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Export Growth and Economic Growth: The Tunisian Experience

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Abstract. This paper attempts to test the export-led-growth theory using Tunisian data. The dynamic interaction between export growth and economic growth is modeled within a vector-error-correction model using the Johansen technique of co-integration and the Granger test of causality. The analysis shows that the level of output and exports share a common stochastic trend that is consistent with Granger-causality running in both directions between economic growth and export growth. In particular causality is found to be the result of the variables adjusting to their long-run equilibrium relationship. Given the robustness of the results, the Tunisian experience shows support for the export-led growth theory and, thus, the paper recommends that Tunisian policymakers should consider export-promotion an engine to economic growth.

Introduction

In recent years, export promotion policies are becoming strongly advocated as an effective development strategy. According to the export-led-growth theory, export-oriented strategies promote economic growth due to the externalities of competing in world markets. These include efficiency of resource allocation, economies of scale, and higher factor productivity.

A vast literature addressed this issue by testing the connection between export growth and economic growth. Initial tests were conducted on a bivariate level to study the correlation between exports and economic growth. Correlation between exports and economic growth through other economic growth determining variables in a production-type function that includes capital formation, manufacturing, and total exports was investigated by Balassa [1], Tyler [2], Feder [3], Kavoussi [4], and Al-Yousif [5]. Kohli and Singh [6] and Moschos [7] considered the differential impacts of exports on economic growth depending on the level of development of the country in order to test the critical minimum effort hypothesis.

Although a high degree of positive correlation between export growth and economic growth was accepted as evidence supporting the export-led growth theory, it did not mean much in the absence of knowledge about the causality structure that links these two variables together. For this, recent empirical research has shifted a remarkable way from testing correlation to testing the existence of causality. Studies along this line include Marshall and Jung [8], Darrat [9], Bahmani-Oskooee, Mohtadi, and Shabsigh [10], Afxentiou and Serletis [11], Dorado [12], Bahmani-Oskooee and Alse [13]. However these studies did not reach a consensus judgment on whether export growth causes economic growth. For example, Marshall and Jung [8] found no consistent causation pattern in a sample of 37 countries; only 4 countries show causality from exports to economic growth. Darrat, supports these results. On the other hand, Chow [14] reports causality in 7 out of the 8 cases he considered.

Given the particular importance of the issue for developing countries, the aim of this paper is to investigate the causal relationship that exists between export growth and economic growth in Tunisia for which the subject has not been addressed in previous research. In particular, we use the Johansen [15,16] and Johansen and Juselius [17] co-integration techniques and develop a vector-error-correction model which we use to test for the existence and direction of Granger-causality between export growth and economic growth. While we found evidence for the existence of a common stochastic trend between the variables, i.e. the variables are cointegrated, Granger-causality is found to be running between export growth and economic growth only through the error-correction term. The important implication of this finding is that in Tunisia, exports Granger-cause economic growth through the long-run relationship that ties these two variables together.

The remaining of the paper is organized as follows: The first section describes the econometric methodology, the second section presents the empirical results, and last section concludes.

The Econometric Methodology

Testing for co-integration

The existing literature that investigates the relationship between exports and economic growth contains only 4 studies that use co-integration techniques.[1] However, with no exception, all of them use the Engle-Granger co-integration method. This paper uses the Johansen co-integration technique which is based on the maximum likelihood procedure. To model the intertemporal interactions between export growth and economic growth, we consider the vector auto-regressive (VAR) specification

$$W_t = \Phi_1 W_{t-1} + \Phi_2 W_{t-2} + \dots + \Phi_k W_{t-k} + \mu + \eta_t, \qquad t=1, \dots, T, \qquad (1)$$

[1] To the best of our knowledge, the only studies available that have used co-integration techniques are Afxentiou and Serletis (1991), Bahmani-Oskooee and Alse (1993), Dutt and Gosh (1996), and Al-Yousif (1996).

where W_t is a 2 x 1 vector containing real GDP, (Y_t) and real exports (X_t). The variables are measured by their natural logarithms so that their first differences approximate their growth rates. If Y and X are both integrated of order one, then by the Granger representation theorem, the dynamics of their growth rates can be captured by a vector-error-correction (VEC) model of the form

$$\Delta W_t = \Gamma_1 \Delta W_{t-1} + \Gamma_2 \Delta W_{t-2} + \ldots + \Gamma_{k-1} \Delta W_{t-k+1} + \Pi W_{t-k} + \mu + \eta_t , \; t = 1,\ldots,T \qquad (2)$$

where ΔW_t is the vector of the growth rates of the variables, the Γ's are estimable parameters, Δ is a difference operator, η_t is a vector of impulses which represent the unanticipated movements in W_t, with $\eta_t \sim$ niid(0, Σ) and Π is the long-run parameter matrix. With r co-integrating vectors ($1 \leq r \leq 2$), Π has rank r and can be decomposed as $\Pi = \alpha\beta'$, with α and β both 2 x r matrices. β are the parameters in the co-integrating relationships and α are the adjustment coefficients which measure the strength of the co-integrating vectors in the model. The adjustment coefficients represent the proportion by which the long-run disequilibrium (or imbalance) in the dependent variables are corrected in each short-term period.

The Johansen [15] multivariate co-integration technique allows estimation of the long-run or co-integrating relationships between the variables using a maximum likelihood procedure which tests for the co-integrating rank r and estimates the parameters β of these co-integrating relationships. As proved by Johansen [16,18], the intercept terms in the VEC model should be associated with the existence of a deterministic linear time trend in the data. If, however, the data do not contain a time trend, the VEC model should include a restricted intercept term associated to the co-integrating vectors.

Co-integration and granger-causality

Causality has always been the subject of controversy among economists. In this study causality is used in the Granger-temporal and probabilistic sense. Granger (1986, 1988) pointed out that if two variables are co-integrated then Granger-causality muexist in at least one direction. This result is a consequence of the relationships described by the error-correction model. If Y and X are co-integrated, then we can rewrite the system in (2) as follows

$$\Delta Y_t = \lambda_1 v_{t-1} + \sum_{s=1}^{k} \theta_{1,s} \Delta Y_{t-s} + \sum_{s=1}^{k} \theta_{2,s} \Delta X_{t-s} + \varepsilon_{1,t} \qquad (3)$$

$$\Delta X_t = \lambda_2 v_{t-1} + \sum_{s=1}^{k} \phi_{1,s} \Delta Y_{t-s} + \sum_{s=1}^{k} \phi_{2,s} \Delta X_{t-s} + \varepsilon_{2,t} \qquad (4)$$

Since the variables are cointegrated, then either ΔY_t or ΔX_t, or a combination of them must be Granger-caused by lagged values of the error-correction term, v_{t-1}, which itself is a function of the lagged values of the lèvel variables. Hence, the co-integration methodology opens a new channel for testing Granger-causality between the variables. With this, Granger-causality can be investigated using one of the following three procedures:

(i) Testing the statistical significance of the lagged error-correction term by applying a t-test on its coefficient in each equation.

(ii) Applying a joint F-test or Wald χ^2-test on the coefficients of each explanatory variable.

(iii) Applying a joint F-test or Wald χ^2-test on the terms in (i) and the terms in (ii).

Empirical Results

Data and variable definitions

Data used in this study are annual and cover the period 1963 - 1993. The definitions of the variables where ln denotes the natural logarithm of the variable are the following:

$Y = \ln(\text{real GDP})$
$X = \ln(\text{real exports})$

where the growth rate of real GDP is taken as a proxy for economic growth[2]. The following graphs (Figs. 1 and 2) portray the evolution of real GDP and real exports during the period of study.

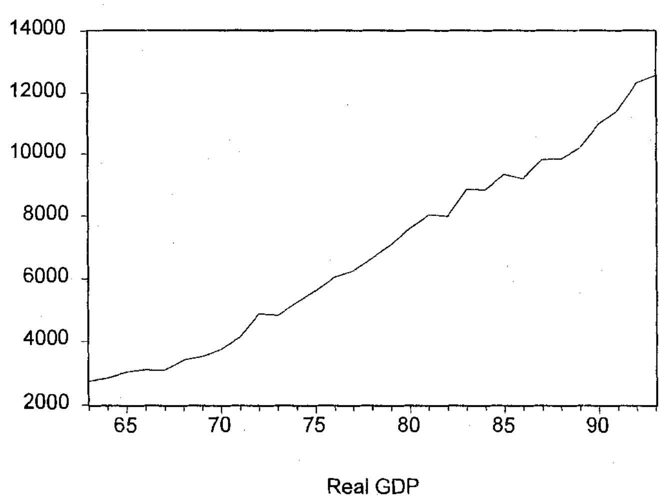

Fig. 1. The evolution of real GDP.

[2] Data on real GDP and real exports are obtained from the Tunisian Ministry of Planning.

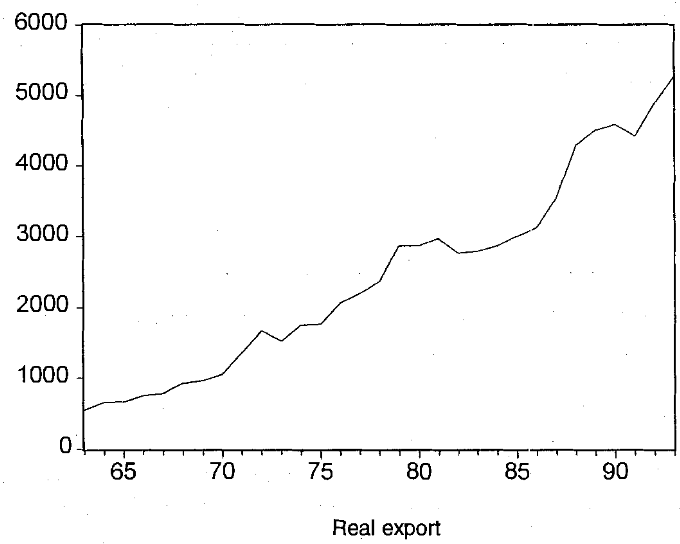

Fig. 2. The evolution of real exports.

Test results for unit roots

The vector-error-correction model described above requires that the variables Y and X are both integrated of order one, i.e. I(1). Therefore we should test for the existence of unit roots in the level variables as well as in their first differences. The tests that we use here are the augmented Dickey-Fuller (ADF) and the Phillips and Perron (P-P) tests of stationary. The null hypothesis tested is that the variable under investigation has a unit root, against the alternative that it does not. In each case the lag-length is chosen by minimizing the final prediction error (FPE) due to Akaike (1969).

The tests are performed sequentially. We first test stationarity around a non-zero constant than we test for stationarity around a linear time trend. The second and third columns of Table 1 report tests of stationarity about a non-zero constant. As shown in the first half of the Table, the null hypothesis that the level variables contain unit roots cannot be rejected by both tests. We then test for stationarity about a deterministic linear time trend. The results of these tests are reported in the fourth and fifth columns of Table 1. Again the null hypothesis that each of the time series has a unit root cannot be rejected. The bottom half of Table 1 reports results of testing for unit roots after differencing the data once. Both tests reject the null hypothesis. Since the data appear to be stationary in first differences, no further tests are performed.

Table 1. Test results for unit roots

	Stationarity around a non-zero mean		Stationarity around a linear trend	
Variable	ADF	P-P	ADF	P-P
Y	-1.297	-1.212	-0.829	-1.321
X	-1.410	-2.508	-1.548	-1.753
ΔY	-3.562	-6.691		
ΔX	-3.465	-5.792		
5% Critical Values	-2.970	-2.966	-3.573	-3.567

Hence, the results of Table 1 are consistent with the null hypothesis that the level variables are each integrated of order one.

Test results for co-integration

Since the Johansen co-integration method is sensitive to the choice of the lag length, before estimation of α and β it is necessary to determine the lag length, k, of the VAR, equation (1), which should be high enough to ensure that the errors are approximately white noise, but small enough to allow estimation. Our choice of k is based on the Akaike's Final Prediction Error (FPE) criterion. Table 2 reports the diagnostic tests for normality and serial correlation in the residuals for each equation in the VAR using k=2. This lag length left the residuals approximately independently identically normally distributed (*niid*) for both equations.

Table 2. Residual diagnostic tests for the VAR equations, k=2

Variable	TSC(10)	N(2)
Y	0.210	2.973
X	0.104	1.726

Notes: TSC(10) is a test for up to the tenth order serial correlation,
$TSC(10) = T\Sigma(r_i^2),\ i = 1, \ldots, 10 \sim \chi^2(10)$.
N(2) is the Jarque and Bera (1980) test for normality which is asymptotically distributed $\chi^2(2)$.
All tests are performed at the 95% confidence level.

The results for testing for the number of co-integrating vectors are reported in Table 3, which presents both the maximum eigenvalue (λ_{max}) and the trace statistics, the 10 percent critical values as well as the corresponding λ values. The results of Table 3 suggest the existence of one cointegrating vector, which means the existence of a sTable, meaningful long-run relationship between Y and X.

Table 3. Testing the Rank of Π

Trace				λ_{max}				
H0	H1	Stat.	90%	H0	H1	Stat.	90%	λ
$r = 0$	$r \geq 1$	36.47	17.79	$r = 0$	$r = 1$	30.34	10.29	0.649
$r \leq 1$	$r \geq 2$	6.14	7.50	$r \leq 1$	$r = 2$	6.14	7.50	0.191

When testing for co-integration, we have assumed the absence of a linear time trend in the VAR model. So, to check the robustness of this assumption and its adequacy with the above results, we now perform a joint test on both the co-integrating rank and the hypothesis of absence of a time trend in VAR. For this we use the Johansen [16] χ^2-test which is based on the so-called Pantula principle [21]. The procedure of this test is as follows. Let $M_{i,j}$ denote the combination of rank and deterministic component where i is the rank (i = 0, 1, 2) and j is the model, j = 0 is the model with no time trend and j = 1 is the model with a time trend. Using the likelihood ratio principle, the Johansen [16] test allows determination of the specification $M_{i,j}$ that is in accordance with the data. Starting from the most restricted model $M_{0,0}$ we compare the trace test statistic to the corresponding critical value. If the model is rejected we keep the rank assumption and change the model of the deterministic trend to the next one. So we continue to model $M_{0,1}$. If this model is also rejected we change the rank to i = 1 and go through the same procedure for j = 0 and j = 1. We keep changing i and j until the first time the joint hypothesis is accepted.

The results of this test are reported in Table 4 where we can see that model $M_{1,0}$ is the one that is consistent with the data. Thus, thetest confirms that the rank is equal to one and that VAR does not contain a deterministic time component. Therefore, we will continue to use restricted intercept in VAR with one co-integrating vector. Consequently, this means that the intercept term does not exist in the VEC model but will be associated to the cointegrating vector.

Table 4. Joint test for the rank and the deterministic component

Model	Trace Statistic	90%	Decision
$M_{0,0}$	36.475	17.794	Reject
$M_{0,1}$	14.889	13.308	Reject
$M_{1,0}$	6.136	7.503	Accept

The estimates of β and α vectors from model $M_{1,0}$ are presented in Table 5. From the α vector we can see that each adjustment coefficient is statistically significantly different of zero and, therefore, both variables are adjusting to their long-run equilibrium relationship. This means that, in the short-run, changes in real exports and changes in real GDP are influenced by the long-run relationship that exists between them. It means also that, in each short-term period, the error-correction term feeds back on the change in each variable to force its movement towards the long-run equilibrium state indicated by the co-integrating vector. From the α values we can see that the variables have almost the same speed of adjustment and are both significant. Therefore the model seems to be identified without having to impose any weak exogeneity restriction on the variables.

Table 5. The β and α vectors

Variable	β	α
Y_t	1	-0.338
		(-7.302)
X_t	-0.694	-0.397
	(-23.931)	(-3.298)
Intercept	-3.663	
	(-16.136)	

Notes: T-ratios are in parentheses.

Test results for granger-causality[3]

The results above imply that export growth and economic growth have a vector-error-correction representation of the form

$$\Delta Y_t = \lambda_1 v_{t-1} + \theta_1 \Delta Y_{t-1} + \theta_2 \Delta X_{t-1} + \varepsilon_{1,t} \quad (5)$$

$$\Delta X_t = \lambda_2 v_{t-1} + \phi_1 \Delta Y_{t-1} + \phi_2 \Delta X_{t-1} + \varepsilon_{2,t} \quad (6)$$

Equation (5) analyzes the hypothesis that export growth leads to economic growth. Equation (6), however, describes the hypothesis that economic growth leads to export growth, which also has a strong theoretical foundation. For instance, economic growth leads to enhancement of labor skills and technology and increased efficiency. This creates a comparative advantage for the country and consequently results in the growth of exports.

OLS estimates of the vector-error-correction model in 5 and 6 are presented in Table 6. Since the results are sensitive to departures from the standard assumptions, we present some diagnostic tests on the residuals of each equation. The first test, TSC(10) is a test for up to the tenth order serial correlation in the residuals, which is distributed $\chi^2(10)$. The second test, N(2), is the Jarque and Bera normality test which is asymptotically distributed $\chi^2(2)$. The third test, RESET(1), is the RESET test for parameter instability which is asymptotically distributed $\chi^2(1)$. Residuals from each equation pass these tests at the 95% significance levels and, hence, there is no significant departure from the standard assumptions. Table 8 presents multivariate diagnostic tests for both equations together. The first test, L-B(7), is a multivariate Ljung-Box test for absence of autocorrelation in the residuals which is based on the estimated auto- and cross-correlation of the first T/4 lags [23]. The second and fourth tests are LM-tests for absence of first and fourth order serial correlation in the residuals, and the last test, N(4), is a multivariate test for normality which is a generalization of the univariate Shenton-

[3]Causality is a subject of great controversy among economists. See Zellner [22] for a detailed discussion of this issue. Interested readers could also refer to a supplementary issue of the *Journal of Econometrics*, September-October 1988, which includes studies discussing the subject. This paper uses the concept of causality in the probabilistic sense rather than in the deterministic sense. Moreover, causality defined here is in the Granger temporal, rather than in the structural sense.

Bowman test [24]. The results of these tests indicate that the estimated system of equations does not violate the standard assumptions at any significance level.

Table 6. Estimates of the error-correction model

Variable	ΔY_t	ΔGI_t
v_{t-1}	-0.338	-0.397
	(-7.302)	(-3.298)
ΔY_{t-1}	-0.345	-0.080
	(-2.085)	(-0.931)
ΔX_{t-1}	-0.321	-0.091
	(-0.747)	(-0.404)
Adj. R^2	0.35	0.24
σ	0.0321	0.0834
TSC(10)	0.131	0.138
N(2)	2.978	0.351
RESET(1)	0.441	0.152

Notes: T-ratios are in parentheses.

As stated earlier, Granger-causality between the variables can be tested either through the significance of the coefficients of the exogenous variables or through the significance of the error-correction term in each equation. From Table 7 we can see that the variables do not enter significantly the equations of each other, whereas the error-correction term is significant in both equations. Thus, according to Granger [19,20] Granger-causality is running in both directions between export growth and economic growth. This flow of causality, however, is not the consequence of the dynamic interaction between changes in the growth rates of the variables, i.e. ΔY and ΔX, but a consequence of the fact that the level variables Y and X are moving along the trend values of each other, i.e. cointegrated. The implication of this result is that in Tunisia economic growth and export growth are both affected by the long-run equilibrium relationship that exists between the level of exports and the level of output, that is through the error-correction term.

Table 7. Multivariate diagnostic tests (robustness of the results)

Statistic	Value	p-Value	Degrees of Freedom
L-B(7)	26.620	0.23	22
LM(1)	1.799	0.77	4
LM(4)	6.465	0.17	4
N(4)	7.640	0.11	4

Consequently, we can conclude that, in Tunisia, there is a simultaneous cause and effect between economic growth and export growth. This simultaneity arises from the fact that, at the initial stages of development, economic growth promotes exports, but along the way exports start generating the capital needed for further economic growth.

The Granger-causality test used in the preceding section can be interpreted as a within sample causality test. It can only indicate the existence or not of Granger-causality within the sample period. Hence it does not provide an indication of the dynamic properties of the system, nor does it allow to gauge the strength of the causal effect that each variable has on the other beyond the sample period. An indication of these relativities can be obtained by partitioning the variance of the forecast-error of a variable into proportions attribuTable to innovations in each variable in the system including its own.

Consider again the vector error correction model in (5) and (6). A change in anyone of the random innovations $\varepsilon_{i,t}$, i=1, 2 will immediately change the value of the dependent variable and, hence, will also change the future values of the remaining variables in the system through the dynamic structure of the model. Since changes in the random innovations produce changes in the future growth rates of the variables, it is possible to decompose the total variance of the forecast-error in anyone of them and determine how much of this variance each variable explains.

For each variable, we decompose the response of its growth rate to a one standard deviation innovation in each variable within a twenty-period horizon. These responses are estimated using random generation of the parameters of the model in a Monte Carlo study with 100 iterations. Since the innovations are not necessarily uncorrelated, the residual terms are orthogonalized using a Choleski decomposition in order to obtain a diagonal covariance matrix of the resulting innovations and, therefore, isolate the effects of each variable on the other.

The results of estimating these causal relativities are presented in Table 8. Given that we have two variables in the system, the forecast variance of economic growth is decomposed into two proportions where, economic growth is responsible for one proportion and export growth is responsible for the other. Likewise, the forecast variance of export growth is decomposed into a proportion due to changes in economgrowth and another due to changes in export growth itself. As we see in the first part of the Table, about 21 percent of future changes in economic growth rates are caused by changes in export growth rates, the remaining (about 79%) are due to changes in economic growth itself. On the other hand, the second part of the Table indicates that about 12 percent of future changes in export growth rates are caused by changes in economic growth rates, the remaining (about 88%) are due to changes in export growth itself.

Table 8. Variance decompositions

Forecast variance of	Forecast error	Forecast period	Percentage of forecast variance due to innovations in	
			ΔY	ΔX
ΔY	0.00485	4	94.962	5.038
	0.00647	8	85.218	14.782
	0.00724	12	81.469	18.531
	0.00745	16	80.164	19.836
	0.00771	20	78.900	21.100
ΔX	0.00745	4	4.796	95.204
	0.00835	8	7.456	92.544
	0.00918	12	9.071	90.929
	0.00971	16	10.992	89.008
	0.01002	20	11.957	88.043

These results of variance decompositions are consistent with the results of the Granger causality tests in the sense that causality is running in both directions between economic growth and export growth. In addition, while both variables are sensitive to changes in each other, we can see that economic growth is more responsive to changes in export growth rates than does export growth to changes in economic growth rates.

The results of the Granger-causality and variance decomposition tests suggest that export promotion in Tunisia can constitute a successful policy towards achieving higher growth rates of real output. For policy makers, these results should be encouraging in light of the recent efforts that Tunisia was making towards trade liberalization. In fact, on July 17, 1995, Tunisia became the first country in the Middle East and North Africa region to sign a Free Trade Agreement (FTA) with the European Union (EU), which is Tunisia's largest partner, accounting for 75 percent of its imports and exports. This agreement represents the third important step Tunisia makes towards opening its economy to international competition after its accession to the GATT in 1990 and its signature to the Uruguay Round in 1994. The elimination of the remaining trade barriers in Tunisia will largely depend on the pace of Tunisia's trade and commercial integration with the EU. The FTA provides Tunisia with extensive technical support from the EU to harmonize product standards and upgrade the quality of Tunisian goods and services. The agreement allows also to increase market access for Tunisian agricultural products and services, which brings important benefits to Tunisia. It would, thus, be beneficial for Tunisia to enhance the competitiveness of its economy and seek greater access to the EU markets and its remaining trade partners.

Conclusion

This paper attempted to investigate the intertemporal causal relationship between export growth and economic growth in Tunisia. Using the Johansen co-integration techniques, we estimated a vector-error-correction model and tested for the existence and direction of causality between the variables.

The analysis shows that in the long-run, the level of output and exports share a common stochastic trend. That is they have a sTable, meaningful long-run relationship. In the short-run the existence of a common stochastic trend is found to be consistent with Granger-causality running in both directions through the error-correction term. Hence in each short-term period economic growth is adjusting to the long-run equilibrium that exists between the level of output and the level of exports. Given the robustness of the results, the Tunisian experience shows support for the export-led-growth theory. In particular, the results support the recent efforts that the Tunisian government has been deploying to enhance the country's international trade competitiveness in order to achieve higher growth rates of its real output.

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الصادرات والنمو الاقتصادي: دراسة تطبيقية على اقتصاد المملكة العربية السعودية

خليفة الغالي

أستاذ، قسم الاقتصاد، كلية الإدارة والاقتصاد،
جامعة الإمارات، العين، الإمارات العربية المتحدة

(قدم للنشر في ١٤١٩/٦/١٩هـ؛ وقبل للنشر في ١٤٢٠/١/٩هـ)

ملخص البحث. يحاول البحث اختبار النظرية القائلة إن نمو الصادرات يؤدي إلى النمو الاقتصادي، وذلك بتحليل سلاسل زمنية تتعلق بالناتج المحلي والصادرات في تونس، انطلاقا من نتائج اختبار التكامل المشترك. توصل البحث إلى اكتشاف علاقة طويلة المدى بين الناتج المحلي والصادرات، وبناء على اختبار اتجاه السببية توصل البحث إلى اكتشاف علاقة سببية بين نمو الصادرات ونمو الدخل المحلي. واستنادا إلى هذه النتائج فإن البحث يوصي أصحاب القرار والمخططين في تونس بالاعتماد على وضع سياسات تحفز القطاع الخارجي لتحقيق معدلات نمو أفضل.