The impact of globalization on the transport sector: The case of Tunisia

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ABSTRACT

This paper aims to present the theoretical and practical aspects of the impact of globalization on the transport sector in Tunisia. Nowadays, globalization affects the transport sector, making it more dynamic. In this respect, most studies, both internationally and in Tunisia, have focused on maritime transport as it is the mode of transport that is most affected by the globalization phenomenon. Therefore, to expand on these observations, we carried out an econometric study in Tunisia covering the 1976–2016 period based on the error correction model. The findings confirm some of the previous observations and show that international trade, which represents globalization, has the greatest impact on national transport, both in the short and long runs. Therefore, this study suggests that if our country wants to promote the transport sector, it should meet the challenges of globalization through greater economic openness and an environment conducive to foreign direct investment.

Contribution/Originality: This study is one of very few which have investigated the impact of globalization on the transport sector through international trade and foreign direct investment at the same time. This relationship would be promising in Tunisia by taking into consideration the national strategy for the development of the transport sector launched in 2016.

1. INTRODUCTION

Globalization is the combined development of trade between continents and between countries in the same economic zone. It is an increasing integration of economies around the world, including the movement of products, services, technology and information across borders. Globalization increases the need for efficient supply chains where all modes of transportation are reliable. The development of transportation and communication has led to globalization and the expansion of international trade to boost the economy.

Due to its geographical position, Tunisia has always shone both in the Mediterranean region and in the Arab African space. Tunisia's policy has always been centered on the development of a dynamic union of the Maghreb and the Arab world. As a founding member of the African Union, Tunisia intends to benefit from the agreements to which it has adhered, such as the African Continental Free Trade Area and the East African Common Market. With the help of these agreements, Tunisia aims to achieve an export rate to Africa of 5% during the 2026–2027 period. Trade between Tunisia and other African countries reached US\$3608.9 million against US\$2,697.7 million during the first eight months of 2022, an increase of around 25% (Derbel & Samet, 2023). In addition, in 1995, Tunisia was one of the

first countries on the southern shore of the Mediterranean to conclude a partnership and co-development agreement with the EU. This agreement, which marked the culmination of a long period of economic reforms in Tunisia, provided for the liberalization of trade relations and the strengthening of financial cooperation. An essential element of this agreement was the creation of a free trade zone. Trade with the EU represents more than three quarters of Tunisia's trade, making the EU its main partner, and almost two thirds of capital inflows into the country come from the EU, mainly in the form of direct investments.

In this context, this study analyzes the impact of globalization on the transport sector in Tunisia by focusing on the progress of international trade and foreign direct investment (FDI) operations. The motivation is that most of the existing studies, such as those by Van Esch (1994); Van Der Zwet (1995) and Castells (1996) have focused only on the economic and social consequences of the changing production and consumption patterns, while much less attention has been paid to the relationship between globalization and transport. This relationship involves a large number of processes and interactions, such as demographic patterns, regional development, and technical progress. Moreover, transport modes are an essential component of globalization, supporting both passengers' mobility and the transport of goods, which, as mentioned by Rodrigue (2020) goes largely unnoticed even though globalization depends on the mobility of raw materials and finished products. Therefore, being defined as a process describing the rise of the costs of long-distance economic interaction and the effects on the geographical distribution of economic activity, the focus will be on the globalization dimension linked to international trade. Consequently, the two questions of interest are: To what extent does globalization, which is essentially represented by international trade, have an impact on the transport sector, and how can this relationship between globalization and transport be analyzed?

2. LITERATURE REVIEW

2.1. Globalization and International Trade

A number of researchers have attempted to clearly define the globalization concept but have not reached a consensus on the matter. However, it is possible to refer to the definition put forward by Thompson (1999) according to whom the term "globalization" is used loosely "as one word among others to simply designate the further internationalization of the economic activity expressed in the increased integration and interdependence of the national economies." Later on, according to Bhagwati (2004) globalization is often used to refer to economic globalization; in other words, it is the integration of national economies into the international economy through trade, FDI, capital flows, migration, and technology diffusion. Moreover, according to a study carried out by Ait Mokhtar (2013) the main characteristics of globalization are international trade, FDI, financial and technological flows, interdependence, and policy evolution. More recently, according to Tambunan, Ananda, Siburian, Matondang, and Indriani (2022) the results of the analysis can be factors known to influence international trading and impact globalization against international trade, including the presence of multinational corporations. In addition, Shenkar, Liang, and Shenkar (2022) showed that international trade and FDI flows in the healthcare sector represent the last frontier of globalization.

However, international trade is an increasingly important factor in globalization, the importance of which is obvious because, as pointed out by Ramirez, Crisologo, Vigonte, and Abante (2023) it offers a range of benefits that can be beneficial to the global economy as it enables countries to cooperate and strengthen their relationships. In this context, Surugiu and Surugiu (2015); Kherbash and Mocan (2015) and Constant et al. (2018) found that international trade plays a driving role in the process of globalization, and that the development of international trade over the years has been the result of the process of globalization. Kherbash and Mocan (2015) showed that export and import of goods and services increased more in developed than in developing countries because of economic globalization. The study by Pekarskiene and Susniene (2014) supports that a country's international trade development has a direct impact on the level of economic globalization of that country.

2.2. Globalization, International Trade and Transport

In reality, increasing globalization has led to a sharp increase in international transport activities. It is within this framework that a number of studies (Janelle & Beuthe, 1997) have explored the causal relationship between globalization and transport. Therefore, according to Woods (2000) there are two effects that can explain the impact of globalization on the transport sector. The first effect is the change in transport conditions, and the second effect is the change in transport service strategies. Furthermore, Ghosh and Dinda (2022) examined the relationship between transport modes and economic growth in India over the 1990–2017 period. The results revealed bidirectional causality, and the authors suggested ways to integrate the transport issues into the concept of globalization.

O'Rourke and Williamson (2001) defined globalization as the integration of international markets through price convergence, including the international commodity markets. Therefore, as long as the transport costs and trade barriers fall, the prices converge and trade volumes increase. Hoa and Hansenova (2006) stated that globalization has significant impacts on almost every area globally, particularly on trade and transport. Later, Surugiu and Surugiu (2015) found that due to international trade, important sectors of the economies can be stimulated, such as transport. Likewise, Kherbash and Mocan (2015) have further shown that the expansion of globalization, and therefore of international trade, has impacted the transport sector. Finally, Strandenes (2021) found that changes in international trade flows affect international transportation.

The existing literature presents the impact of globalization on transport via only one facet of this phenomenon, international trade; the impact of FDI, also representative of globalization, on transport has been largely neglected. As an example, among the rare works that have dealt with the impact of FDI on transport, we can cite the research of Ullah, Sohail, Haddad, Al-Ramahi, and Khan (2022). At this level, the authors used the cross-sectional augmented autoregressive distributed lag (CS-ARDL) model on a panel of 170 countries from 2000 to 2021 and showed a positive and statistically significant impact of FDI on transport infrastructure.

2.3. Globalization, International Trade and Maritime Transport

Transport modes are important in shaping the globalization process worldwide. Moreover, they are an essential component of the global economy as they support passenger and freight mobility. They also affect globalization through the mobility and trade relationships that they support, commercial and social interactions, the organization of the value chains, and the means of manufacturing and distribution, such as vehicles, aircraft and ships. However, maritime transport remains the mode of transport that is most affected by globalization, especially because it plays a crucial role in international trade.

On the other hand, according to a report by the World Trade Organisation (WTO) published in 2009, maritime transport accounted for 95% of international trade in goods, generating worldwide growth. There are various factors that explain this figure today, such as low cost, safety, and the response provided by maritime transport to the environmental concerns of today's world, since it emits only 2.7% of CO_2, which shows that it respects the environment by consuming less energy and emitting five times less CO_2 per ton transported than road transport and 13 times less than air transport. Moreover, Europe, and particularly France, is seeking to develop its maritime routes, which will enable it to exploit the potential of 5,500 km of coastline and relieve congestion on its roads.

According to a study carried out by the United Nations Conference on Trade and Development (UNCTAD) in 2009, maritime transport has developed since the Second World War, the period corresponding to the expansion of globalization, even if this growth is irregular in the short and medium runs. In fact, this growth has been significantly faster than that of the world gross domestic product (GDP), particularly over the 2003–2008 period, which tracks the progress of maritime transport by traffic category and geographical area.

Vadcar (2017) showed that globalization represented by international trade, which experienced an exceptional period from the end of the 1980s until the crisis of 2007–2008, completely globalized transport, while having significant structuring effects on maritime transport.

Fremont (2019) showed that maritime transport has played a key role in globalization since 1945. In fact, more than 80% of international trade per volume is carried by sea, which represents more than 10 billion tons today compared to just 550 million tons in 1950.

The many changes that have taken place in the world since the second half of the 20th century have led to the introduction of new transport units, such as containers, the importance of which has risen, especially in the maritime transport sector. In fact, the container primacy has been a prerequisite for regional integration, given the disparities in overall flows, the imbalances in maritime fleets and the differences in port infrastructures. In fact, container traffic, which is mainly concentrated in hub ports, suggests that there is a territorial consolidation of the economic activities adjacent to the major metropolitan regions, but also a rationalization of the services maintained by the network operators, thus giving secondary ports a role in supplying the major national loading points (Chatti, 2010). Similarly, as asserted by Mako, David, Galierikova, and Materna (2021) the development of container transport on the major maritime routes is having a significant effect on the economies of countries and on the future of container transport between the different regions of the world.

According to Agüero-Tobar, González-Araya, and González-Ramírez (2023) ports are facing a number of logistical challenges and the changing patterns of globalization. For this reason, port operations[1] need to be more efficient than ever. In this regard, the authors conducted a case study of 12 Chilean containerized cargo ports and proposed an estimation method for measuring the economic impacts when maritime operations are carried out efficiently.

Ejaz and Naz (2023) indicated that the role of maritime transport is more influential in determining the intensity, expansion and improvement of global networks.

International trade is mainly carried out by shipping line. However, the existing literature should have given more scope to the impact of multifaceted globalization on different modes of transport and not only focused on maritime transport. As an example, among the rare works that have dealt with the impact of globalization on land transport, we can cite the research of Leonardi, Woodburn, Allen, and Browne (2008) who demonstrated the impact of the growth of international trade on land transport activity at the international level.

3. OBSERVATION: THE RELATIONSHIP BETWEEN GLOBALIZATION AND TRANSPORT IN TUNISIA

While Tunisia has succeeded in integrating into the global economy, it has not fared as well in terms of its ability to meet the challenges of globalization. More precisely, at this level, its success was only partial. Therefore, to fully achieve this objective, our country needs to strengthen its cooperation with EU sectors, such as transport. Consequently, the question that arises in this context is: What impact does the globalization experienced by Tunisia have on the transport sector?

Following its accession to the WTO, and with a view to implementing the association agreements with the EU, the Tunisian government drew up a transport strategy for the 1997–2005 period, focusing on the implementation of appropriate sectoral reforms, the upgrading of infrastructures and the integration of the various modes of transport. In fact, over the 1997–2001 period, the Tunisian government, with the support of various partners, undertook the development of numerous freeways, aimed at modernizing the road network, the main airports, the ports and the fixed railway installations, by doubling the railroads, electrifying the railway lines, etc. Consequently, the main objective of this strategy is to have an efficient, high-quality and low-cost transport system in place for the long term.

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[1] Port operations can be classified as maritime operations, terminal operations and connectivity, or land-based operations. Maritime operations account for around 48% of transport costs and are defined as the processes involved from the arrival of a ship at a quay to the completion of its cargo transfer.

These services and systems can fully contribute to the development of the national economy and help exporting companies to be more competitive by reducing delivery times and transport costs.

In addition, achieving a sectoral growth rate of 5.5% was the main objective of the 2002–2006 Tenth Plan. As a result, planned investment in the transport sector was estimated at 7.13 billion Tunisian Dinars, or 19.2% of the total planned investment between 2002 and 2006. In fact, in the rail sub-sector, for example, the amount of investment retained by the Tunisian Railway Company totaled 450 million Tunisian Dinars, 74% of which was externally financed. In fact, this amount was evenly divided between projects relating to fixed installations and equipment. Moreover, as part of the World Bank's assistance strategy for Tunisia over the 2002–2004 period, a framework project was carried out in 2003, the aim of which was to pursue a program to strengthen and upgrade the country's economic infrastructure in order to contribute to its competitive production and service capacities in the face of the demands of globalization and opening up to the European market. Then, in May 2003, the Tunisian government submitted an official request for funding, following the World Bank's preparatory mission in June 2003 (African Development Bank's routing report for Tunisia, project P-TN-DC0-006, 20012).

However, the 2011 revolution and the resulting political and economic instability in the country led to complications in the implementation of a five-year development plan from 2010–2014 due to the decline of foreign investment. Furthermore, according to the World Bank, in 2007, the transport sector was already in difficulty[2], which led to complications that caused delays or even halted development projects in the sector. In fact, a ranking drawn up by the World Bank in 2014 showed that Tunisia fell from 60th to 118th place in terms of logistics performance. The urban public transport sector suffered greatly from this deterioration; in 2015, for example, the Greater Tunis public bus network only had 220 operational units for around the same number of roads.

In February 2016, a white paper describing the dire situation of the national transport sector was drawn up by the World Bank for the relevant ministry. This highlighted the impact of the cumulative delays of different projects on the degradation of transport systems. These delays mainly concern major infrastructure projects, equipment renewal and institutional reforms. The year 2016 marked a turning point in this trend through the launch of a new five-year development plan from 2016 to 2020, which aims to attract new investors in short- to medium-term transportation infrastructure projects. At the same time, the Ministry of Transport of Tunisia intends to renew its long-term strategic policy through the preparation of a National Transport Master Plan (NTMP) for 2040.

Overall, the national transport sector has a very significant impact on economic growth, contributing 6% to the GDP, broken down into 48%, 30%, 17% and 5%, respectively, for the road, air, sea and rail sub-sectors. Therefore, following Tunisia's integration into the world economy, the transport sector has undergone a remarkable improvement. However, since the mid-2000s, this sector has deteriorated, showing that it has not kept pace with globalization. Consequently, being aware of the seriousness of the situation, the Tunisian government planned to revive the sector in 2016 through a short-term strategy to stimulate investment and the launch of a new long-term transport strategy. The expected results were ambitious but could not be guaranteed given the difficult political, economic and social situations in which our country found itself. However, maritime and road are the two modes of transport most affected by globalization in Tunisia.

Moreover, according to the Tunisian Ministry of Transport, the maritime and port transport sector includes almost 560 companies operating in seafaring jobs and forwarding and port professions, providing almost 6,000 direct jobs. In addition, the port infrastructure is fairly well developed, with seven ports, the most important of which, given their characteristics, are those of Rades (1,110 m of quay), La Goulette (1,090 m of quay), Sfax (1,040 m of quay) and Tunis port (860 m of quay). The main ports are concentrated along a 200 km stretch, from Bizerte to Sousse, so they can be easily integrated to enhance their complementarity and share the traffic.

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[2] The deterioration in public transport infrastructure began as long ago as the mid-2000s, when policies focused on building the road infrastructure for private vehicles but without taking into account the maintenance and the development of the public transport systems.

The maritime transport and port sector plays an important role in the development and promotion of Tunisia's foreign trade. According to the National Institute of Statistics, 98% of Tunisia's foreign trade is carried out by sea via its seven commercial ports. For example, in 2001, the volume of foreign trade by sea was around 27 million tons, including 22 million tons of cereals, phosphate, oil, and gas, and five million tons of other bulk goods (textiles, automotive components, etc.). In 2015, Tunisian ports handled the transit of 28 million tons of goods, 729,000 passengers and 297,000 cars.

The Tunisian fleet currently comprises 20 vessels, 15 of which are privately owned, but productivity in this sub-sector remains low. For example, the port of Rades suffers from congestion as a result of slow port operations, which are carried out exclusively by a public company, Tunisian Stevedoring and Handling. Therefore, in order to improve the quality of services, reforms have been underway since 2001 aimed at introducing competition into the port services and operations. Work is also underway to modernize Rades port with the construction of a container quay and a dry port. More specifically, the development strategy for the maritime and port transport sector is based on the following areas:

- Developing the national maritime fleet by encouraging investment in modern units suitable for the needs of national and international maritime traffic, with the aim of increasing the participation rate of Tunisian maritime carriers in commercial maritime exchanges.
- Strengthening the existing port infrastructure and building a new port infrastructure that meets the requirements of the changes in the maritime transport sector.
- Updating and upgrading the legal and regulatory framework.
- Simplifying the administrative and commercial procedures and the use of new information and communication technologies in the early exchange of information on ships and goods.
- Upgrading maritime and port professions.
- Diversifying and adapting maritime and port training to the market requirements in order to develop job creation and facilitate integration into working life.
- Improving the safety of ships, port facilities and shipping, and protecting the marine environment.

4. DATA AND METHODOLOGY

This section explains the chosen model and presents the estimation method appropriate for this model.

4.1. Study Model

Based on our observations of the relationship between globalization and transport in Tunisia and the literature review, an empirical model was established. At this level, in order to distinguish itself from the literature and to ensure the accuracy of our results, multimodal transport, and not only maritime transport, will be taken into consideration. Our model defines the variation of value-added transport (VAT) in Tunisia, which is the share of different modes of transport of GDP, as a function of the economic openness rate (EOR), represented by the sum of exports and imports normalized to GDP, the real exchange rate of the Tunisian dinar against the currencies of its partners and competitor countries (RER), and the net FDI flows normalized to GDP (FDI). Therefore, the general form of the model is as follows:

$$VAT = f(EOR, RER, FDI) \qquad (1)$$

More specifically, the study model is as follows:

$$Ln\,VAT_t = \beta_0 + \beta_1 Ln\,EOR_t + \beta_2 Ln\,RER_t + \beta_3 Ln\,FDI_t + \mu_t \qquad (2)$$

Where β_1, β_2 and β_3 represent the elasticities of VAT with respect to the economic openness rate, the real exchange rate of the Tunisian dinar and the FDI net flows. In addition, the integration of "Ln" is intended to reconcile the values of the different variables in the model. The chosen study period extends from 1976 to 2016 using annual data, and the total number of observations is 41. We are interested in understanding the impact of globalization on

the transport sector before the national strategy for the development of the transport sector was launched in 2016, and before the Covid-19 health crisis. The data on real GDP, the VAT, the export and import of goods and services and the real exchange rate was taken from the National Institute of Statistics (NIS). The data on FDI in Tunisia was taken from the Foreign Investment Promotion Agency (FIPA).

4.2. Presentation of the Estimation Method

The use of cointegration tests is now very common in econometrics. This is a particularly interesting framework that tests for the presence of long-term equilibrium relationships and is used mainly in macroeconomics, notably to test the various hypotheses of purchasing power parity (PPP), formulate the demand for money models (Singh, Abosedra, Fakih, Ghosh, & Kanjilal, 2023) or examine the relationships between the exchange rates of various countries (Song, Xia, Wang, & Manta, 2023). The idea that a long-term equilibrium relationship can be defined between the variables, which are individually non-stationary, is the basis of the cointegration theory. Therefore, the presence of such an equilibrium relationship is formally tested using statistical procedures, of which the most widely used are those of Engle and Granger (1987); Johansen (1988) and Johansen (1991) with the latter being the exclusive focus of the present work. Subsequently, an error correction model (ECM) is used to analyze the cointegrated variables and the cointegration relationships as it provides a mechanism for understanding the short- and long-term behavior of the variables in the model and also gives efficient coefficient estimates.

Representing the model in error-corrected form has several advantages. First, it is not subject to spurious regression problems since all the variables in the model are stationary. Second, it makes it possible to clearly distinguish between short-term and long-term elasticities since the first differences and the levels of the variables are explicitly involved in the model. Cointegration and error correction models are extensions of VAR modelling applied to non-stationary time series.

Therefore, the methodology adopted in this work consists in first applying a unit root test (the augmented Dickey–Fuller test or ADF test) to examine the stationarity of the time series, and second, the Johansen (1991) test which is used to analyze the cointegration between the series. Finally, the existence of cointegration relationships indicates that there are long-term relationships between the variables in at least one direction. At this level, the ECM is specified as follows:

$$\Delta VAT_t = a_0 + \sum_{i=1}^{m} a_{1i}\Delta EOR_{t-i} + \sum_{i=1}^{n} a_{2i}\Delta RER_{t-i} + \sum_{i=1}^{p} a_{3i}\Delta FDI_{t-i} + \lambda ECM_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta EOR_t = b_0 + \sum_{i=1}^{m} b_{1i}\Delta RER_{t-i} + \sum_{i=1}^{n} b_{2i}\Delta FDI_{t-i} + \sum_{i=1}^{p} b_{3i}\Delta VAT_{t-i} + \theta ECM_{t-1} + \mu_t \quad (4)$$

$$\Delta RER_t = c_0 + \sum_{i=1}^{m} c_{1i}\Delta FDI_{t-i} + \sum_{i=1}^{n} c_{2i}\Delta EOR_{t-i} + \sum_{i=1}^{p} c_{3i}\Delta VAT_{t-i} + \delta ECM_{t-1} + \vartheta_t \quad (5)$$

$$\Delta FDI_t = d_0 + \sum_{i=1}^{m} d_{1i}\Delta RER_{t-i} + \sum_{i=1}^{n} d_{2i}\Delta EOR_{t-i} + \sum_{i=1}^{p} d_{3i}\Delta VAT_{t-i} + \gamma ECM_{t-1} + \omega_t \quad (6)$$

Where Δ is the difference operator; m, n and p represent the number of lags; a, b, c and d are the parameters to be estimated; and λ, θ, δ and γ are the error correction terms, which are derived from the cointegration relationship. It should also be noted that if the variables have a cointegrating vector, this vector represents a deviation from the equilibrium at period t. Furthermore, in each equation, the change of the endogenous variable is caused not only by its lag, but also by an imbalance at the level of the previous period.

5. FINDINGS AND DISCUSSION

5.1. Descriptive Statistics of the Study Model

We begin this section with a presentation of the descriptive statistics of our model and the endogenous and exogenous variables (see Table 1)

Table 1. Descriptive statistics of the study model.

Variable	Output	Inputs		
	VAT	EOR	FDI	RER
Mean	13.892	4.457	0.702	4.919
Median	14.414	4.454	0.531	4.834
Maximum	15.565	4.739	1.960	5.593
Minimum	11.054	4.144	-0.399	4.551
Std. dev.	1.373	0.135	0.683	0.323
Skewness	-0.380	-0.261	0.683	0.778
Kurtosis	0.158	2.764	2.173	2.189
Jarque–Bera	3.683	0.563	1.748	5.266
Probability	0.158	0.754	0.417	0.071
Observations	41	41	41	41

Note: EOR = Economic openness rate; FDI = Foreign direct investment; RER = Real exchange rate.

According to the results in Table 1, the average level of the VAT is 13.892, with a minimum of 11.054 and a maximum of 15.565. It therefore appears that the overall value added varies greatly within the Tunisian transport sector (with a standard deviation of 1.3732). Regarding the variables linked to globalization, the average level is 4.4575 for the EOR (standard deviation = 0.1358), 0.7028 for FDI (standard deviation = 0.6837) and 4.9191 for the RER (standard deviation = 0.3236). In addition, FDI and RER have positive skewness coefficients of 0.6837 and 0.7788, respectively. This means that the data is not normally distributed but is skewed to the right. As a result, a positive value of the skewness coefficient revealed a more expected distribution toward positive values. On the other hand, the economic openness rate has a negative skewness coefficient of -0.2618, implying that the distribution has an elongated tail to the left. In addition, all the independent variables in our study have a Kurtosis coefficient close to 3. In this case, the distribution is leptokurtic, meaning that the dataset is normally distributed. On the other hand, non-linearity is a common feature for these variables because the Jarque–Bera statistics are above the chi-square critical value at two degrees of freedom.

5.2. Results of the ADF Unit Root Test

Before any econometric treatment, it is important to ensure the stationarity of the selected variables, as this is necessary to avoid spurious relationships. To this end, we use the ADF test, which enables us to identify the order of differentiation of a macroeconomic series according to its evolution over time, bearing in mind that it has been carried out under the following three hypotheses:

- Absence of a constant
- Presence of a constant
  - Presence of a constant and a trend in the autoregressive equations for the various tests. Delay orders were specified using the Akaike (AIC) and Schwartz (SIC) information criteria.

The null hypothesis H_0 is a non-stationary hypothesis. Therefore, if this hypothesis is accepted, the process admits a unit root, otherwise it will be stationary. Within this framework, we have attempted to check for the presence of a trend, a constant and a unit root. The results of the ADF unit root test for the VAT, EOR, FDI and RER variables are shown in Table 2.

Table 2. The ADF test results.

Differentiation	Variable	VAT	EOR	FDI	RER
At level	Tc	-1.173	4.029	-3.082	-2.680
	p-value	(0.676)	(0.999)	(0.124)	(0.249)
First difference	Tc	-5.344*	-5.093*	-4.824*	-3.424*
	p-value	(0.000)	(0.0008)	(0.0004)	(0.001)

Note: * Indicates rejection of the null hypothesis per one unit at a significance level of 1%.

The ADF test constitutes a formal test for unit roots. The p-values corresponding to the ADF test are calculated for the two-level series. The results show that all the variables are stationary after first differentiation, suggesting that they are all integrated of order 1.

5.3. Johansen Test Results

Since the different series in the model are of the same order of integration, it is legitimate to look for possible cointegration relationships. The results of the Johansen test (Johansen, 1991) for VAT, EOR, RER and FDI are presented in Table 3.

Table 3. Johansen (1991) test results.

Hypothesis	Eigenvalue	Trace statistic	Critical value at 5%	p-value
None*	0.446	50.283	40.174	0.003
At most 1*	0.369	27.811	24.275	0.017
At most 2	0.236	10.289	12.320	0.107
At most 3	0.0006	0.025	4.129	0.896

Note: * Cointegration of order 0 and order 1.

The likelihood ratio tests show that the null hypothesis of no cointegration relationship (none: r = 0) can be rejected at 5% significance (0.0036 < 0.05), and that the null hypothesis of the existence of at most one cointegration relationship (at most 1: r ≤ 1) can be rejected at 5% significance (0.0172 < 0.05). In fact, both tests suggest the existence of two cointegrating vectors driving the series with two common stochastic trends in the data. In other words, a cointegration relationship exists. Therefore, the presence of at least one cointegration relationship enables us to go further and estimate an ECM, which makes it easier for us to specify the short-term dynamics of the variables with a view to achieving a stable long-term equilibrium.

5.4. ECM Results

An ECM was set up to investigate short- and long-term relationships. In our model, the first difference of each exogenous variable was regressed on a lag of the cointegration equations (Equations 3, 4, 5 and 6). Hence, the results of the ECM estimation are presented in Table 4.

The first row contains the endogenous variable, while the first column contains the exogenous variables as well as the error correction term, the coefficient of determination and the Fisher statistics.

Firstly, according to Table 4, the estimation of the vector error correction model requires the determination of the following long-term relationship:

$$VAT_{-1} = 5.475\ EOR_{-1} + 0.864\ FDI_{-1} - 2.129\ RER_{-1} \qquad (7)$$
$$\qquad\qquad (11.404) \qquad\quad (2.518) \qquad\quad (-4.535)$$

The values in brackets represent the student statistics and indicate that the coefficients linked to the exogenous variables in our model are all statistically significant. Therefore, when the economic openness rate increases by 1%, the VAT rises by 5.475%. Furthermore, when FDI increases by 1%, the VAT increases by 0.864%. Consequently, the economic openness rate and FDI have a statistically significant and positive long-term impact on the VAT with the economic openness rate having a much greater effect. These results are completely in line with those of the literature, especially with the adoption of a free trade policy concluding with entry into a free trade agreement between Tunisia and the EU on January 1, 2008, based on the abolition of tariff barriers. As far as the real exchange rate is concerned, a 1% depreciation of this rate translates into a VAT increase of 2.129%.

Table 4. ECM results.

CointegratingEq:	CointEq1	EOR	FDI	RER
Vector error correction estimates Sample (Adjusted): 1979 2016 Included observations: 38 after adjustments Standard errors are shown in () and t-statistics are shown in [ ]				
VAT (-1)	1.000			
EOR (-1)	5.475 (0.480) [11.404]			
FDI (-1)	0.864 (0.343) [2.518]			
RER (-1)	-2.129 (0.469) [-4.535]			
Error correction:	D(VAT)	D(EOR)	D(FDI)	D(RER)
CointEq1	-0.201 (0.010) [-1.911]	0.018 (0.014) [1.311]	0.147 (0.013) [1.107]	0.002 (0.009) [0.276]
D(VAT(-1))	0.130 (0.233) [0.559]	0.008 (0.031) [0.255]	0.560 (0.295) [1.899]	0.002 (0.021) [0.097]
D(VAT(-2))	-0.311 (0.244) [-1.275]	-0.056 (0.033) [-1.701]	-0.268 (0.309) [-0.867]	-0.005 (0.022) [-0.253]
D(EOR(-1))	-0.222 (1.225) [-0.181]	-0.020 (0.167) [-0.120]	1.789 (1.552) [1.152]	0.149 (0.110) [1.353]
D(EOR(-2))	-0.698 (1.217) [-0.573]	-0.041 (0.166) [-0.247]	2.306 (1.542) [1.495]	0.056 (0.110) [0.509]
D(FDI (-1))	-0.055 (0.184) [-0.298]	0.031 (0.025) [1.263]	-0.508 (0.233) [-2.175]	-0.006 (0.016) [-0.039]
D(FDI(-2))	0.122 (0.190) [0.646]	0.063 (0.026) [2.447]	0.129 (0.240) [0.538]	0.017 (0.017) [1.004]
D(RER(-1))	1.028 (2.002) [0.513]	-0.589 (0.274) [-2.148]	0.156 (2.536) [0.061]	0.815 (0.181) [4.506]
D(RER(-2))	-0.597 (2.436) [-0.245]	-0.417 (0.333) [-1.250]	0.631 (3.086) [0.204]	-0.185 (0.220) [-0.844]
R-squared	0.143	0.462	0.312	0.439
Adj. R-squared	-0.092	0.314	0.122	0.284
Sum sq. resid.	6.430	0.120	10.316	0.052
S.E. equation	0.470	0.064	0.596	0.042
F-statistic	0.609	3.118	1.647	2.836
Log likelihood	-20.165	55.370	-29.146	71.171
Akaike AIC	1.535	-2.440	2.007	-3.272
Schwarz SC	1.922	-2.052	2.395	-2.884
Mean dependent	0.101	0.006	-0.041	-0.024
S.D. dependent	0.450	0.077	0.636	0.050
Determinant resid. covariance (dof adj.)	2.24E-07			
Determinant resid. covariance	7.59E-08			
Log-likelihood	95.815			
Akaike information criterion	-2.937			
Schwarz information criterion	-1.213			

According to the famous J-Curve, any depreciation in the real exchange rate corresponding to a devaluation of the national currency against foreign currencies on the foreign exchange market stimulates exports and discourages imports, leading to a recovery of the trade balance. This stimulation of exports is said to be at the root of an improvement in transport and its contribution to the national economy. Moreover, this result is in line with that of Dees (2001) who indicated that a fall in the real exchange rate, i.e. a fall in the relative price of tradable goods in terms of non-tradable goods, makes it possible, other things being equal, to stimulate the VAT. Overall, we are talking about a long-term impact of globalization on national transport, the most important being the economic openness rate relative to international trade.

Table 4 also shows the results of the following four equations:

$$(VAT) = -0.222D(EOR_{-1}) - 0.0551D(FDI_{-1}) + 1.0285D(RER_{-1}) - 0.6983D(EOR_{-2}) + 0.1229D(FDI_{-2}) - 0.5978D(RER_{-2}) - 0.2012ECM_{t-1} \quad (8)$$

$$(EOR) = 0.0081(VAT_{-1}) + 0.0319D(FDI_{-1}) - 0.5895D(RER_{-1}) - 0.0569(VAT_{-2}) + 0.0637D(FDI_{-2}) - 0.4173D(RER_{-2}) + 0.0189ECM_{t-1} \quad (9)$$

$$(FDI) = 0.5606D(VAT_{-1}) + 1.7893D(EOR_{-1}) + 0.1563D(RER_{-1}) - 0.2681D(VAT_{-2}) + 2.3069D(EOR_{-2}) + 0.6317D(RER_{-2}) + 0.1477ECM_{t-1} \quad (10)$$

$$(RER) = 0.0020D(VAT_{-1}) + 0.1499D(EOR_{-1}) - 0.0065D(FDI_{-1}) - 0.0055D(VAT_{-2}) + 0.0561D(EOR_{-2}) + 0.0172D(FDI_{-2}) + 0.0026ECM_{t-1} \quad (11)$$

Upon reviewing this representation, we notice, first of all, that the estimation quality of this model is good, according to the R^2 coefficient of determination. Furthermore, we notice that the expression "error correction" is negative (- 0.2012) and significant (0.01 < 0.05) only for the VAT variable. In this case, the ECM can be validated. Hence, the equation representing the short-term adjustments is as follows:

$$(VAT) = -0.222D(EOR_{-1}) - 0.0551D(FDI_{-1}) + 1.0285D(RER_{-1}) - 0.6983D(EOR_{-2}) + 0.1229D(FDI_{-2}) - 0.5978D(RER_{-2}) - 0.2012ECM_{t-1} \quad (12)$$

Referring to the above equation, a relationship between the VAT and EOR variables does not exist, especially as the coefficients associated with EOR(-1) and EOR(-2) are -0.222 and -0.6983, respectively, and are not statistically significant. In other words, there is no impact of transport on the economic openness rate in Tunisia[3]. However, a long-term relationship exists from EOR to VAT, especially as the coefficients associated with VAT(-1) VAT(-2) are 0.0081 and -0.056, respectively, and are statistically significant. We therefore deduce the existence of a short-term relationship running from the EOR variable to VAT. All in all, there is a positive and statistically significant impact of the economic openness rate, representative of globalization, on national transport in both the short and long runs.

6. CONCLUSION

The transport sector in Tunisia today is undergoing a rapid transition to meet the challenges of globalization, and it is significantly contributing to economic growth under the impact of globalization. In this respect, the two modes of transport we are most concerned with are maritime and road. These observations have been partly confirmed by econometric work. Over the 1976–2016 period, there was a unidirectional relationship running from globalization to transport as an active element in the growth of the national economy in both the short and long runs, with the greatest impact of economic openness. However, the main limitation of our research remains the failure to specify the mode of transport, in particular maritime transport. However, the results in this study were achieved despite the dismal situation of the national transport sector in 2016, as reported by the World Bank. Thus, taking into consideration the national strategy for the development of the transport sector launched in 2016, materialized by a

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[3] We focus on these two variables because we need to stay in line with previous findings that the most significant long-term relationship exists between the "EOR" variable and the "VAT" variable.

new five-year development plan from 2016 to 2020, and a National Transport Master Plan by the year 2040, Tunisia will benefit from a developed, modern and competitive transport sector. At this level, we propose the following recommendations for transport decision makers in Tunisia:

- The deep-water port megaproject in Enfidha (Sousse), promising a major transformation of the central-eastern region of Tunisia, should be completed. It has unfortunately been on hold since the implementation study dating back to 2006. Designed to become an international trade and services platform, the port aims to better open Tunisia to the outside world and promote logistics and industrial activities thanks to the various modes of transport available in the region.

- The extension of the Port of Rades is one of the major projects planned in the transport sector, and which consists in particular of creating two quays (n°8 and n°9) with a depth of 11 meters to accommodate large ships and ensure connection between the logistics zone and the roads.

- In the field of rail, the development of national transport requires profound reforms and being open to new operators capable of offering international services. The development of international land transport requires the implementation of more complex policies regarding long-term investment in infrastructure, modernization of operations and market regulation.

- The integration of intermodal transport technologies needs to be applied to land and sea modes, including RORO maritime transport, making it possible to diversify routes, stimulate the most competitive solutions and, at the same time, reduce the vulnerability of the transport system.

Consequently, the transport sector will be able to meet the challenges of globalization, and therefore contribute more to the growth of the Tunisian economy. The impacts of such strategies and recommendations could be the subject of future research. In this same vein, it would be judicious to consider the post-Covid-19 period, during which international trade and FDI underwent more or less notable changes, which could have an impact on the Tunisia's transportation sector. At the same time, the digital revolution, which reached its peak during the health crisis, has generated new changes in international trade, and in e-commerce in particular. Therefore, the digital revolution could be taken into consideration by having a disruptive effect on the transport sector.

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