0.156312***	0.270789***	0.349504***	0.402599***	0.441185***
lnEDU	0.187387***	0.322442***	0.419425***	0.487602***	0.537237***

Ullah et al. (2020) emphasized that if there is a structural break in the series, the BDS test should be used to detect nonlinear dependencies. Table 6 shows the BDS results and confirms the data's nonlinearity at the 1% significance level. The

results of the BDS test motivate us even more to continue with the NARDL analysis (Syed, 2021).

After applying the BDS test, we decomposed the increases and decreases in the independent variables. Since the data is quarterly, we determined the maximum lag length to be four (4) as in A-ARDL. The bounds test results show that the variables have a robust nonlinear cointegration linkage. Because the $F_{OVERALL}$ (5.12) value and the t_{DV} (-5.20) value calculated for the NARDL (3, 3, 0, 4, 0, 1, 0) model are significant at the 1% level, we interpret these results as EDU, HEA, SOCPRO, and GDP acting together nonlinearly in the long run.

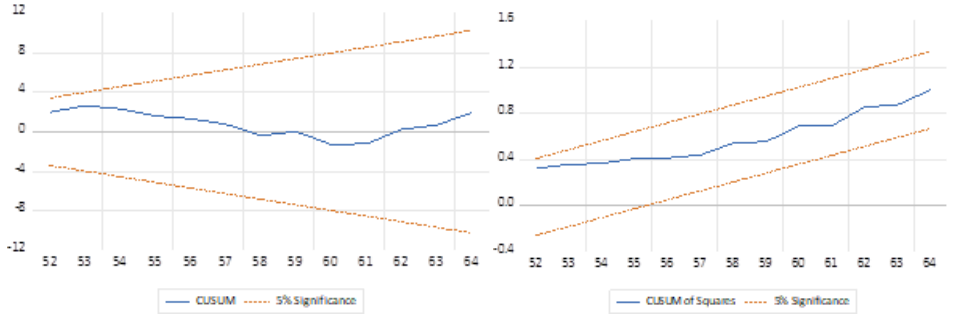
Table 7. Estimation of NARDL results

A) Estimation results	Coef.		t-stat.	p-val.	
C	14.83925		5.210864	0.0000	
$\ln GDP_{t-1}$	-0.575163		-5.205746	0.0000	
$\ln SOCPRO^{+}_{t-1}$	0.082015		2.820654	0.0074	
$\ln SOCPRO^{-}$	-0.133698		-3.027928	0.0043	
$\ln HEA^{+}_{t-1}$	0.112952		3.475490	0.0012	
$\ln HEA^{-}$	-0.062617		-2.558157	0.0144	
$\ln EDU^{+}_{t-1}$	-0.142223		-2.472320	0.0178	
$\ln EDU^{-}$	-0.072427		-1.017683	0.3149	
$\Delta \ln GDP_{t-1}$	0.092458		0.775054	0.4429	
$\Delta \ln GDP_{t-2}$	0.257848		2.225531	0.0317	
$\Delta \ln SOCPRO^{+}$	0.005529		0.201400	0.8414	
$\Delta \ln SOCPRO^{+}_{t-1}$	-0.081225		-2.616899	0.0125	
$\Delta \ln SOCPRO^{+}_{t-2}$	-0.077274		-2.712205	0.0098	
$\Delta \ln HEA^{+}$	0.012181		0.481213	0.6330	
$\Delta \ln HEA^{+}_{t-1}$	-0.092383		-2.863208	0.0066	
$\Delta \ln HEA^{+}_{t-2}$	-0.096499		-2.954919	0.0052	
$\Delta \ln HEA^{+}_{t-3}$	-0.062723		-2.112755	0.0409	
$\Delta \ln EDU^{+}$	-0.005409		-0.074816	0.9407	
DUMMY	-0.056687		-2.521586	0.0158	
B) Long run results					
$L_{\ln SOCPRO^{+}}$	0.142594	[0.0034]	$L_{\ln SOCPRO^{-}}$	-0.232452	[0.0004]
$L_{\ln HEA^{+}}$	0.196383	[0.0001]	$L_{\ln HEA^{-}}$	-0.108869	[0.0091]
$L_{\ln EDU^{+}}$	-0.247275	[0.0169]	$L_{\ln EDU^{-}}$	-0.125925	[0.3299]
C) Asymmetry tests					
$W_{LR, \ln SOCPRO}$	108.6088	[0.0000]	$W_{SR, \ln SOCPRO}$	0.488466	[0.4846]
$W_{LR, \ln HEA}$	84.54768	[0.0000]	$W_{SR, \ln HEA}$	9.559493	[0.0020]
$W_{LR, \ln EDU}$	1.720815	[0.1896]	$W_{SR, \ln EDU}$	-	-
D) Diagnostic tests					
X^2_{SC}	4.7478	[0.0931]	$X^2_{HET(BPG)}$	13.6361	[0.7525]
$X^2_{NORM(J-B)}$	7.6434	[0.0218]	$X^2_{HET(ARCH)}$	1.2551	[0.2626]
CUSUM and CUSUM of Squares	Stable		X^2_{FF}	0.0243	[0.8770]

Notes: Please see the notes in Table 3.

Another critical finding obtained in the study is that the sign of the dummy variable (we determined according to the LS unit root test result of GDP) is significant and negative, as we expected. This finding is empirical evidence that the structural break in "2016: Q3" is significant. We present empirical evidence that the coup attempts in Türkiye on 15 July 2016 harmed GDP. Diagnostic tests in panel D in Table 7 reveal no heteroscedasticity, serial correlation, or functional form problems in the model. Figure 1 confirms that NARDL CUSUM and CUSUMSQ fit the short run and long run coefficients, and the model is stable.

Figure 1. NARDL CUSUM and CUSUMSQ tests



According to the NARDL test results, it is clear that there is a nonlinear cointegration linkage between the variables. Therefore, the causality test is applied to determine the direction of the linkages between the variables. Although the variables integrate in the same order [I(1)] according to the traditional unit root test results, the variables integrate in a different order according to the LS unit root test results considering the structural breaks. Therefore, we preferred the T-Y causality test, which allows for stationarity at different levels and nonlinear linkages. As a result of unit root tests, we decided that the highest degree of integration of the series is d_{max}=1. Then, we determined the optimal lag length for this test. According to the information criteria obtained from the standard VAR model we created, the most appropriate lag is k=5. As a result, we determined that the k+d_{max} level required for the T-Y causality analysis is 6. The T-Y Granger causality results are presented in Table 8.

Table 8. The T-Y Granger Causality Test Results

H_0	k+d_{max}	Wald Stat.	p-val.	Direction of Causality
$lnSOCPRO^{+} \nRightarrow lnGDP$	5+1=6	30.54388 ***	0.0000	$lnSOCPRO^{+} \Leftrightarrow lnGDP$
$lnGDP \nRightarrow lnSOCPRO^{+}$	5+1=6	13.37665**	0.0200	
$lnSOCPRO^{-} \nRightarrow lnGDP$	5+1=6	7.042217	0.2175	$lnSOCPRO^{-} \nRightarrow lnGDP$
$lnGDP \nRightarrow lnSOCPRO^{-}$	5+1=6	116.6887***	0.0000	$lnGDP \Rightarrow lnSOCPRO^{-}$
$lnHEA^{+} \nRightarrow lnGDP$	5+1=6	25.30980***	0.0001	$lnGDP \Leftrightarrow lnHEA^{+}$
$lnGDP \nRightarrow lnHEA^{+}$	5+1=6	198.2062***	0.0000	
$lnHEA^{-} \nRightarrow lnGDP$	5+1=6	10.45874*	0.0632	$lnGDP \Leftrightarrow lnHEA^{-}$
$lnGDP \nRightarrow lnHEA^{-}$	5+1=6	22.04738***	0.0005	
$lnEDU^{+} \nRightarrow lnGDP$	5+1=6	6.537358	0.2574	$lnEDU^{+} \nRightarrow lnGDP$
$lnGDP \nRightarrow lnEDU^{+}$	5+1=6	208.9119***	0.0000	$lnGDP \Rightarrow lnEDU^{+}$
$lnEDU^{-} \nRightarrow lnGDP$	5+1=6	8.950586	0.1110	$lnEDU^{-} \nRightarrow lnGDP$
$lnGDP \nRightarrow lnEDU^{-}$	5+1=6	26.81749***	0.0000	$lnGDP \Rightarrow lnEDU^{-}$

Notes: (*) 10%; (**) 5%; (***) 1%.

According to the T-Y Granger causality test results, the null hypothesis that no causality exists between positive SOCPRO and GDP is rejected (mutually) at the 1% significance level. This result shows that while GDP is the Granger cause of positive SOCPRO, positive SOCPRO is also the Granger cause of GDP. This linkage means that there is feedback between these variables. In addition, these results showing the bidirectional causality linkages between SOCPRO and GDP support the findings obtained from the NARDL method. This bidirectional causality linkage between SOCPRO and GDP shows that both WL and KH are valid for SOCPRO in the long run. This result contradicts with the results of Musaba et al. (2013), Afonso and Alves (2017), and Lupu et al. (2018) for SOCPRO. On the other hand, this finding partially supports the studies of Dritsakis and Adamopoulos (2004), Sedrakyan and Varela-Candamio (2019), and Jaén-Garcia (2020), who found only WL valid for only SOCPRO. In addition, this finding partially supports the studies of Colombier (2011) and Arestis et al. (2021), who found only the KH valid for SOCPRO.

Like SOCPRO, the null hypotheses that no causality exists between positive HEA and negative HEA and GDP are rejected at the (mutually) 1% significance level. This result means a bidirectional causality linkage exists among positive HEA and negative HEA and GDP. In other words, while HEA is the Granger cause of GDP, GDP is also the Granger cause of HEA, and there is feedback between them. This finding supports the HEA variable's positive and negative coefficient values, which are statistically significant and robust in the short and long run according to the NARDL method. The bidirectional causality linkage between HEA and GDP shows that both WL and KH are valid for HEA in the long run, like SOCPRO. This finding fully supports the results of Dritsakis and Adamopoulos (2004), Sedrakyan and Varela-Candamio (2019), and Arestis et al. (2021) for HEA. For HEA, this study differs partially from Afonso and Alves (2017), which rejects only WL, or studies (Bose et al., 2007; Musaba et al., 2013; Fedeli, 2015) that reject only the KH. However, the study entirely contradicts with the study of Husnain (2011), who rejects both WL and the KH for HEA.

Another critical finding is the unidirectional Granger causality linkage from GDP to positive EDU and negative EDU. However, there is no causal linkage from EDU to GDP. While our findings for EDU show that WL is valid, they do not support the KH. These results fully support the results of Tabar et al. (2017), and Sedrakyan and Varela-Candamio (2019) for EDU. For EDU, these results partially differ from the studies of Afonso and Alves (2017), which rejected only WL, or Iqbal and Zahid (1998), Bose et al. (2007), Colombier (2011), Lupu et al. (2018) and Shafuda and De (2020), which only accepted the KH.

The absence of any causality from positive EDU and negative EDU to GDP supports the insignificant coefficients obtained from the NARDL method for EDU. In this finding, we think that the period we analyzed (2004-2019) was not long enough to reveal the impact of EDU on GDP. Studies verifying KH for EDU in the literature mostly cover 30 years or more (Dritsakis and Adamopoulos, 2004; Colombier, 2011; Shafuda and De, 2020) supports our view.

Finally, we compared this study's findings with other studies (Dritsakis and Adamopoulos, 2004; Sedrakyan and Varela-Candamio, 2019; Arestis et al. 2021) examining the linkages between GDP and all components of HCI. However, these studies separately test the linkage between GDP and the components of HCI. The present study, unlike the literature, analyzes all components of HCI in a linear and nonlinear model. The findings obtained from this study are more consistent than the findings of other studies since PEs are made simultaneously and together for a certain period.

IV. CONCLUSIONS

This study examines the effects of HCI on GDP for 2004-2019 period. The difference between the study from other studies is that it analyzes the effects of HCI on GDP with A-ARDL, NARDL, and T-Y Granger causality tests for Türkiye, taking into account nonlinear methods in addition to linear methods. The study reveals significant results for all three components of HCI. First, both increases and decreases in SOCPRO increase GDP. However, GDP's response to a decrease in SOCPRO is about one and a half times greater than its response to an increase in SOCPRO. This linkage between SOCPRO and GDP also reflects countries' preference between the social state function and the efficient use of resources. Increasing SOCPRO as a requirement of the social state function contributes to human capital and positively affects EG. However, allocating funds allocated to SOCPRO to more productive areas may significantly impact EG. Therefore, this result indicates that Türkiye attaches more importance to the effective use of resources in the relevant period (2004-2019) than the social state function. Developing countries with scarce natural resources, such as Türkiye, should attach more importance to the effective use of resources without ignoring the social state function if they want to increase their level of development.

Second, in the long run, both increases and decreases in HEA increase GDP like SOCPRO. However, GDP's response to an increase in HEA is about 1.7 times greater than its response to a decrease. This result shows that the increases in HEA, which is a component of HCI and contributes to the growth of healthy generations, are highly effective on GDP. This situation also indicates that Türkiye uses HEA effectively. Therefore, developing countries like Türkiye should not give up on HEA if they want to use resources effectively without compromising HCI. Third, there is a robust linear linkage between EDU and GDP, while there is no nonlinear linkage. Thus, the impact of EDU on GDP is more striking than the impact of SOCPRO and HEA. The government provides education and health services among the semi-public goods and services. One of the characteristics of semi-public goods and services is that they create positive externalities. Increases in HEA and EDU indicate that the government is providing more health and education services. Among the findings of the study, increases in HEA increase GDP more than decreases, and the fact that there is a linear linkage between EDU and GDP shows that HEA and EDU create positive externalities. HEA and EDU ensure the growth of healthy and educated individuals while also positively affecting the GDP.

In addition, both KH and WL are valid for the period examined in SOCPRO and HEA, which are components of HCI. In EDU, KH is valid, but WL is not.

Another important finding from the study is that the dummy variable we determined for the 2016:Q3 period was negative and significant. Significantly, Türkiye's 15 July 2016 failed coup attempt coincided with this period. In this period, GDP was adversely affected. Especially developing countries like Türkiye should be vigilant against coup attempts that may adversely affect economic development and growth and take steps for more advanced democracy.

Those evaluating the results of the study should note two main limitations. Firstly, the time limitation is that the data on PEs within the scope of COFOG starts from 2004 in the Türkiye sample. This limitation masks the asymmetric effect of EDU on GDP. The second limitation is that our HCI-based model contributes to the literature for a single-country sample. In future studies, applying the HCI model to other countries or country groups will significantly expand the contribution to the literature.

Araştırma ve Yayın Etiği Beyanı

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