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Fertility and economic growth of selected transition countries

Fertilitet i ekonomski rast selektovanih tranzicionih zemalja

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Abstract

The paper investigates the impact of total fertility rate as one of the basic demographic variables on economic growth per capita concerning six selected transition countries (including the five countries of the Western Balkans: Serbia, Bosnia & Herzegovina, North Macedonia, Albania, Montenegro, and Croatia as a member of the European Union), from 2000 to 2018. The fundamental idea of the research is the view discussed in the recent literature and it concerns the reduction of the total fertility rate as a burning problem of a large number of developed modern economies. Inspired by the question of whether such an attitude is relevant for a group of small European transition countries, an econometric model was constructed , as a framework for the application of statistical analysis of multiple regression. The results of empirical research showed that if the rate of total fertility increased by 0.1% in one of the analyzed countries, the GDP growth rate per capita for this country would fall by 0.53 percentage points in the same year of the period under review.
Keywords: *demographic transition, fertility, total fertility rate, economic growth, transition countries*

Sažetak

U radu se istražuje uticaj ukupne stope fertiliteta kao jedne od osnovnih demografskih varijabli na privredni rast po glavi stanovnika u šest odabranih zemalja u tranziciji (uključujući pet zemalja Zapadnog Balkana: Srbiju, Bosnu i Hercegovinu, Severnu Makedoniju, Albaniju, Crnu Goru i Hrvatska kao članica Europske unije) od 2000. do 2018. Temeljna ideja istraživanja je stav o kojem se govori u novijoj literaturi, a tiče se smanjenja ukupne stope fertiliteta kao gorućeg problema velikog broja razvijenih modernih privrede. Inspirisan pitanjem da li je takav stav relevantan za grupu malih evropskih tranzicionih zemalja, konstruisan je ekonometrijski model, kao okvir za primenu statističke analize višestruke regresije. Rezultati empirijskog istraživanja su pokazali da ukoliko bi stopa ukupnog fertiliteta porasla za 0,1% u jednoj od analiziranih zemalja, stopa rasta BDP-a po glavi stanovnika za ovu zemlju bi u istoj godini posmatranog perioda pala za 0,53 procentna poena.
Ključne reči: *demografska tranzicija, fertilitet, ukupna stopa fertiliteta, ekonomski rast, zemlje u tranziciji*

1. Introduction

Demographic change is undoubtedly one of the key factors of economic and social trends in every country. Therefore, the interest of economics in studying their influence on the movement of key macroeconomic variables, and especially on economic growth, is understandable.

It is indisputable that demographic changes affect the level of consumption and the formation of production capacities of the observed economy. Also, it is unquestionable that changes in population and labor force are of primary importance in the analysis of economic growth. The rate of total fertility is one of the most important variables in the factor analysis of economic growth. High rates of total fertility limit GDP growth per

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capita, while at the same time manifesting the problem of unemployment.

From the publication of the famous work of Robert Malthus (1776-1834) “An Essay on the Principle of Population“ (1798) to the present day, the question of the connection between population and the growth of the value of per capita production has aroused the constant attention of economic researchers. In his work, Malthus (1986) attributed the causes of wars, famine, poverty, and every evil to the gap between population growth by geometric progression and food production by arithmetic progression.

Contrary to the interpretation of Malthusians and neo-Malthusians of the nature of the relationship between population size and levels of economic growth and development, the theory of demographic transition starts from the assumption that natural population dynamics are directly conditioned by the process of modernization of society and changes in lifestyle. The theory of demographic transition is based on the view that there is a pronounced correlation between changes in the components of natural population movement (fertility, birth rate and mortality) and changes in the factors of economic, social and cultural development of a country.

According to the theory of demographic transition, the decline in fertility is an irreversible process and is the result of the inevitable long-term increase in the share of the elderly (due to improved living conditions), and thus economically less active population in the total (Lesthaeghe, 2014). Within this theory, four phases of demographic transition are recognized. High and unstable birth and death rates are present in pre-industrial society. The population is growing at low rates, children are of great importance as a source of labor, life expectancy is short. In the early industrial society, high birth rates, a decrease in the mortality rate and a high natural increase were recorded. Late industrial society is characterized by low mortality rates, declining birth rates and high natural growth rates. Post-industrial society is marked by low levels of birth and death rates, which result in low natural growth.

Demographic issues in macroeconomic theory have been largely discussed in the context of key issues of economic growth theory and policy. In many theories of growth and development, the population growth rate is considered an exogenous variable that has served as a starting point for the growth of the manufacturing sector. To illustrate, the growth model of Nobel Laureate Robert (Solow, 1956), in light of the theme addressed in this paper, is of particular importance. The main reason for this is that, unlike the previous Harod-Domar, Solow’s key driver of economic growth, besides physical capital, is the factor of labor (Dragutinović, Filipović, & Cvetanović 2016, 105). The messages of Robert Solow's growth model are that the population growth rate has a slowing effect on the movement of the growth rate of production per capita over the observed period of time. This is due to the fact that population growth lowers the equilibrium value of the coefficient of technology equipment of work, and thus reduces the size of production per capita (Cvetanović, & Mladenović, 2015).

Thomas Malthus and Robert Solow’s focus of research on the relationship between population growth of the founders of demography as a scientific discipline, is diametrically opposite. The starting point of Malthus is the view that a growing population will inevitably result in a reduction in economic resources. However, in Robert Solow's model, the central question is the influence of population growth rate on the size of production. In particular, the higher population growth rate has its impact on the economic growth of countries, through the equilibrium level of the coefficient of technology equipment of labor.

It can be said that the differences between Malthus's view of the interdependence of economic growth and population growth and the view of the non-classical Robert Solow are the result of the time and circumstances in which they appear. In this regard, we ask what are the potential messages relevant to current economic growth policy and population policy, given the latest demographic trends and growth trends of the group of selected transition countries in the period from 2000 to 2018. The question arises whether the evident change in the structure of the population age means that its treatment in modern economic theory must necessarily change radically. A number of authors advocate such an opinion, and as an illustration, according to Longman (2004), overpopulation is not one of the worst dangers faced by many countries in the world. On the contrary, this researcher claims that the biggest problem is the reduction of birth rates, whose economic and social prices are very high. The reason for this is that countries, in which the total fertility rate is below the simple reproduction level, face a growing share of the elderly in the total population and thus, this is closely related to the problem of financing their consumption. Without going into a more detailed analysis of Longman's fertility promotion policy, it is possible to state its relevance not only for EU countries, but also for the transition countries of Southeast Europe (Cvetanović, Mladenović, 2020). An additional problem of the analyzed transition economies is mass immigration, especially of young and educated population.

According to the above-mentioned facts, first there is a presentation of the results of reference research in this area, and then, the analysis of the data on economic growth per capita and demographic trends of selected transition countries in the period 2000-2018 is given in the paper. In the continuation of the paper, the subject, goals, research methods are defined, and the research results are given with appropriate discussions. Concluding remarks and a list of used literature are presented in the last part of the paper.

2. Literature review

Numerous studies of the relationship between demographic trends and economic growth have attracted the attention of economic researchers over the past decades (Maddison, 1995; Bloom, Canning, & Sevilla, 2001; Bloom, Canning, & Sevilla, 2003). Empirical evidence of the impact of population growth has been extensively studied. It is logical that the demographic impact on real GDP is more visible because it has a direct impact on the volume of available labor force, while the impact on real gross domestic product per capita, as a relative indicator, is smaller. To illustrate, the World Economic Outlook, The Global Demographic Transition (Uluslararasi, 2004), states that the annual GDP growth per capita, on the one hand, is positively correlated with the growth of the share of able-bodied population, and on the other hand is negatively correlated with the growth of the share of older, i.e., relatively economically inactive population. By decomposing of GDP growth into productivity growth component and labor input changes component due to population growth and its aging, Choi et al. (2014) concluded that demographic growth in South Korea has a statisticly negative impact on annual GDP growth. Also, some research claims that an aging population will have a tendency to reduce labor force participation in the total population, which will understandably have a negative effect on the dynamics of economic growth (Bloom, Cunning, & Fink, 2011).

In the past two decades of this century, most economically highly developed countries have faced a process of declining overall fertility rates. This fact affected the process of noticeable aging and depopulation, which in the long run can jeopardize their economic development. Because, a country with a higher share of the elderly population is usually associated with reduced productivity, lower savings and higher government spending (Attanasio et al., 2007; Ludwig et al., 2012; Nagarajan et al., 2016). Numerous recent works which examine the impact of population aging on the structural transformation of the economy, have found a shift in consumption towards goods that are more relevant to the elderly, household maintenance, health and recreational services (Aiiar and Ebeke, 2016).

According to the UN Report on Expected Trends in World Population from 2013 during the 1960s, the total fertility rate in the world averaged about 5%. That percentage shows a trend of significant decline in the last half century and is currently just below 2.5%. It is expected to be just over 2% by the end of the 21st century (United Nations, 2017). In addition, there is a globally significant difference between regions and countries depending on their level of economic development. Around the 1960s, the fertility rate was around 6% in less developed parts of the world. The fertility rate in less developed parts of the world is still significantly higher than the world average. In the middle of the last century, the fertility rate in globally relatively developed areas was slightly less than 3%. Beginning in 1985, this rate dropped to less than 2% (United Nations, 2017; 2013).

Concerning the influence of demographic trends on economic growth, three alternative views were singled out: "population growth limits, encourages or is completely neutral in terms of impact on economic growth, and the nature of this impact depends on the achieved level of economic development (where a “rough” division is made into two categories of countries: developed and developing countries)” (Manić, Azdejković, 2012; 111). Research confirms that more than half of the countries in the world have recorded slower growth, while in OECD countries, demographic trends in the past have provided mostly positive macroeconomic effects (Bloom, Cunning, & Fink, 2011, 19).

The key objective of most research on the interdependence and inter-dynamics of population growth and indicators of economic growth is to find an answer to the question of whether demographic trends related to the populations trigger or slow down the movement of per capita output at the level of national economies.

3. Demographic trends and their impact on the economic dynamics of selected transition countries

Selected transition economies have not reduced the lag in value of GDP pc PPP (constant 2017 & current international $) behind the average of the EU in the observed period of time. Specifically, in 2000, the lowest level of GDP per capita was recorded in Albania and amounted to 6,016 dollars (PPP in constant 2017 international $), and in the European Union 39,871 dollars. It turns out that the difference is $ 28,653. The difference in these indicators in 2019 was $ 30,408 (Figure 1).

Figure 1. GDP p.c., PPP (constant 2017 & current international $) – 2019 and progress compared to 2000

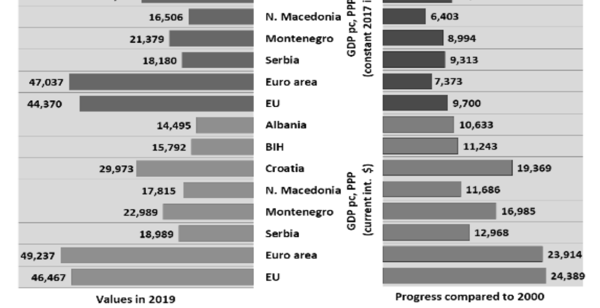
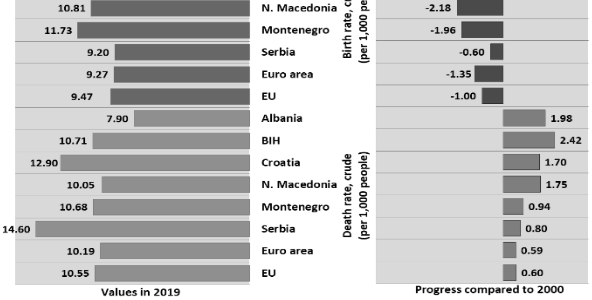


Figure 2. Birth and Death rate, crude (per 1,000 people) – 2019 and change compared to 2000



Source: World Bank (n.d.)

In a series of analyzed transition countries in 2018, lower birth rates were noticed in relation to the average rate of the birth of EU. For example, in Bosnia and Herzegovina it was only 8.11, in Croatia 9.00, in Serbia 9.20, unlike the EU average which was 9.47 that year (Figure 2).

The rate of mortality in 2018 was more noticeable in Serbia (14.60), Croatia (12.90), Bosnia and Herzegovina (10.71), Montenegro (10.68) in relation to the EU (10.55).

The total score of births and deaths gives a much clearer picture of the comparative situation in the observed countries and the EU average (Figure 3). By far the most pronounced rate of negative natural increase is present in Serbia (-5.40). Croatia follows with -3.90 and Bosnia and Herzegovina with -2.60. At the same time, the EU recorded a significantly lower rate of natural increase (-1.08).

Figure 3. Birth-Death rate, crude (per 1k people) for 2000 - 2018

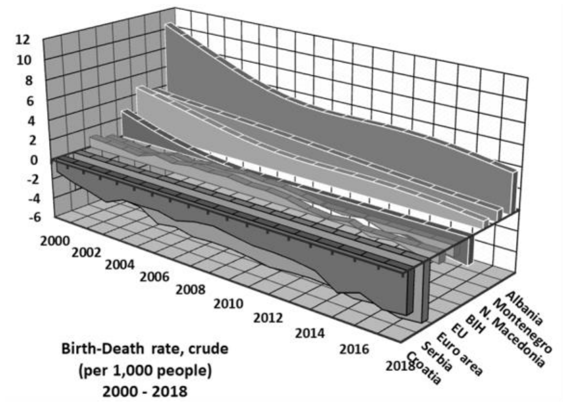
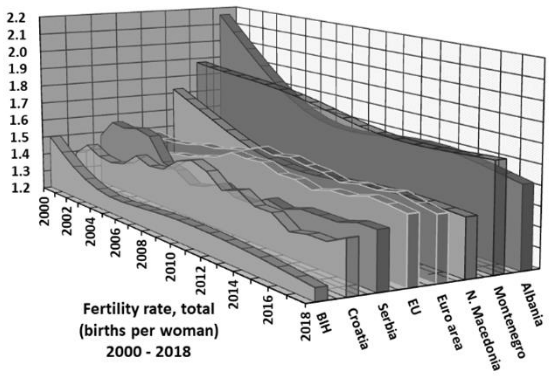


Figure 4. Fertility rate, total for 2000 - 2018

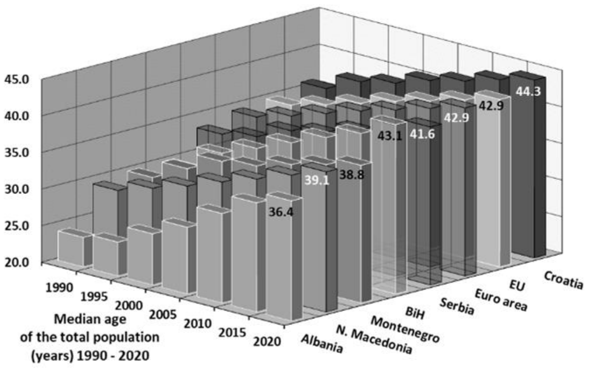


Source: Source: World Bank (n.d.)

Like economically developed countries, the observed transition region between 2000 to 2018 had rates of total fertility below 2.10, which is considered the minimum that ensures simple population reproduction. The only exception was Albania, and only in 2000 with a total rate fertility of 2,16 (Figure 4).

The combination of a very low rate of total fertility in the long run and a continuous increase in life expectancy inevitably leads to an aging population in the observed countries.

Figure 5. Median age of the population between 1990 to 2020

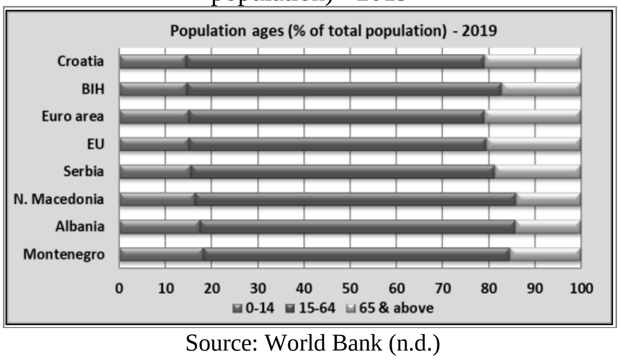


Source: World Bank (n.d.)

Many of authors (see: Lutz et al, 2008, 8; Ranganathan, Swain, & Sumpter, 2015) noticed the fact that almost all European countries face the problem of aging of population. The observed countries of the Western Balkans are in an especially demanding situation, which in the conditions of low fertility and pronounced emigration show a tendency of rapid population decrease both absolutely and relatively (Figure 5).

As the age medians of the population grow, an increasing number of older people in these countries rely on a reduced number of working-age people (Figure 6). For example, the share of residents over the age of sixty in 2019 in Serbia and the European Union was identical and amounted to 20,86%.

Figure 6. Population structure ages (% of total population) - 2019



Source: World Bank (n.d.)

4. Subject, goals, methods, results and discussions

Taking into consideration the previously mentioned theoretical views, the subject of research in this paper is to analyse the role of the overall fertility rate as one of the basic features of demographic trends for economic growth of selected transition countries in Southeast Europe (Albania, Bosnia and Herzegovina, Northern Macedonia, Serbia and Montenegro, or the countries of the Western Balkans and Croatia as a member of the European Union since 2013).

The main research question in the paper refers to the constructing an econometric model that links changes in the rate of fertility and the pace of growth of economic explaned per capita in the observed transition countries between 2000 to 2018. In accordance with the set subject and the research question, the null and alternative hypotheses are defined.

Null hypothesis HO: Changes in the rate of fertility have no impact on economic growth represented by annual GDP growth per capita of the observed countries between 2000-2018.

Alternative Hypothesis H1: Changes in the rate of fertility have an impact on economic growth per capita of the observed countries (with economic transition historical background) between 2000-2018.

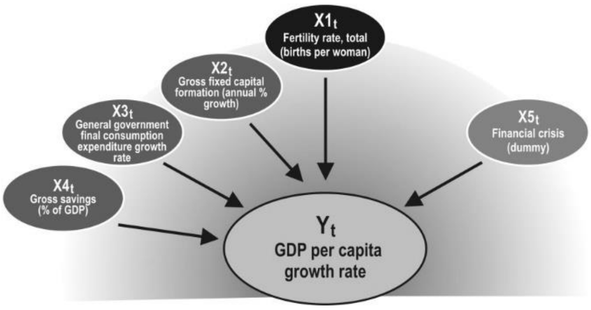
To answer the questions previously asked, the meaning of the basic indicators of the demographic movement is specified in the next parts of the paper. After that, a) a sample, b) potential parameters of importance, c) time frame of observation as well as adequate research methods were determined. The scope (sample) of observations are six selected transition countries (including the five countries of the Western Balkans: Serbia, Bosnia & Herzegovina, North Macedonia, Albania, Montenegro, and Croatia, as a member of the European Union since 2013). The decision to consider this group of countries is motivated by the following facts. First, these are countries that are located in whole or in part on the territory of the Balkan Peninsula. Second, they belong to countries in late transition (Turley, & Luke, 2011) or countries that have become members of the European Union (Croatia, EU member since 2013). Third, the selected countries belong to the group of the least economically developed countries in Europe (except partly Croatia), which can be seen from the data on GDP per capita in this century). Fourth, these countries have birth rates similar of highly developed countries in Europe, except Northern Macedonia, which is contrary to the view that countries with lower levels of economic development, as a rule, have more pronounced birth rates. Fifth, in the observed time interval, these countries had mortality rates close to the average rate of mortality in the EU (as a whole). Sixth, the analyzed countries, except Albania and Montenegro, had negative rates of natural increase (difference between birth rates and mortality rates) in the observed time period. Seventh, the demographic aging in this (observed) region is very pronounced. Besides this, there is the fact that this region have pronounced long term negative migration balances (the difference = the number of immigrants - emigrants). It turns out that the future demographic trends basis of assumptions about the latest demographic dynamics point to a population decrease in the of this region in the short and long term.

The time frame of the analysis is the period from 2000 to 2018. This time interval is long enough for the observations to be valid, and at the same time it represents a period in which the transition processes in the territory of the Western Balkans took place intensively and in which significant changes in demographic trends occurred as a result.

The method we used in our research investigating is the multiple regression technique, which uses panel data in the analysis. The econometric model that is basically defined by the selected parameters within the observed time interval is adapted to a specific research question. In particular, the dynamics of economic growth are represented by real annual growth rates of GDP per capita. Thus, the annual GDP growth rate p.c. in this scientific research it represents an explained, endogenous and dependent variable. The explanatory, exogenous and independent variable, on the other hand, would be the one that determines the overall annual fertility rate. Precisely for that reason, a time period of 19- year-observation was taken, as it is necessary for one newborn resident to become able to work.

In addition to the mentioned independent variable, control variables were introduced into the model, which, in accordance with the theory, contribute to the dynamics of the economic growth. Namely, in the models of economic dynamics, the key figures for explanation of the annual GDP growth rate p.c. are investments, savings and government spending. Considering these facts, the first control variable (X2) is the growth rate of fixed capital formation, the second growth rate of government final consumption (X3), the third savings rate as a percentage of GDP (X4) and the fourth is the control variable and refers to the financial crisis (X5) which spilled over from the USA to Europe at the end of 2008 and the beginning of 2009 and which had negative consequences on the dynamics of economic activities in these countries (Fig. 7). The control variable has the status of an artificial variable in the model. This means that in the year when the crisis affected the analyzed economies (more precisely in 2009), the value of the artificial variable is 1, and when there was no financial crisis, its value was 0 (Nedić, Turanjanin, & Cvetanović, 2020).

Figure 7. Impact model



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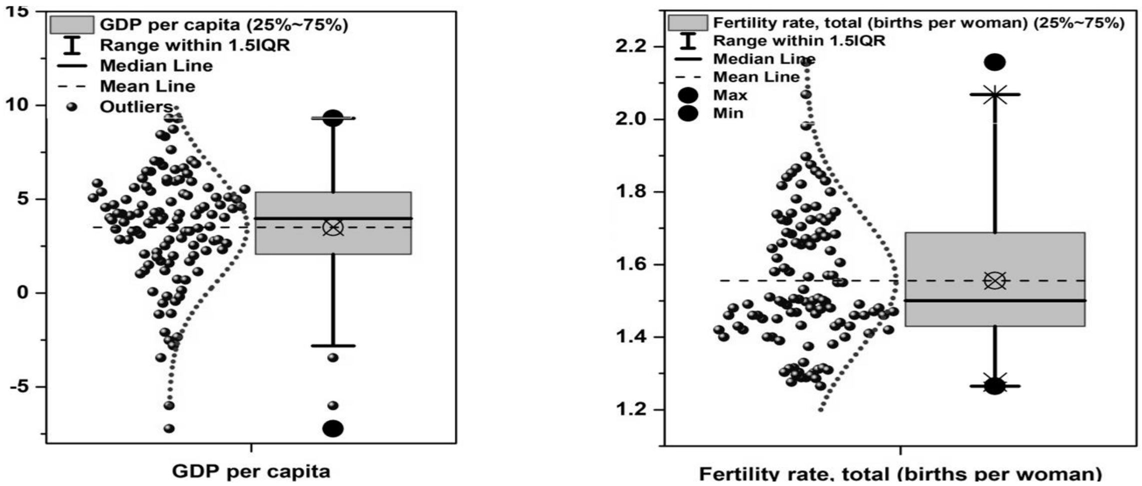
4.1. Descriptive statistics

The summary view of data for the endogenous (dependent) and main exogenous (independent or explanatory) variable of predicted model, for all investigated countries, is shown using a box plot diagrams for the observed period from 2000 to 2018. (Figure 8).

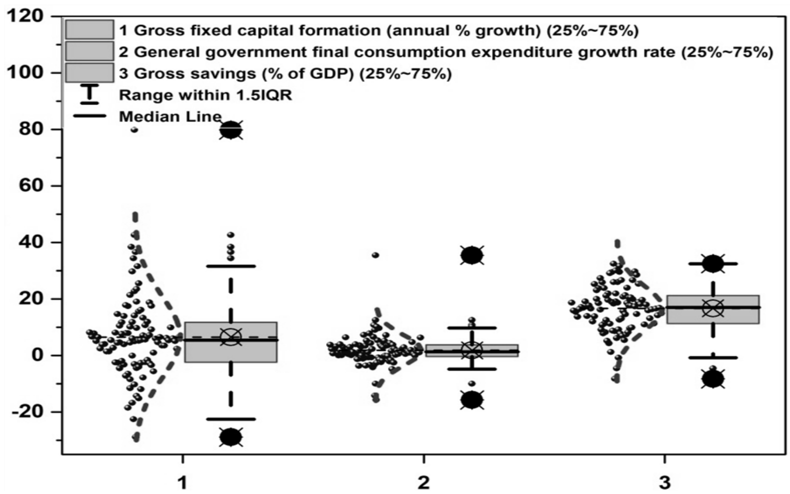
Figure 8. Summary statistics of endogenous / dependent variable and main exogenous / independent variable for the selected / observed countries



Variable	Y - GDP growth rate per capita	X1 - Rate of fertility, total (births per woman)
Mean	3.507	1.555
Median	3.968	1.501
Standard Deviation	2.914	0.186
Minimum	-7.226	1.265
Maximum	9.311	2.157
Range	16.537	0.892
Standard Error	0.273	0.017

In the same manner, the summary statistics for all auxiliary exogenous variables for investigated countries is shown in Figure 9, and the mechanism of their influence reflects the proposed econometric model.

Figure 9. Summary statistics of auxiliary / independent / exogen variables for the selected / observed countries.



Variable	X2 - Gross fixed capital formation (annual % growth)	X3 - General government final consumption expenditure growth rate	X4 - Gross savings (% of GDP)
Mean	6.496	1.793	16.672
Median	5.437	1.315	16.955
Standard Deviation	14.429	5.491	7.958
Minimum	-28.902	-15.759	-8.280
Maximum	79.783	35.460	32.442
Range	108.685	51.219	40.721
Standard Error	1.450	0.552	0.812

The results presented in Figure 8 and 9 show the differences within the observed entities between 2000 to 2018. Considering the dependent variable GDP p.c., it is noticed that the values varians in the observations is acceptable for our model, because the standard deviation is about 3, which is more than five and a half times less than the range value (which is approx. 16.5). Also, concerning aggregate statistics, the following conclusion can be drawn for the selected / observed countries:

- Variables record a statistically satisfactory level of data noise because the coefficient of variation is low for both a) exogenous / independent (X1 to X4) variables and endogenous / dependent variable (Y), which corroborate the potential adequacy of the proposed econometric model for selected / observed countries.
- The dependent variable Y (which stands for the economic growth) records the highest level of data homogeneity for the selected / observed countries;

Visually, it can be noticed outlier (extremely low or high values) data for models' variables appear within the observed population, but this was expected for the period 2000s, when due to the disintegration of SFRY some of the observed countries were the most politically and economically unstable part of Europe. The occurrence of atypical data is very small with the main independent variable X1 (Fertility rate). Approximate values of the median, mean value, as well as the position of the maximum / minimum of the model variables (standard limit value is defined as the level of K3 + 1.5 * IKR / K1- 1.5 * IKR), show that most data are comparable and homogeneous (Chaudhary, 2020). This confirms that the model is sustainable because the deviations of the values of the observed variables in the model are acceptable for analysis. Therefore, the selected variables can be incorporated into the proposed econometric model to analyze their interdependence.

4.2. Stationarity test as a prerequisite for panel data analysis

The precondition for the analysis of panel data is the stationarity of the data of the observed variables in relation to the time axis in the model (absence of a unit root). In cases where there is no time stationarity of the variables, we cannot confirm the reliability of the regression (Levin, Lin, & Chu, 2002) and the estimated parameters of the function become biased. Since, according to the predicted model, three (out of four) independent variables represent scalar indicators of the dynamics of the macroeconomic conditions (as percentage values), it can be said that they have the nature of inherently relative parameters so their time stationarity can be assumed. The dependent variable represented by annual GDP growth rate p.c., also have the nature of inherently relative parameter. To check the preasumption of time stationarity of the panel data, the Levin-Lin-Chu stationarity test (unit root test) was applied and the results are shown in Table 2.

Table 2. Stationarity test results for variables data in the model (balanced data with average values)

Ho: Panel variables show the existence of a unit root; No. of panels (countries) = 6			**Ha: Panel variables are time fixed; No. of time periods = 19**		
Variable	Y GDP growth rate p.c.	X1 Fertility rate	X2 Gross fixed capital formation	X3 General gov final consumpt.	X4 Gross savings as % of GDP
p-value	0.0013	0.0000	0.0000	0.0000	0.0421
Unadjusted t stat.	-5.7172	-7.0484	-8.8627	-9.4613	-1.8010
Adjusted t* statistic	-3.0177	-4.0515	-4.8597	-5.3264	-1.7267

The results of the stationarity test of the analyzed panel data (shown in Table 2), indicate the rejection of the null hypothesis of the applied unit root test (p-value <0.05 for all observed independent variables), which confirms that the independent variables in the model are temporal stationary. Test also shows a statistically significant tendency of time stationarity of endogene / dependent variable Y (GDP growth rate p.c.) in the model. Accordingly, the results of the applied test reject the hypothesis of the existence of stationary variables in the model.

4.3. Multiple linear regression analysis

Marking the number of countries with i, it follows that i = 1, ...6. These countries were observed in a time interval of 19 years, t = 1, ...19. The panel data regression model is described by the following function (Wooldridge, 2013):

$$y_{it} = \alpha + x_{it}^{'}\beta + c_i + u_{it} \qquad (1)$$

Where: yit is dependent variable (for the i-th country and for the t-th year), α is intercept, x′it is a K-dimensional vector of exogen explanatory variables (for the i-th country for and the t-th year), β is K-dimensional vector of functional parameters, ci is effect specific for each country (for the i-th country) and uit is a general error (total value for the i-th country and for the t-th year).
The following matrices model T yearly observations (T = 19 years) for each of the N selected countries (N = 6).

The analysis with a total of T observations for each entity in the panel data is represented as:

Dependent variable yi,:

$$\boldsymbol{y_i} = \begin{bmatrix} y_{i1} \\ y_{i2} \\ y_{i3} \\ \dots \\ y_{i19} \end{bmatrix}_{19\times 1}$$

5 exogenous, explanatory, independent variables Xi=1-5:

$$\boldsymbol{X_i} = \begin{bmatrix} x_{i1}^{'} \\ x_{i2}^{'} \\ x_{i3}^{'} \\ \dots \\ x_{i19}^{'} \end{bmatrix}_{19\times 5}$$

General error (total value):

$$\boldsymbol{u_i} = \begin{bmatrix} u_{i1} \\ u_{i2} \\ u_{i3} \\ \dots \\ u_{i19} \end{bmatrix}_{19\times 1}$$

Countries is denoted by N, (N = 6), years is denoted in the set t by T, (T = 19) and independent variables in regression is denoted by K (K = 5). We can now label N*T as observations for all panel entity (in this case countries) and all time periods as::

$$\boldsymbol{y} = \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ \dots \\ y_6 \end{bmatrix}_{N\times Tx1} \qquad \boldsymbol{X} = \begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \end{bmatrix}_{N\times T\times K\to 6\times 19\times 5}$$

It is assumed that the nature of the analyzed process can be approximated by a linear function in model (formula 1), provided that E[uit]=0 and E[ci]=0.

In practical terms, we distinguish two borderline cases. The first, when it is assumed that the effect that is characteristic of a particular observed entity (in this case the country) is random in relation to other model variables. This means that the variable that represents the specific effects of each entity in the model (ci) is a random variable that does not correlate with the explanatory/independent variables of the same model and this applies to all observed time periods.

On the contrary, the second boundary case assumes a fixed character of the specific effects of individual observed entities, where a correlation with one or more independent, i.e., explanatory variables in the model is possible. Theoretically, this is a setup of a multiple regression model with a random or fixed, entity specific effect (Schmidheiny, 2013). However, in this particular study, this would, in the case of random effects models, assume that country-specific economic effects (ci) do not correlate with explanatory variables at all and change completely independently over time and from country to country. From the econometric viewpoint, this is a very hermetic and strict assumption and, in most cases, it is not realistically applicable. Therefore, multiple models with a fixed effect are much more realistic in economic research because it assumes that the specificity of the each observed country can be correlated with explanatory/independent variables and do not change over time, i.e., to reflect long-term specifics of the economic environment. This assumption is much more realistic from the from the econometric viewpoint and is prevalent in economic analyzes. On that basis, in this research, is also assumed that the more adequate application is a multifactor model with a fixed effect, but with statistical validation test in compare to model with a random effect.

The application of the model showed that the rate of fertility from the current year is a statistically significant variable that affects the annual rate of growth in economy, in the same (current) year, which confirms theoretical postulates. It means that the rate of fertility (without time lag) is a statistically significant variable for the rate of annual economic growth rate in the current year.

$$y_{it} = f(X1_{i,t}, X2_{i,t}, X3_{i,t}, X4_{i,t}, X5_{i,t}) \qquad (2)$$

The results of the chosen model in research method (multiple regressions with a fixed entity specific effect) are shown in the following Table 3.

Table 3. Model with multiple regression (fixed effect)

Panel of Countryes as entities	No. of observation 92					
R^2: within panel = **0.5227**	No. of countries 6					
between panel = 0.0697	Observation per country: minimum=12; maximum=19; average =15.3;					
overall = **0.3693**	F(5,81)= 17.74					
corr(u_i, Xb) =- 0.2727	Prob >F= 0.0000					
GDPpercapitagrowth	**Coefficient**	**Standard Error**	**t**	**P> |t|**	**[95% Confidence Interval]**	
Fertilityratetotalbirthsper	-5.274643	2.718603	-1.94	0.056	-10.68381	.1345244
Grossfixedcapitalformationan	.1071405	.0171406	6.25	0.000	.073036	.1412449
Generalgovernmentfinalconsumpt	-.0582287	.0415622	-1.40	0.165	-.1409245	.0244671
GrosssavingsofGDP	.082457	.0467861	1.76	0.082	-.0106327	.1755467
Dummy	-3.506091	.943496	-3.72	0.000	-5.383352	-1.62883
_cons	9.613344	4.207554	2.28	0.025	1.241632	17.98506
sigma u	1.3779558					
sigma e	2.0556039	(fraction of variance due to u_i)				
Rho	.31003896					
F test that all u i=0:	F(5, 81)= 3.75 Prob > F = 0.0042					

Source: Based on the calculation according to the proposed model.

Table 3 show that the independent and control variables (except X3-General government final consumpt) in the model have statistical significance. Namely, a hypothetical assumption that independent variables are determinants of dependent variables (real growth rates of economic per capita) is accepted with a probability of over 70%. The statistical F test detects a significant level of probability, which indicates that all coefficients of explanatory/exogenous variables are different from zero, and that they have a statistically significant impact on the dependent endogenous variable (annual GDP growth rate per capita). The correlation between the exogenous/independent variables and the residuals (difference betwen predictid and real i.e., observed values of dependent Y) is different from zero (but statisticly insignificant 0.2727), which suggests that the variables are adequately implementid in the model. Specifically, the more successfully the explanatory variable determines the value of the explained variable, the lower the value of the residual (statistical error).

According to the above observations, we can draw the conclusion that the constructed econometric model is adequate and it is presented in the following way: As the influence of the main independent variable X1 is statistically significant but negative, the results of the research presented in the previous equation suggest that, under other unchanged circumstances, the rate increase total fertility by 0.1. In other words, if 10 out of 100 women in their fertile period give birth to at least one more child in one year, this results in a reduction in the annual GDP growth rate p.c. by 0.527% in the following year. The proposed econometric model is in accordance with the previously set postulates and confirms the alternative research hypothesis. The correlation coefficient of determination is R2=0.5227, which means that the model is valid in 52.27% of observations. Coefficient of determination of 0.056 (which is slightly higher than the limit of 0.05) does not statistically diminish the proof of the alternative hypothesis H1 according to which changes in the total fertility rate affect economic growth. In this particular case, this would mean that an initial increase in the rate of fertility and the consequent increase in population would have a negative impact on economic growth per capita in the six analyzed countries of Western Balkans region in the observed period.

Three out of four control variables further confirm the validity of the model. Namely, it is unequivocally pointed out to the generally accepted postulates in the field of macroeconomics, that increasing investment and savings results in higher GDP growth rates p.c. in that business year. In contrast, the occurrence of the financial crisis, or economic crisis in general, is causing a decline in GDP growth rate p.c. Variable X3, representing the amount of public spending, has no significant impact in the model.

The proposed econometric model of multiple regression also assumes a correlation between uit (residues that in one part represent the ci as specific effects of each of the observed economies), on the one hand, and exogenous / explanatory and control variables, on the other hand. Written in the language of mathematics, this means that E= (uit | Xi, ci) =0, which indicates that a multiple regression model with fixed specific effects of each of the observed economies was constructed. This, in practical terms, means that the individual specifics of the observed countries have an endogenous character, i.e., they represent an individual, countries spesific determinant of the real GDP growth rate per capita, which is correlated with independent i.e., control variables. In order to confirm the validity of this assumption, and thus the constructed econometric model, the statistical test of model validity (Hausman test) should be performed. The null hypothesis in this test is that there is no significant correlation between the residual uit (which also contains the side effects specific for the observed economy ci), on the first, and the independent/explanatory and control variables, on the second hand. In other words, a random effect model should be used. An alternative hypothesis is that the correlation still exists and that the model for the fixed effect is adequate. A random effect model was constructed for this purpose (Table 4).

Table 4. Model with multiple regression (random effect)

Panel of Countryes as entities
R^2: within panel =0.4970
between panel =0.1409
overall =0.4657
corr(u_i, Xb) = 0 (assumed)

No. of observation 92
No. of countries 6
Observation per country: minimum=12; maximum=19; average =15.3;
Wald chi2(5) = 74.95
Prob > chi2 = 0.0000

GDPpercapitagrowth	Coefficient	Standard Error	t	P> |t|	[95% Confidence Interval]	
Fertilityratetotalbirthsper	.3534894	1.33691	0.26	0.791	-2.266806	2.973785
Grossfixedcapitalformationan	-.0481776	.044238	-1.09	0.276	-.1348825	.0385272
Generalgovernmentfinalconsumpt	.0646216	.0303386	2.13	0.033	.0051591	.1240841
GrosssavingsofGDP	.0959557	.0178481	5.38	0.000	.0609739	.1309374
Dummy	-3.746942	1.011645	-3.70	0.000	-5.729729	-1.764155
_cons	1.251963	2.063744	0.61	0.544	-2.7929	5.296826
Σ u	0					
Σ e	2.0556039			(u_i share of variance)		
ρ (Rho)	0					

Source: Based on the calculation according to the proposed model

The output data of the Hausman test (for arbitration between models with fixed and random entity specific effects) are given in Table 5.

The results in Table 5, indice that the main hypothesis (H0) of the Hausman test is rejected with a statistical significance of 99%. This tells us that an alternative hypothesis about the existence of correlation and adequacy of the model with a fixed effect has been proven. More precisely, it has been proven that there is a correlation between the residues in the model (which also represents the effect of economic specifics of each of the observed countries), on the one hand, and independent / explanatory as well as control variables, on the other.

Written in the language of math, this means that E= (uit | Xi, ci) ≠0. Accordingly, the proposed econometric model of multiple regression with a fixed specific effect of each observed entity is completely appropriate (Table 6). Comparative results of regression model of panel data with fixed and random effect.

Table 5. Fixed vs. random test results (Hausman test)

Validity testing - Fixed versus random effect	Coefficients (b) Fixed_eff	(B) Random_eff	(b-B) Difference_eff	sqrt(diag(V_b-V_B)) S.E.
Fertilityratetotalbirthsper	-5.274643	.3534894	-5.628132	2.604997
Grossfixedcapitalformationan	.1071405	.0959557	.0111848	.0047174
Generalgovernmentfinalconsumpt	-.0582287	-.0481776	-.0100511	.0068415
GrosssavingsofGDP	.082457	.0646216	.0178354	.0402336
Dummy	-3.506091	-3.746942	.2408509	.0958661
b = sustainable under both hypotheses (both H0 and Ha);				
B = unsustainable under hypothesis Ha, sustainable under hypothesis Ho;				
Assumption of the Test, ie the primary hypothesis Ho says: the coefficients in the panel do not differ due to the systematic (fixed) effect				
chi2(**5**) = (b-B) ' [(V_b-V_B)^(-1)] (b-B)= **16.17**				
Prob>chi2 = **0.0064**				
(V_b-V_B is not positive definite)				

Source: Based on the calculation according to the proposed model

Table 6. Comparative results of regression model of panel data with fixed and random effect

Variables of model	No time Lag Fixed_eff	No time Lag Random_eff	Time Lag 1 year Fixed_eff	Time Lag 1 year Random_eff
Fertilityratetotalbirthsperp	-5.275*(2.719)	0.353(1.337)	-1.180(3.640)	1.147(1.530)
Grossfixedcapitalformationanp	0.107***(0.0171)	0.0960***(0.0178)	0.117***(0.0205)	0.112***(0.0208)
Generalgovernmentfinalconsumptp	-0.0582(0.0416)	-0.0482(0.0442)	0.124**(0.0502)	0.128**(0.0510)
GrosssavingsofGDP	0.0825*(0.0468)	0.0646**(0.0303)	0.0894*(0.0526)	0.0796**(0.0330)
Dummy	-3.506***(0.943)		5.436***(1.064)	
Constant	9.613**(4.208)	1.252(2.064)	2.346(5.621)	-1.055(2.384)
Observations	92	92	89	89
R^2	0.523	0.4970	0.442	0.4016
No. of Countryes	6	6	6	6
CountryID FE	YES		YES	
*** p<0.01, ** p<0.05, * p<0.1 (The standard error value is given in parentheses)				

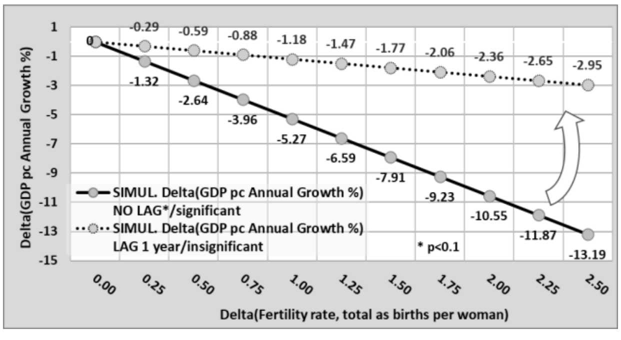
Source: Based on the calculation according to the proposed model

This procedure tested and proved the hypothetical assumption that changes in demographic trends have a significant impact on the realized rates of economic growth per capita. More precisely, we have shown that growth in population in the analyzed economies could have a negative and significant (in statistical terms) impact on the realized yearly growth rate GDP p.c. The application of the proposed econometric model of multiple regression has unequivocally shown that, with the ceteris paribus clause in the observed group of countries and in the selected period of observation, increasing the rate of fertility in one year affects the reduction of yearly growth rate GDP p.c. in subsequent years (with time lag).

Figure 10 graphically shows a simulation of the change in the annual GDP growth rate pc under the influence of the change in the rate of fertility (X1). It is obvious that this influence according to the set model has a negative impact and statistical significance in the current year. With the flow of time lag, this influence is almost completely lost in the first year, both in terms of intensity of impact and significance (in statistical terms).

This procedure tested and proved a hypothetical assumption that changes in demographic trends have influence on the realized of annual economic growth rates per capita. More precisely, we have shown that assuming the rate of total fertility above the actual rate, in the analyzed economies as a whole would have a negative and significant (in statistical manner) impact on the realized growth rates of GDP p.c. The proposed and applied multiple regression model showed with great statistical significance that with the ceteris paribus clause in the observed group of countries and in the observed and analyzed time period, the increase in the rate of fertility in one year affects the decrease in the GDP growth rate per capita in that year.

Figure 10. Graphic representation of the impact in the of Fertility rate (X1) on annual growth of GDP pc (with and without time lag) in the assumed impact model



Source: Based on the calculation according to the proposed model

5. Conclusion

Demographic changes with their overall, but primarily impact on economic growth has captured the attention of macroeconomists for decades. This is due to the fact that the relations between population growth and GDP trends are complex and ambiguous in terms of causes and consequences. Population growth can be seen both as a stimulus and as a constraint on GDP growth. In economically underdeveloped countries, accelerated population growth is generally seen as a barrier to GDP growth per capita.

The subject of the research is the influence of the total fertility rate on the economic growth of six territorially and culturally very close countries. These are developed countries in Southeast Europe, with exeption Croatia, which have a pronounced depopulation. Namely, fertility rate in oberved countries, except Albania, is lower not only not only than 2.1, which ensures simple reproduction of the population, but also lower than the EU average. Thus, this is a region that is not typical according to economic researchers that a low level of GDP p.c., as a rule, correlates with high population growth rates. On the contrary, these countries, in addition to being characterized by low economic development, have a declining trend concerning their population.

Abstracting the issue of migration, the paper investigates the impacting connections of the fertility rate growth on the movement of GDP per capita in this observed region between 2000 to 2018. The research question that if changes in the overall rate of fertility have a pronounced negative and significant (in statistical manner) impact on the economic growth rates of observed transition countries has been proven. This result, no matter how expected, was important for the simple reason that the relations between population growth and GDP trends are complex and ambiguous in terms of causes and consequences. As an outcome of this effect, the movement of the population appears simultaneously as a factor of production, on the one hand, but also as a factor on the side of aggregate consumption.

Applying the multiple regression model, it was unequivocally shown that the ceteris paribus clause in the countries of the observed region and in the observed period, the increase in the rate of population fertility in one year affects the decrease in the GDP growth rate per capita, in the current, but also (to a lesser extent) in following year. Specifically, the results of the constructed model point to the conclusion that, under other unchanged circumstances, the increase in the fertility growth rate of 0.1 (in other words, if in one year 10 out of 100 women in their fertile period give birth to at least one more child), results in a decline in the GDP growth rate p.c. by 0.53%.

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