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The effect of free trade agreements on Tunisia's trade balance: a gravity model approach

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ABSTRACT

A plethora of empirical research studies have unveiled the determinants of bilateral flows. However, little is known about their net effect on the trade balance. In this paper, we aim to examine the role of free trade agreements in the widening of Tunisia's trade deficit in recent years. Our estimations are based on aggregated and disaggregated data for Tunisia and its 164 trading partners over the 1995-2019 period. Using static and dynamic versions of the gravitational equation along with the Poisson Pseudo Maximum Likelihood technique, we find that Tunisia's trade flows increase as Tunisia's and its trading partners' income rises. In addition, the EU agreement is the only FTA that has had beneficial effects on the trade balance in the manufactured sector. The PAFTA has also had some positive effects on the trade balance, but only in the agricultural sector. The free trade agreement signed with Turkey as well as the PAFTA and AGADIR agreements have significantly contributed to an excess of Tunisia's trade deficit in the manufactured sector.

ملخص

كشف عدد كبير من الدراسات البحثية التجريبية عن محددات التدفقات الثنائية. ومع ذلك، لا يُعرف الكثير عن تأثيرها الصافي على الميزان التجاري. وفي هذه الورقة البحثية، نهدف إلى دراسة دور اتفاقيات التجارة الحرة في اتساع العجز التجاري التونسي في السنوات الأخيرة. وتستند تقديراتنا إلى بيانات مجمعة ومفصلة عن تونس وشركائها التجاريين البالغ عددهم 164 شريكا خلال الفترة 1995-2019. وباستخدام إصدارات ثابتة وديناميكية من معادلة الجاذبية إلى جانب تقنية مُقدر دالة الاحتمالية القصوى، نجد أن التدفقات التجارية لتونس تزداد مع ارتفاع دخل تونس وشركائها التجاريين. بالإضافة إلى ذلك، تعتبر اتفاقية الاتحاد الأوروبي اتفاقية التجارة الحرة الوحيدة التي كان لها آثار مفيدة على الميزان التجاري في قطاع التصنيع. كما كان لاتفاقية منطقة التجارة الحرة العربية الكبرى

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(PAFTA) بعض التأثيرات الإيجابية على الميزان التجاري، ولكن بالاقتصار على القطاع الزراعي فقط. وقد ساهمت اتفاقية التجارة الحرة الموقعة مع تركيا وكذلك اتفاقيات بافتا وأكادير بشكل كبير في زيادة العجز التجاري التونسي في قطاع التصنيع.

ABSTRAITE

Plethora of empirical research studies have unveiled the determinants of bilateral flows. However, little is known about their net effect on the trade balance. In this paper, we aim to examine the role of free trade agreements in the widening of Tunisia's trade deficit in recent years. Our estimations are based on aggregated and disaggregated data for Tunisia and its 164 trading partners over the 1995-2019 period. Using static and dynamic versions of the gravitational equation along with the Poisson Pseudo Maximum Likelihood technique, we find that Tunisia's trade flows increase as Tunisia's and its trading partners' income rises. In addition, the EU agreement is the only FTA that has had beneficial effects on the trade balance in the manufactured sector. The PAFTA has also had some positive effects on the trade balance, but only in the agricultural sector. The free trade agreement signed with Turkey as well as the PAFTA and AGADIR agreements have significantly contributed to an excess of Tunisia's trade deficit in the manufactured sector.

Keywords: Arab Spring, Gravity model, Tunisia's trade deficit, Free trade agreements, Poisson Pseudo Maximum Likelihood

1. JEL Classification: F14, F15, C23 Introduction

Trade openness has been acknowledged as an engine for economic development (Edwards, 1993). This is because trade liberalization not only increases Gross Domestic Product (GDP) but also helps developing economies build up foreign exchange reserves (Atif *et al.*, 2017). The export-led growth hypothesis postulates that an expansion of exports in developing countries would usually lead to an improvement in economic growth (Barro, 1991). Being aware of the importance of exports, the Tunisian government has implemented several measures of trade reform over the last decades, which have generated a significant improvement in Tunisia's trade flows. However, despite this expansion of trade flows, Tunisia experienced an alarming widening of its trade deficit (see Appendix 3).

It is of crucial importance for Tunisia to determine the causes of the poor trade performance observed in recent years and to identify measures or

actions that should be taken to reduce Tunisia's trade balance deficit. In this regard, this study examines the role of free trade agreements (FTAs) concluded by the Tunisian government in the widening of Tunisia's trade deficit using an augmented gravity model.

It is common to assume that the implementation of free trade agreements, through reducing barriers to trade, should facilitate international transactions and stimulate the growth of exports and imports between members. However, the implications for the trade balance are ambiguous because they depend on the relative impact of the FTA on export and import growth and on what happens to the prices of traded goods. Therefore, the nature of the relationship between FTAs and the trade balance needs to be investigated empirically.

A careful look at the literature on trade integration effects in Tunisia reveals that several studies have been conducted to analyze Tunisia's external trade in a gravity framework. This empirical research can be subdivided into two groups. The former group of studies assessed the effect of trade integration on trade flows for a sample of countries including Tunisia using aggregate data (e.g., Peridy, 2005; Abedini and Péridy, 2008; Cieślik and Hagemejer, 2009; Abdmoulah, 2011). The vast majority of them only used data covering the late 1990s and early 2000s to investigate trade integration effects on exports without considering the net effect on trade balance. The latter strand of studies reexamined the issue using sectoral data (e.g., Parra *et al*, 2016; Cardozo *et al*, 2020). The present paper contributes to the existing literature in several ways. First, in contrast to previous studies based on the gravity model, we propose to explain the role of FTAs in the widening of Tunisia's current account deficit. Specifically, following the theoretical developments of the gravity literature and the approach of Caporale *et al*. (2012), we estimate two Tunisian trade equations using the Pseudo Maximum Likelihood (hereafter PPML) technique, one for exports and one for imports, and we compare the elasticities of each of the explanatory variables in order to derive their net effect on the trade balance. Secondly, contrary to previous studies on MENA trade flows, we allow for the heterogeneity of the effect of FTAs across countries and use only bilateral trade data for Tunisia. Moreover, we follow Baier and Bergstrand (2007) and calculate the trade integration effect over ten years. Third, we reexamine the nexus between FTAs and both exports and imports in Tunisia, employing a different estimation method (the PPML) from previous studies and more recent

data covering the 1995- 2019 period. Fourth, we investigate the dynamic of Tunisia's trade balance in response to FTAs using sectoral data.

We find that the European Union agreement is the only FTA that has had beneficial effects on the trade balance in manufactured sectors. The PAFTA has also had some positive effects on the trade balance, but only in the agricultural sector. The free trade agreements signed with Turkey as well as the PAFTA and AGADIR agreements have significantly contributed to an excess of Tunisia's trade deficit in the manufactured sector.

In the remainder of the manuscript, we proceed as follows: In Section 2, we provide an overview of Tunisia's free trade agreements. In Section 3, we discuss the econometric specifications, the data sets, as well as the econometric methodology. In Section 4, we present our research findings. Finally, in Section 5, we offer some concluding remarks, as well as some policy implications.

2. An overview of Tunisia's free trade agreements

Tunisia has signed a number of free trade agreements with its major trading partners, including the European Union (Tunisia-EU free trade agreement); Morocco, Jordan, and Egypt (AGADIR agreement); the Pan-Arab Free Trade Area (PAFTA agreement); and Turkey (Tunisia-Turkey free trade agreement).

The bilateral Tunisia-EU trade agreement was signed in 1995 and entered into force in 1998. It covers all industrial products except agro-food. Tunisia has already had duty-free access to the European market since the 1970s. The agreement, therefore, ensures the gradual opening of the Tunisian market to European products on the 2010 horizon. Agriculture and services were excluded from the original agreement, but negotiations on agriculture led in 2001 to an increase in quotas at zero or reduced tariffs granted by Europe to Tunisian products (in particular concentrated tomatoes, oranges, and olive oil) and by Tunisia to European agricultural products (cereals and sugar).

In 1997, Tunisia signed the PAFTA agreement with 13 Arab countries[2]. The agreement went into effect in 1998 and covers both manufactured and agricultural products. It stipulated the gradual elimination of all barriers to trade (tariff, quantitative, health, and administrative barriers) on exports and imports of goods between Arab countries over the 1998-2007 period. By 2005, most of the customs duties between signatories were abolished, however, the agreement has not achieved its final objective of a free trade zone, because problems related to pervasive non-tariff barriers, rules of origin, high transport costs, and ineffective mechanisms to resolve conflicts (Parradutt *et al.*, 2012, Grand, 2019).

In 2004 in Rabat, Tunisia signed with Egypt, Jordan, and Morocco the AGDIR agreement. The agreement came into force in 2007 and aimed at liberalizing trade between the signatory partners. All products, both agricultural and industrial, have been freely traded since 2007. In 2016, Lebanon and Palestine joined the trade area.

Tunisia also signed an association agreement with Turkey on November 25, 2004, with the goal of gradually liberalizing trade flows beginning in 2005. Under this agreement, Tunisia undertook to remove all trade barriers on industrial products originating in Turkey within nine years of implementation. In return, Turkey assumed to remove all customs duties on Tunisia's exports to Turkey immediately after the entry into force of the association agreement. Since July 2014, all tariffs on industrial products have been eliminated, however agricultural and fishing products, including agri-food products, are not covered by the agreement. In addition, tariff preferences are reciprocally granted to certain agricultural and fishery products. The agreement also contains provisions on the protection of intellectual property, services, dispute resolution, anti-dumping, countervailing, and safeguard duties.

[2] The agreement has been extended later to include three other Arab countries. The current members are Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan; Syria, Tunisia, United Arab Emirates, Yemen.

3. Empirical model, variables used, data and econometric methodology

3.1. Econometric specification

Our study relies on the gravity model with a structure that incorporates several characteristics of the theoretical model elaborated by Anderson and Van Wincoop (2003). The authors elaborated a structural gravity equation in the following form:

$$T_{ij} = \frac{Y_i Y_j}{Y_m}\left(\frac{\tau_{ij}}{P_i P_j}\right)^{1-\sigma} \quad (1)$$

, where T_{ij} denotes nominal exports from i; Y_i and Y_j are levels of nominal income; Y_m is world income; P_i and P_j represent the level of multilateral resistance; and allow to take the barriers to trade with all other partners into account; τ_{ij} is level of bilateral trade costs. Finally, $\sigma > 1$ is the elasticity of substitution between goods produced in the source country and those produced in the destination country.

Log-linearizing the structural gravity equation (1) and adding a stochastic error term, ε_{ijt} yields the following equation:

$$Ln(T_{ij}) = Ln(Y_i) + Ln(Y_j) - (Y_m) + (1-\sigma)(\tau_{ij}) - (1-\sigma)(P_i) - (1-\sigma)(P_j) + \varepsilon_{ijt} \quad (2)$$

Following previous research using gravity model, we model the trade cost function, τ_{ij}, as follows:

$$\tau_{ij} = DIST_{ij}^{\delta_1} CC_i^{\delta_2} e^{\delta_3 LANG_{ij} + \delta_4 COL_{ij} + \delta_5 BORD_{ij} + \delta_6 AS_j + \delta_7 FTA_{ij}} \quad (3)$$

, with $DIST_{ij}$, the geographical distance between the two partners; CC_i, a measure of corruption in country i; $LANG_{ij}$, COL_{ij}, $Bord_{ij}$ are dummy variables that take one if the two countries share the same language, the same colonizer, and the same border, respectively; AS_j is a dummy variable taking the value one if the partner j has a maritime border; and FTA_{ij} a vector of regional trade agreement dummies.

Substituting equation (3) into (4) yields the following specification:

$$Ln(T_{ij}) = Ln(Y_i) + \mathrm{Ln}(Y_j) + Ln(Y_m) + \delta_1 ln(DIST_{ij}) + \delta_2 Ln(CC_{it}) + \delta_3 LANG_{ij} + \delta_4 COL_{ij} + \delta_5 BORD_{ij} + \delta_6 AS_j + \delta_8 FTA_{ij} - (1-) Ln(P_i) - (1-\sigma) Ln(P_j) + \varepsilon_{ijt} \quad (4)$$

The terms P_i and P_j are not directly observable. However, Anderson and van Wincoop (2003) argue that their omission is a source of significant estimation biases. Several methods have been used in the gravity literature to account for multilateral resistance (MR). In this study, we follow Frede and Yetkiner (2017) and Stansel and Tuszynski (2019), and choose to combine two approaches. First, we introduced Λ_{ij}, a dummy variable for each partner country to control for bilateral unobserved costs; hence, we can control for MR and address the omitted variables problem when estimating the gravity equation. Through the importer/exporter dummy, we also account for bilateral heterogeneity. We do not include country-time fixed effects because in this case we must introduce a large number of dummies, so we wouldn't be able to estimate our model. Moreover, with country-time fixed effects, we are unable to include time-varying variables such as GDP or institutional variables because of collinearity. Secondly, we use a multilateral resistance index (MRI), developed by Carrère *et al.* (2010) on the basis of Baier and Bergstrand (2009) approach, which is calculated as a weighted linear combination of the logarithmized geographical distance from each partner country[3]. This index is widely used in the empirical literature. See for example Cirera *et al.* (2016) and Xu (2018)[4]. It is used to account for the time-variant part of the multilateral resistance terms.

The econometric specifications of the gravity equations, including the terms of multilateral resistance, are given below. We drop from equation (4) time-invariant variables to avoid the problem of correlation with partner fixed effects. Therefore, the two gravity equations that we employ to study Tunisia's trade are as follows:

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[3] The index is calculated as follows: $MRI_{ij} = \sum_j \frac{Y_j}{Y_m} ln(DIST_{ij})$

[4] We didn't include time-fixed effects in the model to avoid the problem of correlation with time-variant independent variables relative to Tunisia, such as Y_{it} and CC_{it}. We re-estimated the model, including time-fixed effects. The results obtained remained unchanged in almost all cases and didn't alter our main conclusions concerning the effect of FTAs. The estimates are available upon request.

$$\text{Ln}\left(Exports_{ijt}\right) = (\alpha_0) + \alpha_1 \text{Ln}\,(Y_{it}) + \alpha_2\ \text{Ln}\left(Y_{jt}\right) + \alpha_3\ \text{Ln}(CC_{it}) + \alpha_4 FTA\_UE_{ijt} + \alpha_5 FTA\_TURQ_{ijt} + \alpha_6 FTA\_AGA_{ijt} + \alpha_7 FTA\_PAFTA_{ijt} + \alpha_8 MRI_{ijt} + \Lambda_{ij} + \varepsilon_{ijt} \quad (5)$$

$$\text{Ln}\left(Imports_{ijt}\right) = (\beta_0) + \beta_1 \text{Ln}\,(Y_{it}) + \beta_2\ \text{Ln}\left(Y_{jt}\right) + \beta_3\ \text{Ln}(CC_{it}) + \beta_4 FTA\_UE_{ij} + \beta_5 FTA\_TURQ_{ij} + \beta_6 FTA\_AGA_{ij} + \beta_7 FTA\_PAFTA_{ij} + \beta_8 MRI_{ijt} + \Lambda_{ij} + \varepsilon_{ijt} \quad (6)$$

, where t denotes time; Export_{ijt} is the total volume of Tunisia's exports to country j at time t; Import_{ijt} is the volume of Tunisia's imports from country j at time t; ; the world's GDP (Y_m) is absorbed in the intercept; Y_{it} is Tunisia's GDP in year t; Y_{jt} is GDP of the partner country in year t; FTA_UE_{ijt} is a dummy variable equal to 1 if the trading partner and Tunisia are involved in the EU regional trade agreement at time t; FTA_TURQ_{ijt} is a dummy variable equal to 1 if Tunisia and Turkey are engaged in a trade agreement at time t ; FTA_AGA_{ijt} is a dummy variable taking 1 if the two partners are members of the AGADIR regional trade agreement at time t; FTA_PAFTA_{ijt} is a dummy variable taking 1 if the two partners are members of the PAFTA regional trade agreement at time t[5]; CC_{it} is an indicator of control of corruption; MRI_{ij} and Λ_{ij} capture multilateral resistance (MR); and ε_{ijt} is an error term. It is assumed to be uncorrelated with explanatory variables and follows a normal distribution with zero mean and constant variance.

3.2. Data

The gravity equations were estimated using aggregated and disaggregated data for Tunisia's annual bilateral merchandise flows (exports and imports) with its 164 trading partners from 1995 to 2019. The source of aggregated trade data is the IMF's Direction of Trade Statistics (*DOTS*) database. Gross domestic product is extracted from the World Development Indicators database (2021) of the World Bank. Statistics on manufactured and agricultural trade are provided by WITS database of the World Bank. We collected the data on regional trade agreements from the World Trade Organization database. We extracted the control of

[5] Appendix 2 gives an overview of the four FTAs considered in this analysis.

corruption index from the World Governance Indicators database of the World Bank[6].

3.3. Econometric methodology

The estimation of the gravity model is fraught with several econometric problems, such as heteroscedasticity, autocorrelation, and heterogeneity (Santos-Silva and Tenreyro, 2006). Besides, there is a lengthy tradition of log-linearizing and estimating the gravity equation by Ordinary Least Squares (OLS). Nevertheless, this practice is incompatible in the presence of two major econometric problems. The former problem is related to heteroscedasticity. Santos-Silva and Tenreyro (2006) show that estimates tend to be biased when estimating a log-linearized gravity equation with heteroscedastic errors by OLS. Indeed, if the error terms are heteroscedastic, the transformed residuals (by the log-linearization) will generally be correlated with the explanatory variables. The latter problem is related to the presence of zero trade values in the sample considered. In fact, log-linearization is operationally inadequate, especially when using a database containing zero trade values: by taking the log, the zero-trade disappears from the sample[7]**.** The PPML technique proposed by Santos-Silva and Tenreyro (2006) treats properly the two problems mentioned above, that is heteroscedasticity and the presence of zero observations[8]. In addition, this approach makes it possible to obtain more efficient estimators than the other linear estimation methods; it always produces convergent estimates in the presence of heteroscedasticity, and can resolve the bias caused by the autocorrelation of errors and multi-collinearity (Álvarez *et al.*, 2018), as well as non-normal residuals (Agostino and Trivieri, 2014). In this regard, instead of the log of the dependent variable, we regress the level value of Tunisian exports (or imports) using the PPML method.

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[6] The data of this study is available from the corresponding author. See Appendix 1 for further details.

[7] By taking the log of equation (1), zero values will be eliminated automatically by econometric software, as it is impossible to calculate the log of zero. The PPML method estimates the gravity model in its multiplicative form, making it possible to keep the zero observations in the sample.

[8] In this study, the proportion of zero trade flows constitutes 17.7% and 11.2% of the export and import datasets, respectively. Ignoring this number of zeros would lead to misleading results.

4. Econometric results

The econometric methodology involves three steps. First, we estimate a static version of the theoretical gravity model (equations 5 and 6) to determine the average effect of explanatory variables, namely FTAs, on trade flows. Second, we re-estimate the model, including the lagged level of FTAs and the institutional variable. Finally, we investigate the robustness of results using disaggregated data**.**

4.1. Estimation of a static version of the gravity equation

Table 1 below reports estimations of the export and import equations using the PPML approach. The obtained estimated coefficients by PPML reveal that the standard gravity variables (countries' GDP) have an impact consistent with theoretical expectations. According to the results in columns (1) and (2), a higher level of Tunisian GDP increases both goods exports and imports significantly. However, the effect of national GDP is more pronounced on exports.

Likewise, the gross domestic product of the partner country affects positively and significantly exports and imports at a 1 percent level of significance. More importantly, the positive effect of income appears stronger in the import equation than in the export one. This result reflects not only the fact that Tunisian products are less competitive in both local and foreign markets but also, the fact that Tunisian consumers have a greater preference for foreign products.

Regarding free trade agreements, the FTA_EU variable is positive and significantly different from zero for exports, but exhibits a positive and insignificant coefficient in import regressions. At this juncture, it is worth noting that in a paper by Studnicka *et al.* (2019), European regional trade agreements appear to have no impact on total European Union exports. Studnicka *et al.* (2019) further note that this finding breaks down, however, if one distinguishes between individual European countries. This implies that the presence of heterogeneous effects across EU member states may explain the insignificant effect of the FTA concluded with the EU on Tunisia's imports.

The AGADIR variable has a more pronounced effect (in terms of significance) on exports. In fact, while the variable FTA_AGADIR enters

the export regression with a positive and significant sign at 1% level, it is statistically insignificant for imports. These findings are in accordance with Parra *et al.*, (2012), who found that the AGAIR agreement is positively and significantly associated with Tunisia's exports and insignificantly associated with imports.

By contrast, the Turkey agreement variable yields a positive and significant coefficient in the import model, but is negative and insignificant in the export regressions. This insignificant effect reflects not only the fact that the Turkish government still imposes trade barriers on Tunisian exports, such as exports of agricultural products, in which Tunisia has a comparative advantage, albeit remaining very restricted, but also the lack of competitiveness of Tunisian manufactured products on the Turkish market. This is in line with Parra *et al.*, (2012), who found a negative correlation between the Tunisia-Turkey agreement and Tunisia's trade flows for exports and a positive and significant correlation for import regressions.

Finally, the coefficient of FTA_PAFTA dummy is insignificant in both cases of imports and exports, with a negative effect on exports (columns (1) to (4)) and reveals the failure of efforts deployed by Arab countries to foster intra-regional trade. Our results are in line with those of Parra *et al.*, (2012), whose outcomes yield a negative and significant coefficient for the GAFTA agreement in Tunisia's export regression and an insignificant one in import regression. These findings are plausible given the lack of complementarities between Tunisia and the Gulf countries (Péridy, 2005). Moreover, this may reflect the fact that, as mentioned before, the agreement has not achieved its final objective of a free trade zone, because of problems related to pervasive non-tariff barriers, rules of origin, high transport costs, and ineffective mechanisms to resolve conflicts.

Concerning the institutional variable, it exerts a significant impact on exports. Better control of corruption has a negative impact on exports, suggesting that a rise in domestic corruption increases Tunisia's exports. This result reveals the existence of a relatively rigid administration, which leads Tunisian exporters to pay bribes to facilitate their business transactions. This means that corruption in Tunisia serves as a means to "grease the wheels", in other words, allows to compensate for the poor functioning of public institutions (Leff, 1964) or to "correct pre-existing government failures" as indicated by Aidt (2009). The coefficient of

corruption in the model of imports is positive but insignificant. Regarding the net effect on the trade balance, the result is counter-intuitive. It indicates that higher corruption improves Tunisia's trade balance.

Table 1: PPML results for the augmented gravity equations

Variables	Exports	Imports
Ln (Y_{it})	0.765***	0.261***
	(8.191)	(4.339)
Ln (Y_{jt})	0.552***	0.932***
	(7.292)	(23.65)
FTA_UE_{ijt}	0.250***	0.075
	(2.957)	(1.067)
FTA_TURQ_{ijt}	-0.074	0.273***
	(-0.771)	(3.825)
FTA_PAFTA_{ijt}	-0.124	0.003
	(-0.747	(0.022)
FTA_AGA_{ijt}	0.290***	0.115
	(3.577)	(1.075)
Ln(CC_{it})	-0.442**	0.034
	(-2.294)	(0.214)
MRI_{ijt}	0.055***	0.067***
	(3.261)	(5.396)
Constant	-33.49***	-32.06***
	(-22.68)	(-25.57)
Observations	3,844	3,844
R-squared	0.985	0.978

z-statistics are reported in parentheses
*** p-value<0.01, ** p-value<0.05, * p-value<0.1

4.2. Robustness checks

In the present subsection, we investigate the sensitivity of our results. First, we re-estimate our initial gravity model using OLS. Table 2 reports estimation results for export and import models. For each model (exports or imports), we report OLS estimation, and for a comparison purpose, we also report PPML estimations applied to truncated data that only include positive trade values[9], and PPML regressions applied to all data. By comparing the number of observations used by OLS and non-truncated PPML (column 1 *vs.* 3, or column 4 *vs.* 6) we can determine the number of zero trade flows since OLS erases those observations from estimation

[9]. This estimation is provided to obtain comparable results with those obtained with OLS.

while PPML includes them. Approximately 17.7% and 11.2% of export and import data, respectively, carry zero values. By comparing the specifications from the truncated PPML with those obtained with the full PPML (column 2 vs. 3 or column 5 vs. 6), it can be noted that the coefficients in the two models are different, indicating that truncation is causing these differences. This suggests that employing PPML that can consider zero trade flows is necessary. When we compare OLS models to truncated PPML (column 1 *vs.* 2 or column 4 vs. 5), we observe a drastic difference between coefficients on all variables, suggesting that heteroscedasticity can be held responsible for the difference in results. Support for the presence of heteroscedasticity comes from the Breusch-Pagan and Cook-Weisberg test, which rejects homoscedasticity (Prob > chi2 = 0.000). Hence, it appears that the use of the PPML estimator is necessary to deal with the problem of heteroscedasticity and to get robust estimates of the coefficient.

Second, we check whether our results remain stable if we use an alternative proxy for the quality of institution. We adopt the International Country Risk Guide (ICRG) index for perception of corruption (COR)[10]. The results, shown in Table 3, remain stable and are in accordance with our initial estimates (Table 1).

Third, following the empirical literature, we re-estimate our equation using data pooled over 3, 4 and 5-year intervals, as suggested by Yotov et al. (2016). The results are presented in table 4. We report that all FTA variables, except FTA_PAFTA, have coefficients (sign, significance, and the relative magnitude of coefficients across the export and import models) in line with previous findings in almost all regressions. In sum, Tunisia's trade balance is positively correlated with the EU and AGDIR agreements and negatively associated with the Turkey agreement. Concerning estimates of the other explanatory variables, they remain remarkably similar within the different regressions and are in accordance with our initial results in most cases.

[10] It is ranked from 0 to 6, with 6 indicating a low level of corruption.

Table 2: Comparaison OLS vs. PPML

Variables	Exports			Imports		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	PPML (X>0)	PPML	OLS	PPML (X>0)	PPML
Ln (Y_{it})	0.332**	0.771***	0.765***	0.166	0.266***	0.261***
	(2.109)	(8.270)	(8.191)	(0.845)	(4.464)	(4.339)
Ln (Y_{jt})	0.853***	0.541***	0.552***	0.701***	0.922***	0.932***
	(10.60)	(7.156)	(7.292)	(6.977)	(23.52)	(23.65)
FTA_UE_{ijt}	0.963***	0.221***	0.250***	0.884***	0.0490	0.0757
	(6.439)	(2.743)	(2.957)	(4.739)	(0.748)	(1.067)
FTA_TURQ_{ijt}	-0.189	-0.0661	-0.0744	0.548	0.280***	0.273***
	(-0.337)	(-0.688)	(-0.771)	(0.763)	(3.902)	(3.825)
FTA_PAFTA_{ijt}	-0.361	-0.113	-0.124	0.492	0.0208	0.00309
	(-1.229)	(-0.689)	(-0.747)	(1.307)	(0.153)	(0.0226)
FTA_AGA_{ijt}	0.0693	0.294***	0.290***	0.192	0.119	0.115
	(0.217)	(3.640)	(3.577)	(0.468)	(1.115)	(1.075)
MRI_{ijt}	-0.0143	0.0483***	0.0555***	0.108***	0.0528***	0.0677***
	(-0.626)	(3.103)	(3.261)	(4.365)	(4.811)	(5.397)
Ln(CC_{it})	-0.498	-0.457**	-0.442**	-0.706*	0.00908	0.0340
	(-1.522)	(-2.367)	(-2.294)	(-1.787)	(0.0571)	(0.214)
Constant	-28.43***	-32.90***	-33.49***	-25.64***	-31.05***	-32.06***
	(-10.18)	(-23.29)	(-22.68)	(-7.579)	(-25.96)	(-25.57)
Observations	3,161	3,161	3,844	3,413	3,413	3,844
R-squared	0.830	0.985	0.985	0.824	0.978	0.978

t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 3: Estimation using an alternative proxy for institution

Variables	**Exports**	**Imports**
Ln (Y_{it})	0.580***	0.228***
	(6.272)	(3.202)
Ln (Y_{jt})	0.579***	0.924***
	(7.817)	(23.25)
FTA_UE_{ijt}	0.260***	0.162***
	(3.429)	(2.627)
FTA_TURQ_{ijt}	-0.056	0.292***
	(-0.598)	(3.698)
FTA_PAFTA_{ijt}	-0.033	0.003
	(-0.176)	(0.024)
FTA_AGA_{ijt}	0.290***	0.098
	(3.444)	(0.914)
MRI_{ijt}	0.050***	0.069***
	(3.020)	(5.533)
Ln(COR_{it})	-0.313***	-0.109
	(-4.420)	(-1.642)
Constant	-28.91***	-31.04***
	(-18.31)	(-19.32)
Observations	3,685	3,685
R-squared	0.986	0.979

z-statistics are reported in parentheses
*** p-value<0.01, ** p-value<0.05, * p-value<0.1

Table 4: Sensitivity analysis using data over 3, 4 and 5-year intervals

Variables	**3-years intervals**		**4-years intervals**		**5-years intervals**	
	Exports	Imports	Exports	Imports	Exports	Imports
Ln (Y_{it})	0.791***	0.291***	1.023***	0.375***	1.059***	0.392***
	(4.844)	(3.106)	(5.074)	(2.840)	(5.511)	(2.870)
Ln (Y_{jt})	0.536***	0.853***	0.427***	0.958***	0.323*	0.905***
	(3.989)	(11.66)	(2.603)	(12.05)	(1.814)	(10.40)
FTA_UE_{ijt}	1.392***	0.583***	0.236*	0.0826	1.447***	0.455***
	(6.438)	(3.578)	(1.854)	(0.771)	(4.452)	(2.788)
FTA_TURQ_{ijt}	0.0416	0.212*	0.0994	0.172*	0.0164	0.200*
	(0.299)	(1.879)	(0.436)	(1.661)	(0.0930)	(1.830)
FTA_PAFTA_{ijt}	2.446*	6.562***	-0.184	0.00604	6.856***	-3.044**
	(1.848)	(7.053)	(-0.766)	(0.0299)	(5.049)	(-2.562)
FTA_AGA_{ijt}	0.322**	0.147	0.416**	-0.00636	0.208	-0.0867
	(2.338)	(0.718)	(2.441)	(-0.0331)	(1.188)	(-0.533)
MRI_{ijt}	0.0542*	0.0745***	0.0684**	0.0753***	0.158***	0.0431**
	(1.769)	(3.699)	(2.073)	(4.267)	(4.195)	(2.286)
Ln(CC_{it})	-0.362	-0.199	-0.871**	-0.192	-1.359***	-0.516
	(-0.841)	(-0.652)	(-2.208)	(-0.696)	(-2.654)	(-1.170)
Constant	-33.47***	-30.93***	-37.07***	-36.18***	-40.18***	-33.46***
	(-13.07)	(-16.21)	(-13.95)	(-14.60)	(-14.83)	(-12.33)
Observations	1,257	1,272	939	957	619	635
R-squared	0.984	0.977	0.984	0.980	0.993	0.989

z-statistics are reported in parentheses *** p-value<0.01, ** p-value<0.05, * p-value<0.1

4.3. Other robustness tests

Baier and Bergstrand (2007) noted that many agreements are "phased-in" over time (typically over 5–10 years), and FTAs tend to have lagged effects on trade volumes. Consequently, we include 5-, and 10-years lags of the dummy variables FTA-EU, FTA_TURQ, FTA_PAFTA and FTA_AGADIR.

According to Alvarez et al. (2018), institutions may have lagged effects on trade. Therefore, we replace the indicator of institution with its lagged value. This procedure also allows us to deal with the problem of endogeneity (Álvarez *et al.*, 2018).

Table 5 reports the dynamic effect of FTAs on Tunisia's trade flows over a 10-year period. It also provides the total effects of each FTA[11]. Overall, the results indicate that the AGADIR and the EU agreements appear to perform better to improve Tunisia's trade balance in the short run, with a greater effect on the trade balance for the former FTA. In the long run, the EU agreement has had no significant effect on exports. Even worse, it has contributed to the deterioration of imports. For the AGADIR agreement, the FTA has increased Tunisia's trade flows, with a larger positive effect on imports. The result is a negative effect on the trade balance. The Turkey agreement has stimulated imports and deteriorated exports in the long run, resulting in the deterioration of the trade balance over the 10 years following its date of implementation. Whereas the PAFTA agreement has no positive effect on either exports or imports. It is worth noting that our findings contrast with those of Baier and Bergstrand (2007) who found a substantial positive correlation between lagged levels of FTAs and bilateral trade. However, our results are in accordance with Parra *et al.*, (2016), who showed that FTAs effects vary across agreements and periods.

[11] The total effects of FTA are calculated using the command LINCOM in STATA, following Yotov *et al.* (2016).

Table 5: PPML estimation with lagged effects

Variables	**Exports**	**Imports**
Ln (Y_{it})	1.005***	0.627***
	(6.507)	(8.026)
Ln (Y_{it})	0.506***	0.843***
	(5.645)	(20.91)
FTA_UE_{iit}	0.302***	0.152*
	(2.881)	(1.859)
FTA_UE_{iit-5}	-0.0466	-0.178***
	(-0.638)	(-3.521)
FTA_UE_{iit-10}	-0.125***	-0.161***
	(-2.707)	(-4.570)
FTA_TURQ_{iit}	0.0608	-0.0502
	(0.484)	(-0.632)
FTA_TURQ_{iit-5}	-0.290**	0.0961
	(-2.015)	(1.279)
FTA_TURQ_{iit-10}	-0.0230	0.280***
	(-0.181)	(3.454)
FTA_PAFTA_{iit}	-0.123	0.00117
	(-0.566)	(0.00662)
FTA_PAFTA_{iit-5}	0.00683	0.0180
	(0.0545)	(0.181)
FTA_PAFTA_{iit-10}	-0.0636	-0.0958
	(-0.596)	(-1.054)
FTA_AGA_{iit}	0.374***	0.0308
	(3.416)	(0.234)
FTA_AGA_{iit-5}	-0.258***	-0.171
	(-3.831)	(-1.365)
FTA_AGA_{iit-10}	0.152	0.579***
	(1.556)	(4.193)
MRI_{iit}	-0.144	0.467
	(-0.369)	(1.442)
Ln(CC_{it-1})	-0.571***	-0.329**
	(-3.232)	(-2.300)
Constant	-33.67***	-43.40***
	(-9.622)	(-15.73)
Total effect		
FTA_EU	0.129	-0.187**
	(1.000)	(-2.04)
FTA_TUR	-0.252**	0.3260***
	(-2.11)	(3.63)
FTA_PAFTA	-0.179	-0.076
	(-0.77)	(-0.45)
FTA_AGA	0.267*	0.437***
	(1.93)	(3.02)
Observations	3,683	3,682
R-squared	0.987	0.982

z-statistics are reported in parentheses

*** p-value<0.01, ** p-value<0.05, * p-value<0.1

Regarding institutions, the conclusions remain the same compared to those found in previous section. An increase in corruption improves the trade balance by raising exports more than imports. Concerning the effects of GDPs, we retain the same conclusion as before. Tunisian GDP is trade balance improving, whereas foreign GDP is trade balance-worsening.

4.4. Sectoral analysis

In this section, we investigate the dynamic effects of Tunisia's trade balance using sectoral data. Our goal is to assess whether results obtained at the aggregate level remain unchanged using disaggregated data. We use data for two sectors: manufactured goods and agricultural raw materials, considering the Standard International Trade Classification (SITC Rev 2).

Tables 6 and 7 report results for the agricultural and manufactured sectors, respectively. Regarding the North-South agreement, estimates suggest that in the long run, the EU agreement has improved the trade balance in the manufactured sector by increasing exports. In the agricultural sector, the effect is insignificant on exports, but negative and significant on imports. It is worth mentioning that the short run results for agricultural exports and imports are in accordance (in terms of sign) with those in Parra *et al.*, (2016), who found that the instantaneous effect of the Euro-Mediterranean agreement on MENA agricultural trade flows is significantly negative in the case of imports. In the case of exports the authors obtained short run results similar (in terms of significance) to those found in this study but with the opposite sign.

The Turkey agreement has had no significant impact on exports in both sectors in the long run, but has boosted imports, notably in the manufactured sector. Results suggest that the Turkey agreement has been disadvantageous to Tunisia's trade balance in manufactured sectors. Regarding the PAFTA agreement, Tables 4 and 5 indicate that the FTA has been beneficial to the agricultural sector and detrimental to the manufactured sector in the long run. For the AGADIR agreement, the FTA has improved the trade balance in both sectors in the short run. In the long run, the FTA has worsened the trade balance in manufacturing sectors. Concerning the agricultural sector, the results indicate that the FTA has resulted in a reduction of imports. However, no significant effect was detected on exports.

One possible explanation of the negative correlation between FTAs and agricultural imports, particularly, in the case of the EU, the AGADIR, and the PAFTA agreement, is the increase of tariff rates applied by Tunisia on agricultural imports between 1995 and 2016, as reported by Gasiorek and Mouley (2019).

In sum, the EU agreement is the only FTA that has improved the trade balance in manufactured sector in the long run. The PAFTA has also had some positive effects on the trade balance in the long run, but only in the agricultural sector. Unfortunately, the Turkey, the AGADIR, and the PAFTA agreements have been harmful to Tunisia's trade balance in the long run, especially in the manufactured sector.

It is important to mention that even though the EU and the PAFTA agreement have had some positive outcomes on the trade balance in the long run, their effects diminish over time to become insignificant from 5 years on, reflecting a possible degradation of the competitiveness of Tunisian products on international Market. The positive and significant effects of FTAs on manufactured imports obtained in the cases of Turkey, PAFTA and AGADIR agreements reinforce this idea and show that Tunisian products are unable to face international competition on the domestic market. The lack of competitiveness of Tunisian products coupled with the lack of complementarity with product partners as well as various product standards, complicated rules of origin, and pervasive non-tariff measures in Arab counties, all these factors or some of them may explain the insignificant impact of the Turkey, PAFTA and AGDIR agreements on Tunisian exports.

Table 6: PPML estimation for the agricultural sector

Variables	**Exports**	**Imports**
Ln (Y_{it})	-0.540*	1.370***
	(-1.749)	(6.975)
Ln (Y_{it})	1.203***	-0.350***
	(5.098)	(-2.992)
FTA_UE_{iit}	0.270	-0.142
	(0.788)	(-1.430)
FTA_UE_{iit-5}	0.209	-0.00888
	(1.106)	(-0.117)
FTA_UE_{iit-10}	0.00740	-0.153**
	(0.0735)	(-2.143)
FTA_TURQ_{iit}	-0.670	0.141
	(-0.941)	(0.623)
FTA_TURQ_{iit-5}	-0.235	0.0919
	(-0.285)	(0.764)
FTA_TURQ_{iit-10}	0.835	0.0614
	(1.210)	(0.545)
FTA_PAFTA_{iit}	1.958***	0.269
	(2.761)	(1.166)
FTA_PAFTA_{iit-5}	0.297	-0.148
	(0.707)	(-0.779)
FTA_PAFTA_{iit-10}	0.198	-0.641***
	(0.732)	(-2.875)
FTA_AGA_{iit}	0.809*	0.605***
	(1.786)	(2.877)
FTA_AGA_{iit-5}	-0.190	-0.807*
	(-0.493)	(-1.891)
FTA_AGA_{iit-10}	-0.624	-1.438
	(-1.392)	(-1.571)
MRI_{iit}	-0.236	0.396
	(-0.260)	(0.849)
Ln(CC_{it-1})	0.331	-0.00998
	(0.603)	(-0.0411)
Constant	-15.15*	-15.84***
	(-1.943)	(-3.726)
Total effect		
FTA_EU	0.486	-0.303**
	(1.19)	(-2.25)
FTA_TUR	-0.069	0.293
	(-0.12)	(1.29)
FTA_PAFTA	2.452***	-0.520*
	(3.36)	(-1.71)
FTA_AGA	-0.004	-1.63**
	(-0.01)	(-1.89)
Observations	2.355	2.650
R-squared	0.934	0.927

z-statistics are reported in parentheses
*** p-value<0.01, ** p-value<0.05, * p-value<0.1

Table 7: PPML estimation for the manufactured sector

Variables	**Exports**	**Imports**
Ln (Y_{it})	0.809***	0.506***
	(3.681)	(6.286)
Ln (Y_{it})	0.474***	0.879***
	(3.782)	(19.28)
FTA_UE_{iit}	0.365***	0.181**
	(2.693)	(2.471)
FTA_UE_{iit-5}	0.0880	-0.190***
	(1.119)	(-4.277)
FTA_UE_{iit-10}	-0.0899	-0.0744**
	(-1.529)	(-2.253)
FTA_TURQ_{iit}	0.440***	0.177
	(3.137)	(1.224)
FTA_TURQ_{iit-5}	-0.330**	0.219***
	(-2.060)	(4.031)
FTA_TURQ_{iit-10}	-0.184	0.209***
	(-0.948)	(2.636)
FTA_PAFTA_{iit}	-0.0413	0.0932
	(-0.194)	(0.629)
FTA_PAFTA_{iit-5}	0.150	0.136
	(1.165)	(1.473)
FTA_PAFTA_{iit-10}	-0.236*	0.106
	(-1.880)	(1.387)
FTA_AGA_{iit}	0.277**	0.0351
	(2.295)	(0.285)
FTA_AGA_{iit-5}	-0.197**	-0.00184
	(-2.314)	(-0.0173)
FTA_AGA_{iit-10}	-0.0724	0.303***
	(-0.554)	(2.947)
Ln(CC_{it-1})	-0.345*	-0.136
	(-1.875)	(-1.000)
MRI_{iit}	0.550	-0.182
	(1.306)	(-0.755)
Constant	-30.60***	-24.81***
	(-7.511)	(-11.14)
Total effect		
FTA_EU	0.363**	-0.083
	(2.13)	(-0.94)
FTA_TUR	-0.074	0.604***
	(-0.40)	(3.82)
FTA_PAFTA	-0.127	0.335**
	(-0.51)	(2.14)
FTA_AGA	0.007	0.336**
	(0.04)	(2.78)
Observations	3,353	3,353
R-squared	0.990	0.990

z-statistics are reported in parentheses

*** p-value<0.01, ** p-value<0.05, * p-value<0.1

Concerning institutions, it seems that corruption is beneficial to exports and, to a lesser extent, to imports in the manufacturing sector, but doesn't impact trade in the agricultural sector.

The impact of GDP on bilateral agricultural trade is mixed. The GDP in the manufactured sector has coefficients in line with previous results. However, in the agricultural sector, the Tunisian GDP in export regressions and the foreign GDP in import regressions have coefficients with unexpected signs. This may be explained by the modification of the structure of exports over time, from Tunisia to abroad and from the world to Tunisia, in favor of the manufactured sector. These findings are in accordance with those obtained by Guan and Sheong (2020).This said, these unexpected results do not alter our main conclusion concerning the impact of GDP on the trade balance.

5. Conclusion

In this paper, we have investigated the key factors affecting Tunisia's exports and imports using a sample of 164 countries over the 2015–2016 period. We contribute to the existing literature by uncovering factors determining Tunisia's trade deficit over the recent period at an aggregate and disaggregated level using static and dynamic econometric specifications inspired by the theoretical gravity equation established by Anderson and Van Wincoop (2003. We take into account the effect of various free trade agreements concluded by Tunisia and assess the role of corruption in the increase of Tunisia's trade deficit. Finally, we use the Poisson Pseudo Maximum Likelihood approach, which deals with the econometric problems arising from heteroskedasticity in the error term, allows us to handle zero trade flows, and can resolve the bias caused by the autocorrelation of errors, multi-collinearity, as well as non-normal residuals.

Our econometric specification includes, along with countries' GDP, binary variables accounting for the AGADIR and the PAFTA agreements, and the free trade agreements with the EU and Turkey**,** as well as a variable measuring corruption.

The results suggest that national GDP is positively and significantly associated with Tunisian trade. More interestingly, the effect of national GDP is more pronounced in the export model, suggesting that any fall in

Tunisian GDP translates into lower exports than imports. This result may help to explain the increase in the current account deficit since 2011. Recent statistics show that the GDP growth rate has declined from 3% in 2014 to 1.2% in 2015 and 1.1% in 2016. During the same period, goods exports to GDP have declined continuously from 35.35% in 2014 to 32,64% in 2016 (WDI database, 2017).

The GDP of an importing country is also a relevant determinant of Tunisia's trade flow and appears with a positive coefficient in both models of exports and imports, however, the effect is more pronounced for imports, suggesting that the trade balance of Tunisia deteriorates in the long-run when the GDP of a partner country increases. Moreover, the positive effect of a partner's GDP on exports suggests that the fall in demand for Tunisian goods in European Union countries, Tunisia's main trading partners, during the 2008-2009 global financial crises, and the period that followed, has negatively impacted Tunisia's exports.

Concerning trade agreements, it appears from the analysis that only two agreements have had positive outcomes on Tunisia's trade balance. The EU agreement and the PAFTA agreements. The former has improved Tunisia's trade balance in the long run, notably in the manufactured sector, whereas the latter has been beneficial to the trade balance only in the agricultural sector. Unfortunately, the Turkey, the AGADIR, and the PAFTA agreements have been harmful to Tunisia's trade balance, especially in the manufactured sector, over the ten years following their implementation.

With regard to the quality of institutions, surprisingly, the estimated results show that corruption in Tunisia is beneficial for exports as well as imports. The net effect on the trade balance is positive. The results reflect that customs procedures are too heavy and very restrictive. Tunisian exporters and importers are willing to pay bribes to settle their transactions and bypass official channels.

Our findings suggest the following recommendations to policymakers. Our econometric results show that Tunisian GDP has a stronger influence on exports than on imports, implying that an increase in national GDP would translate into higher exports than imports, resulting in an improvement in the trade balance. Therefore, there is a very urgent need to boost production to adjust the trade balance. The EU free trade

agreement and the PAFTA agreement have resulted in an improvement in the trade balance in some sectors. Thereby, the Tunisian government should take care of these two factors to adjust Tunisia's trade balance. Furthermore, there seems to be some inequality in the benefits from the Tunisia-Turkey trade agreements, as well as the PAFTA and the AGADIR agreements. Thus, Tunisia should continue to press for more favorable terms in future agreements. In addition, it seems that pervasive non-tariff barriers, complicated rules of origin, and various product standards in the destination county, coupled with the lack of competitiveness of Tunisian products as well as the lack of complementarities with product partners, have prevented Tunisia from reaping the possible benefits of its integration into the PAFTA, AGADIR, and Turkey Market in the manufactured sector. Hence, it is important to strengthen Tunisia's trade policy with MENA countries. This may be precisely through continuous coordination with other members to abolish all the remaining barriers that still hinder the free movement of goods between members, such as non-tariff barrier, rules of origin, and product standards. This may also be done through the reorganization of countries' production structures, which could lead to a sub-regional diversification, with the aim of strengthening commercial complementarity through the expression of cross-demands. It may also be for the Tunisian government to develop, despite strong international competition, comparative advantages not based on natural endowments. Moreover, as the UE is prone to economic weakness, it is necessary for Tunisia to diversify its export markets and boost its exports to emerging markets such as sub-Saharan African countries, which represent for Tunisia, as pointed out by the African Development Bank (2014), a source of potential and significant growth that is little exploited. The African Development Bank (2014) examined the index of trade complementarities between Tunisia's exports and imports from its main partners and concluded that there is a relatively high degree of complementarity between Tunisia and some in Sub-Saharan African countries that has been so far little exploited. In addition, Tunisia should start negotiations to liberalize and promote exports in the agricultural sector, in which Tunisia has a substantial comparative advantage.

Regarding the effect of institutional factors, it is crucial to establish administrative procedures facilitating trade transactions, and put in place more effective measures to eradicate corruption. Apart from its direct effect on the trade balance, combating corruption should create the

appropriate conditions to encourage investment and production in Tunisia, with positive effects on the trade balance.

Further research could be done to extend our analysis. First, it would be useful to explore the relationship between free trade agreements and Tunisia's trade flows at a more disaggregated sectoral level. Second, looking at data that distinguishes between individual European countries could also lead to a more detailed assessment of the impact of free trade agreements.

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Appendix

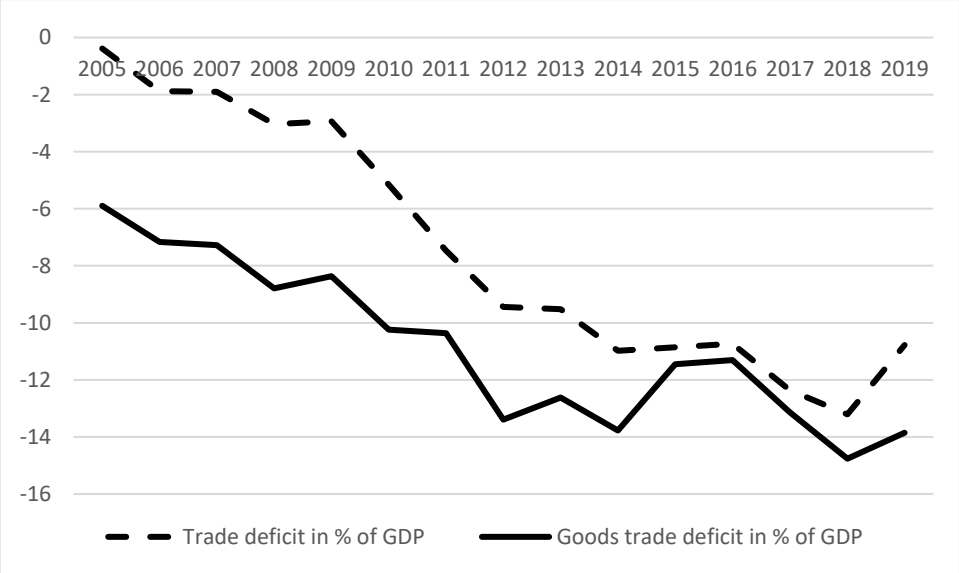
Appendix 1: Source of variables

Variables (definition and unity)	Sources
$Export_{ijt}$ is the volumes of aggregate exports from Tunisia to country j at time t (measured in current US dollars).	*DOTS database*
$Import_{ijt}$ is the volume of imports from country j to Tunisia at time t (measured in current US dollars).	*DOTS database*
Y_{it}: Tunisia's GDP in year t (measured in current US dollars).	WDI database
Y_{jt}: GDP of country j in year t (measured in current US dollars).	WDI database
FTA_UE_{ijt}: dummy for EU – Tunisia's trade agreement. It takes one if the trading partner and Tunisia are involved in the EU regional trade agreement at time t; zero otherwise.	World Trade Organization database
FTA_TURQ_{ijt} : agreement dummy taking one if Tunisia and Turkey are members of a bilateral free trade agreement at time t; zero otherwise.	World Trade Organization database
FTA_AGA_{ijt}: dummy for membership in AGADIR agreement. It takes one 1 if Tunisia and the partner country are engaged in the AGADIR regional trade agreement at time t; zero otherwise.	World Trade Organization database
FTA_PAFTA_{ijt}: dummy for membership in PAFTA agreement. It takes 1 it Tunisia and the partner country are member at time t; zero otherwise.	World Trade Organization database
CC_{it} : control of corruption. It is ranked from -2.5 to 2.5, with 2.5 indicating a low level of corruption.	World Governance Indicators database
COR_{it}: perception of corruption. It is ranked from 0 to 6, with 6 indicating a low level of corruption.	ICRG database

Appendix 2: List of free trade agreements concluded by Tunisia

Agreement	**Year of entry into force**	**partners**
EU - Tunisia	1998	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom
Pan-Arab Free Trade Area (PAFTA)	1998	Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, United Arab Emirates, Yemen
Turkey - Tunisia	2005	Turkey
Agadir Agreement	2007	Egypt, Jordan, Morocco, Lebanon and Palestine

Appendix 3: Structure of Tunisia's trade deficit



Source: Authors' calculations, based on WDI database