# TECHNOLOGY TRANSFER AND FDI: SOME LESSONS FOR TUNISIA

**GHAZOUANI Assaad**

*LEFA University of Carthage*

**TERAOUI Hedia**

*ECCOFIGES University of Mannouba*

## ABSTRACT

*The purpose of this article is to try to see if the FDI actually contributes to technology transfer in Tunisia or are there other sources that can guarantee this transfer? The answer to this problem was gradual as we followed an approach using economic theory, the reality of Tunisia and econometric and statistical tools. We examined the relationship between technology transfer and FDI in Tunisia over a period of 40 years from 1970 to 2010. We estimated in two stages: first, a growth equation, then we have learned from this regression residue (proxy technology), secondly, we regressed on European FDI, exports of manufactures, imports of goods from the European Union in addition to other variables to test the robustness of the results and describing the level of infrastructure in the country.*

*It follows from our study that technology transfer does not originate primarily and exclusively in the FDI and the latter is econometrically weakly with technology transfer and spillover effect of FDI does not seem to occur according to our results. However, the relationship between technology transfer and imports is negative and significant. Although this result is cons-intuitive, is recurrent in the literature of panel data. It has also given rise to intense debate on the microeconomic modeling as well as on the empirical applications.*

Technology transfer through trade or foreign investment, has become a catalyst for growth recognized by numerous empirical studies in particular. However, the relationship technology transfer / FDI is more complex than it appears. This complexity is due, primarily, but not exclusively to the close link between FDI and the characteristics of the host country. This is essentially the host's responsibility to establish general conditions, transparent and conducive to investment, and to strengthen human and institutional capacity necessary for foreign capital flows that can have real effects on growth.

## 1. A LITTLE HISTORY

Following the failure of the experience of socialization of the economy during the 60's, a radical change occurred in the Tunisian government's economic policy in the early 70s. This change has fostered and encouraged:

- The development of export industries.

- The partnership system.

- The installation of foreign firms in Tunisia.

One of the objectives of this policy change was primarily the acquisition of new technologies. This change has resulted in the enactment of several laws that have particularly facilitated the creation of organizations for the promotion of innovation and industrial investment. The first organization was the Agency for the Promotion of Industry (API) in 1973, followed by INNORPI in 1982. These institutions seem to actually contribute to the promotion of industrial investment but this investment has not been at the pace expected by the authorities along with the predisposition of the above conditions and the existence of different actors to support the innovation such as research laboratories, incubators, science parks and a multitude of structures of public and private funding with an upgrading program, action or ITP technology investment priority, innovation is still insufficient even under very low number of innovation patents filed in INNORPI.

**Table-1.** National patents (Applications filed INNORPI)

| year | Patents applied for by | | Total |
|------|-----------|------------|-------|
| | **Tunisians** | **Foreigners** | |
| 2000 | 47 | 210 | 257 |
| 2001 | 22 | 156 | 178 |
| 2002 | 45 | 58 | 103 |
| 2003 | 35 | 120 | 155 |
| 2004 | 46 | 223 | 269 |
| 2005 | 56 | 282 | 338 |
| 2006 | 73 | 383 | 456 |
| 2007 | 76 | 416 | 492 |
| Total | 400 | 1848 | 2248 |

**Source:** INNORPI

Under pressure from Eastern Europe and the intensification of international competition due to globalization of economies, the need for technology transfer has become an urgent need for Tunisia today more than ever, and for several reasons:

- First, to ensure its independence vis-à-vis foreign producers of technology.

- Second, to generate savings on foreign means of payment.

- Third, to master the trade deficit through import controls.

- Fourth, to catch up with the developed countries of the OECD.

- Fifth, to find additional employment opportunities especially for graduates of higher education.

To achieve these objectives and to be inspired by some theoretical teaching stipulating that technology transfer is essential and goes mainly through FDI, Tunisia among others relied heavily on these FDI to appropriate technology. The main question that arises is: according to some studies on development economies similar to Tunisia, do FDI inflows in Tunisia promote technology transfer or not? Are there any other sources that may ensure that technology transfer other than FDI?

## 2. REVIEW OF THE EMPIRICAL LITERATURE

Several empirical studies have attempted to describe the relationship between FDI and technology diffusion in host countries. These studies do not all agree on the idea that new technologies are expanding abroad primarily through subsidiaries of multinationals and not through international trade and it is this thesis we try to check for the case of Tunisia, So We verify empirically the relationship FDI - technology transfer.

The works of Blomstrom (1986) and Miyamoto (2003), Liu (2008), Keller (2010), Javorcik and Harding (2013) confirmed that the FDI channel is the most important technology transfer to developing countries, however, this channel is not automatic but depends on the characteristics of the industry and the host country. These authors emphasize that the success of technology transfer depends on the level of competition, the quality of human capital, fixed capital endowments as well as the business environment enjoyed by the country. Indeed, it is through direct competition between local firms and foreign firms that the level of productivity increases, thus accelerating the convergence of the level of productivity to that of developed countries. Foreign firms thus exert a ripple effect on domestic firms, particularly in areas where they are located.

This article supports the work of Caves (1974) who verified consequences in terms of value added per worker, of foreign presence in the British and Canadian manufacturing sector and identified the gap between foreign and domestic value added tends to disappear as for as the increased foreign presence increases in the sector. This conclusion is dependent on the coexistence of several factors, including those quoted by Caves (1974):

- A well-trained workforce

- The availability of technological and organizational knowledge

Bouoiyour *et al.* (2009) tested for the period 1960 -2004 and for 63 countries the existence of a relationship between FDI and productivity. They conclude that foreign presence has no impact on productivity in this sample. In contrast, human capital has a positive effect on the productivity of the entire sample (even if its impact on growth is negative). These results were also confirmed in a sub-sample for the country in the MENA region. These authors show, in this work, a strong correlation between the quality of human resources and the effects of FDI.

## 3. MODEL SPECIFICATION

Economic growth can be defined as the medium-and long-term product and especially the total product per capita in a given economy. It is a narrow concept and it's exclusively quantitative,

which we sometimes prefer a much broader concept of development that takes into account the qualitative aspects (human, cultural, environmental, etc.). than a quantitative approach that neglects nature.

Economic growth is not a natural fact, it is rather an exceptional historical event, the beginning is recent: the eighteenth century Britain, the nineteenth to some other western countries: France, Germany the United States, Italy, the twentieth century for many, but not all.

Growth is the result of an increase in the total output of an economy, as the macroeconomic production function is at the care of its analysis. A macroeconomic production function is a representation of the production activity at the aggregate level, this is a summary of all production functions of firms. The functions of individual productions (those firms) are obviously the only are with a real existence, the aggregate function can only be an analytical construction.

Many debates have focused on the possibility of such a construction in the 60s in particular. It is easily shown, in particular, the macroeconomic production function can not be obtained by simple addition of individual functions (the nature of returns of individual functions would not be preserved). The macroeconomic production function, regardless of its method of preparation, may be an approximation to be sufficiently accurate, real production conditions of the economy.

The production function is denoted

$$Yt = F(K, L)$$

Where:

Y = real national income (by volume)

K = the total capital stock

L = labor (labor force).

The model that we use in the empirical study has its origins in the production function in neoclassical macroeconomic level. In the neo-classical perspective, it is possible to aggregate individual behavior of producers from their individual production functions for a function whose global production function is a Cobb-Douglas example.

The neoclassical production function has the following form:

$$Y_t = AK_t^{\alpha} L_t^{\beta}$$

Where:

A = coefficient characteristic dimension of the economy;

Kt = quantity of used capital;

Lt = Amount of work used;

$\alpha$ = Share of production that pays K;

$\beta$ = Share of production that pays L;

With $\alpha + \beta = 1$ (returns are constant).

Growth models contain the neoclassical idea that if the rate of population growth (which controls one of the active population) n = 0, that is to say if the workforce is stable, n 'there is no growth (g = n = 0), and there is no variation in the capital since the amount of labor used (L) and

capital intensity that is to say the number of unit of capital per worker (K / L) does not vary, K either. However, this finding is contradicted by the reality of post-war: Denison and Carré in the United States, Dubois and Malinvaud in France have found that there is economic growth even in the absence of population growth. This fact was confirmed by the neo-classical analysis itself. Indeed, with a Cobb-Douglas form Y = Kalb, take the differential Y.

$$dY = \frac{\partial Y}{\partial K} dK + \frac{\partial Y}{\partial L} dL$$

$$\Leftrightarrow dY = aK^{a-1}L^b dK + bK^a L^{b-1} dL$$

$$\Leftrightarrow dY = aY\frac{dK}{K} + bY\frac{dL}{L}$$

$$\Leftrightarrow \frac{dY}{Y} = a\frac{dK}{K} + b\frac{dL}{L}$$

$$\Leftrightarrow g = a\ PmK + bPmL^1$$

where:

g = economic growth

PMK = marginal productivity of capital

PML = the marginal productivity of labor

The economic growth rate should be equal to the sum of the growth rates of K and L respectively weighted by the share of profits and wages in the national income.

However, all empirical studies confirm that the rate of economic growth far exceeded the sum of these two elements during the 30's boom at the time when growth models were developed.

An important part of growth, called residue remained unknown except by a set of elements called technical progress. It was therefore necessary to introduce into the analysis a factor that accounts for the growth in the absence of variation in quantities of traditional factors used or more than that.

Technical progress was thus conceived as a constant trend over time from a starting level. At time t, technical progress would be H: $Ht = H0\ e^{\lambda t}$. It follows that:

$$Y_t = H_t K_t^a L_t^b$$

$$= H_0 e^{\lambda t} K_t^a L_t^b$$

---

[1] The same result can be obtained by differentiating the log of the production function given that, by definition, the differential $Log\ Y = \frac{dY}{Y}$ :

$$\Rightarrow dY = \frac{\partial Y}{\partial t} dt + \frac{\partial Y}{\partial K} dK + \frac{\partial Y}{\partial L} dL$$

$$\Leftrightarrow dY = \lambda H_0 e^{\lambda t} K_t^a L_t^b dt + a H_0 e^{\lambda t} K_t^{a-1} L_t^b dK + b H_0 e^{\lambda t} K_t^a L_t^{b-1}$$

$$\Leftrightarrow dY = \lambda H_0 e^{\lambda t} K_t^a L_t^b dt + a H_0 e^{\lambda t} K_t^{a-1} L_t^b dK + b H_0 e^{\lambda t} K_t^a L_t^{b-1} dL$$

$$\Leftrightarrow \frac{dY}{Y} = \lambda \frac{H_0 e^{\lambda t} K_t^a L_t^b}{H_0 e^{\lambda t} K_t^a L_t^b} dt + a \frac{H_0 e^{\lambda t} K_t^{a-1} L_t^b}{H_0 e^{\lambda t} K_t^a L_t^b} dK + b \frac{H_0 e^{\lambda t} K_t^a L_t^{b-1}}{H_0 e^{\lambda t} K_t^a L_t^b} dL$$

$$\Leftrightarrow \frac{dY}{Y} = \lambda dt + a \frac{dK}{K} + b \frac{dL}{L}$$

So we have a decomposition of economic growth showing the respective contributions to the growth of each factor to technical progress[2].

Following Bouoiyour *et al.* (2009), we specify a first equation in the determinants of economic growth in developing countries, where we use as explanatory variables in the growth rate of gross domestic product the following data:

- The enrollment rate at the secondary level as an indicator of human capital,
- Exports
- The rate of population growth,
- The growth rate of agricultural land
- Investment.

To Barro and Xavier (1997), the poorest countries generally grow faster than richer countries, and therefore tend to catch up: At the end of this hypothesis central convergence, we introduce to enrich our empirical model the logarithm of GDP per head in the first period corresponding to 1971. This variable is by definition constant in time.

Specification of our model is described in the following equation:

$$TPIB_t = PIB_0 + \alpha I_t + \beta KH_t + \lambda X_t + \eta DEM_t + \varphi AGR_t + \varepsilon_t \qquad \text{(Equation 1)}$$

Where we denote by:

TPIB: The growth rate of Gross Domestic Product

---

[2] Growth models taking into account technical progress see it as self-manifested even if traditional factors K and L do not vary. But technical progress, self, is it neutral?!

Three ways to respond:

- The first is that Hicks: The technical progress is neutral if K / L (capital intensity) and therefore does not change w / i; consequently distribution unchanged: This is the case with a Cobb-Douglas.

- The second is that Harrod: The technical progress is neutral if K / Y (capital ratio) does not change when the interest rate does not change it either, and that L varies.

- The third is that of Solow technical progress is neutral if L / Y does not change when the wage rate remains constant, and K varies.

I: The ratio of investment to GDP

KH: Human Capital

X: The ratio of exports to GDP

DEM: The rate of population growth

AGR: The growth rate of agricultural land

$PIB_0$: The log of initial GDP per capita. According to one of the central assumptions of growth models (Barro and Xavier, 1997), the poorest countries generally grow faster than richer countries, and therefore tend to catch up. This assumption implies that the growth rate of real GDP should be inversely correlated to the logarithm of GDP per head in the first period. To test this hypothesis of convergence[3], we enrich our empirical model by introducing the logarithm of GDP per head in the first period LPP. LPP is the explanatory variable, by definition, constant in time. This is the ratio of real GDP in 1971 in thousand dinars compared to the total population in 1971; (4138600/5208154 = 0.795; log (0.795) = -0.1)

This model is estimated by ordinary least squares method (OLS).

Once the estimation of Equation 1 is done, we try to recover the residue, representing a proxy for the technology we regress on the following variables:

- FDI from EU

- Export of manufactured goods,

- Import capital goods

- An indicator reflecting the level of infrastructure

Specification in step 2 is as follows:

$$\varepsilon_t = C + \alpha_1 IDEE_t + \alpha_2 XMA_t + \alpha_3 MEQ_t + \alpha_4 TEL + \xi_t$$

(Equation 2)

Where we denote by:

$C$ : Constant

$IDEE$ : The ratio of foreign direct investment in European GDP

$XMA$ : The share of manufactured exports to total exports of goods

$MEQ$ : Imports of capital goods from the European Union as a percentage of total merchandise imports from Tunisia.

$TEL$ : The level of infrastructure, it is measured by the number of telephone line per 100 inhabitants.

The statistical data-whose statistical properties are annexed, are collected in the database of the World Bank indicators (WBI 2010) available free on its website. These include the following series: TPIB, IDE, KH, I, X, DEM, AGR, PIB0, XMA, MEQ. The study period runs from 1970 to 2010.

---

[3] This assumption implies that the growth rate of real GDP should be inversely correlated to the logarithm of GDP per head in the first period.

To complete the series on FDI between 1971 and 1975 the database of UNCTAD is being used.

For IDEA, the procedure was as follows:

- Between 1992 and 2010 it was called the statistical database of the European Union EUROSTAT[4]. EU was retained (15).

- Between 1970 and 1992, we used global reports on FDI issued by UNCTAD from which we collected for each of the 15 EU member countries the outflow of investments in favor of Tunisia. These flows expressed in U.S. dollars were converted into Tunisian Dinars using the official exchange rate of Dollars compared to DT Americans published by the World Bank WBI (series whose code is PA.NUS.FCRF).

## 4. EMPIRICAL ANALYSIS

Before reviewing the results of estimates it is imperative to examine the stationarity of time series which will carry our regressions. The principle is that statistical series will not be stationary if it is auto correlated in a persistent, way  its value at each period depends heavily on its past achievements. Variables whose autocorrelations are close to unity, and only decrease slowly, while remaining significantly different from zero up to a certain order, are non-stationary variables.

The Dickey-Fuller test (DF) is based on an autoregressive model of order 1 (AR (1)) of the form where μ and θ are parameters and $\varepsilon_t$ is assumed to be white noise. But if the series is correlated with high levels of delays, then the hypothesis of white noise is violated. Assuming that series follows an AR (p) a means to ensure the stationarity of time series and to apply the unit root test of Augmented Dickey-Fuller Increases (ADF). The ADF test performs a parametric correction of higher-order correlations to 1.Table 2 shows the results of serial analysis. These series were regressed according to the following specification.

**Table-2.** Results of the ADF test of Dickey-Fuller

| Variables | $\mu$ | $\beta$ | $\rho$ | $\theta$ | *ADF test* Stat | Seuil | $\bar{R}^2$ | D.W. |
|---|---|---|---|---|---|---|---|---|
| ΔTPIB | -0.37 | 0.009 | -1.9 | 0.25 | -8.26 | 1% | 0.86 | 2.35 |
| ΔKH | 0.82 | -0.039 | -1.97 | 0.41 | -6.70 | 1% | 0.70 | 2.02 |
| ΔI | 0.62 | -0.02 | -0.91 | 0.03 | -3.95 | 1% | 0.39 | 1.78 |
| ΔX | 1.07 | -0.01 | -1.19 | 0.21 | -4.74 | 1% | 0.46 | 1.89 |
| ΔDEM | 0.09 | -0.005 | -1.49 | 0.11 | -5.25 | 1% | 0.64 | 2.03 |
| ΔAGR | -0.066 | 0.008 | -0.75 | -0.22 | -3.13 | 1% | 0.45 | 1.79 |
| ΔTEL | 0.10 | -0.004 | -1.44 | 0.088 | -4.24 | 1% | 0.62 | 2.01 |
| ΔMEQ | 0.55 | 0.005 | -1.31 | 0.15 | -4.99 | 1% | 0.53 | 1.91 |
| ΔXMA | 4.38 | -0.12 | -1.22 | 0.092 | -4.67 | 1% | 0.52 | 1.98 |
| ΔIDEE | 0.072 | -0.005 | -1.63 | 0.139 | -5.52 | 1% | 0.69 | 2.02 |

**Source:** Our calculations based on output EVIEWS 6.0

[4] http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/ (14 février 2012)

## 5. RESULTS

The first difference estimation of Equation 1 gives the results shown in Table[5] 3 below. We choose the specification that presents the sum of squared residuals (SCR) is the lowest specification 3.

**Table-3.** Estimation results

|  | Spécification 1 | Spécification 2 | Spécification 3 |
|---|---|---|---|
| $PIB_0$ | 329 (1.81)*** | 192.5 (2.94)* | 224 (4.54)* |
| I | 0.38 (1.85)*** | 0.19 (0.26)ns | --- |
| KH | 0.34 (2.64)* | -0.21 (-0.64)ns | --- |
| X | --- | -0.22 (-1.99)* | -0.64 (-2.01)* |
| DEM | 0.77 (1.63)** | --- | 0.01(1.69)* |
| AGR | 0.83 (2.28)* | 0.04 (0.33)ns | --- |
| SCR | 59 | 23 | 67 |

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1, ns: no significant

**Source:** Our calculations based on output EVIEWS 6.0

The residue resulting from this specification is illustrated in the following chart (Fig 1).

The residue retained estimation in step 1 is used in the regression equation 2 above as a proxy for technology.

The estimation of equation 2 gives us the following result[6] :

$$\varepsilon = -10.94 - 0.11 \ IDEE - 0.08 \ XMA + 0.31 \ MEQ + 0.47 TEL$$
$$(-1.81) \quad (-0.21) \quad (-2.77) \quad (2.66) \quad (0.02)$$

It thus appears from the estimation that neither o FDI nor the infrastructure is significant. Only trade is significant: importing new equipment has a significant positive effect while exports have a significant but negative are These results confirm the thesis that trade - via imports are-channel transmission technology[7].

International trade is seen as a vector for the dissemination of knowledge. The latter are at the level of the imported product that incorporates information technology. Tunisia, along the lines of all developing countries unable to produce knowledge, to use and exploit foreign imports as a source of accumulation of technology. The results found confirm the work of Coe and Helpman (1995), Coe and Hoffmaister (1997); Keller (1997;1998), Deng *et al.* (2012).

Trade has a significant positive effect in one direction: Imports (knowing that our exports are in fact imports of others). It seems that in the case of Tunisia the nature of foreign investment this

---

[5] Figure in brackets in Table III-3 t-surdents.

[6] See the screenshot of the output of the estimate attached.

[7] At this level include Keller(1997). « *Importing a foreign intermediate good [... allows a country to capture the R&D or 'technology-content' of the good. For a given primary resources, productivity is increasing in the range of different intermediate goods which are employed, due to the assumption that they are imperfect substitutes for each other. The model predicts that total factor productivity is positively affected by the country's own R&D, as well as by R&D investments made by trade partners*».

does not contribute enough or at all to technology transfer, either because the IDE usually are concentrated in low-technology activities such as textiles, or "turnkey" activities.

These results raise numbers of questions for policymakers:

- Should we continue importing more to benefit from technology knowing that increased imports not accompanied by an increase in exports, with the same proportions, increases the trade deficit?

- What FDI should we attract and why? Knowing that the primary FDI has cost a community in terms of incentives, secondly does not contribute to the promotion of employment to the desired level by the authorities and the tertiary do not contribute to technology transfer. In fact this sought FDI because they it's seen as a source of funding for the balance of payments not generating debts.

## 6.   DISCUSSION AND CONCLUSIONS

In this context, this study attempts to provide, to a possible extent response analysis to the important question that's a burning issue for all politicians, non-governmental organizations and industry: does FDI promote technological transfer?

FDI promotion is now a fundamental part of the development strategy of Tunisia. Policy implemented in the field has evolved considerably, nowadays it takes a multidimensional shape Tax and financial benefits provided by the new investment code are certainly powerful element of this policy, but other economic incentive measures, legal and customs were taken, and make the Tunisian offer an attractive offer, these measures relate in essence, price liberalization, the creation of a foreign exchange market and the creation of free zones.

This policy supported by a strategic geographical position and social stability have helped Tunisia before 2011 to attract many foreign investors mainly those of a European origin, but current achievements are still not very satisfactory.

In fact most of the projects are in sectors with low added value technology (47% of the technology investment priority is monopolized by the Textile Clothing sector and leather) and investment in technology transfer remains low in comparison with funds intended to export promotion or protection of the environment, for example, even if a relatively small change in trend is observed.

The private sector is not involved in the national effort to promote research, its share is about 0.13% of the national wealth, only 5% of manufacturing SMEs involved in research - innovation compared to 21.6% in Europe, in terms of patents and innovations, the total demand remains insignificant and not worthy of a country trying to catch up with the developed countries of the OECD.

International comparison in terms of incentives granted to FDI shows that Tunisia is well positioned but the return effect of these incentives does not appear, leaving Tunisia lagging behind economies of a similar level of development.

Although the provisions in order to promote local and foreign private investment are similar or very close, which makes the difference even the success of some countries is their degree of

international integration in the global economy, the level of qualification of labor and the level of flexibility of administrative procedures. The fiscal or financial incentives to support investment followed the decision to invest. The land is an important factor for domestic and foreign investment.

Empirical studies show that the foreign presence is not always sufficient to generate systematic positive effects on the economy of the host country. The existence and extent of such benefits are determined by several factors such as the level of integration of the FMN, the capacity to absorb technology, the stock of human capital, the technological gap between the host country and the investing country. However, these flows can be beneficial if accompanied by significant internal changes. Indeed, countries can benefit from technological externality that supports their policy of openness in terms of foreign capital provided to develop human capital. But developing human capital through institutional reforms not only different levels of education and training but also a questioning of the push factors that encourage graduates and qualified to emigrate.

The Concern for the host country to attract multinational corporation is partly explained by their desire to take advantage of more sophisticated technologies, nevertheless observing the expenditure on R & D conducted by multinationals, we can see that the costs of foreign firms in R & D in their implantation sites are very low compared to expenses of the parent company. This would tend to show that foreign industrial groups contribute very little to the development of the technological potential of host countries.

This observation confirms the heterodox thesis insisting that multinationals tend to retain control of their technology and technology transfer induced FDI is not significant, especially in countries where the fabric developments industry is less dense and less able to assimilate the technology used by foreign firms, Kokko shows studying foreign affiliates located in Mexico, the difficulty of technology transfer through FDI. That is the weakness of this transfer would lead to accentuate the conflict of interest between multinationals and host countries.

Mastery of knowledge and technology has become an essential factor for economic and social development. Tunisia is determined to consolidate the investment in knowledge through the development and adaptation of the system of education and training to provide skills capable of meeting the challenges posed by these changes and strengthen the spirit of initiative, creativity, innovation, and promote growth and employment.

In this context, the guidance in the area of knowledge is based on adapting the curriculum of higher education, improving performance and strengthening the technological base. The effort will focus in particular on a better preparation of the new diplomas of higher education to the demands of the labor market by improving their employability and followed by permanent changes in the labor market in Tunisia and abroad.

In parallel and in the program of creating technological centers, research centers will strengthen and diversify to develop continuously new growth sectors and exploit new opportunities.

In its perpetual quest for development, Tunisia will intensify its efforts in terms of attractiveness in an environment where competitors are numerous and tenacious prepared to do real miracles to attract FDI.

We have seen in this article that empirical studies do not all agree on the fact that FDI contributes to technology transfer but we have seen that in addition to the IDE international trade promotes the transfer. The direction and magnitude of this transfer varies from one country to another and from one region to another.

Ultimately, a legitimate question arises: Will Tunisia considers catching up with technologically developed countries without FDI?

On the road there are of course the emergences of other miracles recipe to stimulate technological development but will also be effective foreign investment?

## REFERENCES

Barro, R.J. and S.M. Xavier, 1997. Technological diffusion, convergence, and growth. Journal of Economic Growth, 2(1): 1-26.

Blomstrom, M., 1986. Multinational and market structure in Mexico, World Development, 14(4): 523-530.

Bouoiyour, J., H. Hanchane and M. El Mouhoub, 2009. Investissements directs étrangers et productivité : Quelles interactions dans le cas des pays du moyen orient et d'afrique du nord ? Revue économique, 60(1): 109-132.

Caves, R., 1974. Causes of direct investment: Foreign firms, Shares in Canadian and United Kingdom manufacturing industries, Review of Economic and Statistics, 56(3): 279-293.

Coe and Helpman, 1995. International R&D spillovers, European Economic Review, 39(5): 859–887.

Coe, H. and A. Hoffmaister, W., 1997. North-South R&D spillovers, The Economic Journal, Royal Economic Society, 107(440): 134-149.

Deng, Z., R. Falvey and A. Blake, 2012. Trading market access for technology? Tax incentives, foreign direct investment and productivity spillovers in China, Journal of Policy Modeling, 34(5): 675–690.

Javorcik, B.S. and T. Harding, 2013. Investment Promotion and FDI Inflows: Quality Matters, CESifo Economic Studies, 59(2): 337-359.

Keller, 1998. Are international R&D spillovers trade-related?: Analyzing spillovers among randomly matched trade partners, European Economic Review, 42(8): 1469-1481.

Keller, W., 1997. Do trade patterns and technology flows affect productivity growth? World Bank Economic Review, 14(1): 17-47.

Keller, W., 2010. Chapter 19- International trade, foreign direct investment, and technology spillovers, Handbook of the Economics of Innovation, 2: 793–829.

Liu, Z., 2008. Foreign direct investment and technology spillovers: Theory and evidence. Journal of Development Economics, 85(1–2): 176-193.

Miyamoto, K., 2003. Human Capital Formation and Foreign Direct Investment in developing Countries, Organization for Economic Co-operation and Development (OECD), OECD Development Centre, Working Paper, No 211.

**BIBLIOGRAPHY**

Barro, R.J., 1996. Determinants of economic growth: A cross-country empirical study. 1 Edn., MIT Press Books: The MIT Press.

Blomstrom and J.Y. Wang, 1992. Foreign investment and technology transfer: A simple model. European Economic Review, 36(1): 137–155.

Blomstrom, M. and Kokko, 2003. Human capital and inward FDI, European Institute of Japanese Studies (EIJS),Working paper No 167: 24.

Blomstrom, M. and Kokko., 1998. Multinational corporation and spillovers. Journal of Economic Surveys, 12(3): 247-277.

Blomstrom, M., Lipsey and M.M. Zejan, 1994. What explain developing country growth? National Bureau of Economic Research (NBER),  working paper No 4132.

Borenstein, De. Gregorio and Lee, 1998. How does foreign direct investment affect economic growth? Journal of International Economics, 45(1): 115–135.

Brainard, S. and Lael, 1997. An empirical assessment of the proximity-concentration trade-off between multinational sales and trade. American Economic Review, 87: 520-544.

Claude Berthomieu and Hajer el ouardani, 2004. libéralisation, investissement direct étranger et multinationalisation des PME, l'attractivité de la Tunisie pour les PME étrangères , septembre 2004, communication au colloque EMMA, Madrid, 4 et 5 juin 2004.

Daly and Globerman, 1991. Foreign direct investment and "Spillover" efficiency benefits in Canadian manufacturing industries, Canadian Journal of Economics, 12(1): 42-56.

Dufourt, D., y. Crozet, R. Sandretto and L. Abdelmalki, 1997. Les grandes questions de l'économie internationale, Nathan, 149 F: 448.

Estrin, S. and A. Bevan, 2004. The determinants of foreign direct investment into European transition economies, Journal of Comparative Economics, 32(4): 775-787.

Feldstein, M., 2000. Aspects of global economic integration: Outlook for the future, National bureau of economic research, Working Paper No. 7899, Published: Aspects of Global Economic Integration, Annual Conference of the federal reserve bank of Kansas City.

Globerman, 1979. Foreign direct investment and "Spillover" efficiency benefits in Canadian manufacturing industries, Canadian Journal of Economics, 12(1): 42-56.

Gorg, H. and E. Strobl, 2001. Multinational companies and productivity spillovers: A meta-analysis. The Economic Journal, 111(475): 723-739.

Keller, W., 1999. Trade and transmission of technology. Journal of Economic Growth, 7(1): 5-24.

Louis Muchielli, 1991. De nouvelles formes de multinationalisation : Les alliances stratégiques. Problèmes Economiques, 55(1): 118-134.

Montoussé, M., 2002. Théories économiques, Bréal: 128.

Mucchielli, J.L. and E. Combe, 1998. The multinational firm versus the host country: A bargaining power approach Emerald Group Publishing Limited.

Oman, C., 2000. quelles politiques pour attirer les investissements directs étrangers ? une étude de la concurrence entre gouvernements, "Éditions OCDE, collection études du centre de développement" repris dans Problèmes économiques, No 2680, pp : 148.

Régis, B. and T. Michel, 2010. Analyse des séries temporelles : Applications à l'économie et à la gestion - Manuel et exercices corrigés, Ed. Dunodi, France Edition Dunod, Coll. ″ Eco sup ″, pp :318.

Van, C.H., M. Catin and S. Ghio, 2002. Investissements Directs Etrangers, Diffusion Technologique et Concentration Spatiale Dans Les Pays En Développement, revue Région et Développement, université de Toulon et du Var, 16(13): 55-83.

Vinish Kathuria, Productivity spillovers from technology transfer to indian manufacturing firm. Journal of International Development, 12(3): 343-369.

Wang, C. and X. Liu, 2003. Does foreign direct investment facilitate technological progress? Evidence from chinese industries. Research Policy, 32(6): 945–953.

**Annex 1**

Statistical properties of the variables

| Variables | Average | Maximum | Minimum | Standard Deviation |
|-----------|---------|---------|---------|--------------------|
| TPIB | 4.60 | 7.94 | -1.44 | 2.38 |
| IDE | 2.46 | 9.51 | 0.60 | 1.77 |
| KH | 54.09 | 92.13 | 21.05 | 23.66 |
| I | 26.80 | 35.89 | 20.70 | 3.61 |
| X | 39.91 | 55.62 | 29.08 | 5.90 |
| DEM | 1.82 | 3.14 | 0.59 | 0.73 |
| AGR | 59.47 | 63.60 | 54.66 | 2.75 |
| TEL | 6.12 | 12.53 | 1.24 | 4.19 |
| XMA | 63.18 | 82.26 | 25.72 | 18.13 |
| IDEE | 1.71 | 5.23 | 0.36 | 0.94 |
| MEQ | 73.10 | 86.81 | 56.97 | 9.62 |

**Source:** Our calculations based on WBI (2010) and UNCTAD

**Graph-1.** Residue specification 2



RESID