

## TRADE FLOWS BETWEEN ALGERIA AND EUROPEAN UNION COUNTRIES

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Received: 26/09/2020/ Accepted: 25/05/2021 / Published: 30/03/2022

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### ABSTRACT

This article aims to empirically analyze the determinants of trade flows between Algeria and the five European Union trading partners, namely, Italy, France, Germany, Spain and Portugal, over the period 1990-2018, using the basic gravity model and the augmented gravity model of international trade. The obtained results show that Algeria's bilateral trade flows with its trading partners is positively affected by GDP growth, and negatively influenced by economic inequality and geographical distance. There is also evidence that colonial past and trade agreements have a weak impact on Algeria's trade flows. Moreover, by suppressing trade barriers and concluding bilateral agreements, Algeria has a real trade potential to promote trade exchanges with Germany, France and Spain.

### KEY WORDS

Algeria, European Union trading partners, Bilateral trade flows, Gravity model, Potential trade.

JEL CLASSIFICATION: C33, F14

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## التدفقات التجارية بين الجزائر ودول الاتحاد الأوروبي

### ملخص

تهدف من خلال هذه الورقة البحثية إلى نمذجة محددات التدفقات التجارية الثنائية للجزائر مع أهم شركائها التجاريين في الاتحاد الأوروبي وهم: إيطاليا، فرنسا، ألمانيا، إسبانيا والبرتغال خلال الفترة 1990 إلى غاية 2018، وبغرض الوصول إلى أهداف الدراسة تم تقدير نموذج الجاذبية الأساسي والموسع للتجارة الخارجية باستخدام تقنيات البيانات الطولية. وأكدت النتائج على أن حجم التدفقات التجارية الثنائية للجزائر مع أحد أهم شركائها التجاريين الأوروبيين يرتبط إيجابياً بإجمالي الناتج المحلي للبلدين، وعكسياً مع الفرق في مستويات المعيشة أو المسافة الجغرافية بين البلدين، كما أظهرت النتائج وجود تأثير إيجابي وإن كان ضعيفاً للاتفاقيات التجارية والماضي الاستعماري على حجم التجارة الخارجية في الجزائر. ولقد كشف تحليل الإمكانيات التجارية للجزائر أن هنالك إمكانيات تستطيع الجزائر أن تستغلها مع كل من ألمانيا، فرنسا وخصوصاً إسبانيا عن طريق الاتفاقيات الثنائية وإزالة الحواجز التجارية والتي تساعدها على تنمية حجم تجارتها الخارجية.

### كلمات مفتاحية

الجزائر، الاتحاد الأوروبي، تدفقات تجارية ثنائية، نموذج الجاذبية، إمكانيات تجارية.

تصنيف جال: C33, F14

## **FLUX COMMERCIAUX ENTRE L'ALGÉRIE ET LES PAYS DE L'UNION EUROPÉENNE**

### **RÉSUMÉ**

L'objet de cet article est d'analyser empiriquement les déterminants des flux commerciaux bilatéraux entre l'Algérie et les cinq principaux partenaires commerciaux de l'Union Européenne à savoir ; l'Italie, la France, l'Allemagne, l'Espagne et le Portugal durant la période de 1990 à 2018. Pour ce faire, le modèle de gravité standard et le modèle de gravité augmenté du commerce international ont été estimés en utilisant des techniques de modélisation des données de panel. Les résultats obtenus montrent que le volume des flux commerciaux bilatéraux entre l'Algérie et l'un de ses partenaires commerciaux européens est influencé positivement par la croissance de leur PIB, et négativement par l'inégalité des niveaux de vie entre eux et la distance géographique qui les sépare. Un faible effet positif des accords commerciaux et du passé colonial sur le volume des échanges commerciaux de l'Algérie a été également confirmé. Par ailleurs, il a été prouvé que l'Algérie possède un véritable potentiel commercial avec l'Allemagne, la France et l'Espagne à travers la suppression des barrières commerciales et la conclusion des accords bilatéraux.

### **MOTS CLÉS**

Algérie, Partenaires commerciaux de l'Union Européenne, Flux Commerciaux Bilatéraux, Modèle de Gravité, Potentiel Commercial.

**JEL CLASSIFICATION:** C33, F14

## INTRODUCTION

Since its independence in 1962, Algeria has strongly developed its trade flows with the European Union (EU) countries. Indeed, as Algeria was under the French occupation, its exports with the EU countries benefited from a preferential treatment until the end of 60's. Nevertheless, Algeria and the European Economic Community have signed the first agreement cooperation in 1976 and entered into force on November 1978 (Khiar, 2016). This latter has been replaced by the Algeria-EU association agreement, signed in April 2002 and entered into force in September 2005, which aims to promote political, economic and trading relationships (European Commission, 2020). This cooperation concerns 9 areas namely; political dialogue, the free movement of goods, services trade, payments, capitals, competition and other economic provisions, economic cooperation, social and cultural cooperation, financial cooperation, cooperation in the fields of justice and internal affairs and institutional, general and final provisions (CACI, 2021).

Despite the established measures to increase its exports to the EU countries, Algeria's trade balance remains deficit. Moreover, Mennad (2019) showed that, in the case of bilateral opening scenario, Algeria-EU association agreement leads to increase the imports from EU by 13.77%; however, exports to EU will rise only by 2.95%. Indeed, the data published by the Finance Ministry of Algeria indicate that trade balance was positive between 2000 and 2014, and it has been experiencing a deficit since 2015. Nevertheless, Algeria's trade deficit with the European Union countries became very important over time. For instance, the trade deficit of Algeria was \$13.71 Billion in 2015, with the coverage rate of imports of 73%, compared to 107% in 2014. In 2019, Algeria's trade balance stills had a significant deficit reaching \$6.11 billion with coverage rate of imports by the exports of 85.43% (Finance Ministry, 2015, 2019). In addition, 53.40% of Algeria's imports and 63.69% of exports were exchanged with the European Union countries in 2019. On the other hand, 50.33% of Algeria's imports are archived with China (18.25%), and four European Union countries; France (10.20%), Italy (8.13%), Spain (6.99%) and Germany

(6.76%). Likewise, 38.16% of Algeria's imports are exchanged only with France (14.11%), Italy (12.90%) and Spain (11.15%). This situation confirms that Algeria's trading partners are not yet diversified enough which represents a great weakness jeopardizing not only the trade balance equilibrium, but also the economic growth (Abidin and Haseeb, 2018, Kong et al., 2020). Furthermore, bilateral trade exchanges are mainly linked to geographical distance, trade agreements, economy size and standard of living (Tinbergen, 1962; Erdem and Nazlioglu 2008; Gul and Yasin, 2011; Doumbe and Belinga, 2015).

Hence, the aim of this paper is to empirically analyze the determinants of Algeria's trade flows with the main trading EU partners, namely France, Italy, Spain, Germany and Portugal, over the period 1990-2018, using the basic gravity model and the augmented gravity model. This study permits not only to assess the potential trade of Algeria, but also to put in place an appropriate trade policy aiming to diversify its trading partners, and reducing significantly the trade deficit. With this aim, the remainder of the paper is organized as follows. In section 2 presents a brief literature review. Section 3 explains the used methodology. The used data and statistics analysis are given in section 4. Section 5 is devoted to results and discussion, while the main conclusions are given in section 6.

## **1- LITERATURE REVIEW**

The extant literature indicates that the gravity model is largely used in the empirical foreign trade analysis (Martinez-Zarzoso and Nowak-Lehmann, 2003; Kepaptsoglou et al., 2010). Indeed, Tinbergen (1962) and Polyhonen (1963) were the first authors which applied the gravity model in view to identify the main factors explaining bilateral trade flows. Kepaptsoglou et al. (2010) suggested that the gravity model allows us to assess the trade policy implications and analyze the effects of free trade agreements on international trade. By using the gravity model, Khayat and McMillan (2019) analyzed the trade exchanges between GCC countries and six developed countries over the period 2001-2012. The obtained results suggest that the GDP per

capita and population of GCC countries, and the distance between the selected countries are statistically significant and positively affect the GCC' trade flows. Moreover, in the absence of trade barriers among the studied countries, the bilateral trade flows will be more important. Likewise, the gravity approach in Gul and Yasin (2011) has been adopted to estimate Pakistan's trade potential during the period 1981-2005. The obtained results confirm that Pakistan has the greatest trade potential with countries of the Asia-Pacific region, European Union, Middle East, Latin America and North America. Furthermore, the study of Martinez-Zarzoso and Nowak-Lehmann (2003), which used augmented gravity model to examine Mercosur-European Union trade flows and trade potential, indicates that infrastructure, income differentials and exchange rates are the most important determinants of bilateral trade flows. Wang and Badman (2016) further highlighted the performance of Peru's exports applying a multifaceted panel data gravity model. It has been shown that the economy size plays a positive role on exports; however the effect of distance is negative. Therefore, the authors suggested that increasing the economic growth is necessary to increase Peru's exports.

Regarding the African countries, Doumbe and Belinga, (2015) attempted to examine the bilateral trade flows between Cameroon and twenty-eight European Union countries using gravity model. The findings suggest that Cameroon's bilateral trade flows with the EU countries is positively linked to economy size and GDP per capita, however the distance between the trading partners has a negative effect. Khiar (2016) attempted to analyze the factors that intensify the bilateral trade flows between Algeria and EU over the period 1991-2011 using gravity model. The author finds that Algeria's bilateral trade with EU is positively linked to GDP, consumer's purchasing power (measured as GDP per capita), free trade agreement, and colonial past. However, the geographical distance negatively affects the volume of trade flows between Algeria and EU. Similarly, Lahrech et al.(2019) applied the gravity model to identify the main factors explaining the performance of Morocco's exports with 18 trading partners over the period 2001-2015. The results reveal that Morocco's

exports performance was affected by the global financial crisis. Moreover, the exports volume is positively influenced by the size market of trading partners and negatively correlated to the geographical distance.

## 2- METHODOLOGY

The gravity model is considered as the most appropriate model to describe and analyze international trade flows, it can also be applied in various research filed such as, analysis of migration and foreign direct investment ...etc (Mehchy et al., 2013). However, the multicollinearity, the spatial interdependence, and how to measure the geographical distance and transport cost are the main limits of gravity model. Indeed, in the gravity model of international trade, exports from country  $i$  to country  $j$  are explained by their economy size (GDP or GNP), their populations, direct geographical distance and a set of dummies variables which capture the institutional characteristics related to trade flows. In that context, this empirical study applies the basic gravity model and the augmented gravity model in order to analyze the factors explaining Algeria's trade flows with the main European Union trading partners (Spain France, Portugal, Italy and Germany).

### 2.1- Basic gravity model

In this model, the volume of trade between two countries depends on their respective GDP and the distance between them (Gul and Yasin, 2011). Hence, the functional form of the model for single period may be written as follows:

$$\text{TRAD}_{ij} = K (\text{GDP}_i^{\beta_1} \text{GDP}_j^{\beta_2}) / \text{DIST}_{ij}^{\beta_3} [1]$$

Where,  $\text{TRAD}_{ij}$  denotes trade from the country  $i$  to the country  $j$ ,  $\text{GDP}_i$  and  $\text{GDP}_j$  are real Gross Domestic Product of the country  $i$  and  $j$  respectively.  $\text{DIST}_{ij}$  measures the geographical distance between the capital city of the country  $i$  and  $j$  (measured in kilometers), and  $K$  is a gravitational constant. However,  $\beta_1$ ,  $\beta_2$  and  $\beta_3$  are the parameters to be estimated.

By introducing the natural logarithm, the equation [1] will be expressed as a log-linear function as follows:

$$\text{Ln}(\text{TRAD}_{ij}) = \text{Ln}K + \beta_1 \text{Ln}(\text{GDP}_i) + \beta_2 \text{Ln}(\text{GDP}_j) - \beta_3 \text{Ln}(\text{DIST}_{ij}) + \mu_{ij} [2]$$

We put  $\text{Ln}K = \beta_0$ , then the equation [2] will be rewritten as follow:

$$\text{Ln}(\text{TRAD}_{ij}) = \beta_0 + \beta_1 \text{Ln}(\text{GDP}_i) + \beta_2 \text{Ln}(\text{GDP}_j) - \beta_3 \text{Ln}(\text{DIST}_{ij}) + \mu_{ij} [3]$$

Where  $\beta_0$  is a constant, and  $\beta_1$ ,  $\beta_2$  and  $\beta_3$  measure the elasticity of  $\text{GDP}_i$ ,  $\text{GDP}_j$ , and  $\text{DIST}_{ij}$  respectively.  $\mu_{ij}$  is the error term.

## 2.2- Augmented gravity model

According to Erdem and Nazlioglu (2008), the augmented gravity model which captures the trade flows between pairs of countries is a function of their GDP, distance between pairs of countries and a set of control variables. Therefore, the equation [1] may be rewritten as follows:

$$\text{TRAD}_{ij} = K [\text{GDP}_i * \text{GDP}_j]^{a1} \text{DIST}_{ij}^{a2} A_{ij}^{a3} \quad [4]$$

Where  $A_{ij}$  represents a set of factors which affect the trade flows between pairs of countries. In that sense, Gul and Yasin (2011) added to the augmented gravity model the per capita Gross National Income differentials between pairs of countries and two dummy variables, namely colonial past and trade agreements. Thereby, the equation [4] may be expressed as follows:

$$\text{TRAD}_{ij} = K [\text{GDP}_i * \text{GDP}_j]^{a1} \text{DIST}_{ij}^{a2} [( \text{GNIPC}_i - \text{GNIPC}_j )^2]^{a3} \text{TRADAGR}_{ij}^{a4} * \text{COLON}_{ij}^{a5} [5]$$

Where  $\text{GNIPC}_i$  ( $\text{GNIPC}_j$ ) is the real income per capita of the country  $i$  (the country  $j$ ).  $[(\text{GNIPC}_i - \text{GNIPC}_j)^2]$  is the squared per capita income differentials between countries  $i$  and  $j$  which measures the economic inequality between countries  $i$  and  $j$ .  $\text{TRADAGR}_{ij}$  is a dummy variable that takes the value of 1 if there are trade agreements between the countries  $i$  and  $j$ , and the 0 otherwise. Furthermore,  $\text{COLON}_{ij}$  is a dummy variable that takes the value of 1 if the countries  $i$  and  $j$  have a colonial past and 0 otherwise. The logarithm form of the equation [5] may be expressed as follows:

$$\text{TRAD}_{ij} = \text{LnK} + a_1 \text{Ln}[\text{GDP}_i * \text{GDP}_j] + a_2 \text{LnDIST}_{ij} + a_3 \text{Ln}[\text{GNIPC}_i - \text{GNIPC}_j]^2 + a_4 \text{LnTRADAGR}_{ij} + a_5 \text{LnCOLON}_{ij} + u_{ij}[6]$$

We put  $\text{LnK} = a_0$ , the equation [6] can be rewritten as follows :

$$\text{TRAD}_{ij} = a_0 + a_1 \text{Ln}[\text{GDP}_i * \text{GDP}_j] + a_2 \text{LnDIST}_{ij} + a_3 \text{Ln}[\text{GNIPC}_i - \text{GNIPC}_j]^2 + a_4 \text{LnTRADAGR}_{ij} + a_5 \text{LnCOLON}_{ij} + u_{ij}[7]$$

Where  $a_0, a_1, a_2, a_3, a_4$  and  $a_5$  are the parameters to be estimated, and  $u_{ij}$  is the error term.

The equation [3] and [7] will be estimated taking into account three functional forms in panel data, pooled model, fixed effect model and random effect model. To identify which model is better to explain the determinants of trade flows between Algeria and the five European partners, a set of tests will be conducted. Hausman test will be used to compare the fixed effect model and the random effect model. If the fixed effect model is accepted, the Fisher test will be performed to identify which functional form is better; the fixed effect model or pooled model. However, if the fixed effect model has been rejected, the Breusch Pagan LM test will be used to test which model should be selected; random effect model or pooled model. Furthermore, the estimated augmented gravity model allows us to calculate the potential trade of Algeria with its trading partners. Indeed, Algeria will have a trade potential once the estimated trade flows are higher than that of the real trade flows (Helmets et al., 2005).

### 3- DATA AND STATISTICS ANALYSIS

The empirical study concerns Algeria and five European Union trading partners, namely Italy, France, Germany, Portugal and Spain. The used data are extracted from three databases; IMF database, World Development Indicators database and of CEPII database, and covering the period of 1990-2018. The definition and descriptive statistics of the selected variables are reported in Table 1 and Table 2 respectively.

Following the data in Table 2, the mean of Algeria's trade flows, with the five European trading partners over the period 1990-2018, was \$4.88 Billion. The maximum value of \$16.7 Billion is recorded in

2012 with Italy; however the minimum value of \$92.9 Million was reached with Portugal in 1998. Moreover, the GDP (in PPP) of Algeria has experienced an upward trend, it moved from \$216 Billion in 1994 to \$485 Billion in 2018, where the mean over the studied period was estimated to \$328 Billion. The mean of GDP (in PPP) of the five European countries is estimated to \$2.08 Trillion, being 6 times more than that of Algeria. Furthermore, the individual income in Algeria has grown throughout the studied period, it moved from \$7399 in 1994 to \$11554 in 2016 and a mean of \$9396. The later remains so far than that recorded in the five European countries, because their mean individual income is estimated to \$38131. This reflects the huge difference in terms standard of living between Algeria and the five European Union trading partners.

**Table1.** Definition of studied variables and data sources

Variables	Symbol	Measure	Source
Bilateral trade flows	TRAD	Total Algerian exports and imports (constant 2010 US\$).	IMF
Real GDP	GDP	Gross domestic product, purchasing power parity (constant 2011 international \$)	WDI
Geographical distances	DIST	The distance between the capital of Algeria and its commercial partner (in kilometers).	CEPII
Gross national income per capita	GNIPC	Standard of living, Purchasing Power Parity (constant 2011 international \$)	WDI
Trade agreement	TRADAGR	Dummy variable	/
Colonial past	COLON	Dummy variable	/

IMF: International Monetary Fund. WDI: World Development Indicators of World Bank.

CEPII: Centre d'Etudes Prosepectives et d'Infomations Internationales, France

Source : elaborated by the authors

**Table 2.** Descriptive statistics

Variable	Mean	Max	Min	StdDev	Obs
TRAD <sub>ij</sub>	4.82E+09	1.67E+10	9.29E+07	4.35E+09	145
GDP <sub>i</sub>	3.28E+11	4.85E+11	2.16E+11	9.03E+10	29
GDP <sub>j</sub>	2.08E+12	4.45E+12	2.35E+11	1.16E+12	145
DIST <sub>ij</sub>	1232.48	1812.23	806.50	327.58	5

GNIPC <sub>i</sub>	9396.09	11553.72	7398.89	1443.66	29
GNIPC <sub>j</sub>	38130.97	55154.65	23522.90	6917.036	145

Source: Elaborated by Authors using Output of Stata15.1.

#### 4- RESULTS AND DISCUSSION

##### 4.1- Basic gravity model estimates

First, we estimate the basic gravity model, equation [3], with panel data. For doing so, the OLS, LSDV and the GLS methods have been used to estimate the pooled model, fixed effect model and the random effect model respectively. The obtained results are reported in Table 3.

**Table 3.**Basic gravity model estimates

Variables	Pooled	Random Effect	Fixed Effect
Constant	-38.409* (-8.48)	-36.829* (-4.44)	-43.282*** (-4.67)
LnGDP <sub>i</sub>	1.849* (11.21)	1.919* (11.72)	2.106* (8.57)
LnGDP <sub>j</sub>	0.943* (17.34)	0.775* (2.86)	0.330 (0.64)
LnDIST <sub>ij</sub>	-2.157* (-11.70)	-1.978*** (-1.86)	Omitted
Adjusted R <sup>2</sup>	0.786	0.778	0.502
Wald or Fisher Test	177.64	371.91	181.49
P-value	0.000	0.000	0.000
Hausman test	/		1.040
P- value			0.595
Breusch Pagan LM Test		441.940	/
P-value		0.000	

Source: Elaborated by Authors using Output of Stata15.1.

*t*-Statistics are in parentheses. \*, \*\*, \*\*\* denote significance at the 1%, 5% and 10% level, respectively. The number of observations equals 145.

The Hausman test has been conducted to identify which model is appropriate, fixed effect model or random effect model. The P-value associated to Hausman test is equal to 0.59 (more than 0.05), which indicates that the null hypothesis is accepted, and therefore the random effect model is chosen. In addition, the Breusch-Pagan LM test has been used to determine which model is better, the random effect model or the pooled model. The P- value associated this test is less than 0.05, thereby the random effect model is the best

specification to estimate the determinants of Algeria's trade flows with five EU countries. According to Wald test, this model is globally significant and explains 78% of the variability of Algeria's trade. Furthermore, except the coefficient with respect to the distance variable which appears significant at 10%, the other coefficients of the selected explanatory variables are significant at 1% significance level and their signs are expected. Indeed, GDP has a positive effect, and if the later increases by 1% the trade flows also rise by 1.92%. This result is in line with the reported results for Algeria in Khier (2016). It is worth noting that in Algeria, the economic growth is strongly linked to the investment in the hydrocarbon sector which leads to increase, in turn, the hydrocarbon exports volume and the foreign currency revenues. Therefore, the exports of goods and services of Algeria continue to increase over time, and the bilateral trade flows variation is more than that of the GDP (1.92% vs. 1%). This situation can be explained by the no sufficient capacity of domestic market to absorb the surplus in GDP to diversify the economy. This result is in line with that obtained in Khayat and McMillan (2019) which applied the gravity model to examine the trade flows between GCC countries and the developed countries over the period 2001-2012. The obtained results suggest that the exports of GCC countries are positively linked to GDP per capita.

Otherwise, the GDP of European Union trading partners of Algeria positively affects the bilateral trade flows, but its elasticity is less than that of Algeria, it estimated to 0.775. This means 1% an increase in GDP of the European Union trading partners, the trade flows will grow by 0.77%. Thereby, the expansion of the economy of one of the trading partners of Algeria leads to enhance the consumption of petroleum products which positively affects the Algeria's exports increasing, in turn, the manufacturing Algeria's imports from the European trading partners. Likewise, Jomit (2014) analyzed the exports of environmental goods between India and 58 trading partners, during the period of 1991-2011, using the gravity model. The estimated results confirm that the exports volume is positively related to their GDP. Moreover, increasing GDP of India leads to a greater

increase in its exports, because the economic growth depends mainly on the exports more than the domestic market. Nevertheless, Khiar(2016) suggested that the coefficient related to the GDP of the EU countries positive and statically insignificant.

Regarding the distance between the importer and the exporter, the estimated coefficient appears with a negative sign implying a negative impact on bilateral trade flows. Therefore, if the distance between the capital of Algeria and its European Union trading partners increases by 1%, the volume of bilateral trade decreases by 1.98%. This result is in line with those obtained by Jomit (2014) and Khiar (2016) where the estimated coefficients are (-1.27) and (-1.90) respectively.

#### **4.2- Augmented gravity model estimates**

In that section, the basic gravity model is augmented with a set of control variables, like trade agreements and colonial past, to estimate and analyze the main factors influencing the trade flows between Algeria and the five EU trading partners, namely Italy, France, Spain, Germany, and Portugal. Indeed, trade agreements, colonial past, language, culture, historical trading relationships, and the income inequality which measures the economic gap between countries are relevant to explain the bilateral trade flows. This point of view is supported by the previous empirical studies (Gul and Yasin, 2011; Doumbe and Belinga, 2015; Martinez-Zarzoso and Nowak-Lehmann, 2003; Wang and Badman, 2016). Hence, the augmented gravity model will be obtained by estimating the equation [6] taking into account three functional forms; pooled model, fixed effect model and random effect model. The obtained results are reported in Table 4.

It should be noted that the estimated coefficients of the pooled model and that of the random model are similar. Applying Hausman test led to confirm that the fixed effect model is better than the random effect model, nevertheless Fisher test proved that the pooled model is the most appropriate model to identify the factors explaining the Algeria's trade flows. The P-value of Fisher test is significant at 1%, therefore the estimated pooled model is globally significant, and 79% of the variability of Algeria's trade flows with the five EU trading

partners is explained by the explanatory variables. In addition, all estimated coefficients are significant either at 5% or 10%, and they have the expected signs. Moreover, the cross product term of Algeria's GDP and that of its EU trading partners is estimated to 1.153 with a positive sign. This implies that 1% an increase in the cross product term of GDP leads to increase the bilateral trade flows by 1.15%. This result is consistent with that obtained in the basic gravity model, and therefore confirming one of the hypotheses of that model which suggests that trade flows are strongly linked to the economy size. These results are in line with the reported results for one of the African countries in Doumbe and Belinga (2015). In this study, the authors suggested that the Cameroons's trade flows with union European, over the period of 2008-2012, are positively influenced by the GDP and negatively linked to geographic distance and their elasticity are estimated to (1.28) and (-2.03) respectively.

**Table 4.** Augmented gravity model estimates

Variables	Pooled	Fixed Effects	Random Effects
Constant	-19.151* (-6.16)	-62.615* (-14.80)	-19.151* (-6.16)
Ln(GDP <sub>i</sub> *GDP <sub>j</sub> )	1.153* (8.83)	1.956* (17.02)	1.153* (8.83)
Ln(GNIPC <sub>i</sub> -GNIPC <sub>i</sub> ) <sup>2</sup>	-0.647** (-1.98)	-1.093* (-4.79)	-0.647** (-1.98)
LDIST <sub>ij</sub>	-1.288** (-2.39)	Omitted	-1.288** (-2.39)
TRADAGR <sub>ij</sub>	0.465*** (1.67)	Omitted	0.465*** (1.67)
COLON <sub>ij</sub>	0.402** (2.46)	Omitted	0.402** (2.46)
Adjusted R <sup>2</sup>	0.791	0.567	0.791
Wald or Fisher Test	110.18	211.45	550.91
P-value	0.000	0.000	0.000
Hausman test	/		571.27
P-value			0.000
Fisher Test specification		-17.808	/

Source: Elaborated by Authors using Output of Stata15.1.

t-Statistics are in parentheses. \*, \*\*, \*\*\* denote significance at the 1%, 5% and 10% level, respectively. The number of observations equals 145.

In addition, the obtained results also show a negative effect of income inequality on the bilateral trade flows, because the estimated coefficient associated to the squared difference between Algeria's national income and that of trading partner has a negative sign and statistically significant. In fact, the income inequality hinders Algeria's trade flows. The latter will decrease by 0.65% if the inequality income with the trading partner increases by 1%. As the Algerian exports are mainly constituted from petroleum products, this weak elasticity can be explained by the dependence of Algeria's international trade to the amount of GDP instead of the level of individual income. This result confirms the Linder hypothesis which indicates that the countries with the similar technological development, individual income and living standard will have the large trade flows between them (Zeray, 2015).

Furthermore, the obtained results confirm that the estimated coefficient of the distance between the importer and the exporter is statistically significant and negatively affects Algeria's trade flows. The latter will decrease by 1.29% if the distance between Algiers and one of the trading partners increases by 1%. The dummy variables with respect to the trade agreements and colonial past are statistically significant and their coefficients are estimated to 0.465 and 0.402 respectively. Hence, the presence of trade agreements between Algeria and its trading partners leads to raise the bilateral trade flows by 0.46%; however the effect of the colonial past is estimated to 0.40%. Indeed, there are strong historical, cultural and linguistic relationships between Algeria and France, because the latter had colonized Algeria during 132 years making their economies interconnected which favorites, in turn, the trade flows between them. These results are in line with the study of Lahrech et al. (2019) indicating that the colonial past has a positive effect on the exports of Morocco, and the trade agreements don't have a significant effect. However, Pham et al.(2014) approved that the colonial past and the trade agreements concluded between Vietnam and European Union positively affects bilateral trade flows.

#### **4.3- Trade potential between Algeria and the five UE trading partners**

This section aims to estimate the potential trade of Algeria with the five UE trading partners. To do so, we estimate the volume of trade flows between Algeria and each studied trading partner using the pooled augmented gravity model over the period 2010-2018. The potential trade is the ratio of estimated volume of trade to observed value. The obtained results are reported in Table 5. Thus, if the percentage of penitential trade exceeds 100% and the restrictions to trade will be suppressed, Algeria possesses a real possibility to promote its trade exchanges with the considered trading partner. Except Germany, the findings indicate that, before 2014, Algeria didn't have potential trade with the four trading partners, because the effective trade was higher than the expected trade. However, during the period 2014-2018, Algeria has had a veritable potential trade with Germany, France, and Spain. Hence, by concluding the suitable trade agreements and suppressing the trade barriers, Algeria could double its bilateral trade with Spain.

**Table5.** Algeria's potential trade flows withits trading partners(%)

Years / Country	Italy	France	Germany	Portugal	Spain
2010	50**	92**	105	50**	97
2011	44**	68**	91**	28**	82**
2012	42**	78**	103	31**	74**
2013	51**	78**	105	31**	61**
2014	63**	84**	79**	30**	64**
2015	90**	116*	101	41**	100
2016	92	142*	114*	54**	138*
2017	92	135*	108*	78**	232*
2018	88**	126*	109*	70**	202*

Source: Elaborated by Authors.

Notes: \* and \*\* Indicates high and exhausted trade potential respectively

## CONCLUSION

This article examines the determinants of Algeria's trade flows and the five EU trading partners, namely Italy, France, Germany, Spain and Portugal over the period 1990-2018. For doing so, we applied the basic gravity model and the augmented gravity model in panel data. The obtained results suggest that the level of GDP, trade agreements and colonial past play a positive effect on bilateral trade

flows; however the latter is negatively linked to geographic distance and income inequality. Indeed, the basic gravity model reveals that a 1% increase in GDP of Algeria increases its trade flows by 1.92%. Moreover, the elasticity related to cross product term of GDP, trade agreements and colonial past in the augmented gravity model are estimated to 1.153, 0.465 and 0.402 respectively. This means that the bilateral trade flows is more sensitive to the level of GDP than the trade agreements and colonial past. The estimated coefficient associated to the squared difference between Algeria's national income and that of trading partner is negative, therefore the economic gap and the standard of living hinder Algeria's trade flows. The latter will decrease by 0.65% if the squared deviation in national income per increases by 1%. Likewise, Algeria's trade flows decrease by 1.29% if the distance between Algiers and the capital of one of the trading partners increases by 1%. On the other hand, Algeria has a real potential trade with Germany, France, and Spain. Furthermore, by concluding the suitable trade agreements and suppressing the trade barriers, Algeria could double its bilateral trade with Spain.

Given the obtained results, Algeria could reduce the trade deficit by diversifying its economy and granting the necessary helps to exports activities. For doing so, Algeria should undertake deep institutional and economic reforms to build real market economy, guarantee business freedom, and enhance doing business.

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