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Human Capital and Economic Growth in Tunisia: Macroeconomic Findings

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ABSTRACT: *Since the seminal work of Solow (1956), along with the accumulation of factors related to physical capital, human capital has become one of the main determinants of economic growth. In this perspective, education is on growth through several channels to know, for example, life expectancy, birth rates and enrollment highlighted in most econometric regressions. The debate on the contribution of education to economic growth, especially in developing countries, is permanent in the economic literature. In Tunisia, this debate is even more pronounced when considering the proportion of the budget allocated to education. Education as an engine of growth, can also analyze various forms since its impact on growth varies we have primary, secondary and higher education.*
This paper aims to answer three sets of questions including: Is education is the only determinant of growth in Tunisia? If not, what are the related factors that enhance or constrain the effects on growth? And economic factors which structural or do they dominate in this process? Finally, what is the direction of causality between the highest education and economic growth? To provide some answers to these research questions, this study's objective is to empirically test a hypothesis defined for this purpose. This is the concern of this article. For this purpose, this paper tries to give some possible reflections that help us to develop the analytical tool that may help us to improving the way towards the amplification of the analysis paradigm.

Keywords: *Gross Enrollment Rate, Economic Growth, Time Series, Cointegration, Short term model, Long term model, VECM.*

I. INTRODUCTION

The growth of modern economies seems to be generated by the special relationship between human capital and growth. Indeed, the process of development in industrialized countries as well as the emerging markets, has historically accompanied by a general increase in the average level of education and skills of their people. The almost simultaneous evolution of stocks of education and growth trajectories sparked a general interest in the analysis of mechanisms and channels of transmission.

Governments took a growing awareness of the vital role that education can play in the process of economic and social development. Thus, it is becoming increasingly clear that the level of education attained by individuals who comprise an economy is a major determinant of its success in the global economy and hence the standard of living of its citizens.

In such context, it is not surprising that education and training play a role in policy development both microeconomic and macroeconomic

II. THE METHODOLOGICAL FRAMEWORK

This section discusses the issue of the problematic of the study and methods of collecting and analyzing data.

II.1. Spotting

Economic growth can sustained continue if the total factor productivity (TFP) in the economy continues to improve and grow. TFP represents the evolution of technical change in the economy. This leads us to the question of the role of human capital accumulation in improving TFP in general and in particular the labor factor in the Tunisian economy. Does human capital have a significant effect on economic growth in Tunisia? What are the main features of the process of human capital formation in connection with the economic growth in Tunisia? To which extent economic policy can be suggested in this process of human capital formation to boost economic growth?

II.2. The interest of the study

The interest of this study is justified by two major events. First, Tunisia invests heavily in education and it is important to see whether such an investment is beneficial for economic growth. Second, human capital is one of the driving factors of economic growth. Therefore, it plays an important role in the formation of the national wealth.
Given the important role of human capital in the productivity of labor and the economic development of a nation, it is urgent that Tunisia has empirical studies on the contribution of human capital to economic growth.

II.3. The objective

The main objective of this study is to investigate the impact of human capital on economic growth momentum Tunisia through an empirical analysis based on the period 1961-2011, taking into account the characteristics of the series used.
The secondary objectives are, first, specify the econometric relationship between human capital and the different variables that determine economic growth. Then analyze the process of human capital formation and its relationship with economic growth.

II.3. The hypothesis of the study

The assumption in this study is that Tunisia like other developing countries is engaged in the process of mass education without having adequate curriculum. In this case, the rapid growth of the school population is detrimental to the quality of education. In addition, the dynamics of the production system is more or less disconnected from the education system. Thus, human capital has a low impact on economic growth.

III. MEASURING THE CONTRIBUTION OF EDUCATION TO ECONOMIC GROWTH IN TUNISIA

III.1. Methodology

- *The equation of the model*

The theoretical basis of the model used in our study is the production function obtained by Mankiw and al. (1992) by improving the Solow model by including human capital accumulation based on the assumptions of growth theories:

$$Y=K^{\alpha}_{t} H_t^{\beta} (L_tA_t)^{1-\alpha-\beta} (1) ;$$

Where Y is output, K the stock of physical capital, L the labor force, H the stock of human capital and A the state of available technology, and α and β are positive parameters such as $\alpha + \beta = 1$.

If s_k and s_h are the fractions of income invested respectively in physical and human capital, the development of the economy is determined by:

$$K'_t=s_k y_t-(n+g+\delta)k_t \quad (2)$$
$$h'=s_h y_t-(n+g+\delta)k_h \quad (3)$$

With y = Y / AL, k = K / AL and H = H / AL, n is the growth rate of L, g is the growth rate of A and δ the depreciation rate.

Is then in a state of equilibrium the following relationship:

$$\text{Ln}\,\frac{y(t)}{L(t)} = \text{LnA0}+gt+\frac{\alpha}{1-\alpha}\text{Ln}\,(s_k) - \frac{\alpha}{1-\alpha}\text{Ln}\,(n+g+\delta) + \frac{\beta}{1-\alpha}\text{Ln}(h^*)+\varepsilon \quad (4)$$

This equation derived many models. Our empirical model which will be tested in the context of Tunisia is written as follows:

$$\text{Ln(PIBH)}_t=C+\beta_1\text{Ln(INV)}_t+\beta_2\text{Ln(OC)}_t+\beta_3\text{Ln(TBS1)}_t+\beta_4\text{Ln(TBS2)}_t+B_5\text{Ln(TBS3)}_t+B_6\text{Ln(EVI)}_t+\beta_7\text{Ln(TCR)}_t+ \beta_8\text{Ln(EDCI)}_t+ \beta_9\text{Ln(TCD)}_t+U_t \quad \text{(Modèle I)}$$

This equation explains the growth rate of gross domestic product per capita (GDPCt) depending on the variable of interest is the enrollment rate from primary to tertiary (TBS) and other determinants of economic growth.

TABLE 1. Variables used in the study

Variables	Description
GDPC	**Level of Gross Domestic Product per capita / year in logarithm**
Ln(INV)	**Investment rate in logarithm**
Ln(TOP)	**Trade openness rate (ratio of exports plus imports divided by GDP in logarithm)**
Ln(GER1)	**Gross enrollment rate of primary in logarithm**
Ln(GER2)	**Gross enrollment rate in secondary in logarithm**
Ln(GER3)	**Gross enrollment rate of higher in logarithm**
Ln(LEAB)	**Life expectancy at birth in logarithm**
Ln(RER)	**Real Exchange rate in logarithm**
Ln(CDE)	**Carbon dioxide emission in logarithm**
Ln(APGR)	**Annual Population growth rate in logarithm**

➢ *Database Sources*

The data for these variables come from the World Bank through the World Development Indicators (WDI), those from Unesco Institute for Statistics UIS, the website of the University of Sherbrooke, the famous www.perspective.usherbrooke.ca.

In addition, we have insisted on the fact that data are collected over a long period from 1961 to 2011, a period of 51 years. This is justified by the need to cover a sufficient number of years to identify trends more or less significant.

III.2. The software

In our study, we will work with the software EVIEWS (Econometric Views). This statistical program for Windows, used mainly for time-series oriented econometric analysis. It is developed by Quantitative Micro Software (QMS), now part of IHS. Version 1.0 was released in Mars1994 and replaced Micro TSP. The current version is 7.2 EVIEWS published in November 2011.

IV. PRESENTATION AND ANALYSIS OF RESULTS OF THE EFFECT OF HUMAN CAPITAL ON ECONOMIC GROWTH IN TUNISIA

IV.1. Treatment of outliers

Before performing the classical tests, check that it has no outliers. The presence of outliers can distort the test results.

For T>30, we have the following confidence interval for residues (for a risk of 5%):

$-1.96s \leq e_t \leq 1.96\ s$ or $-2s \leq e_t \leq 2s$

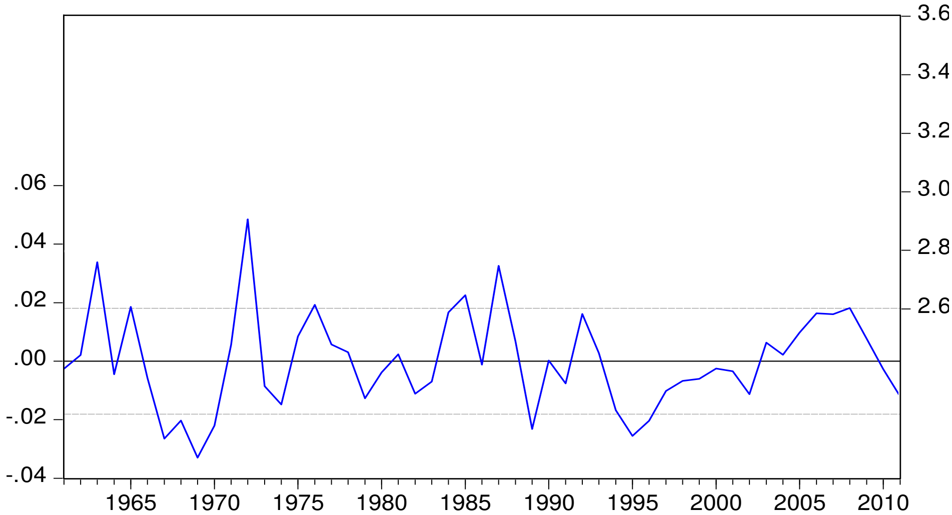


Fig 1. Residues before the introduction of the dummy variable

Here, we have s = 0.018065 (SE of regression), so: $-0.03613 < e_t < 0.03613$
We note that there is a significant outlier in 1972 and another in 1987. You cannot remove this outlier if there is an economic explanation for this. Otherwise it should be taken into account in the modeling.

Adding a dummy variable VIND the model as:

$$\text{VIND} = \begin{cases} 1, \text{ if } t=1972\ ;\ 1987\ ; \\ 0 \text{ else} \end{cases}$$

We note that $R^2 = 0.994998$ and $s = 0.014904$ while $R^2 = 0.992469$ and $s = 0.018065$. Thus, the model with the dummy variable is better than the model without dummy (gives Appendix 6 and 7).

In addition, we find that the coefficient of the dummy variable is significantly different from zero (t-statistic in absolute value = 4.497786> 1.96 for a risk of 5%).

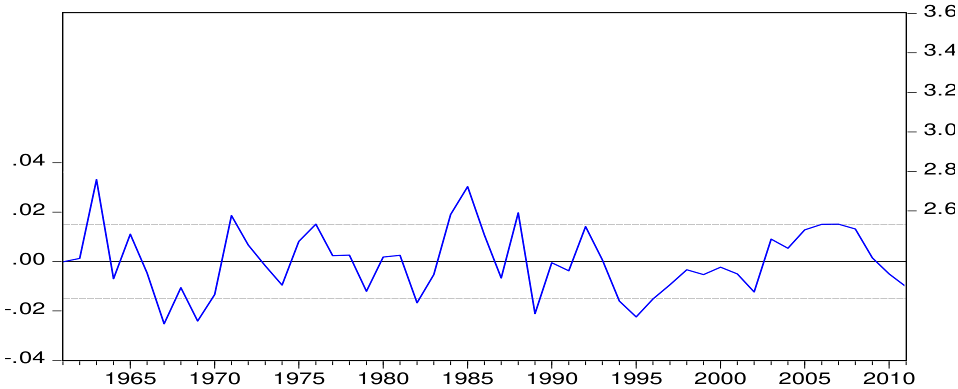


Fig 2. The residue after the introduction of the dummy variable

We see that the outliers in 1972 and 1987 have disappeared. Moreover, EVIEWS offers several techniques to locate the date of the change. All these techniques are based on recursive calculations of the regression coefficients and residuals. Indeed, the Chow test is used to accept or reject the hypothesis of a structural change.
The Fischer likelihood statistic is 0.0096 <5%. We must reject the null hypothesis and accept the alternative hypothesis. Thus, it is concluded by a change of regime in 1987, this is true insofar as Tunisia began to adopt a structural adjustment program (SAP) in a process of economic liberalization.
It then remains to be done both regressions, one for the period 1986 and 1961a of the other 1987 to 2011.

Table 2. Coefficients and R ² of Both Models

Coefficients	Modèle 1961-1986	Modèle 1987-2011
LnINV	-0.018404	0.029807
LnOC	-0.102704	0.045671
LnTBS(1)	-1.222632	-1.845416*
LnTBS(2)	0.162269	0.527733*
LnTBS(3)	-0.013433	0.045912
LnEVI	2.183523	-2.379304*
LnTCR	0.002998	0.017675
LnEDCI	0.226025*	0.488810*
LnTCD	-0.065244	0.030932
R^2	0.988409	0.994894

* The coefficients are significant at 1%.

It is clear that, according to this table, the regression coefficients are significantly different from one period to another.
In fact, we note that physical capital (physical investment and trade openness) have a positive impact on GDP per capita after the adoption of SAP. However, this impact remains insignificant.
On the contribution of human capital, it is clear that ambiguity concerning the contribution of the primary GER and life expectancy on economic growth (the coefficient is greater than 1). Higher education has a positive contribution after 1987, but it is still not significant and this raises a lot of questions about this type of education. The contribution of secondary education (GER2) is remarkable (it is almost tripled) at 1% level. Indeed, an increase in this rate has increased 10% in a positive way the GDPC of 16.22% before structural change. After this period, the contribution becomes significant, this time it reached 52.77%.
This finding also relates to the acceleration of industrialization (CDE). Its contribution to growth is almost doubled (22.60% and 48.88%).
On the rate of population growth, its contribution to GNPC became positive (-6.52% and 3.09%).

IV.2. Matrix of correlation coefficients between the variables

The table below gives the matrix of correlation coefficients between the variables in the equation of our study.

TABLE 3. Matrix of correlation coefficients between the variables

	LNPIBH
LNGDPC	1.0000
LNINV	0.1502
LNPOP	-0.4629
LNGER1	0.6786
LNGER2	0.9457
LNGER3	0.9757
LNLEAB	0.9585
LNRER	0.8710
LNCDE	0.9614
LNAPGR	-0.5914

The comparison of the correlation coefficients between the variables and variable LnGDPC, LnINV, LnTOP, LnGER(1), LnGER(2), LnGER(3), LnLEAB, LnTCR, LnCDE and LnAPGR and suggests an existence of collinearity between variables . They are therefore correlated and linearly independent. Strong collinearity was recorded between GNIPC and EDCI between the GDPC and GER (3) between the GDPC and GER (2), and also between GDPC and LEAB and to a lesser extent between GDPC and GER (1).
This collinearity is positive (that is to say, if a value of a variable increases, the value of the other also increases) for all variables except LnTOP and LnAPGR, collinearity is negative (that is to say, a value of a variable increases, the value of the other decreases). That said, we can say that there is multicollinearity between variables.

IV.3. Examination and tests of the stationarity of time series

To determine whether a variable is stationary or if it is not, two types of tools are available, the correlogram and associated tests correlogram one hand, the stationarity tests on the other.

- *An examination of correlograms*

  - The gross domestic product per capita:

The raw series (not logarithmisé) on GDPC has an uptrend. It increases over time. The correlogram GDPC expressed in logarithm tells us that the series is non-stationary (all autocorrelations are significantly different from zero, Appendix 12). The coefficient associated with the trend has a probability of 0.0913. So, this coefficient is significant. Thus, there is a trend stationarity process (TS). Stationnariser for this series must be the deviation from the trend.

  - Investment :

Gross investment rate series shows that investment fluctuates over time. This series appears to be nonstationary. From the correlogram, we note that the autocorrelations are all significantly different from zero and slowly declining. The first partial autocorrelation is significantly different from zero. This structure corresponds to a non-stationary series. But we think we can confirm this intuition by the Dickey-Fuller test. Moreover, the coefficient associated with the trend is not significant (probability = 0.6168). So we are in the presence of a differencing stationarity (DS) with a drift. It will be stationarized it at the first difference.

  - Trade openness:

This time, the series presents the gross trade openness. It also fluctuates over time. The correlogram of trade openness expressed in logarithm tells us that the series is not stationary. Moreover, this series is a DS without drift since the probability associated with the trend coefficient is equal to 0.3180 (not significant).

  - GER(1) :

The series below shows the GER (1). It fluctuates over time. The correlogram GER (1) expressed in logarithm tells us that the series is non-stationary (the autocorrelations are all different from zero and decreases slowly). Moreover, this series is a DS without drift (probability = 0.4583). To stationarize this series, we move to the first difference.

  - GER(2):

The series on the GER (2) has an upward trend. It increases over time. The correlogram of the series expressed in logarithm shows that the series is non-stationary. Moreover, the coefficient associated with the trend is significant (probability = 0.0183). So we are in the presence of TS. So we stationarize it by the deviation from the trend.

  - GER(3) :

The following chart shows the GER (3). According to this chart, the GER (3) increased greatly from 1993. The series log GER (3) is presented in the correlogram. It seems to be nonstationary. But as we have said, we need to confirm this intuition by the Dickey-Fuller. It is a TS since the probability associated trend is equal to 0.0481.

  - Life expectancy at birth :

The series of the life expectancy at birth increases over time. The correlogram associated with this series expressed in terms of log shows that the series is not stationary. In addition, the series is a DS without drift (probability = 0.3603). So, we must move to the first difference.

  - The real exchange rate :

The series of the exchange rate fluctuates over time. The logarithm applied to this series shows that the series is non-stationary (the autocorrelations are significantly different from zero and decreases slowly). In addition to the series is a TS (probability = 0.0550). So, we must move to the deviation from the trend.

  - The carbon dioxide emission :

This series of emission of carbon dioxide increases over time. The corresponding correlogram shows that the series is not stationary. The series is a DS without drift since the probability is equal to 0.1760. We will therefore stationarize it to the first difference.

  - Annual Population growth rate in logarithm :

The last set shows that the gross growth rate of the population fluctuates over time.The correlogram shows that the series is non-stationary. But we need to confirm this intuition by the ADF test. Moreover, the coefficient associated with the trend is significant. So we are in the presence of TS. We must do away with the trend.

- *Result of the ADF test for stationarity of the variables*

ADF test results are recorded in the summary table in Appendix 8. It is clear from reading this table that the calculated level variables are all insignificant (ADF value satistic> ADF critical value at 5%), while those in first differences are significant at the 5% (value ADF satistic <ADF critical). It is therefore deduced that

the series are non-stationary over the period studied, i.e. they admit a unit root, and therefore require a differentiation of the first order to become stationary.
The completion of this test permits us to found that all variables are stationary in first difference, which brings us back to say that the ten series taken separately are integrated of order 1. So there is a risk of cointegration. So we can use the method of Johansen (1988). Subsequently, we will seek to estimate an ECM.
In addition, the ADF test realized on the residue of the long-term relationship gave the following results:

TABLE 4. Test ADF sur les résidus de long terme / Table 28: ADF test on the residuals of the long term

Variable	Level difference	type of model	confidence level	T.Statistique ADF	critical value
Residlt	1	[1]	5%	-7.240953	-2.923780

Given the non-significance of the trend and constant, the unit root test was performed on the model [1] (without constant or trend). This test revealed no unit root in the series of residues. The residue from the long-term relationship is stationary after first difference, which reveals a risk of cointegration between the variables. The cointegration test would be done in terms of verification.

IV.4. Result of cointegration test

Johansen (1988) proposed a test of cointegration. The table below summarizes the results of the trace of the variables in our study.
Analysis of the results in this table reveals that the statistics of Johansen on the first eigenvalue is above the threshold of 1% critical value (433.1569> 265.5449) is therefore rejects the null hypothesis that there is no cointegration relationship (R = 0) at the 1% level.
However, we accept the hypothesis (R = 5) that there is at most one cointegrating relationship between the variables in the model (80.64372 <85.33651) from the fifth row of the table. Thus, we consider that there is indeed a cointegrating relationship between the variables. (See table below).

Table 5: Test Results of The Trace Of Variables

Null hypotheses	Eigenvalues	Statistics trace	1% critical values
R = 0	**0.873395**	**433.1569**	**265.5449**
R = 1	**0.799953**	**331.8894**	**221.4442**
R = 2	**0.728426**	**253.0385**	**181.5219**
R = 3	**0.679601**	**189.1660**	**145.3981**
R = 4	**0.659232**	**133.3948**	**113.4194**
R = 5	**0.403265**	**80.64372**	**85.33651**
R = 6	**0.321052**	**55.34593**	**61.26692**
R = 7	**0.294420**	**36.37260**	**41.19504**
R = 8	**0.240973**	**19.28461**	**25.07811**
R = 9	**0.111167**	**5.774447**	**12.76076**

However, we accept the hypothesis (R = 5) that there is at most one cointegrating relationship between the variables in the model (80.64372 <85.33651) from the fifth row of the table. Thus, we consider that there is indeed a cointegrating relationship between the variables.

The estimate by the Johansen method leads us to retain a single cointegrating long term relationship. In our case, we choose the specification with constant and trend (intercept no trend in CE and test VAR) because it has been the only happy giving results on the econometric and permissible deviation from economic theory.
The equation below defers the estimated cointegrating relationship:

$$LnPIBH=-8.314+0.373LnINV+0.615LnOC+2.512LnTBS(1)-0.520LnTBS(2)+0.033LnTBS(3)-0.809LnEVI+0.225LnTCR-0.375LnEDCI+0.104LnTCD$$

So we met the existence of a perfect long-term relationship between the variables on the one hand, physical capital (investment and trade openness) and human capital (education and health) policy variable (exchange rate), environmental variables; and on the other hand, economic growth in Tunisia.
Results of the relationship between physical capital and growth that we obtained are all positive. This is consistent with the logic of the economy: the stock of physical capital is the main engine that induces full employment and growth. However, the volume of created wealth and growth depends mainly on the sectors targeted by the investment.

With regard to the relationship between human capital and growth, we note that a low level of the contribution of higher education to growth and ambiguous with respect to primary education.

In addition, environment variables, especially the rate of population growth has a positive contribution to GDP per capita.
Finally, the negative sign obtained for the constant (-8.314) does not demonstrate the existence of variables other than those that we used, which would be likely to explain economic growth.
In sum these tests and made allow us to make the various estimates insofar series are non-stationary in level and are cointegrated. Therefore, it is necessary to estimate their relationship through the error correction model (ECM).

IV.5. Exposure and review of empirical results

This paragraph is intended to make the interpretation of the empirical results of the determinants of GDP per capita in Tunisia. To this end, it will be based on the results of previous conduct an economic interpretation, to check and to validate the research hypotheses and suggestions to make the economic policies that could lead to effective management of internal balance and externally by the authorities in charge of the country's economic policy. In estimating the error correction model, we specify the long-term relationship in the Granger sense and short-term dynamics will be taken into account by the Hendry unique model.

IV.5.1. The model of the long-term relationship

The following table summarizes the results of the long-term relationship.

Table 6. Results Of The Estimation Of The Long-Term Model

Variable	Coefficient	t-statistic	probability
C	3.564*	0.546	0.000
LnINV	0.017	0.722	0.474
LnOC	-0.037	-1.005	0.320
LnGER(1)	-1.211*	-5.059	0.000
LnGER(2)	0.349*	3.156	0.003
LnGER(3)	0.073**	2.280	0.028
LnLEAB	0.758***	1.992	0.053
LnRER	-0.090	-1.055	0.297
LnCDE	0.297*	3.261	0.002
LnAPGR	0.019	0.499	0.620
DUM	0.004	0.586	0.560
R-squared	0.992		
D-W statistic	1.328		
Probabilité	0.000		

*, ** and *** respectively indicate significance of coefficients at 1%, 5% and 10%.

Given the results we can write:
LnGDPC=3.564+0.017LnINV-0.037LnPOP-1.211LnGER(1) +0.349LnGER(2)+0.073LnGER(3)
+0.758LnLEAB-0.090LnRER+0.297LnCDE+0.019LnAPGGR+0.004DUM (Modèle I.1)

➢ *Validation test*

_The correlogram shows that residues of long-term model are not autocorrelated.
_The Jarque-Bera value is 2.48, so it is less than the critical value is 5.99 (still the probability = 0.288 = 28.8%> 5%). So, we accept the null hypothesis. This means that our distribution of residuals is normal.
_The results of autocorrelation errors Breusch-Goldfrey test showed that the errors are uncorrelated. For illustrative purposes, we have for the long-term model, probability = 0.2544 = 25.44%> 5%. Example, there is no autocorrelation in our model.
_ On the heteroscedasticity errors White test for long-term model, there is a probability = 0.1455 = 14.55%> 5%) Thus, the errors are homoskedastic estimates, which means that the variance of model residuals is constant, confirming that the coefficients obtained by OLS are not only unbiased but effective.
We can use these coefficients to forecast and construct confidence intervals.
_ The stability test of Ramsey Reset shows that there is no omission of an important variable (probability (F-statistic) = 0.0887 = 8.85%> 5%).
_ The stability test Cusum shows that the curve is contained in a Cusum corridor at 5%. That is, the model in this study is stable.

The test results Cusum and Cusum SQ 5% show that the series is stable. It should nevertheless be emphasized that the test Cusum SQ has four openwork break periods in 1969, between 1980-1989 and between 2001-2002 and in 2011. This failure was corrected by introducing a dummy varaible (DUM) in the model.

DUM = { 0 : Unfavorable economic and political conditions: 1969; 1980-1989; 2001-2002; 2011 (not a well-faire State) ;
1 : economic and political favorable conditions: the rest (well–faire State).

- *Signifiance of coefficients*

This analysis is done in two stages: analysis of the overall quality of the adjustment on the one hand, and that of the individual quality of the other estimators, on the other hand.

In the case of this study, the probability (F-statistic) = 0.00000 is less than 5% for long-term model: the null hypothesis is rejected and the long-term relationship is globally significant. This result is consistent with the value of the statistic R^2 (here $R^2 = 0.992$), which also provides information on the quality of the fit as it is close to unity.

To decide on the significance of individual estimators, we use the probability provided directly by EVIEWS. The results of the estimation of the long-term relationship clearly show that the 1% level, only variables GER (1) GER (2) and CDE are significant because the associated probabilities are below 0.01. GER (3) is significant at the 5% level.

Nevertheless, some variables that are significant in this model do not have the expected signs. The presentation of the results of different estimates being made, it is necessary to carry out their economic interpretation can lead to suggestions of relevant economic policy.

- *Interpretation*

The long-term results indicate that five variables explain economic growth in our case approximated by gross domestic product per capita. Of these five variables, four are related to human capital.

Indeed, primary education significantly influences but negatively economic growth at 1%. The coefficient is equal to -1.211 is difficult to interpret, this is due to the fact that the gross enrollment rate at primary level is increased by repetition. So, this can skew the results.

Secondary schooling affects growth positively and significantly at 1%. Indeed, when the gross enrollment rate increased by 10%, all else being equal, economic growth increases by 3.497%.

The coefficient on the variable of enrollment level is significantly different from zero at the 5% level. In this context, when the tertiary GER increased by 10, all else being equal, economic growth in Tunisia increases by 0.736%.

The question thus arises: is it logical that higher education has a contribution to the economic growth less than secondary education? The answer is that higher education is not adapted to the changing economic and social environment experienced by the country (the educational sphere is disconnected from the productive sector of the country). Moreover, we note that the largest share of the unemployed in Tunisia came from Higher Education. Add the large base budget allocated to tertiary education. So we do not expect a high contribution of this sector to the country's economic growth.

Health human capital, measured by the logarithm of life expectancy at birth explains the positive economic growth of 10%. When life expectancy at birth increased by 10%, economic growth increases by 7.85%. This may explain the importance of health human capital in the contribution to economic growth in Tunisia over the long term.

In the preceding paragraphs, there is provided a positive sign of the contribution of human capital (education and health) growth. This prediction is thus achieved in the long-term model, except in primary enrollment.

The last variable that significantly explains the growth is the carbon dioxide emission expressed in logarithm. In fact, this variable positively and significantly influences economic growth at 1%. So we can say that as CO_2 emission increases (in other words the acceleration of industrialization), economic growth improves. Indeed, if the emission of carbon dioxide increased by 10%, the growth increases by 2.97%.

Recall that we provided a negative sign for this variable given the harmful effects of carbon dioxide on human health and therefore on economic growth. But this is not the case. The explanation is that, firstly, the relative degree of air pollution in Tunisia. Then, the effects of training and imitation generate positive externalities outweigh the negative externalities of accelerated industrialization.

Otherwise, the investment rate has a positive effect but not significantly and low growth. In fact, an increase in the rate of 10% corresponds to an increase of only about 0.174% to economic growth in the long term. This is explained by the fact that targeted investments are not productive, have no added value and do not target niches.

Trade openness negatively affects economic growth. When the level of trade openness increases by 10%, economic growth down 0.375%. This result can be explained by the fact that some problems still persists on trade liberalization in Tunisia. Trade policies pursued were concentrated on the promotion of exports. Trade reforms occurred in the context of the free trade agreement with the European Union has not resulted in economic performance in trade with the outside world. Add competition from China. Also, the trade does not lead to greater specialization and thus limits gains in total factor productivity. Domestic firms do not benefit from economies of scale despite the expansion of potential markets.

Some economists argue that the gain of economic openness depends on several factors, including the initial situation of the country. This determines the nature of the specialization of the country in the long term and therefore its growth rate.

In addition, there is provided a negative sign of the real exchange rate of the dinar against the U.S. dollar, which is approved in this model. The coefficient is -0.090, this is consistent with the theory. Thus, exchange rate maintained at the wrong level can lead to significant cost in terms of economic growth measured in our study by the logarithm of GDP per capita.

Finally, in the context of our long-term model, the rate of population growth has a positive effect (coefficient = 0.019) on economic growth, which is consistent with economic theory. Indeed, the increase in population size increases the size of the market. The latter has a positive effect on consumption, on its part, increased production and thus per capita GDP is improved.

Overall, we can say that this long-term model can be used in predicting

IV.5.2. The short-term dynamics

The following table presents the results of the short-run relationship.

Table 7. Results Of The Estimation Of The Short-Term Model

Variable	Coefficient	t-statistic	Probabilité
C	**0.0195***	**4.4086**	**0.0001**
DLnINV	**0.0078**	**0.3086**	**0.7592**
DLnTOP	**-0.0210**	**-0.6804**	**0.5002**
DLnGER(1)	**0.3580**	**1.1682**	**0.2498**
DLnGER(2)	**-0.3350****	**-2.0477**	**0.0474**
DLnGER(3)	**-0.0001**	**-0.0038**	**0.9969**
DLnLEAB	**-0.7553**	**-1.2409**	**0.2220**
DLnRER	**-0.0039**	**-0.0601**	**0.9524**
DLnCDE	**0.0937**	**0.2068**	**0.1741**
DLnAPGR	**0.0050**	**0.2068**	**0.8372**
DUM	**-0.0003**	**-0.0615**	**0.9512**
R-squared			**0.2103**
D-W statistic			**2.2404**
Probabilité			**0.4303**

* and ** indicate respectively significance of the coefficients at the 1% and 5% level.

The reading of these results allows writing the following short-term relation:

DLnGDPC=0.0195+0.0078 DLnINV-0.0210DLnTOP +0.3580DLnGER(1) -0.3350DLnGER(2) -0.0001DLnGER(3) -0.7553DLnLEAB-0.0039DLnRER+0.0937DLnCDE+0.0050DLnAPGR -0.0003DUM (Modèle I.2)

- *Validation Tests*

_ The correlogram of the short-term model shows that the residuals are not autocorrelated.
_ For the short-term model, the errors are not normal (JB = 13.460> 5.99).
_ The Durbin-Watson (DW = 2.24 close to 2, shows that the residuals are not autocorrelated. This result is confirmed by the Breusch Goldfrey (BG = 0.6186 = 61.86%> 5%).

_ The test of heteroscedasticity errors of White shows that the probability is 0.6956 = 69.56%> 5% for the short-term model. Then, we accept Ho, which means that there is no heteroscedasticity, so the variance of our residue is constant.
_ The model does not suffer from the omission of important variable according to the Ramsey Reset test (probability (F-statistic) = 0.3016 = 30.16%> 5%).
_ The stability test of Cusum SQ a shown in the associated graph indicates that the Cusum squared curve intersects the corridor. That said, the short-term model is unstable.

➢ Significance of coefficients

The coefficient of determination (R^2) is 0.210. This indicates that only 21% of real GDP per capita is explained by the variables in the model. This statistic shows that one away from the linear relationship between the explanatory variables is weak. Probability (F-statistic) = 0.430 = 43%> 5% indicates that the short-term model does not seem to be of good quality.
Moreover, we note that most of the explanatory variables used in the short-term dynamics are not significant and the majority of them do not have the expected signs.

➢ *Interpretation*

One variable significantly explains economic growth in the short term. Indeed, the gross enrollment rate at the secondary level, expressed in logarithm influenced significantly, but negatively, economic growth at 5%.
In addition, other interest variables are the GER(1) GER(3) and life expectancy at birth do not explain the short-term economic growth in Tunisia. This result was already obtained by several authors in the case of developing countries.
To explain this short term result, we see that Tunisia, like other developing countries, is committed to mass education programs to cope with demographic pressures, but without the proper curriculum.
In this case, the increase in gross enrollment ratio (GER), that is to say, the increase in the number of students and pupils, hides a relative stagnation of available human capital, as increased the school population to the detriment of the quality of education given to each.
Some studies reported problems inherent in the Tunisian educational system (the weak performance of educational institutions the predominance of quantitative aspects in the curriculum and low student achievement, lack of professionalism and lack a culture of evaluation).
Also, we can add the one hand, some problems that trace target performance under a development plan covering a period educational and quantitative and qualitative results actually achieved during this period. Among these problems is:
_Predominance of theoretical aspects in learning;
_The virtual absence of initiation methods of work;
_Presence of a strong trend in quantitative and cumulative programs;
_Stiffness programs that leave little room at the initiative of the teacher;
_Master insufficient by some students transversal key competences, such as analysis, synthesis, research and use of information;
_ Weak students writing both Arabic and French.
On the other hand, we can highlight, along with progress, other problems which degenerate on persistent failures:
_Small place to applications and experimentation;
_Multiple disciplines and lack of integration of intra-and inter-disciplinary
_Modesty means of expression of students in foreign languages;
_No function formative evaluation;
_Lack of professional dimension in teacher training;
_School activities reduced to only teaching activity, which creates a form of alienation of teachers and students towards the school.
In the same vein, the situation of the labor market in Tunisia is characterized by an almost constant mismatch between job seekers who do not have the required qualifications and the needs of the productive world in terms of skilled labor. This raises the problem of the quality of the workforce is also one of the causes of the decline in labor productivity.
Thus, the weakness of human capital is a significant cost to economic growth and poverty reduction. The quality of teaching in Tunisia was also challenged since many years.
That said, we can conclude that the difficult relationship of the contribution of human capital to economic growth in the short term in Tunisia.

This result shows that the impact of human capital on economic growth is not obvious. This is due to the low internal and external efficiency of the education system in Tunisia. Under these conditions, short-term, economic growth is influenced by other factors (low R^2 demonstrated), especially public consumption, the inflation rate, the per capita GDP lagged one period.

V. AN ATTEMPT TO ESTIMATE A VECM WITH THE INTRODUCTION OF TWO EXOGENOUS VARIABLES

Now, we assume that the GDP per capita is expressed by only two exogenous variables: relative to physical capital (control variable: LnINV) and other human capital (interest varaible: GER(3)).
The equation describes this model can be written as follows:

$$LnGDPC = C + \alpha_1 LnINV + \alpha_2 LnGER(3) \qquad \text{(Modèle II)}$$

The results of the estimation indicate that the variables are stationary in first difference. This reveals a shock on the economy which has a temporary effect on GDP per capita in Tunisia.
In addition, the long-term model provides estimates of LnINV and LnGER(3) positive and significant successively threshold of 5% and 1%. $R^2 = 0.95$, which means that the two variables LnINV LnTBS and (3) explains 95% of the variability in GDP per capita.
In the short term, these estimates are positive but not significant, R^2 is 0.006, very low. Thus, this model is generally not significant. This is also confirmed by the probability (F-statistic) = 0.8542 = 85.42%> 5%.

V.1. The cointégration equation

Insofar as we have three variables, the VECM have three equations. In the latter refers CointEq1 residues, delayed by a period of the cointegration relationship previously found.
The equation below defers the estimated cointegrating relationship:

$$LnGDPC = -3.26 + 0.09\, LnINV - 0.37 LnGER(3)$$

According to this equation, the stock of physical capital is a positive vector for growth. This is consistent with the logic of the economy. However, human capital (measured by enrollment in tertiary education) has a negative impact on the logarithm of GDP per capita, this is due to the unemployment of university graduates and structural problems that hinder the development of human capital in Tunisia.
Moreover, the coefficient of the error correction, which is used to measure the speed of adjustment of GDP per capita relative to its equilibrium level was - 0.175932. This coefficient is negative and significant at 5%. Therefore, the formulation of the model form error correction is acceptable.
Indeed, we can see that in the long term, there is a mechanism for error correction which restores imbalance of 17.5% of real GDP per capita.
Any effect produced by a fundamental variable on the equilibrium path of per capita GNP is necessarily subject to a restoring force. This low level of the speed of adjustment in Tunisia indicates that the return to equilibrium is relatively slower.
Thus, the variables used in this equation, namely the rate of investment and tertiary gross enrollment ratio has little impact on economic growth.
The short-term analysis shows that the variation of GDP per capita does not depend on its past values. This is explained by the non-significance, statistically, of the coefficients. The small size of the Tunisian economy is the main cause. In addition, the results regarding the relationship between human capital and physical investment on the one hand and growth on the other hand affect growth in the short term, a positive but not significant (respectively the probabilities associated 0.5766 and 0.9482).
Thus, this result remains ambiguous in the short term. This is explained by the fact that the physical or human capital does off significantly in the medium and long term. In fact, to assimilate and use new technologies effectively, it requires a learning curve.
So, in long term we note that these two variables contribute significantly and positively to economic growth (associated probabilities are 0.0275 and 0.0000 respectively).

V.2. The Granger causality test

Now we will look for the causal relationship between the variables of the study. Thus, we will illustrate the concept of Granger causality by conducting a test of non causality. The results obtained for a delay p = 2, are given in the table below:

Table 8. Granger Causality Test

Null hypothesis	F-statistic	Prob
GER(3) does not Granger cause LnGDPC	6.9784	0.0023
LnGDP(3) does not Granger cause LnGER	1.0767	0.3495

The probability associated with the first null hypothesis that LnGER(3) does not cause LnGDPC, is 0.0023 = 0.23% <5%. Therefore, we reject this hypothesis: the level of human capital as measured by the gross enrollment rate in higher education causes in the Granger sense the logarithm of GDP per capita. Instead, we note that the second null hypothesis LnGDPC not cause LnGER(3), is accepted at the 5% (probability = 0.3495 for = 34.95%> 5%).

Thus, we have:

- LnGER(3) causes LnGDPC, which is consistent with the literature;
- LnGDPC not causeS LnGER(3) at the 5% level.

Therefore, as shown the results, it is clearly that there is unidirectional causality level of human capital on economic growth. We can say that the development of human capital through means of education, invest wisely in this sector would be an additional guarantee for a certain growth.

VI. VERIFICATION OF THE HYPOTHESIS OF THE STUDY

Our research hypothesis assumes that the fundamental internal variables including gross enrollment rate of primary education have little effect on the rate of economic growth in Tunisia saw gaps in quality of human capital. The results of the estimation of long and short term are concluded. That said, our hypothesis is validated.

The validation of the study hypothesis allows us to make suggestions for economic policy in order to give better guidance to policy on human capital in Tunisia.

VII. ECONOMIC POLICY RECOMMENDATIONS

In this study of the impact of education on economic growth, the cointegration test showed that there is a long-term relationship between economic growth and different levels of education. Econometric estimates of the long-term model showed that only the secondary school enrollment rate has a positive and significant impact on economic growth in Tunisia. The impact of higher education is low, while primary school enrollment has a negative effect. In the short term, primary and higher levels have no impact on economic growth.

According to our study, it appears that secondary education is not only a source of human capital accumulation but also a growth factor in the Tunisian economy. In addition, the expansion of primary schooling allows the greatest number of people, but it is unable to provide the economy of human capital capable of capturing knowledge spillovers.

Our results show that higher education influences Tunisia weak growth seen the difficulties of this level of education. Thus, Tunisia cannot become an emerging country if the crisis in higher education persists. The results found in this study can inspire educational policy in Tunisia for sustained growth. First, if Tunisia wants to change the structure of its economy. Efforts must be involved in the financing of secondary and university education, especially in the area of training and research. Otherwise, the educational system is disconnected from its environment. Secondly, as the stock of skilled workers is very low, investment in higher education should be a priority to drive the other two higher levels of training. Similarly, as we have checked, it is not economic growth that causes the development of higher education. Thus, a comprehensive reform of the higher teaching becomes a necessity. Finally, we can say that, according to our estimates provided by the various econometric models of education in Tunisia is not a choice, but rather it is an imperative for growth and development.

VIII. CONCLUSION

The Tunisian economy is characterized by its complementarity. It derives its momentum from the fact that all sectors contribute more or less to national growth. Tunisia invests heavily in human capital formation. Indeed, the assessment according to the indicators mentioned helped make the observation that this effort has resulted in some positive developments: high enrollment rates, equity ensured success rate in constant evolution. However, some constraints and difficulties related to the Tunisian educational system. Against the poor performance of this sector can reduce the level of contribution of human capital in economic growth.

Moreover, the method of cointegration we used allowed us to analyze the relationship between economic growth and human capital in the short and long term. Our estimate leads to the identification of a positive and significant effect of the gross enrollment rate in secondary and tertiary population activity on GDP per capita in Tunisia over the long term. This result is also valid for the health human capital.
Our concentration was focused on determining the impact of education on economic growth by level (primary, secondary and tertiary) and category (health human capital, education and human capital). Therefore, our estimates have no size limits.

Through this study, we were concluded that Tunisia, if it wants to change the structure of its economy, efforts must be engaged in the financing of education and training. Here, investment in higher education should be a priority to drive the other two levels of training. Thus, a comprehensive reform of the higher teaching becomes a necessity. We also demonstrated that education in Tunisia is not a choice but an imperative for growth and development. This study leads us to ask questions about the new direction of education systems in Tunisia.

REFERENCES

[1]. Harrod, F. (1939), “An essay in dynamic theory”, Economic Journal, Vol. 49, N. 193, pp : 14-33.
[2]. Jackson Ngwa Edielle, T. H. (2005), “Education, innovation et croissance économique au Cameroun”, Munich Personal Repec Archive (MPRA), pp : 1-17.
[3]. Ayato, B. et Ahossi C. (2010), “Capital humain éducatif et croissance économique au Bénin”, mémoire de Maitrise en sciences économiques, Université d’Abomey Calavy.
[4]. Barro, R. (2000), “Les facteurs de croissance économique, une analyse transversale par pays”, Economica, (Janvier).
[5]. Barro, R.J. and Sala-I-Martin, X. (1995), “Economic Growth”, Mac-Graw-Hill, New-York.
[6]. Gurgand, M. (2000), “Capital humain et croissance : La littérature empirique à un tournant ? ”, Revue de l’Institut d’Economie Publique, N.6, 2000/2, pp : 71-93.
[7]. Boujelbene, Y. et Mâalej, A. (2009), “L’importance de l’éducation dans la croissance économique”, Faculté des sciences économiques et de gestion de Sfax.
[8]. Nkouka, S. I. (2009), “L’incidence du capital humain sur la croissance économique au Congo”, Annales de l’Université Marien Ngouabi, Vol. 10, N. 2, pp : 63-79.
[9]. Pritchett, L. (2001), “ Where has all the education gone ? ”, World Bank Economic Review, Vol. 15, N. 3, pp : 367-391.
[10]. Bourbonnais, R. et Terraza, M. (2004), “Analyse des séries temporelles”, Dunod, Paris.
[11]. Brown, R. and al. (1975), “Techniques for testing the constancy of regression relationships over time”, Journal of the Royal Statistical Society, Serie B, Vol. 37, pp : 149-192.
[12]. Casin, P. (2009), “Économétrie : Méthodes et applications avec Eviews”, Édition Technip, Paris.
[13]. Coulombe, S. and al. (2004), “Literacy scores, human capital and growth across fourteen OECD countries”, Catalogue no. 89-552-MIE, N. 11, Ottawa: Statistics Canada.
[14]. Coulombe, S. and Tremblay, J.F. (2005), “Public investment in skills: Are Canadian Governments doing enough? ”, C.D.Howe Institute.
[15]. Dessus, S. (1998), “Analyse empiriques des déterminants de la croissance à long terme”, Thèse de doctorat en sciences économiques, Université de Paris I.
[16]. Gurgand, M. (1993), “Les effets de l'éducation sur la production agricole: Application à la Côte d'ivoire”, in Revue d'Economie du Développement, Vol. 4, pp : 37-54.
[17]. Granger, C.W.J. (1969), “Investigating causal relation by econometric and cross-sectional method”, Econometrica 37, pp : 424–438.
[18]. Jarque Carlos, M. and Bera Anil, K. (1981), “Efficient tests for normality, homoscedasticity and serial independence of regression residuals: Monte Carlo evidence”, Economics Letters, Vol. 7, N. 4, pp : 313-318.
[19]. Johansen, S. (1988), “Statistical analysis of cointegration vectors”, Journal of Economic Dynamics and Control, Vol. 12, Isssue 2-3, pp : 231–254.
[20]. Psacharopoulos, G. and Woodhall, M. (1985), “Education for development: An analysis of investment choices”, New York: Published for the World Bank by Oxford University Press.
[21]. Kimseyinga, S. and al. (2004), “Analysing growth in Burkina Faso over the last four decades”, Collaborative Research Project, Growth Working Paper, African Economic Research Consortium, N. 4, pp : 1-33.
[22]. Lucas, R. (1988), “On the mechanisms of economics development”, Journal of Monetary Economics, Vol.22, pp : 3-42.
[23]. Mankiw, N.G. and al. (1992), “A contribution to the empirics of economic growth”, The Quarterly Journal of Economics, Vol. 107, N. 2, pp : 407-437.
[24]. Moulemvo, A. (2007), “Capital humain et croissance durable au Congo- Brazzaville”, Annales de l’Université Marien Ngouabi, Brazzaville, Congo.
[25]. Nadir, A. (2007), “Capital humain et croissance : L’apport des enquêtes internationales sur les acquis des élèves”, Économie Publique, Vol. 18-19, N. 1-2, pp : 177-209.
[26]. Ricardo, D. (1817), “Principes de l’économie politique et de l’impôt”, trad. française, 1847.
[27]. Romer, P. (1990), “Endogenous technological change”, Journal of Political Economy, S71-S 102.
[28]. Sacerdoti, E. and al. (1998), “The impact of human capital on growth : Evidence from West Africa”, IMF Working Paper, N. 98/162.
[29]. Schumpeter, J. (1912), “The theory of economic development: An inquiry into profits, capital, interest and the business cycle”, MA: Harvard University Press.
[30]. Smith, A. (1776), “Recherches sur la nature et les causes de la richesse des nations”, Édition traduite en 1881 par Germain Garnier à partir de l'édition revue par Alolphe Blanqui en 1843.
[31]. Solow Robert, M. (1956), “A contribution to the theory of economic growth”, Quarterly Journal of Economics, Vol. 70, N. 1, pp : 65–94.

APPENDIX

Appendix N°1: The data

obs	LnGDPC	LNINV	LnTOP	LnGER1	LnGER2	LnGER3	LnLEAB	LnRER	LnCDE	LnAPGR
1961	2.795592	2.931826	2.048494	1.973128	1.255273	-0.096910	1.698970	-0.397940	-0.384050	0.125156
1962	2.808605	3.034533	2.034761	1.975432	1.267172	-0.070581	1.699838	-0.397940	-0.384050	0.230960
1963	2.849434	3.084320	1.980375	1.982271	1.267172	-0.070581	1.707570	-0.397940	-0.357535	0.290925
1964	2.861108	3.268883	2.026119	1.982271	1.271842	-0.045757	1.711807	-0.397940	-0.216096	0.322426
1965	2.862865	3.326809	2.054452	1.985427	1.278754	0.033424	1.712650	-0.301030	-0.274088	0.335458
1966	2.868207	3.175305	2.055895	1.986772	1.290035	0.176091	1.716003	-0.301030	-0.215383	0.335659
1967	2.859689	3.162584	2.057610	1.986772	1.292256	0.204120	1.720986	-0.301030	-0.195179	0.326950
1968	2.893784	3.067283	1.988631	1.991226	1.311754	0.301030	1.724276	-0.301030	-0.137272	0.312177
1969	2.905379	3.074229	1.976060	1.993436	1.342423	0.342423	1.732394	-0.301030	-0.115771	0.294246
1970	2.917009	3.021083	1.983419	1.995635	1.352183	0.380211	1.737987	-0.301030	-0.136677	0.275542
1971	2.953787	2.989814	1.985171	2.001790	1.355854	0.419460	1.740363	-0.301030	-0.092589	0.195900
1972	3.017594	2.983954	1.951054	2.001115	1.353628	0.422918	1.748963	-0.301030	-0.048662	0.215109
1973	3.007068	3.020355	1.842610	1.973908	1.339928	0.390759	1.755875	-0.397940	-0.048177	0.247237
1974	3.032410	3.032022	1.800016	1.963344	1.330779	0.419956	1.763428	-0.397940	-0.007889	0.285557
1975	3.053254	3.247519	1.737634	1.977014	1.321640	0.450557	1.773348	-0.397940	-0.005243	0.324694
1976	3.076133	3.371621	1.776122	1.984410	1.323335	0.592732	1.778875	-0.397940	0.007748	0.364363
1977	3.079696	3.422905	1.769472	1.996205	1.335799	0.623249	1.788875	-0.397940	0.059563	0.403807
1978	3.095174	3.435273	1.735535	2.000976	1.362972	0.666143	1.788875	-0.397940	0.092370	0.427811
1979	3.111032	3.418613	1.725709	1.999744	1.382845	0.672098	1.796436	-0.397940	0.149219	0.432809
1980	3.130508	3.342900	1.651755	2.005223	1.396374	0.676694	1.802637	-0.397940	0.171727	0.426837
1981	3.142326	3.433817	1.705076	2.006372	1.432456	0.690196	1.805501	-0.301030	0.175222	0.422590
1982	3.128800	3.527281	1.710786	2.012964	1.478076	0.698970	1.811575	-0.221849	0.150756	0.418301
1983	3.137461	3.460988	1.694847	2.029181	1.501361	0.699057	1.818885	-0.154902	0.213783	0.411788
1984	3.153179	3.469643	1.719071	2.038938	1.533289	0.700444	1.820202	-0.096910	0.214314	0.294466
1985	3.163814	3.337116	1.732394	2.047458	1.561888	0.730863	1.822299	-0.096910	0.215638	0.483730
1986	3.143808	3.218429	1.720986	2.055046	1.593762	0.751818	1.827369	-0.096910	0.206556	0.498173
1987	3.160983	3.073831	1.728354	2.058384	1.588619	0.735359	1.829304	-0.096910	0.184123	0.403464
1988	3.151635	3.022662	1.778875	2.056516	1.601495	0.757700	1.844477	-0.045757	0.200029	0.347330
1989	3.153604	3.113178	1.859739	2.044736	1.637310	0.680426	1.856124	-0.045757	0.220631	0.106531
1990	3.176276	3.192979	1.864511	2.051546	1.643749	0.681241	1.857935	-0.045757	0.211121	0.385428
1991	3.184273	3.179918	1.833784	2.054697	1.650103	0.689398	1.859138	-0.045757	0.269746	0.298635
1992	3.208042	3.303384	1.828660	2.056184	1.661548	0.689486	1.860937	-0.045757	0.247482	0.310268
1993	3.208965	3.336254	1.830589	2.056992	1.689193	0.693903	1.861534	0.000000	0.279667	0.290925
1994	3.214699	3.297936	1.855519	2.065124	1.731532	1.067183	1.862728	0.000000	0.256958	0.257439
1995	3.217849	3.184938	1.869818	2.065662	1.762363	1.090963	1.865104	-0.045757	0.244277	0.203849
1996	3.241482	3.143908	1.829304	2.062274	1.790377	1.124211	1.866287	0.000000	0.265290	0.164650
1997	3.258526	3.205047	1.854306	2.058612	1.800119	1.149096	1.868644	0.041393	0.264109	0.137671
1998	3.273280	3.213547	1.851258	2.069812	1.843096	1.189575	1.869818	0.041393	0.284882	0.105851
1999	3.293140	3.236505	1.838849	2.064046	1.866677	1.238573	1.872739	0.079181	0.287130	0.115611
2000	3.308153	3.257168	1.869232	2.061954	1.880167	1.285737	1.873321	0.146128	0.318481	0.053463
2001	3.324059	3.266739	1.907411	2.058513	1.892072	1.337379	1.875061	0.146128	0.332439	0.058806
2002	3.326347	3.235598	1.890980	2.054441	1.900285	1.366628	1.875640	0.146128	0.331832	0.046495
2003	3.347285	3.152831	1.879669	2.051889	1.892306	1.426023	1.875640	0.113943	0.337060	-0.229148
2004	3.368681	3.117431	1.901458	2.050059	1.916570	1.464698	1.876795	0.079181	0.353724	-0.028260
2005	3.381416	3.098889	1.916454	2.049420	1.930730	1.488029	1.877947	0.113943	0.356408	-0.014125
2006	3.401059	3.156534	1.936011	2.044963	1.939414	1.502277	1.880814	0.113943	0.358316	-0.007446
2007	3.423573	3.054630	1.943495	2.031853	1.955235	1.499357	1.881955	0.113943	0.367729	-0.019542
2008	3.438937	3.124555	1.988559	2.029660	1.962980	1.527630	1.882525	0.079181	0.372175	-0.001741
2009	3.447958	3.157205	1.887054	2.019901	1.975528	1.534863	1.883661	0.113943	0.377670	0.003891
2010	3.468154	3.255466	1.485167	2.011862	1.986530	1.546802	1.884416	0.113943	0.383277	0.017033
2011	3.478196	3.120468	1.501439	2.003672	1.997260	1.558433	1.885265	0.146128	0.418633	0.027757

Appendix N°2: Estimating equation with OLS without dummy variable

Dependent Variable: LNGDPC				
Method: Least Squares				
Date: 05/15/12 Time: 22:54				
Sample: 1961 2011				
Included observations: 51				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_INV_	0.018484	0.023892	0.773624	0.4436
LN__TOP_	-0.029189	0.034258	-0.852024	0.3992
LNGER_1_	-1.222632	0.236762	-5.163962	0.0000
LNGER_2_	0.360158	0.108485	3.319891	0.0019
LNGER_3_	0.073624	0.032015	2.299681	0.0266
LN_LEAB_	0.812459	0.365909	2.220386	0.0320
LN_RER_	-0.106545	0.080132	-1.329625	0.1910
LN_CDE_	0.285590	0.088226	3.237016	0.0024
LNAPGR	0.018187	0.039180	0.464197	0.6450
C	3.455874	0.510581	6.768518	0.0000
R-squared	0.992469	Meandependent var		3.147143
Adjusted R-squared	0.990816	S.D. dependent var		0.188496
S.E. of regression	0.018065	Akaike info criterion		-5.015830
Sum squaredresid	0.013379	Schwarz criterion		-4.637040
Log likelihood	137.9037	Hannan-Quinn criter.		-4.871083
F-statistic	600.3397	Durbin-Watson stat		1.366261
Prob(F-statistic)	0.000000			

Appendix N°3 : Estimating equation with OLS with dummy variable

Dependent Variable: LNPIBH				
Method: Least Squares				
Date: 05/15/12 Time: 22:57				
Sample: 1961 2011				
Included observations: 51				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_INV_	0.054976	0.021317	2.578974	0.0137
LN__TOP_	-0.005461	0.028753	-0.189930	0.8503
LNGER_1_	-1.455093	0.202065	-7.201131	0.0000
LNGER_2_	0.376655	0.089582	4.204601	0.0001
LNGER_3_	0.067810	0.026446	2.564098	0.0142
LN_LEAB_	1.086897	0.308001	3.528877	0.0011
LN_RER_	-0.105500	0.066114	-1.595736	0.1184
LN_CDE_	0.235292	0.073646	3.194910	0.0027
LNAPGR	0.019344	0.032327	0.598396	0.5529
VIND	0.055445	0.012327	4.497786	0.0001
C	3.249956	0.423740	7.669700	0.0000
R-squared	0.994998	Meandependent var		3.147143
Adjusted R-squared	0.993748	S.D. dependent var		0.188496
S.E. of regression	0.014904	Akaike info criterion		-5.385906
Sum squaredresid	0.008886	Schwarz criterion		-4.969238
Log likelihood	148.3406	Hannan-Quinn criter.		-5.226685
F-statistic	795.7463	Durbin-Watson stat		1.444320
Prob(F-statistic)	0.000000			

Appendix N°4: "Chow break test" for 1987

Chow Breakpoint Test: 1987				
Null Hypothesis: No breaks at specified breakpoints				
Varying regressors: All equation variables				
Equation Sample: 1961 2011				
F-statistic	3.329251		Prob. F(11,29)	0.0046
Log likelihood ratio	41.64719		Prob. Chi-Square(11)	0.0000
Wald Statistic	36.62176		Prob. Chi-Square(11)	0.0001

Appendix N°5: Estimating equation model I (1961-1986)

Dependent Variable: LNPIBH				
Method: Least Squares				
Date: 05/15/12 Time: 20:06				
Sample: 1961 1986				
Included observations: 26				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_INV_	-0.018404	0.051460	-0.357644	0.7256
LN__POP_	-0.102704	0.201436	-0.509860	0.6176
LNGER_1_	0.162269	0.586458	0.276693	0.7858
LNGER_2_	-0.204386	0.356643	-0.573081	0.5751
LNGER_3_	-0.013433	0.071618	-0.187567	0.8537
LN_LEAB_	2.183523	1.346002	1.622228	0.1256
LN_ RER_	0.002998	0.144178	0.020792	0.9837
LN_CDE_	0.226025	0.119723	1.887894	0.0785
LNAPGR	-0.065244	0.071511	-0.912359	0.3760
DUM	0.014760	0.015347	0.961785	0.3514
C	-0.612624	2.445501	-0.250511	0.8056
R-squared	0.988409	Meandependent var		3.001835
Adjusted R-squared	0.980681	S.D. dependent var		0.124409
S.E. of regression	0.017292	Akaike info criterion		-4.981060
Sum squaredresid	0.004485	Schwarz criterion		-4.448789
Log likelihood	75.75379	Hannan-Quinn criter.		-4.827786
F-statistic	127.9094	Durbin-Watson stat		1.876280
Prob(F-statistic)	0.000000			

Appendix N°6 : Estimating equation model I (1987-2011)

Dependent Variable: LNPIBH				
Method: Least Squares				
Date: 05/15/12 Time: 20:07				
Sample: 1987 2011				
Included observations: 25				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_INV_	0.029807	0.042293	0.704779	0.4925
LN__TOP_	0.045671	0.025927	1.761548	0.1000
LNGER_1_	-1.845416	0.284301	-6.491065	0.0000

LNGER_2_	**0.527733**	**0.166820**	**3.163487**	**0.0069**
LNGER_3_	**0.045912**	**0.045388**	**1.011537**	**0.3289**
LN_LEAB_	**-2.379304**	**0.708107**	**-3.360093**	**0.0047**
LN_RER_	**0.017675**	**0.097925**	**0.180494**	**0.8594**
LN_CDE_	0.488810	0.142655	3.426513	0.0041
LNAPGR	0.030932	0.030530	1.013164	0.3282
DUM	0.018901	0.007161	2.639493	0.0194
C	**10.16828**	**1.395107**	**7.288532**	**0.0000**
Adjusted R-squared	**0.991246**	**S.D. dependent var**		**0.106007**
S.E. of regression	**0.009918**	**Akaike info criterion**		**-6.088747**
Sum squaredresid	**0.001377**	**Schwarz criterion**		**-5.552441**
Log likelihood	**87.10933**	**Hannan-Quinn criter.**		**-5.939998**
F-statistic	**272.7751**	**Durbin-Watson stat**		**2.610414**
Prob(F-statistic)	**0.000000**			

Appendix N°7: Matrix of coefficients correlation between the variables

	LNGDPC	**LNINV**	**LNPOP**	**LNGER1**	**LNGER2**	**LNGER3**	**LNLEAB**	**LNRER**	**LNCDE**	**LNAPGR**
LNGDPC	**1.0000**	**0.1502**	**-0.4629**	**0.6786**	**0.9457**	**0.9757**	**0.9585**	**0.8710**	**0.9614**	**-0.5914**
LNINV	**0.1502**	**1.0000**	**-0.4933**	**0.1383**	**-0.0233**	**0.0842**	**0.1860**	**-0.0398**	**0.2621**	**0.4183**
LNPOP	**-0.4629**	**-0.4933**	**1.0000**	**-0.1853**	**-0.2431**	**-0.3635**	**-0.4458**	**-0.1624**	**-0.5338**	**-0.2050**
LNGER1	**0.6786**	**0.1383**	**-0.1853**	**1.0000**	**0.7549**	**0.6696**	**0.8316**	**0.8197**	**0.7731**	**-0.2977**
LNGER2	**0.9457**	**-0.0233**	**-0.2431**	**0.7549**	**1.0000**	**0.9524**	**0.9322**	**0.9680**	**0.8870**	**-0.7206**
LNGER3	**0.9757**	**0.0842**	**-0.3635**	**0.6696**	**0.9524**	**1.0000**	**0.9236**	**0.8782**	**0.9256**	**-0.6630**
LNLEAB	**0.9585**	**0.1860**	**-0.4458**	**0.8316**	**0.9322**	**0.9236**	**1.0000**	**0.8954**	**0.9766**	**-0.4982**
LNRER	**0.8710**	**-0.0398**	**-0.1624**	**0.8197**	**0.9680**	**0.8782**	**0.8954**	**1.0000**	**0.8392**	**-0.6764**
LNCDE	**0.9614**	**0.2621**	**-0.5338**	**0.7731**	**0.8870**	**0.9256**	**0.9766**	**0.8392**	**1.0000**	**-0.4261**
LNAPGR	**-0.5914**	**0.4183**	**-0.2050**	**-0.2977**	**-0.7206**	**-0.6630**	**-0.4982**	**-0.6764**	**-0.4261**	**1.0000**

Appendix N° 8: Summary results of the ADF test on the variables

Séries series	**Niveau de la différence Level difference**	**Type de modèle Type of model**	**Retards delays**	**Niveau de confiance Confidence level**	**T-statistiques ADF T-statistics ADF**	**Valeurs critiques critical values**	**Observations Observations**
LnGDPC	**0**	[1]	**1**	5%	**-0.684965**	**-2.922449**	**Nonstationary**
		[2]			**-1.817675**	**-3.504330**	
		[3]			**4.928293**	**-1.947665**	
	1	[1]	**1**	5%	**-5.101483**	**-2.923780**	**Stationary**
LnINV	**0**	[1]	**1**	5%	**-2.928988**	**-2.922449**	**Nonstationary**
		[2]			**-2.869447**	**-3.504330**	
		[3]			**-0.115634**	**-1.947665**	
	1	[1]	**1**	5%	**-3.958231**	**-2.923780**	**Stationary**
LnPOP	**0**	[1]	**1**	5%	**-1.874293**	**-2.922449**	**Nonstationary**
		[2]			**-2.071414**	**-3.504330**	
		[3]			**-1.027435**	**-1.947665**	
	1	[1]	**1**	5%	**-4.741310**	**-2.923780**	**Stationary**

LnGER(1)	**0**	**[1]**	**1**	**5%**	**-1.545281**	**-2.922449**	**Nonstationary**
		[2]			**-0.285807**	**-3.504330**	
		[3]			**0.242683**	**-1.947665**	
	1	**[1]**	**1**	**5%**	**-4.057021**	**-2.923780**	**Stationary**
LnGER(2)	**0**	**[1]**	**1**	**5%**	**0.264980**	**-2.922449**	**Nonstationary**
		[2]			**-2.351226**	**-3.504330**	
		[3]			**2.930585**	**-1.947665**	
	1	**[1]**	**1**	**5%**	**-3.385885**	**-2.923780**	**Stationary**
LnGER(3)	**0**	**[1]**		**5%**	**-0.939958**	**-2.922449**	**Nonstationary**
		[2]			**-2.198944**	**-3.504330**	
		[3]			**1.959101**	**-1.947665**	
	1	**[1]**	**1**	**5%**	**-4.396928**	**-2.923780**	**Stationary**
LnEVI	**0**	**[1]**	**1**	**5%**	**-2.959411**	**-2.92244**	**Nonstationary**
		[2]			**0.1447228**	**-3.504330**	
		[3]			**3.371459**	**-1.947665**	
	1	**[1]**	**1**	**5%**	**-3.214291**	**-2.923780**	**Stationary**
LnRER	**0**	**[1]**	**1**	**5%**	**-0.683643**	**-2.922449**	**Nonstationary**
		[2]			**-2.091307**	**-3.504330**	
		[3]			**-1.530626**	**-1.947665**	
	1	**[1]**	**1**	**5%**	**-4.206278**	**-2.923780**	**Stationary**
LnCDE	**0**	**[1]**	**1**	**5%**	**-3.803150**	**-2.922449**	**Nonstationary**
		[2]			**-2.567237**	**-3.504330**	
		[3]			**-0.249345**	**-1.947665**	
	1	**[1]**	**1**	**5%**	**-5.187731**	**-2.923780**	**Stationary**
LnAPGR	**0**	**[1]**	**1**	**5%**	**-0.989538**	**-2.922449**	**Nonstationary**
		[2]			**-2.330802**	**-3.504330**	
		[3]			**-0.900882**	**-1.947665**	
	1	**[1]**	**1**	**5%**	**-6.145527**	**-2.923780**	**Stationary**

NB: Modele [1] = modèle with constant and without trend ; Modèle [2]= modèle with constant and trend ; et Modèle [3] = modele without constant nor trend.

Appendix N° 9 : Results of cointegration tests for Model I

Date: 05/12/12 Time: 21:44					
Sample (adjusted): 1963 2011					
Included observations: 49 afteradjustments					
Trend assumption: No deterministic trend (restricted constant)					
Series: LGDPC LN_INV_ LN__POP_ LNGER_1_ LNGER_2_ LNGER_3_ LN_LEAB_ LN_RER_ LN_CDE_ LNAPGR					
Lags interval (in first differences): 1 to 1					
Unrestricted Cointegration Rank Test (Trace)					
Hypothesized		**Trace**	**0.01**		
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****	
None *	**0.873395**	**433.1569**	**265.5449**	**0.0000**	
Atmost 1 *	**0.799953**	**331.8894**	**221.4442**	**0.0000**	
Atmost 2 *	**0.728426**	**253.0385**	**181.5219**	**0.0000**	
Atmost 3 *	**0.679601**	**189.1660**	**145.3981**	**0.0000**	
Atmost 4 *	**0.659232**	**133.3948**	**113.4194**	**0.0001**	
Atmost 5	**0.403265**	**80.64372**	**85.33651**	**0.0255**	
Atmost 6	**0.321052**	**55.34593**	**61.26692**	**0.0383**	
Atmost 7	**0.294420**	**36.37260**	**41.19504**	**0.0371**	
Atmost 8	**0.240973**	**19.28461**	**25.07811**	**0.0677**	
Atmost 9	**0.111167**	**5.774447**	**12.76076**	**0.2089**	
Trace test indicates 5 cointegratingeqn(s) at the 0.01 level					
*** denotes rejection of the hypothesis at the 0.01 level**					
****MacKinnon-Haug-Michelis (1999) p-values**					
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)					
Hypothesized		**Max-Eigen**	**0.01**		
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****	

None *	**0.873395**	**101.2675**	**72.09392**	**0.0000**	
Atmost 1 *	**0.799953**	**78.85091**	**65.78362**	**0.0002**	
Atmost 2 *	**0.728426**	**63.87256**	**59.50898**	**0.0029**	
Atmost 3 *	**0.679601**	**55.77118**	**53.12290**	**0.0047**	
Atmost 4 *	**0.659232**	**52.75106**	**46.74582**	**0.0016**	
Atmost 5	**0.403265**	**25.29780**	**40.29526**	**0.4264**	
Atmost 6	**0.321052**	**18.97333**	**33.73292**	**0.4940**	
Atmost 7	**0.294420**	**17.08799**	**27.06783**	**0.2278**	
Atmost 8	**0.240973**	**13.51016**	**20.16121**	**0.1142**	
Atmost 9	**0.111167**	**5.774447**	**12.76076**	**0.2089**	
Max-eigenvalue test indicates 5 cointegratingeqn(s) at the 0.01 level					
*** denotes rejection of the hypothesis at the 0.01 level**					
****MacKinnon-Haug-Michelis (1999) p-values**					

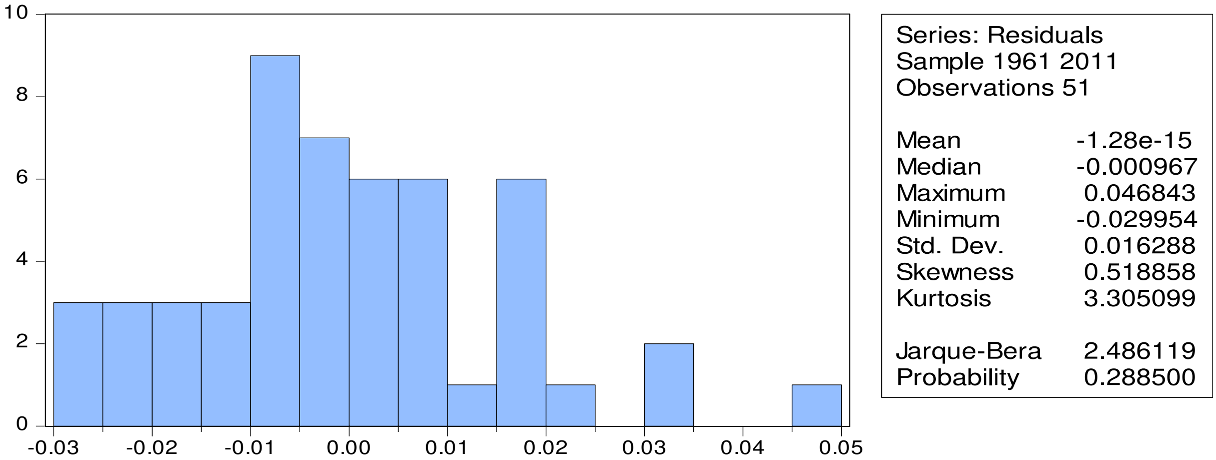
1 Cointegrating Equation(s): Log likelihood 1221.216
Normalized cointegrating coefficients (standard error in parentheses)

LNGDPC	LNINV	LNPOP	LNGER1	LNGER2	LNGER3	LNLEAB	LN_RER	LNCDE	LNAPGR	C
1.00000	0.37365	0.61533	2.51270	-0.52072	0.03381	-0.80957	0.22506	-0.37568	0.104622	-8.31497
	(0.0380)	(0.0643)	(0.3729)	(0.1579)	(0.0483)	(0.4912)	(0.1117)	(0.12427	(0.06388)	(0.77609)

Appendix N°10: Results of the estimation of the model I (long term)

Dependent Variable: LNGDPC				
Method: Least Squares				
Date: 05/07/12 Time: 19:51				
Sample: 1961 2011				
Included observations: 51				
Variable	**Coefficien t**	**Std. Error**	**t-Statistic**	**Prob.**
LN_INV_	**0.017438**	**0.024152**	**0.722029**	**0.4745**
LN__POP_	**-0.037540**	**0.037352**	**-1.005030**	**0.3209**
LNGER_1_	**-1.211461**	**0.239436**	**-5.059649**	**0.0000**
LNGER_2_	**0.349750**	**0.110791**	**3.156831**	**0.0030**
LNGER_3_	**0.073600**	**0.032274**	**2.280476**	**0.0280**
LN_LEAB_	**0.758025**	**0.380351**	**1.992964**	**0.0531**
LN_RER_	**-0.090200**	**0.085446**	**-1.055627**	**0.2975**
LN_CDE_	**0.297431**	**0.091200**	**3.261312**	**0.0023**
LNAPGR	**0.019760**	**0.039588**	**0.499153**	**0.6204**
DUM	**0.004557**	**0.007764**	**0.586906**	**0.5606**
C	**3.564430**	**0.546937**	**6.517077**	**0.0000**
R-squared	**0.992533**	**Meandependent var**		**3.147143**
Adjusted R-squared	**0.990666**	**S.D. dependent var**		**0.188496**
S.E. of regression	**0.018211**	**Akaike info criterion**		**- 4.985189**
Sum squaredresid	**0.013265**	**Schwarz criterion**		**- 4.568520**
Log likelihood	**138.1223**	**Hannan-Quinn criter.**		**- 4.825967**
F-statistic	**531.7013**	**Durbin-Watson stat**		**1.328689**
Prob(F-statistic)	**0.000000**			

Appendix N°10-1 : Result of normality test model I long run



Appendix N°10-2 : Result of the Breusch-Goldfrey model I long term

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.295510	Prob. F(10,40)	0.2659
Obs*R-squared	12.47680	Prob. Chi-Square(10)	0.2544
Scaledexplained SS	8.845907	Prob. Chi-Square(10)	0.5468

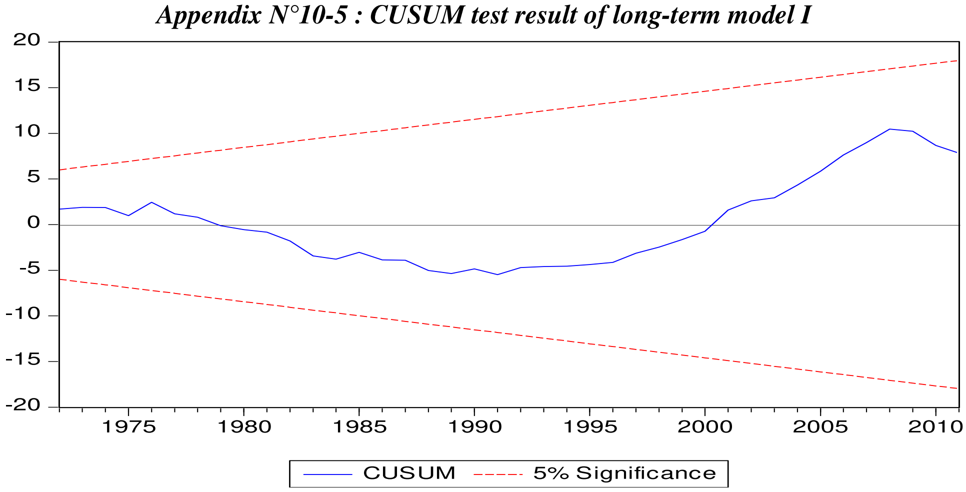
Appendix N°10-3 : White test result of long-term model I

Heteroskedasticity Test: White			
F-statistic	1.611655	Prob. F(10,40)	0.1385
Obs*R-squared	14.64709	Prob. Chi-Square(10)	0.1455
Scaledexplained SS	10.38462	Prob. Chi-Square(10)	0.4074

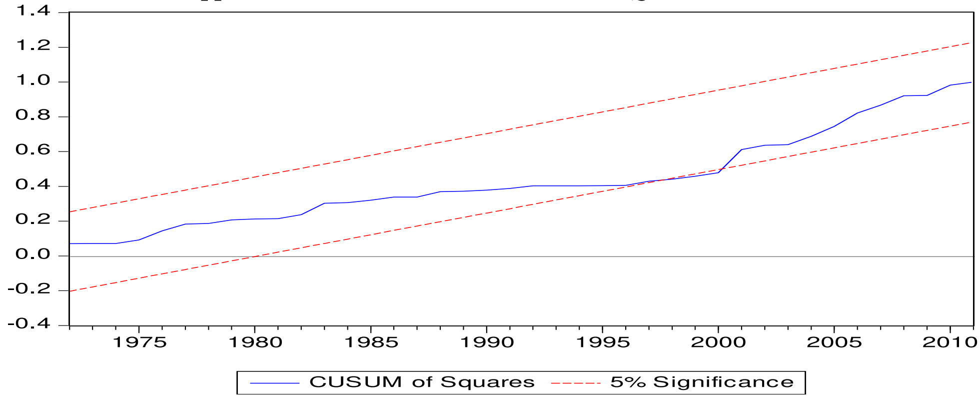
Appendix N°10-4 : Test result Ramsey model I long term

Ramsey RESET Test				
Omitted Variables: Powers of fitted values from 2 to 3				
	Value	df	Probability	
F-statistic	2.583662	(2, 38)	0.0887	
Likelihood ratio	6.502382	2	0.0387	

Appendix N°10-5 : CUSUM test result of long-term model I



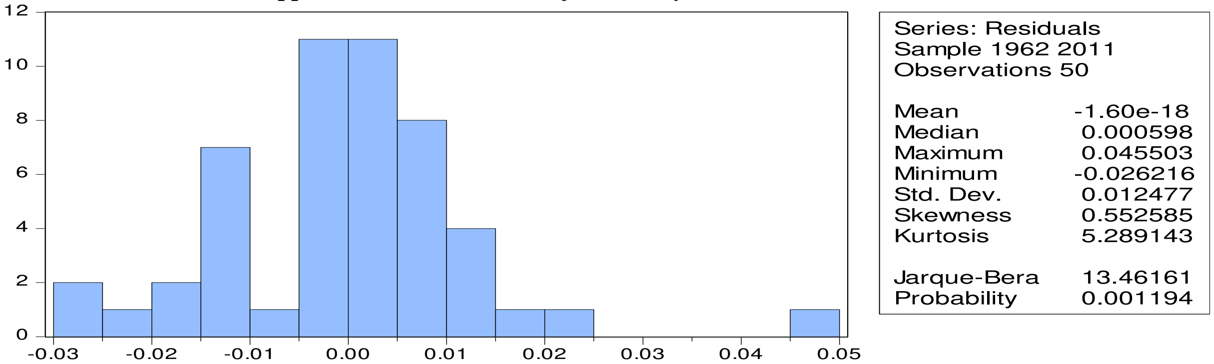
Appendix N°10-6: Test result CUSUM SQ model I term



Appendix N°11: Result of the estimation of the model I (short-term)

Dependent Variable: DLGDPC				
Method: Least Squares				
Date: 05/07/12 Time: 19:46				
Sample (adjusted): 1962 2011				
Included observations: 50 afteradjustments				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
DLN_INV_	**0.007878**	**0.025524**	**0.308651**	**0.7592**
DLN__POP_	**-0.021086**	**0.030987**	**-0.680480**	**0.5002**
DLNGER_1_	**0.358079**	**0.306510**	**1.168247**	**0.2498**
DLNGER_2_	**-0.335043**	**0.163616**	**-2.047741**	**0.0474**
DLNGER_3_	**-0.000139**	**0.035940**	**-0.003856**	**0.9969**
DLN_LEAB_	**-0.775399**	**0.624824**	**-1.240988**	**0.2220**
DLN_RER_	**-0.003977**	**0.066162**	**-0.060114**	**0.9524**
DLN_CDE_	**0.093791**	**0.067742**	**1.384531**	**0.1741**
DLNAPGR	**0.005057**	**0.024450**	**0.206846**	**0.8372**
DUM	**-0.000347**	**0.005639**	**-0.061568**	**0.9512**
C	**0.019579**	**0.004441**	**4.408697**	**0.0001**
R-squared	**0.210381**	**Meandependent var**		**0.013652**
Adjusted R-squared	**0.007915**	**S.D. dependent var**		**0.014041**
S.E. of regression	**0.013986**	**Akaike info criterion**		**-5.510026**
Sum squaredresid	**0.007628**	**Schwarz criterion**		**-5.089381**
Log likelihood	**148.7506**	**Hannan-Quinn criter.**		**-5.349842**
F-statistic	**1.039094**	**Durbin-Watson stat**		**2.240463**
Prob(F-statistic)	**0.430357**			

Appendix N°11-1 : Result of normality test model I short-term



Appendix N°11-2 : Result of the Breusch-Goldfrey Model I short-term

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.754452	Prob. F(10,39)	0.6700
Obs*R-squared	8.104626	Prob. Chi-Square(10)	0.6186
Scaledexplained SS	10.57457	Prob. Chi-Square(10)	0.3916

Appendix N°11-3 : White test result of short-term model I

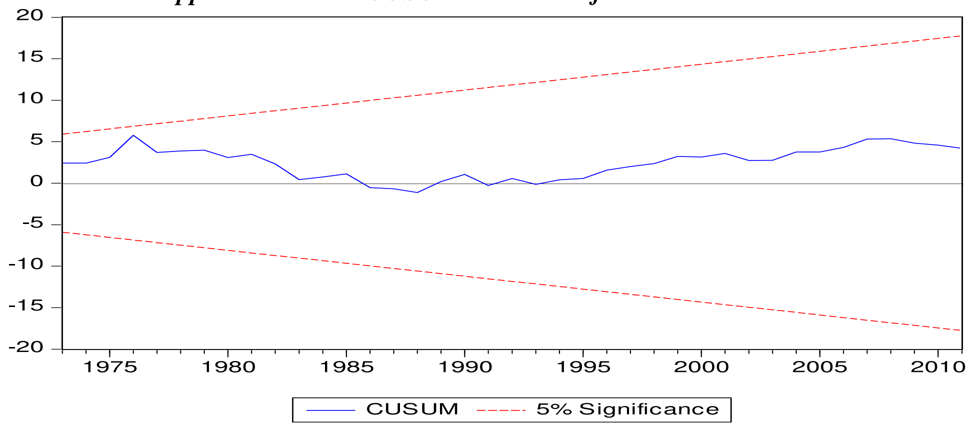
Heteroskedasticity Test: White

F-statistic	0.668157	Prob. F(10,39)	0.7463
Obs*R-squared	7.313202	Prob. Chi-Square(10)	0.6956
Scaledexplained SS	9.541953	Prob. Chi-Square(10)	0.4816

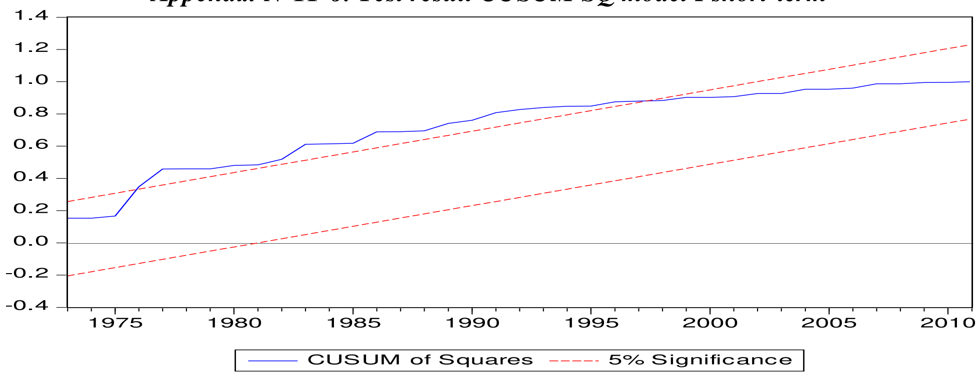
Appendix N°11-4 : Test result Ramsey Model I short-term

Ramsey RESET Test				
Equation: UNTITLED				
Omitted Variables: Powers of fitted values from 2 to 3				
	Value	df	Probabilit y	
F-statistic	1.238325	(2, 37)	0.3016	
Likelihood ratio	3.239572	2	0.1979	

Appendix N°11-5: CUSUM test result of short-term model I



Appendix N°11-6: Test result CUSUM SQ model I short-term



Appendix N°12: Result of model II (Long term)

Dependent Variable: LNGDPC		
Method: Least Squares		
Date: 05/08/12 Time: 09:05		
Sample: 1961 2011		
Included observations: 51		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGER_3_	0.372886	0.011582	32.19395	0.0000
LN_INV_	0.089275	0.039269	2.273460	0.0275
C	2.568104	0.125470	20.46792	0.0000
R-squared	0.956737	Meandependent var		3.147143
Adjusted R-squared	0.954934	S.D. dependent var		0.188496
S.E. of regression	0.040015	Akaike info criterion		-3.542087
Sum squaredresid	0.076859	Schwarz criterion		-3.428450
Log likelihood	93.32322	Hannan-Quinn criter.		-3.498663
F-statistic	530.7453	Durbin-Watson stat		0.450398
Prob(F-statistic)	0.000000			

Appendix N°13: Result of model II (Short term)

Dependent Variable: DLNGDPC				
Method: Least Squares				
Date: 05/08/12 Time: 09:08				
Sample (adjusted): 1962 2011				
Included observations: 50 afteradjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLNGER_3_	0.002216	0.033904	0.065375	0.9482
DLN_INV_	0.013826	0.024592	0.562223	0.5766
C	0.013527	0.002319	5.832274	0.0000
R-squared	0.006682	Meandependent var		0.013652
Adjusted R-squared	-0.035587	S.D. dependent var		0.014041
S.E. of regression	0.014289	Akaike info criterion		-5.600525
Sum squaredresid	0.009596	Schwarz criterion		-5.485803
Log likelihood	143.0131	Hannan-Quinn criter.		-5.556838
F-statistic	0.158075	Durbin-Watson stat		2.164068
Prob(F-statistic)	0.854238			

Appendix N°14: Test result Johansen cointegration model II

Date: 05/14/12 Time: 19:16				
Sample (adjusted): 1963 2011				
Included observations: 49 afteradjustments				
Trend assumption: No deterministic trend (restricted constant)				
Series: LNGDPC LN_INV_ LNGER_3_				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.01	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.575940	57.16303	41.19504	0.0001
Atmost 1	0.161671	15.12694	25.07811	0.2192
Atmost 2	0.123982	6.486038	12.76076	0.1564
Trace test indicates 1 cointegratingeqn(s) at the 0.01 level				
* denotes rejection of the hypothesis at the 0.01 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.01	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.575940	42.03609	27.06783	0.0000
Atmost 1	0.161671	8.640905	20.16121	0.4732
Atmost 2	0.123982	6.486038	12.76076	0.1564

Max-eigenvalue test indicates 1 cointegratingeqn(s) at the 0.01 level	
* denotes rejection of the hypothesis at the 0.01 level	
**MacKinnon-Haug-Michelis (1999) p-values	

1 Cointegrating Equation(s):		Log likelihood	275.6731	
Normalized cointegrating coefficients (standard error in parentheses)				
LNPIBH	LN_INV_	LNTBS_3_	C	
1.000000	0.094550	-0.376476	-3.260202	
	(0.07515)	(0.02088)	(0.24292)	

Appendix N°15: Result of the estimation of the model II error correction

VectorError Correction Estimates			
Date: 05/14/12 Time: 19:17			
Sample (adjusted): 1964 2011			
Included observations: 48 after adjustments			
Standard errors in ( ) & t-statistics in [ ]			
CointegratingEq:	CointEq1		
LNPIBH(-1)	1.000000		
LN_INV_(-1)	0.193670		
	(0.08444)		
	[2.29350]		
LNTBS_3_(-1)	-0.389396		
	(0.02142)		
	[-18.1808]		
C	-3.463187		

Error Correction:	D(LNPIBH)	D(LN_INV_)	D(LNTBS_3_)
CointEq1	-0.175932	-0.207772	0.090140
	(0.04148)	(0.27905)	(0.21357)
	[-4.24119]	[-0.74456]	[0.42206]

Appendix N°16: Result of Granger causality test for model II

Pairwise Granger Causality Tests			
Date: 05/14/12 Time: 16:26			
Sample: 1961 2011			
Lags: 2			
NullHypothesis:	Obs	F-Statistic	Prob.
LN_INV_ does not Granger Cause LNGDC	49	4.07183	0.0239
LNGDPC does not Granger Cause LN_INV_		1.36817	0.2652
LNGER_3_ does not Granger Cause LNGDP	49	6.97841	0.0023
LNGDPC does not Granger Cause LNGER_3_		1.07674	0.3495
LNGER_3_ does not Granger Cause LN_INV_	49	0.75686	0.4751
LN_INV_ does not Granger Cause LNGER_3_		1.32247	0.2769