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DOES WAGNER'S HYPOTHESIS EXPLAIN THE DYNAMICS OF HEALTH EXPENDITURES IN TRANSITION COUNTRIES?*

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Abstract

The purpose of this study is to analyze the short and long run causal relationship between public health expenditure and GDP per capita in transition economies within the context of the Wagner hypothesis. For the period 2000-2020, the empirical analysis was conducted using a dataset covering 22 transition countries: Latvia, Belarus, Czechia, Georgia, Bulgaria, Hungary, Estonia, Croatia, Moldova, Bosnia and Herzegovina, Slovenia, Ukraine, Armenia, Lithuania, Russian Federation, Slovak Republic, Romania, Turkmenistan, Uzbekistan, Tajikistan, Kyrgyz Republic, and Kazakhstan.

Wagner emphasizes that increases in government expenditure, considered an endogenous variable, do not drive GDP growth. In essence, Wagner argues that a rise in GDP leads to an increase in government expenditures. The study assessed the validity of Wagner's hypothesis by applying the Panel Cross-Sectionally Augmented Autoregressive Distributed Lag model (CS-ARDL), developed by Chudik *et al.* (2016), using annual data. For the empirical analysis, panel data from selected transition countries underwent causality tests proposed by Juodis, Karavias and Sarafidis (2021) and Dumitrescu and Hurlin (2012). The stationarity of the series was assessed using a panel unit root test. Subsequently, the panel cointegration test developed by Westerlund (2007) was employed to ascertain the long run cointegration of the variables in the subsequent phase. The results suggest that the Wagner hypothesis holds true within the context of transition countries, as indicated by the outcomes of the CS-ARDL model. The causality test revealed a one-way causal linkage between GDP per capita and health expenditure. Recommendations for those who make policy decisions were made in light of the findings.

Keywords: Wagner hypothesis, transition countries, health expenditures, CS-ARDL model.

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1. Introduction

One of the most significant measures of the state's influence on the economy is public spending. In this context, various ideas have been advanced to provide light on potential connections between public spending and national revenue. The Keynesian or Wagner hypothesis can both be used to analyze the link between these two macroeconomic parameters. The first approach predicts that public spending will be correlated with GDP (Keynes, 1936). In line with the second approach, there will be a causal link between GDP and public spending (Wagner, 1890). The long-term interaction between these two variables is predicted by Wagner's law, and public spending will have an elasticity coefficient greater than one. Knowing how public spending and GDP are related is crucial information for those who make policy decisions. If the Keynesian perspective is correct, public expenditure has a beneficial influence on the national economy and may be an important tool in tackling urgent economic concerns (Singh and Sahni, 1984). In contrast to the Keynesian viewpoint, which regards government expenditure as an external component, Wagner's viewpoint stresses government spending as an internal element (Arısoy, 2005).

The purpose of this study was to analyze the relationship between government expenditure and economic growth and to empirically investigate the validity of Wagner's hypothesis for the circumstances of transition countries namely Latvia, Belarus, Czechia, Georgia, Bulgaria, Hungary, Estonia, Croatia, Moldova, Bosnia and Herzegovina, Slovenia, Ukraine, Armenia, Lithuania, Russian Federation, Slovak Republic, Romania, Turkmenistan, Uzbekistan Tajikistan, Kyrgyz Republic, and Kazakhstan. The current study was focused on the research question: Is the Wagner hypothesis valid for selected transition countries from the period 2000–2020 within the context of public health expenditures? During the era when transition countries were moving from planned economies to market economies, the health system underwent significant transformation. Therefore, the current study focuses on health expenditures, which constitute one of the public expenditure items. The percentage of health expenditures, one of the public spending categories, in GDP, has fluctuated between 3-8% during this period of change. It is striking that health expenditures are higher in Central and Eastern European (CEE) countries compared to other post-Soviet countries. In these nations, the proportion of health expenditure to total public spending ranges from 4 to 15%. While approximately 15% of public expenditures in CEE countries are allocated to the health system, this rate is around 4–5% in Central Asian (CA) countries (Our World in Data, 2022).

To analyze the validity of Wagner's hypothesis in selected transition countries, this study focused on the following objectives:

(i). Determining the direction of causality between public health expenditures and GDP per capita.
(ii). Examining the relationship between public health expenditures and GDP per capita.

The study utilized Dumitrescu and Hurlin (2012) and Juodis, Karavias and Sarafidis (2021) Granger non-causality tests to uncover the causal relationship between public health expenditures and GDP per capita, addressing the first objective. Specifically, the focus was on exploring the causation link based on Gupta's (1967) version of the Wagner hypothesis. The study employed panel data techniques, well-suited for examining short-term versus long-term relationships. To address the second objective, the newly developed Cross-Sectionally Augmented Autoregressive Distributed Lag (CS-ARDL) model proposed by Chudik *et al.* (2016) was utilized to elucidate the relationship between public health expenditure and GDP per capita. CS-ARDL is capable of managing cross-sectional dependence and heterogeneity issues, enabling an understanding of both long and short-run relationships.

Notably, this study adds value to the existing body of knowledge by utilizing a newly developed method to assess relations between variables. Moreover, it contributes by examining CA economies that were not included in previous studies, thereby broadening the scope and depth of the investigation.

In the second part following the introduction part of our study, studies on the validity of the Wagner hypothesis were emphasized. In the next section, the course of health expenditures and GDP per capita in transition countries was presented over the years. The methodology we applied in the empirical analysis was defined in the fourth section. The findings were discussed later. General conclusions and recommendations were provided in the conclusion section.

2. Literature review

Studies have been done to determine the validity of the Wagner hypothesis in various nations. Some of them supported the validity of the Wagner hypothesis, while others supported the Keynesian concept. The validity of Wagner's hypothesis in the context of health expenditures was examined by Pehlivan, Han and Konat (2021), Erdil and Yetkiner (2009), Tsaurai (2014), Subramanian, Belli and Kawachi (2002), Cengiz and Demir (2021), Mehrara and Musai (2011), Elmi and Sadeghi (2012), and Alhowaish (2014). The validity of the Wagner hypothesis was tested by a few recent studies utilizing various methodologies for various nations, as shown in Table 1.

In contrast to the research conducted by Balaban and Zivkov (2021) and Demez (2021), which specifically concentrated on analyzing transition countries and excluded Central Asian (CA) countries from their investigations, our study pursued a different approach by encompassing Central Asian countries in the empirical analysis. Unlike the previously mentioned authors, we utilized the causality analysis method developed by Juodis, Karavias and Sarafidis (2021) in our study and it marks a distinctive contribution to the literature on this subject. This methodology represents a novel approach, previously not employed in similar studies, and is particularly suitable for models with large unit (N) and

Table 1: Literature summary

Authors	Countries	Methods	Outcomes
Inchauspe, MacDonald and Abdul Kobir (2022)	Indonesia, 1980–2014	Causality and cointegration method	Wagner's hypothesis is valid
Balaban and Živkov (2021)	16 transition countries (Albania, Bosnia and Herzegovina, Bulgaria, Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Macedonia FYR, Montenegro, Poland, Romania, Serbia, Slovak Republic, and Slovenia), 1990–2017	Fully modified OLS (FMOLS) and Panel Dynamic OLS (PDOLS) method	Wagner's hypothesis is valid
Demez (2021)	11 transition countries (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, and Slovenia), 1995–2019	Dumitrescu-Hurlin (2012) panel causality analysis	Wagner's hypothesis is valid
Cedillo and Herrera (2021)	16 Latin American countries (Bolivia, Chile, Colombia, Costa Rica, El Salvador, Honduras, Mexico, Paraguay, Argentina, Panama, Ecuador, Guatemala, Brazil, Uruguay, Nicaragua, and Peru)	Panel cointegration test	Wagner's hypothesis is valid
Arestis, Şen and Kaya (2021)	Türkiye	Granger causality	Keynesian hypothesis is valid
Karaş (2020)	BRICS countries (Brazil, Russia, India, China, and South Africa) and Türkiye, 1990–2018	Dumitrescu-Hurlin (2012) panel causality analysis	Wagner's hypothesis is valid
Kumar and Cao (2020)	East Asian countries (China, Hong Kong, Japan, and South Korea)	Gregory and Hansen, Carrion-i-Silvestre and Sanso, Bai and Perron structural break methods	Wagner's hypothesis is valid
Nirola and Sahu (2020)	India	Pedroni's PDOLS mean group estimator	Wagner's hypothesis is valid
Prado and da Silva (2020)	Brazil 2002–2015	Fully modified OLS (FMOLS), Panel Dynamic OLS (PDOLS) method, and Pooled Mean Group estimator (PMG)	Wagner's hypothesis is not valid
Flores Méndez (2019)	Nicaragua 2006-2018	Regression	Wagner's hypothesis is valid
Paparas, Richter and Kostakis (2019)	United Kingdom 1850–2010	Granger causality test and cointegration	Wagner and Keynesian hypotheses are valid
Karahan and Çolak (2019)	Türkiye 1998–2016	ARDL model	Keynesian hypothesis is valid

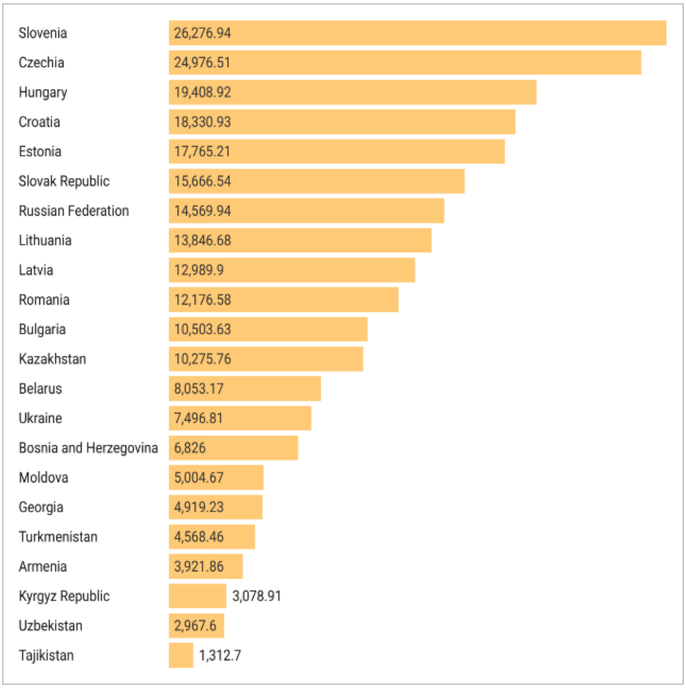
time (T) dimensions. Its applicability extends to both homogeneous and heterogeneous models, providing robust results even in cases of cross-sectional dependency. Additionally, our study stands out for its inclusion of Central Asian countries, a region that has been largely overlooked in previous research on this topic. By incorporating these countries into our analysis, we aim to fill a significant gap in the literature regarding their role in the context under examination.

3. Dynamics of health expenditure and GDP per capita transition countries

Knowing a country's gross domestic product (GDP) per capita can help gain insight into its economic potential, its basic needs, and the general level of living of the average person. As can be observed from Figure 1 these countries can be divided into three groups by GDP per capita level (World Bank, 2023). Countries with the largest GDP per capita: Slovenia, Estonia, Lithuania, Latvia, Czech Republic, Slovak Republic, Romania, Croatia, and Hungary. Countries with a moderate GDP per capita level: Bosnia and Herzegovina, Bulgaria, Kazakhstan, Russia, Belarus, Turkmenistan, Georgia, Moldova, and Armenia. Countries with a lower GDP per capita level: Uzbekistan, Kyrgyzstan, Ukraine, and Tajikistan.

When comparing GDP per capita between 2000 and 2022, it is evident that Slovenia maintained its position with the highest GDP per capita among transition countries, reaching $42,175.2 as of 2022. In 2000, Slovenia also held the top position. In other words, Slovenia retained its place as the leader among transition countries based on GDP per capita. Meanwhile, over the 20-year period, Tajikistan has consistently remained at the bottom of the list in terms of its GDP per capita.

Figure 2 displays the proportions of health expenditures in Gross Domestic Product (GDP). It can be claimed that the range of these nations' healthcare expenditure as a percentage of GDP is between 1 and 8%. When analyzing health expenditure as a percentage of GDP between 2000 and 2020, it becomes apparent that the Czech Republic held the highest health expenditure as a percentage of GDP among transition countries, reaching 8.08% by 2020. Croatia held the top position in 2000. In that year, Georgia ranked at the bottom of the list concerning its health expenditure as a percentage of GDP. By 2020, Turkmenistan emerged with the lowest health expenditure among transition countries. As a percentage of GDP, CEE countries have higher health expenditures than CA countries, which have the lowest.



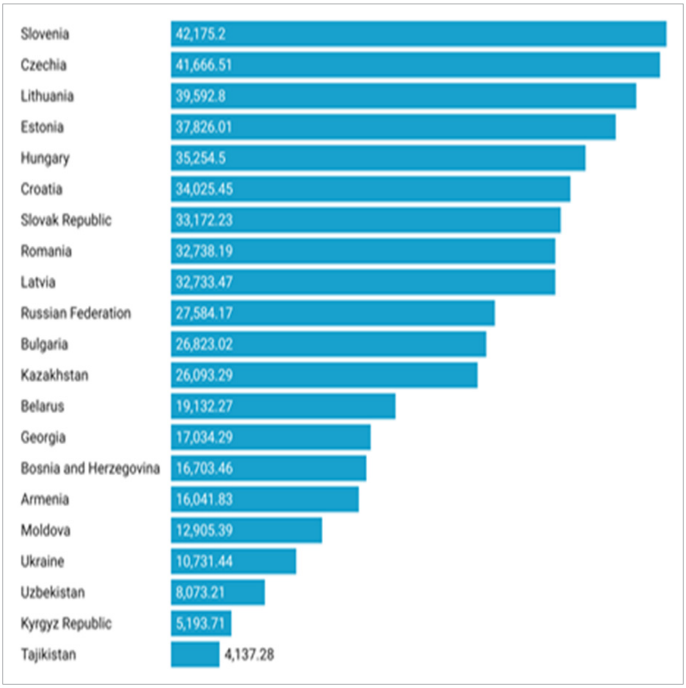
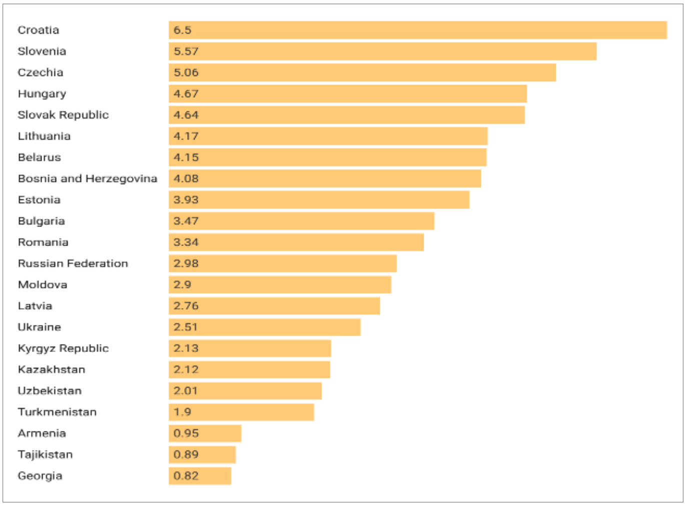


Figure 1: GDP per capita, PPP (constant 2017 US dollar), 2000 and 2022

Source: Table created with Datawrapper based on World Bank database (2023)



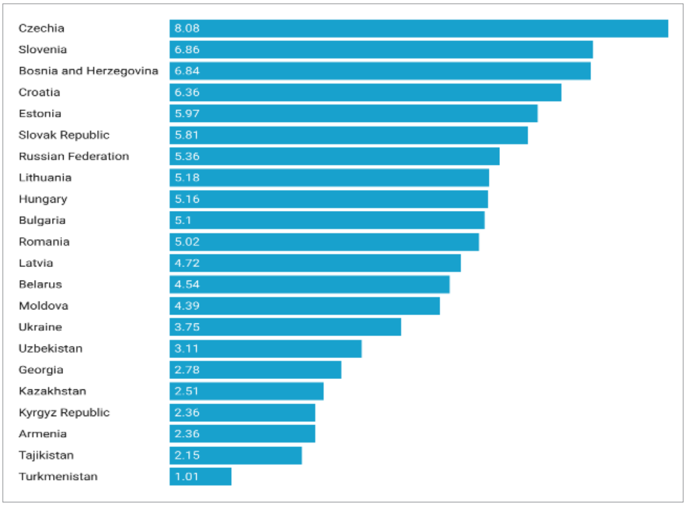


Figure 2: Government health expenditures (% of GDP), 2000 and 2020

Source: Table created with Datawrapper based on World Bank database (2023)

Figure 3 shows health expenditure dynamics for 2020. Per capita health expenditures in the transition countries have increased significantly since 2000. In 2020, health expenditures amounted to 2.417 thousand U.S. dollars per capita in Slovenia. For comparison, in 2000, per capita expenditures for health stood at 796.65 U.S. dollars. The amount spent on healthcare per person in Kyrgyzstan increased from 12.25 thousand dollars in 2000 to 63.69 thousand dollars in 2020.

Figure 4 shows that in transition countries, the GDP and health expenditure are positively correlated. In other words, it means that both variables move in the same direction.

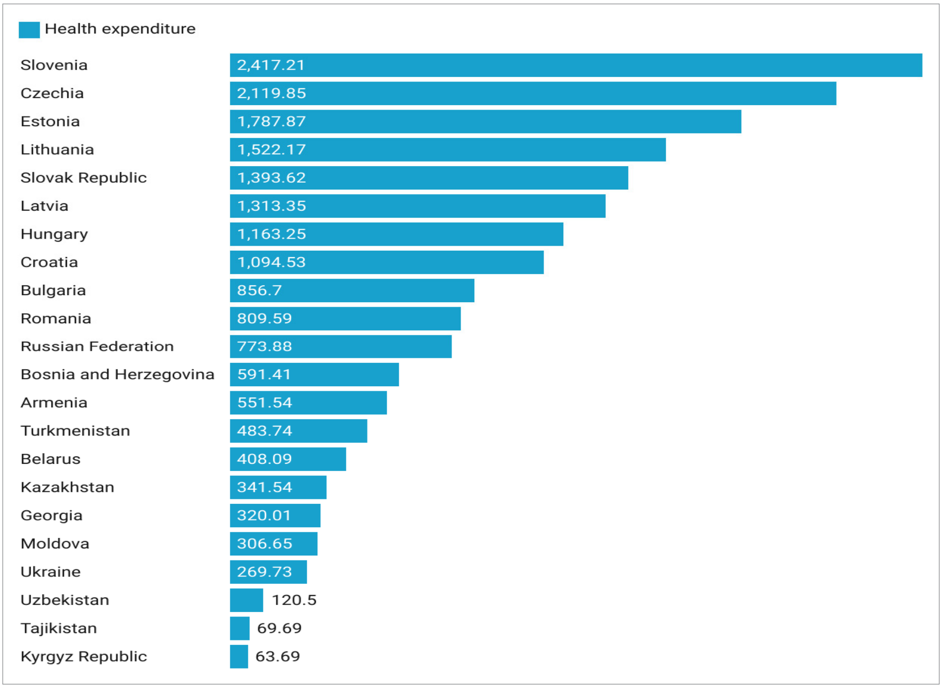


Figure 3: Health expenditure per capita (US dollar), 2020

Source: Table created with Datawrapper based on World Bank database (2023)

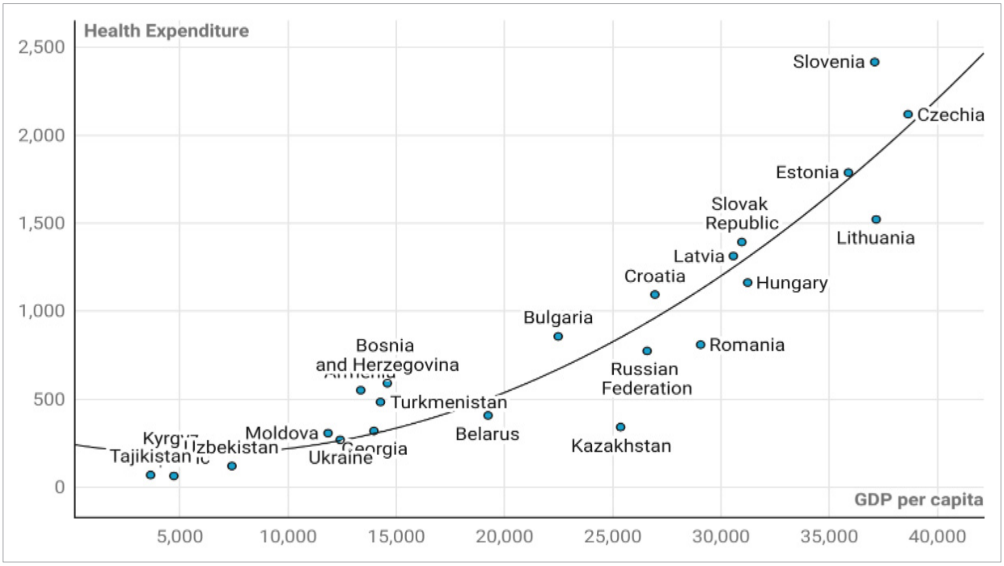


Figure 4: Health expenditure and GDP per capita, 2020

Source: Table created with Datawrapper based on World Bank database (2023)

Figure 5 displays that health expenditure as a share of GDP and per capita gross domestic product also correlate in selected transition countries. Overall, it can be concluded that variables of interest are positively correlated.

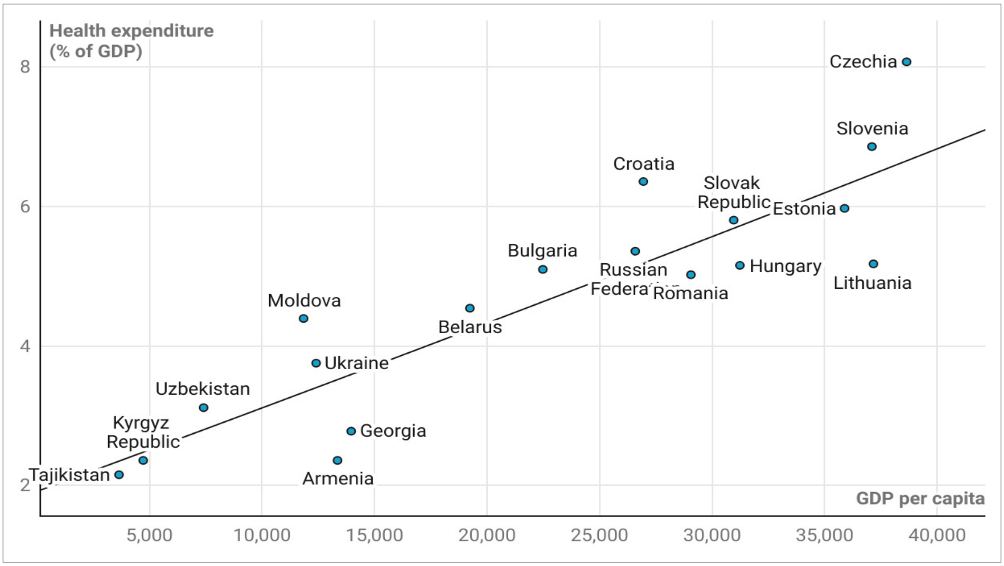


Figure 5: Per capita GDP and health expenditure as a share of GDP, 2020

Source: Table created with Datawrapper based on World Bank database (2023)

The dynamics of per capita gross domestic product and health expenditure exhibit growth in selected transition countries during the last two decades. In addition, it demonstrates that the variables of interest are moving in the same direction.

4. Methodology

4.1. Data and variables

This study examines Wagner's hypothesis in transition economics in both the short and long run and the causal relationship among the variables within the context of public health expenditures. The data for this study comprises 22 transition countries, namely Croatia, Slovak Republic, Romania, Moldova, Bosnia and Herzegovina, Slovenia, Lithuania, Latvia, Estonia, Ukraine, Armenia, Belarus, Russian Federation, Turkmenistan, Uzbekistan Tajikistan, Kyrgyz Republic, and Kazakhstan. Because of data availability constraints, the study focuses on the period from 2000 to 2020, leading to the exclusion of the remaining transition countries from the analysis. All data utilized in this study were sourced from the World Bank database.

Wagner's hypothesis was put to the test in order to determine its validity by researchers such as Musgrave (1969), Mann (1980), Goffman (1968), Peacock-Wiseman (1979), and

Gupta (1967). Table 2 presents these models and their economic expectations. G stands for total public expenditure, P indicates population, and Y indicates GDP.

Table 2: Alternative models interpreting the Wagner hypothesis

Gupta (1967) model	$\boldsymbol{Ln\,G/P_t = \beta_0 + \beta_1 Ln(Y/P)_t + u_t}$	$\boldsymbol{\beta_1 > 1}$
Goffman (1968) model	$LnG_t = \beta_0 + \beta_1 Ln(Y/P)_t + u_t$	$\beta_1 > 1$
Musgrave (1969) model	$Ln\,G/Y_t = \beta_0 + \beta_1 Ln(Y/P)_t + u_t$	$\beta_1 > 1$
Peacock-Wiseman (1979) model	$LnG_t = \beta_0 + \beta_1 LnY_t + u_t$	$\beta_1 > 1$
Mann (1980) model	$Ln\,G/Y_t = \beta_0 + \beta_1 LnY_t + u_t$	$\beta_1 > 1$

The study examined the Gupta (1967) version of the Wagner hypothesis. This version tests the validity of Wagner's hypothesis by accounting for the increase in population.

$$Ln\,G/P_t = \beta_0 + \beta_1 Ln(Y/P)_t + u_t \tag{1}$$

This specification models real per capita government expenditures as a function of real per capita output. Support for the hypothesis requires that the elasticity of per capita real government expenditures with respect to real per capita output exceeds unity (Oktayer and Oktayer, 2013).

In the Gupta version of the Wagner hypothesis, real per capita government expenditures (G/P) are defined as the dependent variable. The current study focuses on exploring whether Wagner's hypothesis effectively explains the fluctuations in health expenditure within transition countries Therefore, a modified Gupta version was used in the study, and health expenditures were utilized as a proxy to represent public expenditure. Table 3 provides a summary of the variables, definitions, and sources of data used in the current study.

Table 3: Variables and definitions

Variable	Definitions	Source
Wagner Hypothesis Dependent Variable		
HE	Public health expenditures per capita	World Bank Database
Independent Variable		
GDP	GDP per capita	World Bank Database

The series of public health expenditures per capita (in US dollars), and GDP per capita, PPP (constant 2017 US dollar) are used to represent health expenditures and economic growth. All data were converted into their natural logarithms before being subjected to the econometric analysis.

Adhering to Gupta's model of Wagner's hypothesis concerning public health expenditures, the model was modified in the subsequent manner:

$$LnHE_{it} = \beta_0 + \beta_1 LnGDP_{it} + u_{it} \tag{2}$$

Where is the logarithmic value of public health expenditures per capita; $LnGDP_{it}$ shows the logarithmic value of the GDP per capita series. For Wagner's hypothesis to hold, the elasticity of public health expenditures concerning economic growth (the coefficient β_1) must be greater than one.

4.2. Cross-section dependence test

Before moving on to the panel unit root analysis in our study, where we evaluate the Wagner hypothesis in explaining health expenditure dynamics, it is important to determine whether the cross-section dependence issue between nations exists. Because a shock in one nation might have an impact on the economic climate in other countries, cross-sectional dependence (CSD) has grown in importance in panel data analysis. Due to widespread social norms, common traditions, and economic policies, the datasets collected for transition countries may suffer from cross-section dependence (CD). In light of the findings obtained, a choice will be made between first-generation and second-generation panel unit root tests. For this purpose, the CD test recommended by Pesaran (2004), Pesaran, Ullah and Yamagata (2008), and Pesaran (2015) will be applied. Pesaran (2004) CD test statistics is written as follows:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\ \left(\sum_{i=j}^{N-1}\sum_{i=j+1}^{N}\hat{\rho}_{ij}\right) \tag{3}$$

Pesaran, Ullah and Yamagata (2008) CD test statistics is defined as follows:

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}}\ \sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(T\hat{\rho}_{ij}^{2} - 1\right) \tag{4}$$

Pesaran (2015) CD test statistics is obtained by the following equation:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\ \left(\sum_{i=j}^{N-1}\sum_{i=j+1}^{N}\hat{\rho}_{ij}\right) \tag{5}$$

In cross-section dependence tests, the null hypothesis (H0) often asserts that there is no cross-sectional dependence among the series or units.

4.3. Panel unit root test

The integration order of the data must be known before conducting a long-run analysis. As a result, a panel unit root test that considers cross section dependence concerns should be employed. Two-unit root tests are suggested by Pesaran (2007) for panels with a common factor structure. The CIPS (Cross-sectionally augmented Im, Pesaran and Shin) and CADF (Cross Sectionally Augmented Dickey-Fuller) unit root tests are used in this study.

CADF regression can be written as follows:

$$\Delta Y_{it} = \alpha_i + b_i Y_{i,t-1} c_i \bar{Y}_{t-1} + d_i \Delta\bar{Y}_t + \varepsilon_{it} \tag{6}$$

CIPS test statistic can be defined as follows:

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_i \tag{7}$$

In these panel unit root tests, the null hypothesis (H0) posits that the series have a unit root, implying non-stationarity.

4.4. Panel cointegration test

In order to reveal whether series are cointegrated in the long run we utilized the panel cointegration test proposed by Westerlund (2007). A bootstrap option should be used in the case of CD to prevent erroneous inference (Persyn and Westerlund, 2008). The test statistics are employed with bootstrapped robust critical values since there is cross-sectional dependency between the series. Group mean test (Gt and Ga) and pooled panel test (Pt and Pa) statistics can be obtained as follows:

$$G_t = \frac{1}{N}\sum_{j=1}^{N}\frac{\widehat{\omega}_i}{se(\widehat{\omega_i})} \tag{8}$$

$$G_a = \frac{1}{N}\sum_{i=1}^{N}\frac{\widehat{T\omega}_i}{1-\sum_{j=1}^{k}\omega_{ij}} \tag{9}$$

$$P_t = \frac{\widehat{\omega}_i}{se(\widehat{\omega_i})} \tag{10}$$

$$P_a = T\widehat{\omega} \tag{11}$$

In this panel cointegration test, null hypothesis (H0) states that there is no cointegrating relationship among the series.

4.5. CS-ARDL model

In order to examine the validity of the Wagner hypothesis explaining health expenditure dynamics in transition countries, we utilized the panel cross-sectional augmented autoregressive distributed lag (CS-ARDL) technique that deals with the combination of I(0) and I(1) variables. Also, this procedure considers cross-sectional heterogeneity, time dynamics and cross-sectional dependence issues.

CS-ARDL equation can be defined as below:

$$LnHE_{i,t} = \alpha_i + \sum_{l=1}^{p_y} \lambda_{l,i}\mathrm{LnHE}_{i,t-l} + \sum_{l=0}^{p_x} \beta_{l,i}X_{i,t-l} + \sum_{l=0}^{p_\varphi} \varphi'_{i,l}\bar{z}_{i,t-l} + \varepsilon_{i,t} \tag{12}$$

where $LnHE_{i,t}$ is the dependent variable; $X_{i,t}$ is defined as $\mathrm{LnGDP}_{i,t}$; $\bar{Z}_{i,t-l}$ equals to $(\overline{Ln\mathrm{HE}}_{i,t-l}, \bar{X}_{i,t-l})$ and defined as the lagged cross-sectional averages of all variables. $\varepsilon_{i,t}$ is the error term. l indicates the optimum lag length.

Equation (13) displays the CS-ARDL's long run mean group estimates (Ditzen, 2021, p. 691)

$$\hat{\theta}_{CS-ARDL,i} = \frac{\sum_{l=0}^{p_x}\hat{\beta}_{l,i}}{1-\sum_{l=0}^{p_y}\hat{\lambda}_{l,i}}, \hat{\theta}_{MG} = {}^{1}/{}_{N}\sum_{i=1}^{N}\hat{\theta}_i \tag{13}$$

where $\hat{\theta}_i$ displays a separate estimation for each cross-section.

The error correction term can be obtained as below:

$$\begin{aligned}\Delta Y_{it} = \; & \partial_i\left[Y_{i,t-l} - \hat{\theta}_i X_{i,t}\right] - \alpha_i + \sum_{l=1}^{p_Y-1} \lambda_{l,i}\Delta_l Y_{i,t-l} + \\ & \sum_{l=0}^{p_x} \beta_{l,i}\Delta_l X_{i,t-l} \sum_{l=0}^{p_\varphi} \varphi'_{i,l}\Delta_l \bar{Z}_{i,t-l} + u_{it}\end{aligned} \tag{14}$$

The error correction term of the CS-ARDL is defined as ∂_i and it is required to be negative and statistically significant.

4.6. Panel causality tests

Panel causality tests were then used to provide evidence confirming the conclusions of the CS-ARDL model. The series acting together in the long run will first be subjected to the causality test created by Juodis, Karavias and Sarafidis (2021). The authors developed a novel approach to assess Granger causality for models with large unit (N) and time (T) dimensions. This method can be applied to both homogeneous and heterogeneous models. The new aspect of the suggested method is that the Granger causality parameters are all zero and homogeneous under the null hypothesis. The estimator's convergence rate is guaranteed to be √NT by pooling across sections. The strategy explains the 'Nickell bias' using the half-panel jackknife (HPJ) technique (Juodis, Karavias and Sarafidis, 2021).

We used the Dumitrescu-Hurlin (2012) panel causality test in addition to the test indicated above. The Granger non-causality test is modified by the Dumitrescu-Hurlin panel causality test for constant-coefficient non-homogeneous panel data models. With the use of this test, we are able to take into consideration both of the heterogeneities that characterize this situation: the heterogeneity of the causal relationships and the heterogeneity of the regression model that was employed to carry out the test. The bootstrap approach can be used to adjust the empirical critical values of the panel Granger causality in the situation of cross-sectional dependency (Dumitrescu and Hurlin, 2012). Even in samples with small values for T and N, this method has excellent properties. Juodis, Karavias and Sarafidis (2021) and Dumitrescu-Hurlin (2012) Granger causality tests were utilized to reveal the direction of the linkages between health expenditures and growth.

Juodis, Karavias and Sarafidis test statistic can be written as below:

$$W = NT\hat{\beta}'(J^{-1}VJ^{-1})^{-1}\hat{\beta} \tag{15}$$

Dumitrescu-Hurlin test statistics can be defined as below:

$$W_{N,T}^{HNC} = \frac{\sqrt{N}(W_{N,T}^{HNC} - N^{-1}\sum_{i=1}^{N} E(W_{i,T})}{\sqrt{N^{-1}\sum_{i=1}^{N} VAR(W_{i,T})}} \qquad N \to \infty, N(0.1) \tag{16}$$

where $E(W_{i,T})$ and $VAR(W_{i,T})$ show the mean and the variance of $W_{i,T}$ respectively. In panel Granger causality tests, the null hypothesis (H0) posits that there is no Granger causality between the variables in the panel dataset.

5. Empirical findings

This section discusses the findings. CD test results, which were utilized in order to reveal cross section dependency among series, are summarized in Table 4.

Findings highlight that according to the three-procedure cross section dependence exists among series. In the next stage second generation panel unit root tests were employed. The outcomes of the panel unit root tests, which seek to reveal the stationary characteristics of the series, are summarized in Table 5.

Table 4: The results of CD tests

	Variables	Test statistics	Probability
Pesaran[a] (2004)			
	LnHE	65.09	0.000
	LnGDP	65.35	0.000
Pesaran[b] *et al.* (2008)			
	LM	1703	0.000
	LM adj*	155.9	0.000
	LM CD*	35.06	0.000
Pesaran[c] (2015)			
	LnHE	65.09	0.000
	LnGDP	65.35	0.000

Note: (1) [a]H_o – cross-section independence; (2) [b]H_o – $Cov(u_{it},u_{jt}) = 0$ for all t and i!=j; (3) [c]H_o – errors are weakly cross-sectional dependent.

Table 5: Results of panel unit root tests

	Level			First Difference		
	Variables	Constant	Constant and trend	Variables	Constant	Constant and trend
CADF[a]						
	LnGDP	-0.545	1.669	ΔLnGDP	-3.839***	-3.839***
	LnHE	-0.459	-0.029	ΔLnHE	-4.779***	-1.897**
CIPS[b]						
	LnGDP	-1.780	-1.649	ΔLnGDP	-2.575***	-2.785**
	LnHE	-2.037	-2.528	ΔLnHE	-3.989	-3.909***

Notes: (1) [a]Ho – Series has a unit root; (2) [b]H_0 – (homogeneous non-stationary), $b_i = 0$ for all i; (3) ***, ** indicate significance at the 1% and %5 level, respectively.

According to the findings of CIPS and CADF, it can be claimed that all the series are integrated of order one I(1). In other words, series become difference-stationary. The findings from the panel cointegration test, which seek to ascertain if the series exhibit long-term movement together, are presented in Table 6.

Table 6: Results of panel cointegration test

Statistics	Value	Z-Value	Robust p-value
Gt	-1.866**	-4.012	0.010
Ga	-4.467*	-0.685	0.080
Pt	-9.084***	-5.732	0.000
Pa	-3.879***	-4.622	0.000

Notes: (1) H_0 no cointegration among series; (2) ***, **, and * indicate significance at the 1%, 5%, and %10 level, respectively; (3) Bartlett kernel window width was chosen according to $4(T/100)^{2/9} \approx 3$; (4) The bootstrap p-value was generated with 100 replications.

Panel cointegration test results highlight that the tests reject the null hypothesis of no cointegration. In other words, both the groups and the panel are statistically significant according to the bootstrap approach. Thus, the bootstrap approach rejects the null hypothesis of no cointegration. In light of this, one can infer that our model exhibits cointegration and that the long-run linkages between the series of the health expenditures per capita and gross domestic product per capita are strong. Table 7 displays the results of the CS-ARDL model.

Table 7: Results of the CS-ARDL (2 0) model

	Coefficients	Standard Errors
Short run estimates		
D(LnHE(-1))	-0.0021	0.0642
D(LnHE(-2))	0.0274	0.0556
D(LnGDP)	1.1707***	0.2260
Adjustment term	-0.9746***	0.0778
Long run estimates		
LnGDP	1.1780 ***	0.2812
CD Statistic	-1.27	
p-value	0.2033	

Note: (1) *** and** indicate the significance levels at 1% and 5%, respectively; (2) D indicates first difference of the given variable.

The positive and statistically significant coefficients of LnGDP demonstrate that rises in gross domestic product per capita cause increases in health expenditure per capita both in the short and long terms (1.170 and 1.178, respectively). The long-term coefficient value was found to be greater than one. This finding indicates the validity of Wagner hypothesis according to the Gupta (1967) version in the context of transition countries.

The Pesaran CD test result (1.27) and p-value (0.2033) demonstrate that the estimates for CS-ARDL have eliminated the cross-section dependency problem, highlighting the fact that the CS-ARDL model's estimates are accurate and faultless.

At a significance level of less than 1%, the error correction term (-0.974) is found to be statistically significant and negative. It implies that the variables have a stable long-run co-integrating relationship, implying that the system will recover from a shock that causes disequilibrium. In other words, 97% of the difference is bridged within a year, providing the impression that the partial adjustment to long-run equilibrium occurs swiftly. It suggests that all variables tend to return to their equilibrium relationship very rapidly. The results of Granger causality test, aiming to identify if there exists a casual relationship between the series, are presented in Table 8.

The Bayesian-Schwarz criterion was used to determine the best lag for both tests, which were conducted on the series' first differences. In transition countries, Granger non-causality test results show that causality went from GDP per capita to health expenditures, according to Dumitrescu-Hurlin (2012) and Juodis, Karavias and Sarafidis (2021). Contrarily, the null hypothesis that GDP does not Granger-cause health expenditure was

Table 8: Results of Granger causality tests

	Null Hypothesis	HPJ Wald Statistic		P-value	Result
Juodis, Karavias and Sarafidis[a] (2021) approach	GDP per capita is not Granger-caused by per capita health expenditure.	2.1469		0.1429	Do not reject null hypothesis
	Health expenditure is not Granger-caused by per capita gross domestic product.	8.2920		0.004	Reject null hypothesis GDP
	Null Hypothesis	**W-bar**	**Z-bar**	**P-value**	**Result**
Dumitrescu and Hurlin[b] (2012) approach	Per capita gross domestic product is not Granger-caused by health expenditure per capita.	1.1617	0.5363	0.7950	Do not reject null hypothesis
	Health expenditure per capita is not Granger-caused by GDP per capita.	3.7370	9.0778	0.0160	Reject null hypothesis GDP

Notes: (1) [a] The appropriate lag length one is chosen based on BIC; (2) [b] P-values computed using 1,000 bootstrap replications; (3) [b] BIC is used to determine the optimal lag length.

disproved. We conclude that there is a one-way Granger causality link between health expenditure and GDP per capita based on the test findings, which suggests that the Wagner hypothesis is valid for these countries. Our findings corroborate previous studies conducted by Balaban and Živkov (2021) and Demez (2021).

6. Conclusions

Using annual data for the period 2000-2020 from selected 22 transition countries, we explored the applicability of the Wagner hypothesis to health expenditure. Through econometric analysis, this study successfully addressed the research question. It probed whether the Wagner hypothesis holds true within the selected transition countries concerning public health expenditures during the specified period.

Based on the objectives outlined for analyzing the validity of Wagner's hypothesis in selected transition countries, this study successfully achieved the following. The study effectively determined the nature and direction of causality between public health expenditures and GDP per capita within the chosen transition countries. Furthermore, by comprehensively examining the relationship between public health expenditures and GDP per capita in these transition countries, the study has successfully verified the hypothesis that GDP per capita has a significant impact on health expenditure. The empirical evidence gathered throughout this study substantiates the influence of GDP per capita on health expenditure within these countries.

Based on the findings derived from this study on the relationship between health expenditure and GDP per capita in transition countries, several policy implications emerge. The consistent long-term cointegrating connection uncovered between per capita health expenditure and GDP supports the validity of Wagner's hypothesis in these contexts, as indicated by the Gupta (1967) versions. The results obtained from the CS-ARDL model, showcasing a long-term coefficient value greater than one, further affirm the validity of the Wagner hypothesis theory within these transition countries. This suggests that as these economies grow, health expenditures tend to increase, reinforcing the idea that public expenditures on health expands relative to GDP per capita.

Furthermore, the outcomes of the Granger causality tests developed by Juodis, Karavias and Sarafidis (2021), and Dumitrescu and Hurlin (2012) exhibit evidence of one-way causal linkages from GDP per capita to health expenditure. This implies that GDP per capita drives health expenditure in these transition countries, suggesting that public expenditure might not effectively serve as a policy instrument to stimulate economic growth.

In light of these findings, it is evident that utilizing public expenditure as a means of policy intervention during periods of deteriorating macroeconomic balances within transition countries may lead to adverse fiscal repercussions. Relying solely on increased public expenditures on health to fuel economic growth might not yield the desired outcomes, indicating a need for diversified policy approaches to maintain fiscal restraint and balance in these contexts.

Therefore, policymakers should consider adopting a more comprehensive and nuanced approach that encompasses multiple policy instruments beyond public expenditures, focusing on structural reforms and diversification strategies to ensure sustainable economic growth while maintaining fiscal stability in transition countries.

The limitations of this study lie in its confinement to transition countries and the period between 2000 and 2020. For prospective research, it would be valuable to delve into the Wagner's hypothesis within each country individually, utilizing more advanced econometric techniques.

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