doi:10.22306/al.v9i4.336 Received: 05 Aug. 2022; Revised: 17 Nov. 2022; Accepted: 30 Nov. 2022

ANALYSIS OF THE IMPACT OF TRADE OPENNESS ON ECONOMIC GROWTH: THE CASE OF MOROCCO

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Keywords: trade openness, economic growth, Morocco, ARDL model, causality.
Abstract: The relationship between openness to international trade and economic growth has been a subject of perennial controversy. This has paved the way for various theoretical and empirical investigations which has yielded inconclusive results, particularly in the case of developing countries. As a good case in point, the Moroccan economy has been subjected to a thorough analysis in order to determine and evaluate the impact of trade openness on economic growth covering the period from 1980 to 2019. To this end, the methodology adopted consists of a complementary approach of statistical and econometric tests using the ARDL bounds test of cointegration and the Toda-Yamamoto causality test. The results have shown that Morocco's openness to international trade positively impacts economic growth in the short term. Yet, it produces adverse effects in the long term, especially with the presence of bidirectional causal relationship between the two variables– i.e economic growth and international trade.

1 Introduction

The impact of trade openness on economic growth is a long-standing controversial issue that has laid the foundations for subsequent and recurrent theoretical and empirical studies. Such studies have tried to explain the divergent consequences of this relationship across a number of countries.

Theoretically, it has been argued that in the long run trade openness potentially promotes economic growth through multiple transmission channels, such as access to technology and knowledge, international financial integration, effective and efficient allocation of resources, access to diversified markets, improvement in domestic factor productivity, attractiveness of foreign capital, and finally international cooperation [1,2].

These theoretical underpinnings have motivated almost all developing countries to both take a range of measures to facilitate global trade and reform their foreign trade policies so as to promote trade openness. The international institutions regulating the global liberal system have also fueled the demand to reform external strategies, especially those of developing countries. Furthermore, the failure of self-centered and inward-looking development strategies has paved the way for promoting this liberal choice extensively [3,4].

Despite the theoretical and empirical developments framing this issue, there is still a lack of consensus on the possible effects of trade openness on economic growth. Variables such as the diversity of countries economic structures and trade policies and the abundance of study techniques, analytical settings, sampling periods and cases selected weigh heavily on the effects of the relationship established between openness to international trade and countries' economic growth.

Morocco has adopted a policy of economic liberalization for several decades, focusing its strategic development on exports and attractiveness of international investment as a long-term development choice. As a result, the reduction of tariff and nontariff barriers, the development of logistics, the simplification of border control procedures and the adoption of an arsenal of multidimensional reforms have contributed to both increase in trade volumes and the restructuring of its foreign trade composition.

Indeed, the Moroccan economy has made significant progress in terms of economic growth and openness to the global market over the last decades. It averaged a growth rate of 7.6% in the period between 1980 and 2019 and a trade openness representing nearly 87% of GDP in 2019. This mixed performance is attributable to the country's commitment to a varied series of reforms and structural measures.

However, this relative performance does not only lay bare the structural deficits that restrain the economic transformation, but it also reveals the complications facing the Moroccan economy in the management of its openness process. Despite the gradual diversification impacting the manufacturing sectors, the national productive sectors suffer from deindustrialization in some specific sectors due to low labor productivity and the absence of high-tech, high-value-added industrial and technological transformation activities [5].

The purpose of this article is to analyze in a multivariate framework the relationship developed between openness to international trade and economic growth in Morocco between 1980 and 2019. The study is conducted to answer the main question raised in this analysis: Does openness to international trade contribute to the promotion of economic growth in Morocco? Within this framework, the hypothesis to be tested is the following: foreign trade does or does not promote economic growth in the Moroccan economy.

Our study attempts to address this problematic by using the ARDL model of Pesaran [6] and the causality test of Toda-Yamamoto [7]. These two analytical tools will help us explain the evolution of the relationship between trade openness and economic growth in the short and long term and identify the causal inferences made among the variables of our hypothetical model.

The remainder of the paper will unfold as follows. The second section contains the theoretical development framing the relationship between trade openness and economic growth. The third section discusses the development of the hypothetical model, the variables adopted and the statistical data. The fourth section presents the econometric methodology, the main empirical results and a discussion of the main findings of the study.

2 Literature review

The role of international trade in promoting economic growth has been widely debated and much has been written in an attempt to confirm or refute the trade-led-growth hypothesis. Within this framework of analysis, the classical theory of international trade, driven by the principle of mutual prosperity between nations, stipulates that the specialization of countries combines the position they have acquired on the international market [8]. Indeed, this specialization, with the factor endowments that it reveals, will tend to stimulate scale production and trade exchange in the sectors with the most abundant factor.

As a result, the accumulation of physical capital generated by the increase in volumes traded on foreign markets implies an increase in national income and, consequently, high overall economic growth [9]. The theory of comparative advantage has been widely developed to combine the vulgate of the neoclassical liberal theory. The neoclassical approach asserts that openness to international trade provides relative compensation for the unequal geographical distribution of productive wealth in the world and thus replaces the exchange of factors of production among economies [10].

In this perspective, the new theories of endogenous growth reconsider international trade in economic development policies as a key factor and a strategic stimulus to the performance and promotion of economic growth. The development of human capital and the acquisition of new technologies, and new production techniques are now the major determining factors for stimulating this relationship developed between openness to international trade and the economic growth of countries [11,12].

Openness to foreign trade allows the least developed economies to benefit from an advanced level of technology and innovation produced by the developed countries in the international market. This kind of distribution on a global scale encourages developing countries, especially small ones, to imitate and produce products with low and medium technological content through the learning and experience effects accumulated by the human capital of those countries [13].

Theoretical analysis has been put forward to include global trade policy from strategic perspective by developing competitive advantages and enhancing the competitiveness of countries at the international level by the adoption of an interactive arsenal of public policies and actions in line with the free trade principles [14,15]. In addition, the management of the reforms undertaken by countries must be able to assist and complement their strategies of trade openness in order to achieve a high level of performance on the international scale.

In the global competitive market, the performance of international trade is intrinsically linked to the innovation and the performance achieved in the logistics at the macro and microeconomic level.

In the long term, trade openness, involving an active transfer of technology and knowledge, the transformation of productive structures, the qualification of human capital and the improvement of efficiency in the allocation of resources and thus increase economic growth, leads to a gradual and progressive convergence between economies [16,17].

The growing impact of foreign trade on the internal progress of countries and the emergence of MNC's as new active operators in the global economic architecture have played a key role in the flow of capital and technological externalities. This has prompted almost all countries to abolish barriers and open their borders to the free circulation of goods and services [18,19]. All these arguments encourage countries to integrate into the global economic sphere through a high degree of trade openness despite the existence of an alternative approach suggesting that trade openness inhibits economic growth and introduces adverse effects, particularly when the country specializes in low-value-added activities and its initial conditions and parallel reforms do not favor the adaptation and absorption of the external shocks initiated by excessive openness to foreign trade [20,21].

Empirically, the analyses of the impact of trade openness on economic growth are often contradictory. A number of studies point to the existence of positive effects of trade openness on economic growth [22,23]. However, other studies contradict the presence of a positive link in this relationship and confirm the existence of negative or the absence of impacts [24].

Moreover, empirical studies, which are scarce on the case of the Moroccan economy, have attempted to analyze the impact of foreign trade on economic growth with the objective of producing policy recommendations for the Moroccan authorities. By conducting a study on the productivity of Moroccan firms, Haddad [25] confirms the existence of a strong positive relationship between the productivity of national firms and the share of exports they make, particularly those of the industrial sector. This indication is in accordance with the results of the study of El Alaoui [26] which also supports the presence of a positive long-term relationship between trade openness and economic growth. While the study of Currie and Harrison [27] demonstrates that trade openness has penalized the strategic sectors of the Moroccan economy through various reduction effects on employment, wages, prices and profits. Similarly, Bouoiyour [28] indicates in his study that there is a weak relationship between foreign trade and economic growth.

3 Methodology

Our hypothetical perspective is based on the model of Mankiw et *al*., [29] which is founded on the original basic formulation developed by Solow [30]. To this can be added the contributions of [11,12] Lucas and Romer developed within the framework of a theoretical construction analyzing economic growth from an endogenous perspective.

The model tests the hypothesis of whether trade openness does or does not promote economic growth in the case of the Moroccan economy. In this framework, the ultimate objective is to explain the variations of the economic growth observed during the period of analysis dealt with in our study by the evolution of the variables including the foreign trade variable.

In view of the above, the formulation of a function of economic growth, inspired by the theoretical reflection developed on this subject, has led to formulating the following dynamic growth function (1):

$$\boldsymbol{Y_t} = \boldsymbol{A_t}\, \boldsymbol{K_t^{\alpha}}\, \boldsymbol{KH_t^{1-\alpha}} \qquad (1)$$

$\boldsymbol{t} = 1, \dots \dots \dots,$
$0 < \boldsymbol{\alpha} < 1$

The theoretically relevant variables induced in this formulation are based on the extended Cobb-Douglas production function, which must be augmented in the context of the design considered above. These variables are respectively the combination of physical capital stock **(K)**, human capital **(KH)** and technological progress **(A)**. the signs **(α)** denote the remuneration of the factors of production inserted in the equation and **(t)** indicates the time range.

Economic growth **(Yt)** is analyzed by the GDP per capita indicator as a key variable that generally tends to explain the evolution of the growth of countries and the standards of living of its population [11,12,29].

The stock of physical capital **(Kt)** is taken in an accumulated form, retained by the measure of gross fixed capital formation calculated by the competent authorities on the basis of annually established data. This stock is generated by the intermittent (perpetual) inventory method, which consists of reconstructing the series of physical capital stock by accumulation starting from the level of initial capital [31]. The initial capital is deduced by calculating the average rate of investment extended over the previous period from 1965 to 1980.

This first formula: $\boldsymbol{K_0} = \boldsymbol{FBCF_0}/(\boldsymbol{\rho} + \boldsymbol{\delta})$ estimates the approximate value of the country's initial capital **(K_0)**, inserting a constant annual depreciation rate of **δ = 0.05 (5%)** (this rate was adopted in the HCP report in [32]). The estimation of this depreciation rate is based on several indicators, including mainly the nature of the physical capital accumulated, the production process and the technology used [33].

In contrast, the second formula estimates, in addition to the formula mentioned above (2), the accumulation of data for the construction of the physical capital stock series.

$$\boldsymbol{K_t} = \boldsymbol{FBCF_t} + (1 - \boldsymbol{\delta})\boldsymbol{K_{t-1}} \qquad (2)$$

The stock of physical capital variable **(Kt)** includes the stock of equipment, basic infrastructure and structures of the economy intended for national production. For our purposes, it includes the panoply of structural and complementary reforms adjusted during the liberalization period to stimulate economic growth and enhance the trade performance of the Moroccan economy in the global market [34,35].

While investment in human capital requires a complex combination of income, education, health, and a multitude of interactive elements, especially at the social level [36], our empirical analysis emphasizes the interpretation of this variable from the perspective of the level of (secondary) education of the labor force, taken as a proxy for the human capital variable **(KHt)**, to refer to the relatively and moderately skilled labor force [37,38].

Regarding the technology variable **(At)**, this variable is manipulated as a mechanism for transferring innovation, knowledge and know-how from developed countries, which are the main producers of technology to less developed countries and thus, to our study context Morocco as a developing economy [16,39,40].

In developed economies, technology is driven by a high level of investment made by rational profit maximizing agents mostly in the private sector, creating a competitive environment of picking winners and thereby stimulating technological progress [41]. However, the process of stimulating technological advancement is usually initiated by public authorities as a part of complementary strategies, such as establishing a research and development platform and providing the necessary equipment and infrastructure for creative ideas and technological innovation [18,42].

Morocco's foreign trade structure reflects the country's technological level; the country exports a relatively small proportion of technology-intensive products compared to its considerable imports in this category of products (machinery and equipment).

However, human capital is crucial to activating these transmission channels in developing countries such as

Morocco. The human capital must develop its capacity to absorb technological progresses and the ability to adapt constantly to changes and advances made in scientific knowledge and innovation worldwide [43,44].

This provides an explanation for the developments in contemporary theories of endogenous growth that attribute a determining role to trade openness in the dynamism of economic growth [13,45]. We suggest in this framework that externalities and technological spillovers are transmitted by openness to international trade as well as by the entry of foreign direct investment to Morocco.

$$\boldsymbol{A_t = \beta TO_t^{\sigma}\, FDI_t^{\rho}\, X_t^{\omega}} \qquad (3)$$

Most empirical studies structuring theoretical thinking and analyzing the impacts of foreign trade on economic growth focus the measurement of trade openness on exports, neglecting the considerable role of imports, especially for the least advanced economies [46,47]. While the theory of comparative advantage asserts that an efficient allocation of resources is possible by importing goods that are more expensive to produce and producing the factor-intensive goods that are vastly abundant in the country [48].

Morocco has a structural trade deficit that favors imports (equipment, machinery, inputs, finished products, semi-finished products and raw materials) for the dynamism of its domestic economy. Trade openness **(TO)** is calculated as a ratio of exports and imports divided by GDP. This index refers to the trade intensity in the creation of added value. The foreign direct investment **(FDI)** indicator is calculated by the net inflow of FDI to the Moroccan territory. This flow provides an active transfer of imported technology and know-how in the form of machinery, equipment, organizational model and various knowledge [49, 50]. The constant in equation **(2)** is identified by **(β)**.

Based on the previous equations **(1)** and **(3)**, the canonical model adapted is formulated in the following equation **(4)**.

$$\boldsymbol{Y_t = \beta TO_t^{\sigma}\, FDI_t^{\rho}\, K_t^{\alpha}\, KH_t^{1-\alpha}\, X_t} \qquad (4)$$

The variable **(X)** is a constant that frames other variables affecting the evolution of the relationship under study and the overall efficiency of the economy, including governance, the quality of institutions, the climate and geographic location of the country and many others. These factors, different from a country to another, are considered a country-specific shock and therefore imply a divergence in growth, living standards and initial conditions for trade openness across countries.

The function is a simple mapping from inputs to outputs of production [51]. This functional form consists of examining the different mechanisms that influence the relationship between economic growth and openness to international trade by specifying the transmission channels that regulate this relationship [52]. A linearization of the adopted model becomes necessary at this stage of analysis by log-linearizing the entire equation (dependent and independent variables) in order to allow a correct estimation of the specified parameters (5).

$$\boldsymbol{\mathrm{Ln}Y_t = \alpha_0 + \alpha_1\, lnK_t + \alpha_2\, lnKH_t + \alpha_3 lnTO_t + \alpha_4 lnFDI_t + \mu_t} \qquad (5)$$

The error term is represented by $(\boldsymbol{\mu_t})$ and the constant is symbolized by this sign $(\boldsymbol{\alpha_0})$. On the other hand, the parameters to be estimated are the signs of **α0**, **α1**, **α2**, **α3**, **α4** and assumed to be positive.

4 Results and discussion

In order to study the impact of openness to international trade on economic growth in Morocco, our econometric methodology is divided into three main steps that are progressive and complementary. The ultimate objective is to verify the existence of a causal relationship between trade openness and economic growth in Morocco as well as to test the robustness of the hypothetical model to empirical examination. Therefore, the study relies on time series data that spans over a 40-year period from 1980 to 2019.

Our econometric approach is based on a complementary process of statistical tests. First, the stationarity test of the time series is used to detect the order of integration of the variables by unit root tests. The next step is to examine the presence of cointegration and short to long term relationships between the variables by the ARDL model. Finally, the Toda-Yamamoto causality test is adopted to verify the existence of causal relationships, particularly between economic growth and openness to international trade.

Table 1 Descriptive statistics

	LnY	**LnK**	**LnKH**	**LnFDI**	**LnTO**
Mean	7.654962	8.689475	2.361596	2.160755	-0.423228
Median	7.586447	8.616020	2.343214	2.153621	-0.450791
Maximum	8.130371	9.475094	3.242592	2.248667	-0.093651
Minimum	7.166648	7.975233	1.845300	2.076341	-0.702220
Std. Dev.	0.298542	0.459705	0.342340	0.052694	0.167706
Skewness	0.116442	0.222040	0.634930	0.165137	0.304441
Kurtosis	1.761417	1.771748	2.856217	1.761629	1.853991

Jarque-Bera	2.647207	2.843019	2.722032	2.737737	2.806790
Probability	0.266174	0.241349	0.256400	0.254395	0.245761
Sum	306.1985	347.5790	94.46385	86.43022	-16.92911
Sum Sq. Dev.	3.475963	8.241816	4.570664	0.108290	1.096890
Observations	40	40	40	40	40

The descriptive statistics table above (Table 1) displays a set of specifications that characterize and describe the trends of data and provides insight into the size, variation, central tendency, mode of dispersion and normality of the variables over the period of the study [53].

The univariate observation and the analysis of the data show that the logs of the two main variables, trade openness and economic growth, reached the highest level in 2019 with 8.130371 and -0.093651, respectively against an average that reaches 7.654962 and -0.423228 successively for the same variables.

Pursuing the analysis by the correlation matrix developed in the following (Table 2), which illustrates the apparent nature of the relationship developed between the variables and determines the linearity of this probable links. Hence, a positive relationship is observed between trade openness and economic growth by a value higher than 90% as well as between the majority of variables that drive economic growth as presented in the Table 2. On the contrary, a positive correlation does not imply a significant causality.

Table 2 Correlation matrix

	LnY	LnK	LnKH	LnFDI	LnTO
LnY	1.000000				
LnK	0.995459	1.000000			
LnKH	0.958096	0.969898	1.000000		
LnFDI	0.995974	0.999753	0.967738	1.000000	
LnTO	0.910108	0.928102	0.896530	0.925562	1.000000

At this level, stationarity tests are applied to determine the order of integration of the variables in our model. The ultimate objective is to identify the econometric method adapted for this study. The data in the series must not contain trend, seasonality or cycle, which by their presence and ignorance will be capable of biasing the results of the study and making them fallacious [54]. These characteristics, affirming the stationarity of time series, are generally invalid in the majority of cases manifesting macroeconomic and financial phenomena; those are dominated by stochastic trends, as demonstrated in the studies conducted by [55,56] Nelson and Plosser and Campbell and Perron.

In order to have a real analysis of the relationship established between the variables, it is necessary to eliminate the effects or shocks often manifested by crises, economic policies and structural reforms, political or institutional changes that lead to non-stationarity of the data [57,58]. To this end, the stationarity test used is the Kwiatkowski, Phillips, Schmidt and Shin (KPSS/[59]), test since it is more robust for small data and observations like in this case study. This test is applied to validate the null hypothesis of stationarity (H0 = stationary series) of the time series.

Table 3 Results of unit root test of (KPSS)

Variables	**KPSS**				**integration order**
	Level		**First difference**		**KPSS**
	C	**T&C**	**C**	**T&C**	
LnY	1.312795**	0.112582**	0.096760**	0.080476**	**I(1)**
LnK	2.392508**	0.456402**	0.188889**	0.091309**	**I(1)**
LnKH	0.401873**	0.173038**	0.455472**	0.189708*	**I(1)**
LnTO	0.506674*	0.131233**	-	-	**I(0)**
LnFDI	4.743531**	0.423788**	0.124602**	0.091875**	**I(1)**

Note: The tests were conducted with individual constant and trend and constant equations and the lag intercepts for each variable were automatically selected by default by the software (Default Barlett Kernel/ Andrews Bandwidth).
Significance level is represented by **critical value at 5%, *critical value at 1%. These critical values are calculated by Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1).

The table 3 displays the results calculated for each data series and asserts the assumption of the stationarity of the time series at first order **I(1)** for all the variables and at level **I(0)** for the trade openness variable in the different stationarity equations (constant, trend & constant) adopted according to the advancement of the stationarity tests. In other words, the results indicate that most of the series are derived from a non-stationary process in level, except for the variable **(LnTO)**. For this purpose and for the non-stationary variables, new series are formed with values that indicate the difference between the observation of the time being and before.

The next step consists on analyzing the cointegration relationship established in the long term between variables. In this framework, the technique of cointegration developed by Pesaran et *al.*, [6], through the specification of the ARDL bounds test, is used to determine the presence of vectors and equilibrium relationship between the series in the long term.

This test requires either level **I(0)** or first order **I(1)** stationarity or a combination of both and it's conducted to examine the movement on a long-run equilibrium path of the dependent variable alongside with the set of explanatory variables designated as regressors in this model.

The relevance of this cointegration technique compared to other conventional and traditional methods, such as those of Granger and Engel, 1987, Johansen and Juselius, 1991, lies in its high capacity to deal with multivariate cases and at various degrees of integration. Besides, this test has relatively more efficient statistical properties that fit with the characteristics of small sample sizes [60].

Considering the results in the table 4 and with the determination of the GDP variable as the dependent variable (first equation), the hypothesis of no cointegration ($H0: \alpha1 = \alpha2 = \alpha3 = \alpha4 = \alpha5 = 0$) was rejected in order to accept the hypothesis of existence of cointegration ($H1: \alpha1 \neq \alpha2 \neq \alpha3 \neq \alpha4 \neq \alpha5 \neq 0$) in the long run between all the variables, in particular between the dependent variable and the set of independent variables over the determined period for the case of the Moroccan economy. Thus, the presence of a strong cointegration reveals that any state of imbalance between the variables is only a short-term phenomenon.

For the rest of the equations and adopting each variable individually as dependent variable, the result also confirms the existence of long-run cointegration relationships between all the variables, which are in this case, GDP per capita growth, physical capital, human capital, foreign direct investment and openness to international trade.

Table 4 Results of the ARDL cointegration test

Estimated Models	Optimal lag length	F-statistics	Diagnostic tests		
			Serial correlation	Normality	Heteroscedasticity
Y = f(K, KH, FDI, TO)	ARDL (5, 2, 0, 0, 1)	4.236924	0.2689	0,030214*	0.0591
TO = f(Y, K, KH, FDI)	ARDL (1, 1, 4, 3, 4)	8.112997	0.3461	0,767647	0.8272
K = f(Y, KH, FDI, TO)	ARDL (5, 3, 4, 4, 3)	10.66637	0.6408	0,098088	0.9047
KH = f(Y, K, FDI, TO)	ARDL (1,0, 4, 4, 1)	4.301396	0.0667	0,520628	0.2767
FDI =f(Y, K, KH, TO)	ARDL (5, 3, 4, 4, 3)	10.52026	0.6290	0,134895	0.9494
Level	**Critical values (T=35)**				
	Lower bounds I(0)		**Upper bounds I(1)**		
10%	2.696		3.898		
5%	3.276		4.63		
1%	4.59		6.368		

Note: The optimal lag number for each variable is selected automatically by the Akaike Info Criterion (AIC) with a maximum lag estimate of 5.
Values are generated with the unrestricted constant model and no trend.
The signs *, **, *** represent the significance of the values at the 1%, 5% and 10% levels respectively.
Probabilities of diagnostic tests are significant at 5% and *1%.
The test for normal distribution of series and residuals is advanced by the Jarque-Bera statistical test. The problem of autocorrelation of series is tested by the Breusch-Godfrey test. The test of heteroscedasticity is checked by the Breusch-Pagan-Godfrey statistical test to determine the variance of the error term.

In this framework, the table 4 presenting the results exposes the F-statistic that indicates a significance with respect to the upper bounds generated in the same table at significance levels of 5% and 10% for all equations. Thus, the results of the cointegration at the bounds reveal the presence of a strong cointegration in the long run between all the variables.

For data samples with a limited number of observations (in our case 40 observations in each series), which varies between T = 30 and T = 80, the upper and lower bounds determined in the table 4 are defined by Narayan, [61] instead of those of Pesaran et *al.*, [6], rather adapted to large samples size (T = 500 to T = 40.000).

Moreover, given the limited data of our time series, the ARDL model is sensitive to the structure of the estimated lag numbers. As explained by Lütkepohl, [62] the dynamic links developed between the time series are detected by this optimal lag number because an appropriate lag in the model used removes the endogeneity and correlation problem between the residual series. Therefore, the optimal lag numbers for each equation are shown in the second column of Table 4 with a maximum lag length of 5 for the dependent variable and 4 for the independent variables. These lags are distributed automatically for each variable by the Akaike Info Criterion (AIC) selection criterion.

To test the robustness of the results, it is important to designate a number of diagnostic tests such as the normality test, the heteroscedasticity test, the error autocorrelation test as well as the stability test of the model (CUSUM) in order to consolidate the results estimated by the ARDL model. All of these tests are significant at the 5% level and confirm the existence of appropriate econometric properties for the tests and, consequently, do not violate the validation assumptions of the selected econometric model.

The cointegration of all variables in the long-term and their stationarity at different levels I (0) and I (1), requires the use of the ARDL model to identify the nature and significance of the short- and long-term relationships between the variables. The ARDL model, which is a dynamic model, will be used to justify the evolution of the dependent variable by both its past variations with respect to the short- and long-term equilibrium and the lagged and current values of all the other variables as explanatory variables since this model is a combination of endogenous and exogenous variables.

This model supports the specification of the short-term results by an error correction model (*ECM*) in order to produce relatively correct estimations in the long run. The empirical formulation of the ARDL test for the dependent variable LnY (6), which is GDP per capita growth, is presented below:

$$\boldsymbol{\Delta LnY_t} = \alpha_0 + \alpha_1 LnY_{t-1} + \alpha_2 LnK_{t-1} + \alpha_3 LnKH_{t-1} + \alpha_4 LnFDI_{t-1} + \alpha_5 LnTO_{t-1} + \sum_{i=1}^{m} \theta_{1i}\,\Delta LnY_{t-i} + \sum_{i=0}^{n} \theta_{2i}\,\Delta LnK_{t-i} + \sum_{i=0}^{p} \theta_{3i}\,\Delta LnKH_{t-i} + \sum_{i=0}^{q} \theta_{4i}\,\Delta LnFDI_{t-i} + \sum_{i=0}^{k} \theta_{5i}\,\Delta LnTO_{t-i} + \mu_t \tag{6}$$

All variables are defined previously. Δ is the difference operator, **(*m, n, p, q, k*)** are the estimated lag or offset number for each variable and μ represents the error term. This equation is subdivided into two major parts: the first specifies the long-term relationship between the variables profiled by the variables in level, and the second frames the importance of the short-term relationships simulated by the variables in first difference. In this regard and to detect the existence of short-term relationships, the equation is displayed as follows (7):

$$\boldsymbol{\Delta LnY_t} = \theta_0 + \sum_{i=1}^{m} \theta_{1i}\,\Delta LnY_{t-i} + \sum_{i=0}^{n} \theta_{2i}\,\Delta LnK_{t-i} + \sum_{i=0}^{p} \theta_{3i}\,\Delta LnKH_{t-i} + \sum_{i=0}^{q} \theta_{4i}\,\Delta LnFDI_{t-i} + \sum_{i=0}^{k} \theta_{5i}\,\Delta LnTO_{t-i} + \beta ECT_{-1} + \mu_t \tag{7}$$

The cointegration equation, referred to as ECT (Error Correction Term), reflects the coefficient of adjustment and Cointegration between the variables in the long term while marking the short-term dynamics [63]. This cointegration coefficient is calculated by the following formula (8):

$$\boldsymbol{ECT_{-1}} = LnY_{t-1} - \hat{\alpha}_0 + \hat{\alpha}_1 LnY_{t-1} + \hat{\alpha}_2 LnK_{t-1} + \hat{\alpha}_3 LnKH_{t-1} + \hat{\alpha}_4 LnFDI_{t-1} + \hat{\alpha}_5 LnTO_{t-1} + \hat{\mu}_t \tag{8}$$

Table 5 Short run estimates of the relationships between the explanatory variables and the dependent variable (GDP)

Explicative Variables (regressors)	Dependent Variable ΔLn(Y)		
	Coefficient	t-statistic	Probability
ΔLnK	-	3.349153	0.0396*
ΔLnKH	0.118839	1.230321	0.2329
ΔLnFDI	35.90226	1.249125	0.2260
ΔLnTO	-	6.384810	0.0072*
Constant	-0.018934	-0.958181	0.3494
ECT (-1)	-0.830843	-3.127157	0.0053*

The two missing coefficients on the table represent variables with estimated lags in the equation, their joint significance is tested with the Wald test.
*Significance at 5%.

The results of the short-run dynamics between the variables are presented in the table 5. The coefficient of the error correction term lagged by 1 is statistically significant, its negative sign indicates the presence of a stable relationship in the long run between the different variables in the model, and its coefficient reflects an adjustment and a return of economic growth to its general equilibrium of 83% if a deviation occurs in the long run.

The physical capital variable and the trade openness variable exert a simultaneously significant and positive short-run effect on the evolution of GDP per capita; their short-run elasticities have been represented by several coefficients because they have lagged and, therefore, have been tested jointly by the Wald statistical test. However, the human capital variable and the foreign direct investment variable do not have a significant direct short-run impact on economic growth in the Moroccan economy represented in our model by GDP per capita.

After estimating the coefficients of the short-run relationships and with the existence of a long-run cointegration, we proceed to the next step to identify the presence of relationships between variables in the long-term. For this very reason, the equation is limited to the following formulation (9):

$$\boldsymbol{LnY_{t-1}} = \alpha_0 + \alpha_1 LnY_{t-1} + \alpha_2 LnK_{t-1} + \alpha_3 LnKH_{t-1} + \alpha_4 LnFDI_{t-1} + \alpha_5 LnTO_{t-1} + \mu_t \quad (9)$$

This empirical approach is utilized to demonstrate the existence of relationships between the dependent variable and the explanatory variables in the long run by the ARDL model specifying the Ordinary Least Squares (OLS) method and by the Fully Modified Ordinary Least Squares (FMOLS) model cointegration regression in order to assist and confirm the initial results.

The results reported in the table 6 show relatively similar coefficients and signs for the two estimated models (OLS) and (FMOLS). These results indicate a long-term relationship between trade openness and GDP per capita growth as well as between human capital formation and the performance of the economic growth. However, the impact of these relationships in the long run on the promotion of economic growth in Morocco is relatively negative because the signs of the coefficients are negative. While the other variables like physical capital and foreign direct investment show no direct long-term effet on the variable GDP per capita.

In other words, and according to the main model ARDL-OLS of the study, the 1% dynamic of human capital in the long run leads to a 0.09% decline in GDP per capita. Similarly, the 1% change in trade openness leads to an indirect decline in GDP per capita of 0.16% in the long run.

Table 6 Long run estimates of the relationship between the explanatory variables and the dependent variable (GDP)

Explicative Variables (regressors)	**Dependent Variable Ln(Y)**					
	ARDL-OLS			**FMOLS**		
	Coefficient	**t-statistic**	**Probability**	**Coefficient**	**t-statistic**	**Probability**
LnK	0.315024	0.667510	0.5088	0.237561	0.463751	0.6458
LnKH	-0.093893	-1.778787	0.0840**	-0.128968	-2.376927	0.0232*
LnFDI	3.960424	1.012841	0.3181	5.090290	1.192808	0.2412
LnTO	-0.161228	-2.349854	0.0245*	-0.231182	-3.304405	0.0022*
Constant	-3.486433	-0.789777	0.4350	-5.202642	-1.074729	0.2901

*Significance at 5% and **significance at 10%.

Taking into account the results obtained, the hypothesis of trade-led-growth, which is the framework of our study, has been rejected in this empirical testing for the case of Morocco over the period cited in this analysis. This result is confirmed in other recent studies analyzing the case of Morocco, such as Okuyan et *al.*, and Ayad and Belmokaddem [64,65].

All the tests carried out above have provided an array of information on the existence of long- and short-term relationships between the variables as well as on the nature of this relationship, omitting the analysis of the probable causality developed between all the variables.

For this purpose, the test of causality in the sense of Granger will be advanced with the aim of apprehending the asymptotic behavior of the studied phenomenon. Causality in the sense of Granger, like most econometric models, is restricted by its sensitivity to the optimal lag and lag numbers that are adopted in its application.

The optimal number of lags to include in our model is considered decisive to have appropriate results. A high number of lags could introduce multi-linearity problems, display statistically insignificant coefficients and reduce the degree of freedom in the manipulation of the model while a low number of lags leads to difficulties in the error specification.

The optimal number of lags is framed by the calculation of several selection criteria as presented in the table 7. This optimal lag number is determined by the value of 5 in most of the selected criteria in table 7. Most often, the Akaike Information Criterion (AIC) is adopted for its accuracy in measuring the quality of a statistical model [66]. In our case, this selection criterion indicates an optimal number of lags of **5**, which must necessarily be incorporated into the estimations constructed in the following test.

Table 7 Results of optimal lag numbers by the lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	354.5478	NA	1.46e-15	-19.97416	-19.75197	-19.89746
1	666.6058	517.1247	1.11e-22	-36.37747	-35.04432*	-35.91727
2	695.7358	39.94975	9.65e-23	-36.61348	-34.16936	-35.76977
3	733.0988	40.56554*	6.15e-23	-37.31993	-33.76485	-36.09272
4	775.6413	34.03396	3.97e-23	-38.32236	-33.65631	-36.71164
5	842.4857	34.37714	1.22e-23*	-40.71347*	-34.93646	-38.71925*

Note: *indicates the order of lags selected by the criterion.
LR: sequential modified LR test statistic (each test at 5% level).
FPE: Final prediction error.
AIC: Akaike information criterion.
SC: Schwarz information criterion.
HQ: Hannan-Quinn information criterion.

The equation that consists in examining the presence of causality in the sense of Granger is formulated as follows (10):

$$\begin{bmatrix} Y_t \\ K_t \\ KH_t \\ FDI_t \\ TO_t \end{bmatrix} = \begin{bmatrix} \alpha_t \\ \alpha_t \\ \alpha_t \\ \alpha_t \\ \alpha_t \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \beta_{1i} & \theta_{1i} & \gamma_{1i} \\ \beta_{2i} & \theta_{2i} & \gamma_{2i} \\ \beta_{3i} & \theta_{3i} & \gamma_{3i} \\ \beta_{4i} & \theta_{4i} & \gamma_{4i} \\ \beta_{5i} & \theta_{5i} & \gamma_{5i} \end{bmatrix} \times \begin{bmatrix} Y_{t-1} \\ K_{t-1} \\ KH_{t-1} \\ FDI_{t-1} \\ TO_{t-1} \end{bmatrix} + \sum_{i=p+1}^{p+d} \begin{bmatrix} \beta_{1i} & \theta_{1i} & \gamma_{1i} \\ \beta_{2i} & \theta_{2i} & \gamma_{2i} \\ \beta_{3i} & \theta_{3i} & \gamma_{3i} \\ \beta_{4i} & \theta_{4i} & \gamma_{4i} \\ \beta_{5i} & \theta_{5i} & \gamma_{5i} \end{bmatrix} \times \begin{bmatrix} Y_{t-i} \\ K_{t-i} \\ KH_{t-i} \\ FDI_{t-i} \\ TO_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{bmatrix} \quad (10)$$

The causality in the sense of Granger [67] established between the variables, especially the dependent variable and the explanatory variables, will be calculated by the causality approach developed by Toda and Yamamoto [7], adapted simultaneously to integrated series with different orders of stationarity and cointegrated in the long-run. For this purpose, an augmented VAR model is used with the insertion of an additional lag number that indicates the maximum order of integration and stationarity **I(1)** of the series to the lag number of 5 held in the optimal lag specification (Table 7) [68]. The VAR estimate as specified in Toda Yamamoto's [7] technique is of order 6.

Table 8 Results of Toda-Yamamoto causality tests

Dependent Variable	Causal Variable				
	Y	**Capital**	**human Capital**	**FDI**	**Trade Openness**
Y	-	0.2740	0.6466	0.2601	0.0538
Capital	0.0192	-	0.2941	0.3220	0.0298
Human capital	0.0392	0.5740	-	0.6001	0.0236
FDI	0.0136	0.3239	0.3984	-	0.0119
Trade Openness	0.0192	0.5053	0.8816	0.5065	-

The values shown in the table are the probabilities of the Wald statistical test.
Significance is at the 10% and 5% level.

In order to have a causal inference, the Wald statistical test is applied to the lagged explanatory variables with the objective of validating or refuting the null hypothesis which suggests the absence of causality (*H0: c25 = c26 = c27 = c28 = c29 = c30 = 0* / null hypothesis: trade openness does not cause in the Granger sense GDP growth and *H0: c125 = c126 = c127 = c128 = c129 = c130 = 0* / null hypothesis: GDP growth does not cause trade openness). In this sense, the Wald statistical test verifies the significance of the explanatory variables in a given model and their presumed impact on the dependent variable.

Causality in the Granger sense is unidirectional and statistically significant among all the variables, in this case physical capital, human capital, foreign direct investment and trade openness, on the dependent variable, which is GDP per capita. In other words, these variables cause and contribute to the growth of GDP per capita (**K, KH, FDI, OC → Y**).

Similarly, for the variable trade openness, adopted as a causal variable to test its effects, there is a strong unidirectional causality among the variables: physical capital, human capital, foreign direct investment. Also, a bidirectional causality was revealed between trade openness and GDP per capita growth, wich attests to the existence of a strong potential between the dynamics of economic growth and the foreign trade of the country. This result is confirming the significance of the short- and long-run coefficients (**Y, K, KH, FDI → OC**).

In other words, this result confirms the existence of an active and dynamic link between trade openness that is also present both in the short and long run and in a bidirectional causal sense (**Y↔OC**).

To complete the analysis of the results yielded by the Granger causality test, the table 9 illustrates a diverse set of tests and calculations involving the generalized forecast error variance decomposition method, which highlights the variance of the different indicators in the study, via the adjusted VAR system [69].

This method permits the total variability of a variable to be decomposed by its own shocks and fluctuations as well as by innovations and shocks emanating from other sources presumed to have an influence on its variance as a key independent variable over different time horizons without determining the type of reaction (positive or negative) that it might experience [68].

Analyzing the variance of the GDP variable over the long term (15 years), this variable is explained by its own shocks to the extent of 21.7%, as well as by the innovative shocks affecting trade openness variable and the variable representing physical capital to a significant proportion of 26.8% and 51.4% respectively. While the effects of human capital and foreign direct investment are insignificant in this decomposition and do not reflect any improvement in the long run.

As for trade openness variable, it is explained by its own innovative fluctuations to the extent of 20.2%, as well as by shocks of GDP per capita with a share of 15.3% and shocks to the physical capital variable with a significant proportion reaching 64.3%. While the impact of human capital is limited compared to the first variables despite its important role in the promotion of trade openness; in parallel with a negligible impact of foreign direct investment on the dynamics of foreign trade.

The human capital variable is determined by the innovative variations of physical capital, the evolution of per capita income and the openness to foreign markets, with various shares of 54.5%, 19% and 26.4% respectively. In this line, the coherence of the results indicates that the trade openness and the evolution of the physical capital by their own fluctuations and by the innovative shocks of the other variables are determining factors of the promotion and the performance of the economic growth, the formation of the human capital as well as the attractiveness of the international investments on the long run.

Table 9 Variance decomposition analysis

Variance decomposition of LnY:

Period	S.E.	LnY	LnTO	LnK	LnKH	LnFDI
1	0.006392	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.019649	13.01093	29.16206	57.82702	7.72E-09	8.88E-07
3	0.023384	21.70058	24.43327	53.86615	2.13E-07	1.44E-06
4	0.024502	20.61024	25.31947	54.07029	1.99E-07	1.64E-06
5	0.025712	24.85243	25.54350	49.60407	1.82E-07	2.01E-06
6	0.046842	14.10271	13.51875	72.37854	2.77E-07	1.23E-06
7	0.060308	19.83610	14.16656	65.99734	6.27E-07	9.58E-07
8	0.088277	19.10686	19.17184	61.72131	6.61E-07	1.65E-06
9	0.098051	19.17709	27.70203	53.12088	9.48E-07	2.73E-06
10	0.109941	15.49536	25.98314	58.52149	7.72E-07	3.07E-06
11	0.199740	16.67028	9.148065	74.18165	3.86E-07	9.81E-07
12	0.412744	16.78078	8.804878	74.41434	4.46E-07	3.99E-07
13	0.678347	19.18385	13.67737	67.13878	6.15E-07	6.77E-07
14	0.894729	20.72539	19.95391	59.32070	7.93E-07	1.39E-06
15	0.964837	21.73767	26.82286	51.43947	9.64E-07	2.72E-06

Variance decomposition of LnTO:

Period	S.E.	LnY	LnTO	LnK	LnKH	LnFDI
1	0.009369	37.51464	62.48536	0.000000	0.000000	0.000000
2	0.023208	86.39473	12.27544	1.329825	3.62E-07	5.21E-06
3	0.028637	56.74173	13.69275	29.56552	2.38E-07	3.48E-06
4	0.033075	54.76701	11.27839	33.95460	2.18E-07	2.86E-06
5	0.036628	44.71839	16.69741	38.58419	2.56E-07	2.80E-06
6	0.062861	15.52268	11.01640	73.46092	1.40E-07	1.07E-06
7	0.066771	16.87003	12.13055	70.99942	3.29E-07	1.02E-06
8	0.075511	32.48950	10.87955	56.63095	4.02E-07	1.21E-06
9	0.087603	41.65467	8.378913	49.96641	3.76E-07	1.59E-06
10	0.099094	34.96638	7.203871	57.82974	3.06E-07	1.49E-06
11	0.133581	21.07564	7.890721	71.03364	3.06E-07	8.21E-07
12	0.183151	18.10210	10.12156	71.77634	4.65E-07	7.31E-07
13	0.242248	18.29122	15.43660	66.27218	6.37E-07	9.71E-07
14	0.276885	18.53360	22.13862	59.32778	8.16E-07	2.03E-06
15	0.303993	15.37562	20.24583	64.37854	7.14E-07	2.82E-06

Variance decomposition of Lnk:

Period	S.E.	LnY	LnTO	LnK	LnKH	LnFDI
1	0.005719	18.19214	8.533997	73.27386	0.000000	0.000000
2	0.007446	12.61777	11.59305	75.78918	2.52E-07	8.27E-07
3	0.008388	15.74519	9.807680	74.44713	2.82E-07	2.10E-06
4	0.014937	4.971418	15.40575	79.62283	1.87E-07	1.01E-06
5	0.024970	4.130401	18.55038	77.31922	3.25E-07	3.65E-07
6	0.037712	8.460029	21.57515	69.96482	4.98E-07	2.93E-07
7	0.049555	9.489401	26.75850	63.75210	6.28E-07	6.27E-07
8	0.053924	8.860887	34.71699	56.42213	7.45E-07	1.23E-06
9	0.063329	8.675782	26.34376	64.98046	5.41E-07	1.24E-06
10	0.127117	11.95062	10.57914	77.47024	3.75E-07	3.19E-07
11	0.245561	13.66816	12.51938	73.81246	4.99E-07	3.59E-07
12	0.376873	14.73487	17.96745	67.29767	6.58E-07	8.03E-07
13	0.459057	15.65011	25.53545	58.81444	8.52E-07	1.72E-06
14	0.483784	14.31147	29.76194	55.92659	9.00E-07	2.96E-06
15	0.787796	11.33160	11.72218	76.94622	4.12E-07	1.32E-06

Variance decomposition of LnKH:

Period	S.E.	LnY	LnTO	LnK	LnKH	LnFDI
1	0.026299	5.066459	25.82873	69.10481	4.12E-07	0.000000
2	0.040381	11.82940	30.72967	57.44093	6.16E-07	4.68E-07
3	0.058377	7.220845	32.87095	59.90821	4.13E-07	2.29E-07
4	0.071806	6.069487	39.68384	54.24667	5.18E-07	1.05E-06
5	0.085456	13.49667	30.35456	56.14877	3.66E-07	9.61E-07
6	0.190921	14.12005	12.27836	73.60159	3.32E-07	2.08E-07
7	0.352403	14.95006	13.99605	71.05390	4.94E-07	2.74E-07
8	0.533466	16.74615	18.82726	64.42659	6.67E-07	7.56E-07
9	0.657394	16.09195	26.67028	57.23776	8.29E-07	1.56E-06
10	0.692863	14.58580	31.94352	53.47067	8.85E-07	2.71E-06
11	1.103466	12.14439	12.89096	74.96464	4.17E-07	1.25E-06
12	2.344424	14.08433	8.938872	76.97680	4.07E-07	3.38E-07
13	4.130008	15.88274	13.02376	71.09350	5.54E-07	5.05E-07
14	5.788182	17.68643	18.94838	63.36518	7.32E-07	1.10E-06
15	6.502943	19.04118	26.40995	54.54887	9.27E-07	2.26E-06

Variance decomposition of LnFDI:

Period	S.E.	LnY	LnTO	LnK	LnKH	LnFDI
1	0.000652	17.42702	8.775810	73.79717	1.98E-10	2.57E-09
2	0.000841	12.08026	11.97865	75.94109	2.67E-07	8.97E-07
3	0.000953	15.83966	9.889125	74.27121	2.97E-07	2.22E-06
4	0.001684	5.084662	14.84868	80.06666	1.89E-07	1.08E-06
5	0.002810	4.342123	17.85148	77.80640	3.25E-07	3.92E-07
6	0.004264	9.002047	20.82514	70.17282	4.98E-07	3.03E-07
7	0.005633	10.29527	25.87221	63.83252	6.31E-07	6.40E-07
8	0.006156	9.837162	33.73440	56.42844	7.55E-07	1.25E-06
9	0.007128	9.015042	26.55028	64.43468	5.63E-07	1.34E-06
10	0.014158	11.65990	10.56752	77.77259	3.74E-07	3.45E-07
11	0.027515	13.44865	12.34285	74.20849	4.93E-07	3.49E-07
12	0.042545	14.57987	17.72214	67.69798	6.51E-07	7.79E-07
13	0.052212	15.56388	25.19594	59.24018	8.45E-07	1.67E-06
14	0.054937	14.39504	29.91468	55.69028	9.09E-07	2.94E-06
15	0.087580	11.24636	12.14742	76.60622	4.21E-07	1.39E-06

Cholesky Ordering: LnY LnTO LnK LnKH LnFDI

5 Conclusion

The causal relationship identified between trade openness and economic growth has been the subject of vigorous and intense debate for the diversity of results and consequences that it implies across countries. The case of the Moroccan economy is not an exception; the empirical analyses carried out concerning this issue in the Moroccan economy provided varied results as demonstrated in the works of [26,65,70]. The results of those studies confirm the existence of divergent impacts stemming from this relationship (positive, negative or insignificant).

Our empirical analysis confirmed the existence of a bidirectional causality between trade openness and economic growth. The reverse causality reflects an interdependence and a transitional dynamic that could occur if the economy reaches a threshold of emergence ensuring economic and industrial development.

On the one hand, the results confirm the presence of a positive short-term relationship between the accumulation of physical capital, the openness to international trade and economic growth. This asserts that the dynamics of the Moroccan economy can be partially explained by a strong demand for national consumption, resulting in an increase in imports of raw materials, semi-finished products and finished products. The evolution of national economic production oriented mainly toward exports, revealing the comparative and competitive advantages of the Moroccan economy in the international markets, play also an important role in the dynamic of trade and economic growth.

On the other hand, the results indicate the presence of a negative long-term relationship established among foreign trade, human capital and growth of GDP per capita for our case study. For this, the hypothesis of trade-led-growth has been refuted in the case of the Moroccan economy.

A substantial part of Morocco's national economic growth is driven by domestic factors. Trade openness is not an obstacle to development since this variable develops a strong bidirectional causality with economic growth and the dynamics of the country's national productive sectors. The difficulty lies in implementing and managing economic and trade policies simultaneously to a restructuring social field.

The development of human capital requires a multidimensional strategy, encompassing a set of strategic sectors targeting mainly health, education, training research and development in order to stimulate its productivity and its capacity to absorb new production techniques and technologies over the long term. This explains the magnitude of investments needed to develop human capital. Interactive and complementary links have been found between Human capital and economic growth for the case of the Moroccan economy.

This implies a reorganization of the reforms undertaken during these last decades and a reformulation of export-oriented strategies in order to adapt its products to the requirements and standards of the foreign markets and of the international supply chain management and to operate a restructuring of the commercial exchanges by targeting the production and export of technological products with high added value. Also, the development and the investment in both logistics capacities and logistics skills results in easier access to foreign markets and thus, an increasing integration in international trade [71].

Our results in terms of long-run causality affirm the importance of human capital formation and qualification for the economic growth performance, trade openness and the relationship developed between these last two variables.

The aim objective of the different policies and reform measures is to place human capital at the heart of economic development and social welfare in order to improve the competitiveness of the Moroccan economy, increase private sector productivity, neutralize external shocks, take advantage of the positive externalities of free trade, stimulate good governance and institutions, and through all these variables promote economic growth [13].

Like any field of empirical analysis, our study has a number of limitations. First of all, the analytical framework and the estimation method adopted, which may be subject to endogeneity problems and omitted variables for the case of the Moroccan economy. Therefore, future research perspectives should include other variables relevant for the activation of the economic growth process driven mainly by foreign trade in order to derive a broader and more detailed representation of the Moroccan economy in its complex and heterogeneous international environment. Similarly, the study needs to adjust the trade openness index to assess individual sectors' impact of foreign trade on the country's economic growth.

Acknowledgments
We thank anonymous referees for their valuable comments and remarks on this initial draft of the paper. The usual disclaimer applies and views are our sole responsibility.

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