European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.2667868

Volume 6 │ Issue 2 │ 2019

THE RELATIONSHIP BETWEEN WOMEN'S EDUCATION WITH WOMEN'S LABOR PARTICIPATION AND NATIONAL INCOME: A RESEARCH ON G20 COUNTRIES[i]

Kasım Karakütük[1],
Ece Ozdogan Ozbal[2ii]
[1]Prof. Dr., Ankara University,
Faculty of Educational Sciences,
Turkey
[2]Dr., Ankara University,
Faculty of Educational Sciences,
Turkey

Abstract:
The purpose of this research is to reveal the relationship between women's education, women's labor force participation and national income in G20 countries. The relationships between women's education, women's labor force participation and national income were analyzed by the panel data analysis method for the G20 countries for the period 1997-2018. Stability of series were tested by "Fisher ADF" and "Fisher PP" panel root tests and the series were determined to be I (1). Pedroni (2004) was used to test the existence of cointegration relationships between the series. The series were found to be cointegrated. The long- and short-term relationships of the series were analyzed by the Panel DOLS method and it is determined that the increase of female schooling level increase the female labor force participation rate, increase of female schooling level and female labor force participation rate increase the per capita (real) national income. A two-way causality relationship was found between the ratio of women in higher education and national income per person. In addition, two-way causality relations between women's labor force participation rates and schooling rates at all levels of women were determined. In the study, it is concluded that in G20 countries, women's schooling rate increases the women's participation in the labor market and increases of women's schooling rate and female employment increase the national income per capita in countries.

Keywords: national income per capita, schooling rates of women, labor force participation rate of women, panel data analysis

[i] This work was presented as an oral presentation in IV. International Conference on Applied Economics and Finance & Extended with Social Sciences Aydın, 28-30 November 2018.
[ii] Correspondence: email ece.ozdogan@ankara.edu.tr

1. Introduction

Education is considered as a significant value in the development of countries, and the raise of employment and national income. What values are affected by education in a society or what are lost due to lack of education have been research subjects especially for the last fifty years. From the 1960s on, people working in the field of economics, such as Mincer (1958), Schultz (1960, 1961), Becker (1975), have been performing studies related to benefits of education.

Especially in economically based studies, it is seen that education is seen as an investment tool and evaluations are made within this framework. When evaluated from this perspective, the individual is expected to invest in education and receive the return of this investment to a certain level. One is educated until the marginal increase in one's productivity is equal to the marginal cost of education (Psacharopoulos and Patronas, 2004, 2-3). With this approach, education is considered as an investment and national or individual evaluations are made related to its future benefits. At the individual level, the benefits discussed are those such as education's impact on the individual, future employment status of the individual and the monthly income to be received in this context; while discussing on the macro level, variables such as national growth and national income are taken into account. When the studies are evaluated, although it is difficult to evaluate the researches on the efficiency of human capital, these researches are needed. Sianesi and Reenen (2003) found that a one-year increase in the average educational level increase the per capita production level by three to six percent according to the increased neo-classical determinations and cause a faster growth rate than one percent according to the estimates of the new growth rate; they also found that the effect of the increase in different education levels depends on the development level of a country and that higher education is the most important educational level for growth in OECD countries. As it can be seen, the benefits of education differ depending on many different variables. In addition to direct benefits of education, its indirect benefits to individuals and society are undoubtedly very important too.

The direct or indirect benefits of educating all individuals in a society cannot be denied. Since the relationship between education and income is considered to contribute to national and individual income, individual and social benefits of education are emphasized (Çalışkan, 2007). Macro evaluations should also be taken into account when evaluating the subject of education, as education does not only provide benefit to the individual, but also the society. In particular, the benefits of the education to be provided to the disturbed clusters may be revealed in a more striking way. Many variables (race, gender, socioeconomic status, etc.) can be specified related to clusters that are limited (disadvantaged) in different terms. Especially for gender variables, it can be mentioned that there is a limitation (disadvantage) for women in almost all countries in the world. The rates of women receiving education at a lower level than men are noteworthy all over the world. Therefore, researches on women's education, women's participation in the work force and the development of countries are important.

Studies on women's education often refer to many variables such as the level of education, employment, and the status of women's education compared to men. In a study by Peet et al. (2015), it was examined whether the benefits of education in developing countries were on higher levels. As a result of the research that evaluated household data of the twenty-five developing countries for the years 1985-2012, no excessive rate of benefits was detected in developing countries and the average benefit on schooling was estimated as 7.6% in the countries selected for the study. One reason for the lack of excessive rate of benefits in developed countries is that these countries already reached certain levels of education. However, it was concluded that education's benefits were more for women than men, and also more for African and Latin American regions than Asia and Eastern Europe. This situation shows that while a certain satisfaction was achieved in the educational benefits of developed countries, the requirements for women's education continue. Asplund's (2000) study on the returns of education in Finland showed that education benefits did not make a difference for men between 1984 and 1995, but the benefit rate of education for women, which was on low levels in the 1980s, reached the same level with men's in the 1990s. According to the multivariate regression analysis results of Halmon et al. (2013) in their research based on the United Kingdom micro data, it was found that the annual schooling rate in England is between 7% and 9% and for women this rate is between 9% and 11%. . This means that the benefit rate of women's education is higher than the benefit rate of men's education. Ammermüller and Weber (2005) also conducted a study that supports these findings. In the study, it was concluded that the educational benefits of 1985-2002 were between 8-10% for the West and 7-8% for the East. In the same study, it was determined that the educational benefits of women in West Germany were higher than that of men, and the educational benefits of women in East Germany were less than women in West Germany. In addition, the benefit rates in terms of both region and gender were discussed and it was determined that the benefit rates of women's education differ, even within the same country.

In his research, Tansel (2010) examined the change in the benefit rates of schooling within ten years and found a decrease in educational benefits between 1994 and 2005. In the research, it was found that the educational benefits of women were higher than men's, and a significant decrease was observed in the year 2001, when an economic depression (crisis) happened. It can be said that especially the economic crisis periods directly affect women's education and women's employment. During an economic crisis, women can be considered by their employers as employees who can be separated first from the work force.

Women's education cannot be evaluated solely by comparison with men. Many variables can be considered in the evaluation of women's education, such as the level of education provided to women, interregional differences, and the labor lost to marriage. It is expected that the benefits of primary education and the benefit of higher education will not be at the same level in the evaluation of the benefits of different educational levels. This situation is related to the development of the country. For example, for a country where the schooling rate is limited at a primary level, the benefit rate of higher education will be quite high. Because higher education graduates are expected to have higher benefit rates in terms of employment. In general, however, it is stated that the return of the labor market to education is the highest for elementary education, which is the primary level of education, and lower for the subsequent levels. Pasacharopoulos (1994) found that the effect of primary education is higher in underdeveloped countries than in developed countries. Therefore, the evaluation made between the education levels is also related to the development level of that society. There are also researches that do not support the view that the return of labor market to education is the highest for primary education, and lower for the subsequent levels. In the research of Colclough et al (2010), it was stated that this model has changed, that the benefit of primary education is not as much as it was in the past, and that the reason for this decline is the weakening of qualified primary education due to the intense decrease in public expenditures. It is possible to explain the higher effect of primary education in underdeveloped countries than in developed countries (Pasacharopoulos, 1994), with the participation to work force in underdeveloped countries. While primary education is not an adequate level of education for work force participation in developed countries, it can be a reason of preference for employment in underdeveloped countries.

Work force participation is an important variable in evaluating the direct benefit rates of education. In terms of women, there are many factors affecting work force participation. Many reasons such as marital status, age and fertility are effective in women's lives and participation in labor force, especially in advanced ages. In Barro's (2001) study, it was found that growth was insignificantly correlated with women's access to middle and higher levels of school. One reason for this is that highly educated women in many countries cannot be employed in the labor market sufficiently. In addition, women's participation in primary education promotes economic growth indirectly by providing a lower fertility rate, as fertility affects the benefit rate (Barro, 2001). Another research that supports this view is the study of gender-specific changes in total financial benefit by Kim and Sakamato (2017). In the study, the data from the American Community Survey for employees between the ages of 35 and 4 for the years of 1990-2000 and 2009-2011 were evaluated. The results of the study show that women have made significant progress in education and labor market results over the years. Moreover, within the scope of the research, it has been observed that there is a decrease in the benefit rate of education of women due to marriage, while there is a significant increase in the benefit rate of education of men. The decrease in the benefit rate of women's education due to marriage may be considered as the tendency of women to leave the workforce.

In some countries, another possible cause of the low benefit rate of women's education is the discrimination in the labor market. Sometimes, it is assumed that the wage discrimination toward women indirectly reduces their educational rate through the reduction of their earnings, and that the practice of equal wage between men and women will help to eliminate the difference between the benefit rates Educated women are more opposed to wage discrimination than women who receive less education;

because higher education provides access to many workplaces where equal wages are applied, thus the impact of wage discrimination decreases (Woodhall, 1973).

In spite of all the variables related to women's education and employment, it is expected for women's education to increase women's employment in the general framework. Tansel (2001) investigated long-term relationship with the work force participation of women in Turkey, economic development level of women, and especially the relationship with the U-shaped hypothesis of the participation of women in the workforce. Accordingly, it was not determined that women's education rate has a strong and positive impact on women's work force participation. Besides, regional differences were found in women's labor participation; moreover, it was determined that unemployment has a discouraging effect on women's labor participation, while education has a considerably positive effect.

Women's education has not reached the desired level in developed countries either. Not only education, but also employment is not at the same level. Women's employment areas were limited to certain occupational groups (Tansel, 2001), and women were not able to participate in the production process adequately. Klasen (2002), in his study analyzed gender inequality's effects on economic growth among countries, revealed that gender inequality has important impact on economic growth. In addition, growth is affected indirectly due to the effect of gender inequality on investments and population growth. Today, revealing the effects of the fact that women's education and employment rates in developed countries cannot reached the desired level either, and the analyses of this situation towards developed countries, can draw a route for developing and underdeveloped countries. Therefore, within the scope of this study, it was aimed to show the relation of women's education in countries under the title of G20 (Group of Twenty) with women's participation to work force and national income, in order to evaluate different countries.

2. Material and Methods

This section contains information about model and data set of the research.

2.1. Research Model

The standard method for predicting the effect of education on economic growth is to estimate the annual average growth in per capita national income (gross domestic product, GDP), schooling measurements and the growth and regressions specified as a set of important variables for several decades in transnational terms (Hanushek and Wößmann, 2010).). From this point of view, G20 countries have been chosen in this research to better demonstrate the affects of different country characteristics and dynamics of women's education on growth. In this research, it was aimed to show the relation of women's education in G20 countries with women's work force participation and national income. In this context, two different econometric models were formed within the study:

Model 1:
$LnLBPRF_{it} = \beta_{0i} + \beta_{1i}LnSEPF_{it} + \beta_{2i}LnSESF_{it} + \beta_{3i}LnSETF_{it} + \beta_{4i}D_{2008} + e_{it}$ (1)

Model 2:
$LnGDPPC_{it} = \alpha_{0i} + \alpha_{1i}LnSEPF_{it} + \alpha_{2i}LnSESF_{it} + \alpha_{3i}LnSETF_{it} + \alpha_{4i}LnLFPRF_{it} + \alpha_{5i}D_{2008} + \varepsilon_{it}$ (2)

In the models, the following indicate:
$LFPRF$: Women's labor force participation rate (Female (% of female population ages 15+) (modeled ILO estimate),
$SEPF$: Women's elementary (primary) schooling rate (School enrollment, primary, female (gross %),
$SESF$: Women's middle and high (secondary) schooling rate (School enrollment, scondary, female (gross %),
$SETF$: Women's university (tertiary; associate and undergraduate programs) schooling rate (School enrollment, tertiary, female (gross %),
$GDPPC$: Real national income per capita (Gross Domestic Product Per Capita),
i: The cross-sectional dimension of the study (countries, $i = 1, 2, \ldots, 17$)
t: Time dimension of the study ($t = 1, 2, \ldots, 22$).
$\beta_{1i} > 0, \beta_{2i} > 0, \beta_{3i} > 0$ is expected as a result of the analyses related to Model 1 which examines the effects of women's education on women's work force participation rate. $\alpha_{1i} > 0, \alpha_{2i} > 0, \alpha_{3i} > 0, \alpha_{4i} > 0$ is expected as a result of analyses related to Model 2 which examines the effects of women's education and work force participation rate on national income.

2.2. Data Set

In this study, in order to reveal the relationship of women's education with women's work force participation level and national income; data related to the real national income, the schooling rate of women and the work force participation rates of women in the G20 countries for the period of 1997-2018 were used. G20 members include Turkey, Russia, Saudi Arabia, Mexico, Canada, Japan, Italy, England, India, South Korea, South Africa, France, Indonesia, China, Brazil, Australia, Argentina, Germany, the United States, and The European Union. Since the European Union is not a single country and some countries in it (Germany, England, Italy and France) will already be included in the analysis, all members of G20 with the exception of the European Union have been analyzed. Women's work force participation rate, the primary school attendance rate of women, the secondary school attendance rate of women, the university attendance rate of women, and the real per capita national income data of these countries were included in the analysis. The data were taken from the tables of the World Bank and Penn World (international database covering world countries, containing information on relative income, output, input and productivity levels). Logarithmic transformation was applied to all data that were used in analyses. In addition, the 2008 global economic crisis, which took place during the analysis period and significantly affected the world economy, was also taken into account as a dummy variable in analyses. A dummy variable is created to include concepts such as gender, race, religion, region (east-west; above-below the equator) in analyses. The dummy variable, which is generally used to take into account the economic crises and the structural changes in economies, was taken into evaluation for the years of 2008 and 2009, when the economic crisis was effective in all world countries, since the research includes the time series of 1997-2018. Information on descriptive statistics for the data set is given in Appendix 1. The correlation matrix between the variables is presented in Appendix 2.

Determining the stationarity levels of the series at the beginning of the econometric analyses and accordingly deciding on the analysis methods to be used in the later stages would be appropriate. Otherwise, results can be devaint (Arltová and Fedorova, 2016: 48-52). In this study, Fisher ADF and Fisher PP panel unit root tests used to test stationarity of series. Pedroni (2004) method was used to existence of cointegration relations between the series. The long-short term relations of the series have been analyzed with DOLS (Dynamic Ordinary Least Squares) method. Causality relationships between variables were investigated with panel causality test (Dumitrescu and Hurlin, 2012).

A. Panel Unit Root Test

In this research, series' stationarity was examined with Fisher ADF (Maddala and Wu, 1999) and Fisher PP (Choi, 2001) panel unit root tests. The test, known as the Fisher ADF test, is based on Fisher's study (1932) and is calculated using the ϱ probability value of the ADF unit root statistics applied for each section (Şak, 2018). In the Fisher PP (Choi, 2001) test, the test statistic is calculated by using the ϱ probability value of the ADF unit root statistics applied for each cross-sectional unit, so it helps removing to problem of inflexibility in terms of observation number and length in the application of other panel unit root tests (Demirhan, 2019).

Unit root tests are executed show that there may be differences between G20s. that make up the panel. Since Fisher PP test is stronger in the series with tendency from the Fisher ADF test, two methods were used together in the study. The hypotheses of these tests:

H_0: The series are not stationary.

H_1: The series are stationary.

When the hypothesis H_0 can be rejected, series are stationary. Series are stationary at the level value are called l(0) series. Series that are not stationary only turn into stationary after the first differences taken are called I(1) series (Gujarati and Porter, 2012: 744-747).

B. Panel Cointegration Test

The existence of cointegration relationship between series in models was tested by Pedroni (2004) method. In this test, seven different test statistics are used and the cointegration test is performed considering all optional (alternative) situations according to the states of homogeneity and heterogeneity of the horizontal sections (countries) forming the panel. Hypotheses of cointegration tests;

H_0: There is no cointegration between the series.
H_1: There is cointegration between series.

In this reseach, Pedroni (2004) cointegration test was used. In panel data analyses, the method developed by Pedroni (1999, 2004) is used, especially in the literature for cointegration analysis. The method based on Engle-Granger's cointegration test, tests the residues of the spurious regression in the series that are not stationary and become stationary in I(1). If the series are cointegrated, the regression residues are expected to be I(0) or be stationary on the level. If the series are not cointegrated, the residues are expected to be I(1) or to be stationary in the first difference.

C. Panel DOLS Method

Panel DOLS is an effective predictor (estimator) because it uses the lagged and antecedent values of the independent variables as an explanatory variable in model. Panel DOLS is also a robust estimation method for variable variance and autocorrelation problems (Melo-Velandia, Leon and Saboya, 2015: 46-47). In addition to this superiority of the Panel DOLS method, the secret prerequisite for its use is a high number of observations (Mark and Sul, 2003: 656). Since there is sufficient observation in this study, both short and long term analyses were carried out with Panel DOLS method.

D. Panel Causality Test

Panel causality tests are used to specified the existence of interaction between variables used in the analyses and its direction if there is an interaction. In this research, existence of causality relations between series were analyzed with panel causality tests (Dumitrescu and Hurlin, 2012). This method is stronger than the Granger (1969) test, and it can determine the causality relationships that apply not only to the whole panel but also to some of the countries that make up the panel.

3. Results and Discussion

As mentioned above, panel unit root tests of Fisher ADF and Fisher PP used for test the stationarity of series. Pedroni (2004) method used to the existence of cointegration relationships between series. The long and short term relations of the series were analyzed with Panel DOLS method and the causality relationships between variables were determined with panel causality test (Dumitrescu and Hurlin, 2012).

3.1. Findings Related to Unit Root Tests

Fisher PP unit and Fisher ADF root tests were initially performed on the data set. The results obtained from the tests are given in Table 1.

Table 1: Panel Unit Root Test Results

	Fisher ADF Test				Fisher PP Test			
	ADF - Fisher Chi-Square Statistics		ADF - Choi Z-Statistics		PP - Fisher Chi-Square Statistics		PP – Z-Statistics	
	Test Statistics	Probability Value	Test Statistics	Probability Value	Test Statistics	Probability Value	Test Statistics	Probability Value
LnGDPPC	37.67	0.48	-0.36	0.35	22.26	0.98	1.28	0.90
LnLBPRF	42.34	0.28	-0.77	0.22	43.50	0.24	-0.51	0.30
LnSEPF	67.27*	0.00	-2.51*	0.00	43.74	0.24	-0.96	0.16
LnSESF	31.49	0.68	1.43	0.92	138.26*	0.00	-3.63*	0.00
LnSETF	85.44*	0.00	-0.52	0.29	71.24 *	0.00	-0.48	0.31
Δ LnGDPPC	174.66*	0.00	-8.77*	0.00	182.42*	0.00	-9.48*	0.00
Δ LnLBPRF	206.77*	0.00	-9.82*	0.00	195.26 *	0.00	-9.73*	0.00
ΔLnSEPF	-	-	-	-	209.33*	0.00	-10.88*	0.00
ΔLnSESF	465.53*	0.00	-13.45*	0.00	-	-	-	-
ΔLnSETF	439.39*	0.00	-11.70*	0.00	448.84*	0.00	-1245*	0.00

Note: *, ** and *** indicate that the related series is stable at 1% significance level. Optimum lag length is selected according to Akaike Information Criteria. The first difference was not tested for stationarity for the series which was stationary at the level value. Δ; shows that the first difference of the related series is taken.

As seen in Table 1, not all series are stationary on level values. They turn into stationary after their first differences were taken. Therefore, all of the series are *I(1)*. Though LnSEPF seris seemed stationary on the level values according to the ADF test, and LnSESF series seemed stationary according to the PP test, optional (alternative) test did not support these findings. Therefore, the series are not stationary on the level values. In this case, according to Granger and Newbold (1974), a spurious regression problem can be seen in the analyses to be conducted with series' level values. According to Engle and Granger (1987), the existence of a cointegration relation between the series must first be tested in order to avoid this problem.

3.2. Cointegration Test Findings

In this research, findings of the Pedroni (2004) cointegration test are given in Table 2.

Table 2: Panel Cointegration Test Results (Model 1)

	Model 1				Model 2			
			Weighted Statistics				Weighted Statistics	
	Statistics	Probability	Statistics	Probability	Statistics	Probability	Statistics	Probability
Panel ϑ Statistics	-0.32	0.62	-1.42	0.92	-1.18	0.88	-1.04	0.85
Panel ρ Statistics	0.36	0.64	-0.32	0.37	2.21	0.98	1.98	0.97
Panel PP Statistics	-1.29***	0.09	-2.45*	0.00	-1.33***	0.09	-2.39*	0.00
Panel ADF Statistics	-1.96**	0.02	-325*	0.00	-0.77	0.21	-2.58*	0.00
Group ρ Statistics	1.39	0.91	-	-	3.55	0.99	-	-
Group PP Statistics	-207**	0.01	-	-	-2.03**	0.02	-	-
Group ADF Statistics	-329*	0.00	-	-	-3.96*	0.00	-	-

Note: *, ** and *** show the level of cointegration relationship between the variables on the significance levels of 1%, 5% and 10%.

As seen in Table 2, there is a cointegration relationship between series in models. The series move in the long term. There will not be any spurious regression problems in the long term analyses to be performed on the level values of the series. Existence of a cointegration relationship between series show that women's education rates move together and affect each other with women's work force participation rate and per capita national income series in the long term.

3.3. Long Term Analysis

When the series are cointegrated, it will be more accurate to perform the long term analysis with one of the Panel DOLS (Dynamic Ordinary Least Squares) or Panel FMOLS (Fully Modified Least Squares) methods, which consider the cointegration vector between series, instead of the Panel OLS (Ordinary Least Squares) method (Baltagi, 2001). Panel FMOLS is preferred to make effective estimations in cases where the number of observations is low (Rao and Kumar, 2008). Whereas Panel DOLS is an effective predictor because it uses the delayed and antecedent values of the independent variables as an explanatory variable in the model. Since there is enough observation in this research, long-term analyses were carried out with Panel DOLS method. Models used in long term analyses:

Model 1:

$$LnLBPRF_{it} = \beta_{0i} + \beta_{1i}LnSEPF_{it} + \beta_{2i}LnSESF_{it} + \beta_{3i}LnSETF_{it} + \beta_{4i}D_{2008} + e_{it} \quad (3)$$

Model 2:

$$LnGDPPC_{it} = \alpha_{0i} + \alpha_{1i}LnSEPF_{it} + \alpha_{2i}LnSESF_{it} + \alpha_{3i}LnSETF_{it} + \alpha_{4i}LnLFPRF_{it} + \alpha_{5i}D_{2008} + \varepsilon_{it} \quad (4)$$

These models are estimated by Panel DOLS method. The obtained findings are given in Table 3.

Table 3: Long Term Analysis Results

Model 1 (Dependent Variable: Women's Work Force Participation Rates)			**Model 2 (Dependent Variable: Real Per Capita National Income)**		
Variable	**Coefficient**	**Probability**	**Variable**	**Coefficient**	**Probability**
LnSEPF	0.50*	0.00	LnLBPRF	0.52***	0.08
LnSESF	0.25*	0.00	LnSEPF	-1.05**	0.01
LnSETF	0.10*	0.00	LnSESF	2.00*	0.00
D_{2008}	0.01	0.47	LnSETF	0.85*	0.00
			D_{2008}	0.40	0.10
Model Verification Tests			**Model Verification Tests**		
R^2	0.73		R^2	0.97	
$\bar{R}^2$	0.35		$\bar{R}^2$	0.89	
Standard Error of Regression	0.25		Standard Error of Regression	0.40	
Long Term Variance	0.04		Long Term Variance	0.02	

The Sum of Squares of Error Terms	9.53	The Sum of Squares of Error Terms	11.37

Note: *, ** and *** show that the relevant coefficient is statistically significant at 1%, 5% and 10% levels respectively.

Looking at the results obtained for Model 1 in Table 3; it is observed that the growth in rate of women's schooling at all levels increase in rate of women's work force participation and schooling at primary education level has the biggest effect. It is seen that the 2008 global economic crisis tends to increase women's work force participation rate, but this effect is not statistically significant. It is known that more people tend to participate the work force due to decline in their income during economic crises (Can et al. 2017). Looking at the results obtained for Model 2; the increase in women's work force participation rates, and women's schooling rates in secondary education and higher education increase the per capita national income in G20 countries, while schooling in the primary education level decrease the real per capita national income. The reason why schooling at the primary educational level reduces the real per capita national income is considered to be low level of human capital and the inability to produce effectively of individuals on this educational level. It can be seen that the variable increasing the real per capita national income the most is women's schooling rate at the secondary educational level. It is thought that the graduates of this level of education are generally involved in production as intermediate staff and contribute significantly to the economy. Model validation tests show that the estimates are reliable.

3.4. Short Term Analysis

Short term analysis of the research was done with Panel DOLS method. Models used in short term analyses:

Model 1:

$$\Delta LnLBPRF_{it} = \beta_{0i} + \beta_{1i}\Delta LnSEPF_{it} + \beta_{2i}\Delta LnSESF_{it} + \beta_{3i}\Delta LnSETF_{it} + \beta_{4i}\Delta D_{2008} + \beta_{5i}ECT_{1,t-1} + e_{it} \quad (5)$$

Model 2:

$$\Delta LnGDPPC_{it} = \alpha_{0i} + \alpha_{1i}\Delta LnSEPF_{it} + \alpha_{2i}\Delta LnSESF_{it} + \alpha_{3i}\Delta LnSETF_{it} + \alpha_{4i}\Delta LnLFPRF_{it} + \alpha_{5i}\Delta D_{2008} + \alpha_{6i}ECT_{2,t-1} + \varepsilon_{it} \quad (6)$$

Δ; in these models shows that the first difference of the series is taken. $ECT_1$and $ECT_2$are the error correction terms of the first and second models respectively. When the coefficients of these terms are found to be statistically significant as a result of the analyses to be made; it is decided that the error correction mechanisms of the models are working (Hylleberg and Mizon, 1989: 114-116). These models are estimated with the Panel DOLS method and the results are given in Table 4.

Table 4: Results related to short term analysis

Model 1 (Dependent Variable: Women's Work Force Participation Rates)			**Model 2 (Dependent Variable: Real Per Capita National Income)**		
Variable	Coefficient	Probability	Variable	Coefficient	Probability
ΔLnSEPF	0.10*	0.00	LnLBPRF	1.14*	0.00
ΔLnSESF	0.09*	0.00	LnSEPF	1.41*	0.00
ΔLnSETF	0.02*	0.00	LnSESF	1.72*	0.00
$ECT_{1,t-1}$	-0.03*	0.00	LnSETF	-0.06	0.22
			$ECT_{2,t-1}$	0.01*	0.00
Model Verification Tests			**Model Verification Tests**		
$\mathbf{R^2}$	0.77		$\mathbf{R^2}$	0.70	
$\mathbf{\bar{R}^2}$	0.25		$\mathbf{\bar{R}^2}$	0.33	
Standard Error of Regression	0.02		Standard Error of Regression	0.15	
Long Term Variance	0.0001		Long Term Variance	0.0008	
The Sum of Squares of Error Terms	0.024		The Sum of Squares of Error Terms	1.67	

Note: *, ** and *** show that the relevant coefficient is statistically significant at 1%, 5% and 10% levels respectively.

According to the panel DOLS test results of Model 1 in Table 4, the schooling rates of women are all positively and statistically significant at 1%. This means that the increase in the level of women's participation in educational activities has positively affected women's work force participation rate in the short term. The model's error correction mechanism works. When the results of the short term analysis for Model 2 are examined, the schooling rates of women (except for the higher education level), their work force participation and per capita national income are all positively and statistically significant at 1%. According to these results; the increase in women's work force participation rates and schooling rates positively affected the per capita national income in the short term. Only university-level schooling rate of women was found to be statistically insignificant in the short term. Model 2's error correction mechanism works. So the analyses are reliable. Model verification tests also show that the findings are reliable.

3.5. Panel Causality Test

To determine the existence of an interaction between variables used in the analyses and the direction of such interaction, panel causality tests are used. The existence of causality relations between series were analyzed with the help of panel causality tests (Dumitrescu and Hurlin, 2012). This method is stronger than the Granger (1969) test, and it can determine the causality relationships that apply not only to the whole panel but also to some of the countries that make up the panel. The causality relations between the two variables in the form of X and Y, can be examined in the panel causality test by using the following equations (Anoruo and Elike, 2015):

$$Y_{i,t} = \beta_i + \sum_{j=1}^{p} \zeta_j Y_{it-j} + \sum_{j=1}^{p} \varphi_j X_{it-j} + u_{it} \quad (7)$$

$$X_{i,t} = \alpha_i + \sum_{j=1}^{p} \psi_j X_{it-j} + \sum_{j=1}^{p} \phi_j Y_{it-j} + v_{it} \quad (8)$$

Here, p; signifies optimal lag length. 7th equation tests the existence of a causal relationship from X to Y; while 8th equation tests the existence of a causal relationship from Y to X. The hypotheses of this test;

$H_0: \beta_j = 0 \; for \; all \; cross \; sections.$ There is no causality relation from X to Y in all cross sections.

$$H_1: \begin{cases} \beta_i^{(k)} = 0, i = 1, 2, \ldots, N_1 \\ \beta_i^{(k)} \neq 0, i = N_1 + 1, N_1 + 2, \ldots, N \end{cases}$$

There is a causality relation from X to Y in some cross sections.

In the study, Dumitrescu and Hurlin (2012) determined the optimal lag length required for panel causality testing as 3, with the help of a standard VAR estimation. The results of this procedure are given in Appendix 3, while the inverse characteristic roots graph showing that the 3 delays VAR model and therefore the causality test is stable is in Appendix 4. The findings obtained from panel causality test (Dumitrescu and Hurlin, 2012) are given in Table 5.

Table 5: Panel causality test results

The Direction of Causality	W Statistics	$\bar{Z}$ Statistics	Probability Value
LnLBPRF → LnGDPPC	4.91	1.53	0.12
LnGDPPC → LnLBPRF	10.68*	8.24*	0.00
LnSEPF → LnGDPPC	4.23	0.73	0.46
LnGDPPC → LnSEPF	5.04***	1.67	0.09
LnSESF → LnGDPPC	4.20	0.70	0.48
LnGDPPC → LnSESF	5.34**	2.02**	0.04
LnSETF → LnGDPPC	5.70**	2.44**	0.01
LnGDPPC → LnSETF	9.05*	6.34*	0.00
LnSEPF → LnLBPRF	7.51*	4.55*	0.00
LnLBPRF → LnSEPF	6.12*	2.93*	0.00
LnSESF → LnLBPRF	7.64*	4.70*	0.00
LnLBPRF → LnSESF	5.86*	2.63*	0.00
LnSETF → LnLBPRF	6.43*	3.29*	0.00
LnLBPRF → LnSETF	7.81*	4.90*	0.00

Note: *, ** and *** show that there is a causality relationship directed from the first variable to the second variable at 1%, 5% and 10% significance levels respectively.

As it is seen in Table 5, there is a causality relationship directed from per capita national income to the schooling rate of women. The causality relationships obtained for the easier monitoring of the results were visualized with the help of Figure 1.

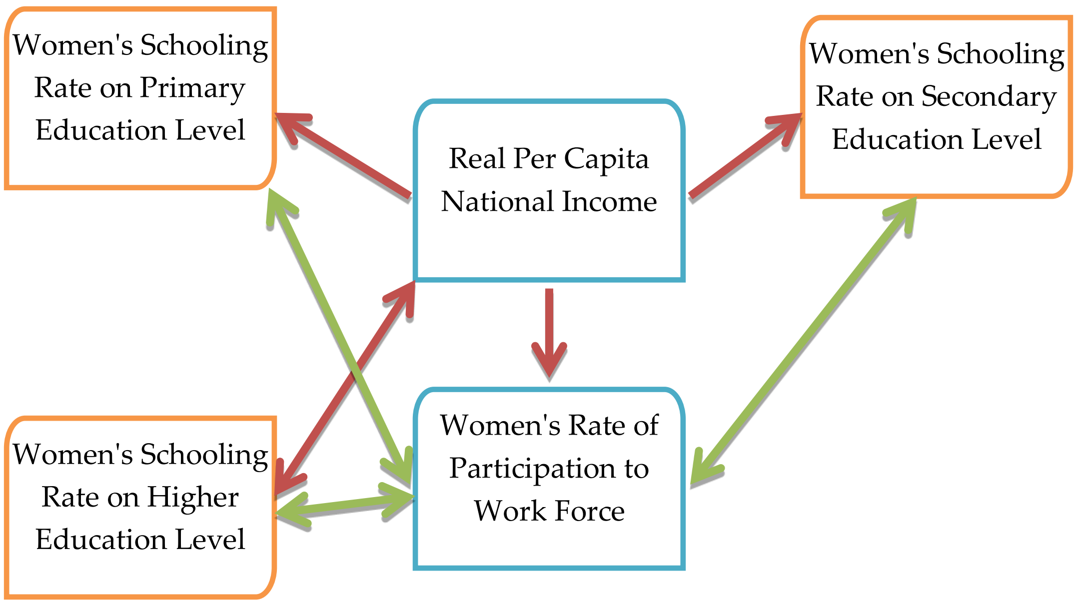


Figure 1: Causality Relationships

Looking at the causality relationships in Figure 1; while there is no causality relation directed from the level of women's schooling rate on primary and secondary education levels to per capita national income, it is seen that there is a causality relationship directed from national income per capita to women's schooling rate. In this case, the per capita national income is considered to increase women's schooling rate. There is a two-way causality relationship between women's schooling rate and per capita national income. In this case, it is thought that the increasing per capita national income increases the possibility of women going to university and the increase in the amount of women going to university increases per capita national income. When considered in terms of work force participation and labor produced, it can be said that the post higher education benefits contribute more to the per capita national income of that country. The most striking finding in Figure 1 is the two-way causality relationships between women's schooling rates at all levels and women's work force participation rate. In this case, it is considered that increasing schooling rate of women also increases women's entry into the labor market, and increasing employment of women creates more opportunities for girls to get educated.

4. Discussion, Conclusion and Recommendations

Using relationships between women's education, women's work force participation and national income, along with real national income, women's schooling rate and women's work force participation rates of G20 countries for the period of 1997-2018, 7 different variables along with 2 different econometric models were utilized with panel data analysis methods. Within scope of analysis, stationarity of the series were examined with Maddala & Wu's (1999) Fisher ADF and Choi's (2001) Fisher PP panel unit root tests. It was defined that all series were I(1). The existence of cointegration relationships between series in the models was tested with Pedroni (2004) methodi and it was found that the series are cointegrated; meaning women's schooling rates move together with women's work force participations rates and per capita national income series in the long term, and they are affected from each other.

Long-term relationships of the series were analyzed by Panel DOLS method and it was found that the increase in women's schooling level increases women's work force participation rate and that increases the real per capita national income. In addition, it was determined that women's work force participation rate positively affects the real per capita national income. Panel DOLS method was used for short-term analyses, and it was found that increase in women's schooling rates increase women's work force participation rates; and increases in women's schooling rates and women's work force participation rates increase the real per capita national income in the short term too. In the short term analyses, error correction mechanisms of the models were found to be working. This finding provides additional evidence that the analyses are reliable.

The causality relationships between the variables used in the analyses were examined with panel causality tests. While there was no causality relationship directed from women's schooling rate on primary and secondary levels to per capita national income, it was observed that there were causality relationships directed from per capita national income to women's schooling rate. A two-way causality relationship was found between women's schooling rate and per capita national income. In addition, two-way causality relationships were found between women's schooling rates on all levels and women's work force participation.

According to the findings of this study; it can be stated that, as women's schooling rate increases in G20 countries, the courage of women to participate in the labor market also increases; and increases in women's schooling rate and women's employment increase per capita national income. Results of Tansel's (2001) research within the scope of Turkey seem to support this research. Accordingly, in the research conducted on women's work force participation in Turkey, it was determined that women's education has a powerful and positive effect on women's work force participation.

It was determined that gender inequality indirectly affects growth due to its effect on investments and population growth. In Seguino's (2000) research, it was determined that income inequality slows growth down. Er (2012), in his research, while evaluating the real per capita national income growth rate of 187 countries in 1998-2008 with relation to women's education, work force participation and the work sectors they are employed in; it was concluded that decreases in women's fertility increase the resources related to product production; in addition, women's participation to work force and education instead of raising children, women's further employment, further education and further participation into politics also increase economic growth.

When the results are evaluated, countries need to reduce inequality in women's education rates or employment and improve their indicators related to women in order to maintain or improve economic growth. It can be stated that state authorities, who want to increase economic growth and per capita national income in their countries, should pay special care to the schooling of women and their participation in the labor market. It may be advisable for policymakers to implement practices aimed at increasing women's education and employment, and to include the element of women in the country's economic plans.

References

Ammermueller, Andreas and Weber, Andrea Maria, Educational Attainment and Returns to Education in Germany (March 2005). ZEW - Centre for European Economic Research Discussion Paper No. 05-017. Erişim Tarihi: 25.02.2019 SSRN: https://ssrn.com/abstract=711063 or http://dx.doi.org/10.2139/ssrn.711063

Anoruo, E., and Elike, U. (2015). Human Capital-Economic Growth Nexus in Africa: Heterogeneous Panel Causality Approach. *International Journal of Economics and Financial Issues*, 5(4), 1017-1023.

Arltová, M., and Fedorova, D. (2016). Selection of Unit Root Test on the Basis of Length of the Time Series and Value of AR(1) Parameter. *Statistika*, 96(3), 47-64.

Asplund, Rita (2000). *Private returns to education in Finland: Back to basics*, ETLA Discussion Papers, The Research Institute of the Finnish Economy (ETLA), No. 720.

Baltagi, B. (2001). *Econometric Analysis of Panel Data.* (2nd Ed.). UK: John Wiley & Sons Ltd.

Barro, R. J. (2001). Education and economic growth. *The contribution of human and social capital to sustained economic growth and well-being*, 14-41.

Can, R., Erdem, B. P., Kassap, V. ve Demirel, B. (2017). *Türkiye İşgücü Piyasasındaki Yapısal Dönüşüm.* Ankara: Kalkınma Bakanlığı, Ekonomik ve Stratejik Araştırmalar Dairesi.

Choi, I. (2001). Unit Root Tests for Panel Data. *Journal of International Money and Finance*, 20, 249-272.

Colclough, C., Kingdon, G., and Patrinos, H. (2010). The changing pattern of wage returns to education and its implications. *Development Policy Review*, *28*(6), 733-747.

Çalışkan, Ş. (2007). Eğitimin getirisi (Uşak ili örneği). *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 12(2), 235-252.

Dumitrescu, E. I., and Christophe, H. (2012). Testing for Granger Non-Causality in Heterogeneous Panels. *Economic Modeling*, 29, 1450-1460.

Engle, R. F., and Granger, C.W.J. (1987). Co-integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, 55, 251–276.

Er, Ş. (2012). Women indicators of economic growth: a panel data approach. *Economic Research Guardian*, *2*(1), 27-42.

Granger, C. W. J., and Newbold, P. (1974). Spurious Regressions in Econometrics. *Journal of Econometrics,* 2, 111-120.

Gujarati, D. N., and Porter, D. C. (2012). *Temel Ekonometri*. (5. Basımdan Çeviri, Çevirmenler: Şenesen, Ü. ve Şenesen, G. G.), İstanbul: Literatür Yayınları.

Hanushek, E. A., and Woessmann, L. (2010). Education and economic growth. *Economics of education (Eds* Dominic J. Brewer, Patrick J. McEwan), 60-67, Spain: Elsevier.

Harmon, C., Oosterbeek, H., and Walker, I. (2003). The returns to education: Microeconomics. *Journal of economic surveys*, *17*(2), 115-156.

Henderson, D. J., Polachek, S. W., and Wang, L. (2011). Heterogeneity in schooling rates of return. *Economics of Education Review,* 30(6), 1202-1214.

Hylleberg, S., and Mizon, G. E. (1989). Cointegration and Error Correction Mechanisms. *The Economic Journal*, 99(395), 113-125.

Kim, C., and Sakamoto, A. (2017). Women's Progress for Men's Gain? Gender-Specific Changes in the Return to Education as Measured by Family Standard of Living, 1990 to 2009–2011. *Demography*, *54*(5), 1743-1772.

Klasen, S. (2000): Does Gender Inequality Reduce Growth and Development? Evidence from Cross-Country Regressions. Sonderforschungsbereich 386, Discussion Paper 212, https://doi.org/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. *The World Bank Economic Review*, *16*(3), 345-373.

Maddala, G., and Wu, S. (1999). A Comparative Study of Unit Root Tests With Panel Data and a New Simple Test. *Oxford Bulletin of Economics and Statistics*, Special Issue, 631-652.

Mark, N. C., and Sul, D. (2003). Cointegration Vector Estimation by Panel DOLS and Long-run Money Demand. *Oxford Bulletin of Economics and Statistics*, 65(5), 655-680.

Melo-Velandia, L. F., Leon, J. J., and Saboya, D. (2015). Cointegration Vector Estimation by DOLS for a Three-Dimensional Panel. *Revista Colombiana de Estadística*, 38(1), 45- 73.

Park, S. (2011). Returning to school for higher returns. *Economics of Education Review*, *30*(6), 1215-1228.

Patrinos, H. (2008). Returns to education: The gender perspective. *Girls' Education in the 21st Century: Gender Equality, Empowerment and Economic Growth. Washington, DC: The World Bank*, 53-661.

Pedroni, P. (2004). Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. *Econometric Theory*, 20(3), 597- 625.

Peet, E. D., Fink, G., and Fawzi, W. (2015). Returns to education in developing countries: Evidence from the living standards and measurement study surveys. *Economics of Education Review*, 49, 69-90.

Psacharopoulos, G. ve H. A. Patrinos (2004a). Human Capital and Rates of Return, *International handbook on the economics of education*, Ed. G. Johnes ve J. Johnes, Northampton: Edward Elgar.

Psacharopoulos, G., and Patrinos, H. A. (2004). Returns to investment in education: a further update. *Education economics*, *12*(2), 111-134.

Rao, B. B., and Kumar, S. (2008). A Panel Data Approach to the Demand for Money and the Effects of Financial Reforms in the Asian Countries. *Munich Personal RePEc Archive*, MPRA Paper No. 6805.

Seguino, S. (2000). Gender inequality and economic growth: A cross-country analysis. *World Development*, *28*(7), 1211-1230.

Sianesi, B., and Reenen, J. V. (2003). The returns to education: Macroeconomics. *Journal of economic surveys*, *17*(2), 157-200.

Şak, N. (2018). *Uygulamalı Panel Veri Ekonometrisi*, İstanbul: Der Yayınları.

Tansel, A. (2001, December). Economic development and female labor force participation in Turkey: time-series evidence and cross-province estimates. Economic Research Forum for the Arab Countries, Iran & Turkey.

Tansel, A. (2010). Changing returns to education for men and women in a developing country: Turkey, 1994-2005. In *ESPE 2008 conference*.

Appendices

Appendix 1: Descriptive Statistics for the Data Set

	LnGDPPC	LnLBPRF	LnSEPF	LnSESF	LnSETF
Mean	9.394	3.827	4.647	4.528	3.842
Median	9.542	3.916	4.628	4.590	4.074
Maximum	11.127	4.277	5.094	5.078	4.992
Minimum	6.014	2.736	4.426	3.566	1.601
Standard Deviation	1.232	0.309	0.078	0.238	0.680
Skewness	-0.780	-1.685	2.011	-1.173	-0.757
Kurtosis	2.792	5.542	10.531	6.007	2.753
Jarque-Bera	43.151	310.473	1269.473	253.398	41.021
Probability	0.000	0.000	0.000	0.000	0.000
Total	3926.660	1599.888	1942.598	1892.891	1605.996
Sum of Squares of Standard Deviations	633.251	39.934	2.555	23.532	192.969
Number Of Observations	418	418	418	418	418

According to the data in the table; the standard deviation of the series is low, which reduces the likelihood of encountering a spurious regression problem. The number of data used in the analysis is 418; which is sufficient.

Appendix 2: Correlation Matrix

	LnGDPPC	LnLBPRF	LnSEPF	LnSESF	LnSETF
LnGDPPC	1	0.190	-0.226	0.751	0.796
LnLBPRF	0.190	1	0.076	0.377	0.315
LnSEPF	-0.226	0.076	1	0.118	-0.088
LnSESF	0.751	0.377	0.118	1	0.772
LnSETF	0.796	0.315	-0.088	0.772	1

According to the correlation matrix; there is a negative and low relationship (-0.226) between women's schooling rates on primary school level and per capita national income, and there is a positive and high relationship between women's education on secondary school (0.751) and university (0.796) levels and per capita national income. There is a positive and low (0.19) relationship between women's work force participation rate and per capita national income.

On the other hand, there are positive and low (0.076) interactions between schooling rates on primary school level and women's work force participation, while there are positive and high interactions between schooling on secondary education (0.377) and university (0.315) levels and women's work force participation rates.

Appendix 3: Result of the Optimal Lag Length Determination Process

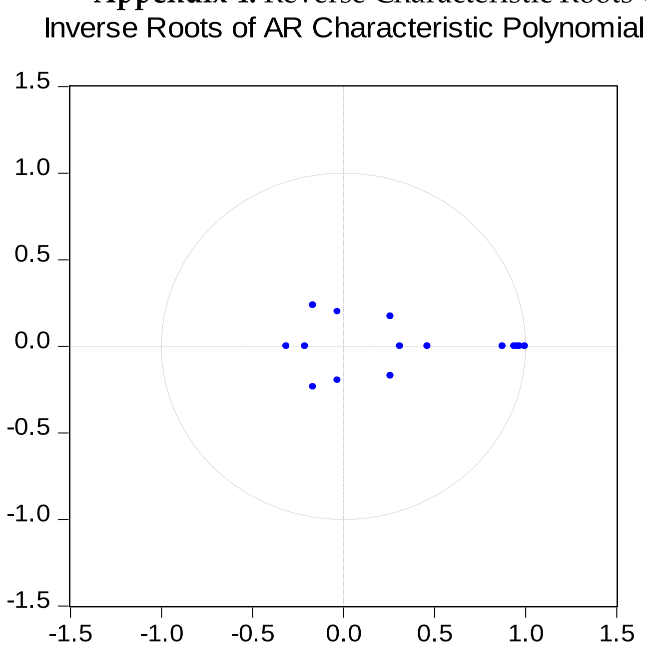
VAR Lag Order Selection Criteria
Endogenous variables: LNGDPPC LNLBPRF LNSEPF LNSESF LNSETF
Exogenous variables: C
Date: 02/24/19 Time: 23:06
Sample: 1997 2018
Included observations: 266

Lag	LogL	LR	FPE	AIC	SC	HQ
0	45.00861	NA	5.09e-07	-0.300817	-0.233458	-0.273756
1	2555.151	4907.046	3.91e-15	-18.98610	-18.58195*	-18.82373
2	2600.976	87.85945	3.34e-15	-19.14268	-18.40173	-18.84501*
3	**2630.819**	**56.09634**	**3.23e-15***	**-19.17909***	**-18.10135**	**-18.74612**
4	2650.043	35.41168	3.37e-15	-19.13566	-17.72112	-18.56738
5	2667.162	30.89188	3.58e-15	-19.07641	-17.32507	-18.37283
6	2690.320	40.91891	3.64e-15	-19.06256	-16.97443	-18.22368
7	2714.172	41.24781*	3.68e-15	-19.05393	-16.62900	-18.07974
8	2731.792	29.80756	3.91e-15	-18.99843	-16.23672	-17.88895

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The optimal lag length was determined as 3 according to the FPE and AIC criteria.

Appendix 4: Reverse Characteristic Roots Chart



In this graph, the causality tests performed are stable, because the inverse characteristic roots remain within the unit circle.