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Agricultural Exports, Other Exports, Imports, and Economic Growth: An ARDL Approach for Tunisia

Emna Trabelsi [a, b *], Nesrine Kachout [b]

[a] *Higher Institute of Management of Tunis, Social and Economic Policy Analysis Laboratory, University of Tunis, Tunis, Tunisia*
[b] *Faculty of Economic and Management Sciences of Sousse, University of Sousse, Sousse, Tunisia*

ABSTRACT

This paper aims to study and quantify the impact of agricultural exports on economic growth along with other variables in Tunisia. For that purpose, we estimate the relationship between GDP, agricultural exports, other exports, and imports by applying the ARDL approach under the period 1990-2020. The results show a negative and insignificant impact of agricultural exports on economic growth in the long and short run. Other exports negatively and significantly impact economic growth, while imports are found to have a positive impact on long-term economic growth. The findings have economic implications for sectors and activities that should be promoted to accelerate economic growth.

KEYWORDS

Agricultural exports; other exports; imports; economic growth; ARDL; Tunisia

* Corresponding author: Emna Trabelsi
E-mail address: emna.trabelsi2007@yahoo.fr

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1. Introduction

Export is defined as an economic and commercial activity considered very important for the economic growth and sustainable development of countries (Tyler, 1981; Kavoussi, 1983; Ram, 1985). In particular, it is a crucial tool for acquiring foreign currencies, which are a country's instrument of economic and financial intervention in foreign markets (Shane et al., 2008). Exports stimulate an economy by ensuring the sustainability of companies, which in the context of globalization is strongly linked to their position in the world market and to the establishment of competitive advantage (Piercy et al., 1998). Furthermore, exports are considered a powerful catalyst for promoting and fueling investment growth, ultimately leading to higher employment rates through the implementation of effective strategies and policies supported by sound governance (Brambilla et al., 2015; Sasahara, 2019).

Countries' development has especially evolved by relying on trade in agricultural and food products to supplement their domestic production. Thus, agriculture trade appears as a major element of change and improvement in the structuring of economies (Beckman and Countryman, 2021).

The growth of agricultural trade has helped provide more and more people with better, more varied, and cheaper food. This trade is also, directly and indirectly, a source of well-being and income for millions of people (Brown et al., 2018; Miller et al., 2020). Many countries derive most of the foreign currency they need to finance their imports and their development; while for others, food security largely depends on the ability to finance food imports. Agricultural trade can give rise to conflicts of interest due to the influence of pressure groups on agricultural policies, rather than decisions being driven by national, international, or global considerations. Additionally, serious distortions in international markets contribute to these conflicts (Wan et al., 2019).

Imports also play a crucial role in stimulating economic activity, particularly in emerging and developing countries (e.g., Zhang and Maimbridge, 2012; Yoon, 2019; Carrasco and Tovar- García, 2021), for several reasons. First, imports provide access to goods and services that may not be readily available or affordable domestically, enabling consumers and businesses to meet their needs and preferences (Sirgy et al., 2007). This promotes consumer welfare, improves productivity, and fosters competition, ultimately driving economic growth (Morris and Einhorn, 2008). Second, imports facilitate technology transfer by exposing domestic industries to advanced technologies and production methods (Acharya and Keller, 2009). This helps to improve local industries, improve efficiency and improve competitiveness in global markets (Inotai, 1988). Furthermore, imports act as inputs for domestic production (Colantone and Crinò, 2014), giving companies access to raw materials, components, and intermediate products needed for manufacturing processes. This helps diversify the economy, promote industrialization, and create employment (e.g., Tregenna, 2008).

This paper aims to empirically examine the impact of agricultural exports, other exports, and imports on economic growth in the case of Tunisia. The topic remains crucial as it provides insights into the country's trade dynamics, the performance of its agricultural sector, and the potential for economic growth and development. As things evolve, we need to refresh previous conclusions to spot similarities and disparities in existing findings. The application of the Autoregressive Distributed Lag (ARDL) model to analyze the long-run dynamics between the studied variables has not been extended to the case of Tunisia, thus requiring further exploration in the methodology for understanding the relationships between them.

Our paper is structured as follows. Section 2 presents a review of the literature in which we will present the various studies that have examined the link between agricultural exports and economic growth. In Section 3, we expose our empirical methodology. Results and discussion will be presented in Section 4, and Section 5 concludes.

2. Literature review

There is an extensive body of literature examining the effects of exports, export diversification, and imports on economic growth, with studies exploring various dimensions such as the role of export-led growth models, the impact of export diversification on resilience, and the relationship between imports and domestic industries. It is quite important to survey some of these works as they help understand the complex dynamics of international trade and economic development.

2.1. The link between exports, imports, and economic growth

Theoretically, several studies have shown that increased exports have positive and beneficial effects on economic growth (e.g., Michaely, 1977; Balassa, 1978; Tyler, 1981; Savvides, 1995; Asmah; 1998; Edwards, 1998; Ram, 1987). The effect is driven by the export-led growth (ELG) hypothesis. According to this hypothesis, countries can achieve higher levels of investment, technological progress, and employment generation by expanding exports. The idea is that exporting industries tend to be more productive and globally competitive, leading to increased production, economies of scale, and enhanced efficiency.

The ELG hypothesis has been supported by empirical evidence from various countries in the short and in the long-run (see Islam, 1988; Bahmani-Oskooee et al.,1991, 1993; Ukpolo, 1994; Asmah, 1998; Abual-Foul, 2004; Sooreea-Bheemul and Sooreea, 2013; Hussaini et al. 2015; Riyath and Jahfer, 2016; Ee, 2016; Sunde, 2017; Ali and Lee, 2018; Subhan et al., 2021, etc.)[1]

Kalaitzi and Chamberlain (2021) find mixed results in the case of GCC countries. Nopiana et al. (2022) find a negative effect of exports on the economic growth of Indonesia. Others support the ELG hypothesis only in the short run (e.g., Dhawan and Biswal, 1999; Kumari and Malhotra, 2014; Ozkan and Dube, 2018; Kalaitzi and Chamberlain, 2020) or only in the long run (e.g., Husein, 2009; Faisal et al., 2017; Bakari and Ahmadi, 2018).

Weak or absence of ELG hypothesis evidence is also documented in empirical literature such as Panas and Vamvoukas (2002), Gokmenoglu et al. (2015), Bakari (2017a), El Alaoui (2015), and Odhiambo (2022). Several explanations can be associated with such a finding. Countries with limited resources may struggle to compete in global markets. External factors such as global demand fluctuations, trade barriers, or economic crises can negatively impact export-led growth strategies. Moreover, inadequate infrastructure, weak institutional frameworks, and insufficient investment in education and research may hamper the ability of some countries to drive economic growth through exports.

Focusing on exports as the sole positive source of economic growth might be misleading. The import-led growth (ILG) hypothesis asserts that rather than relying solely on exports, a country can achieve economic growth by focusing on raising its imports. This theory contends that importing products and services from other nations can boost domestic economic growth. A country can raise its productivity, directly and indirectly, by importing capital goods, technology, and intermediate inputs. Importing can also make a wider variety of goods and services more accessible, increasing consumer choice and raising living standards. Humpage (2000), Awokuse (2007), Mishal and Abulaila (2007), Muhammad Adnan Hye (2012), Mishra (2012), Saeed and Hussain (2015), Stievany and Jalunggono (2022), etc. support the ILG hypothesis while using different economic techniques et focusing on different countries. Bakari and Mabrouki (2017a) show that imports are a source of economic growth in Panama. The authors affirm that the favorable outcome stems from a robust customs barrier strategy, bolstered by multiple global agreements and leveraging its advantageous geographical position.

While import-led growth has been heralded as a viable strategy for economic development in the aforementioned literature, some analyses highlight its limitations. Studies such as Kartikasari (2017), Uddin and Kahaman (2017), and Bakari and Krit (2017) reject the ILG hypothesis. Alternatively, imports may fail to stimulate

[1] Please refer to Giles and Williams (2000a, 2000b) for surveyed papers until the late of 1990s and Bakari (2017a) for a more recent empirical literature.

economic growth (see Taghavi et al., 2012; Bakari and Mabrouki, 2016; Sunde et al., 2023). Makun (2018) recommends reducing imports and focusing on remittances and foreign direct investment.

2.2. The link between export diversification and economic growth

It is often claimed that it is not just the level of exports that leads to growth, but also the degree of diversification of those exports. Proponents of this view have pointed to the strong impact of diversification on growth (e.g., Vernon, 1966; Krugman, 1979; Hausman and Rodrik, 2003; Agosin, 2007; Lederman and Maloney, 2007; Hausman et al., 2010). This is because diversification is seen as a factor of production (Romer, 1990) and can increase earnings by allowing investment risks to be spread over a larger portfolio (Acemoglu and Zilibotti, 1997). However, export diversification can have a non-linear effect on economic growth (see Hesse, 2009).[2]

Existing empirical studies show that the effect may depend on the economic development of a country (Hesse, 2009). Other papers focus on the target sector. For example, Bakari et al. (2018) argue that industrial exports cannot drive economic growth in the long run in Tunisia.

Hachicha (2003), Abu-Qarn and Abu-Bader (2004), Siliverstovs and Dierk (2005), Siliverstovs and Herzer (2007), Dunusinghe (2009), Torayeh (2011), Bakari et al. (2018), Kalaitzi and Cleeve (2018) support the view that exports of manufactured products drive economic growth of countries from the Middle East and North Africa (MENA) region. Manufactured industries tend to create value-added products, which command higher prices in the global market. This generates revenue and profits for exporting countries. Moreover, exporting manufactured goods allows countries to diversify their sources of income and reduce dependence on specific sectors, contributing to overall economic resilience. Meanwhile, Alam (2003) does not find any evidence of a significant effect of manufactured exports the on economic growth of Brazil and Mexico. Disparities between countries in this context rely on available resources, labor, geographic conditions, the level of technological advancement, and innovation. Privileged economies can establish a competitive edge in the global market and attract more export demand, leading to sustained growth. Countries that comply with export requirements he different sectors generally experience long-term economic expansion.

2.3. The link between agricultural exports and economic growth

Empirical literature underlines the importance of agricultural exports as an engine of long-term economic growth (see Alam and Myovella, 2016; Uremadu and Onyele, 2016; Toyin, 2016; Bakari, 2016; Bakari, 2017b, 2017c; Bakari and Mabrouki, 2017; Bakari and Krit, 2017; Bakari, 2018; Mahmood and Munir, 2018; Ahmad and Sallam, 2018; Kappa, 2020; Gizwa et al., 2022).

The positive effect evidence stems from many reasons. The export of agricultural products generates national income and foreign currency earnings. They also foster job creation across the entire value chain, from production to distribution. Additionally, exporting agricultural goods encourages the influx of investments into the agricultural industry, which boosts technological advancement and productivity. Nevertheless, a negative effect or absence of effect is made possible as agricultural exports rely on climate hazards and changes in the world market prices (Bakari, 2016). This outcome is documented in Faridi (2012), Shah et al. (2015), Simasiku and Sheefeni (2017), Bakari (2017a, 2018), Bakari et al. (2018), Ntavoua (2021), etc. For instance, Ntavoua (2021) highlights the potential challenges and areas that need attention for the agricultural sector to contribute more effectively to sustained and inclusive economic growth.

[2] For a succinct review of literature, we recommend Hesse (2009).

3. Data and methodology

3.1. Data

We use annual time series data on economic growth, labor and capital stock, and agricultural and non-agricultural (other) exports, and imports in Tunisia (see Table 1). The period under investigation is 1990-2020 and the variables are mainly gathered from the World Bank.[3]

Table 1. Description of variables.

Variable	Definition	Source
Y	Gross Domestic Product (Constant price in US dollars)	World Bank
K	Gross fixed capital formation (Constant price in US dollars)	World Bank
L	Population (in millions)	World Bank
AX	Agricultural exports (Constant price in US dollars)	World Bank
OX	Other exports (Constant price in US dollars): These include textiles, phosphates, and chemicals. Tunisia also sends abroad mechanical and electrical goods and hydrocarbons.	World Bank
M	Imports (Constant price in US dollars)	World Bank

The agricultural sector of Tunisia has experienced consistent growth in both output and investment. As the country's primary industry, agriculture contributes approximately 10.6 percent to its GDP in 2018, with manufactured products being the primary export category. Furthermore, nearly 20 percent of the workforce in Tunisia is employed in the agricultural sector. The country exports significant quantities of agricultural products to Europe, Qatar, and Saudi Arabia. It is also noteworthy that Tunisia has been facing widening trade deficits in recent years (see Figure 1).

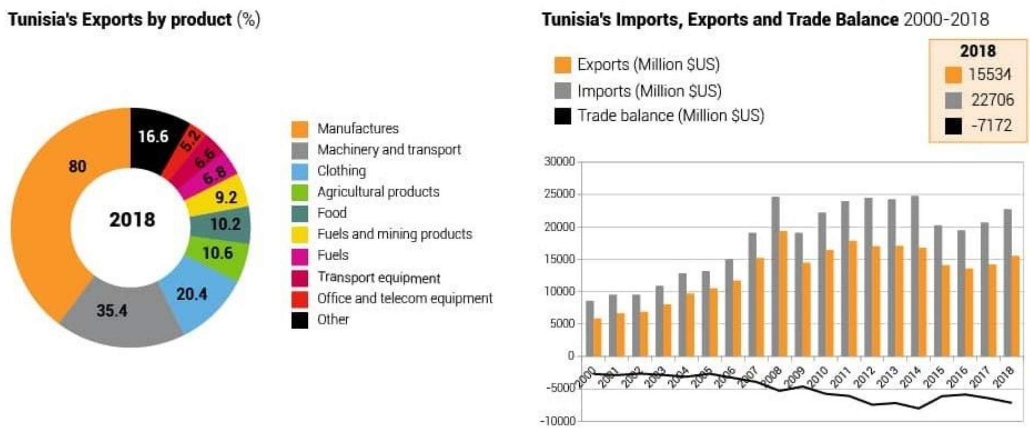

Figure 1. Tunisia's trade dynamics.

Sources: International Monetary Fund (IMF), World CIA Factbook, World Bank Data, and World Trade Organization (WTO). @Fanack

3.2. Econometric specification

[3] The choice of the period of investigation is constrained by data availability. Further, the starting year represents a point in time when Tunisia embarked on a series of economic reforms and liberalization measures, aiming to integrate into the global economy.

The point of departure is the Neoclassical Cobb-Douglas production function which is given by the following equation:

$$Y_t = F[(K_t, L_t);\ X_t, M_t] \tag{1}$$

Since our objective is to explore and quantify the effect of agricultural exports (our variable of interest) on economic growth, taking into account control variables, we will estimate an ARDL model. The ARDL approach presents the advantage of analyzing short and long-run effects. It also accommodates many variables and can be run on a small sample size. The ARDL representation of equation (1) is given by the following:

$$\begin{aligned}\Delta LOGY_t = \alpha_0 &+ \sum_{i=1}^{P-1} \alpha_{1i}\Delta LOG(Y)_{t-i} + \sum_{i=0}^{q-1} \alpha_{2i}\Delta LOG(K)_{t-i} + \sum_{i=0}^{q-1} \alpha_{3i}\Delta LOG(L)_{t-i} \\ &+ \sum_{i=0}^{q} \alpha_{4i}\Delta LOG(AX)_{t-i} + \sum_{i=0}^{q} \alpha_{5i}\Delta LOG(OX)_{t-i} + \sum_{i=0}^{q} \alpha_{6i}\Delta LOG(M)_{t-i} \\ &+\beta_1 LOG(Y)_{t-1} + \beta_2 LOG(K)_{t-1} + \beta_3 LOG(L)_{t-1} + \beta_4 LOG(AX)_{t-1} \\ &+\beta_5 LOG(OX)_{t-1} + \beta_6 LOG(M)_{t-1} + \varepsilon_t\end{aligned} \tag{2}$$

Where α_0 is a constant, LOG: is the natural logarithm of the variables, Δ: is the first difference operator. The coefficients $\alpha_{1i}, \alpha_{2i}, \alpha_{3i}, \alpha_{4i}, \alpha_{5i}, \alpha_{6i}$ are the short run effects, while $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ are the long run effects.
We follow the procedure of Pesaran et al. (2001) to test for a cointegrating relationship between variables in ARDL model. The procedure is known by “Bounds test to cointegration”. For that purpose, we, first, determine the optimal lag for p and q by using the standard information criteria of AIC, SC and HQ. Second, we apply the Fisher test to verify these hypotheses:

$$\begin{cases} H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0: \text{No cointegrating relationship} \\ H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0: \text{There is cointegrating relationship} \end{cases} \tag{3}$$

According to Pesaran et al. (2001), if F-statistic falls above the upper critical values, then a cointegrating relationship between variables exists. Otherwise, we reject the null hypothesis. To check the validity of the ARDL model, a battery of diagnostic tests is mandatory. We therefore apply the serial correlation, heteroscedasticity and normality tests. We, further, test the stability of the model through cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ).

4. Results and discussion

4.1. Long-run dynamics

Before presenting empirical results and interpreting the analysis, it is generally considered necessary to perform preliminary tests on the data. Descriptive statistics table is one of the pre-tests of the data realization, which provides certain prerequisites or information about the relevance of the compressed variables.
According to Table 2, all variables rang between positive values and the interval between these values is short, implying that the variables have limited variation or a narrow range. The variable's values are concentrated within a close proximity, suggesting that there is little dispersion or diversity in the observations. Moreover, the standard deviation of the variable takes into account the changes and fluctuations of the statistics during the survey period. The skewness and population kurtosis coefficients indicate that the variables follow a normal distribution. The probabilities associated with the Jarque-Bera test (>0.1) confirm this observation.

Table 2. Descriptive statistics.

	LOGY	LOGK	LOGL	LOGAX	LOGOX	LOGM
Mean	24.19818	22.58929	15.04731	20.77132	22.97328	23.42241
Median	24.24560	22.51075	15.04700	20.79428	22.95096	23.35352
Maximum	24.61914	23.11989	15.23982	21.33221	23.66022	23.99639
Minimum	23.59129	21.93793	14.73413	20.21497	22.50616	23.03243
Std. Dev.	0.331174	0.382727	0.151817	0.329071	0.316770	0.275246
Skewness	-0.380406	-0.092195	-0.463390	0.003964	0.468168	0.535871
Kurtosis	1.754706	1.630981	2.122942	1.794035	2.099060	1.986152
Jarque-Bera	2.750726	2.464776	2.103031	1.878620	2.180873	2.811338
Probability	0.252748	0.291595	0.349408	0.390898	0.336070	0.245203
Sum	750.1436	700.2681	466.4668	643.9108	712.1716	726.0948
Sum Sq. Dev.	3.290296	4.394397	0.691454	3.248641	3.010295	2.272813
Observations	31	31	31	31	31	31

Notes: Y: GDP in $, K: Gross Fixed capital formation in $, L: Population, AX: Agricultural exports in $, OX: Other exports in $, M: Imports in $.

We test for multicollinearity by applying the variance inflation factor (VIF). The rule of thumb is that a VIF greater than 10 is a sign of a severe multicollinearity. Table 3.2 shows that we do not have to worry about the issue. In all cases, "*the* ARDL *model addresses the issue of collinearity by allowing the lag of the dependent variable in the model with other independent variables and their lags.*" (Chetty, 2018).[4]

Table 3. Variance Inflation Factor result.

	Coefficient	Uncentered
Variable	Variance	VIF
DLOGK	0.004662	1.441313
LOGL	1.47E-07	1.334824
DLOGAX	0.000425	1.112563
DLOGOX	0.011979	7.453851
DLOGM	0.013462	7.887122

Notes: Y: GDP in $, K: Gross Fixed capital formation in $, L: Population, AX: Agricultural exports in $, OX: Other exports in $, M: Imports in $.

To apply the ARDL test, the series must be not integrated of order two. The results of ADF and PP unit root tests are shown in Table 4 and 5. ADF and PP results indicate that L are integrated at the level, and Y, K, AX, OX and M are integrated of order one. Also, according to the results of the unit root tests, we can conclude that none of the variables used in the model is integrated in order two. So, we can use the ARDL approach for our empirical estimation.

Table 6 indicates that the test value F (5.413203) is higher than the critical value bound I1 at all the significance levels. Therefore, a cointegrating relationship remains between the variables in the ARDL model.

The estimation of the ARDL model consists in extracting the long-term equilibrium equation and interpreting the directions of causality between the variables. Then, we must test the meaning of the long-term equilibrium equation since we always keep the hypothesis of cointegration between the variables included in the estimated equation. In fact, the long-term equilibrium equation is presented as follows:

$$DLOG(Y) = 1.9405 - 0.5106*DLOG(K) - 0.1254*DLOG(L) - 0.0074*DLOG(AX) - 0.6890*DLOG(OX) + 0.9829*DLOG(M)$$

The long-term equilibrium equation indicates that the variable that designates agricultural exports (AX) has a negative effect on economic growth. A 1% increase in agricultural exports leads to a 0.0074% decrease in economic

[4] Please note that we apply the VIF on variables as they appear in the long run equation of the ARDL model afterwards.

Table 4. PP stationarity test.

UNIT ROOT TEST TABLE (PP)							
In level							
		LOG(Y)	LOG(K)	LOG(L)	LOG(AX)	LOG(OX)	LOG(M)
With Constant	t-Statistic	-3.0498	-1.0329	-4.4218	-2.1504	-1.3689	-1.2334
	Prob.	0.0416	0.7283	0.0015	0.2276	0.5839	0.6465
With Constant & Trend	t-Statistic	5.5938	-2.6480	-1.2196	-2.3812	-0.3642	-0.0190
	Prob.	1.0000	0.2635	0.8880	0.3811	0.9844	0.9940
Without Constant & Trend	t-Statistic	4.3723	3.5227	4.7496	0.0024	0.1681	-0.0627
	Prob.	1.0000	0.9997	1.0000	0.6755	0.7278	0.6538
In first difference							
		d(LOG(Y))	d(LOG(K))	d(LOG(L))	d(LOG(AX))	d(LOG(OX))	d(LOG(M))
With Constant	t-Statistic	-1.8383	-6.8102	-1.0755	-7.3739	-4.9948	-5.1936
	Prob.	0.3554	0.0000	0.7116	0.0000	0.0004	0.0002
With Constant & Trend	t-Statistic	-3.1207	-6.8355	-2.3095	-7.2716	-5.4833	-5.7151
	Prob.	0.1205	0.0000	0.4160	0.0000	0.0006	0.0003
Without Constant & Trend	t-Statistic	-1.3384	-5.3887	-1.5168	-7.5145	-5.0667	-5.2790
	Prob.	0.1634	0.0000	0.1191	0.0000	0.0000	0.0000

Notes: Y: GDP in $, K: Gross Fixed capital formation in $, L: Population, AX: Agricultural exports in $, OX: Other exports in $, M: Imports in $. Source: Own calculation using Eviews.

Table 5. ADF stationarity test.

UNIT ROOT TEST TABLE (ADF)							
In level							
		LOG(Y)	LOG(K)	LOG(L)	LOG(AX)	LOG(OX)	LOG(M)
With Constant	t-Statistic	-3.0498	-1.0286	-2.3236	-2.2707	-1.2780	-1.1605
	Prob.	0.0416	0.7299	0.1717	0.1874	0.6265	0.6779
With Constant & Trend	t-Statistic	1.7584	-2.6882	-0.8493	-2.3625	-0.3467	-0.2258
	Prob.	1.0000	0.2480	0.9486	0.3902	0.9851	0.9893
Without Constant & Trend	t-Statistic	1.1467	2.6810	0.3878	-0.0134	0.1854	-0.0637
	Prob.	0.9311	0.9974	0.7894	0.6703	0.7330	0.6534
In first difference							
		d(LOG(Y))	d(LOG(K))	d(LOG(L))	d(LOG(AX))	d(LOG(OX))	d(LOG(M))
With Constant	t-Statistic	-1.8383	-6.8231	-1.0755	-7.3739	-4.9558	-5.1517
	Prob.	0.3554	0.0000	0.7116	0.0000	0.0004	0.0002
With Constant & Trend	t-Statistic	-3.2799	-6.7992	-2.3454	-7.2716	-5.4647	-5.7057
	Prob.	0.0896	0.0000	0.3983	0.0000	0.0006	0.0003
Without Constant & Trend	t-Statistic	-1.5958	-5.3498	-1.5286	-7.5145	-5.0301	-5.2423
	Prob.	0.1027	0.0000	0.1165	0.0000	0.0000	0.0000

Notes: Y: GDP in $, K: Gross Fixed capital formation in $, L: Population, AX: Agricultural exports in $, OX: Other exports in $, M: Imports in $. Source: Own calculation using Eviews.

growth. In contrast, the long-run equilibrium equation suggests that other exports (OX) have a negative effect on long-run economic growth. Indeed, a 1% increase in other exports results in a 0.6890% decrease in economic growth. The results portray the need to promote economic diversification, invest in domestic sectors, and balance the emphasis on exports with developing a robust domestic market.

For the control variables, we can affirm that capital has a negative impact on economic growth. This result is found in the case of other countries by the studies of Bakari et al. (2020), but contradicts the one of Bakari and Tiba (2019) for the case of China and Bakari et al. (2019) for the case of Brazil. The active population has also a negative impact on economic growth, in accordance with Bakari (2017c). Human capital heterogeneity poses challenges to

Table 6. Test of Bounds.

ARDL Bounds Test		
Test Statistic	Value	k
F-statistic	5.413203	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Own calculation using Eviews.

economic growth in Tunisia. Disparities in education, health, and marital status can have undesirable effects. The employment of low-skilled workers also weakens productivity, in addition to the scourge of brain drain.

Overall, export-led growth hypothesis is neither valid for other exports, nor for agricultural exports. The same observation is made by Toyin (2016) in South Africa, but differs from Bakari (2016) and Bakari (2017b) in the Tunisian context. On the other hand, Import-led growth is well verified. This coincides, for example, with Bakari (2017c) and Bakari et al. (2018), but it does not confirm the findings of Bakari and Bouchoucha (2021) and Bakari et al. (2019). Imports seem to quite stimulate the Tunisian economic growth in the long run as they enable foreign technologies to be absorbed into the domestic economy.

It is clear that, except for the imports, the results of the long-run equation of ARDL contradicts the Pearson correlation matrix which shows positive linkages.[5] Observing such difference is natural since the ARDL model takes into account the lagged relationships between variables, capturing dynamic interactions that may not be captured by a simple correlation analysis.

To justify the robustness of the last results, it is necessary to examine the significance of the long-term equilibrium relationship. Econometric rules indicate that in the long run, the error correction term (ECT) must have a negative coefficient and a probability lower than 5%. In this case, we can say that the equilibrium cointegration equation is significant and that there is a long-term relationship between the variables.

Table 7 reports the significance of the long-term equilibrium equation for the ARDL model. The results indicate that the ECT is negative (-0.784970) and that the probability of this coefficient has a probability of less than 1%. This means that the long-term equilibrium equation of the ARDL model is significant.[6]

Table 8 presents the results of various diagnostic tests conducted to assess the efficiency and consistency of the ARDL model. The findings indicate that the model is devoid of autocorrelation, functional form, normality, and heteroscedasticity issues. In all five tests, the null hypothesis cannot be rejected, suggesting that the model is robust.

Figure 2 displays the CUSUM and CUSUMSQ plots, which assess the stability of the long-run parameters and short-run dynamics in the ARDL-Error Correction Model. It is clear that the CUSUM and CUSUMSQ statistics are within the critical bounds set at the 5% significance level, implying that the null hypothesis of stable coefficients in the regression cannot be rejected.

4.2. Short-run dynamics

The ARDL model provide insights about the long-term relationship between variables, but it is also important

[5] The correlation matrix is not shown to save space but it is available upon request from the authors.
[6] We tried to control for specific events such as the 2011 revolution and the Covid-19 crisis, but the ARDL model cannot be estimated because of the 'singular matrix' message. The same applies to interaction with the variables of interest.

Table 7. Results of ARDL estimation.

ARDL Cointegrating And Long Run Form				
Dependent Variable: DLOG(Y)				
Selected Model: ARDL (2, 2, 0, 0, 1, 1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(Y(-1), 2)	-0.554805	0.273023	-2.032081	0.0591
DLOG(K, 2)	-0.008966	0.068763	-0.130395	0.8979
DLOG(K(-1), 2)	0.172805	0.078393	2.204339	0.0425
DLOG(L)	-0.098466	0.041200	-2.389944	0.0295
DLOG(AX, 2)	-0.005838	0.015406	-0.378928	0.7097
DLOG(OX, 2)	-0.279845	0.090282	-3.099669	0.0069
DLOG(M, 2)	0.435736	0.103324	4.217191	0.0007
ECT	-0.784970	0.410607	-1.911730	0.0040
DLOG(Y) = -0.5106*DLOG(K) -0.1254*LOG(L) -0.0074*DLOG(AX) -0.6890*DLOG(OX) + 0.9829*DLOG(M) + 1.9405				
Long run Equation				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOGK	-0.510648	0.364404	-1.401321	0.1802
LOGL	-0.125439	0.049938	-2.511888	0.0231
DLOGAX	-0.007437	0.020059	-0.370742	0.7157
DLOGOX	-0.688970	0.390044	-1.766390	0.0964
DLOGM	0.982901	0.508614	1.932511	0.0712
C	1.940489	0.760206	2.552585	0.0213

Notes: Y: GDP in $, K: Gross Fixed capital formation in $, L: Population, AX: Agricultural exports in $, OX: Other exports in $, M: Imports in $. Source: Own calculation using Eviews.

Table 8. Diagnostic tests.

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.996001	Prob. F(11,16)	0.4891
Obs*R-squared	11.38033	Prob. Chi-Square(11)	0.4120
Scaled explained SS	3.591713	Prob. Chi-Square(11)	0.9804
Heteroskedasticity Test: Harvey			
F-statistic	1.403476	Prob. F(11,16)	0.2611
Obs*R-squared	13.74984	Prob. Chi-Square(11)	0.2471
Scaled explained SS	17.23556	Prob. Chi-Square(11)	0.1011
Heteroskedasticity Test: Glejser			
F-statistic	0.875997	Prob. F(11,16)	0.5789
Obs*R-squared	10.52455	Prob. Chi-Square(11)	0.4839
Scaled explained SS	5.902784	Prob. Chi-Square(11)	0.8798
Heteroskedasticity Test: ARCH			
F-statistic	1.008227	Prob. F(1,25)	0.3249
Obs*R-squared	1.046674	Prob. Chi-Square(1)	0.3063
Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	2.148665	Prob. F(2,14)	0.1535
Obs*R-squared	6.576110	Prob. Chi-Square(2)	0.0373

Source: Own calculation using Eviews.

to focus on the effect of those variables in the short-run. Unlike the standard Granger causality test, the Toda-Yamamoto approach discharges from the constraints of unit root tests. Thus, we estimate a Vector Autoregressive (VAR) model with lag (k + dmax) on variables in level, where k is the optimal lag using Akaike Information Criterion

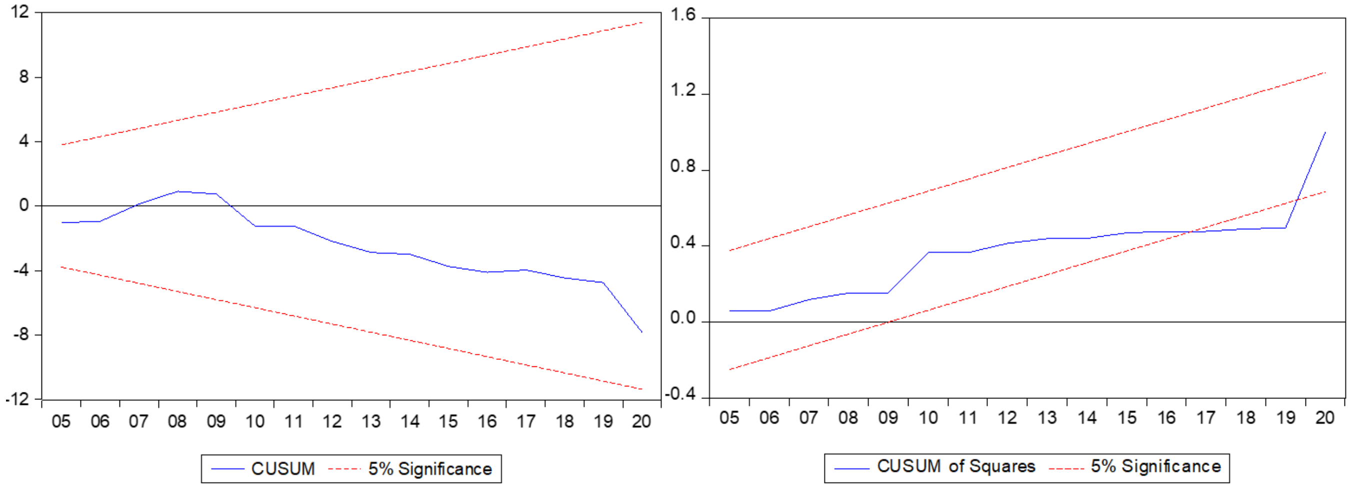

Figure 2. CUSUM and CUSUM SQ tests.

Source: Own graph using Eviews.

(AIC) and Schwarz Criterion (SC) in the first step and dmax is the maximum order of integration of the variables. According to Figure 3, there is no relationship between the variables of interest and economic growth in the short-run, while there is a statistically significant bidirectional relationship between domestic investment and GDP at 5%. Population causes economic growth, but not *vice versa*. The effect of agricultural exports and investment are consistent with the findings of Bakari (2016), while the absence of a short-run effect of imports on economic growth contradicts the results of Bakari (2017a) and Bakari (2018). We also disagree with Bakari (2018) on the effect of other exports on economic growth of Tunisia.

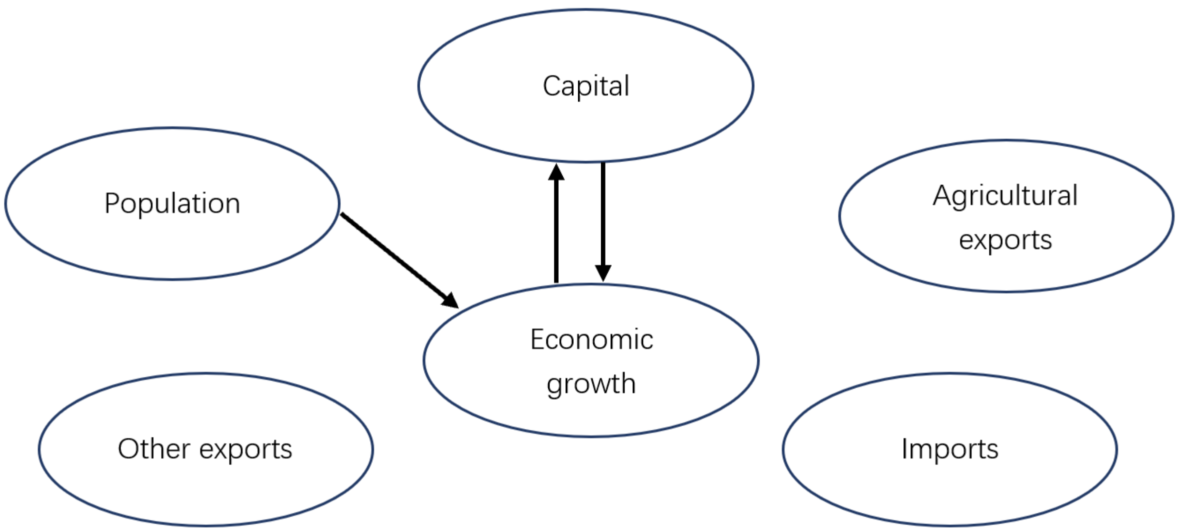

Figure 3. Toda Yamamoto Granger causality/Block exogeneity Wald tests.

Note: $\longrightarrow$ *significant at 5%. Source: Own graph using Eviews.*

5. Conclusion

This paper aims to discern the impact of agricultural exports, other exports, and imports on economic growth along with other variables in Tunisia using the ADF unit root test, PP unit root test, Bounds test and ARDL model for the period 1990 – 2020.

As a whole, agricultural exports, other exports, domestic investment, and labor force have a negative effect on

long-term economic growth, but the effect is not statistically significant for the former. This means that agricultural exports are not considered a source of economic growth in Tunisia.
Tunisia's export performance remains modest. However, imports seem to promote economic growth. Imports are essential to economic growth as they enable foreign technologies to be absorbed into the domestic economy.

Compared to other North African countries, agriculture plays a relatively modest role in the Tunisian economy, accounting for 12% of the country's GDP, with growth of around 2% per year. Despite its importance, the sector remains politically sensitive and highly regulated.

Heterogeneity in human capital is detrimental to long-term growth, as it contrasts with the positive effect of the average level of human capital. This heterogeneity is due to the level of education, health and marital status, which in turn affect the participation rate of men and women in the workforce (Jeguirim and Plassard, 2006).

The problem of quality job creation, distortions, and misallocation of resources result in low productivity.

Discrepancies in findings among empirical studies investigating a similar research question within a specific country can be attributed to a range of factors. These include disparities in data sources and quality, variations in sample sizes and sampling methodologies, differences in the selection of variables and model specifications, and variations in the time periods examined. Thereby, it is necessary to renew the empirical conclusions

Our findings have implications over urgent actions to be implemented by policymakers such as:

- Establish innovative approaches to develop agricultural trade and investment.
- Increase the share of gross fixed capital formation in the agricultural sector.
- It is necessary to better encourage and develop investment and exports in the agricultural sector to cover the value of imports.
- Tunisia needs a lot of resources and to improve its international competitiveness by focusing on goods that have a strong chance on international markets.
- The institutional context is also necessary to ensure stable growth. Government bureaucracy, corruption, and political instability are the three major challenges that businesses face in Tunisia.

One limitation to our study relies on the use of the ARDL approach, which assumes constant coefficients of the lagged variables over time. Such an assumption does not hold true in dynamic and evolving economic environments. A compelling option is to broaden our analysis by including additional countries. By employing a panel GARCH, we can investigate the trade dynamics in Tunisia with respect to exchange rate uncertainty (Kim and Jin, 2023) and/or geopolitical risks (Zhang et al., 2023). From a research standpoint, we plan to incorporate specific governance indicators and examine their interaction with exports on economic growth. It is quite important to shed light on the quality of regulatory frameworks governing different sectors in Tunisia.

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Conflict of interest

All the authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

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