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The Impact of Human Capital on Economic growth: Case of Tunisia, Morocco, Japan and South KoreaI

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Abstract

Since the early '90s, the empirical literature on human capital and economic growth is full of conflicting results. Indeed, most theoretical analyzes have confirmed that human capital has a positive and significant effect on growth. This article explores time series causality between human capital (particularly higher education) and growth in four countries economically different, namely Tunisia, Morocco, Japan and South Korea during the period 1960-2012. For this, we use cointegration techniques and Granger causality tests. The results show that cointegration between higher education and economic growth exists only in Japan and South Korea. This finding is explained by the high level of economic growth and human capital of those countries.

Key words: human capital; economic growth; causality and cointegration
JEL Classification: E24; O4; C32

1. Introduction

This work took place in the context of research on "Human Capital and Economic Growth" in particular "Higher Education and Economic Growth". Economic growth as calculated measures only the quantitative variation of an economic aggregate (real GDP per capita, it represents the best indicator), it is not synonymous with the development in the true sense of the term. The development is an abstract concept defining the qualitative evolution of a country it is generally associated with growth, but there may be growth without development.

The problem was to find the effect of higher education on economic growth in four countries: Tunisia, Morocco, Japan and South Korea in order to compare the results obtained in the estimation of time series data. This allows identifying the importance of state intervention in the field of education in a world marked by privatization more thrust.

It should be noted that the concept of human capital and its formulation have evolved from the sixties. However, the importance of human capital has been studied since the seventeenth century.
Adam Smith (1776), a classical economist, developed the basic concepts of the theory of growth in his book "The Wealth of Nations" by considering that human beings were a part of the wealth of nations.
According to this economist, the higher level of education of a worker contributes to improve business productivity, because the worker is more likely to innovate, to imagine new forms of production and to

improve it. Similarly, improving the level of education leads to increase efficiency of all factors of production. This helps to explain income disparities between developed and developing countries.
In the first section, we present the theoretical part which is envisaged to analyze the different transmission mechanisms through which education contributes directly or indirectly to growth. We will demonstrate the effect of human capital as a factor of production; some studies have approved its contribution either by externalities (Lucas (1988)) or by trade openness (Berthélemy top and Varoudakis (1997)).

Then plans to show the role of human capital in imitation and innovation activities based on Aghion and Cohen (2004) report.
The last section will be devoted to the empirical part of which we will try to examine whether the results of recent empirical studies on the effect of education (especially higher education) on economic growth coincide with the theoretical results. It is essential to remember the old basic empirical work before presenting recent works. Economists still refer to the old basic models. These will be summarized in a summary table.

Finally, we will examine the causal relationship between higher education and growth for four countries (Morocco, Tunisia, Japan and South Korea). Our analyses are based on the time series data for the period from 1960 to 2012. We will work those estimates on the E-Views econometric software. In other words, we will answer to our problem: Does the effect of higher education on economic growth exist? For this, more tests will be done following a certain methodology called "The methodology of causality tests."
After making various estimates, we will interpret the results and we will try to compare the results to see if they are consistent with the literature or not.

2. Effect of human capital on economic growth in new theories of growth

Economic thinking on growth focused particularly on the importance of human capital at the beginning of the sixties. Frankel (1962) pointed out that the per capita output increases on a regular basis and this is explained by the action of various forces such as technological change, the improvement in the organization and improving the "human factor".

Economists have proposed more sophisticated models to analyze the impact of human capital on growth since the late 1980s (Lucas, 1988, Romer, 1990).

2.1 The basic model of Lucas (1988)

Lucas (1988) developed a model of endogenous growth based on the idea of "education product knowledge." He was interested in his study of the possibilities offered by the accumulation of human capital. He specified two models that establish the possibility of a sustained long-term growth. The first model consists of two sectors. The first is related to the production of goods from physical capital and a part of the human capital, it is a function of education production. Lucas, then, integrated a second technology related to the formation and accumulation of human capital. This technology is related to the unused portion in the first production function. The second model shows that the accumulation of human capital is by learning (Learning-by-Doing). In this section we will look at the first model.

The production function in this area is represented as follows:

$$Y_t = A_t K_t^{\beta} [u_t N_t h_t]^{1-\beta} h_a^{\gamma} \qquad (1)$$

Where K_t is the stock of physical capital, $(u_t N_t h_t)$ is the efficient labor factor. This is the product of the fraction of time spent on production "u_t" with ($0 \leq ut \leq 1$), h_t : the average skill level of workers involved in the production and N_t the labor input is assumed to be constant.

A_t is the level of technology and h_t is the average stock of human capital calculated on all individuals. The parameters β and (1 -β) denote the elasticities output with respect to physical capital and labor.

According to equation (1), human capital act in two ways of production current, by directly affecting the production, on the one hand. And to the influence through an external positive effect on the other hand.

The accumulation of human capital is an increasing function of time devoted to education. It is formulated as follows:

$\dot{h}_t = Bh_t\,(1-u_t) - \delta h_t$ (2) Where $\dot{h} = \frac{dh}{dt}$ represents the variation of human capital

$(1-u_t)$ *: i*s the time spent in training,

δ *:* is the rate of depreciation of human capital assumed to be zero,

B: is a constant that indicates the learning capacity of individual that is to say the efficiency of the education sector.

To determine the optimal growth trail we must ask the consumer's problem of optimizing the following program taking into account the externality $\gamma \neq 0$:

$$Max\ u_0 = \int_0^{\infty} \frac{N(c_t^{1-\sigma} - 1)}{1-\sigma} e^{-\rho t}\, dt$$

With :

$$\begin{cases} \dot{K}_t = A\,K_t^{\beta}(u_t N\ \ h_t)^{1-\beta}\, h_a^{\gamma} - N\,c_t \\ \dot{h}_t = B\,h_t(1-u_t) \\ h_{at} = h_t \qquad \forall t \end{cases}$$

The Hamiltonian associated with this program is:

$$H_t^c = \frac{N}{1-\sigma}\,(c_t^{1-\sigma} - 1) + \theta_{1t}\left[AK_t^{\beta}(u_t N_t h_t)^{1-\beta}\, h_a^{\gamma} - N\,c_t\right] + \theta_{2t}[B\,h_t(1-u_t)]$$

Where θ_1 and θ_2 implied respectively discounted price of physical capital and human capital. They are obtained by discounting the implicit price in current value of physical capital and human capital with the discount rate r.

After development, we obtain: $\dot{\theta}_1 = \rho\,\theta_1 - \frac{\partial H^c}{\partial K_t}$ and $\dot{\theta}_2 = \rho\,\theta_2 - \frac{\partial H^c}{\partial h_t}$

So,

$$\dot{\theta}_1 = \rho\,\theta_1 - \theta_1\left[\beta\,A\,K_t^{\beta-1}(u_t N_t h_t)^{1-\beta}\, h_t^{\gamma}\right]$$

$$\dot{\theta}_2 = \rho\,\theta_2 - \theta_1\left[(1-\beta+\gamma)A\,K_t^{\beta}(u_t N_t)^{1-\beta}\, h_t^{-\beta+\gamma}\right] - \theta_2[B\,(1-u_t)]$$

2.2 The impact of human capital accumulation on economic growth

Assuming that the fraction of time devoted to education is constant the steady state, the growth rate v of human capital is constant and equal to:

$g_h = \frac{\dot{h}}{h}$ = B (1 - u_t) (3)

Equating to zero the marginal productivity of physical capital, we obtain the expression of growth rate "g" in steady state:

$g_k = \frac{(1-\beta+\gamma)}{(1-\beta)}\ g_h$ (4)

According to equation (4), human capital is the engine of growth in the long term. Indeed, the growth rate of per capita output depends on the human capital.

The resolution of the optimization problem also gives results interesting. The model shows that the rate of economic growth in "g^{o}" centralized and decentralized equilibrium "g^{e}" balance are:

$$g^{0} = \frac{(1-\beta+\gamma)(\delta-\rho)}{\sigma(1-\beta)}$$

$$g^{e} = \frac{1}{\sigma}(\delta-\rho)\left[\frac{(1-\beta+\gamma)}{(1-\beta+\gamma) - (\frac{\gamma}{\sigma})}\right]$$

Comparing the two growth rates (with σ = 1 to simplify calculations), we find that the growth rate of central balance is higher.Finally, Lucas (1988) notes that, in the absence of externalities, the two growth rates are equals and that the presence of externalities may increase the rate of growth but it is not necessary to obtain the long-term growth.
We have in the case $\gamma = 0$: $g^0 = g^e = \frac{1}{\sigma}(\delta - \rho)$

The main idea of this model is that the increase skill level of the workforce is a determinant key of growth. The accumulation of human capital can sustain growth long term by acting directly on the productivity of labor and also through the positive externalities.

3. Transmission mechanisms of the effect of human capital on economic growth

Transmission mechanisms can be divided into two sections, the first considers human capital as a factor of production and the second focuses on the role of human capital stock in the imitation and innovation activities.

3.1 Human capital is a factor of production

It is from the 1960s that economists began to analyze the effect of human capital on economic growth. Over the years, some of them have studied theoretically the impact of education on growth. They agreed on the idea that the accumulation of human capital has a positive effect on growth, but opinions differ as to the mechanism by which human capital affects growth.

The introduction of human capital in the production function has contributed to improving the quality of labor which has increased the growth rate of GDP per capita. The first impulses were given by Schultz (1961) and Denison (1962). They have stressed that education contributes directly to growth by improving the qualifications, skills and productive capacities of individuals. The main purpose of Denison's study was to find contributions of various production factors to economic growth. With reference to studies of Solow (1956) and Schultz (1961), Denison is based on a function of Cobb-Douglas, Y = f (K, L, ED) where Y is aggregate output, L is labor, K is physical capital and human capital is ED. This function shows that the growth rate of per capita GDP is the sum of two terms. The first represents an explained part by the increase in growth factors of production, the labor and capital. The second term is the unexplained part by these growth factors. This share measures the Solow residual or the evolution of total factor productivity (TFP). To reduce the proportion of unexplained residue Denison added education and showed that a large proportion of the residue is explained by education.

3.1.1 Externalities

With the development of the theory of endogenous growth, many mechanisms have emerged. According to some economists, there are some mechanisms by which education has a positive impact on growth.

In this context, growth is characterized by the inclusion of human capital and increasing returns to scale. Ignoring diminishing returns Romer (1986) notes, in his research, that the dissemination of knowledge and innovation is based on education level.
According to the work of Lucas (1988), human capital generates externalities. The main idea was: social competence is the result of exchange of ideas. Following the theoretical models that have concluded that human capital generates externalities, Romer and Lucas agree that there is a positive correlation between human capital and economic growth. This helps to explain income disparities between countries. Barro (1991) confirmed that there is a positive relationship between the initial level of human capital and the growth rate of GDP per capita and a negative correlation with this latter and the initial level of GDP per capita.

The empirical approach, developed by Norman Gemmell (1996) and based on the model of Mankiw, Romer and Weil (1992), argues that in different countries there was a positive correlation between education and growth of income per capita in the long term.

In this context, the results show that human capital has a positive and significant effect on growth through both the initial level of human capital accumulation and the three levels of education (primary, secondary and higher education). Indeed, the results show that primary and secondary education has a greater impact in developing countries, while higher education has a greater effect in the developed countries.

3.1.2 Returns to scale

The externality presented by Lucas (1988), related to the average social level of human capital in the economy, has a positive effect and shows that the social return is higher than the individual one. Indeed, the average social level of human capital take account the collective effects caused by individual capacity enhancement of the workforce. The Lucas model shows that in the aggregate level the returns are raised. That allows to generate an endogenous positive growth rate in the long term.

3.1.3 Openness trade

Berthélemy, Dessus and Varoudakis (1997) analyzed a basic model to explain the result found by Mankiw, Romer and Weil (1992). These economists said that the human capital has a negative effect on the growth of national income. The authors included in the growth equation variables that represent the opening to the outside such as export and import. According to estimations the coefficients associated with these variables are always positive and significant. This shows that the opening of developing countries has a positive and significant effect on growth. This finding confirms that when developing countries are economically open the access to knowledge and the speed of convergence will be rapid.

3.2 The role of human capital in imitation and innovation activities

Theoretical approaches, based on the relationship between education and growth, confirm the positivity of the correlation between human capital accumulation and economic growth.

Indeed, higher education is an essential element of economic development and the construction of the knowledge economy. Mankiw, Romer and Weil noted that science students have more impact on economic growth than those who study human and legal sciences: « not all spending on education is intended to yield productive human capital: philosophy, religion, and literature for example… »(1992).

Aghion and Cohen (2004) analyzed the impact of education on growth and focused on two mechanisms: The human capital accumulation and technological progress.

- The accumulation of human capital implies that an individual can't become productive without passing through the education system. The example presented in the report is that in France, one additional year of education increases the productivity to about 8%.
- Concerning the technical progress, with a higher level education the possibility to develop or adapt new technologies will be easy.

According to Aghion and Cohen the impact of education varies according to the degree of regional development, which means the distance to the technological frontier formed by the United States. This distance is measured by the total factor productivity (TFP) of the country and compared to the United States. This productivity measures the fraction of the output (usually GDP) not attributable to volume growth of production factors (physical capital and labor) and can explain the differences in development between countries. Higher education is an important factor that defines the total factor productivity. It is able to train researchers, scientists and technicians. It also facilitates the development of production capacity and access to knowledge worldwide.

The empirical findings of this report confirm that if the distance between the country and the technological frontier is important, it will be better to invest in primary and secondary education and the main activity will be to imitate the discovery technologies by the rich countries. In this case, the main aim is to catch up the technological frontier. In contrast, if this distance is reduced, the country has more interest to innovate and invest in higher education. And there main goal will to remain globally competitive.

4. Empirical analysis of the contribution of human capital on economic growth: Variables and data

The approach consists of investigating empirically the causality human capital and economic growth Tunisia, Morocco, Japan and South Korea. Unit root tests are first used to establish the degree of integration of the variables and then the cointegration techniques are used to test the existence of a co-evolution between human capital and growth proxies in the long-run.

In this study, we are chose four indicators of human capital (especially higher education). The first one is used to measure the physical capital. We mean the *gross fixed capital formation (GFCF)* as a % of GDP. Second, we have the *openness rate (Openness)*. In fact, it is the sum of exports and imports of goods and services as a % of GDP. The third indicator of human capital is *the secondary school enrolment rate (School)*. Refers to Benhabib and Spiegel (1994) this indicator is taken from the Barro and Lee database.

This latter indicator is defined as the ratio between the number of children enrolled in secondary education and population the age group over 17 years. Finally, the fourth indicator represents *the number of graduates in science and engineering (GRD).* Concerning the economic growth, the standard literature on the ties between economic growth and human capital generally uses the growth rate of GDP per capita. The data sources are the Word Development Indicators (WDI) of the World Bank. (2012), and all variables are expressed in national currencies. The time span of the variables is 1960-2012.

Methodology

The aim of this paper is to resolve the causality issue between human capital and economic growth. First, we have to check whether each variable is stationary or not. In other words, it's necessary to establish the degree of integration (the stationarity) of the series. One these tests are carried out, we focus on the non-stationary variables. For these variables, we say that a co-evolution between human capital and economic growth indicators in the long-run may exist. And we have to test the cointegration between them. Such a test provides evidence of existence of a stable long-run equilibrium relationship between different proxies of human capital and economic growth. But, if the long run relationship between these indicators is absent, the causality tests are limited to short-run test of causality.

4.1 The analysis of the stationarity

This test consists to detect the non-stationary variables and then apply the cointegration test on these variables. If the variable is stationary, it called integrated I(0). Besides, the non-stationary variable is integrated I(1). To start, we use the technique of augmented Dickey-Fuller (ADF) to identify the order of integration of each variable. We apply this test on the remainders of the equation of equilibrium. In the table 1, we find the different indicators of human capital and the proxy of economic growth expressed in their natural logarithm. The results of unit root tests are presented in level and in first difference.

Table-1. Unit root tests for the variables in levels and first differences with only a constant Augmented Dickey-Fuller (ADF), § Null hypothesis: the variable contains a unit root

Variables in level:

Countries •	LGDP per capita	LGDR	LGFCF	LOpenness	LSCHOOL
Tunisia	-0.684*	-1.471*	-1.905*	-1.973*	-1.847*
Morocco	-1.438*	-1.542*	-2.784*	-1.039*	-2.470*
Japan	-0.522*	-2.724*	-0.972*	-1.488*	-2.734*
South Korea	-1.428*	-2.843*	-2,580*	-1.548*	-1.547*

Variables in first difference:

Countries •	LGDP per capita	LGDR	LGFCF	LOpenness	LSCHOOL
Tunisia	-4.587	-5.8401	-3.971	-4.247	-6.218
Morocco	-5.074	-3.687	-4.780	-5.183	-3.896
Japan	-4.657	-6.870	-5.522	-6.648	-4.570
South Korea	-7.872	-5.754	-5.981	-6.246	-7.837

(*) The variable is non stationary; rejection of the null hypothesis
§ The order of the lag in the Dickey-Fuller regression is the minimum number ensuring that the residuals are white noise.
• The different sample periods are as follows: Tunisia 1967-2012; Morocco 1965-2012; Japan 1967-2010; South Korea 1962-2011

4.2 Cointegration Testing

The notion of cointegration has been introduced by Granger (1988), then the cointegration tests were appeared with the *VAR* approach established by Johanson. (1988). The cointegration tests consist to identify the stationarity of the residue of two linear combinations. If the cointegration is demonstrated, so a long-run relationship of equilibrium exists between the two series. In other words, if the residue is stationary we use an error correction model (ECM) to test the causality between the two series. However, if the variables are not cointegrated we test the causality in the short-run based on *bVAR*. In this paragraph we will study the cointegration tests between the different indicators of human capital and the economic growth. The computations are based on the Johanson procedure trace statistic and the null hypothesis (H_0) is that there is no cointegration vector; the alternative one (H_1) is that there is one cointegrating vector.

The Johanson tests are based on the likelihood ratio or the so-called trace statistic (Johanson., 1988). The cointegration analysis is made using a bivariate vector auto-regressive model *(bVAR)* for different period spanning 1960 to 2012.The statistic of the tests are carried out in the table 2 with an optimal lag determined according to the Akaike information criterion (AIC). In addition, using this lag length, the residuals in each of the VAR equations were tested for the normality distribution and for the absence of serial correlation.

Table-2. Johanson cointegration tests *Trace statistic* $-T\sum_{i=r+1}^{p} Ln\ (1-\lambda_i)$
§Null hypothesis r=0, alternative hypothesis r=1

Countries	Variables	Hypotheses H0	Hypotheses H1	Trace	Critical value 5%
Tunisia (1967 – 2012)	GDP and GRD	r= 0	r≥1	10.51	15.49
		r≤1	r≥2	1.88	3.84
	GDP and GFCF*	r= 0	r≥1	21.49	15.49
		r≤1	r≥2	1.34	3.84
	GDP and Openness	–		–	–
	GDP and School	r= 0	r≥1	13.76	15.49
		r≤1	r≥2	2.64	3.84
Morocco (1965 – 2012)	GDP and GRD	r= 0	r≥1	10.80	15.49
		r≤1	r≥2	2.91	3.84
	GDP and GFCF	–		–	–
	GDP and Openness*	r= 0	r≥1	18.87	15.49
		r≤1	r≥2	3.75	3.84
	GDP and School	r= 0	r≥1	13.24	15.49
		r≤1	r≥2	1.57	3.84
	GDP and GRD**	r= 0	r≥1	20.57	15.49
		r≤1	r≥2	6.83	3.84
	GDP and GFCF	r= 0	r≥1	9.81	15.49
		r≤1	r≥2	0.26	3.84

Japan (1967 – 2010)	GDP and Openness	r= 0 r≥1 r≤1 r≥2	11.08 3.08	15.49 3.84
	GDP and School	r= 0 r≥1 r≤1 r≥2	12.67 2.53	15.49 3.84
	GDP and GRD	r= 0 r≥1 r≤1 r≥2	7.27 1.97	15.49 3.84
	GDP and GFCF	–	–	–
South Korea (1962 – 2011)	GDP and Openness	r= 0 r≥1 r≤1 r≥2	12.91 2.98	15.49 3.84
	GDP and School*	r= 0 r≥1 r≤1 r≥2	18.37 1.93	15.49 3.84

(*) indicates the presence of one relationship of cointegration between the variables at 5% significance level
(**) indicates the presence of two relationships of cointegration between the variables at 5% significance level
§ r is the number of cointegration vectors

The tests carried out according to the Johanson procedure show less cases of cointegration, as it is expected. First, we detect the cointegration in Tunisia for the variable *(GFCF)*. Second, we note that the cointegration exist in Morocco with the variable (*Openness).* Third, with the variable (*School)*, there is one case of cointegration with GDP per capita: South Korea. Finally, with the number of graduates in science and engineering *(GRD)*, the hypothesis of non-cointegration is rejected in the case of Japan. For all the countries studied, the cointegration is detected and the variables are in a long-run equilibrium state. Consequently, the short-run dynamics of the variables are seen as fluctuations around this equilibrium. And the Error Correction Model (ECM) indicates how a system adjusts to converge to its long-run equilibrium state. In fact, the speed of adjustment is indicated by the magnitudes of the coefficients of α vector. We interpret the effect of the error correction term βX_{t-1} on economic indicator by explaining the sign of βX_{t-1} itself and the sign of the adjustment coefficient. We note that α_2 represent the adjustment coefficient of the human capital indicators and α_2 is the adjustment coefficient of growth.

Table-3. The adjustment coefficients and the error correction term

Countries	The adjustment coefficient Vector α		The error correction term $\beta X_{t-1}\beta X_{t-1}=y_{t-1}-\beta_1(GRD)_{t-1}-\beta_2$
	α_1	α_2	
Tunisia	0.634	1.255	$y_{t-1} + 4.819\ (GFCF)_{t-1} - 1$
(GFCF)	(2.18)	(2.87)	(-0.18)
Morocco	-0.814	-0.215	$y_{t-1} - 2.507\ (Openness)_{t-1} - 1$
(Openness)	(1.02)	(-1.15)	(0.70)
Japan	-1.784	-2.179	$y_{t-1} - 9.648\ (GRD)_{t-1} - 1$
(GRD)	(-4.57)*	(-3.08)*	(4.08)*
South Korea	-1.865	1.128	$y_{t-1} - 5.673\ (School)_{t-1} - 1$
(School)	(-3.68)*	(0.65)	(6.58)*

The numbers in parentheses are t-statistics
(*) (**) (***) indicate that the variables are significant at respectively 1%, 5% et 10%.

According to table 3, in the cases of Tunisia and Morocco α_1 and the error correction term are not significant, this means that the effect of human capital on long-run growth does not exist. However, α_2 is also not significant which excludes any effect of growth on the proxies of human capital. In contrast, for Japan α_1 and the error correction term are negatives and significant. So, human capital has a long run effect on growth. Moreover, α_2 is negative and significant. We can interpret that the indicator of economic growth exerts a positive effect on human capital. However, for South Korea, only α_1 and the error correction term are negatives and significant, that means that human capital has a positive effect on growth. The reverse impact does not detect.

To check the robustness of these results, one has to see the dynamic interaction between the cointegrated variables in the long-run and how each one is causing the other. To achieve that aim, we should use the Granger causality tests.

4.3 Granger causality tests

According to Granger (1988), if two variables are cointegrated, then one should test for Granger causation in at least one direction.

Table-4. Results of Granger causality tests according to the Johanson procedure

Null Hypothesis				
	HK does not Granger-cause GDP		*GDP does not Granger-cause HK*	
Countries	t_1: $\alpha_1 = 0$	F_1: $\gamma_{12} = 0$	t_2: $\alpha_2 = 0$	F_2: $\gamma_{21} = 0$
Granger causality between GRD and GDP				
Japan	(-4,57)*	4,78*	(4,61)*	-3,08*
Granger causality between School and GDP				
South Korea	(-2,68)*	3,91*	(0,19)	0,65

(*) Significant at least at 10%

In table 4, the results show that for South Korea the causality tests are in favor of a unidirectional causality between the proxies of human capital and economic growth. However, we note that for Japan the evidence is in favor of bidirectional causality between the growth rate of GDP per capita and human capital. Indeed, we conclude that in Japan t_1 and F_1 statistics are both significant, and t_2 and F_2 statistics are also significant. That means that real growth has two effects on human capital: The first one is coming from the lagged dynamic terms and the second from the error correction term. According to the first effect, each short-term change in the economic growth is responsible to the future change in the growth rate of human capital indicators. For the second effect, given the significance of the error correction term in the second VAR equation, real growth exerts an impact on human capital through the error correction term. This means that human capital is adjusting to the previous period disequilibrium between the growth rate of GDP per capita and human capital.

4.4 Short-run Granger Causality: Tests based on first-differenced VARs

Table-5. Causality tests based on first-differenced *bVAR* framework[§]

Countries and variables	**Null hypothesis**	**F(n,k)**
	HK ≠> Growth	**Growth ≠> HK**
Tunisia		
(GDP , GR)	0.671	0.551
(GDP , Openness)	0.581	1.006
(GDP , School)	1.308	0.579
Morocco.		
(GDP , GRD)	1.058	1.149
(GDP , GFCF)	1.067	0.167
(GDP , School)	0.819	0.608
Japan		
(GDP , GFCF)	2.574**	0.841
(GDP , Openness)	1.167	3.411*
(GDP , School)	0.514	0.573
South Korea		
(GDP , GRD)	3.543*	0.651
(GDP , GFCF)	0.026	0.003
(GDP , Openness)	0.271	0.873

All estimates are achieved using first differences of integrated variables

§ The order of the lag is determined using the Akaike information criterion (AIC) on the unrestricted bVAR,
(*) The Fischer statistics are significant at the 5% level.

We remember that, according to the table 2, in all the countries and for some variables the cointegration is detected. For the remaining variables, we applied the causality tests using the first differenced VARs. The evidence presented is not far from the results obtained from the ECMs. The causation turns out to be bidirectional in the case of Japan. Indeed, for South Korea the evidence is in favor of a causation going from human capital to economic growth, with at least one human capital proxy at 5% level.

5. Conclusion

This study has examined empirically the causality between human capital and economic growth in a bivariate VAR structure for a sample four countries (Tunisia, Morocco, Japan and South Korea) over the period 1960-2012. Johanson cointegration analysis provides that human capital seems to affect positively the long-run economic growth. Indeed, the results of this paper clearly indicate that a strong evidence exist in favor of a reverse causation running from growth to human capital for Japan. For countries where human capital and economic indicators are not cointegrated, Granger causality tests were carried out with first-differenced VARs to check the causality problem in the short-run. The results display that evidence was found of bidirectional causality and causality from growth to human capital (Japan). The empirical evidence presented above has important implications for the conduct economic policies in this country. Indeed, despite the results of the study, development strategies in Tunisia and Morocco must take into consideration the fact that the governments must develop effective action plan to improve the quality of human capital.

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