Impact of women's education on the economic growth: An empirical analysis applied to Morocco, Algeria, Tunisia, and Egypt

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Abstract

This paper tries to examine if women's education affects the economic growth. To illustrate this aim, four countries cases have been presented: Morocco, Egypt, Tunisia, and Algeria, named MATE. The motive behind choosing them was because these countries have many common religious and cultural norms and values. The statistical analysis of data over the period 1960-2012 shows that the relationship between fertility rate and different measures of education is negative. Averages literacy rate and labour participation of the female are less than that of male. Two panel models are estimated over the period 2000-2012: a 'general' panel model and a 'gender' panel model. In the first model, the explanatory variables are introduced without gender's characteristics in order to measure their impact on the economic growth. In the second model, the explanatory variables are introduced in the first model with gender's distinguishing excluding variables that measure the quality of governance and institutional. The main findings are that women's education, particularly, tertiary education, women's labour force participation and institutional capital affect positively economic growth. On the contrary, the primary and secondary school enrolment are negatively linked to the economic growth. This paper concludes that women's tertiary education is a master-key to economic growth and development accompanied by a healthy and good quality of institutional capital and by eliminating all forms of gender discrimination.

Keywords: *Economic growth, Panel analysis, Women's education, Institutional capital*

Jel classification codes: *C23, O15, O47, I25*

1. Introduction

Economic growth involves a combination of different types of capitals to produce goods and services, such as human, natural and produced capital. Certainly, economic growth depends also on political institutions and social conditions quality.

In the early 60s, economists have given a big importance to the concept of human capital principally with the writing of Becker (1962), Schultz (1961, 1962), Mincer (1958, 1962), Kiker (1966) and Blaug (1976). All these authors confirmed that human capital is different from other types of capitals. Without human capital, the country cannot grow. This capital affects and controls other factors that explain economic growth and development of a country.

Barro (2013) specified that human capital includes education, health, and "social capital"[2]. This capital is defined by Organization of Islamic Cooperation (2011) as a capital that "refers to the knowledge and capabilities embodied in people that can be utilized to advance the production techniques and contribute to the social and economic development", (OIC, 2011, p. 1). Thus, education plays a considerable role in the human capital accumulation. This organization declared

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[2] This concept was popularized, namely, by Bourdieu (1985), Coleman (1988a; 1988b), Putnam (1993), and Portes (1998).

also that "the role of education in increasing the productivity and efficiency of labour force by increasing the cognitive stock of economically productive human capability is well acknowledged" (OIC, 2011, p. 1).

According to numerous studies, human capital and economic growth have a positive and long-run relationship. This capital continued to be a master-key of growth and development of a country, as well as an important factor to decrease poverty and migration, and to improve the quality of institutions and social conditions of citizens. Studying and measuring the impact of human capital on economic growth is always important, especially, in developing countries where the school enrolment remains feeble, mainly for girls and in rural area.

Several studies such as Psacharapoulos (1994), Hill and King (1995), Barro (1996), Klasen (2002), and Bloom, Canning and Chan (2006) have showed that women's education has a positive direct and indirect effect on the economic growth through reducing fertility rate and infant mortality, and increasing labour participation, total factor productivity, health, and life's conditions. However, few of these studies are applied in Morocco, Algeria, Tunisia, or Egypt. For that, this paper tries to investigate the effects of the education as measures of human capital on the economic growth in Morocco, Algeria, Tunisia, and Egypt, noted MATE. The human capital refers to both women and men. The proportion of women is a little over half of the World's population which is similar to that of the countries under study. However, the women's contribution in economic growth and wellbeing is far below their potential, which leads to serious macroeconomic consequences, especially, in developing countries including MATE. So, it is important to show if women's education contributes positively in economic growth like men's education and to determine the level of education (primary, secondary and/or higher education) that can contribute more in economic growth in these countries. A panel model is used to investigate the effect of women's education on the economic growth over the period 2000-2012.

The second section of this paper reviews a sample of literature that focuses on economic growth and education, especially women's education. The third section describes the economic situation and education development in MATE. The fourth section is dedicated to present the methodology used in this study and to discuss the main results and findings. The last section is served to conclude.

2. Literature reviews of education and economic growth

Past studies linking education to economic growth have focused predominantly on the effects of primary and secondary education, and have neglected others aspects of education especially higher education and women's education. These areas of studies are considered as a way to improve economic growth and social conditions in order to decrease the technology and gender gap and to establish the democratic society. So, recent studies have shown not only the importance of primary and secondary education on the economic growth, but also the importance of higher and women's education on both economic growth and social development. Due to vast existing literature in the area on women's education and economic growth, it is suitable to recite some of them.

Poor countries differ from rich countries, like people, not only because they have less capital or income but because they have less knowledge, World Bank (1999)[1]. In its report, World Bank illustrated the case of Ghana and the Republic of Korea that had the same income per capita in 1958, but Korea's income per capita was six times higher than Ghana's in by the end of 90s. Using Solow model, the World Bank showed that half of the gap is due to Korea's greater success in acquiring and using knowledge. So, this example showed clearly that there is a positive correlation between education and economic performance. The World Bank confirmed also that the absorption of knowledge involves ensuring a universal basic education - including special emphasis on extending education to girls and other traditionally disadvantaged groups -, creating opportunities for lifelong learning, and supporting tertiary education, especially in the science and engineering. Thus, countries without a "minimum scientific and technological capacity will also lag in realizing social and human benefits such as rising life expectancy, lower infant mortality, and improved health, nutrition, and sanitation. Such countries will be increasingly vulnerable to emerging threats", (World Bank, 2002, p. 13). The knowledge is considered a driver of growth in the context of globalization and technological revolution. Among results of the World Bank is that the benefits of women's education include better child nutrition, a good health and reduced fertility. Similar results are found by numerous authors, such as Ainsworth, Beegle, and Nyamete (1996), Klasen (2002), Barro and Sala-i-Martin (2003), Lawson (2008), Pritchett (2001, 2006), and Quamrul, Weil and Wilde (2013).

Examining relationship between female schooling and two behaviours (the cumulative fertility and contraceptive use) in fourteen Sub-Saharan African countries, Ainsworth, Beegle, and Nyamete (1996) showed that increased women's education is linked to lower fertility. Similar results are found by Klasen (2002). This author showed that there is a statistically significant correlation between a lower fertility rate and an increase in human capital and the economic growth.

In a cross-sectional study, Barro and Sala-i-Martin (2003) found that the fertility rate tends to decline with an increase in GDP per capita and there are stronger relationships between educational attainment and fertility, i.e. female schooling is negatively linked with fertility rate, whereas male schooling is positively related with fertility rate, (p. 16). These authors found also that the average years of male's secondary and higher schooling -observed at the start of each period, 1965, 1975, and 1985- is often significantly related to subsequent growth. Then, women's attainment and for both sexes at the primary level turn out not to be significantly related to growth rates.

In his work, Lawson (2008) tried to evaluate the potential economic impact of women's education on the BRICs and N-11 countries[2]. The main findings are that women's education leads to longer life expectancy (for women and men) and larger use of technology. In the BRICs and N-11 countries, greater investments in women's education could yield to a 'growth premium' that raises trend GDP growth by about 0.2% per year, (p. 10). Thus, he confirmed that women's education affects economic growth across multiple channels. Firstly, women's education can improve household welfare via higher wages and better jobs, lower fertility and maternal mortality, better

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[1] The report of World Bank (1989/1999) distinguishes between two kinds of knowledge: (1) technical knowledge or simply know-how is linked to the technology, and (2) knowledge linked to the products, the processes, or the institutions.

[2] The BRICs are Brazil, Russia, India and China. The N-11 (for 'Next 11') are Bangladesh, Egypt, Indonesia, Iran, Korea, Mexico, Nigeria, Pakistan, Philippines, Turkey and Vietnam.

health (lower rate of HIV/AIDS infection), entrepreneurial success, and intergenerational benefits. Secondly, women's education supports macroeconomic/growth through higher women's labour-force participation rates in tertiary activities, stronger human capital and higher productivity, higher returns on investment, increase of productive agriculture, and the "demographic transition".

Using a combination of microeconomic estimates and standard components of quantitative macroeconomic theory to investigate the effect of a change in fertility from the United Nations (UN 2010) medium-variant to the UN low-variant projection in Nigeria, Quamrul, Weil and Wilde (2013) constructed a general equilibrium model where "output is produced with a neoclassical production function that takes physical capital, land, and a human capital aggregate (embodying education and experience) as inputs", (p. 11). The exogenous variables are fertility and mortality rates (and thus population size and age structure) and the endogenous variables include physical and human capital, labour force participation, and wages. The authors concluded that the long-run effect of reducing fertility from the UN medium variant to the low variant is to raise output per capita by 5.6% at a horizon of 20 years, and by 11.9% at a horizon of 50 years, (p. 25).

Another aspect of studies is measuring the impact of human capital on economic growth by only the quantity of education, i.e. the primary or secondary school enrolments, was inappropriate. So, a range of studies have shown the importance of higher education to economic growth.

Jenkins (1995) investigated the relationship between total factor productivity and different levels of educational attainment. This author showed that an increase in the proportion of workers with higher qualifications by 1% raises annual output by between 0.42% and 0.63%, where higher education qualifications included undergraduate, postgraduate, and other tertiary graduate stock.

The economic growth is affected by ideas and invention, which in turn are related to the stock of human capital either through research and development (R&D) activities or through adoption behaviour. Hanushek and Dennis (2000) proposed introducing a quality of education using "student cognitive performance on various international tests of academic achievement in mathematics and science", (p. 1185). The main findings showed that a "one standard deviation in mathematics and science skills translates into more than one percentage point in average annual real growth, also looks implausibly large", (p. 1204).

Using a modified neoclassical growth equation and a dynamic panel estimator, Gyimah-Brempong, Paddison and Mitiku (2006) found that all levels of education, including higher education, have positive and statistically significant effect on the growth rate of per capita income in African countries during 1960-2000 period as a 1% increase in the average years of higher education increases the growth rate of per capita income by about 0.09% points per year.

Among conclusions of Barro is that the schooling variable[1] was positive and highly significant in economic growth, and countries can grow faster by 0.2 percentage points per year (Barro, 1992, p. 211). Analysing the effect of education on the growth in a panel of around 100 countries observed from 1965 to 1995, Barro (2001) highlighted the importance of knowledge spillover. The growth is positively related to starting level of average years of school attainment of adult males

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[1] In Barro's model, the schooling variable is entered as log (1+total years of school attainment), where the years of attainment apply to the start of each period and the parameter 1 represents the effective number of years obtained without formal schooling.

at secondary and higher levels. However, school attainment of females at secondary and higher levels has not affected economic growth because highly educated women are not well utilized in labour markets. In recent work, Barro and Lee (2010) confirmed that workers' education has a significant positive effect on the level of income at the country level. Similar results are found in his recent work, Barro (2013). He showed that the quality and quantity of schooling both matter for growth but that the quality is much more important, i.e. a one-standard-deviation increase in sciences scores - by 0.08 - would raise on the growth rate impact by 1.0 percentage per year, whereas a one-standard-deviation raise in attainment would increase on the growth rate impact by only 0.2 percentage per year, (Barro, 2013, p. 322).

Bloom, Canning and Chan (2006) highlighted also the importance of higher education in economic growth and development. They suggested that higher education can help countries with technological catch-up and thus improve the potential for faster growth. It can produce both public and private benefits. The private benefits for individuals included better employment, higher salaries, and a greater ability to save and invest, thereby, a better health and a good quality of life. The public benefits can be found in the economic development through technological catch-up facilitated by the higher education. It can also "improve a nation's health, contribute to reduced population growth, improve technology, and strengthen governance", (Bloom, Canning and Chan, 2006, p. 1). The authors found that "a one-year increase in the tertiary education stock would raise the long-run steady-state level of African GDP per capita due to factor inputs by 12.2%. The growth rate of GDP per capita would rise by about 0.24 percentage points in the first year as a result of convergence to a higher steady state", (p. 28). And, increase in the tertiary education stock would, also, "raise African output growth by an added 0.39 percentage points in the first year due to faster technological catch-up, generating a total increase of 0.63 (=0.24+0.39) percentage points in the first year", (p. 28), and an income gain of roughly 3 percentage after five years. The authors concluded that the tertiary education plays a recognizable role in promoting economic growth, and can decrease knowledge gaps and help reducing poverty in Africa.

3. Description of the economic situation in MATE

After so-called 'Arab Spring'[1], Egypt and Tunisia are undergoing a profound political and social transformation especially political election/vote and expression freedom. In Morocco, the main reforms include those linked to law such as approved a new constitution. In Algeria, the situation is quite unchanged.

Despite their differences in their macroeconomic structure and political systems, MATE has a larger resemblance in society's characteristics. In its report, UN-Women (2013) declared that "the Arab countries have in common many cultural, historical and geographical aspects" where "more or less women have suffered - and continue - from legal, economic, socio-cultural and political discrimination", (UN-Women, 2013, p. 7).

In MATE like in all Arab countries, women's life options are typically limited to the household chores, takes care her children and siblings, and financial contribution to her family by working, especially, in informal and agricultural sectors. Her 'ultimate' and 'respectable' aims in life are limited to marriage and childbearing. For this, girl's marriage is considered as a transfer of the

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[1] The term 'spring' has been in the main used by western academic and media. But, in the Arab World, this term has been referred to the *'thawra'*, meaning the 'revolution'.

investment in daughters to another family, with little benefit to the girl's parents because it is supposed that the male assists/aids his parents in old age, and female -after marriage- is responsible of her husband, her children and her husband's parents in old age. Thus, a girl's education is considered a luxury. Unfortunately, women's situation in these countries remained awful, especially, in rural area and poor families in spite of the change in political and judiciary systems.

Social development in MATE differs significantly from a country to a country and within the same country as economic growth, education, health, institutional capital, and natural capital. Economic growth in Morocco is speedily growing and reached 3.9% during 2010-2013 against 3.1%, 2.8% and 2.6% in Algeria, Egypt and Tunisia, respectively. Figure 1 provides an idea of the average growth of real GDP over the period spanning from 1970 to 2013.

Figure 1. Growth rate of the real GDP (constant 2005 US$) in MATE, 1970-2013
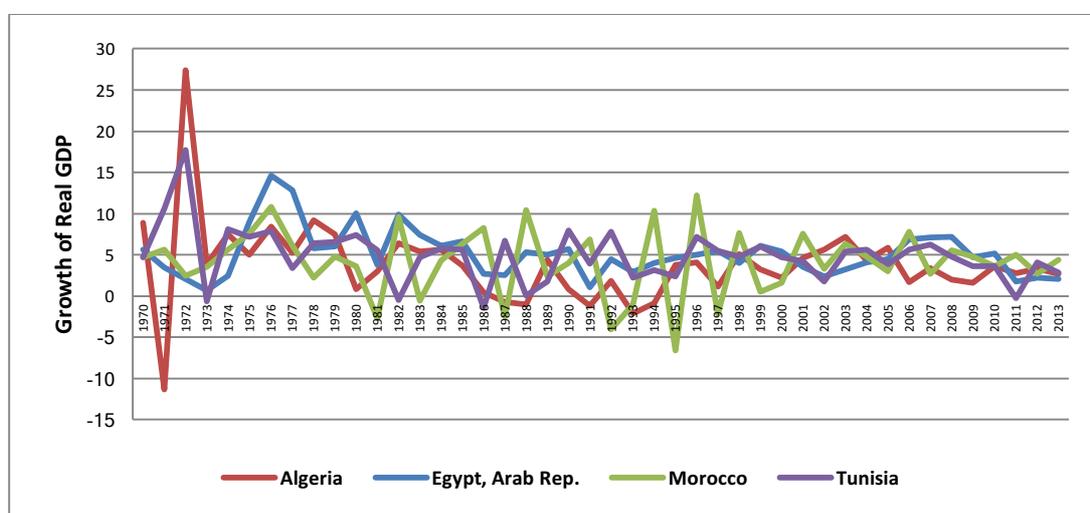
Source: Elaborated using data of World Development Indicators (WDI), 2015.

Figure 1 shows that Algeria, Egypt and Tunisia recorded the best and the worst real GDP growth (noted g) at the beginning of 1970. Nevertheless, Morocco recorded the best and the worst growth during the years 90s, Table 1.

Table 1. The best and the worst growth rates of the real GDP recorded by MATE during 1970-2013

Countries	Best growth rate		Worst growth rate	
	g (%)	Year	g (%)	Year
Algeria	+27.4 + 9.2	1972 1978	-11.3	1971
Egypt	+14.6 +12.8	1976 1977	- 0.7	1971
Morocco[(*)]	+12.2	1996	- 6.6 - 4.0	1995 1992
Tunisia	+17.7 +10.6	1972 1971	- 0.7	1973

(*) Morocco recorded, also, an important growth in 1976 with +10.8%.

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However, growth in MATE becomes less fluctuating in the beginning 2000. Table 2 provides the average growth rates of the real GDP and real GDP per capita in MATE and in other regions of the World.

Table 2. Growth of the real GDP (g%) and of the real GDP per capita (g_y%) in MATE and other regions of the world

Countries /Region of World	1970-1979		1980-1989		1990-1999		2000-2009		1980-2009		2010-2013	
	g%[1]	g_y%[2]	g%	g_y%	g%	g_y%	g%	g_y%	g%	g_y%	g%	g_y%
Algeria	7.2	4.2	2.8	-0.3	1.6	-0.4	3.9	2.3	2.7	0.5	3.1	1.2
Egypt	6.2	4.0	5.9	3.5	4.3	2.6	4.9	3.2	5.0	3.1	2.8	1.1
Morocco	5.3	3.0	3.9	1.6	2.8	1.2	4.7	3.7	3.8	2.1	3.9	2.5
Tunisia	7.2	4.9	3.6	1.0	5.1	3.3	4.6	3.5	4.4	2.6	2.6	1.5
China	8.4	6.2	10.1	8.5	9.6	8.4	10.2	9.5	10.0	8.8	8.8	8.2
EAP- all income levels[3]	4.8	2.7	5.1	3.5	3.5	2.2	3.8	3.0	4.1	2.9	4.8	4.1
EAP- developing only	7.7	5.4	7.9	6.2	8.0	6.6	8.8	7.9	8.2	6.9	8.1	7.4
LAC-all income levels[4]	6.0	3.5	2.1	0.0	2.9	1.1	3.0	1.6	2.6	0.9	3.8	2.6
LAC -developing only	6.2	3.6	2.0	-0.1	2.8	1.0	3.0	1.7	2.6	0.9	3.9	2.7
MENA-all income levels[5]	9.2	6.2	1.2	-1.9	4.2	2.0	4.9	2.9	3.5	1.0	4.0	2.1
MENA-developing only	6.4	3.6	1.9	-1.0	4.0	1.7	4.5	2.8	3.5	1.2	2.3	0.6
OECD members[6]	3.7	2.6	3.0	2.2	2.6	1.8	1.7	1.0	2.4	1.6	1.8	1.2
South Africa	3.3	1.0	2.2	-0.3	1.4	-0.8	3.7	2.0	2.4	0.3	2.8	1.4
South Asia	3.0	0.6	5.6	3.2	5.5	3.4	6.5	4.9	5.9	3.8	6.4	5.0
SSA-all income levels[7]	4.1	1.3	1.7	-1.1	1.9	-0.9	5.1	2.4	2.9	0.1	4.2	1.5
SSA-developing only	4.1	1.3	1.7	-1.1	1.8	-0.9	5.0	2.3	2.9	0.1	4.3	1.5
Africa	4.8	2.1	2.9	0.1	3.3	0.9	4.8	2.4	3.7	1.2	4.7	2.3
World	4.0	2.0	3.1	1.3	2.7	1.1	2.6	1.4	2.8	1.3	2.9	1.7

Source: Calculated using World Development Indicators (WDI), 2015. (1) g is growth rate of real GDP (2005 US$). (2) g_y is growth rate of real GDP per capita [real GDP per capita =GDP (constant 2005 US$)/total population]. (3) EAP is East Asia and Pacific. (4) LAC is Latin America & Caribbean. (5) MENA is Middle East and North Africa. (6)OECD is Organisation for Economic Co-operation and Development. (7) SSA is Sub-Saharan Africa.

Table 2 shows that over the period 1970-1979 the average growth rates of real GDP in MATE are higher than that in many regions of the World, such as EAP (all income levels), South Africa, South Asia, SSA, African countries, OECD members, and the World. The highest growth rates of real GDP are recorded in MENA (all income levels). Similarly, growth rates of real GDP per capita in MATE are higher than that in many regions of the World, such as EAP (all income levels), South Africa, South Asia, SSA, African countries, and the World. The highest growth rates of real GDP per capita are recorded in MENA (all income levels) and China.

Over the period 1980-2009, average growth rates of real GDP in Morocco, Egypt and Tunisia (excluding Algeria) are higher than that in LAC, MENA, South Africa, SSA, African countries, OECD members, and the World. The highest growth rates of real GDP are recorded in China, EAP (developing countries), and South Asia. Similarly, growth rates of real GDP per capita in Morocco, Egypt and Tunisia (excluding Algeria) are higher than that in LAC, MENA, South Africa, SSA, African countries, OECD members, and the World. But, the highest growth rates of real GDP per capita are recorded in MENA (all income levels) and China.

In the beginning of the 80s, Algeria recorded the lowest average growth rate of real GDP per capita with negative average growth rates over the period 1980-1999, Figure 2. This situation can be ascribed to the conflicts and political instability. While, average growth rates of real GDP per capita in MATE are higher over the period 1970-1979 than that recorded during 1980-1989, 1990-

1999 and 2000-2009. The worst period of growth in MATE is shown at the beginning of 1980 until 1999.

Figure 2. Average growth of the real GDP per capita in MATE
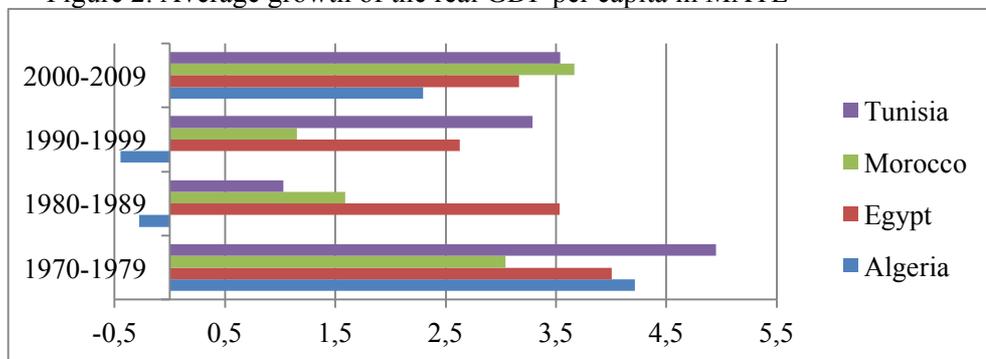
Source: Elaborated using WDI, 2015

Figure 3 presents average growth rates of real GDP per capita in MATE and in other regions of the World during 2010-2013[1]. It is shown that China recorded an important average growth rate albeit the global crisis of 2008 and Morocco recorded the higher average growth rate than that recorded in Algeria, Egypt and Tunisia. It seems that the Moroccan economy is less impacted by the financial crisis, the 'Arab Spring' / the 'revolution' and the terrorist organization of 'Daesh'.

Figure 3. Average Growth of the real GDP per capita, 2010-2013
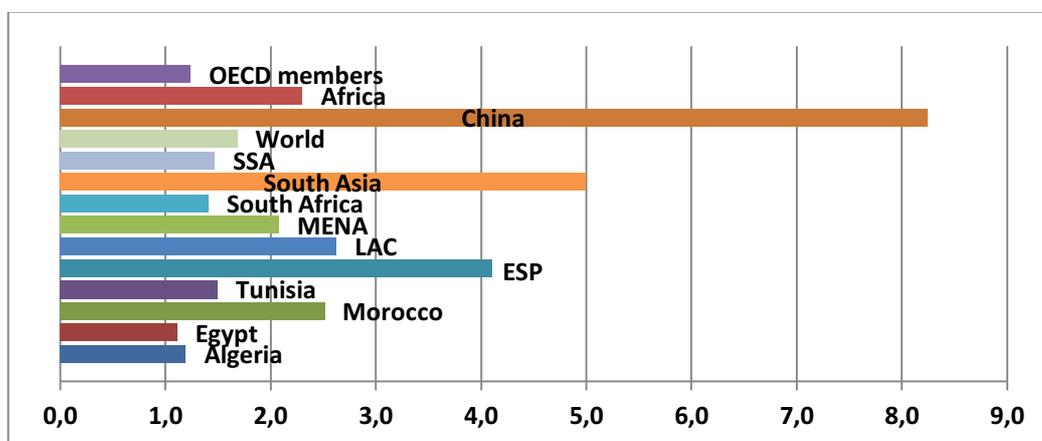
Source: Elaborated using WDI, 2015

Figure 4 shows that the real GDP per capita (constant 2005 US$) of the World is higher than that of MATE. There is a considerable divergence between them; the average real GDP per capita in MATE is $1775.72 and that in the World is $5484.83. However, the real GDP per capita (constant 2005 US$) of OECD members is very higher than that of MATE and the World.

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[1] This period is presented separately to other periods because it is a period after global financial crisis of 2008 and a period of *'revolution'* which is started in Tunisia and spread to other Arab countries.

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Figure 4. Growth of the real GDP per capita (constant 2005 US$) in MATE, OECD members and the World over the period 1960-2013
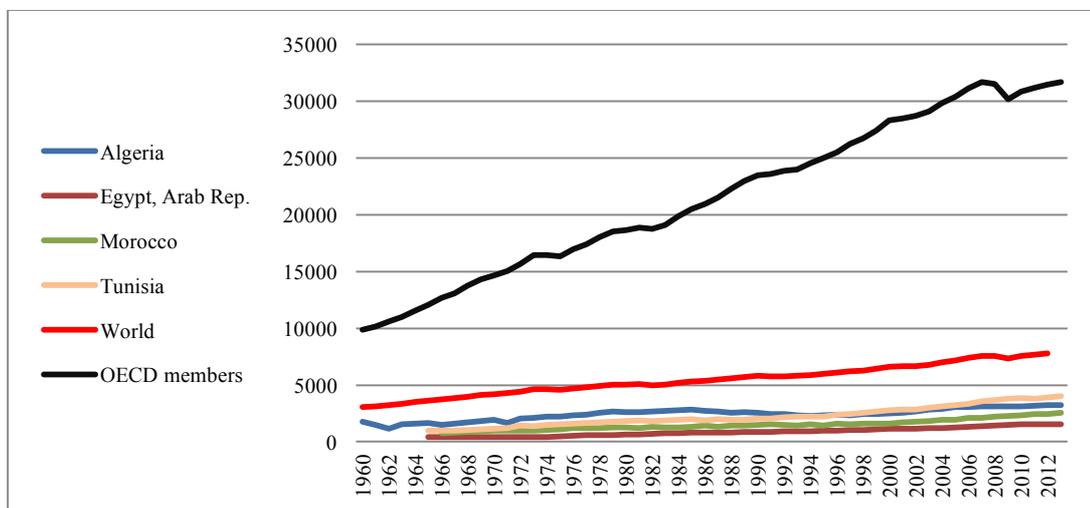
Source: Elaborated using WDI, 2015

Due to important political and social development realized by MATE albeit there are unsatisfying and unpleasing, the roles of women in these societies were enlarged. Improvement of women's contribution in the political activity, increasing their participation in the labour force, and reinforcement the role of the law and justice are the principal keys of these political and social developments. Consequently, the improvement in women's situation influenced many aspects in the society such as fertility, literacy, infant mortality, and life expectancy. Using data from WDI (2015) over the period 1960-2013, four remarkable changes in MATE can be identified : (1) negative relationship that links fertility rate and different measures of education; (2) average literacy rate of female is lower than that of male; (3) average labour force participation of female in MATE is lower than that of male, and that of other regions of the World; (4) mortality rate of the neonatal, the baby and the infant in MATE is lower than that of the World.

- First remarkable change on MATE is that the fertility rate is on its downward trend from 7 children to around 3 children, Figure 5. The same trend is recorded in the World, South Africa and South Asia where the fertility rate is established at around 3 children. But, this rate remains higher in SSA at around 5 children.

Figure 5. Fertility rate in MATE and in other regions of the world, over the period 1960-2013
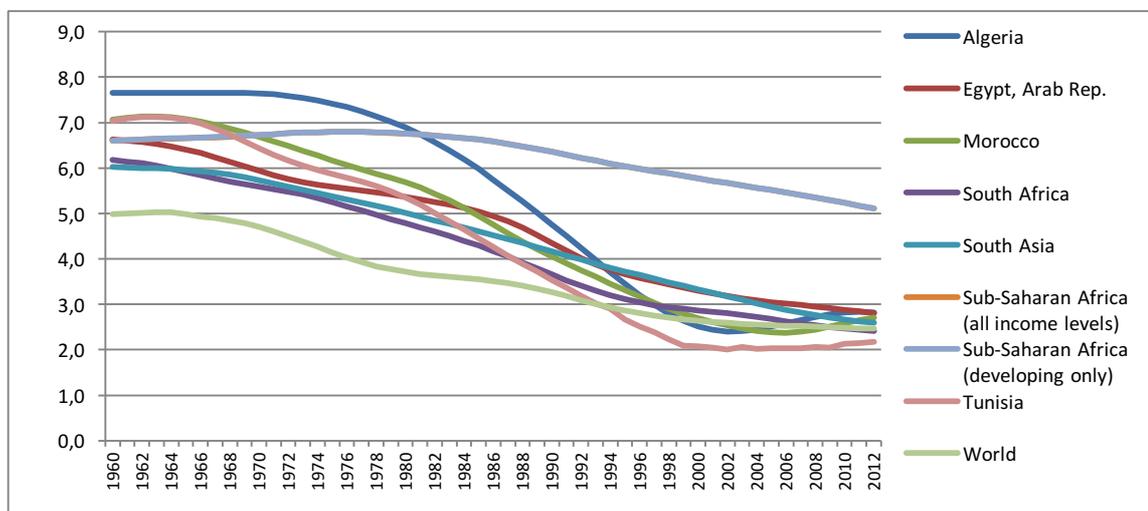
Source: Elaborated using WDI, 2015

Several factors could be attributed to the effects of the decreasing fertility rate as, economic growth, intensive participation of women in labour force[1], increase in 'literacy rate' measured namely by four indicators: 'primary completion rate', 'primary school enrolment', 'secondary school enrolment', and 'tertiary school enrolment'.

Figure 6. Statistical relationship of MATE over the period 1980-2012

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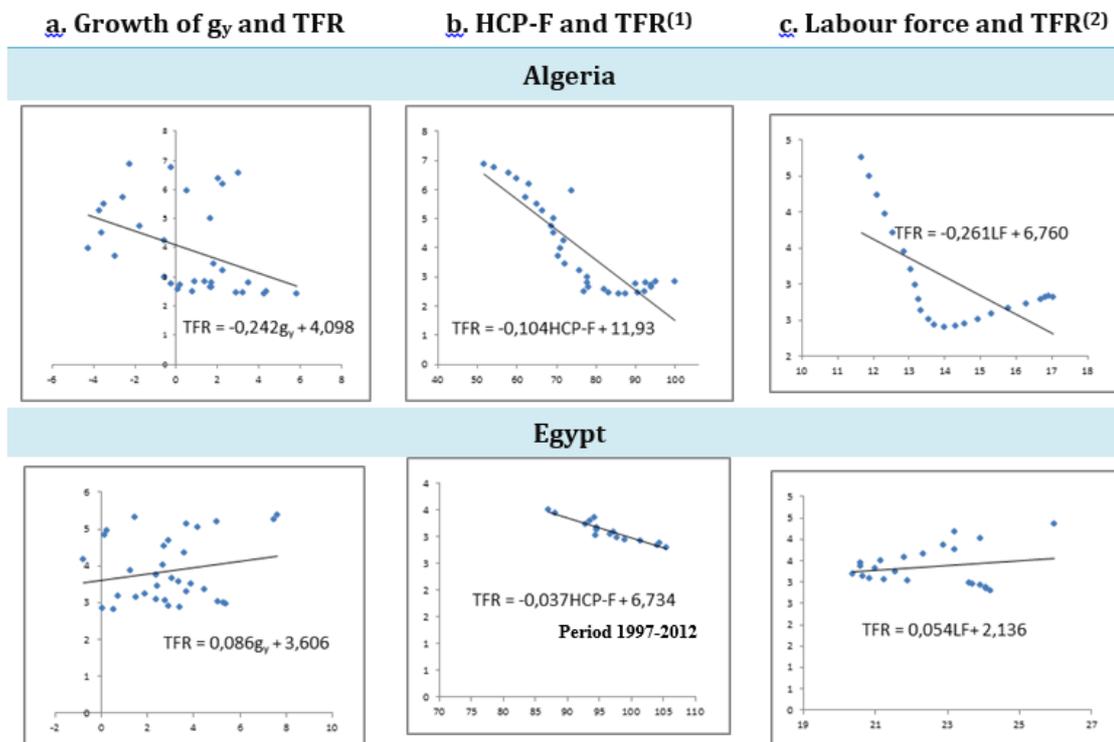
[1] The female labour force defined "as a percentage of the total shows the extent to which women are active in the labour force. Labour force comprises people ages 15 and older who meet the International Labour Organization's definition of the economically active population", World Bank, WDI, 2015.
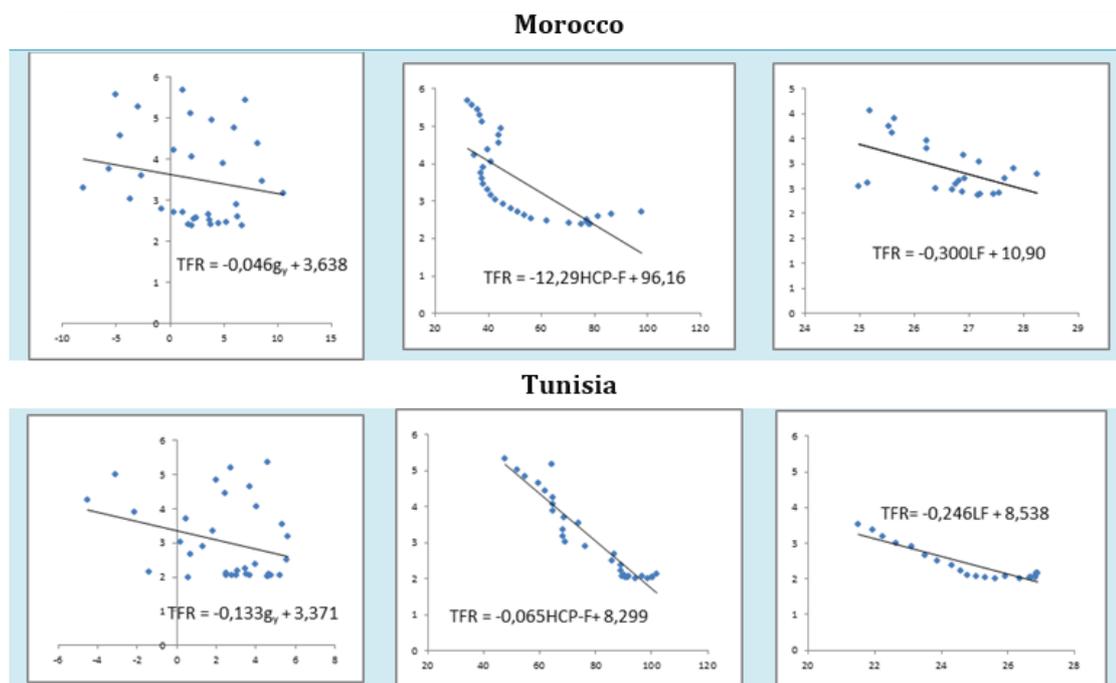
Source: Elaborated using WDI, 2015. *(1)* Egypt's data is available only over 1997-2012. *(2)* MATE's data is available only over the period 1990-2012.

Figure 6 draws a statistical relationship that links a simple regression of *(1)* fertility rate, (noted TFR) and real GDP per capita (noted g_y); *(2)* fertility rate and women's participation in labour force (noted LF); and *(3)* fertility rate and primary completion rate of female (noted HCP-F).

Primary completion rate of female (HCP-F) and fertility rate (TFR) are negatively linked, Figure 6(b). The reasoning behind this is quite simple. It states that the fertility rate is driven by female education levels, such as women's education can be accompanied by a corresponding decrease in the fertility rate. Verification of the statistical relationship that links on a simple regression of the fertility rate and other measures of education ('primary school enrolment of female', 'secondary school enrolment of female', and 'tertiary school enrolment of female') reveals similar results. Therefore, there is a negative relationship that links fertility rate and different measures of education.

Excluding Egypt, female participation in labour force (LF) and fertility rate (TFR) are negatively linked, i.e. each increase in female participation can reduce fertility rate, Figure 6(c). In addition, growth rate of the real GDP per capita (g_y) and fertility rate (TFR) are negatively linked, Figure 6(a).

- *Second remarkable change on MATE* is that the literacy rate is on its upward trend from around 55% in the beginning 1987 to 70% in 2012. However, an average rate over the period 2006-2013, literacy rate of the female is always lower than that of male. Table 3 gives an idea about average literacy rates of adult people (ages 15 and above) and of young people (ages 15-24).

Table 3. Average literacy rate of MATE and of other regions of the World, during 2006-2013[*]

	People ages 15 and above			People ages 15-24		
	Female	Male	Total	Female	Male	Total
Algeria	63.9	81.3	72.6	89.1	94.4	91.8
Egypt	62.4	78.9	70.8	84.0	90.3	87.2
Morocco	48.0	71.1	59.4	72.0	87.1	79.6
Tunisia	70.6	86.9	78.4	95.7	98.1	96.9
South Africa	91.0	93.6	92.3	98.8	98.1	98.5
South Asia	50.4	72.8	61.4	73.3	85.7	79.3
Sub-Saharan Africa	51.0	68.1	59.3	64.2	75.5	69.6
China	92.7	97.5	95.1	99.6	99.7	99.6
World	80.2	88.6	84.3	86.9	92.1	89.4

Source: calculated using WDI data, 2015. *(*)* Data is available only over this period for all countries.

The main remarks are (1) the literacy rates of MATE are lower than that of the World; (2) only 48% of Moroccan adult women are educated in comparison with 64% for Algeria, 62.4% for Egypt, and 70.6% for Tunisia; (3) the highest literacy rate is recorded in China; (4) the lowest female literacy rate is recorded in Morocco, South Asia and SSA; and (5) measuring in terms of gap between males and females' literacy rates, the differential ranges are just 3 ppt in South Africa and 5 ppt in China, but more than 18 ppt in MATE.

- *Third remarkable change in MATE* is the labour force participation of female in MATE that showed that a slight increase from 22% in 1990 to 24% in 2012. But, these rates remain lower than that recorded in other regions of the World. Table 4 gives an idea about average labour force participation per gender of adult people, ages 15-64.

Table 4. Average labour force participation per gender (population ages 15-64) in MATE and in other regions of the World

	1990-1999			2000-2009		
	Female	Male	Total	Female	Male	Total
Algeria	11.8	79.8	46.1	13.8	76.5	45.5
Egypt	22.9	75.6	49.5	22.3	77.3	50.1
Morocco	29.1	83.2	55.9	28.4	81.1	54.2
Tunisia	24.1	78.0	51.0	26.3	74.0	49.9
EAP (all income levels)	71.8	87.2	79.7	68.8	84.8	76.9
EAP (developing only)	73.8	87.8	81.0	69.8	85.1	77.6
LAC (all income levels)	47.6	85.0	66.0	54.4	83.7	68.8
LAC (developing only)	47.9	85.3	66.3	54.8	84.0	69.1
MENA (all income levels)	19.2	78.1	49.5	21.2	76.7	49.8
MENA (developing only)	18.3	77.8	48.3	20.1	76.2	48.4
OECD members	57.6	81.0	69.3	59.9	79.8	69.8
South Africa	46.7	68.8	57.6	50.7	65.5	57.9
South Asia	37.4	86.5	62.9	37.1	85.4	62.0
Sub-Saharan Africa	61.4	79.4	70.3	64.0	77.0	70.5
China	78.4	88.8	83.8	73.0	85.0	79.2
World	57.1	84.1	70.7	56.5	82.3	69.6

Source: Calculated using WDI data, 2015

Table 3 reveals that the average labour force participation of females is lower than that of males over the period 1990-2009. The highest rate is recorded in China (75%) and the lowest is recorded in Algeria (13.2%) over the period 1990-2012. Measuring in terms of the gap between

males and females' participation in labour force, differential ranges are just 5 ppt in South Africa and 12 ppt in China, but more than 54 ppt in MATE.

- Fourth remarkable change in MATE is that mortality rates of neonatal, baby and infant are on their downward trend.

The infant mortality rate in 2013 decreased from an average of 167 in 1960 to average of 20 infants per 1,000 live births against 34 recorded in the World in 2013, Figure 7(a). The neonatal mortality rate decreased also from an average of 29 neonatal in 1990 to an average of 13 neonatal per 1,000 live births against 20 recorded in the World in 2013, Figure 7(b). The baby mortality rate declined also from an average of 266 babies in 1990 to 23 babies per 1,000 live births against 46 recorded in the World in 2013, Figure 7(c).

Figure 7. Mortality rate per 1,000 live births in MATE and in the World (1960-2013)
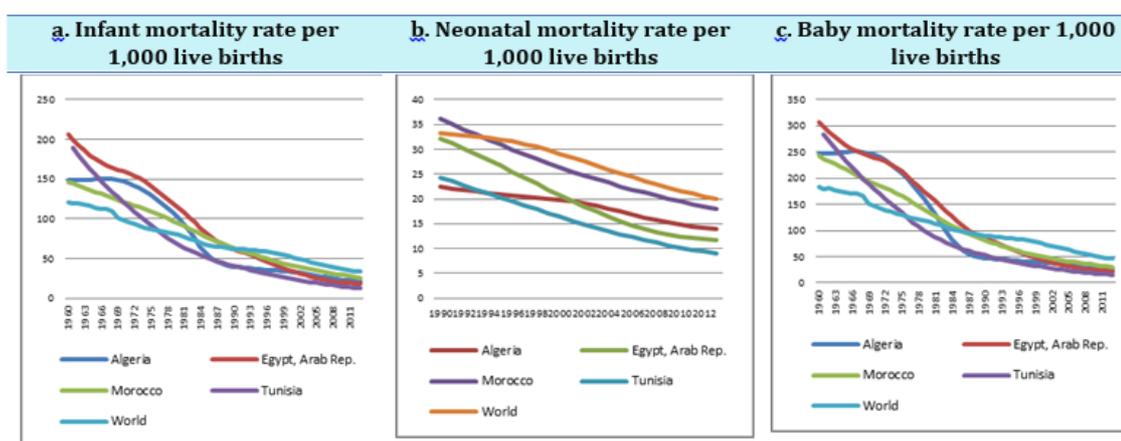
Source: Elaborated using WDI, 2015.

The economic situation for women in MATE records the lowest levels in education and economic activities. There are potentials that have not been used to improve the economic growth of these countries. Several factors continue to affect the access of girls to education and participation in the labour force, such as poverty, gender gap, level of parents' education, infrastructure, religious and cultural norms.

4. Methodology, data and results

As stated by several studies, the function of growth rate of real GDP is generally a function of technology, physical capital, institutional capital, and human capital to explain its change, whether an increase or a decrease. However, it is not possible to introduce to the model all factors of those capitals that explain the economic growth. So, this study assumes that the human capital is directly proportional to the educational attainment. Since the effects of education on the growth differ by education levels (primary, secondary and higher).

Two types of panel models are estimated, a 'general' panel model and a 'gender' panel model. In the first model, education and labour force participation are introduced regardless to gender. The objective is to test if these two variables affect the economic growth. In the second model, each level of education and labour force participation are divided by gender to measure especially if the women's education affects the economic growth.

The 'general' panel model equation is presented as follows.

$$g_{it} = \beta_0 + \beta_1 pe + \beta_2 se + \beta_3 te + \beta_4 labor + \beta_5 inv\_edu_{it} + \beta_6 ic_{it} + \varepsilon_i \qquad (1)$$

Where, the dependent variable is the growth rate of real GDP per capita (g_y). The independent variables are total of primary education (pe), total of secondary education (se), total of higher education (te), total of labour participation (labor), investment on education or public expenditure on education (inv_edu)[1], and institutional capital (ic). Term ε is the error term.

The 'gender' panel model equation is presented as follows.

$$g_{yit} = \beta_0 + \beta_1 pefem + \beta_2 pemale + \beta_3 sefem + \beta_4 semale + \beta_5 tefem + \beta_6 temale + \beta_7 laborfem + \beta_8 labormale + \beta_9 inv\_edu_{it} + \beta_{10} ic_{it} + \varepsilon_i \qquad (2)$$

Where, the dependent variable is the growth rate of real GDP per capita (g_y). The independent variables are primary education of female (pefem) and of male (pemale), secondary education of female (sefem) and of male (semale), higher education of female (tefem) and of male (temale), labour participation of female (laborfem) and male (labormale), investment on education or public expenditure on education (inv_edu) and institutional capital (ic). Term ε is the error term.

This study uses annual data for variables of growth rate of the real GDP, growth rate of the real GDP per capita, primary, secondary and higher school enrolment, and labour force participation in order to analyse the impacts of women's education on the economic growth. All these data are taken from the World Bank. The variables that measured institutional capital are taken from Worldwide Governance Indicators (WGI) (2014). Definitions and notations are listed in the annex, Table 5. The countries included are Algeria, Morocco, Egypt and Tunisia. The data are balanced panel and involved from 2000 to 2012 because the variables are not available for all countries and all year. Table 6 summarizes the descriptive statistics of all variables used in this study.

Before applying the classical method to regress equation 1 and equation 2[2], it is necessary to check the stationarity of the variables because most of them are non-stationary according to several empirical studies. Non-stationary data might lead to some problems such as spurious regression which gives incorrect results even if the regression is assumed as stationary. For this reason, the panel unit root tests are used to check the stationarity of these economic series.

Table 6. Statistic descriptive of the variables, 2000-2012

Variables	Mean	St. Dev	Max	Min	Obs.	Variables	Mean	St. Dev	Max	Min	Obs.
g	4.19	1.79	7.76	-0.23	52	labor	50.02	3.06	56.10	45.30	52
g_y	2.81	1.87	6.75	-1.40	52	pefem	104.15	5.78	113.97	84.05	52
icc	-0.34	0.32	0.55	-0.97	52	pemale	111.05	4.19	120.70	98.84	52
icg	-0.17	0.40	0.63	-0.96	52	pe	107.68	4.87	117.41	91.62	52
icl	-0.23	0.35	0.24	-1.18	52	sefem	74.59	17.79	99.55	33.81	52
icp	-0.60	0.60	0.31	-1.96	52	semale	75.48	14.38	95.74	42.30	52
icr	-0.34	0.33	0.12	-1.29	52	se	75.15	15.93	97.61	38.12	52
icva	-0.91	0.28	-0.19	-1.38	52	tefem	25.85	10.57	43.44	7.98	46
laborfem	22.93	5.54	30.60	12.70	52	temale	23.43	8.08	36.28	10.83	45
labormale	77.16	2.59	82.30	72.70	52	te	23.75	8.62	36.06	9.41	52

Source: Calculated using WDI (2015) and WGI (2014).

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[1] Data of this variable is not available for MATE and of all year.
[2] We also run these two equations with the real GDP as endogenous variable.

Two generations of the panel unit root tests are applied[1] in order to provide more meaningful results[2]. First generation can assume that individual time series in panel are cross-sectional independent across units. Among of these tests are Maddala and Wu (1999), Hadri (2000), Im, Pesaran and Shin (2003), and Levin, Lin and Chu (2002). Second generation can assume that there is a common unit root process. Among of these tests are Pesaran (2007), and Moon and Perron (2004). Table 7 in annex presents detail of these tests and Table 8 resumes the results of all tests. However, if these results are not identical we conclude based on most of them.

Table 7. Results of stationarity tests, period 1980-2012

Variables	Conclusion of all unit root tests	Variables	Conclusion of all unit root tests	Variables	Conclusion of all unit root tests
g	I(0)	pefem	I(1)*	se	I(1)*
g_y	I(0)	pemale	I(1)*	tefem	I(1)*
laborfem	I(1)*	pe	I(1)*	temale	I(1)*
labormale	I(1)*	sefem	I(1)*	te	I(1)*
labor	I(1)*	semale	I(1)*		

Source: Our elaboration. *(*)* All variables are stationary in the first difference.

The panel models, which are offered by equation 1 and equation 2 mentioned above, incorporate the usual fixed effect model (FE) and random effect model (RE) as special cases and go considerably beyond these options. The RE assumes that the omitted time-invariant variables are uncorrelated with the included time-varying covariates while the FE allows these variables to freely correlate, (Bollen and Brand, 2010, p. 2). Indeed, there are numerous variants of the panel models and a large number of models that a researcher could choose[3]. The first step is to be sure which model would apply the fixed effect model (FE) or the random effect model (RE). For this, we use a Hausman test among others. The result of this test shows that the fixed effect model is appropriate.

Table 9. Results of the 'general' panel model (fixed effect model), sample: 2000-2012

Explanatory Variables	Endogenous variable: g				Endogenous variable: g_y			
	Coef.	Std. Error	t-Statistic	Prob.	Coef.	Std. Error	t-statistic	Prob.
constant	3,503	1,234	2,839	0,008	2,164	1,244	1,740	0,091
pe	-0,052	0,082	-0,642	0,525	-0,085	0,083	-1,021	0,315
se	-0,131	0,055	-2,373	0,024	-0,134	0,059	-2,290	0,029
te	0,322	0,106	3,033	0,005	0,343	0,112	3,057	0,004
labtot	-0,404	0,570	-0,709	0,483	-0,410	0,570	-0,719	0,477
icr	1,537	1,672	0,919	0,365	1,816	1,689	1,075	0,290
icg	8,459	2,160	3,916	0,000	8,479	2,208	3,840	0,001
icp	-2,133	1,463	-1,458	0,154	-2,476	1,500	-1,651	0,108
icc	-5,037	1,879	-2,681	0,011	-4,880	1,999	-2,441	0,020
icl	1,545	1,393	1,109	0,276	1,895	1,360	1,393	0,173
icva	0,027	1,093	0,025	0,980	0,019	1,114	0,017	0,987
R-squared	0,509	**F-statistic**	2,629		**R-squared**	0.536	**F-statistic**	2.932
		Prob(F-statistic)	0,012			**Prob(F-statistic)**		0.006

Source: our estimation.

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[1] The panel unit root tests are not used for the institutional capital because *(1)* running these tests with short period data is not right approach. With 13 years of data, some unit root tests are invalid; *(2)* transformation of the institutional variables is too slow for the countries.

[2] For more explication see Hurlin and Mignon (2006), Table 1, p. 4.

[3] For more explication see Bollen and Brand (2010).

Table 9 displays the result of the 'general' panel model (equation 1) which mentioned that there are three main results. The *first result* is that the tertiary school enrolment (te) is positively and significantly linked to the economic growth (measured by g or g_y). The *second result* is that the variables of institutional capital (icr, icg, icva and icl) are positively linked to the economic growth. The *third result* is, surprisingly, that the primary and the secondary school enrolments are negatively linked to the economic growth.

The results of 'gender' panel model (equation 2) are given in Table 10. There are five main results. The first result is that the primary school enrolment of males is positively and significantly linked to the economic growth, but that of females is negatively and significantly at 10% linked to the economic growth. The second result is that the secondary school enrolment of males and females are negatively linked, albeit insignificantly, to the economic growth as like in the 'general' panel model. The third result is that the tertiary school enrolment of males and females are positively linked to the economic growth. The fourth result is that the institutional capital (icg, icr, and icva) is positively linked to the economic growth and it is like in the 'general' panel model. The fifth result is that the labour force participation of females is positively linked to the economic growth. In contrast, the labour force participation of males is negatively linked to the economic growth.

Table 10. The results of ' gender' panel model (equation 2), (fixed effect model), sample: 2000-2012

Explanatory Variables	Endogenous variable: g				Endogenous variable: g_y			
	Coef.	Std. Error	t-Statistic	Prob.	Coef.	Std. Error	t-statistic	Prob.
Constant	3,729	1,242	3,002	0,006	2,411	1,283	1,879	0,072
pefem	-0,204	0,108	-1,895	0,070	-0,189	0,109	-1,733	0,096
pemale	0,384	0,131	2,943	0,007	0,325	0,135	2,415	0,023
sefem	-0,093	0,087	-1,058	0,300	-0,066	0,095	-0,688	0,498
semale	-0,049	0,103	-0,480	0,635	-0,073	0,108	-0,678	0,504
tefem	0,100	0,150	0,667	0,511	0,125	0,154	0,809	0,426
temale	0,056	0,083	0,679	0,504	0,051	0,087	0,586	0,563
labfem	0,123	0,335	0,366	0,717	0,132	0,334	0,394	0,697
labmale	-0,602	0,136	-4,422	0,000	-0,570	0,147	-3,873	0,001
icl	-0,552	1,507	-0,366	0,717	-0,480	1,577	-0,304	0,764
icr	1,133	1,345	0,842	0,408	1,238	1,374	0,901	0,376
icc	-5,850	1,456	-4,019	0,001	-5,743	1,520	-3,779	0,001
icg	8,203	1,929	4,252	0,000	7,782	1,938	4,015	0,001
icva	0,215	1,106	0,194	0,847	0,207	1,148	0,180	0,858
icp	-0,266	1,278	-0,208	0,837	-0,192	1,322	-0,145	0,886
R-squared	0,639	F-Statistic	2,602		R-squared	0,653	F-Statistic	2,762
	Prob(F-statistic)		0,015			Prob(F-statistic)		0,010

Source: Our estimation.

After discussing results of the panel models, it is necessary to recognize that MATE countries differ significantly from one to another in the characteristics that influence how women's education may affect the economic growth. The differing political and economic histories and geographical circumstances of these countries have created an array of environments in which women's education institutions operate.

Our results show a positive impact of women's education on the economic growth especially women's tertiary education. Other important result is that the variables of institutional capital play

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an important role on the economic growth. So, to attain sustainable, rapid and continuous economic growth, it is necessary to encourage women's education through establishing economic and social strategy able to improve women's situation and, in addition, reducing poverty of the citizens.

5. Concluding remarks

Poet and writer Louis Aragon (1897-1982) wrote that "woman is the future of man"[1]. These words give us the best solution if we want to have both a gender equality and growth in developed and developing countries. In MATE countries, the gender gaps persist in education, health, work, law, culture and political participation. Hence, education is a master-key to attain growth and a master-help to eliminate all forms of gender discrimination.

This study found that women's education, especially women's tertiary education, is positively linked to the economic growth; meanings that increased access of women to tertiary education should be a mainly strategy for MATE. This strategy can generate intergenerational benefits because woman with high education are more likely to educate their children, especially, their girls (Sandra, 2008, p. 14), and to increase their chances to participate in labour force which can positively affect economic growth. Increasing woman's income can improve wellbeing of the family because she allocates more resources to her husband, her children, her parents and her parents' husband.

Governmental strategy should be oriented in improved not only primary or secondary education but also tertiary education because it is the best way to reduce child mortality, to increase the productivity and to improve the quality of health. Herz and Sperling (2004) confirm that "there may be no better investment for the health and development of poor countries around the World than investments to educate girls", (p. 16). However, the education alone was not enough. MATE needs also a good political and social system that expands women's opportunities and freedoms. Healthy environment of investment, good quality of public and civil services, and credibility of government's commitment to such policies are the primary steps for MATE to realize a sustainable development. Despite the difference between Morocco, Algeria, Tunisia and Egypt, some conclusions may be applied broadly such as women's education that can create the potential, but the governments and private institutions must seize the opportunities.

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[1] *Le Fou d'Elsa* (1963) was a great book talking about love, tolerance and the treasures of all the different cultures.

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Annex

Table 5. Definitions and notation of the variables

Description	Notation
Growth rate of real GDP at 2005US$ (%)	g
Growth rate of real GDP per capita at 2005US$ (%)	gy
Institutional capital measured by:	
1. Control of corruption [1]	icc
2. Government effectiveness [2]	icg
3. Rule of law [3]	icl
4. Political Stability and absence of Violence/ Terrorism [4]	icp
5. Regulatory quality [5]	icr
6. Voice and accountability [6]	icva
Labour force participation:	
Female labour force (% of total labour force)	laborfem
Male labour force of (% of total labour force)	labormale
Total of Labour force)	labor
Human capital measured by:	
Primary completion rate of female	pcrfem
Primary completion rate of male	pcrmale
Primary completion rate, total	pcrtot
Primary enrolment rate, female	pefem
Primary enrolment rate, male	pemale
Primary enrolment rate, total	pe
Secondary enrolment rate, female	sefem
Secondary enrolment rate, Male	semale
Secondary enrolment rate, Total	se
Tertiary enrolment rate, female	tefem
Tertiary enrolment rate, male	temale
Tertiary enrolment rate, total	te

Note: Source of all variables is the **WDI**, 2015 excluding the variables that measure governance and institutional capital, their source is the **Worldwide Governance Indicators (WGI)**, 2014. **(1)** "Reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests", WGI (2014). **(2)** "Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies", WGI (2014). **(3)** "Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence", WGI (2014). **(4)** "Reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism", WGI (2014). **(5)** "Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development", WGI (2014). **(6)** "Reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically motivated violence and terrorism", WGI (2014).

Table 7. Panel Unit Root Tests, over the period 1980-2012

		Intercept is include in test					Intercept and trend are include in tests					
		LLC [1]	IPS [2]	Fisher-ADF	Fisher-PP	Hadri	LLC	IPS	Fisher-ADF	Fisher-PP	Breitung	Hadri
g	Stat.	-1.545	-5.164	43.703	88.350	0.004	-0.295	-4.013	33.604	152.181	-2.981	1.336
	P-value	0.061	0.000	0.000	0.000	0.498	0.384	0.000	0.000	0.000	0.001	0.091
gy	Stat.	-8.903	-10.281	80.086	79.692	1.504	-8.616	-10.323	141.974	146.143	-5.730	1.025
	P-value	0.000	0.000	0.000	0.000	0.066	0.000	0.000	0.000	0.000	0.000	0.153
laborfem	Stat.	-1.420	-0.451	10.410	22.034	3.465	-2.783	-1.762	14.755	6.931	0.499	4.824
	P-value	0.078	0.326	0.237	0.005	0.000	0.003	0.039	0.064	0.544	0.691	0.000
labormale	Stat.	-1.579	0.244	7.429	4.329	5.262	-0.677	-1.324	16.177	13.999	0.421	3.432
	P-value	0.057	0.597	0.491	0.826	0.000	0.249	0.093	0.040	0.082	0.663	0.000
labor	Stat.	-0.642	-0.313	9.786	6.938	2.944	-1.054	-1.444	13.949	9.440	-1.699	4.648
	P-value	0.260	0.377	0.280	0.543	0.002	0.146	0.074	0.083	0.307	0.045	0.000
pcrfem	Stat.	-0.636	1.576	7.502	11.122	6.897	-1.327	-1.227	19.929	22.862	0.364	5.611
	P-value	0.263	0.942	0.484	0.195	0.000	0.092	0.110	0.011	0.004	0.642	0.000
pcrmale	Stat.	-1.040	-0.736	15.913	16.893	5.705	-1.604	-2.743	27.505	39.564	-0.271	5.135
	P-value	0.149	0.231	0.044	0.031	0.000	0.054	0.003	0.001	0.000	0.393	0.000
pcrtot	Stat.	-0.866	0.893	8.429	7.481	6.874	-2.338	-2.484	25.193	38.787	-0.186	5.424
	P-value	0.193	0.814	0.393	0.486	0.000	0.010	0.007	0.001	0.000	0.426	0.000
pefem	Stat.	0.448	0.719	17.628	13.826	6.175	-1.751	-0.866	9.945	8.245	-0.237	4.708
	P-value	0.673	0.764	0.024	0.086	0.000	0.040	0.193	0.269	0.410	0.406	0.000
pemale	Stat.	2.040	2.651	2.694	2.125	4.944	-1.584	-0.481	10.526	10.651	0.705	4.729
	P-value	0.979	0.996	0.952	0.977	0.000	0.057	0.315	0.230	0.222	0.760	0.000
pe	Stat.	1.409	1.443	11.206	6.151	5.487	-1.515	-0.460	9.174	8.520	-0.633	4.710
	P-value	0.921	0.926	0.190	0.630	0.000	0.065	0.323	0.328	0.384	0.263	0.000
Sefem	Stat.	1.036	3.336	2.499	2.410	6.890	0.789	1.866	2.279	2.101	-0.762	3.765
	P-value	0.850	1.000	0.962	0.966	0.000	0.785	0.969	0.971	0.978	0.223	0.000
Semale	Stat.	0.408	1.883	3.121	3.211	6.615	1.327	1.415	2.632	2.747	-1.871	3.142
	P-value	0.658	0.970	0.927	0.921	0.000	0.908	0.921	0.955	0.949	0.031	0.001
Se	Stat.	0.323	2.265	2.536	2.662	6.910	1.447	1.923	1.686	1.872	-0.972	3.667
	P-value	0.627	0.988	0.960	0.954	0.000	0.926	0.973	0.989	0.985	0.166	0.000
tefem	Stat.	0.350	2.519	0.704	0.700	5.782	-0.366	1.176	3.869	3.500	1.413	4.713
	P-value	0.637	0.994	1.000	1.000	0.000	0.357	0.880	0.869	0.899	0.921	0.000
temale	Stat.	0.839	2.116	1.916	2.282	5.392	0.753	0.706	5.712	9.243	0.098	1.487
	P-value	0.799	0.983	0.984	0.971	0.000	0.774	0.760	0.680	0.322	0.539	0.069
te	Stat.	1.892	4.424	0.360	0.265	6.165	0.641	3.161	2.249	2.188	1.827	3.516
	P-value	0.971	1.000	1.000	1.000	0.000	0.739	0.999	0.972	0.975	0.966	0.000

Notes: *(1)* LLC is referred to Levin, Lin and Chu (2002). *(2)* IPS is referred to Im, Pesaran and Shin (2003). Null hypothesis of Hardi test is stationary. Null hypothesis of the rest of the tests is nonstationarity.