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# Gender equality in education and economic growth in Algeria

# المساواة بين الجنسين في التعليم والنمو الاقتصادي في الجزائر

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**Abstract**

This study aims to empirically analyse the relationship between gender equality in education and economic growth in Algeria over the period of 1971-2017 using the ARDL model.For doing so, GDP is considered as a function of a set of explanatory variables namely; gross fixed capital formation as a measure of capital investment, gender parity index in secondary education, exports and imports of goods and services.

The obtained results show that GDP is positively influenced by the gender parity index in secondary education and investment in physical capital, and imports and exports of goods and services. Indeed, an increase by 1% in gender equality in education leads to raise the GDP by 0.32%. The elasticity with respect to gender educational equality index is three times more than that of physical capital.

**Keywords** : Gender equality, Economic growth, ARDL Model, Elasticity, Imports and exports, Algeria.

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**ملخص**

تهدف هذه الدراسة القياسية إلى تحليل العلاقة بين المساواة بين الجنسين في ميدانالتعليم والنمو الاقتصادي في الجزائر خلال الفترة 1971-2017 باستخدام نموذج الانحدار الذاتي للفجوات الزمنية الموزعة.للقيام بذلك، نعتبر الناتج الداخلي الخام دالة لمجموعة من المتغيرات التفسيرية وهي؛ الاستثمار في رأس المال المادي، ومؤشر التكافؤ بين الجنسين في التعليم الثانوي، وصادرات وواردات السلع والخدمات.

تظهر النتائج التي تم الحصول عليها ان الناتج الداخلي الخام يتأثر إيجابيا بمؤشر التكافؤ بين الجنسين في التعليم الثانوي والاستثمار في رأس المال المادي،وواردات وصادرات السلع والخدمات.اما المرونة فيما يتعلق بمؤشر المساواة في التعليم بين الجنسين أكبر بثلاث مرات من رأس المال المادي.

**الكلمات المفتاحية:** المساواة بين الجنسين، النمو الاقتصادي، نموذج الانحدار الذاتي للفجوات الزمنية الموزعة،المرونة، الواردات والصادرات، الجزائر.

## 1. INTRODUCTION

The literature had ignored for long period the effects of gender in education on economic growth(Benavot, 1989). Indeed, high investment in education, both female and male education, contributes to enhance significantly the level of human capital leading, in turn, to increase the labor force productivity, and therefore sustain the economic growth (Lucas, 1988, Romer, 1986, 1990, Benhabib and Spiegel, 1994). Furthermore, female education generates various social gains which affect indirectly the economic growth (Shultz, 1988) and(Klasen, 1999). Indeed, educated woman leads to reduce the fertility rate making the population growth rate slower which allows, in turn, the increase of savings and physical capital investment necessary to stimulate the long run growth rate (Pervaiz, 2011).Similarly, women education decreases the infant mortality, raises significantly the child's enrolment and health may promote the future cognitive skills, level human capital and innovations activities.

According to(Gatti, 1999), the low investment in women's human capital and gender educational gap are the real obstacle to developing countries seeking to sustain their economic growth. Likewise, (Mankiew N. G., 1992), (Knwles et al., 2002)) introduced to the model of (Mankiew N. G., 1992)three explanatory variables as proxies of human capital namely; female education, male education and health. The obtained results show that the coefficient related to female education has a positive sign and robust to various sensitivity analysis in the estimated growth model. Therefore, the countries which invest highly in female education improve their labor force productivity necessary to boost the economic growth rate. Moreover, in order to identify the direct and indirect effects of gender educational inequality on economic growth, Klasen (2002) used data covered 109 rich, middle and poor countries over the period of 1960-1992. The findings

confirm the direct effects of female education on economic growth. Therefore, the annual growth rate will grow by 0.4% if the country could reach the gender equality by raising the female-mal ratio from 0.5 to 1.0. The obtained results confirm also that female education indirectly stimulates economic growth by improving the investment in physical capital and reducing the population growth rate.

Following the World Bank's Report on gender equality and development published in 2012, women's education has experienced a spectacular improvement throughout the five last decades in many developing countries. For instance, in developing countries, the percentages of the educated females to males in primary, secondary and tertiary moved from 67%, 53%, and 36% in 1960 to 86%, 75% and 64% in 1990 respectively. It is worth noting that all developing countries had closed educational gender gap in the primary level; however this gap tends to close faster in the secondary level. Thus, in some developing countries, like the MENA countries, had inverted gap because women became more enrolled than men.

Regarding Algeria, the female-male ratio in the secondary was only 0.26 in 1963; however, this gap has been inverted in 2011 where the ratio became 132 females per 100 males. Despite this educational performance, the Algerian growth rate GDP per capita was weak; it had been estimated to 3.58% between 1970 and 2010 (Bouznit et al, 2015). Furthermore, the World Bank classifies Algeria as a developing country belonging to the upper-middle income group. Hence, it seems so interesting to empirically analyze the effects of gender equality on economic growth in Algeria over the period 1971-2017 using ARDL model.

With this aim, the remainder of the paper is structured as follows: the used data and statistics analysis are presented in section 2. In section 3,

we present briefly the methodology, while the obtained results and discussion are given in section 4.

## 2. Used data and statistic analysis

Table 1 shows the main indicators of statistics des descriptive of the studied variables. The GDP at constant US$ (GDP), gross fixed capital formation as parentages GDP which represents the investment in physical capital (K), gender parity index (GPI) in secondary education as proxy of human capital (GPI), imports of goods and services (constant 2010 US$) (IMP), and exports of goods and services (constant 2010 US$) (EXP). All data are annual figures covering the period 1971 to 2017 and taken from World Development Indicators database (World Bank, 2020). The used data are summarized in Table 1.

**Table 1:**Descriptive statistics

| Variable | Mean | Max. | Min. | Std. Dev. | Obs. |
|---|---|---|---|---|---|
| **GDP** | 1.08E+11 | 1.98E+11 | 3.47E+10 | 4.42E+10 | 47 |
| **K** | 3.59E+10 | 8.43E+10 | 1.00E+10 | 1.87E+10 | 47 |
| **GPI** | -0.210812 | 0.091284 | -0.887971 | 0.284932 | 47 |
| **IMP** | 3.10E+10 | 7.00E+10 | 1.00E+10 | 1.57E+10 | 47 |
| **EXP** | 24.53301 | 25.01204 | 23.76508 | 0.319017 | 47 |
| **LnGDP** | 25.31439 | 26.01364 | 24.27111 | 0.430790 | 47 |
| **LnK** | 3.427570 | 3.883316 | 3.028910 | 0.211604 | 47 |
| **LnGPI** | -0.210812 | 0.091284 | -0.887971 | 0.284932 | 47 |
| **LnIMP** | 24.04282 | 24.97138 | 23.03052 | 0.473478 | 47 |
| **LnEXP** | 24.53301 | 25.01204 | 23.76508 | 0.319017 | 47 |

**Source**: Elaborated by the authors using Eviews 10

It is worth noting that, in 2014, the World Bank has classified Algeria as a developing country, belonging to the upper-middle income

group. The GDP moved from $34738475528 in 1971 to $1,98418E+11, being an annual growth rate of 10%. However, for the same period, the annual growth rate of GDP per capita was only 2.22%. This means that the standard of living didn't experience a notable change throughout the five last decades. This situation can be explained by the dependency of Algerian economy to hydrocarbon sector and external shocks. Therefore, the hydrocarbon sector contributes to GDP by more than 40% and 98% of the total revenues of exports are hydrocarbons products.

Regarding education sector, Algeria was colonized pending 132 years and has had its independence in 1962. The educational system was characterized by the weak literacy rate especially in secondary and tertiary level and the inequality between male and female. However, Algeria provided conservable efforts to guarantee education for all. In 1971, the school enrollment in secondary was 11.56% and it moved to 99.61% in 2017. Likewise, at the same period, the gender parity in secondary level moved from 0.41% to 1.03%.

## 3. Methodology

### 3.1. ARDL model

We employ the ARDL model to estimate the effect of gender equality in education on economic growth. For doing so, GDP at constant 2010 US$ is explained (GDP) by the gross fixed capital formation as a measure of capital investment (K), the human capital index measured as a school enrollment, secondary (gross), gender parity index, and two control variables namely exports and imports of goods and services. The used data are annual figures from the period 1971 to 2017 and taken from the World Development Indicators of the World Bank database (2020).

We will apply the ARDL model developed by Pesaran et al. (2001) to test the possible co-integration relationship between the studied variables

is more flexible than that of Engle and Granger (1987) and Johansen (1988). Indeed, the ARDL approach to cointegration to be applied even the selected variables are not integrated at the same order, but it should only ensure that there is no variable is stationary at the second differences and more. Hence, the ARDL model is implemented into three steps:

**a. Estimating the conditional error correction of the ARDL model**

The equation [1] gives the functional form of the conditional error correction of the ARDL model and the least squares method will be used to estimate it. The optimal lag (p) will be obtained using the VAR optimal model, which means that the lag minimizes both Akaike and Schwarz statistics.

$$\Delta LnGDP_t = \propto_1 LnGDP_{t-1} + \propto_2 LnK_{t-1} + \propto_3 LnGPI_{t-1} + \propto_4 LnIMP_{t-1} + \propto_5 LnEXP_{t-1} + \sum_{i=0}^{p-1} \beta_{1i} LnGDP_{t-i} + \sum_{i=0}^{p-1} \beta_{2i} \Delta LnK_{t-i} + \sum_{i=0}^{p-1} \beta_{3i} \Delta LnGPI_{t-i} + \sum_{i=0}^{p-1} \beta_{4i} \Delta LnIMP_{t-i} + \sum_{i=0}^{p-1} \beta_{5i} \Delta LnEXP_{t-i} + C + \gamma_t + \varepsilon_t [1]$$

Where $\Delta$ indicates the first in the variable, and $Ln$ is the natural logarithm. c is an intercept, $\gamma_t$refers to a temporal dummy and t is the time period in years from 1971 to 2017. $\varepsilon_t$ is a white noise error term. Furthermore, the cointgration relationship between the studied variables will be confirmed when the null hypothesis $H_0 : \propto_1 = \propto_2 = \propto_3 = \propto_4 = \propto_5 = 0$ is rejected. This means that the value of F-stat related to the coefficients of the lagged level variables is higher than that of the upper critical bounds value(Pesaran M. H., 2001).

**b. Estimating the cointegration relationship**

The cointegration relationship between the selected variables to capture the long run dynamic, it may be expressed as follows:

$$LnGDP_t = \vartheta_1 LnK_t + \vartheta_2 LnGPI_t + \vartheta_3 LnIMP_t + \vartheta_4 LnEXP_t + C + \gamma t + \varepsilon_t [2]$$

**c. Estimating the error correction model**

The short run dynamic between the studied variables may be written as follows:

$$\Delta LnFDP_t = \sum_{i=1}^{P1} \beta_{1i}\, \Delta LnGDP_{t-i} + \sum_{i=1}^{P2} \beta_{2i}\, \Delta LnK_{t-i} + \sum_{i=1}^{P3} \beta_{3i}\, LnGPI_{t-i} + \sum_{i=1}^{P4} \beta_{4i}\, \Delta LnIMP_{t-i} + \sum_{i=1}^{P5} \beta_{5i} \Delta LnEXP_{t-i} + \mu ECM_{t-1} + C + \gamma t + \varepsilon_t \quad [3]$$

where $\mu$ is the parameter which captures the speed of adjustment to restore long-run equilibrium in the dynamic model. The optimal lags (p1, P2, P3, P4, P5) will be determined on the basis of the minimum values of Akaike and Schwarz statistics.

## 4. RESULTS AND DISCUSSION

### 4.1. Unit root test and conditional error conditional ARDL model estimates

The results of the augmented Dickey-Fuler (ADF) unit root test are reported in Table 2. The results show that all selected variables are stationary at level or at first differences. Therefore, the ARDL approach to cointegration is suitable to estimate the effect of gender equality in education on economic growth. Hence, the estimating of the conditional error correction ARDL model with the optimal lag length equal to 2 (eq.[1]) has been estimated. The obtained results of bounds for cointegration are reported in Table5.

**Table 2:** unit root test analysis

| Variables | ADF unit root test in: | | Decision |
|---|---|---|---|
| | level | first difference | |
| LnGDP | 5.07 | -5.80*** | I(1) |
| LnK | 0.22 | -5.25*** | I(1) |

| | | | |
|---|---|---|---|
| LnGPI | -3.35*** | | I(0) |
| LnIMP | 2.20 | -4.35*** | I(1) |
| LnEXP | -2.80* | | I(0) |

**Notes**: *** and * show significance at 1% and 10 level respectively.I(0): stationary at level. I(1): Stationary after first difference

**Source**: Elaborated by the authors using Eviews 10

**Table3:** Bounds testing for cointegration

| F-stat value | Bounds test at 5% significance level | |
|---|---|---|
| | I(0) | I(1) |
| 27.85 | 3.05 | 3.97 |

**Source**: Elaborated by the authors using Eviews 10

According to Table3, the F-stat is higher than the hyper value of bounds test. Therefore, the null hypothesis $H_0 : \propto_1 = \propto_2 = \propto_3 = \propto_4 = \propto_5 = 0$ is rejected implying a presence of cointegration relationship between GDP, capital physique, GPI, imports and exports. The long run dynamic and the error correction model are presented in Table 3.

**Table 4:** Long run and short run estimates

| **Long run estimates** | | |
|---|---|---|
| Dependent variable LnGDP | Coefficients | Standard error |
| LnK | 0.10** | 0.054 |
| LnGPI | 0.32*** | 0.097 |
| LnIMP | 0.33*** | 0.032 |
| LnEXP | 0.32*** | 0.098 |
| Trend | 0.01*** | 0.001 |
| **Short run estimates (Error correction model)** | | |

| Dependent variable ΔLnGDP | Coefficients | Standard error |
|---|---|---|
| Intercept | 2.78*** | 0.199 |
| ΔLnY(-1) | -0.26*** | 0.066 |
| ΔLnGPI | 0.07 | 0.082 |
| ΔLnGPI(-1) | 0.25*** | 0.075 |
| ΔLnK | 0.01 | 0.012 |
| ΔLnEXP | 0.27*** | 0.025 |
| LnEXP(-1) | 0.10*** | 0.034 |
| ECM(-1) | -0.31*** | 0.022 |
| **Validity tests** | | |
| Sensitivityanalysis | test-value | p-value |
| Normality test | 0.29 | 0.86 |
| LM test | 0.47 | 0.78 |
| Breusch-Pagan-Godfrey test | 9.50 | 0.65 |
| Heteroskedasticity test: ARCH test | 0.007 | 0.93 |
| CUSUM test | Fig.1 | Stable |
| CUSUM of squares test | Fig.2 | Stable |

Notes: *** and ** indicate significance at the 1% and 5% levels, respectively

**Source**: elaborated by the authors using Eviews 10

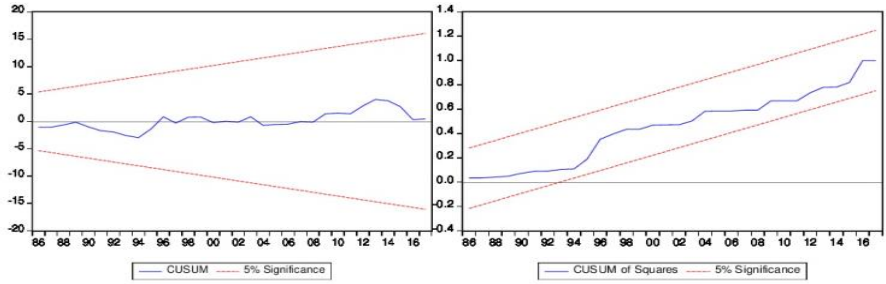
According to Table 4, the estimated coinegration relationship between the selected variables may be written as follows:

$LnGDP_t$=0.10 $*$ $LnK_t$+0.32 $*$ $LnGPI_t$+0.33*$LnIMP_t$+0.32 $*$ $LnEXP_t$+ 0.01 $*$ $t$[4]

The estimated model is robust because the estimated coefficient of the error correction term is negative, equal to (-0.31), and statistically very

significant (1% significance level). This means the adjustment toward the long run model equilibrium will be corrected by 31% each year. Moreover, normality test shows that the error term has a Gaussian distribution, while LM test and Breusch-Pagan-Godfrey test lead to reject the null hypothesis of the presence of serial correlation and Heteroskedasticity respectively. Regarding the CUSUM test and the CUSUM of Squares test, the Fig.1 confirms that the plots are between the critical bounds at the 5% significance level. This means that the coefficient of the error correction model is stable throughout the studied period.

**Fig1.** CUSUM test and the CUSUM of Squares test




**Source:** Elaborated by the authors using Eviews 10

Regarding the long run analysis, the obtained results indicate that all estimated coefficients have the positive sings and statistically significant either at 1% or 5% significance level. Therefore, the GDP is positively influenced by the investment in the physical capital, gender parity index in secondary education, imports and exports of goods and services. Indeed, the coefficient related to physical capital is estimated to 0.10 and statically significant at 5%. This means if the gross fixed capital formation increases by 1%, the real GDP also grows by 0.10%. This result is in line with that obtained in Bouznit et al.(2015), (Oukaci, 2015), Mankiew *et al*. (1992);(Benhabib, 1994). Likewise, an increase by 1% in gender equality in

education leads to raise the GDP by 0.32%. The elasticity with respect to gender educational equality index is three times more than that of the physical capital. This result confirms the positive effect of human capital accumulation on the economic growth. In that sense, (Lucas, 1988)showed that human capital, accumulated mainly from education, is the main factor to faster and sustain the economic growth rate. Moreover,(Romer, 1986) argues that human capital leads to boost innovation activities which stimulate in turn the growth rate.(Pablo-Romero M. P., 2014) showed that human capital has various positives externalities. A sufficient endowment of human capital leads to boost the generation and the absorption of the technology necessary to sustain economic growth. This means that the technological progress will be continually developed through the intensification of the physical capital investment which requires the presence of the highly educated workers. Similarly, high level of human capital leads to encourage private investors to invest in the R&D in view to product high technology machines which contribute to enhance continuously the highly educated workers productivity. Dollar and Gatti(1999) noted also that sustainable development can be reached by increasing the enrollment rate of education women and reducing significantly gender education gap.

Otherwise, as stated in (Bouznit, 2015), (Feng, 2001), (Aisen A. and Veiga F. J., 2013), and(Tang, 2014), the weak effect of physical capital and human and capital on economic growth can be explained by the political instability in developing countries reducing significantly the investment in physical capital and human capital and encouraging brain drain phenomena(Gyimah-Brempong, 1998). Moreover, a weak economic growth of Algeria may be explained by the quality of education because the gap between developing and developed countries remains very

important(Hanushek, 2013). In that sense, one year of schilling in USA, or Japan, does not have the same economic yield compared to any other developing countries, such as Algeria.

The empirical evidence confirms also a positive effect of imports and exports on economic growth. A 1% increase in imports and imports increases GDP by 0.33% and 0.32% respectively. As stated in(Carrasco C. A. and Tovar-Garcia, 2020), the domestic content of exports, the share of high-tech imports and capital goods imports play a positive role on economic growth in developing countries. Therefore, the development strategy favorites importing products used as inputs to boost production in the exporting sectors. Furthermore, the coefficient associated to trend is positive and significant at 1%, and its value is so weak. It is worth nothing that trend may capture the technological change, however the weak effect means that Algerian economy does not attract enough technology from developed countries able to generate innovation.

## 5. CONCLUSION

Since 1994, the World Bank's development policies have argued that investing in women education is more important to economic development than the investment in men education. Indeed, high investment in education, for both female and male education, contributes to raise significantly the level of human capital which leads to increase labor force productivity, and hence sustains the economic growth. Similarly, women education decreases the infant mortality, raises significantly the child's enrollment and health that may promote the future cognitive skills which can improve human capital level and innovation activities. This paper has examined the relationship between gender equality in education in economic growth in Algeria during the period 1971-2017. The main results confirm

the long run relationship between GDP and a set of explanatory variables namely; gross fixed capital formation (K), gender parity index (GPI) in secondary, exports and imports of goods and services. Indeed, the investment in the physical capital, gender parity index in secondary education, imports and exports of goods and services have a positive effect on GDP during the studied period. The elasticity with respect to gender educational equality index is three times more than that of physical capital. Therefore, reducing the education gap between male and female will be the best way to faster the economic growth rate.

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