European Research Studies Journal
Volume XXVI, Issue 1, 2023

pp. 354-378

Gender Equality and Economic Growth in BSR and EAP Countries: A Quantitative Approach

Submitted 05/02/23, 1st revision 25/02/23, 2nd revision 11/03/23, accepted 30/03/23

Anna Gdakowicz[1], Małgorzata Guzowska[2], Marta Hozer-Koćmiel[3], Leszek Gracz[4]

Abstract:

Purpose: *The main objective of the paper is to quantitatively analyze the relationship between gender equality and economic growth in selected countries worldwide.*
Design/Methodology/Approach: *The study is based on the Solow Augmented model. Four hypotheses have been tested: Hypothesis 1 (H1): Higher educational levels of women lead to greater economic growth. Hypothesis 2 (H2): Greater participation of women in the labor market leads to greater economic growth. Hypothesis 3 (H3): Higher fertility and fecundity rates lead to lower economic growth. Hypothesis 4 (H4): Greater participation of women in the democratic system leads to greater economic growth.*
Findings: *The research on links between gender, economic growth and development has proven that the power and mutual impact of these categories can differ significantly depending on the type of growth and key driving factors. The relation between GDP per capita and female wages was proved statistically significant.*
Practical Implications: *Increased women's market activity means a more effective allocation of human resources, better use of people's talents (both women and men), the consequence of which is a positive impact on economic growth. Gender equality was thus described as "smart economics". We have proved that in the European countries under study plus Georgia and Armenia a 1 % increase of female wages will result in GDP per capita rising by 0.56%.*
Originality/value: *The paper is based on own, primary research.*

Keywords: *Gender Equality, Economic Growth, Quantitative Approach. BSR, EAP.*
JEL classification: *E61, J16, R12.*
Paper Type: *Research study.*

Acknowledgement: *The project is co-financed within the framework of the program of the Minister of Science and Higher Education under the name „Regional Excellence Initiative" in the years 2019 – 2022; project number 001/RID/2018/19; the amount of financing PLN 10,684,000.00*

[1]*University of Szczecin, Institute of Economics and Finance, ORCID: 0000-0002-4360-3755, anna.gdakowicz@usz.edu.pl;*
[2]*University of Szczecin, Institute of Economics and Finance, ORCID 0000-0002-7000-7916, malgorzata.guzowska@usz.edu.pl;*
[3]*University of Szczecin, Institute of Economics and Finance, ORCID: 0000-0003-0443-516X, marta.hozer-kocmiel@usz.edu.pl;*
[4]*University of Szczecin, Institute of Spatial Economy and Socio-Economic Geography, ORCID: 0000-0002-1152-5676, leszek.gracz@usz.edu.pl;*

1. Introduction

The topic of gender equality and its impact on social, political, and economic aspects is a recurring theme in literature, with efforts in the social and political arenas to include women in different decision-making areas under conditions of equality with men. Inclusive economic growth means that a country's growth and development should involve the contribution of all citizens without excluding an important group, specifically women.

Most authors have focused on gender factors that trigger an increase in economic growth for both low- and high-income countries, resulting in inclusive economic growth, and the idea that "gender equality brings about economic growth, but economic growth does not necessarily bring about gender equality" (Brashaw et al. 2013) is widely accepted.

Based on a review by Cabeza-García, Del Brio, and Oscanoa-Victorio (Cabeza-García *et al.,* 2018), four pervasive hypotheses were defined about the relationship between economic growth and gender equality:

- Hypothesis 1 (H1). A higher educational level of women leads to greater economic growth.
- Hypothesis 2 (H2). Greater participation of women in the labor market leads to greater economic growth.
- Hypothesis 3 (H3). Higher fertility and fecundity lead to lower economic growth.
- Hypothesis 4 (H4). Greater participation of women in the democratic system leads to greater economic growth.

The main goal of the article was a quantitative analysis of the relationship between gender equality and economic growth in selected countries worldwide, using the Solow Augmented model.

2. Literature Review on Effects of Gender Factors on Economic Growth[5]

The four assumed hypotheses are based on the literature review. Table 1 presents the elaboration and justification of the hypotheses.

[5]*The analysis has been performed for the purpose of the Swedish Institute project 'EUSBSR Forum for Gender Equality and Economic Growth', 3.0, 2020 – 2022.*

Table 1. *Expansion of four hypotheses about the relationship between economic growth and gender equality*

Hypothesis 1 (H1) With a higher educational level of women, greater economic growth is expected	
The relationship between the education levels of women and economic growth has been previously studied, with contradictory results since evidence exists for both a negative and positive relationship.	(King and Hill 1993) (Knowles et al. 2002)
The education gender gap was found to block economic growth and significantly reduce GDP, when modeled theoretically.	(Licumba et al. 2015) (Cuberes and Teignier 2012) (Qureshi et al. 2011)
Most of the researchers used the access of women to primary education measured by the number of girls in school, or the access of women to secondary education. Few studies measured the access of women to university, although a positive relationship between economic growth and university studies were identified.	(Barro and Lee 1994) (Klasen and Lamanna 2009) (Barro and Lee 1996) (Barro and Sala-i-Martin 2003)
Studies indicated that gender inequality in education reduces the average amount of human capital in a society and, therefore, harms economic growth.	(Hakura et al. 2016) (Knowles et al. 2002) (Dollar and Gatti 1999) (Forbes 2000) (Klasen 2002) (King and Hill 1995)
Hypothesis 2 (H2) With a higher participation of women in the labor market, greater economic growth is expected	
Most authors, with few exceptions, have found a positive relationship between the greater access of women to employment and economic growth.	**(**Cuberes and Teignier 2012) (Moghadam 2003) (Baliamoune-Lutz and McGillivray 2007) (Elborgh-Woytek et al. 2013)
Two measures of inequality have been used in analyzed papers: the proportion of women participating in the overall labor force, and the proportion of the female population of working age in formal employment.	(Klasen and Lamanna 2009) (Klasen 1999)
Hypothesis 3 (H3) With higher fertility and fecundity, lower economic growth is expected	
The changes in fertility and the age structure can affect the rates of national savings and investment and increase productivity by improving the health and education of each child.	(Bloom et al. 2012) (Deaton and Paxson 1997) (Lee et al. 2001) (Goldin 2014) (Angelov et al. 2016) (Kleven and Landais 2017)

Lower fertility can induce higher rates of business activity or employment for women, especially in low-income countries.	(Bloom et al. 2009)
It has been confirmed that fertility has a negative and significant effect on the rate of GDP growth, whereas fertility and income per capita have been shown to be positively associated in the majority of high-income OECD countries. This relationship is also produced when salaries increase, the salary gap persists (Hartman 2010), and the results of fertility are translated into higher salaries for women (Kumara 2013).	(Hartmann 2010) (Day 2012) (Komura 2013)
The necessity of good social planning so that fertility significantly raises the production per capita has been demonstrated.	(Razin and Sadka 1995) (Golosov et al. 2007) (Kleven 2019)
Hypothesis 4 (H4) With the greater participation of women in the democratic system, greater economic increase is expected	
Early research on the relationship between economic growth and democracy underscored a positive relationship between the two variables.	(Lipset 1959) (Bolleen 1979)
The greater proportion of women with legislative power would help introduce new policies for social and economic development that also empower women. These policies include establishing gender quotas, redirecting the distribution of wealth, and eliminating discrimination against women, since women politicians know the many difficulties, they have faced to dedicate themselves to politics.	(Kabeer and Natali 2013) (Ramanayake and Ghosh 2017) (Gerring et al. 2005)

Source: *Own elaboration.*

3. The Augmented Solow Model Including Human Capital

Solow (1956) developed a model from the neoclassical production function and assumed diminishing marginal returns to capital, exogenous population growth and savings rate, no depreciation and technological progress. The model predicts how the steady-state level of income per capita depends on the savings rate and the population growth rate, which leads to the view of convergence.

In testing the Solow model, Mankiw, Romer and Weil (1992) presented the augmented Solow growth model which yielded up with an equation that includes both physical and human capital as the fundamental determinant of growth. It sees output growth as an element of physical capital, human capital, exogenous labor growth rate and technological improvement.

Hence the researchers derived the augmented Solow growth model containing the variable for human capital (Mankiw *et al.*, 1992):

$$Y = Af(K, H, L) \tag{1}$$

where:
Y – output
A – technology level
K – physical capital
H – human capital
L – inputs of labor

By arranging this model into a Cobb-Douglas production function one gets:

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} (A(t)L(t))^{1-\alpha-\beta} \qquad \alpha + \beta < 1 \tag{2}$$

Parameters a and b are the output elasticities with respect to physical and human capital (shares of physical and human capital in total income), respectively. Mankiw, Romer and Weil (1992) extended the Solow dynamics of physical capital accumulation to human capital. Thus, the dynamic of growth takes the form:

$$\dot{K}(t) = s_k Y(t) - \delta K(t) \tag{3}$$
$$\dot{L}(t) = nL(t) \tag{4}$$
$$\dot{A}(t) = gA(t) \tag{5}$$
$$\dot{H}(t) = s_h Y(t) - \delta H(t) \tag{6}$$

Where s_k and s_h denote the fraction of output devoted, respectively, to physical and human capital accumulation, n is the rate of growth of labor, g is technological progress, and d is the rate of depreciation. A dot over a variable indicates the derivative with respect to time. Assuming the existence of a steady state with $\alpha + \beta < 1$, Mankiw, Romer and Weil (1992) obtained the following steady-state estimable version of the model:

$$ln\frac{Y_t}{L_t} = lnA(0) + gt + \frac{\alpha}{1-\alpha-\beta}\ln(s_k) + \frac{\beta}{1-\alpha-\beta}\ln(s_h) - \frac{\alpha+\beta}{1-\alpha-\beta}\ln(n+g+\delta) \tag{7}$$

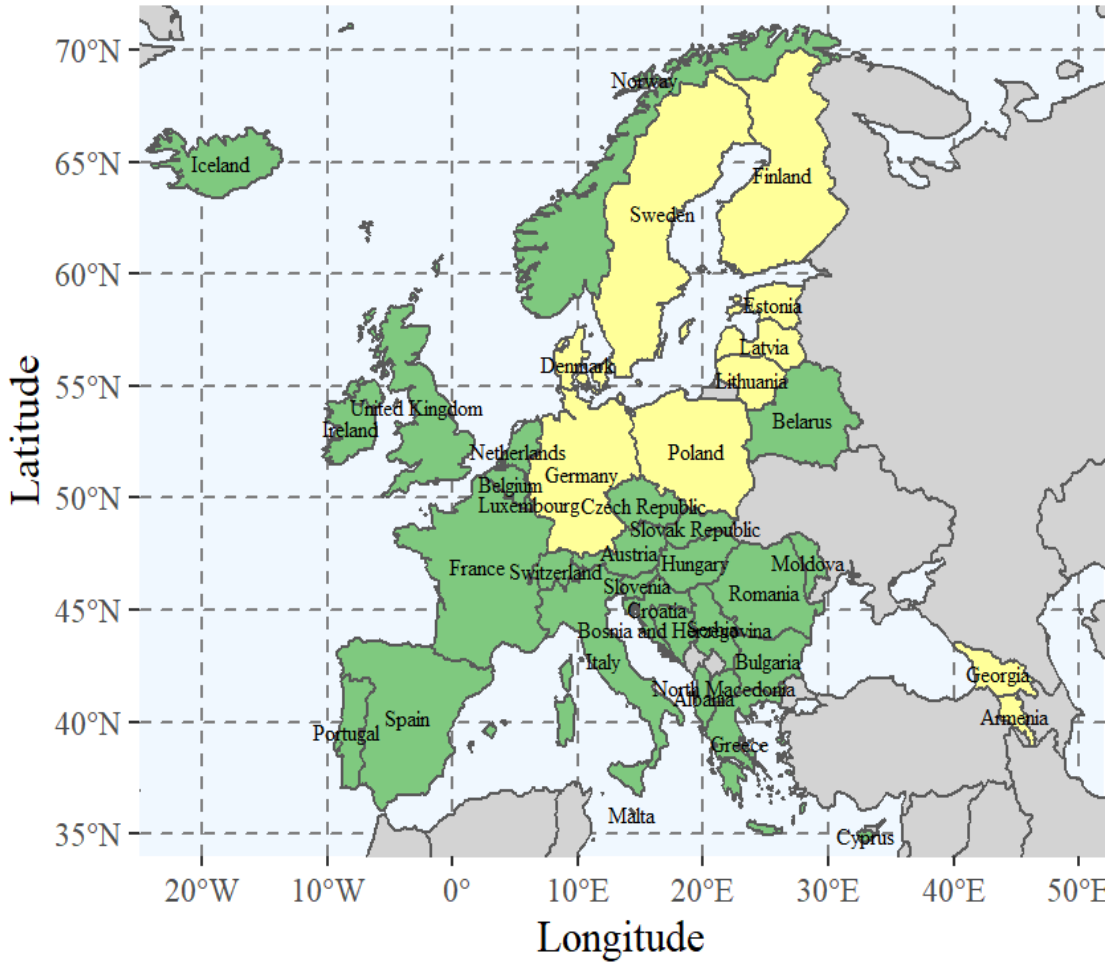
Equation (7) provides the basic framework for testing the augmented Solow model. The model predicts that the steady-state level of income per capita is positively affected by investment in both physical and human capital and negatively affected by population growth, depreciation, and exogenous technological progress, and requires that they coefficients sum to zero.

4. Empirical Study of the Relation between Economic Growth and Gender Equality

The original plan for the study was to cover all European countries. However, due to insufficient data, the scope was narrowed down to 37 countries, which are highlighted in green and yellow on the map.

The study also placed particular emphasis on countries associated with the Winnet: Baltic Sea Region (BSR) and Eastern Partnership (EAP) countries, which are marked in yellow on the map. This decision resulted in the inclusion of two non-European countries, Georgia and Armenia, bringing the total number of analyzed countries to 39, as shown in Figure 1.

Figure 1*. The countries under analysis*



Source: *Own elaboration.*

Solow's augmented growth model that includes the impact of gender has been proposed:

$$Y_i = Af(X_{1i}, X_{2i}, X_{3fi}, X_{3mi}, X_{4fi}, X_{4mi}, X_{5fi}, X_{5mi}, u_i) \quad (8)$$

where:
Y_i – GDP per capita (PPP),
X_{1i} – Capital stock (PPP),
X_{2i} – Population,
X_{3fi} – Female net enrolment rate (%),
X_{3mi} – Male net enrolment rate (%),
X_{4fi} – Female labor participation rate (%),
X_{4mi} – Male labor participation rate (%),
X_{5fi} – Mean nominal monthly earnings of female employees (PPP),
X_{5mi} – Mean nominal monthly earnings of male employees (PPP),
u_i – random component.

All variables that are presented in money units have been converted to PPP[6].

According to the theory of growth models, we proposed the following variables:

Y_i – GDP per capita – this is the dependent variable. The variable is stated in current PPP.

The next variable, represents **the capital** impact – K:
X_{1i} – This explanatory variable is the country's level of capital stock. The variable was calculated from the gross capital formation given in % of GDP (from the WDI) and multiplied with GDP for each year to find the actual gross capital formation.

This variable should have a positive impact on GDP since capital is related to investment. A higher level of capital generates higher level of capital per worker, all else equal, hence higher level of production output.

Human capital is defined by the next three variables – H:
X_{2i} – This explanatory variable is the country's total population. The variable is assumed to have a positive impact on GDP, all else equal, since a larger share of population increase production.

[6]*Purchasing power parities (PPPs) are the rates of currency conversion that try to equalize the purchasing power of different currencies, by eliminating the differences in price levels between countries. The basket of goods and services priced is a sample of all those that are part of final expenditures: final consumption of households and government, fixed capital formation, and net exports. This indicator is measured in terms of national currency per US dollar.*

X_{3fi} – Female net enrolment rate or female primary school completion rate. This explanatory variable denotes the percentage of female students completing last year of primary school stated as a share of all females in the relevant age group. An increased level of females completing last grade of primary school is expected to have a positive impact on GDP.

X_{3mi} – Male net enrolment rate (%) – the same variable for men, and also expected positive impact. Our variables refer to school completion at the elementary level[7].

The last variables represent the inputs of **labor** – L:
X_{4fi}, X_{5fi} – Female and male labor participation rate (%) – This explanatory variable show the proportion females (and males) in the labor force as a share of all females (males) in the age over 15 which are economically active, i.e. all people supplying the labor force in the production of goods and services. This variable is expected to influence GDP positively since when more females (males) enter the labor force the output of production is expected to increase and hence also the level of GDP.

The last two dependent variables (X_{5fi} i X_{5mi}) refer to the average nominal monthly earnings of women and men employees, respectively. These variables are expected to have a positive impact on GDP because when workers earn more, so they get richer, GDP also increases.

All data were obtained from WDI – World Bank's data base and international labor organization – ILO. Data were collected for the years 2011-2018.

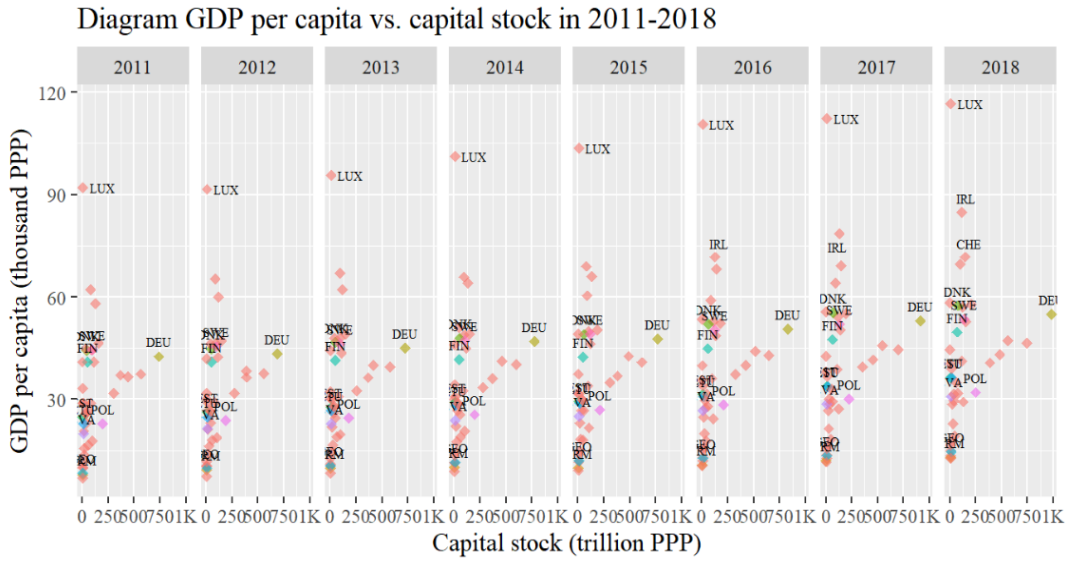
4.1 Correlation Analysis

We examined the correlation between each explanatory variable Xi and the dependent variable Yi – GDP per capita in the following years. The results are presented in the Figures 2-9. Baltic Sea Region (BSR) and Eastern Partnership (EAP) countries are marked as colored dots and described by the abbreviation. In addition, we marked countries where GDP per capita was higher than 70 thousand PPP (Luxemburg, Ireland and in 2018 Switzerland).

BSR and EAP countries, based on GDP per capita, form three clusters: the first one – the richest countries: Scandinavian countries and Germany (GDP over 40 thousand PPP per capita), the second cluster – post soviet countries: Estonia, Lithuania, Poland and Latvia (GDP: 23-29 thousand PPP per capita), and the third cluster – two Asian countries – Georgia and Armenia (about 11 thousand PPP per capita). The lowest GDP was seen in Moldova.

[7] *We considered the enrolment rate at secondary level, but unfortunately the data gaps were so great that we abandoned this idea.*

Figure 1. *Correlation diagrams of GDP per capita versus capital stock (X_{1i}) in 2011-2018*



Source: *Own elaboration.*

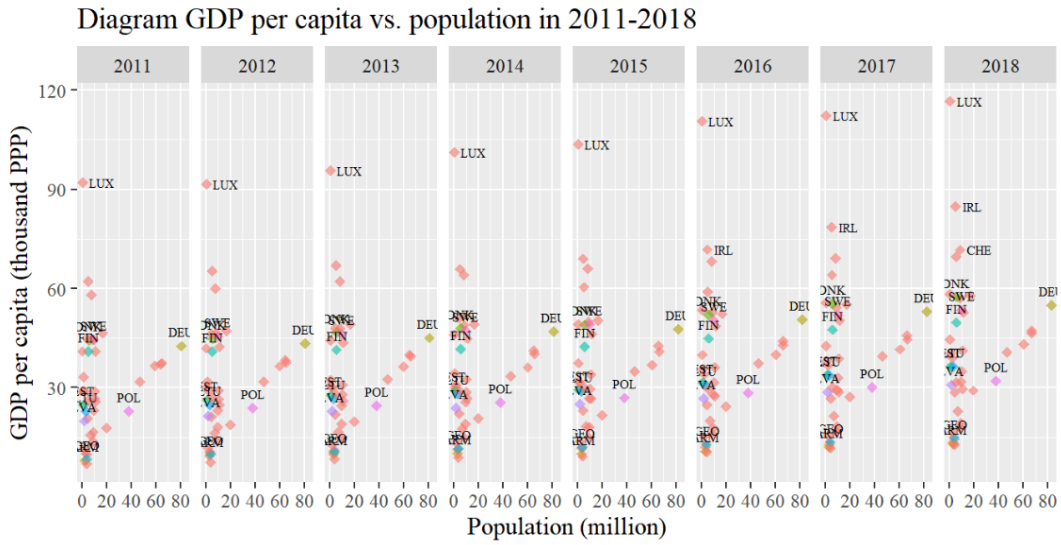
A positive trend is the GDP growth in all BSR and EAP countries in the analyzed years. The highest level of capital stock was in Germany at over 740 trillion PPP (740 in 2011 – 980 w 2018), then Poland – about 200 trillion PPP, the Scandinavian countries – 40-50 trillion PPP. The lowest level in 2011 was seen in Estonia, Armenia and Georgia – about 7 trillion PPP. Only Armenia remained below 10 trillion PPP in 2018. Correlation between variables in the following years was weak and not statistically significant – 0,237.

The country with the largest population was Germany with over 80 million inhabitants, followed by Poland with about 38 million inhabitants. The least populated countries covered by the analysis were: Armenia, Lithuania and Latvia – with populations below 3 million people.

In some countries the number of inhabitants increased in 2018 compared to 2011. This was the case of Germany, Sweden, Denmark, Finland and Armenia. In other countries, the figure decreased: from 0.3% in Estonia to more than 9% in Lithuania. No correlation was observed between GDP per capita and country population[8].

[8]*We also considered only working-age population, or the growth of their number, but the time range of the study resulted in very low variation in these variables, and thus the variables had an insignificant impact on GDP.*

Figure 2. *Correlation diagrams of GDP per capita versus population (X_{2i}) in 2011-2018*



Source: *Own elaboration.*

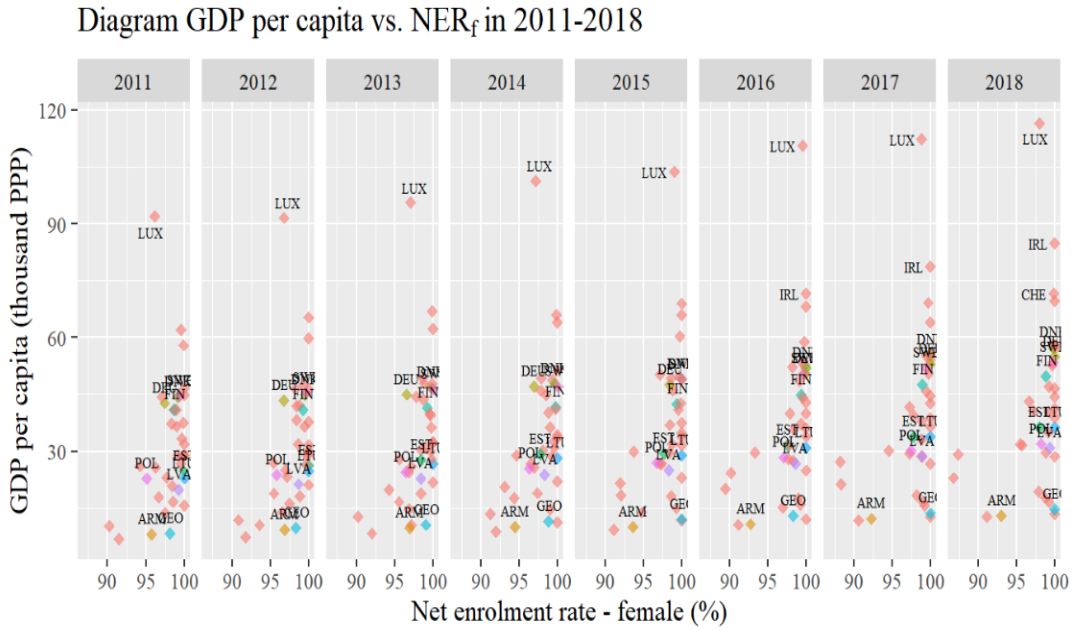
The country with the largest population was Germany with over 80 million inhabitants, followed by Poland with about 38 million inhabitants. The least populated countries covered by the analysis were: Armenia, Lithuania and Latvia – with populations below 3 million people. In some countries the number of inhabitants increased in 2018 compared to 2011. This was the case of Germany, Sweden, Denmark, Finland and Armenia. In other countries, the figure decreased: from 0.3% in Estonia to more than 9% in Lithuania. No correlation was observed between GDP per capita and country population[9].

The net enrolment rate is an indicator that relates to primary education, and we would expect 100% of girls (and boys) to complete elementary school without delay. In 2011, only in Lithuania did 100% of girls complete elementary school. In Denmark, Estonia, Latvia, Sweden girls were also in a good situation – the rate was over 99%. In 2018, the rate of over 99% was reported in the following countries: Germany, Denmark, Georgia, Lithuania, Latvia, and Sweden. In most cases the indicator has improved. The exceptions were Armenia with the rate falling from 96% to 93% and Estonia with the decrease from 100% to 98%.

Also this indicator was not significantly correlated with GDP.

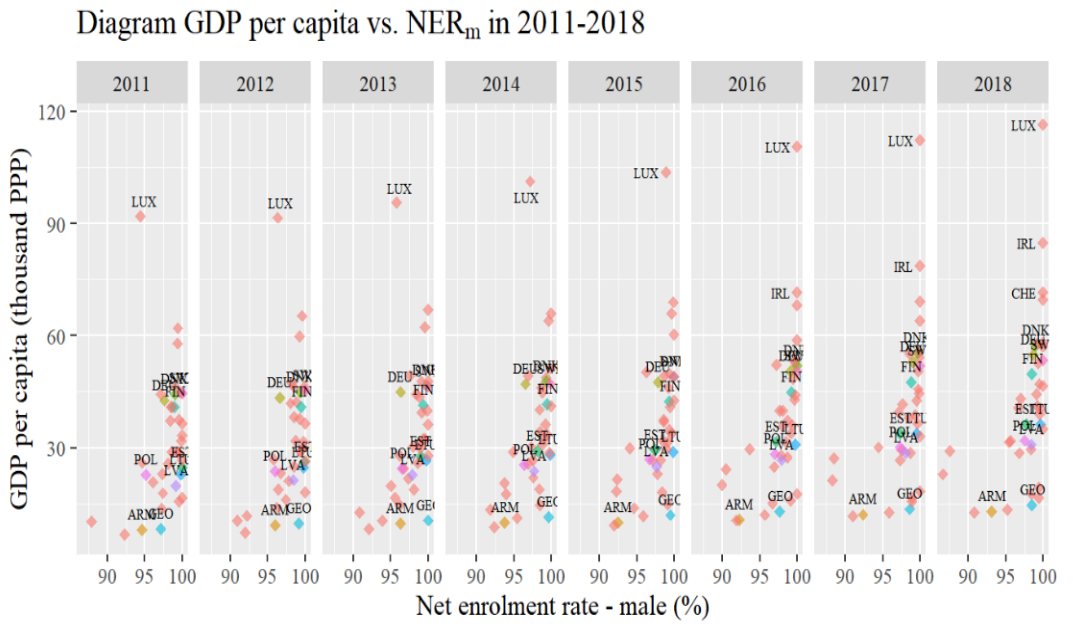
[9]*We also considered only working-age population, or the growth of their number, but the time range of the study resulted in very low variation in these variables, and thus the variables had an insignificant impact on GDP.*

Figure 3. *Correlation diagrams of GDP per capita versus net enrolment female rate (X_{3fi}) in 2011-2018*



Source: *Own elaboration.*

Figure 4. *Correlation diagrams of GDP per capita versus net enrolment male rate (X_{3mi}) in 2011-2018*



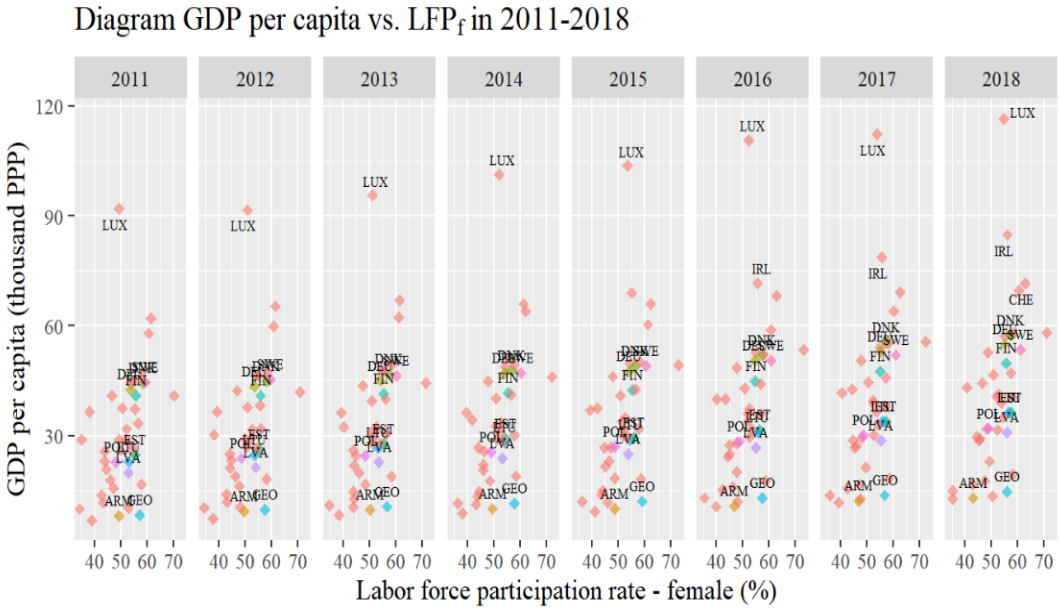
Source: *Own elaboration.*

More girls than boys complete primary education on time, but the differences are very small, on the order of 1 percent, which means that completing primary school on time is not a gender issue, and the problem rather lies in the education system.

Half of the countries (5) reported a lower rate in 2018 compared to 2011 (Armenia, Estonia, Finland, Lithuania, Latvia). The largest decreases were in Estonia 2.3% and Armenia (reduction from 94.6% to 93%). The lowest rate in 2018 was in Bulgaria and Romania (86%).

Also this indicator was not significantly correlated with GDP.

Figure 5. *Correlation diagrams of GDP per capita versus female labor force participation rate (X_{4fi}) in 2011-2018*



Source: *Own elaboration.*

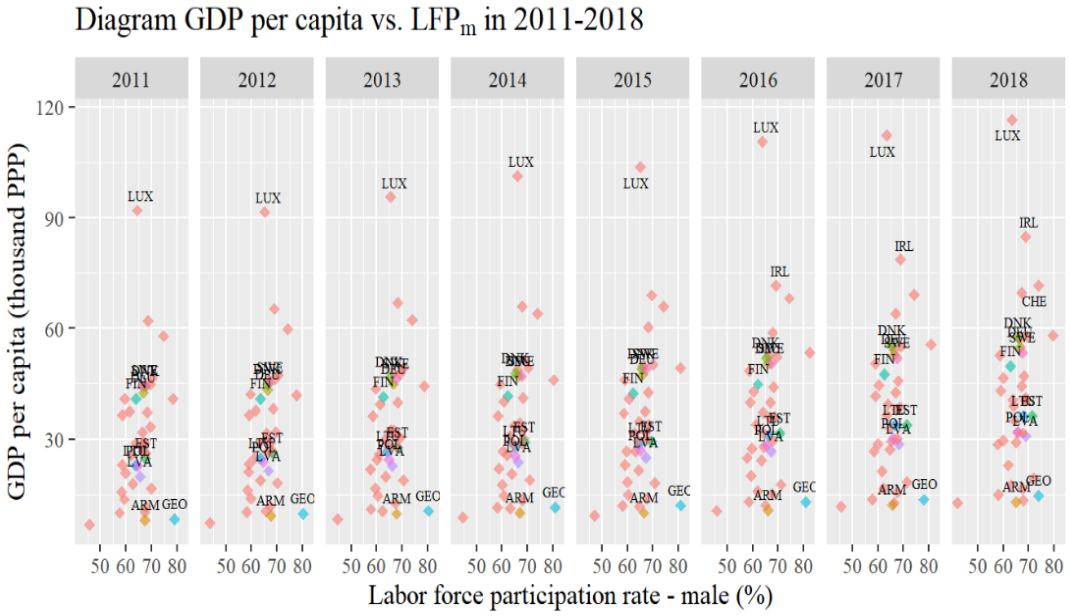
For all the countries surveyed, the average rate was 51%. This means that on average in these countries every second woman of working age is employed.

In BSR and EAP countries the highest percentage of employed women was in Sweden – about 60% and in Denmark with about 57-58%, depending on the year. The lowest number of women worked in Poland (48-49%) and Armenia (43-49%).

In 2018, as compared to 2011, the female labor force rate decreased in 4 countries. But while in Denmark, Finland, and Georgia the decrease was at about 1 percentage point, in Armenia it reached 6 percentage points, which is a very high number.

In this case, a positive significant correlation was seen between female labor force and GDP, higher percentage of women working and higher GDP per capita.

Figure 6. *Correlation diagrams of GDP per capita versus male labor force participation rate (X_{4mi}) in 2011-2018*



Source: *Own elaboration.*

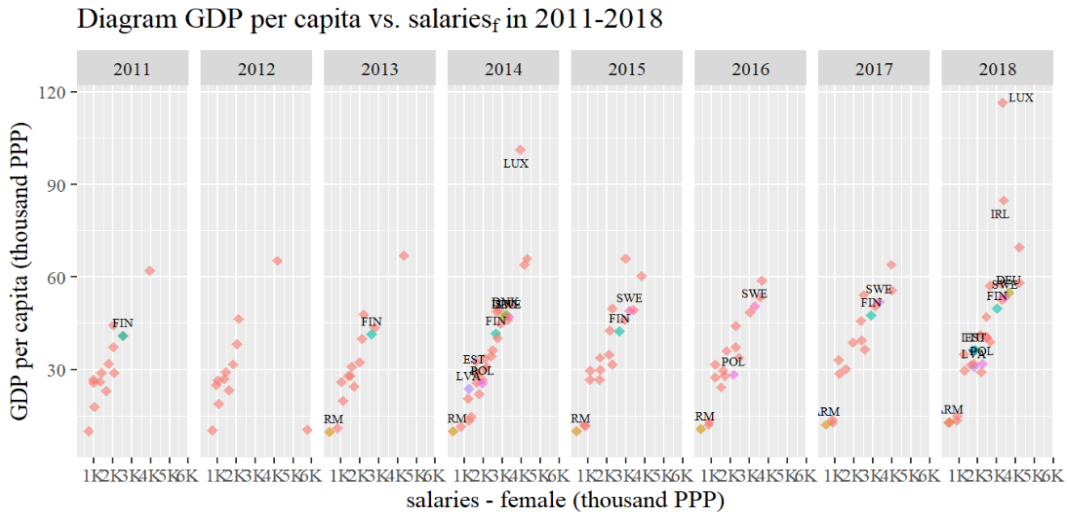
The average percentage of working-age men in employment between 2011 and 2018 in all the studied countries was 65%, which was significantly more than women. In 2018, the range of the indicator ranged from 42% (Moldova) to 79.5% (Iceland).

In BSR and EAP countries the largest proportion of men worked in Georgia (79-74%). In Armenia, Denmark, Estonia and Sweden it exceeded 67%, while in Finland, and Lithuania the rate was the lowest at about 64%. In 2018, 6 countries saw decrease in male labor force compared to 2011. The biggest decrease was recorded in Georgia (from 79% to 74%, but still maintaining high male labor force participation) and in Armenia (from 67.6% to 65%). The largest increase in the male employment rate was reported in Estonia, Lithuania, and Latvia – more than 3 percentage points.

No significant correlation was observed between male labor force rate and GDP.

The last (but not least) indicators are mean nominal monthly earnings of female and male employees. Information on these variables is scarce because not every country reports average monthly earnings. Most reported data concerned 2014 and 2018.

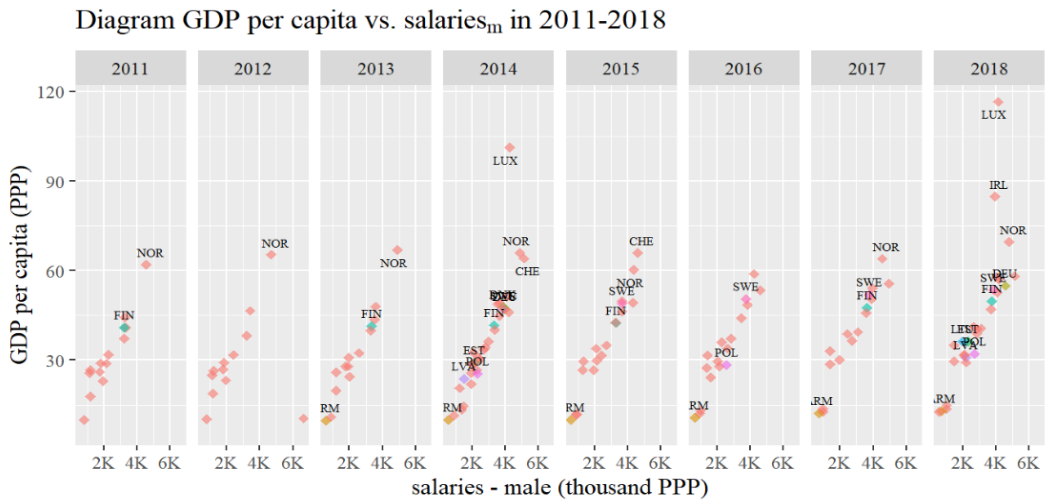
Figure 7. *Correlation diagrams of GDP per capita versus female salaries (X_{5fi}) in 2011-2018*



Source: *Own elaboration.*

In 2014 the average female salary exceeded 2.3 thousand PPP. Women in richer countries earned more in: Sweden, Denmark, and Germany – over 3,000 PPP, while the lowest salary of 390 PPP was earned in Armenia. The good news is that women's salaries in every country have been increasing year by year. Average female wages were very strongly, significantly positively correlated with GDP per capita. It means that the higher the wage, the higher the GDP.

Figure 8. *Correlation diagrams of GDP per capita versus male salaries (X_{5mi}) in 2011-2018*



Source: *Own elaboration.*

In 2014, the average salary of men was 2,800 PPP and was 21% higher than the average salary of women. That year, men in Germany, Denmark, and Sweden earned the best – around 4,000 PPP. The lowest paid men were in Armenia – 600 PPP. Men also earned more every year. The salary gap in 2014 varied from 17% in Sweden to as high as 53% in Armenia. Also this variable was very strongly positively correlated with GDP per capita.

4.2 Econometric Analysis

As we noted in point 3, it is possible to estimate a Solow growth model that includes the impact of gender. The accepted hypothesis (formula 8) leads to the following econometric model:

$$lnY_{1i} = \beta_0 + \beta_1 lnX_{1i} + \beta_2 lnX_{2i} + \beta_3 lnX_{3f,i} + \beta_4 lnX_{3m,i} + \beta_5 lnX_{4f,i} + \beta_6 lnX_{4m,i} + \beta_7 lnX_{5f,i} + \beta_8 lnX_{5m,i} + u_i \quad (9)$$

where: all symbols are the same as in formula 8.

Unfortunately, we were able to estimate this figure only for 2014, due to missing data.

In the next step of the research, for each year we would like to estimate such 6 models (formulas 10-15). In each of these models, the explanatory variables are always capital stock (X_{1i}) and population (X_{2i}), and one of the gender variables:

$$lnY_{2i} = \beta_0 + \beta_1 lnX_{1i} + \beta_2 lnX_{2i} + \beta_3 lnX_{3f,i} + u_i \quad (10)$$

$$lnY_{3i} = \beta_0 + \beta_1 lnX_{1i} + \beta_2 lnX_{2i} + \beta_4 lnX_{3m,i} + u_i \quad (11)$$

$$lnY_{4i} = \beta_0 + \beta_1 lnX_{1i} + \beta_2 lnX_{2i} + \beta_5 lnX_{4f,i} + u_i \quad (12)$$

$$lnY_{5i} = \beta_0 + \beta_1 lnX_{1i} + \beta_2 lnX_{2i} + \beta_6 lnX_{4m,i} + u_i \quad (13)$$

$$lnY_{6i} = \beta_0 + \beta_1 lnX_{1i} + \beta_2 lnX_{2i} + \beta_7 lnX_{5f,i} + u_i \quad (14)$$

$$lnY_{7i} = \beta_0 + \beta_1 lnX_{1i} + \beta_2 lnX_{2i} + \beta_8 lnX_{5m,i} + u_i \quad (15)$$

where: all symbols are the same as in formula 8.

All seven models were estimated only in 2014, while in the other years the first model (formula 9) did not include the X_{5fi} and X_{5mi} variables, and the sixth (formula 14) and seventh models (formula 15) were not estimated.

In Table 2 we summarized the estimated parameters of models $lnY_{1i}lnY_{7i}$ (formulas 10-15) for 2014 year.

Table 1. *Estimation results for Solow's augmented growth models lnY_{1i}–lnY_{7i} in 2014*

Variables	lnY_{1i}	lnY_{2i}	lnY_{3i}	lnY_{4i}	lnY_{5i}	lnY_{6i}	lnY_{7i}
Constant	-2.823	-13.946	-18.233	1.170	2.646	-1.509	-2.054
lnX_{1i}	0.366	0.789	0.762	0.828	0.867	0.405	0.355
lnX_{2i}	-0.396	-0.792	-0.769	-0.827	-0.872	-0.422	-0.376
lnX_{3fi}	0.373	3.472					
lnX_{3mi}	0.178		4.421				
lnX_{4fi}	0.124			0.182			
lnX_{4mi}	-0.481				-0.196		
lnX_{5fi}	-0.082					0.558	
lnX_{5mi}	0.675						0.626
R^2	0.918	0.838	0.844	0.832	0.831	0.930	0.940
***F*-statistics**	43.190	65.017	67.848	63.582	63.365	137.580	162.480

Note: *Marked in red are significant parameters at the 0.05 level.*
Source: *Own elaboration.*

All models were fairly well fitted to the real data – R^2 was over 83%. *F*-statistic confirms that the regression model, as a whole, was statistically significant.

In the first model lnY_{1i}, only the capital and population variables were statistically significant. Whereas in the next models, apart from variables lnX_{1i} and lnX_{2i}, variables lnX_{3i} – enrolment rate and lnX_{5i} – monthly salary were also significant (both for men and women).

The models that best explain the formation of GDP were the last two models – lnY_{6i} and lnY_{7i} (the highest level of R^2).

Sample interpretation of the results obtained:

For model lnY_{6i} – an increase in capital stock (lnX_{1i}) by 1% will increase GDP by 0.405%. An increase in population (lnX_{2i}) by 1% will cause GDP to decrease by 0.422%, a 1% increase in female wages (lnX_{5fi}) will cause GDP to increase by 0.558% (assuming other variables are constant).

In Table 2 we summarized the parameters of the estimated models lnY_{1i}–lnY_{5i} (formulas 9-13) (without X_{5i} variables) in 2018. Models lnY_{1i}–lnY_{5i} were estimated in each year of analysis, but in Table 3 we present detailed results for models estimated in the last year of analysis (for the most recent and available data).

Table 2. *Estimation results for Solow's augmented growth models $lnY_{1i}$$lnY_{5i}$ in 2018*

Variables	lnY_{1i}	lnY_{2i}	lnY_{3i}	lnY_{4i}	lnY_{5i}
Constant	0.369	1.463	-1.111	1.512	3.780
lnX_{1i}	0.810	0.874	0.856	0.871	0.916
lnX_{2i}	-0.802	-0.861	-0.841	-0.857	-0.909
lnX_{3fi}	-3.880	0.059			
lnX_{3mi}	4.675		0.629		
lnX_{4fi}	0.646			0.057	
lnX_{4mi}	-1.118				-0.507
R^2	0.897	0.879	0.880	0.887	0.894
***F*-statistics**	54.650	90.262	91.362	100.330	107.919

Note: *In red marked significant parameters at the 0.05 level.*
Source: *Own elaboration.*

All models explained GDP well (R^2 over 88%) and the models as a whole – were statistically significant (*F*-statistics statistically significant).

The best model in 2018 was the first model lnY_{1i}, although many of the gender variables were statistically insignificant.

Capital stock (lnX_{1i}) had a significant positive effect on GDP, while population (lnX_{2i}) had a significant negative effect, meaning that as population increases, GDP decreases.

The only gender variable that was statistically significant was male labor participation, but the relationship was negative, meaning that a 1% increase in male labor participation (lnX_{4mi}) caused GDP to decrease by 1.118%

In Table 4, we summarized the expected (according to theory) effect of each variable on GDP (positive in all variables) and the actual observed effect in all estimated models for all years.

In all years we observed a positive impact of capital stock (X_{1i}) on GDP, which means that an increase in capital stock causes an increase in GDP.

In all years we observed a negative impact of population (X_{2i}) on GDP, which means that an increase in population causes a decrease in GDP.

Not in all models was the effect of female enrolment rate (X_{3fi}) on GDP positive, but if it was significant, it was positive.

Table 3. *Signs and significance of coefficients of Solow's augmented growth models estimated in years 2011-2018*

Variables	Theory	2011	2012	2013	2014	2015	2016	2017	2018
X_{1i}	+	+	+	+	+	+	+	+	+
X_{2i}	+	–	–	–	–	–	–	–	–
X_{3fi}	+	+	+	–/+	–/+	–/+	–/+	–/+	–/+
X_{3mi}	+	+	+	+/+	+/+	+	+	+	+
X_{4fi}	+	–	+/–	+	+	+	+	+	+
X_{4mi}	+	–	–	–/+	–	–/–	–/–	–/–	–/–
X_{5fi}	+				–/+				
X_{5mi}	+				+/+				

Note: *Marked in red are significant parameters at the 0.05 level.*
Source: *Own study.*

In all years we observed a positive (but not always significant) impact of male enrolment rate (X_{3mi}) on GDP, which means that an increase in this rate causes an increase in GDP.

Female labor participation (X_{4fi}) had a rather positive effect on GDP, but unfortunately it was not statistically significant.

Male labor participation (X_{4mi}) had a negative (and sometimes statistically significant) effect on GDP. An increase in this rate causes a decrease in GDP. So, we can say that the excessive proportion of employed man does not stimulate the GDP growth.

Wages (X_{5i}) had a positive significant effect on GDP. Wage growth stimulates the GDP growth.

5. Discussion

The seminal paper by Mankiw *et al.* (1992) highlights the cross-country correlation between human capital (measured by educational attainment), income, and growth. Subsequent papers have attempted to separate the effect of male and female educational attainment and provide evidence on the relationship between gender inequality in schooling and economic growth, using Solow's growth model.

Selected works that successfully used the Solow model to study the influence of gender inequality on economic growth are presented below. One of the few cross-

country studies to estimate theory-based specifications is Knowles et al. (2002). Following Mankiw *et al.* (1992), the authors augmented the Solow model to incorporate female and male human capital separately and estimated the effect of these types of human capital and the gender gap on the steady-state level of income using long averages between 1960 and 1990. Their findings indicate a negative correlation between the size of the gap and income: controlling for male educational attainment, a lower level of female educational attainment is associated with lower steady-state income.

In line with the cross-country growth regression boom of the 1990s, most studies estimate the relationship between gender inequality in education and growth rather than the level of income. The first estimates by Barro and Lee (1994) began a heated debate by identifying a positive relationship between gender inequality and economic growth. The authors estimated economic growth equations in a cross-section of 116 countries for the 1965-75 and 1975-85 periods and found that while male secondary-school attainment (defined as the fraction of the over-25 male population for whom some secondary school is the highest level of education) is positively correlated with economic growth, the correlation between female secondary-school attainment and economic growth is negative.

The relationship between gender inequality and economic growth has been subjected to further scrutiny using different samples and theory-based specifications, leading to diverse findings. Dollar and Gatti (1999) estimated five-year economic growth rates between 1975 and 1990 in a panel of 127 countries. In contrast to Barro and Lee (1994), they found a positive correlation between the growth of per-capita income and the initial level of female secondary school attainment, controlling for male secondary-school attainment.

Andersson (2010) studied the effect of increased gender equality on economic growth in developing countries. The main objective of that work was to investigate whether increasing the level of human capital and reducing gender inequality in the labor market affected the growth rate and welfare of developing countries. The paper used data covering 74 emerging and developing countries for the years 2001 and 2007.

The extended Solow growth model was used to estimate how increased primary school completion rates of men and women affected economic growth to see what impact the Development Goal (MDG) effect of universal primary education had on the economy. The thesis shows that an increase in the number of women and men completing primary school has a positive effect on economic growth, as expected.

In Ezeh's (2020) analysis, gender inequality in education and its impact on economic growth was examined. The objective of the thesis was to investigate the influence of gender inequality in education on economic growth, as exemplified by Sub-Saharan African countries. Two gender inequality indicators were used: the gap in female-to-

male primary and secondary enrolment. The core of the study was built on the Solow Model, but it was augmented with both human capital and healthcare expenditure (HCE) per capita.

The empirical analysis centered on annual data for 40 Sub-Saharan African countries between 1990 and 2018. The estimation method employed was both the Ordinary Least Squares (OLS) and the Fixed Effect Within-Group Estimator in a panel data set. The main findings of the paper suggest that there is a statistically significant negative relationship between gender inequality in education at the primary and secondary levels and economic growth, as well as a negative effect of female labor participation on economic growth.

As the above studies indicate, the application of econometric methods based on the Solow Augmented Model in socio-economic analyses requires certain theoretical requirements. The most important ones include: satisfactory variability of explanatory variables (at least 10%); statistically significant relationships between explanatory variables and the dependent variable; and statistically insignificant relationships between explanatory variables to avoid collinearity. In addition, as demonstrated in the examples cited above, diversity and the economic development of the countries studied play a significant role here.

The analysis conducted in this study focused on European countries, as well as Armenia and Georgia, being countries with good statistical reporting. Therefore, countries with insufficient information were removed from the analysis, such as Kosovo and Montenegro. Statistics are readily available in countries with good economic development.

The analysis of the socio-economic development of the countries under study revealed a clear similarity in variables related to male and female education, as the indicators for all countries were consistently high throughout the years studied, with very low variability of these characteristics at about 2.5%. From an econometric perspective, these variables should have been removed from the model. However, a detailed study showed that in some years, they had a statistically significant impact on GDP per capita (2013-2015).

The results of the analysis are surprising in two aspects: Firstly, the negative, statistically significant impact of population size on GDP per capita. Secondly, the negative, sometimes statistically significant, impact of male labor participation on GDP per capita. The former can be explained by the level of development of the countries under study. When the population increases, it becomes difficult to achieve satisfactory growth in GDP per capita, even though the latter indicator also shows an upward trend. The differences in population size of the countries studied are greater than the differences in their GDP per capita.

In the latter case, the highest values of the male labor participation rate were observed in countries with the lowest GDP per capita (e.g. Georgia with 80%). In most countries (even those with the highest GDP), this indicator ranged between 60%-70%, implying that there is a certain norm in the number of employed men. If this figure (70%) is exceeded, it has a negative impact on GDP.

The Solow Augmented Model, like any neoclassical growth model, has an equilibrium point to which the solution should aspire, but which may not be reached. The analysis of the study findings indicates that in some countries (such as Sweden), the equilibrium point has been exceeded, and we can observe the effect of inefficient resource utilization.

6. Conclusion

Research on the links between gender, economic growth, and development has shown that the mutual impact of these categories can vary significantly depending on the type of growth and key driving factors. In the majority of European countries, economists and politicians strongly emphasize the need to increase female participation in employment. It is generally believed that this is the best way to reduce the growing gap in the labor force due to aging (excluding migration).

Increased women's market activity leads to more effective allocation of human resources and better use of people's talents, both women and men. As a result, there is a positive impact on economic growth. Gender equality has been described as "smart economics."

In the quantitative part of the report, the Solow Augmented Model was used to measure the influence of diverse variables (including gender equality ones) on economic growth. According to the theory, all the chosen variables should have positive impact on GDP: X1i – Capital stock (PPP), X2i – Population, X3fi – Female net enrolment rate (%), X3mi – Male net enrolment rate (%), X4fi – Female labor participation rate (%), X4mi – Male labor participation rate (%), X5fi – Mean nominal monthly earnings of female employees (PPP), X5mi – Mean nominal monthly earnings of male employees (PPP).

The analysis covered European countries and Eastern Partnership countries, as well as Armenia and Georgia, between 2011 and 2018. Therefore, the set included countries that were well or very well-developed. The obtained results are not entirely consistent with the theory of the Solow Augmented Model. The reason for this is the choice of countries, the availability of data, and the time period of the analysis.

The literature confirms that one of the most important elements of empirical analysis is the selection of appropriately diversified countries at different economic levels. For the same reason, the years of analysis should be as distant as possible so that the data can take into account political, social, and economic changes that occurred

within the time span. Despite these issues, we have demonstrated that in the European countries studied, as well as Georgia and Armenia, a 1% increase in female wages will result in a 0.56% increase in GDP per capita. Female wages were expressed as the mean monthly earnings of female employees in purchasing power parity. The relationship between GDP per capita and female wages was found to be statistically significant.

References:

Andersson, A. 2010. The Effect of Increased Gender Equality on Economic Growth in Developing Countries. Jönköping, https://www.semanticscholar.org/paper/The-Effect-of-Increased-Gender-Equality-on-Economic-Andersson/d2b6c7dfa8979e0774a565966bb215ba6cac1c8b.

Angelov, N., Johansson, P., Lindahl, E. 2016. Parenthood and the Gender Gap. Pay. J. labour Econ, 34, 545-579. https://doi.org/10.1086/684851.

Antonopoulos, R., Hirway, I. 2010. Unpaid Work and the Economy. Gender, Time Use and Poverty in Developing Countries. Palgrave Macmillan. https://doi.org/10.1057/9780230250550.

Baliamoune-Lutz, M., McGillivray, M. 2007. Gender Inequality and Growth in Sub-Saharan Africa and Arab Countries? Afr. Dev. Rev., 21, 224-242. https://doi.org/10.1111/j.1467-8268.2009.00209.x.

Barro, R., Lee, J.W. 1994. Sources of Economic Growth. Carnegie-Rochester Conf. Ser. Public Policy, 40, 1-46. https://doi.org/10.1016/0167-2231(94)90002-7.

Barro, R., Lee, J.W. 1996. International Measures of Schooling Years and Schooling Quality. Am. Econ. Rev., 86, 218-223. https://www.jstor.org/stable/2118126.

Barro, R., Sala-i-Martin, X. 2003. Economic Growth, 2nd ed. The MIT Press: Cambridge, MA, USA. ISBN:9780262025539.

Bloom, D., Canning, D., Fink, G., Finlay, J. 2009. Fertility, Female labour Force Participation, and the Demographic Dividend. J. Econ. Growth, 14, 79-101. https://doi.org/10.1007/s10887-009-9039-9.

Bloom, D., Canning, D., Fink, G., Finlay, J. 2012. Microeconomic Foundations of the Demographic Dividend; Program on the Global Demography of Aging. Working Paper No. 93, Program on the Global Demography of Aging. Cambridge, MA, USA.

Bollen, K.A. 1979. Political Democracy and the Timing of Development. Am. Sociol. Rev., 44, 572-587. https://doi.org/10.2307/2094588.

Brashaw, S., Castellino, J., Diopet, B. 2013. Women's Role in Economic Development: Overcoming the Constraints. Sustainable Development Solutions Network. http://unsdsn.org/resources/publications/womens-role-in-economic-development-overcoming-the-constraints/. DOI:10.46692/9781447335719.009.

Cabeza-García, L., Del Brio, E.B., Oscanoa-Victorio, M.L. 2018. Gender Factors and Inclusive Economic Growth: The Silent Revolution. Sustainability, 10, 121. https://doi.org/10.3390/su10010121.

Cuberes, D., Teignier, M. 2012. Gender Inequality and Economic Growth. World Development Report. https://openknowledge.worldbank.org/handle/10986/4391.

Day, C. 2012, Economic Growth, Gender Wage Gap and Fertility Rebound. Econ. Rec., 88, 88-99. https://doi.org/10.1111/j.1475-4932.2012.00799.x.

Deaton, A., Paxson, C. 1997. The Effects of Economic and Population Growth on National Saving and Inequality. Demography, 34, 97-114. https://doi.org/10.2307/2061662.

Dollar, D., Gatti, R. 1999. Gender Inequality, Income and Growth: Are Good Times Good For Women? World Bank Working Paper No.1. Development Research Group, The World Bank: Washington, DC, USA. https://documents.worldbank.org/pt/publication/documents-reports/documentdetail/251801468765040122/gender-inequality-income-and-growth-are-good-times-good-for-women.

Elborgh-Woytek, K., Newiak, M., Kochhar, K., Fabrizio, S., Kpodar, K.R., Wingender, P., Clements, B.J., Schwartz, G. 2013. Women, Work, and the Economy: Macroeconomic Gains from Gender Equity. Staff Discussion Note 13/10. International Monetary Fund: Washington, DC, USA. ISBN/ISSN: 9781475566567/2617-6750.

Ezeh, K. 2020. Gender inequality in education and economic growth. http://hj.diva-portal.org/smash/get/diva2:1447860/FULLTEXT01.pdf.

Forbes, K.J. 2000. A Reassessment of the Relationship between Inequality and Growth. Am. Econ. Rev., 90, 869-887. DOI:10.1257/aer.90.4.869.

Gerring, J., Bond, P., Barndt, W.T., Moreno, C. 2005. Democracy and Economic Growth: A Historical Perspective. World Politics, 57, 323-364. https://www.jstor.org/stable/40060105.

Goldin, C. 2014. A Grand Gender Convergence: Its Last Chapter. Am. Econ. Rev., 104, 1091-1119. DOI:10.1257/aer.104.4.1091.

Golosov, M., Jones, L.E., Tertilt, M. 2007. Efficiency with Endogenous Population Growth. Econometrica, 75, 1039-1071. https://doi.org/10.1111/j.1468-0262.2007.00781.x.

Hakura, D., Hussain, M., Newial, M., Thakoor, V., Yang, F. 2016. Inequality, Gender Gaps and Economic Growth: Comparative Evidence for Sub-Saharan Africa. IMF Working Paper No. 111. International Monetary Fund: Washington, DC, USA. ISBN/ISSN: 9781484382349/1018-5941.

Hartmann, A.M. 2010. Fertility and Economic Growth. How does the Fertility Economic Growth in Developing Countries? Master's Thesis, University of Aarhus, Aarhus, Denmark.

Hozer-Kocmiel, M., Zimoch, U. 2010. Statistical Portrait of Women in ICT in BSR countries. Report Baltic Sea Region Conference with focus on Gender ICT. Winnet Sverige.

Izdes, O. 2007. Financial Crises of Turkey and Gendered Employment Outcomes. https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=IAFFE2010&paper_id=292.

Johnsson-Latham, G. 2007. A study on gender equality as a prerequisite for sustainable development. Report to the Environment Advisory Council, Sweden. http://www.genderandenvironment.org/admin/admin_biblioteca/documentos/rapport_engelska.pdf.

Kabeer, N., Natali, L. 2013. Gender Equality and Economic Growth: Is there a Win-Win? IDS Working Paper No. 417. Institute of Development Studies: Brighton, UK. https://doi.org/10.1111/j.2040-0209.2013.00417.x

King, E., Hill, M.A. 1993. Women's Education in Developing Countries: An Overview. In: Women's Education in Developing Countries: Barriers, Benefits and Policies, King E.M., Hill M.A., Eds.; Johns Hopkins UniversityPress: Baltimore, MD, USA. https://doi.org/10.1596/0-8018-4534-3.

King, E., Hill, M.A. 1995. Women's Education and Economic Well-Being. Fem. Econ., 1, 21-46. https://doi.org/10.1080/714042230.

Klasen, S. 1999. Does Gender Inequality Reduce Growth and Development? Evidence from Cross-Country Regressions. World Bank Working Paper No. 7. The World Bank: Washington, DC, USA. DOI: 10.5282/ubm/epub.1602.

Klasen, S. 2002. Low Schooling for Girls, Slower Growth for All? Cross-Country Evidence on the Effect of Gender Inequality in Education on Economic Development. World Bank Econ. Rev., 16, 345-373. https://doi.org/10.1093/wber/lhf004.

Klasen, S., Lamanna F. 2009. The Impact of Gender Inequality in Education and Employment on Economic Growth: New Evidence for a Panel of Countries. Fem. Econ., 15 (3), 91-132. https://doi.org/10.1080/13545700902893106.

Kleven, H., Landais, C. 2017. Gender Inequality and Economic Development: Fertility, Education and Norms. Económica, 84, 180-209. https://doi.org/10.1111/ecca.12230

Knowles, S., Lorgelly, P.K., Owen, P.D. 2002. Are Educational Gender Gaps a Brake on Economic Development? Some Cross-Country Empirical Evidence. Oxford Economic Papers, 54, 118-149. https://doi.org/10.1093/oep/54.1.118.

Komura, M. 2019. Fertility and Endogenous Gender Bargaining Power. J. Popul. Econ., 26, 943-961. DOI:10.1007/s00148-012-0460-6.

Lee, R., Mason, A., Miller, T. 2001. Saving, Wealth, and Population. In: Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World, Birdsall, N., Kelley, A.C., Sindig, S.W., Eds.; Oxford University Press: Oxford, UK. https://doi.org/10.1093/0199244073.001.0001.

Licumba, E.A., Dzator, J., Zhang, J.X. 2015. Gender Equality in Education and Economic Growth in Selected Southern African Countries. In: Proceedings of the Australian Conference on Business and Social Sciences, Sydney, Australia, 13-14 April. DOI:10.1353/jda.2015.0102.

Lipset, S. 1959. Some Social Requisites of Democracy: Economic Development and Political Legitimacy. Am. Political Sci. Rev., 53, 69-105. https://doi.org/10.2307/1951731.

Lis, C. 2010. Modelowanie predyktywne wartości dodanej brutto w Polsce. CBE, Szczecin. DOI:10.18276/epu.2016.124-06.

Lofstrom, A. 2009. Gender equality, economic growth and employment. Swedish Ministry of Integration and Gender Equality.

Mankiw, N.G., Romer, D., Weil, DN. 1992. A contribution to the empirics of economic growth. Journal of economics, 107(2), 407-437. https://doi.org/10.2307/2118477.

Moghadam, V. 2003. Modernizing Women: Gender and Social Change in the Middle East. Lynne Rienner Publishers: Boulder, CO, USA. https://doi.org/10.1111/j.1949-3606.2004.tb00995.x

OECD. 2008. Glossary of Statistical Terms. http://stats.oecd.org/glossary.

Qureshi, S.A., Khan, M., Rafique, A., Khan, G., Wahid, M.S., Nazli, A. 2011. Gender Differential in Education and its Impact on Economic Growth. Pakista in study (1965-2007), a Generalized Method of Moment Approach. Interdiscip. J. Contemp. Res. Bus., 3, 1310-1317.

Ramanayake, S.S., Ghosh, T. 2017. Role of Gender Gap in Economic Growth: Analysis on Developing Countries versus OECD Countries. Indira Gandhi Institute of Development Research: Mumbai, India.

Rashid, Y., Rashid, A., Warraich, M.A., Sabir, S.S., Waseem, A. 2019. Case Study Method: A Step-by-Step Guide for Business Researchers. International Journal of Qualitative Methods, 18, 1-13. https://doi.org/10.1177/1609406919862424.

Razin, A., Sadka, E. 1995. Population Economics 1st ed. The MIT Press: Cambridge, MA, USA.

Ruminska-Zimny, E. 2009. Gender Gap and Economic Policy. UNECE. http//www.unece.org/gender/publications.

Seguino, S., Berik, G., Rodgers, Y. 2009. Promoting Gender Equality as a means to Finance Development. Friedrich Ebert Stiftung.

Solow, R.M. 1956. A contribution to the theory of economic growth. The quarterly journal of economics, 1, 70(1), 65-94. https://doi.org/10.2307/1884513.

Stiglitz, J.E, Sen, A., Fitoussi, J.P. 2010. Report by the Commission on the Measurement of Economic Performance and Social Progress. http://www.stiglitz-sen-fitoussi.fr.

Stocky, J.G. 2006. Gender and Its Relevance to Macroeconomic Policy: A Survey. Working Paper WP/06/233. International Monetary Fund. https://doi.org/10.5089/9781451864939.001.