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The Impact of technological innovation on economic growth: The case of Mediterranean countries

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Abstract

This paper aims is an attempt to examine and analyse the impact of technological innovation on economic growth, as well as to identify major internal and external determinants of the innovative behavior on both North and South shores of the Mediterranean.The use of a panel of 17 countries which signed the Euro-Med agreement between 1995 and 2006, seems to be relevant to enhance and illustrate this analysis.The statistical analysis results, added to previous achieved researches, reveal that the significance of the determinants of technological innovation in the Mediterranean countries differs between the North and the South Basin.

Keywords: technological innovation- R&D- knowledge

1. Introduction

All economists have agreed, over the last decades, that technological innovation, knowledge and the knowhow, play an increasingly important role in the economic development process thanks to the significant technological advance. (Adler, 2001).

These three items represent the backbone of contemporary economy which is based on the phenomenon of globalization. Economy has been characterized by a movement of internalization of production, a relatively strong global growth and an explosion of trade particularly in favor of China. It has been also marked by the increase of researchers, engineers and students mobility as well as the emergence of the supremacy of the knowledge economy and expertise.

In fact, one can notice a significant change from a unipolar world dominated by the United States to a multipolar world characterized by the rise of India and China. The rise of such countries has changed the flow of trade as well as the balance of power. These strong trends are continuing to have a global scale engendering, risks on the developing and under-deveoped world unable to face such a harsh international competition.

Therefore, these new economic changes and the risks they present, create new opportunities the Euro-Med partnership is one of them. However, faced with these intensive developments, the Euro-Med integration remains the most powerful and the best suited instrument to cope with the demands and challenges of globalization. In the new global context, the large field of technological innovation

which is based on expertise and knowledge provides, a mutual motivation for a cooperative organization to the countries of the European Union on the one hand and to those of the East and South Mediterranean Countries (SEMC) on the other hand.

The Med-intelligence network is based on scientific and technological skills as well as on a high quality of training facilities to ensure its efficiency and to be able to generate technological innovation as well as to create strong relations between its different actors.

The main contribution of this research is the following questionning :

How does the technological innovation affect the economic growth?

2. Literature's review:

The relationship between technological development, research, innovation, ICT investment, profitability, enhancement of the general living standards, productivity, and economic growth have been widely analyzed by researchers from several disciplines. In fact, various authors have attempted to explore the situation that has emerged, and which is marked by the development of different forms of technology, the emergence of the economy of knowledge and know-how, as well as the fast progress in information systems.

The literature's examination of « technological innovation » reveals that this term covers a broad spectrum of change. It extends the small improvement in the researchers minds to reach the sle of ceconomic revolution. The term remains ambiguious because of its uncertain nature and diversity. The intensification of these activities is undoubtedly the phenomenon that marked the behavior of firms in recent years and has attracted the interest of several theorists since Schumpeter (1942) and Nelson & Winter (1982). Various schools of thought have treated this phenomenon and seen the great importance it acquires. Each author has analyzed it according to its own convictions and its own thinking.

This research is applied on the model developed by Romer (1990) who considers monopoly rents as a source of funding for R&D activity while substituting the sunk costs generated by this activity in order to increase the production of intermediate and final goods. This model places the pattern of growth in the context of a social division of labor, while the author considered the physical capital as a source of economic growth in its first model in 1986.

Returning to his model of (1990), Romer has opted for the R&D as a primary source of economic growth to mitigate the importance that has been given to physical capital. According to this economist, the R&D is a paid activity, specific to the firm. He introduced a model of four factors of production:

- The Physical capital: it is measured in unit of consumer goods.
- Unskilled labor: it is calculated by the number people hired.
- Human capital: it is evaluated by the level of education and acquired knowledge.
- Technology: it is estimated by the variety of new goods available in the economy.

In addition, and in a second attempt to explain the role of the R&D activity in the economic growth, Romer (1995) has oriented its reflection from a macro-economic perspective to a micro-economic perspective, while highlighting the role of knowledge in the company.

Therefore, the Romer model describes the economy into three sectors respectively producing research, intermediate and final goods or consumer goods. Thus, the first research sector uses human capital and the available stock of knowledge to produce new knowledge. As for the second sector, it employs the latter to implement a large number of innovative and sustainable productive assets. Meanwhile, the last sector uses labor and human capital as well as all new and improved goods to reach a final out-put.

Moreover, human capital is divided between the scientific research and the production of final goods incorporating all the knowledge already cleared.

According to Romer, the more the human capital devoted to scientific research increases, the higher the growth rate of the economy concerned will be.

In addition, and in a second attempt to explain the role of the R&D activity in the economic growth, Romer (1995) has oriented its reflection from a macro-economic perspective to a micro-economic perspective, while highlighting the role of knowledge in the company.

At this level, he associated the firm to a repository of knowledge while assimilating it to an institutional unit of production, storage and reuse of knowledge.

Unlike Romer, Aghion and Howitt (1992) have applied their model of endogenous growth on the principle of the process of innovation "creative destructive" by Schumpeter through which any new innovation, makes the preveous ones obsolete and outdated. These economists show that in LT the growth depends mainly on the accumulation of knowledge rather than on the other factors of production. Furthermore, this accumulation is essentially based on scientific research seen as the cornerstone of technological innovation.

These economists distinguish three categories of work in which this distinction is based on the qualification of the individuals who offer this work.

- For the area of research, a skilled workforce is required.
- The intermediate goods sector uses skilled labor.
- The unskilled labor is employed in the sector of consumer goods.

Considering the inadequacy of the explanation of economic growth only through the evolution of the labor force and the accumulation of physical capital equipment, the economic literature and specifically the new theories of growth with a neoclassical Lowering made of technological innovation is a key determinant of economic dynamics while indigenizing it, i.e. by integrating it in the calculation of economic growth.

Thus, the Aghion and Howitt (1992) model predicts that knowledge represents the main determinants of economic growth and that information should be managed in an appropriate manner while having sufficient internal knowledge to evaluate new technological knowledge in order to exploit the results of the efforts in R&D

Moreover, referring to the traditional approach in terms of technological differences between countries from the work of Vernon (1966), to the most recent models of endogenous growth, it was confirmed that specialization of countries are not sustainable and that an erosion phenomenon occurs due to the existence of the activity of imitation practiced by the least developed countries.

In this respect, the monopoly position occupied by the developed countries that hold advanced technology and temporary. In others words, these countries are gradually losing their comparative advantages held in the producing sectors of innovation to seek new growth areas.

As a result, this despecialization of advanced countries, leaders in innovation, is in favor of the follower countries through the imitation of varieties, the approaches or the production methods newly discovered. However, among the most recent approaches admitting the inertia phenomena in technological advantages held by the innovative countries, Grossman and Helpman (1991) have developed a model of product cycle in which both innovation and imitation are considered as endogenous activities.

These authors proposed a model of a world economy with two countries which are mainly different in terms of their technological capabilities. It is from this model that we started to build our econometric model, while relying on its basic assumptions namely:

H1: The north country has a unique advantage in product innovation whereas the South country is only able to imitate these varieties.

This hypothesis follows three sub-hypotheses:

- H11: The same way of thinking in the production of innovated or imitated varieties is respectively adopted by the North and South. Indeed, the entrepreneurs of each region devote resources to develop either new products which is the case of innovative countries or imitated products in the second case. This is when the future expected profits exceed the current costs generated in the process of innovation and imitation.

- H12: Firms of the North and South operate within a framework of Bertrand competition, so that the product manufactured by the North cannot be imitated only once by the firm of the South in order to maximize its profit.

- H13: By positioning the South side of the firm, the activity of imitation also requires fixed costs to support this activity, but these costs are low compared to those generated by the activity of R&D provided in the North.

- H14: It is a world where the varieties produced are differentiated horizontally and / or only a subset is produced in time. Therefore, there is no product obsolescence in other words, the new types of products do not replace the old ones.

3. Specification of the econometric model

To enrich this paper and provide some answers to the basic issue, an empirical analysis is developed by making use of econometric estimation. The context of technological innovation analyzed in this paper can be translated by a multinomial probit model based on the estimation of equations relative

to only one endogenous variable (economic growth) which varies according to the nature of the introduced explanatory variable, measuring the technological innovation.

In fact, we seek to test the interaction between the various determinants of technological innovation, likely to promote economic growth. For this, we take the work of Grossman and Helpman (1991) in terms of the analysis of technological innovation .Therefore, these economists relied in their analysis on the stock of R&D that represents the tacit knowledge available to the economy as the key factor in technological innovation.

The structure of these equations is determined in relation to the availability of data on the one hand, and the rigor of the theoretical framework within which this work fits, on the other hand. The form of the equations is presented as follows:

Equation 1 :

log(yi,2006)-log(yi,1995)=C0+C1.log(yi,1995)+C2.log(school)+C3log(invt)+C4.log(trad) +C5.log(pe)+C6.log(fdi)+C7.log(technological innovation)+ui

Equation 2 :

log(yi,2006)-
log(yi,1995)=C0+C1.log(yi,1995)+C2.log(school)+C3log(invt)+C4.log(trad)+C5.log(pe)+C6.log(fdi)+C7.1.log(htex)+C7.2 log(itc)+C7.3 log(npub /res)+C7.4 log(r&d)+C7.5 log(tel)+ui

All variables are measured in their first difference, that is why they are introduced in their log-linear specifications. Compared to the equations of Grossman and Helpman (1991) some changes are introduced. Indeed, in their model, these economists assume that technological innovation depends on the stock of knowledge available in the country as well as the effort that it provides in R&D, measured by the share of its GDP devoted to the financing of this activity.

Meanwhile, since this effort is quite small especially for Eastern and Southern Mediterranean countries, the impact of technological innovation on economic growth is attempted to be measured through the introduction of four indicators of measure for technological innovation namely: the share of high tech exports, ICT expenditure and the income of the telecommunications sector (measured as a share of GDP) and the ratio number of publications per researcher. However, economic growth depends also on public instructions and human capital.

To highlight the relationship of technological innovation and economic growth, 5 modified versions of the equation are estimated (2) where the variable technological innovation which is approximated by one of its aforementioned indicators each time (htex , ict, npub /res,r&d, tel). The last regression (6), all variables are introduced: measurement indicators of technological innovation as well as economic growth to finally interpret the various interactions that may exist between these indicators of measurement making of innovation a key to economic growth.

4. DATA SOURCES:

At this level, it should be noted that reliable measures of human capital are unfortunately rare especially for the countries of the South. Therefore, the secondary enrollment rate is preferred to be

used as a proxy for human capital. The database used contains 16 countries and 11economic indicators measuring the growth over a period running from 1995 to 2006.

Data were obtained from the CD-ROM of the World Bank and supplemented by data from Pen World Tables. All variables in the model include the real GDP and are expressed in purchasing power parity, as they are at constant prices with 1995 as a base year. Since the ratio number of publications / researcher is not a directly available data, it has been calculated on the basis of the ratio between the numbers of scientific publications of each year with the number researchers corresponding to the same year.

Therefore, the summary table below shows the different model variables with their sources:

Table 1: Definition of variables:

Variable	Measure
school	Enrollment in secondary (net)
Ivt	The investment volume (expressed in% of GDP)
Trad	The volume of exports and imports (as% of GDP)
pe	The volume of public expenditure (as% of GDP)
dfi	The level of direct foreign investment (as% of GDP)
g95	The level of initial GDP with 1995 as base year (expressed in% of GDP)
Htex	The share of high-tech exports (as% of GDP)
itc	Spending on information technology and communication (expressed in% of GDP)
npub/res	This ratio represents the number of publications per researcher. *with the number of researchers calculated per 1000 inhabitants .eprésente le nombre de publications par chercheur.
r&d	This is the share of GDP devoted to financing the R&D activity (expressed as% of GDP)
tel	Income in the telecommunications sector (in% of GDP)

The examination of these empirical results is summarized in the following table:

Table 2 :Estimation of the model of "Grossman and Helpman (1991)"

explanatory variable	**Reg (1)**	**Reg (2)**	**Reg (3)**	**Reg (4)**	**Reg (5)**	**Reg (6)**
a_0	-0.001	-0.032	-0.016	0.017	0.0665	-0.0586
log (shcool)	0.018	0.108	0.105	0.296	0.201	0.278
log (trad)	0.603*	0.167	0.375	-0.329	0.516***	0.295
log (pe)	-0.291	0.091	-0.762	0.813**	0.408***	0.950**
Log (fdi)	0.010	0.031*	0.029***	0.025**	0.017***	0.015
log (g95)	-0.050	-0.012***	-0.012	-0.032	-0.085	-0.098**
log (htex)	0.062***	-	-	-	-	0.101**
log (itc)	-	0.031	-	-	-	0.023
Log (npub/res)	-	-	0.018	-	-	0.0736
log (r&d)	-	-	-	0.101	-	0.646**
Log (tel)	-	-	-	-	0.044	0.0188
R^2	0.2975	0.5440	0.9648	0.3348	0.2927	0.6916
X^2(000)	14.40	24.20	26.54	12.16	14.49	20.09
N obs	41	27	28	36	42	22

Technological innovation in the Mediterranean Union countries for the period : 1995-2006
(*)Significant coefficient at the 1% level

(**)Significant coefficient at the 5% level

(***)Significant coefficient at the 10%

5. Discussion and interpretation of results

From the regression (1) to (6) we tried to introduce each time the variables of technological innovation one by one in order to test their effects on economic growth.

In this respect, these empirical analysis, allow to highlight several key facts: firstly one notes that among the ten variables, four are statistically significant on economic growth and admitting coefficients of expected signs namely (pe, g95, htex and r&d), whereas for the remaining variables (shcool, trad, fdi, npub / res, tel and itc) having a positive but insignificant effect in explaining the

economic development the countries which are members of the Med union during the study period. Thus, to interpret these results an empirical review of the literature seems to be essential.

Starting from the outward variable, one notes that the coefficient of this variable is of an expected sign, which is in favor of the positive impact of trade openness on economic growth, but this variable is not significant. Several reasons can be advanced to clarify this state of affairs in which the first is that the SEMC are characterized by a high level of trade protection, likewise their markets are still tight and the European Union remains their main partner in addition to their South-South partnership which is still underdeveloped.

Then, regarding the analysis of the effect of FDI on the growth of the economies studied, we found that this impact is positive but insignificant. Such a result was found by (Brostein De grogoric and Lee (1998)) as a part of the analysis of the effect of FDI on economic growth relying on the Romer model and developing a model of endogenous growth, these economists have argued on the one hand and from a theoretical point of view that due to the decrease of the introduction of new varieties' costs, the FDI plays an important role in stimulating the pace of economic development through the effects of spillovers.

These technological effects are concerned with the development of foreign competition, the technology transfer and the accumulation of physical and human capital as well as the increased international investment. So, the FDI could contribute significantly in increasing the rate of economic growth after the improvement of the structural conditions in the host countries.

In fact, these authors have empirically showed that the IDE does not allow a significant impact on economic growth unless the level of schooling of population exceeds the given threshold. In this perspective and keeping the same reasoning, we can see that the IDE cannot contribute positively and significantly to the explanation of the growth of a given economy unless if this latter presents a balance between the national performance in terms skilled labor and its demands in terms of new productive structures emerging from a phenomenon of technology transfer.

While addressing the variable of enrollment, one finds that this variable has a positive effect but doesn't show a significant contribution to the explanation of the growth of the economies in question. This result has been empirically validated by (Helpman (1997)) which proves that the restricted effort in the field of education that is provided by the countries of the union Med, with the exception of EU countries and Israel, creates not only a low productivity of new knowledge workers, but also insufficient learning effects to generate significant productivity gains either in the introduction of new technologies or due to the technological transfers emerging from the location of FDI.

However, this phenomenon is accentuated if there is a complementarity between the introduced technology and the level of education and training required. Moreover, given the gaps in the Mediterranean educational systems generating the formation of a low-skilled labor and non-performing which is weighing on the productivity of material and immaterial factors (Zawdee (1995)) emphasizes in particular on the lack of balance between educational policies and the development stage of the SEMC.

The variable state spending has a positive and significant effect on the economic growth of countries which are partners of the union Med. This could be checked by (Bassu and sirinivasan (2002)), as it gives a great importance to the role played by the government in ensuring the favorable conditions

for technology transfer between the different partner economies. Moreover, the introduction of physical infrastructure (transport and telecommunications) and technology as the establishment of poles of competitiveness enables companies to benefit from the effect of agglomeration. This effect stimulates their innovative abilities thanks to the sharing of their technology know-how, knowledge and skills to ensure their performance and competitiveness of all the territory.

Furthermore , the role given to the government in stimulating technological innovation can be interpreted through the implementation by the existence of positive agglomeration technology effects as a necessary condition. This effect is possible through the training of a skilled labor and highly qualified, stimulating the attractiveness for foreign investors.

Like his works, (Blonigen (2005)) emphasizes the importance of public intervention in the explanation of economic development, a work including the adequate technological infrastructure established for the promotion of technological innovation. It indicates that a low level either in terms of infrastructure or human capital will result in relatively high transaction costs which can hamper not only the international trade, but also the pace of technological innovation and generally the economic growth .

In addition, our empirical analysis reveals a positive and significant impact of expenses incurred in the activity of R&D on the economic growth for all members of union MED. At first glance, it seems that the programs of industrial, economic and technological cooperation developed between the European Union's countries and the SEMC in the Mediterranean framework of partnership, enables technology transfer to the benefit of the countries of the southern shore of the basin.

In this context, cooperation in R&D has taken a primary importance in the developed strategies between riparian countries. This occurs in a technological environment increasingly evolving, competitive and globalized. It is in this sense that partner countries can ensure the complementarity of their know-how, trying to internalize various externalities of technological knowledge at the same time.

The Works of (Brandstetter and Sakakibara (1998)) attest these empirical results on the impact of R&D activity on stimulating productivity, while starting from an econometric analysis of Japanese scientific research consortia. These authors argue that the increase of the state expenditure in favor of the promotion of the R&D sector measured by the number of patents issued, ensures the increase of the productivity of various economic sectors and especially the more intensive ones in terms of technologies, implying a direct and positive effect on increasing the rate of economic growth.

Therefore, according to (Cohen and Levinthal (1990)) the R&D is both an "activity- product" and a construction activity for the production process and the learning ability. This is due to the fact that this activity gives rise to new knowledge and to improvement in the ways of thinking and learning abilities as well as it contributes to the adoption of new skills.

In this regard, (Le Bas and Van pottelsbergh de la potterie (1999)) consider the R&D as a fundamental variable for the explanation of the evolution of both the productivity of the country and its performance in different areas.

Moreover, the fragility of this last growth indicator also lies on the existence of quite different technologies of R&D depending on the industries and which are intensive in terms of scientific

research. It gives rise to more abstract and universal new knowledge to ensure new performance for the technological environment: these are, therefore the characteristics of high-tech products.

The Variable of high technology export used as an indicator measuring the technological innovation, presents a coefficient of positive and significant, illustrating the positive impact of High Tech exports on the Mediterranean economic growth . This result was theoretically validated in the economic literature in which (Evenson (1993)) shows that as a result of the increase in the share of high-tech products for export, domestic firms are experiencing a significant and increasing external demand. Thus, they will be more efficient and productive

Therefore, to be innovative, competitive and be able to defend their share of the international market, these firms will be encouraged to increase their efforts in R&D. This results in the increase of the country's economic productivity simultaneously with a scientific and technological improvement allowing the acceleration of the pace of economic development.

It is the same thing for (Duguet and Kabla (1998)) who argues that any increase in the share of high tech exports, accompanied by an increase in competitive pressure, promotes the stimulation of the effort of technological innovation, inducing as a result the stimulation of the pace of economic growth. However, the ratio of the number of publications per researcher proves a positive effect but does not allow a significant effect on the explanation of the economic growth of the Union Med countries. To explain this result, some reasons can be put forward.

Starting with the new strategic directions followed by the framework programs of technological partnership aiming to substitute the not yet operational tacit knowledge by a more abstract and universal knowledge, responsible for discovering the various possible problems before reaching the factory, while controlling the gaps between the research laboratories and the factories to establish the results of the research.

Therefore, a relative increase is yet seen in the number of patents filed by all the countries during the period of this study. This increase can be explained by the fact that the form of the knowledge produced by most of the Mediterranean countries became increasingly silent.

Such reasoning was followed by (Pavitt (2001)), who puts the notions of routines, skills and competences in the heart of the process of technological innovation which remains the key word in explaining economic growth. On the other side, and by adopting a growing awareness of the importance of the scientific profiles in the scientific, technological and economic development of their economies, the different partner countries have given great importance to the introduction of the conditions enabling the promotion of the R&D characterized by an increase in the number of researchers, technicians and engineers during the period of this study. This implies downward trends in the studied ratio and therefore its low explanatory power of the pace of economic development.

If one moves to the analysis of the variable ICT expenditure, a variable is considered to have a positive effect on economic growth. Such an impact has been theoretically verified by the endogenous growth theories considering the new technologies as the backbone of the economy. New technologies refer to technologies of production, final consumption and intermediate consumption respectively for households and firms in which the use of the Internet, computers and telephone services are also elementary for the formation of fixed immaterial for the company capital.

However, while trying to study the impact of these technologies and the expenditure devoted to it on the economic development of the Euro-Med countries union, one notes that this variable does not contribute to the significant explanation of the growth of these countries.

This result provides information about the proven inability by SEM, with the exception of Israel, to adapt their economies to modern technologies regarding the huge costs they require. This is identically the result found by (Ben Youssef, and whinnied Methammem Me (2003)) which, in the context of an empirical study with SEM, shows that this effect remains limited despite the undeniable effort that these countries are providing in terms of increasing of the adoption of these new technologies.

However, these economists have shown that the digital divide between the two blocks of Med union countries, exists and is deep and followed by cumulative dynamic upward and that the technological catch-up mechanisms are not significant since the economic growth is a major component of any dynamics of convergence and is unable to reduce the technology gaps in a significant and quick manner by its own. This implies a relatively low income provided by the telecommunications sector.

This latter finding coincides with the results concerning the impact of the telecommunications sector income on the economic growth of the countries bordering the Mediterranean. This variable is also proved to have a positive effect but still unable to significantly contribute to the explanation of economic development.

Indeed, a theoretical explanation has been given by (Small (1999)) which states that in order to optimize their usage and ensure economic profitability coming from the investment in this new sector, these new technologies require one of the prerequisites provided by a high level of education and to significant level of specific skills.

This Economist highlighted the case of Europe, that has witnessed the emergence of an economy based on technological know-how thanks to its high rate of education.

Moreover, and returning to the thinking of Ben Youssef, Methammem et M'henni (2003) one can say that the differences in terms of investment in human capital are the main cause of the existing digital divide between the two shores of the Med.

The last variable that one proposes to study its effect is the initial GDP. In fact, from the regression (1) to (6) we note that the GDP / initial head i.e. that of 1995 which represents the base year, is significant in explaining the economic development and has a negative effect. Such a result joins the assumptions of different theories of economic growth in favor of the convergence towards the long-term equilibrium.

In this respect, one can see that in spite of technological, scientific and social differences between the richest countries, the countries of eastern and southern shores of the Mediterranean, may have the opportunity to join the growth rate of the European countries and have the same equilibrium path in the long-term. This result is shown by the report of Femise (2007) which proves that with average annual growth rate oclose to 5% in 2006-2007, the increase is of the order of 1% on average between1995 and 2000

Therefore, the growth rate SEMC began to converge with that of the EU. This may be explained by the demographic transition that these countries have recently witnessed, particularly following their

integration into the Euro-Med partnership. This transition is marked by a growth rate of the population on an average close to 1.8% in 2007 against 0.4% in the EU countries

In addition, the start of the convergence income / head in the SEMC is accompanied by a small favorable evolution of the human development indicators, namely the improvement of life expectancy at birth, life and the access to utilities. However, despite the important efforts made by the Mediterranean East and South countries, some other indicators remain significantly lower and indolent as the case of enrollment which remains lower, while it is already achieved by the North Shore countries and specifically the EU ones. Thus, the human development and the onset of the convergence towards the growth rates achieved by the countries of the northern region, cannot be discussed without mentioning the role of Mediterranean governments in ensuring the vitality of the Euro-Med area based on the knowledge-based economy.

Such a role is interpreted via the progress of institutional and organizational reforms containing the economic areas to increase the pace of economic growth in all partner countries.

6. Conclusion

Literature reveals that technological innovation has a major impact on the economic growth of countries. The case of the Mediterranean Union countries is the main operating highlights of the explanatory effect of public expenditure, the initial per capita income, the share of exports of high technology and spending devoted to finance the R&D on the economic growth of the countries considered in the study. It seems also that North-South cooperation programs are still marginalized and that their practical implications are still low in speeding the pace of the economic growth and especially the South Shore countries one. Furthermore, the international distribution of R&D and the results of this activity in particular require the establishment of the appropriate channels for technology transfer, which are likely to generate the highest possible scientific and technological benefits. However, it should be noted that these channels are still being defined and identified.
In contrast, this study shows that the trade openness to the outside and in particular the openness to the EU countries, remains an underdeveloped strategy in the Mediterranean Union.

Further, the presented FDI results raise the issue of the lack of attractiveness of these investors in MENA, while these investments represent an alternative mode of technological diffusion. Therefore, the level of investment in the South Mediterranean countries and in particular that from abroad remains insufficient to stimulate the foreign or even the partner countries supply as it is still unable to sustain the economic growth.

In this context, and given the diversity of the areas covered by programs of the Euro-Med partnership, it seems interesting to extend this study in order to clarify the sources of externalities in R&D for each country separately and determine the most productive commercial links which ensure the most efficient technology transfer that contributes to both the stimulation of technological innovation and the limitation of the existing technological gap between the two Mediterranean shores.

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