Research Article

Intellectual Property Rights Protection and Technology Imports : The Tunisia -European Union Free Trade Agreement

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Abstract: This paper investigates the effects of Free Trade Agreement (FTA) between the European Union (EU) and Tunisia on stimulating exchanges between them, highlighting the effect of the protection of intellectual property rights (IPRs). Using data for Tunisia and 28 EU countries over the period 1991-2014, we estimate the effects of IPRs protection on Tunisian's imports at the aggregate level and high-tech product categories. The results suggest that the UE –Tunisia FTA and the associated reforms in IPRs will boost Tunisia's imports. Moreover, strengthening IPRs protection in Tunisia contributes to increasing its imports of pharmaceutical products, electrical and electronic equipment, and optical and medical apparatus.

Keywords : Free Trade Agreement; intellectual property rights; trade, European Union; Tunisia.

1. Introduction

Free trade has been promoted under the auspices of the World Trade Organization (WTO) as a vehicle for economic growth. Since the sixties and seventies, several States have been greatly keen on economic integration. The latter is a process by which economic relations are established between a group of countries with or without common borders (Balassa , 1994). According to Poirot (2001, p.1), the degree of integration between a region's economies is most often identified by a type of formal agreement binding the States: whether a free trade zone, a customs union, a common market, an economic union, or an economic and monetary union (Balassa , 1961; 1994).

The free trade zone is the least restrictive form of trade agreement of these different forms of integration. There is trade liberalization between member countries but these retain full freedom of their trade policies with the rest of the world. During the integration processes, barriers to product mobility are progressively removed (abolition of duties, elimination of quantitative restrictions). The objective is to promote trade within the zone.

The WTO Committee on Regional Trade Agreements listed more than 500 regional trade agreements around the world that were negotiated and concluded during the period 1948-2018. By type of agreement, the Committee reports 249 Free Trade Agreements (FTAs) that came into effect. Since 1995, several FTAs have been negotiated and concluded between developed and developing countries. The contemporary FTAs have evolved. They go much beyond traditional trade restrictions at the border. They increasingly focus on regulatory rules.

The existence and the proliferation of bilateral FTAs projects have raised many concerns from the outset of the negotiations, especially by the advocates of developing countries' access to foreign technology. In recent bilateral agreements, intellectual property rights (IPRs) clauses are introduced. The latter can increase the costs of access to technology, restrict informal technology transfers to developing countries, and increase the problem of their access to pharmaceutical products (Rodrik, 2018).

The European Union (EU) is fully committed to this dynamic of economic integration. In fact, the EU, which is an economic and monetary union between countries of the European continent, has concluded many FTAs with countries outside the union, among others, the African, Caribbean and Pacific States, the Andean Community and the countries of Central America. As for its process of economic integration with the southern Mediterranean countries, it began in the 1990s. More specifically, it deals with the 1995 agreements for the creation of free trade zones in the framework of the Euro-Mediterranean partnership. The EU as a whole has signed a FTA with each of the non-member countries separately: Tunisia (year 1998), Morocco (year 2000), Jordan (year 2002), Egypt (year 2004), Algeria (year 2005) and Lebanon (year 2006).

Our study will address only one part of the association agreement between the EU and Tunisia. It is limited to the study of the effects of IPRs protection.

Previous empirical studies have investigated whether regional trade agreements promote trade (Ejones et al., 2021). However, they have ignored the impact of IPRs protection on trade flows. Empirical models examining the link between IPRs protection and trade flows (Awokuse and Yin, 2010 ; Smith ,1999 ; Maskus and Penubarti ,1995) have focused on trade flows either by individual exporter countries (Smith ,1999; Rafiquzzaman , 2002) or for

a number of bilateral trading partners (Shin *et al*., 2016; Maskus and Penubarti , 1995), but they have ignored the impact of FTAs.

Compared to the literature, this study aims to address the following two issues: (i) How has the Tunisian economy adapted itself since 1995 to its opening up to European markets in terms of IPRs protection? (ii) What are the effects of IPRs protection on the development of Tunisia's high technology imports from the EU?

To achieve this objective of analyzing the effects of the IPRs protection linked to the FTA on Tunisian -EU imports, we adopt a panel approach and we consider total imports and imports of five product sectors: (1) optical, photo, technical, medical, apparatus; (2) reactors, nuclear, boilers, machinery, etc ;(3) electrical and electronic equipment; (4) vehicles other than railway, tramway; and (5) pharmaceutical products. Chen (2017) shows that these imports are relatively research and development (R&D) intensive products (see Chen, 2017, Chart 2, p. 872). According to OECD-EUIPO (2017), these products are strongly IP intense. Panel models related to international trade are estimated for the two partners Tunisia and EU countries (28 countries) over the period 1991-2014.

Our paper is structured as follows: the following section highlights the history of industrial property regulation in Tunisia. A brief review of the literature on the relationship between trade and IPRs protection will be discussed in the third section. The fourth section presents the methodology and the models used. The presentation of the results of the estimates and their interpretations are the subject of the fifth section. The last section is the conclusion.

2. The Euro-Mediterranean Association Agreement and IPRs Protection in Tunisia

Tunisia signed a Euro-Mediterranean association agreement with the EU on 17 July 1995, which came into effect in March 1998. The agreement took place according to a timetable in which the duration of the liberalization process varies according to the products. Initially, the FTA is limited to the exchange of industrial products. More specifically, there has been a dismantling of tariff and non-tariff barriers on imports of these products from the EU over a 12-year period. Tunisian industrial products had free access to the European market. Customs duties on industrial products in the form of raw materials or equipment were removed at the time when the agreement went into effect. Dismantling customs duties was then carried out for final consumer goods over a five to twelve- year period.

Following the decision of the European Commission on 14 December 2011, a "new category" of FTA is negotiated by the EU with Tunisia. This is a deep and comprehensive trade agreement (DCFTA). The first negotiations on the DCFTA between the two partners began in October 2015.This agreement goes beyond mere trade liberalization. It aims to further increase bilateral relations and enable closer and deeper economic integration of the Tunisian economy into the EU internal market. It will cover many and very diverse areas of cooperation such as trade liberalization in agricultural products, processed products and fishery products, trade liberalization in services, internal market issues which include the following two key areas : government procurement, and investments establishment and protection, sanitary and phytosanitary measures, regulatory transparency, competition policy, intellectual property, anti-dumping and countervailing measures, sustainable development and energy-related trade aspects.

The regulation of industrial property in Tunisia is very old. Patents of invention were governed by a legal text that dates back to the 19th century (the Beylical decree of December 26, 1888). As for trademarks, the decree is that of June 3, 1889 which is elaborated on the model of the French law of June 23, 1857. The industrial designs are the object of a law which dates back to 1911.

Tunisia, which has been a member of the World Intellectual Property Organization since 1975, is a signatory to most international conventions for the protection of industrial property, such as the Paris Convention on the Protection of Industrial Property since 1984.

In 1995, Tunisia signed the Association Agreement with the EU. The latter includes IPR provisions relating to compliance and adherence to multilateral agreements. It states that "The parties shall provide adequate and effective protection of intellectual, industrial and commercial property rights in accordance with the highest international standards, including effective means of asserting such rights".

In the same year, in 1995, Tunisia became a member of the WTO. It has signed the agreement on trade-related aspects of IPRs (TRIPS Agreement).This agreement requires all WTO members to adopt and enforce minimum standards for the protection of IPRs; a condition for granting the WTO planned benefits.

After 1995, with the aim of enhancing economic growth through technology adoption Tunisian policymakers have undertaken major initiatives. Tunisia strengthened its participation in international conventions and treaties for the protection of industrial property in order to guarantee the respect of its citizens' IPRs, as well as those of foreigners'. In 2001, it joined the Patent Cooperation Treaty; and the International Convention for the Protection of New Varieties of Plants in 2003. In 2014, it signed an agreement with the European Patent Organization on the validation of European patents in Tunisia. This agreement came into effect on December 1, 2017.

In parallel, Tunisia has revised its industrial property legislation to make it compatible with the EU Association Agreement and the TRIPS Agreement requirements. This mainly includes the enactment of Law No. 2000-84 of 24 August 2000 on patents and its implementing decrees , the enactment of Law N° 2001-36 of April 17, 2001 on the protection of the trademarks and services, and the enactment of Law No. 2001-21 of 6 February 2001 on the protection of industrial designs. The integrated improvements are generally industrial property measures very similar to those defined by the trade agreements.

In addition, Tunisia has established measures to enforce the protection of IPRs in its national legislation by adopting dissuasive sanctions for violations of these rights (including imprisonment and / or heavy fines). Similarly, the texts provide for border measures preventing counterfeit or pirated goods from entering the channels of commerce. Authorities are allowed to order the destruction of counterfeit or pirated goods. Tunisia's anti-counterfeiting efforts are also confirmed by its weak trade intensity in counterfeit goods around the world. Indeed, the OECD (2008) report on the relative intensity with which an economy exports counterfeit and pirated goods observed over the period 1999 to 2005 shows that the index of GTRIC-e (general index linked to the counterfeiting and piracy trade) recorded by Tunisia is close to zero and close to the indices of the EU countries. According to OECD-EUIPO (2017), Tunisia is also not identified producer of counterfeit pharmaceuticals, counterfeit optical, photographic and medical instrument, and counterfeit electronics and electrical equipment.

3. Trade and IPRs Protection: Literature Review

The existing literature assumes that strong IPRs protection stimulates domestic innovation and economic growth (Panda *et al.*, 2020; Falvey et al., 2006; Park and Ginarte , 1997; Gould and Gruben, 1996). In particular, patent reforms are expected to influence local productive and innovative capacity of developing countries (Ivus and Park, 2019).

Moreover, some studies have examined the link between IPRs protection and trade flows. IPRs protection sh ould influence trade flows among countries. According to some theoretical studies, the relationship between strong PRs of destination countries and the trade flows of source countries is ambiguous because of two opposing effects; namely "market expansion" and "market power" effects (Maskus and Penubarti, 1995; Smith, 2001). Hence, empirical analysis is typically pursued to see which effect dominates.

More specifically, according to the first effect, trade is positively correlated with the effectiveness of the current protection in the importing country. Indeed, increased protection can reduce counterfeiting, which in turn increases demand for innovative firms. According to the second effect, enhanced IPRs protection can have a negative effect on trade flows. Greater protection allows the patent-holding firm to reduce the quantities exported thanks to its monopoly power in the host country's market, and to increase its price.

Smith (1999) indicated that the impact of enhanced protection on trade flows depends on the two contradictory effects;" market expansion " and "market power". The total effect depends on the imitative capacity of the importing country.

Under conditions of "market expansion», the relationship between weak IPRs protection and trade flows is strongly positive when imitative capabilities are strong. Indeed, assuming that there is weak IPRs protection and that imitating firms are efficient, counterfeiting increases and takes up a significant share of the market. Their exclusion increases the demand for the original product. On the other hand, under the conditions of "market power", the relationship between strengthening IPRs protection and trade flows is negative, essentially when imitation capabilities are weak. Competition from domestic imitating firms will be weak. Whereas, there is ambiguity about the nature of the relationship between weak IPRs protection and trade flows when the importing country's imitative capacity is weak. Similarly, the relationship between strengthening IPRs protection and trade flows is ambiguous when imitative capabilities are strong.

The empirical analysis of the relationship between strengthening IPRs protection and trade was the subject of some studies (Panda *et al.*, 2020, Chen, 2017 ; Awokuse and Yin, 2010 ; Smith ,1999 ; Fink and Primo Braga ,1999 ; Maskus and Penubarti ,1995).The results obtained differ according to the estimation methods applied and the goods exchanged, the subject of the study. Some of these studies show that protection regimes in developing countries attract trade flows from developed countries (Mrad, 2017; Awokuse and Yin, 2010 ; Smith ,1999 ; Maskus and Penubarti ,1995). According to other studies, the effect of IPRs protection depends, among other things, on the partner countries 'level of development and the intensity of the technology-traded products (Panda *et al.*, 2020, Chen, 2017; Shin *et al*., 2016, Fink and Primo Braga, 1999). The interaction effect of a destination country's PRs protection and a source country's level of technology on trade has empirically analyzed.

Panda *et al., (*2020), using panel data analysis on 67 countries from 1996-2014,show that that the market power effect of destination patent rights dominates the market expansion effect on exports in the case of greater technologically developed products. Shin *et al*., (2016) argued that as an importing country's level of IPR increases, the net marginal effect of technology on exports decreases. The economists have used a pooled panel data set for 70 countries and the period *2000*–2007 and found assymetric results. The destination country's level of IPRs can act as an obstacle to trade diminishing the exports from southern countries. IPRs protection in the South does not thwart with Northern exporting.

Chen (2017) conducted an empirical study on the relationship between country import flows and IPRs protection for a sample of 119 countries and for the period 1976-2010. His empirical results indicate a positive effect of IPRs protection on trade, and that this effect differs according to the products' technology intensity and the countries' development level. The positive effect of IPRs protection is greater for the relatively R&D - intensive products. The author also highlighted a stimulating role of IPRs protection only for a sample of middle- income countries.

Fink and Primo Braga (1999) found, from the estimation of a gravity model for a sample of 89 countries, a positive relationship between IPRs protection and trade flows for total trade (excluding oil). However, a negative and non-significant relationship is highlighted for trade in high-tech goods (e.g. chemistry, electrical and office machinery, telecommunications equipment, etc.). The absence of a strengthening effect of IPRs protection at the level of certain industries exports, the high-technology intensive ones, can be explained by the predominance of a "market power" effect in these areas. This corresponds to a reduction of the quantity marketed in countries where IPRs protection is high. This lack of increased IPRs effect at the level of exports in high-tech industries can also be explained by the substitution of FDI for exports.

Awokuse and Yin (2010) found a positive and significant effect of IPRs protection on the flow of imports to China by estimating a gravity model. According to the authors, the introduction of a patent policy stimulates the quantities imported. More particularly, this stimulating effect is greater in the technology-intensive sectors (e.g. chemistry, electronics, instruments and machines). In addition, positive effects and significant patents protections are highlighted in the case of imports from OECD countries since these countries are the major technology-intensive goods producers and patent-sensitive goods exporters. Similarly, the positive effects are highlighted in the case of imports of non-technology-intensive products (e.g. appliances, paper, rubber and wood products) from non-OECD countries. In fact, the latter have a relative comparative advantage in producing and exporting less technology- intensive products.

In a gravity model estimation, Smith (1999) shows that the nature of the relationship between a country's IPRs policy and the US economy's exports to that country depends on the imitating capacity of the importing country as well as its level of development. Three essential results have been found from Smith's (1999) empirical work. Low IPRs protection is a barrier to US exports to countries with high imitation capacity. Strengthening IPRs protection favors US exports to high imitation countries under the "market expansion " effect. Alternatively, stronger IPRs protection reduces US exports to countries with low imitation capacity due to the "market power" effect.

Smith's (1999) findings are consistent with those of the Rafiquzzaman (2002) study for Canadian manufacturing exports. By estimating a gravity model, Rafiquzzaman (2002) shows that Canadians tend to export more to countries where patent ownership is highly protected. In addition, strong patent protection encourages Canadians to export relatively more to high-income than low-income countries. According to the author, strong patent protection has the effect of increasing exports to countries that present a higher imitation threat while limiting them to countries that present a lower imitation threat.

Maskus and Penubarti (1995) specified an empirical model for a set of developing countries where exports from OECD countries (on average) to developing countries are explained by IPRs protection regimes; measured

by the Rapp and Rozek indicator. Their empirical results show that IPRs protection policies in developing countries favor the entry of import flows of manufactured goods from OECD countries.

Relying on the aforementioned IPRs protection studies, as well as the empirical models used to account for international trade flows, we offer specifications that account for imports of goods with the protection of IPRs associated to FTA.

4. Empirical Models and Methodology

Our empirical work consists of estimating gravity equations. In fact, as some economists have pointed out (Fontagné et al., 2002, Sanso et al., 1993), the gravitational trade model has become, in recent decades, a standard tool for modeling international trade (Ejones *et al*., 2021). Originally, the gravity model predicts the existence of a proportionality relationship between trade and the product of the partners 'GNP (Tinbergen , 1962) In the first applications of this international trade gravity model (Linnemann ,1966 ; Aitken, 1973) additional variables were incorporated.

In fact, the following variables were added to the factors the GNP of country i and country j: populations, transport costs, tariff and non-tariff barriers to trade as well as indicators of "cultural" factors such as common history and common language. Geographic distance is, generally used as a proxy variable for the transportation cost.

The trade gravity model underlies the idea that trade flows between two countries are positively correlated to their GDP but inversely proportional to the geographical distance between them. An increase in the GDP of the importing country leads to an increase in income, which favors the increase in demand for imports of products. Likewise, the rise in the wealth of the partner country favored by the increase of its GDP stimulates its production and its exports. The greater the distance between these two countries, the higher the transport costs. As a result, the price of goods increases, which reduces imports.

Sharing a common language can significantly reduce trade barriers and increase a country's import flows. Similarly, trade is relatively more important between two countries that have historical links such as are post-colonial ones.

- ***Free Trade Agreement and Import of High Technology Goods : Model n ° 1***

Our first model to estimate is based on the assumption that Tunisia's imports (country i) from a EU country (country j) depend on gravity variables, namely country j variables (GDP, population), country i variables (GDP, population), and the geographical distance separating the two countries i and j. In addition, dummy variables capturing the FTA, sharing a common language and historical links (colonial past) between partner countries i and j are introduced into the model.

Our first equation is given by:

$$M_{ijt} = F(GDP_{it}, GDP_{jt}, POP_{it}, POP_{jt}, Dist_{ij}, FTA_{ijt}, LANG_{ij}, COL_{ij}) \qquad [\text{Equation n°1}]$$

Where i denotes Tunisia. j denotes the EU country. M is the value of imports of Tunisia from country j. GDP and POP represent gross domestic product and population, respectively. $Dist_{ij}$ is the distance between country i and country j. FTA is a dummy variable for free trade agreement between countries. LANG is a dummy variable to indicate whether countries i and j share a common language. COL is a dummy for colonial relationship, (historical links, and colonial past)".

In line with the work of Awokuse and Yin (2010), we consider the variable GDP_{ij} the product of the GDP of Tunisia and the GDP of the country j (GDPi*GDPj), as well as the variable POP_{ij} the product of the population of Tunisia and the population of the country j (POPi*POPj) as determining variables of Tunisia's imports from the country j, (see Awokuse and Yin ,2010; Equation (7) , p. 1097).

Rewriting the equation n°1 by using this transformation, we get:

$$M_{ijt} = F(GDP_{ijt}, POP_{ijt}, Dist_{ij}, FTA_{ijt}, LANG_{ij}, COL_{ij}) \qquad [\text{Equation n°2}]$$

M, Dist, FTA, LANG and COL are the same variables defined in equation n°1.

Our objective is to estimate the effects of a FTA on Tunisian imports both at an aggregate level (Tunisia's total imports from all its different EU partner countries) and at a sectoral level (by product groups). The existence of a FTA has the effect of bringing the signatory countries closer and reducing the barriers (tariff and non-tariff) of the exchange between them. This has the effect of increasing exchanges between them.

In addition to total imports (M_total) , we consider different product groups. These include the following products : (1) optical, photo, technical, medical, apparatus; (M_ apparatus) (2) reactors, nuclear, boilers, machinery, etc (M_ nuclear) ;(3) electrical and electronic equipment (M_equipment); (4) vehicles other than railway, tramway (M_vehicles); and (5) pharmaceutical products (M_pharmac). These products are classified, according to some studies (Chen, 2017), as high technology goods.

In its logarithmic form, the basic model used for each sector and for total imports is given as follows:

$$\ln(M_{kijt}) = \alpha_0 + \alpha_1 \mathrm{FTA}_{ijt} + \alpha_2 \ln(GTP_{ijt}) + \alpha_3 \ln(POP_{ijt}) + \alpha_4 \ln(Dist_{ij}) + \alpha_5 \mathrm{LANG}_{ij} + \alpha_6 \mathrm{COL}_{ij} + \varepsilon_{ijt}$$

(model n°1)

Where: i denotes Tunisia. j denotes the EU country. k denotes the product group. ε is the error term.

We expect coefficients α_1, α_2,α_3 ,α_5 and α_6 to be positive and coefficient α_4 to be negative.

In this Model 1, we included control variables, namely temporal effects relative to the year t, " year fixed effects ", in order to control the omitted variables that could be specific in time.

This model, focusing on Tunisian imports from EU countries (28 countries) over the period 1991-2014, is estimated by the ordinary least squares (OLS) estimator while correcting the problem of heteroscedasticity.

The sample of EU countries includes the following countries: Germany , Austria , Belgium , Denmark , Spain , Finland , France , Greece , Ireland , Italy , Croatia ,Luxembourg ,the Netherlands ,Portugal ,United Kingdom , Sweden , Estonia , Latvia , Lithuania , Hungary , Poland ,Slovakia , Slovenia , Czech Republic , Cyprus , Malta , Romania and Bulgaria.

The results of Model 1 estimates for overall imports and imports of high-tech goods are shown in Table 1.

- ***IPRs Protection and Import of High Technology Goods: model n°2***

Our second empirical model is inspired from the works of Awokuse and Yin (2010) and Smith (1999). We include the protection of IPRs in the country i as a determinant of its products imports in a gravity model applied to international trade.

Similarly, we consider total imports (M_total) from each EU country as well as imports by sector (M_apparatus, M_nuclear, M_equipment, M_vehicles, and M_pharmac). All these variables are expressed in logarithm.

Our model n°2 is given by:

$$\ln(M_{kijt}) = \beta_0 + \beta_1 \mathrm{FTA}_{ijt} + \beta_2 \ln(GDP_{ijt}) + \beta_3 \ln(POP_{ijt}) + \beta_4 \ln(Dist_{ij}) + \beta_5 \mathrm{LANG}_{ij} + \beta_6 \ln(IPR_{it}) + \varepsilon'_{kijt} \quad \text{(model n°2)}$$

Where: i denotes Tunisia. j denotes the EU country. k denotes the product group. ε' is the error term.

M, FTA, GDP, POP, Dist, and LANG are the same variables defined in model n°1.The variable In(IPRi) is the logarithm of the IPRs Protection index of Park and Ginarte.

As in Model 1, we include year fixed effects as control variables. Compared to the Model 1, the dummy variable "COL" is excluded.

All variables included in the Model 1 and 2 and the data sources are described in the Appendix.

We expect positive signs for the coefficients β_1, β_2, β_3 and β_5; and negative sign for the coefficient β_4. The sign of coefficient β_6 is to be determined. As discussed above, the impact of enhancing IPRs protection on trade flows depends on two contradictory effects; "market expansion" and "market power". The first effect is positive while the second is negative. The total effect, then, is to be determined. If the sign of β_6 is positive and significant, the "market expansion" effect outweighs the "market power" effect. Otherwise, the "market power" effect dominates.

This model 2 is a panel model where Tunisian imports from 28 EU countries are observed over a 24-year period (1991-2014).

The use of panel data has the merit of exploiting the two sources of variation in statistical information: temporal or intra-individual variability (Within) and individual or inter- individual variability (Between). The increase in the number of observations makes it possible to guarantee a better accuracy of the estimators, to reduce the risks of multicollinearity and especially to widen the field of investigation.

The estimation of a model with random effects is better than a fixed effects model in our case. In fact, the fixed effects model is not used to estimate our gravity Model 2 because the inter-individual variability is not exploited to estimate the model's structural parameters.[1] Another inherent limitation in the fixed effects model is that the impact of invariant factors over time cannot be identified (for instance the FTA variable, geographical distance, and sharing a common language), (Awokuse and Yin,2010, p. 1089).

The results of the estimation of the Model 2 are presented in table 2. This is a random effects model estimated by the generalized least squares (GLS) method. In addition, the statistics of the Breusch-Pagan test show that the random effects are globally significant at 1% threshold for the different gravitational equations.

4. Results Estimations

The different regressions in Table 1 demonstrate that the coefficients signs of the Model 1 variables are in accordance with the literature.

Table 1- Free Trade Agreement and Import of High Technology Goods : model n ° 1

Sectors	M_total	M_ apparatus	M_ nuclear	M_equipment	M_vehicles	M_pharmac
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
FTA$_{ij}$	**1.761*** (8.42)**	**1.950*** (4.42)**	**1.618*** (4.68)**	**2.075*** (7.28)**	**1.069*** (2.71)**	**1.600*** (3.46)**
In((GDP_{ij})	0.269*** (2.96)	0.644*** (2.87)	0.5717*** (2.80)	0 .376*** (3.18)	0.4200*** (2.84)	0 .399*** (3.07)
In(POP_{ij})	0.825*** (8.45)	0.503** (2.22)	0 .804*** (4.06)	0.998*** (7.67)	1.344*** (8.06)	0.232 (1.42)
In(*Dist* ij)	-1.540*** (-10.70)	-0.830*** (-4.33)	-1.145*** (-6.43)	-1.331*** (-7.05)	-1.437*** (-5.37)	-0.054 (-0.22)
LANG$_{ij}$	0.975*** (5.79)	0.904*** (3.12)	1.264*** (5.44)	0.562*** (2.67)	1.937*** (6.22)	0.431 (1.14)
COL$_{ij}$	0.413* (1.89)	1.048** (2.37)	-0.096 (-0.26)	0.982*** (3.24)	0 .6436 (1.63)	2.736*** (6.65)
constant	- 11.126*** (-4.77)	- 29.262*** (-6.61)	- 30.688*** (-7.84)	-27.726*** (-10.03)	-40.008*** (-8 .97)	-13.930 *** (-3.46)
Observ.	623	563	574	600	534	497
F Prob	F(29,593) = 89.64 (0.0000)	F(29,533) = 39.26 (0.0000)	F(29, 544) - -	F(29,570) = 60.77 (0.0000)	F(29,504) =52.69 (0.0000)	F(29,467) = 29.41 (0.0000)
R-squared	0.7873	0.6083	0.7071	0.7007	0.5887	0.4319
Year fixed effects	yes	yes	yes	yes	yes	yes

*Notes: Student t-values in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent*

levels respectively.

The results indicate a positive and significant effect of the "FTA" variable. The estimated coefficients of this variable are significant at the 1% threshold. Signing a FTA with the EU countries helps to increase Tunisia's total imports as well as its imports of high technology goods.

[1] The estimation of a model on panel data consists of checking whether the individual effects are fixed or random. The Hausman test (1978) is used to know which estimates should be retained.

In addition, the results indicate that the sharing a common language and the existence of Tunisia's historical links with the EU countries contribute to the improvement of its imports. The results displayed in the first five columns of Table 1 show that the variable "sharing a common language" positively and significantly influences Tunisia's imports from its European partners. Indeed, being able to communicate with its European partners leads to a reduction in the costs of commercial transactions, thus contributing to the increase in Tunisia's imports.

As for the "colonial past, COL" variable, the results show that its estimated coefficient is positive in the different equations but is statistically non-significant for imports from the sector of nuclear reactors, boilers and machinery; as well as imports from the sector of vehicles.

Distance, the proxy variable for transportation costs, greatly reduces the flow of Tunisia's imports. A 1% increase in trade costs (transportation) leads, ceteris paribus, to a fall in Tunisia's total imports in more than a proportional way of -1.54 %. These results, obtained on the effects of distance at the aggregate level, are similar to those at the sectoral level. It is worth noting here that the negative effect of distance is non-significant for the case of pharmaceutical products.

The estimated coefficients of the logarithmic variable of "product of Tunisia's GDP and that of its exchange partner", proxy variable of national income, are positive and statistically significant at 1%. The increase in Tunisian imports from EU countries is favored by a rise in national income.

In addition, the results in the first five columns of Table 1 indicate that the estimated parameters of the logarithmic variable "product of Tunisia's population and that of its exchange partner" are positive and statistically significant. An increase in the market size stimulates the rise of Tunisian imports. A positive but statistically non-significant effect is highlighted for the case of imports of pharmaceutical products.

- ***IPRs Protection and Import of High Technology Goods: model n° 2***

The results of the estimation of the Model 2 are presented in Table 2.

Table 2- IPRs Protection and Import of High Technology Goods: model n °2

Sectors	M_total	M_ apparatus	M_ nuclear	M_equipment	M_vehicles	M_pharmac
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
FTAij	1.219*** (8.92)	1.224*** (5.49)	0.727*** (4.40)	1.620*** (8.25)	0.626** (2.12)	0.836*** (3.13)
In (IPRi)	**1.966*** (2.83)**	**2.534** (2.36)**	**1.479* (1.83)**	**2.306** (2.39)**	**0.7640 (0.57)**	**2.195* (1.77)**
In(*GDP*$_{ij}$)	0.097*** (2.60)	0.223*** (4.04)	0.158*** (3.25)	0 .196*** (3.82)	0.150** (2.17)	0.142** (2.35)
In(*POP*$_{ij}$)	1.077*** (12.76)	1.115*** (9.36)	1.418*** (11.63)	1.261*** (9.50)	1.632*** (7.81)	0.989*** (7.17)
In(*Dist* ij)	-1.558*** (-6.28)	-1.072*** (-3.11)	-1.390*** (-3.89)	-1.512*** (-3.73)	-1.655** (-2.53)	-0.137 (- 0.35)
LANGij	1.446*** (4.25)	2.092*** (4.49)	2 .320*** (4.26)	1.323** (2.40)	2.859*** (3.24)	1.520** (2.87)
constant	-13.368*** (-4.33)	-30.047*** (-6.95)	-30.882*** (-6.93)	-28.142*** (-5.67)	-36.228*** (-4.57)	-27.282*** (-5.59)
Obser v.	623	563	574	600	534	497
Breusch and Pagan Lagrangian multiplier test for random effects:						
chibar2(01)	711.67	1385.15	828.38	1128.3	1360.48	961.77
Prob> chibar	(0.0000)	(0.0000)	(0.000)	(0.000)	(0.000)	(0.000)
R-squared betwe en	0.8612	0. 6448	0.7428	0.7866	0.7096	0.4030

Year fixed effects	yes	yes	yes	yes	yes	yes

*Notes: Student t-values in parentheses. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels respectively.*

As shown by the results presented in Table 2, the "between" estimator using the GLS method generates results for gravity variables that are in accordance with those obtained by the OLS method (Table 1). The coefficients of the variables FTA, In (GDP), In(POP), In (Dist), and LANG are statistically significant with the expected signs. In fact, introducing the variable "In(IPR)" in the model altered neither the sign nor the significance of these variables. However, the results of the estimation of the Model 2 for the case of the imports of the pharmaceutical products (column 6) indicate that the coefficient of the variable distance is non-significant. Our result is similar to the findings of the Awokuse and Yin study (2010) for the case of China.

The results of the Model 2 estimates confirm our conclusion that Tunisia's signing of a FTA with the EU countries favors the growth of its total imports, and its imports of high technology goods.

Moreover, they show that the variable "In(IPR)" has a positive and statistically significant effect on total imports of goods (in logarithm). At the sectoral level, this positive and significant effect is only verified for imports in the following four sectors : the imports of optical, photos, technical, medical apparatus (M_ apparatus), imports of nuclear, reactors, boilers and machinery (M_ nuclear); imports of electrical and electronic equipment (M_equipment) ; and imports of pharmaceutical products (M_pharmac). The "market expansion" effect dominates the "market power" effect for the case of Tunisia. Our results confirm that the further Tunisia strengthens its IPRs protection, the greater its imports of foreign technology goods from the EU will be. However, the variable "In(IPR)" has a statistically insignificant effect on the vehicles imports.

We see that the values of the estimated coefficients of the variable IPRs protection indicator differ depending on the sector of imported products. We note that imports from the "optical, photo, technical, medical, apparatus" sector ($\beta_6 = 2.53$) and those of the "electrical and electronic equipment" sector ($\beta_6 = 2.3$) are relatively the most sensitive to the IPRs protection policy. The results also indicate that an increase of 1% in the IPRs indicator leads to an increase in imports of pharmaceutical products by 2.19%, ceteris paribus. Imports from the nuclear reactors, boilers and machinery sector are relatively least sensitive to IPRs protection.

This difference in the effects of IPRs protection on products imports can be explained by the degree of intensity of the technology involved in these different products. Strengthening IPRs protection in the importing country Tunisia reduces the risk of imitation and gives EU countries the guarantee of being able to benefit from their innovations. Our results confirm those found by Chen (2017). Indeed, the author shows that the rise in the IPRs protection indicator strongly stimulates imports of the most technology-intensive goods.

Our results of Model 2 estimates indicate, first, significant effects of IPRs protection on imports of "optical, photo, technical, medical apparatus", imports of "electrical and electronic equipment" as well as pharmaceutical products; second, less significant effects for imports of nuclear reactors, boilers and machinery; and third, non-significant effects in the case of the vehicle sector. One possible explanation for these results is that IPRs protection is more important in the case of easily imitated products (such as pharmaceuticals) and is moderate for products that are difficult to imitate (such as machinery, transport), (Park and Lippoldt, 2014).

5. Conclusion

In this paper, we focus on the study of the Tunisia-EU FTA signed on July 17, 1995 and enforced in March 1998. Negotiations on a DCFTA between the two partners have started since 2015. This agreement aims to complement and deepen the free trade area for manufactured products. In summary, Tunisia's IPRs protection policy is based on principles and standards that are broadly similar to those of the EU and in line with international standards. The legal and institutional measures required for IPRs protection are, overall, very close to those defined by the trade agreements.

Four main results emerge from our empirical study of the effects of this FTA on Tunisia's imports at an aggregate and a sectoral level and; the effects of IPRs protection on these imports from the EU. First, Tunisia's signing of a FTA with the EU countries favors the growth of its total imports and imports of high technology

goods. Secondly, sharing a common language with the EU countries and the existence of historical links with the EU, and in particular with France, have contributed to the increase of Tunisian imports at the aggregate level as well as at the level of high technology goods. Third, IPRs protection in Tunisia is an attraction factor for the flow of imports from its EU partner countries. This is the "market expansion" effect, which dominates the "market power" effect. Strengthening IPRs protection in the importing country Tunisia reduces the risk of imitation and gives EU countries the guarantee of being able to benefit from their innovations. Fourth, the effects of IPRs protection differ according to the sector of the imported products, or more precisely according to the intensity of the technology incorporated in these different products. Strengthening IPRs protection in Tunisia contributes to increased imports of its pharmaceutical products, electrical and electronic equipment, and optical and medical apparatus.

Thus, the protection of IPRs linked to the signing of a FTA with the EU countries, promotes Tunisia the importation of goods at a lower cost and the access to foreign technology; which can accelerate its economic growth. In addition, free trade allows Tunisia to acquire new knowledge and to efficiently allocate its resources; which favors the increase of its companies' competitiveness.

Our empirical analysis of the FTA between Tunisia and the EU focused on the flow of imports. It would be particularly relevant to examine the effects of IPRs protection and the effects of a FTA on licences and foreign direct investment flows in an extension of our study.

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APPENDIX

Table. Definition of variables and Data Information

Variable	Definition	Source
Imports	Imports in real US dollars.	The United Nations Commodity Trade Statistics Database. [UN comtrade]; "International Trade in Goods and Services by Country and Commodity comtrade.un.org"
FTA	We create a dummy variable where the value equals one if Tunisia and the EU country are a free trade agreement members in a particular year and zero otherwise.	The Member States of the European Union. (https://www.schengenvisainfo.com/eu-countries).
GDP	Gros Domestic Product in real US dollars.	World Bank ; World Development Indicators
POP	Population.	
DIST	Geographic distance between the capital cities of countries .	Center for International Prospective Studies (CEPII) (http://www.cepii.fr).
LANG	a dummy variable to indicate whether countries share a common language. It is 1 if both countries speak the same language and 0 otherwise.	
COL	a dummy variable to indicate whether countries have historical links (colonial relationship).	
IPRs protection	index of patent rights of Park and Ginarte.	Data Base Park et Ginarte(1997) and Park (2011).