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# Technology Transfer: Role of FDI and Trade Case of Tunisia

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***Abstract:***
*The aim of this study is to analyze by which means Tunisia transfers to her area the technology is it through foreign investment or international trade? The answers to this problem was gradual as we followed an approach using economic theory, the reality of Tunisia and econometric and statistical tools. We tested the relation between Technology transfers and the Foreign investment, trade in Tunisia over a period of 38 years from 1975 to 2013.So, we estimated in two phases, for the 1ST estimation is for the economic growth equation, and we deduced that residue is a proxy of technology. Then as a second phase, we regressed on European Foreign investment, exports of manufactures, imports of goods in addition to other variable to test the robustness of the results and describing the level of infrastructure in the country.*
*Thus, it appears from our study that foreign direct investment does not contribute in transferring the technology and does not have an impact on the economic growth of Tunisia. However, it follows from our study that the international trade only through the imports represent the main channel of technology transfer in Tunisia*

***Keywords:*** *Technology transfer, foreign direct investment, trade, economic growth*

## 1. Introduction

Many countries whether industrialized or newly industrialized countries such as china, South Korea, Mexico and Brazil considerate as a successful example of technological transfer. Those countries have succeeded to transfer to her area a sophisticated and developed technology.

This transfer allowed to those countries not only to boost them productivity factors and ameliorate the rate of them economic growth but also to profit from the spillovers of this transfer such as a strong competition and offers for them the ability to ameliorate them openness degree and a higher development level.

However, for Tunisia case, because of the failure of the socialization experience of its economy during the 60‟s, the governments have applied a radical change occurred to her economic policy in the early 70s. This change based on encouraging the development of export industries; ameliorate the partnership system, improve the number of foreign firms in Tunisia. One of the basic objectives that Tunisian government has fixed to with the new strategy of the 70‟s is the ability to own sophisticate, high level technologies to profit from it like the other developed countries specially when this technology became a curtails instruments of developing and a factor to raise the rate of the economic growth.

Therefore, technology has become a necessity to Tunisia for several reasons such as:

- Catch up the developed countries
- Ameliorate and developed her productivity factors
- Boost her competition capacity and the ability to face some strong competitors
- Protect her local market form foreign domination
- Ability to create new jobs, so decreasing the unemployment rate

Thus, according to many studies this objective of technology transfer can be reached only through 2 essential channels, first the Foreign direct investment and second the international trade, and those channels for Tunisia are the basic pillars of her economy. So, the curtail questions that should be answered to analyses whether the objects have been reached or not are: What is the real contribution of foreign investments and the international Trade in Tunisian economy? And which one of those channels does truly transfer technology to it?

## 2. Review of the Empirical Literature

Most of empirical literature is trying to prove that one of those instrument FDI and international trade are not only one of basic pillars of the fulcrum for the economic development of the countries but also one of the main channel of technology transfer Therefore we can note that all of those studies try to reach one of those result and conclusion:

FDI leads to economic growth, so have a positive impact on the economy and also transferring technology to those host countries, also FDI can contribute to economic growth of developing countries that if they have minimum stock of human capital that enable to use the benefit from technology diffused:

- Famous Empirical studies that support this conclusion: Blomstrom and Al 1998 and DE Mello 1999, They found that the effect of FDI is more important for developing countries only if those FDIs is with high income.
- Empirical studies that support this conclusion: Borenztein and al 1998 , Xu 2000, Lee 2001 : they found developing countries a minimum share of human capital is required to benefits from FDI more account way to benefit from foreign technologies and the majority of developing countries have not reached yet that threshold

The presence of sufficient degree of openness in the host country that may help to boost the international trade contribution in those countries that seeking for economic growth and which considerate by same authors as the key for a successful technology transfer and diffusion specially for development countries:

- same of famous empirical study that proves this result is the one of De Melle 1997 how concluded that Trade policies in the host countries appears to shows that there is link between trade regimes and economic growth that lead to technology transfer.
- other studies like Atikal and banga 2003 on India how proves that trade is the essential channel of technology transfer

With lesser interest few studies has analysis both instruments together to find out which one between both in the same model is the main channel of technology transfer and which one has better and bigger impact on the economic growth such as:

- Alaya in 2006 , study the impact of FDI and trade on Tunisia , morocco , turkey and she found out that FDI has negative impact on economic growth and the Economic growth in those countries is mainly determined by TRADE And local investment and lesser interest by human capital.
- Alaya2010 , find out that both instruments has a positive impact on the economic growth and both can be considerate as channels of technological transfer

**3. Model Specification**

The growth is the result of the increase in total output of an economy, as macroeconomic production function is the center of his analysis. Macroeconomic production function is a representation of the production activity at the aggregate level; this is a summary of all firms" production functions.

The functions of individual productions (those firms) are obviously the only ones having a real existence; the aggregate function can only be an analytical construction. Many discussions focused on the possibility of such a construction in the 60s in particular. We show easily, especially as macroeconomic production function can be achieved by simply adding individual features (the nature of the returns of individual functions is not stored). Macroeconomic production function, whatever its method of production, can only be an approximation, which must be sufficiently loyal, actual production conditions of the economy.

- The production function will be:

$Y_t = F(K, L)$

Y = real national income (by volume)

K = the total capital stock

L = labor (labor force).

The model that used in the following empirical study has its dynamic in production function in neoclassical macroeconomic level (neoclassical production function Solow)as a Cobb-Douglas production function.

$Y = AK^{\alpha}L^{\beta}$

K=capital of capital used

- L=Quantity of labor used,
- A=is a Coefficient that characterize the dimension of the economy

α+β=1 so, the returns to scale are constant

with α=Part of capital price and β= Part of labor price

Based on Denin and carre also on Deboise and Malinvard franc which They found that is possible to calculate the economic growth even in the absence of population and later this has been confirmed by neoclassical theory. Indeed, with a Cobb-Douglas function of the form$Y = AK^{\alpha}L^{\beta}$ take the Differential Y.

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

$$dy = \alpha K^{\alpha-1}L^{b}dK + \beta K^{\alpha}L^{\beta-1}dL$$

$$dy = \alpha Y\frac{dk}{k} + \beta Y\frac{dl}{l}$$

If we divided the equation with Y) $\frac{\mathbf{dy}}{\mathbf{y}} = \alpha\frac{\mathrm{dk}}{\mathrm{k}} + \beta\frac{\mathrm{dl}}{\mathrm{l}}$

g = αPMK + βPML

g = economic growth

PMK = the marginal productivity of capital

PML = marginal productivity of labor.

Economic growth is equal to the sum of growth rates of capital and labor weighted by the share of profit and wages in total incomes. However, the economic growth equation has developed after 30's booms, several empirical papers has confirmed, the Neoclassical theorist, found that an important part of the economic growth called residual remain unknown only few they defined as technical progress (as Smith and BARRO).

Therefore, it necessary to introduce in the analysis a factor that explains the unknown part of the economic growth. According to empirical study, technical progress was conceived as a constant trend in time from a certain starting level. At time , Technical progress would be noted as "H" so it will be equal to

$Ht=Hoe^{\lambda t}$

the production function will be:

$Yt=HtKt^{\alpha}Lt^{\beta}$

$Yt= Hoe^{\lambda t}Kt^{\alpha}Lt^{\beta}$

$$dY = \frac{\partial y}{\partial t}dt + \frac{\partial y}{\partial k}dk + \frac{\partial y}{\partial L}dL$$

$dY= \lambda H0e^{\lambda t}Kt^{\alpha}Lt^{\beta}dt+ \alpha H0e^{\lambda t}Kt^{\alpha-1}Lt^{\beta}dK+\beta H0e^{\lambda t}Kt^{\alpha}Lt^{\beta-1}dL$

If we divided all the equation by Y: $\frac{dY}{Y} = \lambda dt + \alpha\frac{dk}{k} + \beta\frac{dL}{L}So$

We have a decomposition of economic growth showing the respective contributions to the growth of each factor to technical progress. following El Mouhoub.M and Jamal.J and Helam.H (2009) and Nassif Wahiba(2012), The economic growth can be measured by the rate of GDP and we can use as variable to explained but it depend on the availability of those variable :

- Rate GDP
- FDI : the ration Foreign invest to GDP
- HK : human capital : The enrollment rate at the secondary level
- DI ; the ratio Domestic invest to GDP
- X : The ratio of exports to GDP
- PL : The population growth rate
- M : The ratio of imports to GDP
- Et : error

So the 1st equation of the model will be like

$RGDP = C+ a1 *FDI +a2*HK+a3*X+a4*DI +a5*PL+a6*m+ + \varepsilon t$

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

- Xma: part of manufactured export in the total exports
- Mma: The ratio of imports to GDP
- Tel : as proxy for infrastructure: number of phone line by 100/ resident
- FDI (7(UE) :the ration of Foreign invest to GDP of EU7

Specification in step 2 is as follows:

$\varepsilon t = C+a1*Xma +a2*Mma + a3*tel +a4*FDI(7E.U)+\varepsilon t$

## 4. Data

The data used in this research are draw from 1975-2013. The statistics are collected from the World Bank database (WBI 2010) available on its website. These include the following series: The real Gross Domestic Product growth rate (%),foreign direct Investment, Exports of goods and services (% of GDP), Import of goods and services (% of GDP), Fixed telephone subscriptions, Manufactures exports (% of merchandise exports), manufactures Imports (% of merchandise imports), Population growth (annual %), the enrollment rate in secondary education (in %), Domestic Investment.

To complete the statistical series, we appealed to the UNCTAD database. L'INS Tunisia, and the organization of economic co-operation and development, last and not least, statistical database of the European Union Eurostat to collect from it:The Foreign investment of basic 7 European countries in Tunisia such as French, Italy, Germany, Netherlands, Belgium, Luxembourg and Sweden

## 5. Empirical Analysis

Before reviewing the results of estimates it is imperative to examine the stationary of time series which will carry our regressions. Therefore, a statistical series called not stationery, if their variables are correlated presently. In other world, the value of each period depends heavily on its past or previous achievements, the variable whose auto-correlated is close to unity which is only decreasing slowly but remaining significantly different of zero to some orders, so, they are non-stationary variables.

Thereis one way to ensure the stationary, of time series by applying the unite root test of Augmented Dickey Filler (ADF). For this study we aregoing to apply the ADF test augmented Dickey-Fuller for the 3rd specification (constant and trend), as a result we deduced that some variables such as Gross domestic product, Foreign investment, domestic investment, population growth, imports, export and Foreign investment (7 euro) are stationary in 1stdifference. However, the rest of the variables are stationary in 2nd difference like the Exports of goods and services, import of goods and services, Fixed telephone subscriptions and the Foreign investment of basic 7 European the results are shown table 1 annexes I.

## 6. Results

The first estimation of Equation 1 by using the OLS regression gives the results shown in Table5 2 below.

| Variable | Coefficient | Std.Error | T-Statistic | Prob |
|---|---|---|---|---|
| C | -18.1119 | 8.892.3816 | -2.02962 | 0.0536 |
| FDI | -0.14755 | 0.262856 | -0.56132 | 0.5798 |
| HK | 0.032326 | 0.040159 | 0.804941 | 0.4288 |
| X | 1.024004 | 0.316262 | 3.237835 | 0.0035 |
| DI | 0.965 | 0.272469 | 3.541681 | 0.0017 |
| PL | -0.00963 | 1.009038 | -0.00954 | 0.9925 |
| M | -1.02463 | 0.28949 | -3.53942 | 0.0017 |

*Table 2: Estimation result*

The previous result of the OLs regression cannotbe considered as a final result only if we verify the condition of this method:

- Heteroskedasticity. The variance of "εt" should be constant in time: we applied the breusch-pagan-godfrey test , as a result we find the p.value = 0.42 > 5% , so the model is homoskedasticity so the var (ε) is constant
- Autocorrelation: , it means that the covariance between ε should be equal to 0 , we applied also the breusch-godfrey serial correlation lm test as a result we find the p.value = 0.9922 > 5% , so absence of autocorrelation issue therefore cov (εt, εs)=0

So, we can take the pervious regression as a final one because she verifies all the condition of the OLS.
The residue resulting from the previous result estimation is illustrated in Annex II. (Fig 1). The residue retained estimation in 1st phases is used in the regression of the 2nd equation above as a proxy for technology.
The estimation of equation 2 gives us the following result[1]

$$\varepsilon t = -15{,}366 + 2.8335\, FDI\ (euro7) + 0.244750 Mma - 0.028166 Xma - 0.139865\, TEL$$
$$(-2.8744)(2.0317)(2.52925)(-0.5687)(-0.97805)$$

It thus, in 1% level it appears from the estimation that neither Foreign investment nor the infrastructure and the export is significant, only importing new equipment has a significant positive effect, these results confirm the theory that trade - via imports are-channel transmission technology. Such as the work of Coe and Helpman (1995); Coe, Helpman and Hoffmaister (1997); Enenson (1995); Keller (1997) and Jamal B., H. Hicham El Mouhoub M. (2009) and Nassifwahiba (2012)

International trade as imports is seen as an instrument of dissemination of technology. Tunisia, like all developing countries, unable to produce knowledge as some authors defined as technology, must resort to foreign imports and operate as a source of accumulation of technology.

Our study shows that FDI do not transfer technology and do not as well have a positive impact on growth. It seems for the Tunisian case, that the nature of foreign investment does not help enough or at all in transferring the technology and that may be because the latter is concentrated in sectors with low technological contributions such as textiles and do not boost the economic growth as well.

## 7. Discussion and Conclusions

We have seen in this study; the same empirical studies agree with the fact that FDI is the main channel of the technology transfer but also we view too that other studies parallel considered that international trade via imports promotes the transfer of the technology. The degree, the direction and magnitude of this transfer changes from one country to another and from one region to another

Overall, it seems that despite the different conclusion between the empirical studies, some of them conclude and conformed that there is a positive and significant effect of trade liberalization via imports on technology and it help countries specially the development ones to transfer developed and sophisticated technologies, this effect can have reached to insure the productivity gains and the growth of production (Cogneau, Dumont, and Mouhoud [2000]). However, the availability and the efficiency of skilled labor, which is a mean of the productivity and economic growth, appears as a strong condition for the effectiveness of this liberalization. In the case that we studied which is the case of Tunisia and the purpose of our estimation we realized that FDI does not contribute to technology transfers and do not affects the economic growth of it and the international trade not only affect the economic growth positively through import and negatively via export but also that only imported capital good appears to be the main channel of technology transfer in Tunisia.

This result forces us to ask a series of questions such as the effectiveness of the strategy of Tunisia to attract the FDI with high technology elements and the nature of the incentives granted by the State to foreign investors to push and encourage them to choose Tunisia as a destination to invest. However, it is true that Imports are channels to transfer

[1] Annex3 results of 2nd estimation via Eviews 9.0

technology to the country but the question is, it's enough to guaranty a sophisticate technology? and whether those technologies transferred are they developed enough to enhance the industrial sectors of Tunisia?

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l. Gramma corrected by beya chebbi (chebbibeya91@yahoo.com)

## Annexure

| With Constant and Trend (3rd Specification) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1st diffrence | | | | | 2nd diffrence | | | | |
| | unite root | | trend | | | unite root | | trend | |
| Variable | test statistic | 1% Critical value | Pvalue | 1% Critical value | Variable | test statistic | 1% Critical value | Pvalue | 1% Critical value |
| d.GDP | -4.3499 | -4.3943 | 0.0956 | 1% | | | | | |
| d.FDI | -8.903 | -4.284 | 0.8416 | 1% | | | | | |
| d.Ses | -4.2311 | -4.284 | 0.2042 | 1% | d2.Ses | -6.8519 | -4.3098 | 0.6955 | 1% |
| d.DI | -4.5953 | -4.3743 | 0.1642 | 1% | | | | | |
| d.X | -5.2629 | -4.2845 | 0.5477 | 1% | | | | | |
| d.PI | -6.256 | -4.3098 | 0.4039 | 1% | | | | | |
| d.M | -6.3428 | -4.2845 | 0.1868 | 1% | | | | | |
| d.Xma | -7.0609 | -4.2845 | 0.0027 | 1% | d.2Xma | -6.3229 | -4.3292 | 0.9156 | 1% |
| d.Mma | -4.247 | -4.3239 | 0.0165 | 1% | d2.Mma | -4.4816 | -4.356 | 0.8094 | 1% |
| d.tel | -0.5812 | -4.2845 | 0.0675 | 1% | d2.tel | -5.8475 | -4.2967 | 0.0761 | 1% |
| d.FDI (EU7) | -5.1648 | -4.3239 | 0.9274 | 1% | | | | | |

*Table 1: ADF test result*

Source: Our calculations based on output EVIEWS 9.0

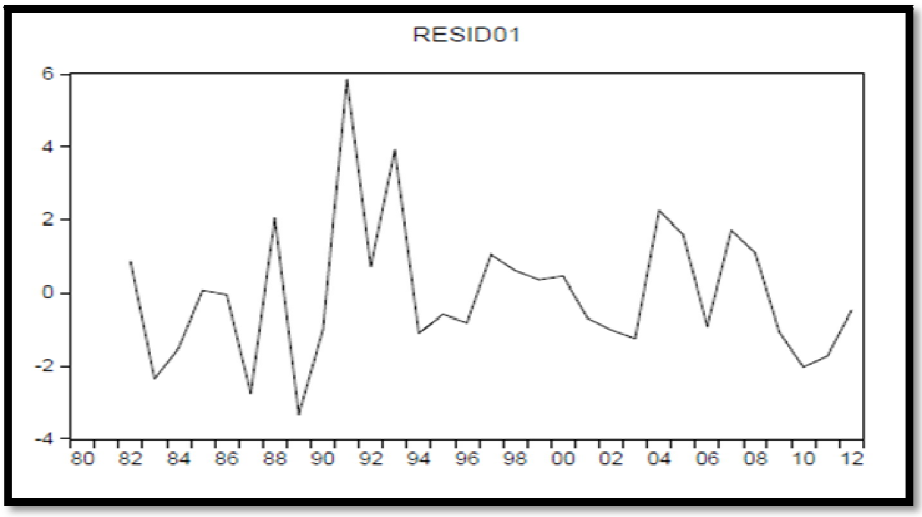


*Figure 1: Residual of 1st Equation*

Dependent Variable: RESID01
Method: Least Squares
Date: 04/22/16 Time: 20:13
Sample (adjusted): 1982 2012
Included observations: 31 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| IDEE | 2.833587 | 1.394682 | 2.031708 | 0.0525 |
| MMA_ | 0.247504 | 0.097856 | 2.529254 | 0.0178 |
| XMA__(-1) | -0.028166 | 0.049521 | -0.568764 | 0.5744 |
| TEL_100ER | -0.139865 | 0.143003 | -0.978055 | 0.3371 |
| C | -15.36625 | 5.345862 | -2.874419 | 0.0080 |

*Table 2*