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RESEARCH ARTICLE

External factors and economic growth in Tunisia: ARDL approach with structural change analysis

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Abstract: This paper examined the effect of external factors on economic growth in Tunisia. The economic analysis was carried out using recent quantitative technique of annual time series data from 1976 to 2017. Based on co-integration test with unknown structural breaks and ARDL bound testing we investigated importance of each factor in stimulating economic growth. Our results show that in the long-run FDI does not affect economic growth. Remittances and imports negatively affect economic growth. Exports promote economic growth such that a 1% increase stimulates economic activity by 0.702%. In the short term, our estimates emphasize a structural break in 1988 linked to the structural adjustment program. Likewise, FDI does not have a significant effect on economic growth while remittances and imports slow economic growth significantly at the conventional level. On the other hand, exports form a relevant engine of economic growth. Therefore, our conclusions imply that political decision-makers in Tunisia must guarantee certain level of training and infrastructure to ensure the gain of transfers of new technologies and experiences related to the FDI. Thus, Tunisia must encourage peoples living aboard to create new investment opportunities instead of just supporting their families for consumption. In addition, the state must develop financial system capable of transferring funds for investment in order to better benefit from remittances. Finally, the government must restrict import of consumer goods and allow import of equipment and machinery goods that promote production and economic growth.

Keywords: economic growth, external factors, structural change, ARDL

1 Introduction

Tunisia, as a developing country, has tried to achieve and maintain long-term sustainable economic growth since independence. There are several factors determining economic growth, which can be divided into domestic and external according to economic theory. Domestic determinants such as sound macroeconomic policies, good governance, human capital, political stability and national saving have been validated by theory as engine of economic growth [1, 2]. However, there are external factors such as exports, remittances and foreign direct investment (FDI) that are able to influence the extent of economic growth, especially for small developing economies [3, 4]. Recent social and economic researches suggest that high economic growth rate improves education and human capital formation, which are fundamental to reduce unemployment and poverty [5, 6]. Thus, a developed and prosperous society is certainly the ultimate goal of all economic activities. This work examines effect of external factors on economic growth in the case of Tunisia. To achieve this objective, annual observations of exports, imports, remittances, foreign direct investment and economic growth from 1976 to 2017 were used. The econometric methodology applied is the Autoregressive Distributed-Lag (ARDL) bounds testing approach developed by Pesaran and Shin (1999) [7] and Pesaran *et al.* (2001) [8]. Developing countries, including Tunisia, receive a very large amount of funds from growing number of emigrants living and working abroad whose contribution to economic growth is determined by several factors, namely the size of the economy and the level of financial development. Indeed, in 2016 the *National Institute of Statistics* in Tunisia announced that the volume of remittances by Tunisians residing abroad and their contributions in kind and in cash is the equivalent of 5% of GDP. Similarly, these transfers contribute up to 20% of national savings and have played an important role in the regulation of the balance of payments by absorbing about 37% of the deficit of the trade balance. Foreign direct investment in Tunisia, mainly in the tourism and textile sector, was impressive in the early 1980s. However, due to recurring political instability, amplification of terrorism, larger part of informal sector, corruption and weak global economic conditions, there has been a lack of manufacturing-related investment leading to reduced foreign investment. In addition, exports also play a significant role in the domestic economy and overall economic growth of developing countries.

In this regard, it is essential to examine the short and long-term relationship between exports, imports, remittances, foreign direct investment and economic growth that would be useful for government and policy decisions. There are three things that stand out in the literature. First, there are very limited studies of small developing economies. Second, the literature provides mixed evidence about long-term economic relationships between external factors and economic growth. Thirdly, there is scarcely any study that has examined the effect of these external factors on economic growth jointly in the case of a small developing country, hence the importance of undertaking this empirical study of external factors and economic growth. Therefore, our contribution consist on distinguishing between short run and long run effect of these factors taking account of break points which was not the case of previous works. We show that Tunisian government should undertake appropriate political strategies with regard to these external factors taking into account their importance for economic growth not only in Tunisia, but also in other similar economies.

The rest of this paper is organized as follows: The first section presents a review of the literature. The second section describes the model specification and the econometric method. The results and discussions of the study are presented in the third section. The last section provides the conclusion of the paper with strategic recommendations.

2 Literature review

The issue of the relationship between external factors and economic growth has long attracted the attention of economists. For example, the relationship between remittances and economic growth is widely discussed in the literature. The results show that there is no consensus regarding the long-term impact of remittances on economic growth. This could be linked to the financial development of the recipient country, but the direction of the link remained uncertain. Empirical studies which show that the link between remittances and growth is positive are numerous [9–12]. These studies assume that remittances improve the well-being of immigrant family members and help them invest in agriculture and other (small-scale) projects. They thus help to reduce poverty; help families fight income shocks and finance their education and health. They also increase the economy's foreign exchange reserves, which increases liquidity for growth-friendly activities and investment projects. In addition, Meyer and Shera (2017) [13] and Bahadir *et al.* (2018) [14] have studied the result of remittances on economic growth. They showed that economies with a developed financial system experience a significant and positive effect of remittances on growth. Similarly, Chen and Jayaraman (2016) [3] examined this type of potential link and showed that despite the existence of a positive relationship between remittances and economic growth, their interaction with the financial system is negative, implying that their marginal effect on growth is diminishing with financial development.

The impact of foreign direct investment (FDI) on growth remains a thorny issue for researchers and policymakers. At the theoretical level, it has been argued that FDI promotes growth [1, 15–17]. However, existing empirical studies have left researchers and policymakers perplexed as these studies do not seem to establish a strong link between these variables.

New technologies, job creation, increased research and development and domestic human capital development are the pillars of productivity. However, many small developing economies suffer from the lack of resources needed for their productivity and overall performance in economic growth. This lack of resources can explain and justify FDI inflows to fill these deficits in small developing economies. There are four key mechanisms by which foreign direct investment affects economic growth according to the endogenous growth theory. First, FDI fills the capital gaps facing many developing countries. In addition, FDI reduces the foreign exchange deficit by entering foreign capital directly and indirectly through export earnings. This increases the country's foreign exchange earnings and its ability to pay its external debt and improve its export competitiveness. Likewise, FDI increases government revenues through direct and indirect taxes of foreign firms. These taxes can be huge if there are a lot of FDI inflows and the government can use them to finance development projects such as infrastructure and various other expenses that enhance economic growth [18]. Finally, FDI is able to improve the knowledge through the transfer of skills and vocational training and brings new technological improvements to the economy.

The idea that FDI can positively affect economic growth is widely defended in economic theory [19, 20]. These authors prove that this relationship is conditioned by factors such as the level of domestic human capital, trade openness and domestic investment.

Literature examining the relationship between trade openness and economic growth also closely reflected the impact of imports and exports on economic growth [21–23]. Exports of goods and services are seen as a driver of economic and social development because of their ability to influence economic growth, and are subject to growth strategies adopted by developing countries. Indeed, as shown by Goh *et al.* (2017) [21] exports constitute an outlet for local goods and services, a source of foreign exchange inflows to cope with demand for imports and government revenues for the financing of the national economy. Similarly, a low level of export can be at the root of rising unemployment and poverty. A reduction in government revenue limits the import capacity of capital goods and the inputs needed for the productive activity, which could hinder economic growth.

3 Empirical evidence

3.1 Data and methodology

In our study, the relationship between economic growth and its external determinants, namely, FDI, exports, imports and remittances is investigated in the case of Tunisia. We have employed annual time series data covering the period 1976 to 2017 taken from the World Development Indicators online database (WDI, 2018). The sample is carefully selected based on the data availability. We modified the model of Barro (1996) [24] to include our variables of interest. The economic growth specification can be expressed as follows:

Where:

(1) *Growth*: Real GDP per capita growth (*GDPC*);

(2) *FDI*: Net inflow of Foreign Direct Investment as share of GDP;

(3) *REM*: Remittances as share of GDP;

(4) *EXP*: Exports as share of GDP;

(5) *IMP*: Imports as share of GDP.

We prove that economic growth is a function of foreign direct investment, remittances, exports and imports. In other words, this model suggests that FDI, REM, EXP and IMP might determinate economic growth. All variables were then transformed into natural logarithmic. The log-linear specification was intended to make the distribution of variables more symmetric, to reduce the influence of outlier's observations if they exists and make interpretation easy (We can interpret the coefficients as elasticities.).

The log-linear model specification for the econometrics analysis can be shown as follows:

$$LGDPC_t = \alpha_0 + \alpha_1 LFDI_t + \alpha_2 LREMT_t + \alpha_3 LEXP_t + \alpha_4 LIMP_t + \varepsilon_t;\ t = 1976, \ldots, 2017 \quad (1)$$

Where, the slope coefficients α_1, α_2, $\alpha_3$and α_4 represent the long run elasticities estimates of real GDP per capita growth (*constant 2010 US dollars*) with respect of FDI, remittances, exports and imports, respectively. L is the natural logarithm operator and ϵ represents the disturbance term assumed to be normally distributed. The subscript t refers to the time-period.

We apply the Autoregressive Distributed Lag (ARDL) bounds testing approach developed by Pesaran and Shin (1999) [7] and Pesaran *et al.* (2001) [8] to establish the existence of possible long run or co-integration relationship between the variables. Indeed, compared to other co-integration procedure like Engel and Granger (1987) [25] and Johansen and Juselius (1990) [26] using the ARDL bounds testing approach, we can estimate both the short and long-run relationships simultaneously.

Our methodology needs many steps. At the first, we applied the Bai and Perron (1998, 2003a) [27, 28] breakpoints test to check for the existence of the number of breakpoints in the data. At the second step, we apply the Clemente *et al.* (1988) [29] unit root test with structural breakpoints checking the period and order of integration among the series. Thirdly, we are invited to examine the robustness of the co-integration relationship between the economic growth and external factor by applying such a co-integration test of Hatemi-J (2008) [30] that accommodates double endogenous structural breaks in the series data. At the forth step, we apply the ARDL bounds testing approach developed by Pesaran *et al.* (2001) [8]. Finally, relevant post-estimation stability and diagnostic tests such as *Ramsey-RESET*, *CUSUM*, *CUSUMQ*, *Jarque-Bera*, *Breuch-Godfrey* and *ARCH* were employed.

3.1.1 Unit root tests

According to Pesaran *et al.* (2001) [8] and Sam *et al.* (2019) [31] the ARDL bounds test assumes that the dependent variable must be I(1) and regressors are purely I(0), purely I(1) or mutually co-integrated. Therefore, the objective is to ensure that the variables are not I(2) to avoid erroneous findings. In our study, we consider a relatively long period spread over 42 years. Throughout this period, Tunisia's economy has known several fluctuations mainly after 1986 and 2010. These economic and financial impacts reflect some structural changes, and it is important to consider these breaks points when performing unit root tests. In our knowledge, all the conventional standard unit root tests, namely Augmented Dickey Fuller (1979) [32], Phillips and Perron (1988) [33], Ng and Perron (2001) [34] and KPSS (1992), fail to detect structural break points in the series. These different tests provide spurious findings when they lack data about all possible structural break points in the series observations. However, the presence of theses breaks may affect the relationship between the variables of the regression. Based on Figure.1, we suspect that there is more than one structural breakpoints in the Data Generating Process (DGP) of the variables *GDP per capita, FDI, exports, imports and remittances*).

3.1.2 Structural Breakpoints Test: Bai-Perron procedure

When we are unable to easily examine the potential existence of structural break in the dataset we should use the Bai and Perron (1998, 2003a, 2006) [27, 28, 36] multiple breakpoint test (Several studies using macroeconomic time series asks whether structural changes have occurred at exogenously determined break or whether a single change has happened at an unknown break date. In this case, the basic Chow (1960) [37] test and Andrews *et al.* (1996) [38] test could be applied.). The advantage of this test is that selects the break dates endogenously. This methodology allows detect the presence of multiple unknown structural breaks under very general conditions for errors and regressors to allow for non-stationary variables. Bai-Perron (2003a) [28] adopted the following linear regression model with *m* breaks and *m+1* regimes.

$$y_t = x_t'\beta + z_t'\delta_i + \varepsilon_t, \quad t = TB_{i-1}, \ldots, TB_i \text{ and } i = 1, 2, \ldots, m+1 \tag{2}$$

When TB_i (Time Break) representing the period in which the break appears, *m* is the number of breaks, y_t is the dependent variable, x_t and z_t are the covariates, β and δ_i are the corresponding vectors of coefficients and ϵ the error term.

To determine the existence of breaks, we can use the UD_{max} (*unweighted maximized statistic*) and WD_{max} (*weighted maximized statistic*) tests that examine for the null hypothesis of no structural breaks versus the presence of an unknown number of breaks. Hence, we can verify this by using only the value of WD_{max} defined as follows:

$$WD_{\max} F_T(M, q) = \max_{1 \le m \le M} \frac{c(q, \alpha, 1)}{c(q, \alpha, m)} \sup_{(\lambda_1, \ldots, \lambda_1) \in \Lambda_\varepsilon} F(\lambda_1, \ldots, \lambda_m; q) \tag{3}$$

Where is the asymptotic critical value of the test for a significance level α,ϵ is a trimming parameter equal to (*h/T*) where *T* is the sample size and *h* is the minimal permissible length of a segment (For more details, see Bai and Perron (2003a) [28].)

3.1.3 Clemente-Montanes-Reyes unit root tests

A known obvious weakness of the Zivot and Andrews (1992) [39] unit root tests is its inability to deal with more than single structural breakpoint in a time series. In order to address this issue, we shall use the Clemente *et al.* (1988) [29] unit root tests (*CMR*) (The authors extend the work of Perron and Vogelsang (1992) [41] to the case where the variable exhibits double structural breaks in the underlying data set.). This test contains information about more than one unknown structural breaks occurring in the data during the sample period, which may occur under both the assumptions of stationarity or non-stationarity. CMR proposed tests that would provide for two models. The first is labeled additive outliers (AO) and captures marginal change in a series due to a transitory shock or to an anomaly in the data. The second is labeled innovational outliers (IO) allowing for a gradual shift in time of the mean of the series.

We recall that if the structural break occurs abruptly, one assumes an additive outlier model (AO model), if it occurs gradually, than an innovation outlier model (IO model). The two events specify the transition mechanism of the structural break.

We explore a simple model with double-break additive outliers as employed in Baum *et al.* (1999) [40]:

$$y_t = \alpha + \theta_1 DU_{1t} + \theta_2 DU_{2t} + \eta_{1t} \tag{4}$$

Where DU_t is a dummy variable with $DU_{it} = 1$ for $TB_i < t (i = 1, 2)$ and zero otherwise $(i = 1, 2)$. TB_1 and TB_2 are the breakpoints dates. $\{y_t\}$ is the variable to be studied, while α and θ are the parameters of regression. $\eta_{1t}$is the white noise error term. This model assumes double shifts in the level of the DGP of the series.

The equivalent form for the innovational outlier model in this context could be:

$$y_t = \alpha + \theta_1 DU_{1t} + \theta_2 DU_{2t} + \omega_1 DT_{1t} + \omega_2 DT_{2t} + \rho y_{t-1} + \eta_{2t} \tag{5}$$

Where DT_{it} is a dummy variable with $DT_{it} = 1$ if $t = TB_i + 1$ and zero otherwise $(i = 1, 2)$. η_{2t} is the white noise term.

This model expresses the shocks to the series as having the same ARMA process as other shocks to the model. A significant estimate of ρ ($|\rho| < 1$) will provide evidence against *I(1)* null hypothesis.

3.1.4 ARDL bounds test

Several studies in the literature shows that conventional tests techniques for co-integration have low power and provide spurious results in the presence of a regime shift in data that is not taken into account [42, 43]. Therefore, this study uses the Autoregressive Distributed Lag (ARDL) bounds testing approach developed by Pesaran *et al*. (1999, 2001) [7, 8] to test for existence of a possible long-run or co-integration relationship between economic growth and external factor with presence of structural breakpoints in the Tunisian data. However, according to Pesaran and Shin (1999) [7] this methodology provides more consistent empirical findings in cases of small and finite sample size and generally provides unbiased estimates in long-run model, even in presence of the problem of endogeneity. Our econometric model of the ARDL and its associated unrestricted equilibrium correction formulation can be expressed as the following:

$$\begin{aligned}\Delta GGDPC_t =& \alpha_0 + \alpha_1 T + \alpha_2 DUM^{TB} + \lambda_1 LGDPC_{t-1} + \lambda_2 LFDI_{t-1} + \\ & \lambda_3 LREM\Gamma_{t-1} + \lambda_4 LEXP_{t-1} + \lambda_5 LIMP_{t-1}\end{aligned} \tag{6}$$

When $\Delta \equiv 1 - L$ is the first difference operator and α_0 is the drift component. *DUM*^{TB} is a dummy for structural breakpoints. Here *p* and *q* signifies the maximum lag length (The long run relationship between the variables can be estimated after the selection of the optimal structural lag-length using *Akaike information criterion* (*AIC*).). The ϵ represent the error term that is assumed to be normally distributed. The first expression on the right-hand side corresponds to the long run relationship between the series. The second part on the right-hand side represents the short run dynamics of the model.

3.1.5 ARDL co-integration test

To capture the existence of co-integration relationship a Wald-test (F-Statistic) is computed from an OLS regression of the Equation (6). The null hypothesis of no co-integration is tested by restricting the parameters attached along with lagged levels of the variables to zero $(H_0 : \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0)$ against the alternative hypothesis which states the presence of a long run relationship $(H_1 : \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq 0)$.

To estimate the Equation (6) we apply the OLS technique. This estimation provides a test statistic which can be compared to two sets of asymptotic *critical value bounds* given by Pesaran *et al.* (2001) [8]. According to theses authors, the lower *bound critical value* assumed that the regressors are I(0), while the upper *bound critical value* assumed that the regressors are I(1). Thus, if the *Wald or F-statistic* is greater than the upper *bound critical value*, the null hypothesis of no long run relationship can be rejected, meaning that the variables are co-integrated. Alternatively, when the *Wald or F-statistic* is smaller than the lower *bound critical value*, the null hypothesis is accepted, meaning that there is no co-integration among the variables of the model. If the sample test statistic falls inside these two bounds, inference is inconclusive (Since our sample size is not very large, we use Narayan's (2004) [49] critical values. Thus, calculated F-statistics will be compared to these critical values.). In such an inconclusive case, it is preferable to establish the co-integration relationship is by applying the ECM generated by the long-run estimated parameters in ARDL model [44].

One main overall objective of the ARDL approach application is to develop the conditional error correction model (*ECM*) to identify short run dynamics. The short run expression involves the error correction term *i.e.* ECT_{t-1} which tests the speed of convergence of short run disequilibrium towards the long run equilibrium. Based on Equation (6) the conditional error correction model below required for the short run result can be expressed as follows:

$$\begin{aligned}\Delta LGDPC_t =& \alpha_0 + \alpha_1 T + \alpha_2 D^{TB} + \sum_{i=1}^{p} \delta_i \Delta LGDPC_{t-i} + \sum_{j=0}^{q} \beta_j \Delta LFDI_{t-j} + \\ & \sum_{j=0}^{q} \omega_j \Delta LIMP_{t-j} + \sum_{i=0}^{q} \theta_j \Delta LREMT_{t-j} + \varphi ECT_{t-1} + \varepsilon_t; \\ & t = 1976, \ldots, 2017\end{aligned} \tag{7}$$

Where δ, β,ω and θ represent the short-run coefficient and ϕ is the speed of convergence. *ECT* is the error correction term which derived from the residuals of the Equation (6). The coefficient of *ECT* (speed of convergence ϕ) is expected to be significant and negatively associated with the dependent variable.

3.1.6 Hatemi-J co-integration with double regime shifts

Once the long run relationship between variables using the ARDL approach is estimated, it is recommended to check whether this co-integration relationship is robust. Like unit root tests, standard co-integration tests mostly used in the literature, namely Granger (1981; 1983) [45,46]; Engel and Granger (1987) [25] and Johansen (1991) [47] do not take into account for a possible existence of structural regimes in long run relationship. However, when one or more structural breaks exist in the data, these standard co-integration tests may not be acceptable and a co-integration test with structural regimes shifts should be performed [42,48].

Building on Gregory and Hansen (1996) [42]; Hatemi-J (2008) [30] presented co-integration test accounting for double structural break in the data (Gregory and Hansen (1996) [42] test employed only for one endogenous structural break detected in the data.). As we mentioned, the Hatemi-J (2008) [30] residual based-test of co-integration is an extend procedure of Gregory and Hansen (1996) [42] method that allows for a single structural shifts in three alternative models: in the level (model C), in level shift with trend (model C/T) and in the level and slope coefficients (model C/S). Hatemi-J (2008) [30] considers only the model (C/S) in which double endogenous breaks affect both the constant and the slopes coefficients and he proposed the following equation:

$$y_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \beta_0' x_t + \beta_1' D_{1t} x_t + \beta_2' D_{2t} x_t + u_t; \;\; t = 1, \ldots, n \qquad (8)$$

Where D_{1t} and D_{2t} are *dummy* variables, y_t the dependent variable (*LGDPC*) and x_t a vector of independent variables (*LFDI*, *LEXPT*, *LIMP* and *LREMT*) defined as:

$$D_{it} = \begin{cases} 0 & \text{if } t \leq [n\tau_i] \\ 1 & \text{if } t > [n\tau_i] \end{cases} \; ; \text{ with } \tau_i \in (0,1) \text{ and } i = 1,2 \qquad (9)$$

Where the unknown parameters τ_1 and τ_2 refers to the timing of the first and second breaks dates, respectively. The two brackets "[.]" denotes the integer part.

To test the null hypothesis of no co-integration, Hatemi-J (2008) [30] suggests three residual based test statistics (commonly used) namely the modified augmented Dickey–Fuller (ADF*) test (suggested by Engle and Granger (1987)) [25] and the two modified Phillips (Z_a* and Z_t*) tests (suggested by Phillips (1987) [50]):

$$\begin{cases} ADF^* = \underset{(\tau_1,\tau_2)\in T}{inf} \; ADF(\tau_1,\tau_2) \\ Z_t^* = \underset{(\tau_1,\tau_2)\in T}{inf} \; Z_t(\tau_1,\tau_2) \\ Z_\alpha^* = \underset{(\tau_1,\tau_2)\in T}{inf} \; Z_\alpha(\tau_1,\tau_2) \end{cases} \qquad (10)$$

Where the set *T* can be any compact subset of (0, 1): $T = (0.15n; 0.8n)$.

Once the co-integration relationship is confirmed, long run and short run coefficient are estimated with the ARDL procedure.

3.1.7 Stability and Diagnostic tests

Several model stability and residuals diagnostic tests were conducted in this study to investigate the robustness of the ARDL long run model and ECM. The *RAMSEY-REST* test is considered to examine the estimated ARDL model specification and the *CUSUM* and *CUSUMSQ* tests developed by Brown *et al.* (1975) [51] can be employed to investigate the stability of the ARDL parameters. In addition, residuals diagnostics tests such as *Jarque-Bera* test, *Breuch-Godfrey* LM test and *ARCH* test are also performed to examine the normality distribution, the serial correlation and the heteroscedasticity, respectively.

3.2 Results and interpretations

In this section, we shall try to show our empirical findings concerning the relationship between external factor and economic growth in Tunisia's case between 1976 and 2017.

3.2.1 Descriptive analysis

Table 1 reports the summary statistics of variables included in this work. We can conclude that all series are approximately normally distributed, as the value of Jarque-Bera test do not reject the null hypothesis of normality distribution of a variable. Table 2 shows the result of the

Variance Inflation Factor which provides that data are free from the problem of multicollinearity. Figure 1 illustrates the logarithmic trend of all variables used in the regression, which provides that all variables are relatively stable over the entire study period.

Table 1 Summary statistics and correlations

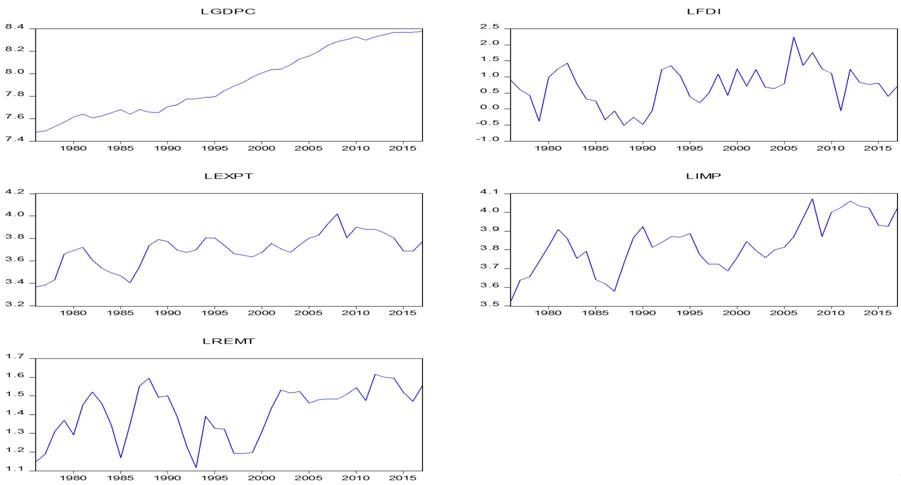
	LGDP	LFDI	LEXP	LIMP	LREM
Obs.	42	42	42	42	42
Mean	7.9286	0.6850	3.7012	3.8290	1.4109
Std. Dev	0.2998	0.6236	0.1492	0.1351	0.1410
Min	7.4799	-0.5101	3.3702	3.5268	1.1168
Max	8.3765	2.2432	4.0192	4.0724	1.6154
J-Bera test	3.9325	0.1394	1.6314	0.6013	3.3785
LGDP	1.0000				
LFDI	0.3831	1.0000			
LEXP	07021	0.3114	1.0000		
LIMP	0.7150	0.3424	0.8459	1.0000	
LREM	0.5378	0.0147	05570	0.5830	1.0000

Source: Authors calculations

Table 2 Variance Inflation Factor

	Coefficient Variance	Centered VIF
C	1.0068	NA
LFDI	0.0031	1.2117
LIMP	0.2146	3.9426
LEXP	0.1615	3.6189
LREM	0.0827	1.6532

Source: Authors calculations



Source: Authors calculation based on World Bank Online Database (2018) [35]

Figure 1 Plots of data overview (1976 – 2017)

3.2.2 Unit root test

As a first step, the likely existence of structural breaks is addressed by using Bai-Perron test. Table 3 presents the results of the Bai-Perron (1998) [27] test for structural regime shifts in the deterministic components of a univariate time series. In this study, we employed the Bai-Perron (2003a) [28] algorithm to determine locations of structural changes. The results obviously confirm our suspicion concerning presence of breaks in the structural relationship between economic growth and its external determinants variables in Tunisia throughout the period 1976 to 2017.

We can verify this by computing the WD_{max} statistics. The second column of the table presents the WD_{max} (at 5% significance level), which clearly reject the null hypothesis of no breaks. To determine the number of breaks we employed a sequential examination of the $F_T(M, q)$ statistics. The structural breaks dates for each variable are reported in last three column of the table. Relatively, the results show that a different number of breaks, up to three, has been detected by the test statistics for all variables. Thus, it is necessary to consider the

Table 3 Results of Bai-Perron Multiple Structural Breaks test

Variable	$WD_{max}^{0.05}$ Statistic	TB_1	TB_2	TB_3
LGDPC	34.84	1987	1996	–
LFDI	46.50	1986	1992	2011
LREMT	33.40	1992	2001	–
LEXP	07.09	1988	2005	–
LIMP	27.62	2007	–	–

Note: The $WD_{max}^{0.05}$ test the null hypothesis of no structural break. These statistics has been obtained by correcting the possible autocorrelation and/or heteroscedasticity through the quadratic spectral kernel with the bandwdith being selected according to Andrews (1991) [52]. TB_1, TB_2 and TB_3 are the estimated time breaks according the modified Bayesian-Schwarz criterion (*LWZ criterion*).

presence of theses breaks to test for unit roots. The second step consists to investigate the period and order of integration among the variables, the Clemente *et al.* (1988) [29] unit root tests have to be applied to all variables. This test considers the presence of two endogenous structural breaks in the underlying data set under the null hypothesis that series has unit root with structural breaks. The results of calculated statistical values are represented in Table 4.

Table 4 Results of CMR unit root tests with two changes in the mean

Variable	Additive Outliers				Innovational Outliers			
	t-Stat	TB_1	TB_2	Decision	t-Stat	TB_1	TB_2	Decision
LGDPC	-3.564	1993	2004	I(1)	-4.737	1988	1994	I(1)
LFDI	-4.951	1985	1989	I(1)	-5.298	1984	1990	I(1)
LREMT	-0.457	-	2001	I(1)	-5.543	1989	2000	I(0)
LEXPT	-5.831	1989	2008	I(0)	-5.720	1985	2002	I(0)
LIMP	-4.746	1985	2008	I(1)	-4.798	1986	2005	I(1)

Note: TB_1 and TB_2 are the first and second optimal time breaks, respectively. The variables were tested for double structural breakpoints unit root tests using the CMR's test for additive outliers (which captures a sudden change) or innovational outliers (allowing for a gradual shift in the mean) in the series. The 5% critical value is -5.490.

Table 4 displays two parts one is *additive outliers'* model, which capture marginal change and the second, is innovative outlier model, which shows sudden and perpetual changes in data series. Looking at results, an *innovational outliers'* model seems to be relatively more appropriate in our case. Indeed, the persistent shocks that influenced the variables of interest for a longer period seems more likely in this context. Based on the calculated *t-statistics*, in column 1, of *innovational outliers* model, we cannot reject the null hypothesis that GDP per capita, FDI and imports are integrated I(1) at level in the presence of structural breaks, on the other hand, both remittances and exports are stationary at level I(0) in the presence of structural breaks. However, the *CMR* test provides that our selected variables used in the regression are mutually integrated, which support the use of the ARDL. Moreover, the test revealed the existence of two significant structural breaks for all series (*e.g.* 1984, 1988, 2000 and 2005).These likely dates are highly correlated to numerous structural political and economic events that occurred in Tunisia. The structural break in 1984 implies that the Tunisian economy continued to suffer from growing foreign debt and the foreign exchange crisis started in 1980, while it was up a little after the launch of the structural adjustment program in 1986 and the privatization program of 160 state-owned enterprises in 1987. The mid-1990s Tunisia entered into an "Association Agreement" with the European Union, which removed the tariff and barriers on goods. This is evident from the existence of structural beaks in 2000 and 2005. We find similar empirical results by using the Lee and Strazicich (2003) [53] LM unit root test, which validate the consistency of the empirical analysis (Results are available upon request from the authors.).

3.2.3 Co-integration with two unknown structural breaks

After investigating the integration order of the series in presence of double unknown structural breaks, the next step consists to examine the presence of long-run relationship between economic growth and its external determinants. In doing so, we apply the Hatemi-J (2008) [30] co-integration test in presence of two unknown structural breaks.

The results from Hatemi-J (2008) [30] co-integration test with break in level and slope is reported in Table 5. Since Hatemi-J (2008) [30] suggests three residual based test statistics (namely the modified ADF (ADF*) test and the two modified Phillips (Z_a*and Z_t*) tests), our analysis will depend on Z_t* test statistics [42] (Gregory and Hansen (1996) [42] indicates that Z_t* is better than ADF* and Z_a*in term of power and size.). As can be seen from the results reported in Table 5, the Hatemi-J (2008) [30] test strongly reject the null hypothesis of no co-integration at the five percent significance level (*the estimated* Z_t* (-7.171) *is higher than the critical value* Z_t* (-6.015) in absolute value). In other words, the test supports the existence of long run relationship between economic growth, foreign direct investment, imports, exports and remittances. Moreover, the test proposes two unknown break dates, which very linked to several political and economic events that happened in Tunisia. The first date selected is 1988, which corresponds to the political regime change and the second date was to be at the 1999. Our guess is that this break is related to the government's success in the gradual liberalization of trade and manufacturing, which was started in 1996.

Table 5 Result of Hatemi-J co-integration test with double Structural break (Model C/S)

Panel A: Hatemi-J cointegration test statistics				
	Estimated test value	TB_1	TB_2	Lag
ADF^*	-6.522^a	1988	1996	7
Z_t^*	-7.171^a	1988	1999	0
Z_α^*	-46.988	1988	1999	0
Panel B: Asymptotic Critical Values				
Level	1%	5%	10%	
ADF^*	-6.503	-6.015	-5.653	
Z_t^*	-6.503	-6.015	-5.653	
Z_α^*	-90.794	-76.003	-52.232	

Note: TB_1 and TB_2 are the first and second optimal time breaks, respectively. Critical values are for significance levels of 1%, 5% and 10% are obtained from the Hatemi-J (2008) [30]. (^{a}), (^{b}) and (^{c}) indicate rejection of the null hypothesis at significance level for 1%, 5% and 10% respectively. The lag length was selected using Schwartz and Akaike information criteria with maximum lag equal to five. The Hatemi-J (2009) [54] GAUSS module endogenously detects break dates.

3.2.4 ARDL bound testing

Although the Hatemi-J (2008) [30] co-integration test provides enough evidence for long run association between variables, we also prefer to apply the ARDL bound testing approach to co-integration to further confirm results reported in Table 5 and avoid criticism of using conventional co-integration tests that may have serious shortcomings [55]. As mentioned above, the variables are mutually integrated which support the use of ARDL specification. Therefore, we apply the ARDL bound testing approach to co-integration in the presence of two structural breakpoints to examine both the long and short-run relationship between economic growth and external factors. We include two dummies variables (year 1988 "Dum88" and year 1999 "Dum99") based on Hatemi-J (2008) [30] test findings. Prior to performing co-integration analysis, we should determine the appropriate lag length of variables. The optimal lag length chosen will be used in the ARDL model specification. We can indicate that the ARDL specification is sensitive to lag order selection. Indeed, Lütkepohl (2006) [56] argues that the dynamic relationship between the series can be correctly captured if an appropriate lag order is selected. Table 6 indicated the lag length criteria. The optimal lag order of series used is being determined following the Akaike Information Criterion (AIC) due to its superiority over the other lag criteria. From Table 6 we can indicate that for (4) is the optimal lag length over the period 1976-2017. The results of ARDL bounds testing represented in Table 7 reveals that the calculated F-statistic (6.577) is greater than the asymptotic critical value (6.250) of the upper bound at one percent significance level generated by Narayan (2004a) [49]. This finding, suggest the existence of co-integration relationship among variables. In light of the findings from the two co-integration tests namely the Hatemi-J (2008) [30] test and ARDL bound test in presence of structural breakpoints, we can emphasize that there is a co-integration relationship among real GDP per capita growth and FDI, imports, exports and remittances in presence of structural change.

Table 6 Selection of Lag length criteria

Lag	LogL	LR	FPE	AIC	SBIC	HQIC
0	74.2434	-	1.8e-08	-3.6449	-3.4289	-3.5677
1	221.119	293.75	3.0e-11^d	-10.0589	-8.7661^d	-9.5989^d
2	238.315	34.393	4.8e-11	-9.6482	-7.2780	-8.8049
3	272.356	68.082	3.6e-11	-10.124	-6.67647	-8.8974
4	303.199	61.685^d	4.1e-11	-10.4315^d	-5.9066	-8.8216

Note: (^{d}) indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SBIC: Schwarz-Bayesian information criterion and HQIC: Hannan-Quinn information criterion.

Table 7 ARDL Bounds Testing to Cointegration (*LGDPC is the independent variable*)

Model	Variables		F-statistics		Decision	
DUM88 and DUM99	LFDI, LIMP, LEXP, LREM		6.577^a		Cointegration	
Asymptotic Critical Value	1% Critical bounds		5% Critical bounds		10% Critical bounds	
	LB	UB	LB	UB	LB	UB
T= 40	4.428	6.250	3.202	4.544	2.660	3.838

Note: (^{a}) represent significance at 1% level. UB means Upper Bound and LB means Lower Bound. Asymptotic Critical Value for bounds test are from Narayan (2004a) [49], case III restricted intercept and trend.

Table 8 Econometric results for the long-run model (LGDPC is the dependent variable

Variables	Model with DUM88 and DUM99	
Optimal lag	ARDL (2, 4, 4, 4, 4)	
	Coefficient	t-statistic
LFDI	0.0109	1.3899
LREM	-0.2978^c	-2.0748
LEXP	0.7021^a	4.5514
LIMP	-0.6573^b	-2.1930
R^2	0.998	-
F-Statistics	553.84^a	-
D.W	2.224	-

Note: (^{a}), (^{b}) and (^{c}) represent significance at 1%, 5% and 10% level, respectively. To reduce possible effects of heteroscedasticity on inference we are employing the *White-Hinkley* method: heteroscedasticity-consistent standard error (HCSE) estimator of OLS parameter estimates, Hinkley (1977) [57] and White (1980) [58].

The existence of co-integration association among the variables brings us back to estimate long-run and dynamic short-run relationships between the variables. Table 8 reports the long-run coefficients from the ARDL estimates model.

3.2.5 Discussion on long run

The empirical findings in Table 8 indicate that foreign direct investment does not significantly linked with economic growth in Tunisia over the period 1976-2017. Several studies in the literature have shown a non-significant effect of FDI on economic growth [59]. This was perhaps because the model omitted other important variables that enhance the relationship between FDI and economic growth. A growing body of literature has shown that developing countries (host countries) would benefit from FDI only if these countries guarantee certain favorable conditions for the entry of FDI. Two main conditions has been discussed in the literature, namely, a sufficient level of education [60] and quality of infrastructures [61] which affect the speed of adoption of new technology and experience of productivity gains. Since 2011, Tunisia experienced a period of crisis (political instability, terrorist threats and lack of confidence) because of the revolution which directly affects the entry of FDI. According to the Tunisian *Agency for the Promotion of Foreign* Investment (FIPA-Tunisia), Tunisia recorded a 28.8% drop in FDI in the first quarter of 2011 and a 31% drop in 2014 compared to 2010.

Further, several studies in the literature shows that remittance inflows, especially in foreign currencies, have positive effects on the economic growth of the recipient country by stimulating the investment activities such as Fayissa and Nsiah (2008) [62] for the case of African countries, Vargas *et al.* (2009) for Asian Countries and Mundaca (2009) [63] for Latin America and the Caribbean region. In recent works, Jouini (2015) [9] and Kouni (2016) [65] have found a significant long run relationship between remittances and economic growth in Tunisia through boosting investment. In contrast to these two works, the long run findings from Table 8 revealed a significant inverse economic relationship between remittances and economic growth in Tunisia. The estimated coefficient of –0.297 indicated that workers' remittances negatively influence the GDP per capita growth in Tunisia. There is numerous explanation, technic and real, for this phenomenon. In technical term, we used a relatively large period and we took into account the existence of structural change in the regression. In real terms, we can explain this negative effect of remittances on growth in two ways. Firstly, Tunisian workers living abroad send their money to supports their families so for consumption and not for possible investment opportunities. Secondly, the Tunisian financial system is not sufficiently developed to play its real role by transferring funds to investment to provide more employment which boost therefore the economic growth.

Additionally, the attained results exhibited a robust support for a negative economic association between the economic growth and imports in Tunisia. The calculated long-run coefficient of 0.657 indicated that foreign imports from abroad have a negative impact on economic growth. This result shows that Tunisian imports more consumption goods and not capital and technology goods. In theory and according to international trade economists, the importation is essential for economies that are in their first stages of development by transferring foreign new technology and innovations [66–68]. Indeed, if a country imports capital, intermediate, and technology goods (*i.e.* machines and equipment investment), then it is expected that imports would increase economic growth [69].

Finally, the analyses provide a positive long run relationship between exports and economic growth. In the long run, one percent increase in exportation leads to 0.702 percent increase in per capita real GDP of Tunisia. Studies such as Jawaid (2014) [23] suggested that exports have a positive influence on economic growth.

Regardless of the Tunisian government efforts to diversify their external markets and put an end to the European Union (EU) domination over trade activities since the Association Agreement between the EU and Tunisia which entered into force in 1998, the EU remains the first destination for Tunisian exports especially for sales of industrial products. Recent statistics, according to the Tunisian Central Bank and the National Institute of Statistics, indicates that Arab Maghreb Union accounted for 9.5 percent of Tunisian exports in 2017 against 8.0 percent in 2008, up 18.75 percent and EU accounted for 74.3 percent of Tunisian exports in 2017 against 72.0 percent in 2008, up 3.19 percent. Recent years has shown the continued performance of exports in the manufacturing sectors following the acceleration in sales of the textile, clothing and leather sector (up 16.3% in 2017), the mechanical industry and electrical energy (up 20.4% in 2017) and other manufacturing industries (up 15.1% in 2017) as a result of improved foreign demand from the European and Asian countries.

The diversity of exports destination increased the inflow of foreign currency, which increased current receipts and therefore the economic activity. According to the Central Bank, the exports in value has risen from 12054.9 MTD in 2004 to 27607.2 MTD in 2015, and foreign exchange has increased from 4760.3 MTD in 2004 to 14250.3 MTD in 2015.

3.2.6 Discussion on short run

We obtain the short run dynamic relationship by estimating the conditional ECM Equation (7). From results Table 9 we obtain a statistically significant coefficient for the dummy of 1988. This structural change date is substantially related to the political and economic regime change. In this year, Tunisia solicited an extended credit facility mechanism from the IMF and the World Bank for which the removal and repayment of the installments. The main conditions imposed by the IMF's 1986 Stand-By Arrangement and subsequently by the 1988 Expanded Credit Facility Agreement are representative of the IMF's Structural Adjustment Program (SAP). Namely, the liberalization of foreign trade, investment, financial sector, prices and withdrawal of the role of the State to give way to the private sector. In Panel (A) the results reported in Table 9 indicates that the impact of remittances and imports on economic growth is negative and statistically significant at the 5% and 10% levels, respectively. However, the exports have a positive and statistically significant impact on economic growth at the 1% level. Further, we also point out that there is no short run direct effect of FDI on economic growth. The findings indicate that Error Correction Term coefficient (ECT_{t-1}= –0.661) takes a negative sign and statistically significant at 1% level. This estimated coefficient implies a relatively fast speed (0.661) correction towards the long run equilibrium path yearly. In fact, 66.1% of last year's imbalances of GDP is corrected in the current year, implying that speed of adjustment is relatively fast.

3.2.7 Diagnostics tests

To ensure the goodness of fit of model, the diagnostic and stability tests are also showed. According the Panel (B) in Table 9 which presents the diagnostics and stability tests performed in Tunisia's growth model. The result of Breuch-Godfrey serial correlation LM test (4.453) and the ARCH test for heteroscedasticity (0.381) suggests that residuals are free from serial correlation and heteroscedastity at 5% level, respectively. The Jarque-Bera test of residual normality corroborates the no reject of the null hypothesis that residuals are normally distributed at 5% level of significance. Further, the calculated Fisher statistic of RAMSEY-RESET test confirms a well specification of the ECM model. Additionally, the cumulative sum of residuals (CUSUM) and cumulative sum of square (CUSUMSQ) test are used for testing the stability of the short run model. The graphs of the CUSUM (Figure 2) and CUSUMSQ (Figure 3) statistics show that the line is well within the critical bounds of 5%, suggesting that, all coefficients in the ECM model are stable to any minor innovative shock over the sample period 1976–2017.

Table 9 Econometric results for the short-run error correction model

Variables	Model_88 and 99	
Optimal lag	ARDL (2, 0, 4, 4, 4)	
	Coefficient	t-statistic
Panel (A)		
$\Delta LGDPC_{t-1}$	-0.2199	-1.4833
$\Delta LREM$	-0.1391[a]	-3.3662
$\Delta LREM_{t-1}$	-0.0519	-1.6351
$\Delta LREM_{t-2}$	0.0276	0.8918
$\Delta LREM_{t-3}$	0.1138[a]	3.1932
$\Delta LEXP$	0.2669[a]	4.1166
$\Delta LEXP_{t-1}$	-0.2893[a]	-3.9002
$\Delta LEXP_{t-2}$	-0.1381[c]	-1.9370
$\Delta LEXP_{t-3}$	-0.1740[b]	-2.6278
$\Delta LIMP$	-0.1102[c]	-1.8880
$\Delta LIMP_{t-1}$	0.3910[a]	4.6398
$\Delta LIMP_{t-2}$	0.3529[a]	4.2327
$\Delta LIMP_{t-3}$	0.3248[a]	4.6499
Intercept	5.1431[a]	6.4255
Trend	0.0206[a]	6.0662
DUM_88	-0.1606[a]	-5.2830
DUM_99	-0.0151	-1.0009
ECT_{t-1}	-0.6610[a]	-6.4115
Panel (B)		
$\bar{R}^2$	0.687	
χ^2_{Auto} (2)	4.4538(0.1079)	
χ^2_{Norm} (2)	1.5246(0.4665)	
$\chi^2_{ARCH}(1)$	0.3816 (0.5367)	
$F_{RESET}(1, 15)$	1.1965(0.2913)	
CUSUM	Stable	
CUSUMQ	Stable	

Note: ([a]), ([b]) and ([c]) represent significance at 1%, 5% and 10% level, respectively. $\chi^2_{Auto}(2)$is the *Breuch-Godfrey* serial correlation LM test; $\chi^2_{Norm}(2)$ is the *Jarque-Bera* normality test; $\chi^2_{ARCH}(1)$ is the *ARCH* test for heteroscedasticity and $F_{RESET}(1, 15)$ is the *RAMSEY-RESET* test for functional specification. Critical value for $\chi^2_{1-\alpha}(2)$and are 5.99 and 3.84, respectively, with$\alpha = 5\%$. Value in parenthesis are p-values.

Summing up, these tests validated that the calculated ECM equation did not have serious estimation issues.

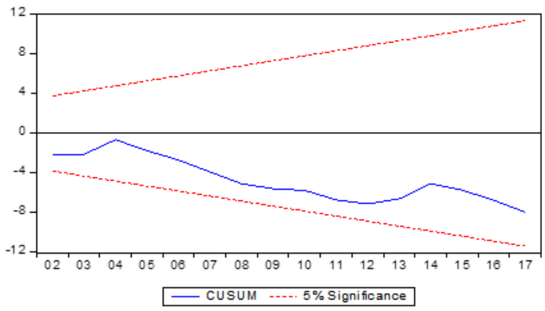


Figure 2 Plot of cumulative sum of recursive residuals

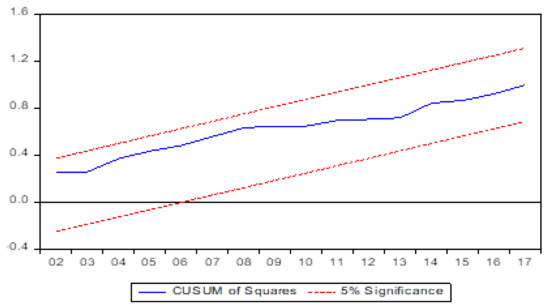


Figure 3 Plot of cumulative sum of squares of recursive residuals

4 Conclusion and recommendations

The main purpose of this work is to analyze how external factors effect economic growth in Tunisia during the period 1976-2017. The regression results express a negative relationship between remittances, imports and economic growth but no link between Foreign Direct Investment and economic activity both in the short and long run. The negative result shows that a large part of imports are in consumer goods and no longer in capital and that the majority of remittances are used for non-productive purposes. In Tunisia, remittances are used for non-productive purposes and do not generate profits. In this context, the emphasis is placed on some negative effects of migration such that the brain drain depresses the average level of education and skills of workers in the countries of origin of immigrants. Thus, the moral hazard problem is one of the factors explaining the negative effect of remittances on economic growth such that the sending of funds reduces the motivation to look for work among the members of the beneficiary families, which reduces the economic activity. Thus, Foreign Direct Investments do not allow more economic growth in a significant way perhaps because they require an infrastructure and a level of financial development allowing benefiting from technological transfers. Either way, the inflow of foreign capital appreciates the real exchange rate and lowers countries' trade competitiveness. Then, to deal with the negative effects of remittances, policy makers must convince both senders and recipients to invest in creative wealth projects. Therefore, the state must increase trade competitiveness to reduce the negative effect of the inflow of funds following the exchange appreciation and the decline in production by beneficiary families. In order to remedy the situation, the Tunisian government must firstly make greater efforts to attract FDI through incentives such as rebuilding new confidence and dynamic climate of investment through political stability, legislative measures to ensure the security of foreign investors, and founding an appropriate physical and financial infrastructure. Secondly, Tunisia needs more financial development and export diversification.

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