International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2019, 9(5), 140-146.

Innovation and Economic Development: Case of Tunisia

Kaies Samet[1], Abdelkarim Yahyaoui[2]*, Ahlem Saidi[3], Majid Ibrahim Al Saggaf[2]

[1]Department of Economics, High Institute of Industrial Management of Sfax, Tunisia, [2]Department of Finance and Insurance, College of Business, University of Jeddah, Saudi Arabia, [3]Department of Economics, Central University, Tunisia. *Email: yahyaoui.abdelkarim@yahoo.fr

Received: 22 July 2019 **Accepted:** 02 September 2019 **DOI:** https://doi.org/10.32479/ijefi.8444

ABSTRACT

This paper empirically inspects the link between innovation and economic development in Tunisia, both in a direct and indirect contribution of the research and development to the total factor productivity growth and therefore to the economic growth. At this level, we will carry out an empirical inquiry through using an endogenous growth model, covering the period 1970-2008. The results of estimation prove that contrarily to a developed country, Tunisia was not able to benefit from its own R&D capital stock in one part, neither from the R&D conducted in developed countries through international trade and foreign direct investment in another part, which do not seem to be a technology transfer vector in our country. This can be explained essentially by the weakness of the national absorptive capacities, which is itself ought to the inefficiency of the Tunisian educational systems. A significant investment in R&D combined with some brain gain could be adequate solutions for our country in terms of technology.

Keywords: R&D, Innovation, Productivity, Economic Development, Economic Openness, Foreign Direct Investment, Absorptive Capacity
JEL Classifications: C1, F0, O1, O3, O4

1. INTRODUCTION

The concept of "development" comes from the Greek word "Phusis," a concept commonly used by Homère. To get an idea on the criterion of "development," it is imperative to participate in the life of the country in order to challenge the uncontrolled development in a world where individualism and ostentatious consumption thrive; they are often described by Veblen (1979) as situations that have been forged in the race for development, leading to pollution that suffocates people, destroys nature and deteriorates the quality of life. Development occurs at very heterogeneous levels. It is indeed impossible to compare the consumption of a European or an American to that of an African. It would be synonymous with irony and unreality in a totally unbalanced world, especially when we know that three billion people live on less than $2 a day (Mazoyer and Roudart, 2005); apart from the problem of water, which is becoming increasingly important in all poor countries, and the urgent solution of which involves global collaboration to provide it to human beings, even if it is just clean consumable water which is safe for drinking and washing. Desalination of seawater is very expensive; and where there is a lack of financial means, the problem worsens and grows so that both men and the economy suffer from this lack. Indeed, in the current development process, the quality of air and water is exhausted with droughts and permits to pollute. It feels like living in a powder keg, as is the case for example in the city of Sfax, in Tunisia.

The development of knowledge and even disturbing ideas is desirable. At the end of the eighteenth century, to reduce population growth, Malthus proposed to develop education which creates in the educated man a certain maturity and awareness regarding a growing but miserable population. However, economists' attention is usually focused on economic development rather than the environment and the quality of life. If we do not tolerate Western domination, we must understand that this is a historical process imposed by the countries of the old continent for four centuries (from the early sixteenth century until the end of the nineteenth century), in which they applied the chrysohedonic principle and the antagonism of national interests. During this time, the colonized countries got only crumbs. Over the years, the gap in economic development has been steadily growing through education and technological innovation. The human capital accumulation in rich countries witnesses, indeed, an exponential growth compared to that of poor countries: the rich countries are the creators of technological inventions, new theories in all scientific and technical fields, new know-how,…; on the other hand, developing countries (DCs) are simply imitators in all areas, and still, they don't even know how to do it correctly. The situation is further complicated by the absence of effective institutions capable of guaranteeing every citizen a job, some freedom of expression, a healthy environment. As a matter of fact, the latter do not exist in 2/3 of the countries of the planet, as Sen says. The author argues that development inequalities between nations cannot be reduced to differences in macroeconomic aggregates (gross domestic product and per capita income), but are rather due to an average level of economic and social phenomena in a given country (Sen, 1981).

In this article, we will then study empirically the relationship between innovation and economic development, focusing on the case of Tunisia as a developing country during the period 1970 through 2008. At this level, the main idea is the following: taking into account the inequalities of economic development and their causes, Tunisia has relied on imitation to hope to take advantage of the research and development (R&D) externalities of developed countries. In this context, in recent decades, Tunisia has benefited from the R&D spillovers in the North; but international trade, intra-industry trade and foreign direct investment (FDI) do not seem to be a technological diffusion vector. This is mainly due to the weak national absorptive capacity, particularly in the manufacturing sector, itself explained by the inefficiency of the Tunisian educational systems (Samet and Chaabane, 2010). Indeed, the manufacturing sector is the sector through which most technology transfer takes place, but it is also important to test other scenarios, including taking into account all the sectors of the economy to better determine the international technology diffusion channel for Tunisia, in comparison with the previous results. In addition, and in parallel with the indirect contribution of R&D to the national total factor productivity (TFP) growth and thus to economic growth, we are curious to analyze, in recent decades, the direct contribution of innovation to Tunisia's economic development, obviously by relying on domestic R&D. As a result, although the latter is clearly small compared to that of the developed countries, its contribution to the national economy remains a subject which is worth studying. Thus, the main idea is an attempt to apply the endogenous growth theory to the case of Tunisia, a theory stating that a developed country can improve its TFP and therefore the overall efficiency of its economy both by benefiting from the R&D spillovers that it undertakes and by benefiting from the R&D spillovers conducted in another developed country, as part of the North-North R&D international externalities.

2. LITERATURE REVIEW

The main studies on the impact of technological innovation on development in the 1970s relied on individual data for a set or a group of countries. These studies were based on total or partial correlation coefficients between development and the openness rate (OR), which was approximated by the ratio of the sum of imports to gross domestic product (GDP). At this level, Edwards (1998) concluded that there is a restrictive link between openness and development. More recently, new studies have emerged to address the impact of external openness on development. These studies are based on the channels through which openness has affected development, namely the physical capital formation through FDI, skills-based human capital formation, and knowledge formation measured by imported technology.

As for developed countries, the relationship between innovation and economic development has been verified by Coe and Moghadam (1993), who have shown that exchanges and capital in the broad sense have been responsible for the French economic growth over the last 20 years. In addition, Coe and Helpman (1995) worked on a sample of 22 industrialized countries. They found that the TFP of an industrialized country depends not only on its own R&D capital stock, but also on that of its trading partners. They thus verified that the existence of a positive link between foreign R&D and the TFP of an industrialized country depends on its degree of openness. In addition, Brecher et al. (1996) have shown the link between R&D externalities and the TFP growth of sectors in Canada and the United States. So, the question that arises at this level is: What about the case of emerging and more particularly DCs?

First of all, and with regard to the direct contribution of R&D to economic growth, Fagerberg et al. (2010) concluded that innovation is important for DCs, and that in order for them to exploit their own technology, they need to develop their absorption capacities. In addition, Gumus and Celikay (2015) have shown that R&D expenditure has a positive and significant effect on economic growth for all countries in the long run. For DCs, the effect is small in the short term, but it is strong in the long run. In addition, Pece et al. (2015) used, for CEE countries, multiple regression models based on variables such as number of patents, number of trademarks and R&D expenditure. The authors have found a positive relationship between innovation and economic growth. Later, in 2017, by adopting a multidimensional approach, Casadella and Uzunidis concluded on the importance of national innovation systems in the economic development of DCs. In the same year and according to a World Bank Report, low innovation is a critical barrier to growth in a developing country.

On the other hand, and concerning the indirect contribution of R&D to economic growth, the results obtained by Fan and Hossain in 2018, over the period 1974-2016, revealed that technological innovation, openness to trade, and CO_2 emissions have a significant positive impact on economic growth in the long run for India and China. Also, Erdal and Göçer (2015), using the panel causality and cointegration methods in 10 DCs in Asia over the period 1996-2013, showed that FDI inflows would increase the R&D and innovation activities of these countries. Finally, Asuantri and Bani (2017) used panel data over the period 1997-2014 for a sample of 39 DCs while applying the system-GMM estimator. Both authors concluded that FDI inflows induce technological innovation in a country with an adequate level of absorptive capacity. The results also imply that FDI inflows and absorptive capacity are needed to increase technological innovation in host DCs.

As Tunisia is a developing country, what about the case of our country?

3. RESEARCH METHODOLOGY

3.1. Model Specification

Our database was obtained from the Tunisian National Institute of Statistics (TNIS). It covers the period 1970 through 2008, based on monthly observations. The variables are R&D (RD) approximated by the Tunisian State's expenditures on scientific research (materializing innovation), the OR as the ratio of imports to real GDP and FDI (both materializing the imitation), human capital measured by secondary school enrollment (SSE), and TFP as an endogenous variable. This last variable will be determined by a Cobb-Douglas type function in the following form:

$$RGDP_t = TFP_t\left(K\right)_t^{\beta}\left(L\right)_t^{1-\beta}$$

Where:

$$\begin{cases} K = \text{Gross fixed capital formation}\left(\text{GFCF}\right); \\ L = \text{Labor factor measured by the work force}; \\ \beta = \text{Elasticity of real gross domestic production} \\ \text{relative to the capital factor.} \end{cases}$$

The reference model, which describes the impact of technological innovation on development, is an extension of the earlier works of Levin and Raut (1992), Edwards (1992) and Coe et al. (1997). It is represented by the following nonlinear function:

$$\exp\left(TFP_t\right) = A\left(RD\right)_t^{\delta}\left(SSE\right)_t^{\gamma}\exp\left(OR\right)_t^{f}\left(FDI\right)_t^{\phi}\exp\left(\varepsilon_t\right)$$

3.2. Econometric Methodology

Before using the Johansen and Juselius multivariate approach (1990), it proves necessary to linearize our reference model while integrating the log-log specification, knowing that log A designates the average effect of the omitted variables, that is, the average of the effects, positive or negative, of the non-explanatory variables, and that ε_t corresponds to the hidden or omitted variables.

3.2.1. The Johansen and Juselius multivariate approach (1990)

In order to detect the link between innovation and economic development in Tunisia, we will use statistical and econometric tools. These tools are based on the cointegration technique, and especially on the Johansen and Juselius multivariate approach (1990). This technique will be used to show the existence of a relationship between economic growth and openness in our country.

In this context, we will use the Perron test (1997) to check for the absence or presence of a unit root with trends cut-offs under the null hypothesis and its alternative for each variable of our basic model. For this test, the trends change dates are set endogenously. The results of this test are shown in Table 1.

Table 1: Perron test (1997)

Model with change of constant and slope[1]				
Variables	**T-statistics**	**Break dates**	**Critical values (%)**	**Number of lags**
TFP	−4.06837	2000	−5.59 (5)	1
LFDI	−6.14269	1987	−6.32 (1)	2
LSSE	−3.47641	1998	−5.59 (5)	2
OR	−6.12835	1996	−6.32 (1)	3

Despite the trend cut-off for each component of TFP, all variables in our basic model contain unit roots and the filtering effect remains necessary to stabilize these variables. Hence, the latter are integrated of order 1.

The Johansen and Juselius multivariate approach (1990) is based on the determination of the optimal number of vector autoregressive (VAR) lags. This optimal number is shown in Table 2.

From this table, we can see that the optimal number of lags is equal to 4, while referring to the two-information criteria AIC and SC, and that the likelihood ratio test gives an optimal number of lags equal to 1[2].

The reparameterization technique of the VAR process gives us the vector error correction model (VECM). To better specify this VECM, we will use the likelihood ratio test. This test makes it possible to detect the presence or absence of linear (or quadratic) trend in cointegration relationships and in short-term adjustments. The null hypothesis of this test and its alternative are presented as follows:

$$\begin{cases} H_0: \text{Absence of linear trend in cointegration} \\ \text{relationships and short - term adjustments} \\ H_1: \text{Presence of linear trend in cointegration} \\ \text{relationships and short - term adjustments} \end{cases}$$

The likelihood ratio statistic under the null hypothesis is defined as follows:

$$\chi^2 = -T\sum_{i=r+1}^{5}\log\left(\frac{1-\lambda_i}{1-\lambda_i''}\right) \sim (5-r)$$

$$\text{Where: } \begin{cases} 5 = \text{Number of variables} \\ r = \text{Number of cointegrating vectors} \end{cases}$$

The likelihood ratio statistic is defined under the null hypothesis by a Chi-square at (5–r) degrees of freedom. If the realization of this statistic exceeds the Chi-square critical value, we will accept the existence of a linear trend in cointegration relationships or in short-term adjustments. To better identify this linear trend, we will test in a first step the absence of linear trend in cointegration relationships under the null hypothesis against the presence of this one under the alternative hypothesis. The two hypotheses then appear as follows:

1 The test was written in RATS language; source: Estima.

2 The likelihood ratio test determines the optimal number of lags for autoregressive vector processes. This test follows a chi-square distribution with k degrees of freedom.

$$\begin{cases} H_0^1: \text{Absence of linear trend in the cointegration relationships} \\ H_0^1: \text{Presence of linear trend in the cointegration relationships} \end{cases}$$

We can also distinguish the existence of a constant or a linear or quadratic trend in the cointegration relationship:

$$\begin{cases} H_0^{11}: \text{Absence of constant in the cointegration relationships} \\ H_1^{11}: \text{Presence of constant in the cointegration relationships} \end{cases}$$

$$Þ\begin{cases} H_0^{12}: \text{Absence of trend in the cointegration relationships} \\ H_1^{12}: \text{Presence of trend in the cointegration relationships} \end{cases}$$

In a first step, we will test the existence of a constant if the likelihood ratio statistic is greater than the critical value at (5–r) degrees of freedom. In a second step, we will proceed to check for the existence or absence of a linear (or quadratic) trend. We will also use the following hypotheses in the specification of the short-term dynamics:

$$\begin{cases} H_0^{21}: \text{Absence of constant in the short-term adjustments} \\ H_1^{21}: \text{Presence of constant in the short-term adjustments} \end{cases}$$

$$Þ\begin{cases} H_0^{22}: \text{Absence of trend in the short-term adjustments} \\ H_1^{22}: \text{Presence of trend in the short-term adjustments} \end{cases}$$

The VECM specification test for TFP is presented in Table 3.

Referring to this table, we can conclude the presence of constant and the absence of linear trend at the level of the long-term relationships. But in the short-term dynamics, the constants are identified, and the trends are absent.

To determine the number of cointegration relationships, Johansen (1988) proposed two statistical tests, which are likelihood ratio tests, namely trace and maximum eigenvalue tests. The first test makes it possible to test the existence of more than r cointegrating vectors, while the second tests the hypothesis of the presence of (r+1) cointegrating vectors. The determination of the number of cointegrating vectors by the trace and maximum eigenvalue tests is shown in Table 4.

Variables	TFP	LSSE	LRD	OR	LFDI
Cointegrating vector normalized by Lm1r	1	−0.053	0.00789	−0.0600	0.00284

The likelihood ratio and the trace and maximum eigenvalue tests

Statistic state the existence of a single cointegrating vector for TFP.

3.2.2. Weak exogeneity test

The weak exogeneity test of Hendry (1995) consists in questioning the fact that certain variables of our model can be regarded as weakly exogenous for the parameters of these cointegration relationships found previously. If this is the case, these parameters can be estimated without loss of information from the conditional model, which is more readily manageable since it is extracted from the full VECM. This hypothesis of weak exogeneity is expressed by the nullity of a certain number of coefficients of the matrix of the long-term adjustment speeds (α). The null hypothesis of weak exogeneity and its alternative will be as follows:

$$\begin{cases} H_0: \alpha_{5r} = 0 \\ H_1: \alpha_{5r} \neq 0 \end{cases}$$

Under the null hypothesis, the weak exogeneity test follows a chi-square with r degrees of freedom. In the case where the realization of the likelihood ratio statistic is greater than the chi-square critical value, we assert that the variable of interest is non-weakly exogenous, that is to say that this variable undergoes an error correction phenomenon.

Table 5 summarizes the exogeneity test for all TFP variables.

The results can be summarized as follows: At the 5% threshold, we reject the weak exogeneity of TFP. Otherwise, the joint hypothesis

Table 2: Optimal number of vector autoregressive lags

	X_{1t} = (TFP_t, $LSSE_t$, LRD_t, OR_t, $LFDI_t$)			
Lags	**1**	**2**	**3**	**4**
AIC	−26.8440	−27.1536	−27.3544	−30.5484*
Schwartz	−25.4972	−24.6344	−23.6178	−25.5526*
LR	37.1689 (0.1173)	34.5979 (0.0957)	30.0949 (0.2208)	113.1026 (0.0000)

The number in parentheses indicates the marginal asymptotic level, that is, the probability that the value of the calculated statistic exceeds the tabulated value. Thus, a marginal asymptotic level of 99.7% or 89.78% means that for a threshold α<99.7% and 89.78%, the hypothesis H_0, of a single lag, is accepted

Table 3: Specification of the vector error correction model

Specifications	Specifications of cointegration relationships		Specifications of short-term adjustments	
	Absence or presence of a constant	Absence or presence of a linear trend	Absence or presence of a constant	Absence or presence of a linear trend
LR	1,61602	1,44634	−21,26484	2,41324

For all specifications we have χ^2 (5−1)=9,49 of weak exogeneity for the other variables is widely accepted at the 5% threshold. We choose to estimate the cointegration relationship that describes TFP within a VECM composed of five variables (TFP_t, $LSSE_t$, LRD_t, OR_t and $LFDI_t$), four of which are weakly exogenous ($LSSE_t$, LRD_t, OR_t and $LFDI_t$). It is therefore not necessary to explicitly model these long-term variables, although they may influence TFP.

3.2.3. Exclusion test

The exclusion test of long-term variables indicates whether a single group of variables, not all the variables, is needed in the cointegration space. The exclusion test statistic of long-term variables follows the distribution $\chi^2(r)$. Unlike the exogeneity test, the null hypothesis and its alternative are applied to the cointegrating vector:

$$\begin{cases} H_0 : \beta_{r5} = 0 \\ H_1 : \beta_{r5} \neq 0 \end{cases}$$

As for the weak exogeneity test, when the realization of the likelihood ratio exceeds the tabulated chi-square value at r degrees of freedom, we maintain that the variable of interest belongs to the cointegrating space. Table 6 traces the exclusion test for the Tunisian TFP.

The results showed that all variables, except FDI, are included in the cointegration space. So, these variables are very important in the long-term equilibrium. TFP is not weakly exogenous and belongs to the cointegration space. For this, the long-term relationship, estimated by the maximum likelihood technique, converges partially towards a stable long-term situation. Then, it is interesting to ask whether there are no variables in the cointegrating space that are in themselves a cointegration relationship. To do this, Table 7 presents the results of the stationarity test of the various variables of the system around a fixed deterministic trend.

The results of this test are categorical, since we reject each time the stationarity hypothesis around the constant for these five variables belonging to the cointegrating space of the TFP.

4. RESULTS AND DISCUSSION

The last Table 8, which summarizes the cointegrating vectors and the adjustment speeds of the long-term relationship, describes the TFP as a function of the explanatory variables.

The imbalance of the TFP is corrected of 18.1507% by market mechanisms. All the coefficients associated with the explanatory variables are non-statistically significant (no effect on the TFP), with the exception of the one associated with the secondary school enrollment (LSSE). First of all, these results show that Tunisia could not benefit from its own R&D. This is due to Tunisia's low investment in R&D, as a developing country, compared to developed countries. Moreover, Tunisia is sorely lacking in innovation. Then, and in parallel with the lack of a direct contribution of R&D to the national TFP growth, our country was able to benefit from foreign R&D, but not through openness (imports) and FDI, which do not seem to be a technological diffusion vector. At this level, the main explanatory factor for this result remains the weakness of national absorptive capacities, explained by the inefficiency of the Tunisian educational systems, justified in turn by a partial withdrawal of the State from the educational system (especially on the financial level).There are

Table 4: Tests of the number of cointegrating vectors

$X_{1t} = (TFP_t, LSSE_t, LRD_t, OR_t, LFDI_t)$								
Specifications	**Test λ_{trace}**				**Test λ_{max}**			
Null hypothesis	r=0	r≤1	r≤2	r≤3	r=0	r=1	r=2	r=3
Alternative hypothesis	r≥1	r≥2	r≥3	r=4	r=1	r=2	r=3	r=4
Statistical value	69.68912	33.7006	14.20759	6.852304	35.98853	19.49300	7.355288	6.713073
Critical value at 5%	68.52	47.21	29.68	15.41	33.46	27.07	20.97	14.07

Table 5: Weak exogeneity test or long-term granger causality test (1988)

$X_{1t} = (TFP_t, LSSE_t, LRD_t, OR_t, LFDI_t)$					
Variables	**TFP_t**	**$LSSE_t$**	**LRD_t**	**OR_t**	**$LFDI_t$**
χ^{2C} (1)	5.235473	0.251363	4.960470	2.443875	0.700235
Significance	0.022131	0.616117	0.025933	0.117984	0.402705

Table 6: Exclusion test

$X_{1t} = (TFP_t, LSSE_t, LRD_t, OR_t, LFDI_t)$					
Variables	**TFP_t**	**$LSSE_t$**	**LRD_t**	**OR_t**	**$LFDI_t$**
χ^{2c} (1)	4.285639	7.131032	6.057688	6.458087	0.946710
Significances	0.038436	0.007576	0.013846	0.011045	0.330558

Table 7: Stationarity test around the constant

$X_{1t} = (TFP_t, LSSE_t, LRD_t, OR_t, LFDI_t)$					
Variables	**TFP_t**	**$LSSE_t$**	**LRD_t**	**OR_t**	**$LFDI_t$**
χ^{2c} (4)	27.88418	28.35155	27.25611	24.37065	28.07346
Significances	0.000013	0.000011	0.000018	0.000067	0.000012

Table 8: Maximum likelihood estimation of normalized cointegrating vectors and error correction coefficients

Variables	Normalized cointegrating vectors (matrix β)	Error correction coefficients (matrix α)
TFP	1.000000	−0.181507
LSSE	−0.053095	−0.616609
LRD	0.007898	−72.42059
OR	−0.060095	4.931058
LFDI	0.002843	20.71799

certainly efforts made by the Tunisian State to improve the quality of the educational systems, combined with a steady improvement in the secondary school enrollments, but without boosting the national absorptive capacity, which will have a negative impact on the national TFP. Statistically speaking, this is confirmed by a negative and statistically significant coefficient associated with the "LSSE" variable; moreover, and economically speaking, the output of the Tunisian educational systems consists of Tunisian skills that do not meet the requirements of the labor market[3]. In other words, there is a mismatch between the qualifications of the providers of labor and the needs of companies. These results have already been confirmed during the same period in the Tunisian manufacturing sector, considered as the sector through which most of the technology transfer takes place (Samet and Chaabane, 2010). The solution then lies in a greater financial commitment of the State in education, by investing more particularly in skills which have a high added value and which are much sought after on the labor market. As a result, part of the structural unemployment will be absorbed, and companies will be provided with an absorptive capacity that can take advantage of the advanced foreign technology and why not participate in innovation and thus improve the national TFP. As we notice in recent decades in Tunisia an increasingly important brain drain, it has been shown that brain gain (the return option and the diaspora option included), through teachers and researchers and other managerial staff, can be a substitute to international trade and FDI as a technology diffusion vector in Tunisia. An improvement in these results, in the sense of involving more categories in the development of their country of origin, would be expected if we take into account the post-revolutionary period, and especially the long term, with an expected improvement of the country's economic and political situation in the context of a new democratic environment (Samet, 2014). At the same time, Tunisia must have a certain autonomy in R&D, in the sense that our country must 1 day come to rely on its own R&D, by investing more in this field.

5. CONCLUSION

The field of science and technology has been recognized everywhere as an important element of future development. Indeed, thanks to a sustained technological progress, an economy can achieve a long-term economic growth. This growth rate is positively influenced by R&D spending, which is itself dependent on the availability of a workforce with a high level of education, which shows the importance of human capital in economic growth. This is evident in developed countries, which can improve their TFP and thus their economy both by relying on their own R&D and on the R&D conducted by other developed countries, in accordance with the endogenous growth theory. However, these observations are not valid in the case of Tunisia as a developing country. In fact, on the one hand, Tunisia cannot yet benefit from its own R&D; on the other hand, our country can benefit from R&D in developed countries, but not through international trade and FDI that do not seem to be a technological diffusion vector, because of the weakness of national absorptive capacities and thus the inefficiency of the educational systems. A sustained improvement in R&D investment coupled with brain gain may be adequate solutions for our country in its sustainable development efforts.

3 Structural unemployment is the type of unemployment that concerns us the most in Tunisia.

REFERENCES

Asuantri, M., Bani, Y. (2017) Foreign Direct Investment, Absorptive Capacity and Technological Innovation: Empirical Evidence in Developing Economics, Global Conference on Business and Economic Research (GCBER), Universiti Patra Malaysia, Malaysia. p14-15.

Brecher, R.A., Choudhri, E.U., Schembri, L.L. (1996), International spillovers of knowledge and sectoral productivity growth: Some evidence for Canada and the United States. Journal of International Economics, 40(3-4), 299-321.

Casadella, V., Uzunidis, D. (2017), The national innovation systems of the South, innovation and economic development policies: A multidimensional approach. Journal of Innovation Economics and Management, 2(23), 137-157.

Coe, D.T., Helpman, E. (1995), International R and D spillovers. European Economic Review, 39(5), 859-887.

Coe, D.T., Helpman, E., Hoffmaister, A. (1997), North-South R and D spillovers. Economic Journal, 107(440), 134-149.

Coe, D.T., Moghadam, R. (1993), Capital and trade as engines of growth in France: An application of Johansen's cointegration methodology. IMF Staff Papers, 40(3), 542-566.

Edwards, S. (1992), Trade orientation, distortions and growth in developing countries. Journal of Development Economics, 39(1), 31-57.

Edwards, S. (1998), Openness, productivity and growth: What do we really know? The Economic Journal, 108(447), 383-398.

Erdal, L., Göçer, I. (2015), The effects of foreign direct investment on R and D and innovations: Panel data analysis for developing Asian countries. Procedia-Social and Behavioral Sciences, 195, 749-758.

Fagerberg, J., Srholec, M., Verspagen, B. (2010), Innovation and economic development. In: Handbook of the Economics of Innovation. Vol. 2. North Holland: B. Hall, N. Rosenberg. p833-872.

Fan, H., Hossain, M.I. (2018), Technological innovation, trade openness, CO_2 emission and economic growth: Comparative analysis between China and India. International Journal of Energy Economics and Policy, 8(6), 240-257.

Gumus, E., Celikay, F. (2015), R and D expenditure and economic growth: New empirical evidence. The Journal of Applied Economic Research, 9(3), 205-217.

Hendry, D.F. (1995), Dynamic Econometrics. Oxford: Oxford University Press. p869.

Johansen, S. (1988), Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control, 12(2-3), 231-254.

Johansen, S., Juselius, K. (1990), Maximum likelihood estimation and inference on cointegration with applications to the demand for money. Oxford Bulletin of Economics and Statistics, 52(2), 169-210.

Levin, A., Raut, L.K. (1992), Complementarities Between Exports and Human Capital in Economic Growth: Evidence from the Semi-

Industrialized Countries. University of California, San Diego Department of Economics Working Paper No 92/14.

Mazoyer, M., Roudart, L. (2005), La Fracture Agricole et Alimentaire Mondiale: Nourrir L'humanité Aujourd'hui et Demain. Paris: Universalis. p869.

Pece, A.M., Simona, O.E.O., Salisteanu, F. (2015), Innovation and economic growth: An empirical analysis for CEE countries. Procedia Economics and Finance, 26, 461-67.

Perron, P. (1997), Further evidence on breaking trend functions in macroeconomic variables. Journal of Econometrics, 80(2), 355-385.

Samet, K. (2014), Brain gain, technology transfer and economic growth: Case of Tunisia. International Journal of Economics and Finance, 6(9), 57-72.

Samet, K., Chaabane, A. (2010), Recherche et développement, diffusion, adoption et croissance de la productivité: Cas du secteur manufacturier tunisien. Mondes en Développement, 38(151), 99-112.

Sen, A. (1981), Poverty and Famines: An Essay on Entitlement and Deprivation. New York: Clarendon Press, Oxford University Press Published to Oxford.

Veblen, T. (1979), Théorie de la Classe de Loisir. Paris: Editions Gallimard. p322.