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COUNTRY-SPECIFIC DETERMINANTS OF INTRA-INDUSTRY TRADE BETWEEN TUNISIA AND THE EUROPEAN UNION

The aim of this article is empirically to test various hypotheses related to the country-specific determining factors of intra-industry trade – IIT – horizontal IIT-HIIT – and vertical IIT-VIIT- between Tunisia and its main trading partners of the European Union (EU-12), using a static and a dynamic panel data over the 2000-2012 period. Results verify that determinants of horizontal and vertical IIT differ and suggest that FDI is positively related to IIT, HIIT and VIIT. There is a relatively strong positive correlation between factor endowment and HIIT. The economic dimension has a positive impact on horizontal intra-industry trade.

Keywords: *determinants; intra-industry trade; total; horizontal; vertical; static and dynamic panel data.*

Classification JEL *– F14, C33.*

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Афеф Сугюр

СПЕЦИФІЧНІ ДЛЯ КРАЇНИ ДЕТЕРМІНАНТИ ВНУТРІШНЬОГАЛУЗЕВОЇ ТОРГІВЛІ МІЖ ТУНІСОМ ТА ЄВРОПЕЙСЬКИМ СОЮЗОМ

У статті досліджено емпіричний шлях перевірки різної гіпотези, пов'язані з визначальними для країни чинниками внутрішньогалузевої торгівлі – ІІТ – горизонтальний ІІТ-ГІІТ – і вертикальний ІІТ-ВІІТ – між Тунісом та його основними торговими партнерами Європи Союз (ЄС-12), використовуючи статичні та динамічні дані панелі за період 2000-2012 років. Результати підтверджують, що детермінанти горизонтальної та вертикальної ІІТ відрізняються, і дозволяють припустити, що ПІІ позитивно пов'язані з ІІТ, ГІІТ та ВІІТ. Існує відносно сильна позитивна кореляція між факторною обробкою та ГІІТ. Економічний вимір позитивно впливає на горизонтальну внутрішньогалузеву торгівлю.

Ключові слова: *детермінанти; внутрішньогалузева торгівля; сумарні; горизонтальні; вертикальні; статичні та динамічні дані панелі.*

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Афеф Сугюр

СПЕЦИФИЧЕСКИЕ ДЛЯ СТРАНЫ ДЕТЕРМИНАНТЫ ВНУТРИОТРАСЛЕВОЙ ТОРГОВЛИ МЕЖДУ ТУНИСОМ И ЕВРОПЕЙСКИМ СОЮЗОМ

В статье исследованы эмпирический путь проверки различной гипотезы, связанные с определяющими для страны факторами внутриотраслевой торговли – ИИТ – горизонтальный ИИТ-ГИИТ – и вертикальный ИИТ-ВИИТ – между Тунисом и его основными торговыми партнерами Европы Союз (ЕС-12), используя статические и динамические данные панели за период 2000-2012 годов. Результаты подтверждают, что детерминанты горизонтальной и вертикальной ІІТ отличаются, и позволяют предположить, что ПИИ положительно связаны с ІІТ, ГІІТ и ВІІТ. Существует относительно сильная поло-

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жительная корреляция между факторным обработкой и ГIIТ. Экономическое измерение положительно влияет на горизонтальную внутриотраслевую торговлю.
Ключевые слова: *детерминанты; внутриотраслевая торговля; суммарные; горизонтальные; вертикальные; статические и динамические данные панели.*

I. Introduction. The international trade theory has recently been enriched with new forms of trade explanations. Intra-industry trade is part of these new forms unexplained by the traditional theories which are based on comparative advantage and constant economies of scale. However, these new forms emphasize the presence of constant economies of scale, the product differentiation, and the imperfect competition as determinants of the simultaneous flows of exchange of products belonging to the same industrial classification.

Since the innovative work of Verdoorn (1960), Michaely (1962), Balassa (1966), Grubel (1967) and Finger (1975), the aspect of intra-industry trade has attracted much attention in the theoretical and empirical literature. This phenomenon occurred in the years following the formation of the European Economic Community (EEC). However, it was only with the arrival of the influential study of Grubel and Lloyd (1975) that empirical research on intra-industry trade proved its robustness. The authors proposed the Grubel-Lloyd index, which has become the most widely used measure for the calculation of intra-industry trade intensity between trading partners.

The subsequent contributions of Krugman (1980, 1981), of Lancaster (1980), and of Helpman (1981) explain the development of exchanges intra-branches of products differentiated horizontally (the different varieties of a product are of a similar quality) in a competitive frame of monopolistic competition with increasing savings.

Falvey (1981), Shaked and Sutton (1984) studied the exchange of vertically differentiated products, respectively in a perfectly competitive and oligopolistic market framework. A phenomenon called vertical intra-industry trade (VIIT). Shaked and Sutton (1984) explained the vertical intra-industry trade by the firms' strategy of vertical differentiation associated with an income differentiation and the availability of consumers to pay for quality.

Several articles (see, for example, Attila, 2015; Bojnec and Ferto, 2016; Jambor, Balogh, and Kucsera, 2016; Lapinska, 2016 and Aggarwal and Chakraborty, 2017) have shown that the impact of determinants varies by type of horizontally or vertically differentiated intra-industry trade. In fact, the non-discrimination between the two types of intra-industry trade in empirical studies brings us to the results of econometric analyzes and the variable bilateral exchange determinants.

Among the empirical analysis methods, which emerged to distinguish between the two components of intra-branch horizontal and vertical trade, (Abdel-Rahman (1986) and taken up by Greenaway, Hine and Milner (1994, 1995) and Fontagnйe and Freudenberg (1997, 1999), which appears to be the most accurate and therefore has caught our attention, is the methodology developed by Kandogan (2003).

Building on the theoretical and empirical studies mentioned earlier, our objective is to conduct an empirical analysis by focusing on the relationship between the determinants of intra-industry trade and the different types of trade (IIT, HIIT and VIIT). More specifically, our focus is on the bilateral trade between Tunisia and the –

12 European Union countries through a balanced panel with 10 industries for the 2000 / 2012 period. Actually, two estimation methods were used; the classical estimation method (the "Within" fixed effect and the "Between" random effect) and the Generalized Method of Moments (GMM) in a dynamic panel recommended by Arellano and Bover (1995).

This article is organized as follows. Section 2 is devoted to the presentation of the method of measuring intra-industry trade. Section 3 includes a formulation of some hypotheses about the determinants of different types of bilateral trade. Section 4 describes the data used and discusses the relationship in question. Finally, section 5 concludes our work.

II. Intra-industry trade measurement[1]. The most commonly used indicator to identify intra-industry trade is the one proposed by Grubel and Lloyd (1975), which is calculated as follows:

$$IIT_{jf} = 1 - \frac{\left|X_{jf} - M_{jf}\right|}{X_{jf} + M_{jf}} \Leftrightarrow \quad IIT_{if} = \frac{\left(X_{jf} + M_{jf}\right) - \left|X_{jf} - M_{jf}\right|}{\left(X_{jf} + M_{jf}\right)} \qquad (1)$$

where X_{jf} and M_{jf}, respectively represent the exports of industry k of domestic country (*d*) to country (*f*) and the imports of industry k from the domestic country from country (*f*), for a given period of time. This indicator measures the intensity or proportion of intra-industry trade in the industry with the country. This measure varies between zero (zero intra-industry trade for industry k, that is, either $X_{jf} = 0$ or $M_{jf} = 0$) and one (the whole industry trade *j* is intra-industry, that is, $X_{jf} = M_{jf}$). The percentage is obtained by multiplying this indicator by 100.

The GL index has been extended by Abd el-Rahman (1991), Greenaway, Hine and Milner (1994, 1995), Fontagnй and Freudenberg (1997) and Fontagne, Freudenberg, and Gaulier (2006) to distinguish vertical differentiation intra-branch from horizontal differentiation intra-branch. Assuming that the quality differences between traded goods are reflected in the price differences, the authors use unit value data to separate both components. Although this method has been used by a great deal of research, it has been the target of much criticism. Zhang and Clark (2009) and Azhar and Elliott (2006) revealed some problems with this method, suggesting, among other things, that the VIIT measurement is likely to be inflated. Therefore, this study uses Kandogan's (2003) methodology to separate the horizontal trade from the vertical one. According to this methodology, horizontal intra-industry trade (HIIT) is defined as the overlap of trade in a broad category of industries, which consists of bilateral trade in narrowly defined industries. VIIT is a balanced trade within a broadly defined industry that includes exports and imports in narrowly defined industries (Bergstrand and Egger 2006). Horizontal (HIIT) and vertical (VIIT) intra-industry trade summarize the whole intra-industry trade (IIT). The methodology of Kandogan (2003) is summarized as follows:

$$TT_{Jf} = X_{jf} + M_{jf} \qquad (2)$$

with: TT_{jf}: total trade of industry *j* to country *f*; X_{jf}: exports of industry *j* to country *f*; M_{jf}: imports of industry *j* from country *f*.

[*] For more details about the measurement of intra-industrial trade, see Pablo Coto-Millan's book (2004), pp: 124-134.

$$IIT_{jf} = TT_{jf} - \left|X_{jf} - M_{jf}\right| \tag{3}$$

$$IIT_{jf} = \left(X_{jf} + M_{jf}\right) - \left|X_{jf} - M_{jf}\right| \tag{4}$$

$$HIIT_{jf} = \sum_{n}^{N}\left(X_{njf} + M_{njf} - \left|X_{njf} - M_{njf}\right|\right) \tag{5}$$

X_{njf}: exports of product n from industry[2] j to country f;

M_{njf}: imports of product n from industry j from country f.

$$VIIT_{jf} = IIT_{jf} - HIIT_{jf} \tag{6}$$

Since this approach calculates IIT, HIIT and VIIT in levels and not the corresponding shares in overall trade, we use standardized aggregated indices of the different measures as follows (Thorpe and Leitao 2013), where the IIT between partners d and f is determined for industry j:

We have

$$IIT_{jf} = 1 - \frac{\left|X_{jf} - M_{jf}\right|}{X_{jf} + M_{jf}} \Leftrightarrow \quad IIT_{if} = \frac{\left(X_{jf} + M_{jf}\right) - \left|X_{jf} - M_{jf}\right|}{\left(X_{jf} + M_{jf}\right)} \tag{7}$$

$$HIIT_{jf} = 1 - \frac{\left|\sum_{n=1}^{N}\left(X_{njf} - M_{njf}\right)\right|}{\sum_{n=1}^{N}\left(X_{njf} + M_{njf}\right)} \Leftrightarrow$$

$$HIIT_{jf} = \frac{\sum_{n=1}^{N}\left(X_{njf} + M_{njf}\right) - \left|\sum_{n=1}^{N}\left(X_{njf} - M_{njf}\right)\right|}{\sum_{n=1}^{N}\left(X_{njf} + M_{njf}\right)} \tag{8}$$

The bilateral indices of intra-industry trade in sector j between country d and all its trading partners are obtained by calculating a weighted average of the bilateral indices (7) for each partner country f using as a weighting coefficient (Φf) the trade share with country f in the whole trade of country d.

$$IIT_{f} = \sum_{j=0}^{9} \Phi_{f} * IIT_{jf} \Leftrightarrow$$

$$IIT_{f} = \sum_{j=0}^{9} \Phi_{f} * \left[1 - \frac{\left|X_{jf} - M_{jf}\right|}{X_{jf} + M_{jf}}\right] \Leftrightarrow IIT_{f} = \frac{\sum_{j=0}^{9}\left(X_{jf} + M_{jf}\right) - \sum_{j=0}^{9}\left|X_{jf} - M_{jf}\right|}{\sum_{j=0}^{9}\left(X_{jf} + M_{jf}\right)}$$

[2] The sectoral data follow a 1-digit nomenclature (2-digits for products) according to the Standard International Trade Classification (SITC) revision 3 (Rev-3). At this level, this database is divided into two groups: on the one hand, non-manufactured goods classified between 0 and 4 (SITC0-4) and, on the other hand, manufactured goods the classification of which is from 5 to 9 (SITC5-9).

$$with \quad \Phi_f = \frac{X_{jf} + M_{jf}}{\sum_{j=0}^{9}(X_{jf} + M_{jf})} \tag{10}$$

The bilateral indices of intra-industry trade between partner countries d and f for all industries j correspond to the weighted average of the bilateral indices of (8) for all the categories of product n, the weighting coefficients (Φ_{njf}) given by the share of the total trade of product n in the whole of the exchanges of the whole j industry,

$$HIIT_f = \sum_{j=0}^{9} \Phi_{njf} * HIIT_{jf} \Leftrightarrow HIIT_f = \sum_{j=0}^{9} \Phi_{njf} * \left[1 - \frac{\left|\sum_{n=1}^{N}(X_{njf} - M_{njf})\right|}{\sum_{n=1}^{N}(X_{njf} + M_{njf})}\right] \tag{11}$$

$$\Leftrightarrow HIIT_f = \frac{\sum_{j=0}^{9}\sum_{n=1}^{N}(X_{njf} + M_{njf}) - \sum_{j=0}^{9}\left|\sum_{n=1}^{N}(X_{njf} - M_{njf})\right|}{\sum_{j=0}^{9}\sum_{n=1}^{N}(X_{njf} + M_{njf})}$$

$$with \ \Phi_{njf} = \frac{X_{njf} + M_{njf}}{\sum_{j=0}^{9}(X_{njf} + M_{njf})} \tag{12}$$

With j as the number of industries.

The synthetic indicators are applicable to all the foreign exchanges of a country (the percentage of which is obtained by multiplying the indicators by 100).

$$IIT = \frac{\sum_{j=0}^{9}\sum_{f}^{F}(X_{jf} + M_{jf}) - \sum_{j=0}^{9}\sum_{f}^{F}\left|X_{jf} - M_{jf}\right|}{\sum_{j=0}^{9}\sum_{f}^{F}(X_{jf} + M_{jf})} \tag{13}$$

$$HIIT = \frac{\sum_{j=0}^{9}\sum_{f}^{F}\sum_{n=1}^{N}(X_{njf} + M_{njf}) - \sum_{j=0}^{9}\sum_{f}^{F}\left|\sum_{n=1}^{n}(X_{njf} - M_{njf})\right|}{\sum_{j=0}^{9}\sum_{f}^{F}\sum_{n=1}^{N}(X_{njf} + M_{njf})} \tag{14}$$

$$VIIT = IIT - HIIT \tag{15}$$

III. The decisive variables and their hypotheses. The development of intra-industry trade theory stimulated suitable empirical analyses that try to identify the determinants of these exchanges. Intra-industry trade improves the gains through the economies of scale and the product differentiation, as they drive companies to focus on a narrow range of products, and consequently help reduce fixed costs. It is therefore important to discover what determines intra-industry trade. Most of the appropriate empirical models that were developed in the mid-1970s, tend to classify these determinants into two groups: country-specific and industry-specific factors. Moreover,, we can talk about a third group, which is the specific market.

Country-specific determinants, which include trade policy-related determinants, fall into five broad categories: economic development, market size, geographic proximity, economic integration, and trade barriers. The country's characteristics,

such as the income per capita, the economic size, the costs of transactions, come from theoretical studies of Helpman and Krugman (1985) as well as from three other studies which are closely related, like those of Balassa (1986), Helpman (1987), Bergstrand (1990).

According to most of the theoretical and empirical studies, the following research hypotheses seem justified.

Per Capita Incombe (PCI):

Hypothesis (a): the higher the income per capita of the partner country is, the greater the intra-industry trade will be. Intra-industry trade with a given partner may be higher if the partner country's per capita income (PCIj) is higher. According to Greenway and Milner (1994), the demand from consumers who have low levels of PCI is generally low and standardized compared to the characteristics of the product, however, with a high level of PCI, the application becomes more complex and differentiated. This may lead to a greater demand for differentiated products. On the other hand, if the level of development is measured with the CPI, a big PCI then leads to high intra-industry trade. The effects of this variable, measured with GDP per capita on the scale of the intra-industry trade, should be positive, which reflects the rise of the demand for differentiated products.

Difference of physical contribution (EP):

Hypothesis (b): the smaller the physical contribution difference is, the more likely that countries specialize in the horizontally differentiated products and the less likely that they specialize in vertically differentiated products. The EP log is an approximation of the physical contribution differences. It is the logarithm of the absolute difference of the electric energy consumption (Kwh per capita) between two partner countries. The study of Leitao and al (2014) found a positive sign for the Romanian case.

$$ln\ EP_{df} = ln\ \left|EP_d - EP_f\right| \tag{16}$$

The difference in the per capita income between two countries (DGDP):

Hypothesis (c): The smaller the difference in the per capita income between two countries, the greater the proportion of IIT in the totals of the manufactured goods will be. This hypothesis reflects the theoretical position that the overlap in application templates and similar consumers taste in two countries will create larger markets for the exchange of products differentiated from similar qualities. As a result, to provide opportunities which help exploit economies of scale, total intra-industry trade (IIT) as well as the horizontal intra-industry trade (HIIT) increased (Linder, 1961). Focusing on the states of supply, Helpman and Krugman (1985) and Helpman (1987) stipulate that the differences in the per capita incomes can also be used to capture the magnitude of the relative levels of economic development of both countries, used to dominate, in particular, the differences in endowments of factors. In fact, the greater the difference in per capita income, the greater the opportunity for vertical disintegration of the production process in a group of industries across economies. We expect the IIT and HIIT to have a negative relationship with the DGDP while the VIIT is likely to have a positive sign.

$$\ln\ DGDP_{df} = \ln\ \left|GDP_d - GDP_f\right| \tag{17}$$

Foreign Direct Investment (FDI)*:

Hypothesis (d): The higher the levels of efficiency-seeking FDI, the greater the shares of horizontal (HIIT) and vertical (VIIT) intra-industry trade. However, the higher the levels of market-seeking FDI, the smaller the shares of HIIT and VIIT will be. Actually, several research studies have examined the impact of foreign direct investment (FDI) on the intra-industry trade and concluded that, the greater FDI in an industry, the higher the levels of intra-industry trade will be. This coefficient should be positive for the HIIT and negative for the VIIT (Zhang and Li, 2006). Besides, Veeramani (2007) showed that foreign direct investment is positively correlated with intra-industry trade, while suggesting that the levels of intra-industry trade increase with a greater multinational participation.

However, when FDI is in interaction with the trade barriers, its coefficient becomes negative, which indicates that high trade barriers prompt multinational firms (MNF) to search for markets for FDI (Veeramani, 2007). Moreover, according to Byun and Lee (2005), the FDI negative coefficient sign implies that vertical intra-industry trade and FDI can act as substitutes for trade. Similarly, Markusen (1984) and later Brainard (1997) predicted that the substitution between FDI and trade predominates the complementary relationships.

In other words, a multinational company will serve the overseas market through the establishment of a subsidiary instead of exporting products. As a consequence, it will have a negative impact on the share of intra-industry trade. However, Helpman (1984) predicted complementary relationships between FDI which seeks efficiency and trade, given that it is usually related to a greater specialization in plants located in different countries, where the economies of scale appear in the production, which in turn increases intra-industry trade. Zhang et al. (2005) found an FDI negative sign coefficient involving FDI activities to reduce vertical intra-industry trade in generating effects of FDI agglomeration. Other authors, such as Zhang et al. (2005) and Zhang and Li (2006), found a positive relationship between FDI and horizontal and total intra-industry trade.

IV. Empirical validation. This section presents the main features and steps of the estimation methods mentioned in the introduction. In fact, two estimation methods were used. The first takes into account the unobserved heterogeneity of the countries in the sample, the individual characteristics of which may be either deterministic, or random. Besides, the Hausman specification test enables to choose either of these specifications. The second method is the GMM (Generalised Method of Moments) of dynamic panel in which the share of intra-industry trade delayed by one period is among the explanatory variables. Our database is extracted from the "World Development Indicators and the Eurostat data base".

The data on the global trade flows used between Tunisia and the EU-12 are those of Eurostat. The sectoral data follow a 1-digit nomenclature (2-digits for products) according to the Standard International Trade Classification (SITC) revision 3 (Rev-3). At this level, this database is divided into two groups: on the one hand, non-manufactured goods classified between 0 and 4 (SITC0-4) and, on the other hand, man-

* Other studies used country- specific FDI factor, see for example, Shahbaz and Leitao (2010).

ufactured goods the classification of which is from 5 to 9 (SITC5-9). The overall descriptive statistics of the sample are presented in appendix A.

The general specification of the model that is going to be estimated can be written as follows:

$$y(\tau)_{dft} = \gamma_f + \beta X_{dt} + \sigma_t + \omega_{dft} \quad \text{(I)}$$

with y_{dft} the share of intra-industry trade expressed as a percentage (IIT) between domestic country d and its trading partner f during periods t and τ varying over the total intra-branch (IIT), the horizontal (HIIT) and vertical (VIIT) trade. X_{dt} represents the vector of the explanatory variables including country-specific variables (PCI, DGDP, EP, and FDI); where $\gamma_f =$ is the effect specific to each country, $f = 1 \ldots F$, $\sigma t =$ the temporal specific effect, t=1 ... ..T and β being the vector of the respective coefficients of these variables. ω_{dft} is a random variable distributed according to a normal distribution of zero expectation: $\omega_{dft} \rightarrow N(0, \sigma^2)$.

The dynamic models are characterized by the presence of one or more lagged values of the endogenous variable among the explanatory variables.

$$y(\tau)_{dft} = \gamma_f + \varphi\, y(\tau)_{dft-1} + \beta X_{dt} + \sigma_t + \omega_{dft} \quad \text{(II)}$$

$y_{dft\text{-}1}$ is the lagged value of intra-industry trade

The estimation of the model (II) by the classical methods (the Wthin and Between estimates) gives biased and non-convergent estimators because of: 1) the correlation between one of the independent variables and the term representing the fixed effect (γ_f) and 2) the correlation between any of the independent variables and the error term (ω_{dft}). To avoid these difficulties we estimate equation (II) using the Generalized Method of Moments in differences (DIF-GMM) suggested by Arellano and Bond (1991). The Arellano-Bond procedure (1991) consists in rewriting equation (II) in first differences, which removes the individual fixed effects (γ_f) and thus eliminates the potential source of this bias, and then uses, as instruments for differentiated series, their own lagged levels to solve the endogeneity problem arising from a contemporary correlation between ($y_{dft\text{-}1}$) and the term ($\omega_{dft\text{-}1}$).

$$\Delta y(\tau)_{dft} = \varphi \Delta y(\tau)_{dft-1} + \beta \Delta X_{dt} + \Delta \sigma_t + \Delta \omega_{dft} \quad \text{(III)}$$

with Δ, is an operator of first difference.

However, Arellano and Bover (1995) showed that if the variables are persistent over time, then the difference estimator is biased. Therefore, they proposed the GMM as a system. Consequently, and in accordance with most of the current empirical research studies, we opted here for the implementation of the estimation recommended by Arellano and Bover (1995). The GMM system estimator proposed by

Arellano and Bover (1995) consists of first difference equation proposed by Arellano-Bond (1991) and a level equation. As a consequence, the system with the level equation (II) and in difference equation (III) has the following form:

$$y(\tau)_{dft} = \gamma_f + \varphi\, y(\tau)_{dft-1} + \beta X_{dt} + \sigma_t + \omega_{dft} \quad \text{(II)}$$

$$\Delta y(\tau)_{dft} = \varphi \Delta y(\tau)_{dft-1} + \beta \Delta X_{dt} + \Delta\sigma_t + \Delta\omega_{dft} \quad \text{(III)}$$

In this section, the focus is on the assessment of the determinants of bilateral intra-industry trade of Tunisia with its European Union trading partners (EU-12) over the 2000/2012 period.

The employed variables and their statistical sources are defined in the following table:

Table 1. **Sources, definitions and the Proxy of the explanatory variables and the expected signs**

Explanatory variables	Variable	Proxy and Sources	IIT	HIIT	VIIT
The per capita GDP	PCI	The per capita GDP of the partner country in US$ according to the database of the World Bank Development Indicators.	+	+	+
The difference of the per capita GDP	DGDP	The difference of the per capita GDP between Tunisia and its business partner, en US$ calculated on the basis of the World Bank Development Indicators database.	-	-	+
Physical endowment	EP	The difference of physical capital endowments (Kwh per capita) calculated on the basis of the World Bank Development Indicators database.	+/-	-	+
Foreign Direct Investment	FDI	The share of foreign direct investment net flows in the GDP taken from the World Bank development indicators database.	+/-	+/-	+/-

Source: Own composition

To identify the different components of intra-industry trade, we first tried to test the relationship between its various types, such as IIT, HIIT and VIIT, using the 4 variables explained above. As a consequence, the gravity model to be estimated can be specified as follows (static representation):

$$\ln IIT(\tau)_{dft} = \gamma + \beta_1 \ln EP_{dft} + \beta_2 \ln DGDP_{dft} + \beta_3 \ln PCI_{ft} + \beta_4 FDI_{dt} + \sigma_t + \omega_{dft} \quad \text{(IV)}$$

With IIT $(\tau)_{dft}$ as the index or the share of (Total, Horizontal and Vertical) intra-industry trade, *d* Tunisia and f the partner country for period *t*, which are calculated on the basis of the Eurostat database.

Starting from equation (II) and equation (III), which shows that the estimates were carried out using the GMM system in dynamic panel, we obtain the following system:

$$\ln IIT(\tau)_{dft} = \gamma + \beta_1 \ln III(\tau)_{dft-1} + \beta_2 \ln EP_{dft} + \beta_3 \ln DGDP_{dft} + \beta_4 \ln PCI_{ft} + \beta_5 FDI_{dt} + \sigma_t + \omega_{dft} \quad (V)$$

$$\Delta \ln IIT(\tau)_{dft} = \gamma + \beta_1 \Delta \ln III(\tau)_{dft-1} + \Delta\beta_2 \ln EP_{dft} + \Delta\beta_3 \ln DGDP_{dft} + \Delta\beta_4 \ln PCI_{ft} + \Delta\beta_5 FDI_{dt} + \Delta\sigma_t + \Delta\omega_{dft} \quad (VI)$$

4.1. Results for the Static Models:

In fact, the gravity model estimation is made according to equation (I). Besides, the analysis covers the 2000/2012 period, and the results of the EF and EA estimate for all the intra-industrial trade flows (total, horizontal and vertical) are presented in table 2.

Table 2. **The relationship between the type and determinants of intra-industry trade: 2000-2012 (Fixed and Random effects results)**

Explanatory variables	Dependent variables in Ln					
	Fixed Effets			Random Effets		
	IIT (1)	HIIT (2)	VIIT (3)	IIT (4)	HIIT (5)	VIIT (6)
Constante	0.268904 (0.066621) [0.9470]	**-12.18084** (-2.186419)** [0.0304]	**11.63715** (1.992135)* [0.0483]	1.741355 (0.807966) [0.4204]	-5.623390 (-1.447493) [0.1498]	4.361268 (1.276894) [0.2036]
LnEP	0.326403 (0.777720) [0.4380]	**2.177340** (3.758710)*** [0.0003]	**-1.311794** (-2.159703)** [0.0325]	0.187201 (0.712717) [0.4771]	**1.616178** (3.601961)*** [0.0004]	-0.674135 (-1.639259) [0.1032]
LnDGDP	-1.188617 (-1.205222) [0.2302]	**-4.445336** (-3.265677)*** [0.0014]	0.943805 (0.661252) [0.5095]	-1.042468 (-1.328603) [0.1860]	**-4.834025** (-3.932364)*** [0.0001]	1.371013 (1.147034) [0.2532]
LnPCI	0.767965 (0.863549) [0.3893]	**3.527497** (2.873795)** [0.0047]	-1.135265 (-0.882068) [0.3793]	0.599244 (0.806597) [0.4212]	**3.737794** (3.292513)*** [0.0012]	-1.377053 (-1.229147) [0.2209]
FDI	0.014957 (1.292122) [0.1984]	0.009112 (0.570307) [0.5694]	0.026180 (1.562723) [0.1204]	0.016369 (1.498946) [0.1360]	0.016511 (1.077984) [0.2828]	0.018035 (1.136154) [0.2577]
Number of Observations	156	156	156	156	156	156
F-Test F(11,140)	11.100502*** Prob > F = 0.0000	40.625601*** Prob > F = 0.0000	12.973609*** Prob > F = 0.0000			
Hausman-Test				3.878752 Prob>chi2 = 0.4227	8.447501* Prob>chi2= 0.0765	3.416168 Prob>chi2 = 0.4907

The values in bold indicate that these variables are significant.
(.) Student's t-test
[.] Probabilities
Significance threshold: *** (1%), ** (5%) and * (10%).

Source: Results for regression analysis generated using Eviews-9.

For both of the variables to be explained, that is, the total and vertical intra-branch trade (columns 4 and 6 of Table 2), following the two econometric tests, the MCG estimator was chosen and the regression is then made in panel with random effects. However, the Within estimator is retained for the variable to be explained, that is, the horizontal intra-branch trade (column 2 of the table). Moreover, on the basis of the statistical values presented in the table about the IIT and VIIT variables, it appears that the random effect is present from the moment when the Hausman statistics does not accept the fixed effects hypothesis and the P-value associated with the Chi-two statistic is high.

All the variables have the expected signs for the IIT model. However, the HIIT model has an unexpected for the lnEP variable, whereas the VIIT model has an unexpected sign for both the lnEP and lnPCI variables. Moreover, the estimated coefficients are almost the same for the total and horizontal intra-industry trade. This result is not surprising since the horizontal intra-industry trade accounts for most of the total intra-industry trade over the 2000-2012 period.

The results presented in table 2 show that the lnDGDP variable, which is used to assess the similarities between the trading partner countries has a negative correlation with the total intra-industry trade (IIT), when the fixed and random effects estimators are used. These results are inconsistent with a recent study by (Ferto and Soos (2008), Leitao and Faustino (2009)). Our results show that the greater the difference of the per capita GDP between Tunisia and its trading partners, the smaller the total intra-industry trade (IIT) will be, which seems to be consistent with the old literature of (Loertscher and Wolter (1980), Greenaway et al. (1994) who found a negative sign)

Regarding the relationship with the lnEP variable, the estimated coefficient has a positive and significant sign but unpredicted for the HIIT models. Therefore, our results validate the following hypothesis: 'intra-industry trade occurs more frequently within the countries that are not similar in terms of physical endowments.

It is worth noting that the estimated impact of the FDI on intra-industry trade is positive but seems in contrast with the results obtained by Balassa (1986), Sharma (2000), Seo and all (2002), Debaere (2005) and Aydin (2010) and compatible with those of Egger and Pfaffermayr (2005), Aizenman and Noy (2006).

4.2. Results of Dynamic Models:

Table 3 gathers the results of the dynamic estimates and some preliminary tests taken out of Stata 13 for the different types of intra-industry trade (IIT, HIIT and VIIT). Therefore, we use the GMM estimator in one-stage system. In fact, several important lessons can be drawn from these regressions. Firstly, the high coefficient is still significant at 1% threshold of the lagged variable, which means that intra-industry trade (for the different types of intra-industry trade, IIT, HIIT, VIIT) of year (t) depends positively on that of year (t-1). Moreover, the Wald tests, which are provided with the results, confirm the good quality of the estimates in terms of overall significance (statistically significant at 1% level for all the models). On the other hand, Sargan's over-identification test is used to test the validity of the selected instruments, which implies that the higher the "J-statistics" value, the better the instruments and the estimates will be. In our case, that is, for the three models of the horizontal and vertical total intra-industry trade, chi2 (76) is equal to 115.5075, 111.0628, 109.6089

and the Prob >chi2 is equal to 0.0024, 0.0054 and 0.007, respectively. This verifies the correct choice of the dynamic GMM system.

Table 3. **The relationship between the type and determinants of intra-industry trade: 2000-2012 (one-step system GMM results)**

Explanatory variables	Dependent variables in Ln		
	IIT	HIIT	VIIT
ln(IIT, HIIT, VIIT)$_{t-1}$	**0.2235166** (3.03)*** [0.002]	**0.2435165** (3.32)*** [0.001]	**0.2638273** (3.53)*** [0.000]
lnEP	0.0778258 (0.33) [0.740]	**1.982815** (4.82)*** [0.000]	**-0.8063891** (-2.29)** [0.022]
lnDGDP	0.1255695 (0.18) [0.856]	**-4.033292** (-3.79)*** [0.000]	1.584966 (1.37) [0.170]
lnPCI	-0.4572881 (-0.69) [0.493]	**2.928971** (2.86)*** [0.004]	-1.516589 (-1.38) [0.169]
FDI	**0.0170801** (1.76)* [0.078]	0.0222181 (1.56) [0.120]	0.0160118 (1.16) [0.248]
Constant	2.068631 (1.08) [0.279]	**-8.067512** (-2.33)** [0.020]	**5.286701** (1.94)* [0.052]
Number of obs	144	144	144
Wald test Chi2(5)	**20.59***** Prob >chi2 = 0.0010	**80.48***** Prob >chi2 = 0.0000	**21.89***** Prob >chi2 = 0.0005
Sargan Test chi2(76)	**115.5075***** Prob >chi2 = 0.0024	**111.0628***** Prob >chi2 = 0.0054	**109.6089***** Prob >chi2 = 0.0070
The values in bold indicate that these variables are significant. (.) Student's t-test [.] Probabilities Significance threshold: *** (1%), ** (5%) and * (10%).			

Source: Authors' calculation using STATA 13.

The impact of the explanatory variables has been the subject of several comments. The absolute difference of the electrical energy consumption (lnEP) capturing the difference of factor endowment between two partner countries positively (negatively) and significantly affects intra-horizontal (vertical) trade at 1% (5%). The lnPCI variable (the GDP per capita of the trading partner) positively and significantly affects horizontal trade at 1%. It negatively and not significantly affects the overall intra-branch and vertical trade. However, the last two models, IIT and VIIT, are not significantly affected by the lnDGDP variable (income per capita difference). The last variable (lnDGDP) negatively and significantly affects horizontal trade at the threshold of 1%. Despite this significant difference, foreign direct investment positively and significantly affects the overall horizontal and vertical intra-industry trade, except for the IIT model. This result confirms the complementarity between foreign direct investment and intra-industry trade.

V. Conclusion. The aim behind this empirical study is the analysis of some determinants of intra-industry trade. We also examined vertical and horizontal intra-

industry trade because these different types of intra-industry trade have different determinants. In the light of this study, we have been able to draw several fundamental conclusions.

By looking at the results in table 3, we can notice that the GMM system does not modify the existing relationship between the 4 explanatory variables and the horizontal and vertical intra-branch trade. In fact, the coefficients of the exogenous variables are of the same sign (of different magnitude and significance) than those presented in table 2, for both HIIT and VIIT models.

A comparison of our results to those of other empirical studies gave us similar results for some variables but not for others. Therefore, the econometric evaluations support the advanced hypotheses. Taking into account these results, it seems clear that Tunisia's economic policy, its trade in differentiated products with the most developed countries, is an important factor. In fact, its partner countries' economic size (lnPCI) has been positive and statistically significant for horizontal intra-industry trade.

Regarding all the estimates, the lnEP variable is highly significant and has an unexpected sign for the HIIT model. In fact, the results indicate that this variable positively affects horizontal intra-industry trade and has a coefficient varying between 1.98 and 2.17, depending on the used estimation methods. These results also indicate that any increase of the lnEP variable implies an increase of the share of horizontal intra-industry trade by about 2 percent points. Moreover, the (lnEP) variable is harmful for the VIIT model, but significant only for the GMM system because it causes a fall by between 0.67 and 0.80 after a 1% increase, according to the used estimation methods. In other words, the differences in physical endowments between Tunisia and its trading partners reduce its intra- industry trade in substandard products but increase it in higher quality products. On the basis of this result, Tunisia has a high competitiveness in quality products. For this reason, most of intra-industry trade is devoted to horizontal intra-industry trade.

The (lnDGDP) variable used to assess the economic differences between the trading partners is negatively and very significantly correlated with the horizontal intra-industry trade for both the GMM-system and the fixed effects estimation methods. This result confirms Linder's hypothesis (1961) which states that countries with similar per capita incomes tend to have similar demand patterns for differentiated products. In other words, Tunisia's entire specialization is concentrated on products similar to those produced and sold by the EU (12).

Based on the GMM method, foreign direct investment appears to be a key factor in promoting the overall intra-industry trade (IIT). Indeed, a 1% increase of this variable is reflected in an increase of the overall intra-industry trade by 0.17%. Actually, our results show that FDI flows and intra-industry shares are complementary rather than substitutes. In general, the assumption is as follows: "If the FDI increases in Tunisia, the country's share of intra-industry trade with its EU-12 trading partners will increase.

Finally, our results suggest that FDI flows and intra-industry trade shares are complementary rather than substitutes. In general, the advanced hypothesis is "if FDI in Tunisia increases, the country's share of intra-industry trade with its EU trading partners will increase.

To conclude, it can be said that the inclusion of Tunisia in a dynamic regional group undoubtedly helps to explain its significant degree of trade by nature (in particular, horizontal intra-industry trade). In fact, its geographical and cultural proximity to the European market, which benefits Tunisia, as well as the similarities in consumer preferences, strengthens the Euro-Tunisian ties and opens the way to a real partnership. Moreover, the improvement of the political environment between the trading partners had a real impact on the Euro-Tunisian cross-trade (93% in 2012). If Tunisia is to continue on this path of emergence in the long term, it has to follow deep structural reforms. Actually, Tunisia is aware of the need to adopt a progressive approach that takes into account its specificities, its strengths and weaknesses.

Abd-El-Rahman K. (1986). Reexamen de la definition et de la mesure des echanges croises de produits similaires entre les nations. Revue economique, volume 37, n°1, pp. 89-116.

Abd-el-Rahman, K. (1991). Firms' Competitive and National Comparative Advantages as Joint Determinants of Trade Composition. Weltwirtschaftliches Archiv, 127, pp. 83-97.

Aggarwal, S., Chakraborty, D. (2017). Determinants of India's Bilateral Intra-Industry Trade over 2001-15: Empirical Results. MPRA Paper

Aizenman, Joshua, Ilan Noy. (2006). FDI and trade-two-way linkages?. The Quarterly Review of Economics and Finance, 46(3), pp. 317-337.

Arellano, M., Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies 58(2), 277-297.

Arellano, M., Bover, O. (1995). Another look at the instrumental variable estimation of errorcomponents models. Journal of Econometrics 68(1), 29-52.

Attila, J.A. (2015). Country-and Industry-Specific Determinants of Intra-Industry Trade in AgriFood Products in the Visegrad Countries. Studies in Agricultural Economics, 117(2), 93-101, https://doi.org/10.7896/j.1514

Aydin Ahmet (2010). On the Interaction Between Foreign Direct Investment Inflows and International Trade : Complementary or Substitution? A Case Study of Turkey. International Research Journal of Finance and Economics, ISSN 1450-2887 Issue 48. http://www.eurojournals.com/IRJFE_48_10.pdf

Azhar, A., Elliott, R. (2006). On the measurement of product quality in intra-industry trade. Review of World Economics, 142, 476-95.

Balassa, B. (1966). Tariff Reductions and Trade in Manufactures Among the Industrial Countries. The American Economic Review, 56, pp. 466-73.

Balassa, B. (1986). The Determinants of Intra-Industry Trade Specialization in United States Trade. Oxford Economic Papers, 38(2), pp. 220-233.

Bergstrand, J.H. (1990). The Heckscher-Ohlin-Samuelson Model, The Linder Hypothesis, and The Determinants of Bilateral Intra-industry Trade. Economic Journal, 100(403), pp. 1216-1226.

Bergstrand, J. H., Egger, P. (2006). Trade costs and intra-industry trade. Review of World Economics, 14, 433-58.

Bojnec, I., Ferto, I. (2016). Patterns and Drivers of the Agri-Food Intra-Industry Trade of European Union Countries. International Food and Agribusiness Management Review, Volume 19 Issue 2, pp. 53-74.

Brainard, S.L. (1997). An Empirical Assessment of The Proximity-Concentration Trade-Off Between Multinational Sales and Trade. American Economic Review, 87, pp. 520-544.

Byun, J., Lee, S. (2005). Horizontal and Vertical Intra-industry Tade : New Evidence From Korea, 1991-1999. Global Economy Journal, 5(1), pp. 1-29.

Debaere, Peter (2005). Monopolistic Competition and Trade, Revisited : Testing the Model Without Testing for Gravity. Journal of International Economics, 66(1), pp. 249-266.

Egger, Peter., Michael Pfaffermayr. (2005). The Determinants of Intra-Firm Trade : In Search for Export-Import Magnification Effects. Weltwirtschaftliches Archiv/Review of World Economics, 141(4), pp. 648-669.

Falvey, R.E. (1981). Commercial Policy and Intra-Industry Trade. Journal of International Economics, 11(4), pp. 495-511.

Ferto, I., Soos. A. (2008). Treating Trade Statistics Inaccuracies: The Case of Intra-Industry Trade. Applied Economics Letters, pp. 1-6.

Finger, J-M. (1975). Trade overlap and intra-industry trade, Economic Inquiry, 13(4), 581-58.

Fontagnй, L., Freudenberg, M. (1997). Intra-Industry Trade: Methodological Issues Reconsidered. CEPII Working Paper, No. 97/02.

Fontagnй, L., Freudenberg, M. (1999). Marchй unique et dйveloppement des йchanges. Йconomie et Statistique, n° 326-327, pp. 71-95.

Fontagnй, L., Freudenberg, M., Gaulier, G. (2006). A systematic decomposition of world trade into horizontal and vertical IIT. Review of World Economics, 142, 459-75.

Greenway, D., Hine, R., Milner, C. (1994). Country-Specific Factors and the Pattern of Horizontal and Vertical Intra-Industry Trade in the U.K. Weltwirtschaftliches Archiv, 130(1), pp. 77-100.

Greenway, D., Hine, R., Milner, C. (1995). Vertical and Horizontal Intra-Industry Trade : A Cross-Industry Analysis for the United Kingdom. Economic Journal, 105, pp. 1505-1518.

Grubel, H.G. (1967). Intra-Industry Specialisation and the Pattern of Trade. Canadian Journal of Economical and Political Sciences, vol.33, n°3, p. 374-388.

Grubel, H.G., Llyod, P.J. (1975). Intra-Industry Trade: the Theory and Measurment of International Trade in Differentiated Products. London: Macmillan.

Helpman, E. (1981). International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition: A Chamberlin-Heckscher-Ohlin Approach. Journal of International Economics, 11(3): 305-340.

Helpman, E. (1984). A Simple Theory of International Trade with Multinational Corporations. Journal of Political Economy, 92(3), pp. 451-471.

Helpman, E. (1987). Imperfect Competition and International Trade: Evidence From 14 Industrial Countries. Journal of Japanes and International Economics, 1, pp. 62-81.

Helpman, E., Krugman, P.R. (1985). Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition and the International Economy. Cambridge, Mass: MIT Press.

Jambor, A., Balogh, J., Kucsera, P. (2016). Country and industry specific determinants of intra-industry agri-food trade in the Baltic countries. Agricultural Economics (Zemedelska Ekonomika), 62(6), 280-291.

Kandogan Yener (2003). Intra-Industry Trade of Transition Countries: Trends and Determinants. Emerging Markets Review, 4, pp. 272-286.

Krugman, P.R. (1980). Scale Economies, Product Differentiation and the Pattern of Trade. American Economic Review, 70(5), pp. 950-959.

Krugman, P.R. (1981). Intra-Industry Specialization and Gains From Trade. Journal of Political Economy, 89(70), pp. 959-973.

Lancaster, K. (1980). Intra-Industry Trade Under Perfect Monopolistic Competition. Journal of International Economics, 10(2), pp. 151-175.

Lapinska, J. (2016). Determinant Factors of Intra-Industry Trade: The Case of Poland and Its European Union Trading Partners. Quarterly Journal of Economics and Economic Policy, 11(2): 251-264.

Leitєo, N.C., Faustino, H. (2009). Intra-Industry Trade in the Automobile Components Industry : An Empirical Analysis. Journal of Global Business and Technology, 5(1), pp. 32-41.

Leitєo, N.C., Surugiu, M.R., Surugiu, C. (2014). Romanian intra-industry trade: A panel data approach. Euro Economica, Issue 2(33) pp. 7-17.

Linder, S.B. (1961). An Essay on Trade and Transformation. John Wiley and Sons, New York.

Loertscher, R., Wolter, F. (1980). Determinants of Intra-Industry Trade Among Countries and Cross Industries. Review of World Economics, 116(2), pp. 280-293.

Markusen, J. R. (1984). Multinationals, Multi-Plant Economies, and the Gain From Trade. Journal of International Economics, 16, pp. 205-226.

Michaely, M. (1962). Multilateral Balancing in International Trade. The American Economic Review, 52, pp. 685-702.

Pablo Coto-Millan (2004). Essays on Microeconomics and Industrial Organisation. Second Edition, Physica-Verlag Heidelberg New York.

Seo, Jung-Soo, Jong-Soon Kang, Deok-Ki Kim (2002). Intra-Industry Foreign Direct Investment and Intra-Industry Trade in Korea. Pacific Economic Papers, 329.

Shahbaz, M., Leitao, N.C. (2010). Intra-Industry Trade: The Pakistan Experience. International Journal of Applied Economics, vol. 7, no. 1, pp. 18-27.

Shaked, A. Sutton, J. (1984). Natural Oligopolies and International Trade. In Henryk Kierzkowski (ed). Monopolistic Competition and International Trade, Oxford, pp 34-50.

Sharma, K. (2000). Pttern and Determinants of Intra-Industry Trade in Austrilian Manufacturing. The Australian Economic Review, 33(3), pp. 245-255.

Thorpe, M. W., Leitao, N. (2013). Determinants of United States' vertical and horizontal intra-industry trade. Global Economy Journal, 13(2), 233-250.

Veeramani (2007). Trade Barriers, Multinational Involvement and Intra-Industry Trade: Panel Data Evidence. Applied Economics, pp. 1-13.

Verdoorn, P. J. (1960). The Intra-Block Trade of Benelux. In: Robinson, E. A. G. (ed): Economic Consequences of the Size of Nations, 291-329. Macmillan.

Zhang, J.A., Van Witteloostuijin, Zhou, C. (2005). Chinese Bilateral Intra-Industry Trade: A Panel Data Study for 50 Countries in the 1992-2001 Period. Review of World Economics, 141(3), pp. 510-540.

Zhang, Y., Clark, D.P. (2009). Pttern and Determinants of United States' Intra-Industry Trade. The International Trade Journal, 23, pp. 325-356.

Zhang, Z., Li, C. (2006). Country-Specific Factors and the Pattern of Intra-Industry Trade in China's Manufacturing. Journal of International Development, 18, pp. 1137-1149.

Appendix A

Table A1. **Descriptive statistics,** *author's calculations*

variable	obs	Mean	Std-Dev	Min	Max
LogIIT	156	-0.9150807	0.398205	-2.406862	-0.265653
LogHIIT	156	-1.68639	0.8617991	-4.072387	-0.5234387
LogVIIT	156	-1.845595	0.5488068	-3.550469	-0.5168033
LogEP	156	8.612724	0.358261	8.005217	9.643617
LogDGDP	156	10.15389	0.3748568	9.371422	11.30041
LogPCI	156	10.44578	0.308473	9.789879	11.42247
FDI	156	3.468708	2.081328	0.9431006	9.424248

Table A2. **Correlation Matrix,** *author's calculations*

	LogIIT	LogHIIT	LogVIIT	LogEP	LogDGDP	LogPCI	FDI
LogIIT	1.0000						
LogHIIT	0.6855	1.0000					
LogVIIT	0.3482	-0.3575	1.0000				
LogEP	-0.2999	-0.2083	-0.1153	1.0000			
LogDGDP	-0.4081	-0.4226	-0.0426	0.8310	1.0000		
LogPCI	-0.4104	-0.4211	-0.0394	0.7887	0.9875	1.0000	
FDI	0.0570	0.0277	0.0493	0.0476	0.0845	0.0998	1.0000