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THE SHORT AND LONG RUN CAUSALITY RELATIONSHIP BETWEEN PUBLIC HEALTH SPENDING AND ECONOMIC GROWTH: EVIDENCE FROM TUNISIA AND MOROCCO

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This study aims to analyze the short run and long run relationship link between economic growth and public health spending in Tunisia and Morocco cover the 1980-2017 periods. The basic analysis process involves four steps: stationarity test, Bound tests for Cointegration, ARDL approach inspired by Pesaran et al. (2001), and VECM method. The results confirm the existence of cointegration between variables. In long run, public health spending affects positively the Tunisian and Moroccan economic growth, but more intensively in Tunisia. The short run causal relationships exist between variables and the result of Granger causality indicate the existence of positive bidirectional causal relationships between economic growth and public health spending in both countries. The results warrant for the attention of Tunisian and Moroccan governments to investigate more in health sector as a factor of economic growth. In addition, these two governments should give the attention of their monetary policy and corruption.

Keywords: Public Health Spending, Economic Growth, Bounds Test, ADRL, Causality Relationship, VECM
JEL Classification: B22, B23, F43, H51

1. INTRODUCTION

The contributions of health to human capital development and economic simulation draw attention to the participation of governments in improving this sector. Indeed, the fact is that over the last twenty years, health policy has flourished in all countries of the world, especially in developing countries. Countries are trying to invest more and more in human capital, that is, in the acquisition of knowledge, skills and care; because they may have realized that, it is currently impossible to speak economic growth without resorting to health sector. Health is not any more than the lack of illnesses; it is besides

the capacity of people to expand to their prospective through their whole lives. In that intellect, health is an advantage individual own, which has essential value as well as active value. In instrumental conditions, health effects economic growth in different ways like productivity and innovation.

As such, we can highlight that investments in health have increased more in developing countries. Among these countries, we noted that the Tunisian and Moroccan public authorities have made considerable efforts over the past decade to increase the envelope of their national budget allocated to health. These huge investments focus on the efficiencies of these expenditures on economic growth. Thus, it must be pointed out that the choice to study Tunisia and Morocco has been dictated by a few specific indicators. First, it must be said that these two economies had per capita income close: according to the World Bank (2010), GDP per capita in Tunisia and Morocco are, respectively, of the order of 4 thousand dollars and 3 thousand dollars (constant price). Similarly, it is important to note the close economic situation, particularly in terms of competition in the conquest of markets, among others compared to the European market, in terms of exports and attractiveness of foreign investments. This economic competitiveness is well supported by the similar geographical location of the two countries opposite target or even common markets. In addition, their economies have relied heavily on returns from the tourism and agriculture sectors. A large part of their income is for the development of their human capital through investment in health. In 2017, Tunisian government devotes more than 7% of its GDP to health sector, while the Moroccan government allocates more than 5% of its GDP to improve and to develop the health sector; according to World Bank, 2018. As result, we note an increase in Tunisian life expectancy at birth 42 years in 1960 to more than 74 years in 2017. In Morocco, this rate increased from 48.45 years in 1960, to 74 years in 2017 (World Health Organization, 2018). However, from this issue arise the following questions: what are the effects of public health spending on economic growth? Are these the same effects for both countries? Do these expenses have the same efficiencies in the short and long term? These few questions illustrate the disparity in the issues involved in taking public health spending into consideration in economic growth.

However, using the Auto Regressive Distributed Lags Approach (ARDL), for annual data during the period 1980-2017, we try to estimate the impact of public health spending on Tunisian and Moroccan GDP per capita, moreover to investigate the dynamic relationship between these variables. In addition, we apply the Augmented Dickey Fuller test (ADF) and Phillips-Perron test (PP) in order to check the order of integration of variables. Bounds test was used to verify the existing of long run relationship between these variables, and finally we use the Granger causality test to detect the causality relationships between variables of econometric model. The rest of the paper proceeds as follows: Section 2 provides a literature review on relationships between public health expenditure and economic growth. Section 3 represents a spatial analysis of distribution of human resources and infrastructure in Tunisia and Morocco. Section 4 describes the data and methodology. Section 5 contains the results and

discussions and finally, Section 6 represents the conclusion of study.

2. LITERATURE REVIEW

Public health spending review is a permanent procedure of investigation that facilitates to create economic development in the country. The human capital has a priority function for a supportable economic growth. The theories of economic growth propose the function of the human capital situation as significant for the procedure of growth. Therefore, health has an essential role in terms of the value of human capital. All kinds of spending on health increase the level of human capital and create a positive input to economic growth.

In this part of study, we examine the relationship between health expenditure and economic growth through the results of empirical work by other authors. The study of Sorkin (1977) can be given as one of the first studies to examine the impact of health on economic growth. To the finest of our information, there has never been an attempt to explore the short and long run relationship between economic growth and public health spending in Tunisia and Morocco before. There are little studies accessible in the current literature examining the relationship between economic growth and public health expenditure. The results founded by authors are diverse and indifferent depending on the study sample. As example, Becker (1962) has shown that the investment in human capital and especially in health has a direct and positive impact on productivity and income. His idea was that the squared and healthy workforce should be relatively more productive. Other authors as such as Lucas (1988) and Barro (1995) confirm that human capital is a necessary element in explaining differences and lagging growth between two or more countries.

Sevilla et al. (2001) examined the effects of work experience and health on total production. They showed that good health has a significant positive effect, as well as a statistically significant effect on overall income. Narayan and Mishra (2010) study the relationship between health and economic growth through including investment, exports, imports, and research and development, for five Asian countries for the period 1974-2007. The result shows that in the long run, public health spending has contributed positively to economic growth of these countries.

Wang (2011) used global health care expenditure data from 31 countries from 1986 to 2007 to explain the causal link between rising health care spending and economic growth. The estimation of the panel regression reveals that the increase in value of spending on health has an important role and it is a driving force for economic growth. Spence and Lewis (2009) shows that the relationship between health and growth leads to causality in two ways, but none is definitive. He has shown with his macroeconomic studies, analyzing relations at the country level, that this is a strong relationship between health and economic growth. Targeted projects that alleviate poor health and malnutrition help raise education levels and productivity, which can stimulate economic

growth. In addition, the policy implications should focus on needs to improve institutions to provide effective services and to provide a return on rational investment, the difficulties that exist in many countries.

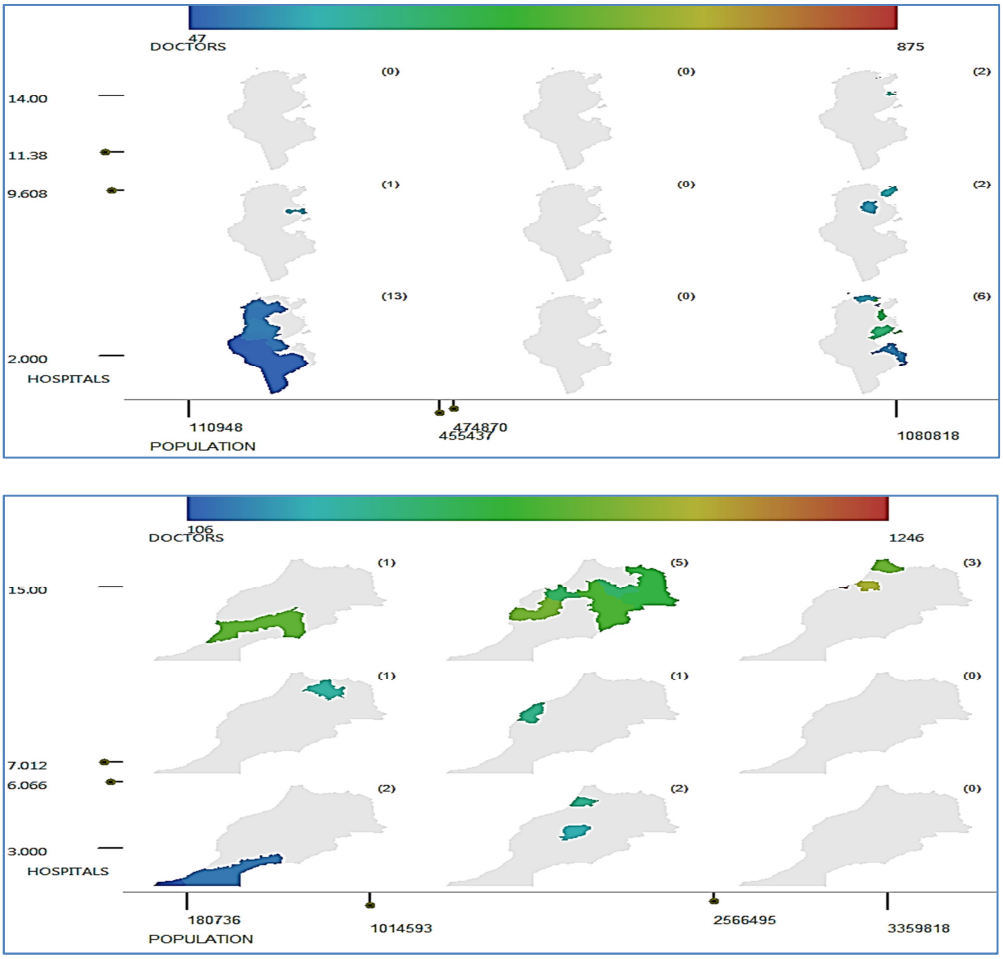
Peykarjou et al. (2011) estimated the link between health and economic growth for the member countries of the Conference of the Islamic Organization using panel data for the period 2001-2009. The results obtained show that the increase of life expectancy leads to an improvement in economic growth of these countries, while there is a negative relationship between fertility rate and economic growth.

For their part, Mohsen et al. (2011) have studied the causal relationship between national income and government spending on health for all 11 oil-producing countries. They concluded that there is a strong causality at the same time between national income, oil incomes and volume of public spending on health. However, the cointegration test indicates the absence of any short-term or long-term cointegration relationship between public spending on health and GDP; as well as the existence of a strong dependence of these countries' incomes on the price of oil. For this reason, these authors propose the creation of new financing mechanisms of health sector not related to oil prices volatility, but linked to the current revenue of state budget. Granados (2012) studied data from England and Wales during 1840-2000 periods. The result of their study indicates a negative relationship between economic growth and health (measuring by life expectancy at birth). Gong et al. (2012) analyze the effect of investment in health and thus the capital devoted to health. They concluded that economic growth is dependent on both the rate of development of health sector and level of health. While health capital growth still facilitates economic growth, the gross effect of health level on economic growth depends on how it affects the accumulation of physical capital.

Ogungbenle et al. (2013) confirm that there is a bidirectional causal relationship between public health spending and growth economic in Nigeria. David (2014) shows that there is a good evidence to suggest that causality goes back and forth between health and economic growth. In the first place, healthy people are the most productive, even in poor working conditions; in addition, logically they have a longer life, which is an important indicator of the accumulation of human capital. Second, higher income for household or countries improves health in many ways, from better nutrition to building public health infrastructure.

Using a sample of 306 estimates from 31 primary studies, Sefa et al. (2015) found that government spending on health has negative effects on growth. Fatima et al. (2014) analyzed the causality, as well as the cointegration between the public financing of health in Algeria and the economic growth during a period of 41 years. They concluded that there is a causal relationship between these two economic factors only in the long term.

3. SPATIAL ANALYSIS: A COMPARATIVE ANALYSIS BETWEEN TUNISIA AND MOROCCO



Source: The Office of the High Commissioner of Morocco government, Moroccan Ministry of Health, Tunisian National Institute of Statistics, and Tunisian Ministry of Health, figure developed by the author, 2017.

Figure 1. Distribution of Doctors According to the Numbers of Hospitals and the Population in Tunisia and Morocco

Figure 1 shows that small populations are located in the interior regions of Tunisia (specifically the south and west). The results indicate that the majority of regions suffer from a remarkable lack of doctors and hospitals, even from highly populated areas. Even large population areas (Capital and coastal areas) have a remarkable need for numbers of doctors and hospitals. The lack of sufficient numbers of doctors and hospitals raises the question of conditions and access to health issues in Tunisia, as well as the density of the number of inhabitants per bed and doctor. For Morocco, the results appear better than that of Tunisia. In general, regions with large population sizes are characterizing by high

numbers of hospitals and doctors. On the other hand, small numbers of doctors and hospitals appear rather small for the regions of Guelmim-ES-Semara and Laayoune-Boujdour-Sakia El Hamra; this result appears logical since these two regions group very small numbers of individuals.

In general, it can be seeing that the distribution of health facilities (expressed in terms of the number of hospitals) and human resources (expressed in terms of physician numbers) relative to the population in the different Moroccan regions are more Effective compared to that in Tunisia. Thus, regional equality in health care in Morocco is more adequate than in Tunisia.

4. METHODOLOGY AND DATA

4.1. Data

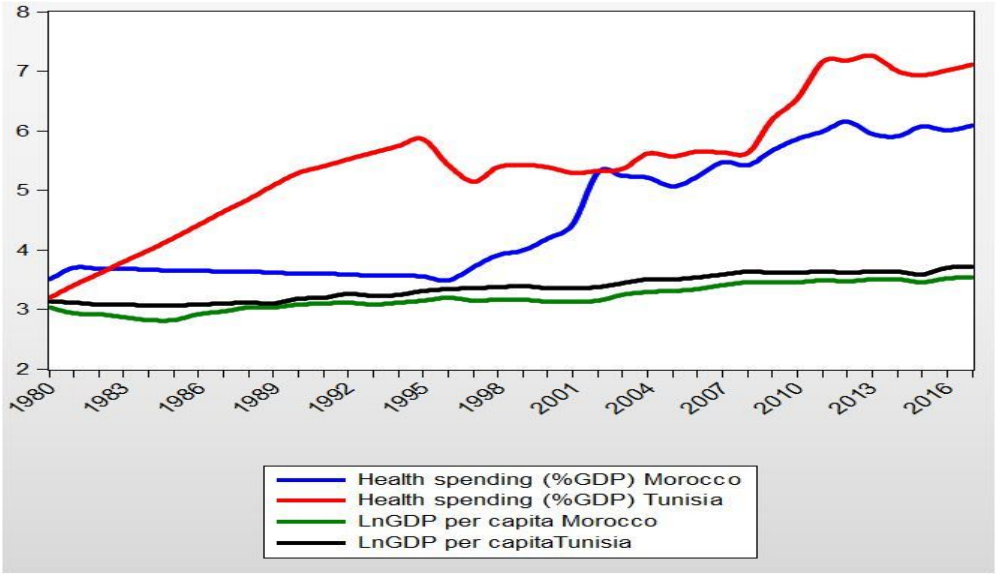
The analysis covers Morocco and Tunisia. The choice of the starting period (1980-2017) was restricted by data availability. The main variables of the analysis are GDP per capita, public health spending, corruption, gross enrollment rate in secondary, degree of trade openness, life expectancy at birth, mortality rate and inflation. Data are collected from the World Development Indicators database (World Development Indicators (WDI, 2016)), United National Educational, Scientific and Cultural Organization; 2018 and World Health Organization; 2018. The different definitions of the set of variables, their sources and the summary statistics (mean value, maximum, minimum and observation) are defined in Table 1.

Table 1. Descriptions and Data Sources of Variables

Variables	Description	Data sources
Economic growth	Economic growth was expressed by GDP per capita growth.	World Development Indicators, World Bank; 2018.
PHS	Public Health Spending expressed in millions of Tunisian dinars.	World Development Indicators, World Bank; 2018
Corruption	Index reflecting the level of the fight against corruption in both countries.	World Development Indicators, World Bank; 2018.
GERS	Gross Enrollment Rate in Secondary Total (for both sexes).	United National Educational, Scientific and Cultural Organization; 2018.
LEB	Life expectancy at birth, expressed on logarithm.	World Health Organization; 2018
DTO	Degree of Trade Openness.	World Trade Organization; 2018.
MR	Mortality rate, crude (per 1,000 people).	World Health Organization; 2018.
Inflation	Inflation, consumer prices (in% annually).	World Development Indicators, World Bank; 2018.

The logarithm of public health spending and life expectancy at birth was used to simplify the explanation of the estimated coefficients, which are identified as elasticities. Moreover, it was making to correct the heteroscedasticity problem and to make likely to explain or decrease the margin between the variables, because we have separate units of measurement. Theoretically, capital stock and human capital are identified as necessary inputs process producing real economic procedure output.

Figure 2 shows that health spending in both countries is growing at an increasing rate over time. This rhythm appears more accelerated in Tunisia than in Morocco. In addition, health spending is growing faster than increases of GDP per capita in both countries. We can therefore conclude that Tunisia and Morocco give an importance to health sector, which aims to improve the health index of their populations.



Source: World Bank; Figure developed by the author, 2018; using Eviews 9.

Figure 2. Annual Growth in Public Spending on Health and per Capita GDP in Tunisia and Morocco between 1980 and 2017

4.2. Methodology

The study focuses on determining the short and long-term relationship between public health spending and GDP per capita using ARDL approach inspired by Pesaran et al. (2001).

Subsequent the work of Mehrara et al. (2011), Rajeshkumar et al. (2014) and Kurt (2015) we developed the econometrical model based on the standard Cobb Douglas

production function with constant incomes and the aggregate output function by time t, can be expressed as follows:

$$Y_t = AK_t{}^{\beta_1} L_t{}^{\beta_2} e^u, \quad (1)$$

where Y denote GDP per capita, e the error term then α_1 and $\alpha_2 \in [0,1]$ indicating constant returns to scale and representing the output elasticities. In this paper, we integrated public spending on health (proxy of capital) and gross secondary school enrollment ratio (proxy of labor) an augmented Cobb-Douglas production function (Ifa and Guetat, 2018). Life expectancy at birth and mortality rate represents important variables as correlates with the degree of capital flows in health, corruption and Inflation. Then, we consider technology factor as endogenously defined by degree of trade openness and represented by equation (2) as follows:

$$A_t = \sigma DTO_t^{\beta_3}, \quad (2)$$

where σ represents constant of time stable. We substitute equation (2) into equation (1):

$$Y_t = \sigma DTO_t^{\beta_3} K_t^{\beta_1} L_t^{\beta_2} \mu^e. \quad (3)$$

To transfer equation (3) into linear equation, we adopt the logarithmic function. The linearized production function takes the following form:

$$\ln Y_t = \beta_3 \ln DTO_t + \beta_1 \ln K_t + \beta_2 \ln L_t + \varepsilon_t. \quad (4)$$

Empirically, to study the relation between GDP per capita, public health spending, corruption, gross enrollment rate in secondary total, life expectancy at birth, degree of trade openness, mortality rate and inflation, we require the following model:

$$\ln GDPpercapita_t = \beta_0 + \beta_1 \ln PHS_t + \beta_2 \ln Corruption_t + \beta_3 \ln GERS_t + \beta_4 \ln LEB_t + \beta_5 \ln DTO_t + \beta_6 \ln MR_t + \beta_7 \ln Inflation_t + \varepsilon_t, \quad (5)$$

where, $\ln GDP$ per capita is the logarithm of GDP per capita growth, $\ln PHS$ is the logarithm of public health spending, $lnCorruption$ is the logarithm of Corruption, $\ln GERS$ is the logarithm of gross enrollment rate in secondary, $\ln LEB$ is the logarithm of life expectancy at birth, $\ln MR$ is the logarithm of mortality rate and finally $\ln Inflation$ is the logarithm of inflation.

After checking the stationarity of our variables, the dynamic method of time series ARDL model $(p, q_1, \ldots, q_k)$ can be defined as follows, which p and q are the optimal lag length:

$$\begin{aligned}\mathrm{D}\ln GDPpercapita = {} & \beta_0 + \sum_{i=1}^{p} \gamma_i D\ln GDPpercapita_{t-i} + \sum_{i=1}^{q} \delta_i D\ln PHS_{t-i} \\ & + \sum_{i=1}^{q} \theta_i DCorruption_{t-i} + \sum_{i=1}^{q} \vartheta_i DGERS_{t-i} + \sum_{i=1}^{q} \mu_i D\ln LEB_{t-i} \\ & + \sum_{i=1}^{q} \eta_i DTO_{t-i} + \sum_{i=1}^{q} \pi_i DMR_{t-i} + \sum_{i=1}^{q} \tau_i DInflation_{t-i} \\ & + \beta_1 \ln GDPpercapita_{t-1} + \beta_2 \ln PHs_{t-1} + \beta_3 Corruption_{t-1} + \beta_4 GERS_{t-1} \\ & + \beta_5 \ln LEB_{t-1} + \beta_6 DTO_{t-1} + \beta_7 MR_{t-1} + \beta_8 Inflation_{t-1} + \varepsilon_t, \end{aligned} \quad (6)$$

where D is the first difference; $\alpha_0$is the constant; γ, δ, θ, ϑ, μ, η, π, and τ mean short-term dynamics, while β_1, β_2, β_3, β_4, β_5, β_6, and β_7 are the long-term coefficients; as well as ε is the error term of the white noise. The model was verified under the hypotheses H_0 (existence of cointegration relationships).

In this study, ARDL bounds testing approach (Pesaran and Shin, 1999; Pesaran et al., 2001) is used as technique to test the relationship summarized in equation (4). The ARDL approach has frequent advantages. First, the ARDL approach can be practical whether the time series variables are stationary at level I(0), stationary in first difference I(1) or frictionally integrated (Pesaran et al., 2001). Second, the ARDL approach detects the optimal number of lags in data making process principally in general to precise process. Third, the ARDL procedure practices a single summary form equation; however, the conservative cointegration procedures estimate the long-run relationships inside a framework of system equations.

Several steps develop the ARDL model: the first step is to test the stationarity of the variables to determine their order of integration. To do this, we use the ADF test and PP test; which the threshold is 5%, and the null hypothesis (H_0) indicate the presence of unit root, means the non-stationary of variable. The results of tests are given in Table 2 (stationarity at level) and Table 3 (stationarity in first difference) below for Tunisia and Morocco. In second step, we apply the Wald test to check the long-run cointegration between the variables of model based on null hypothesis of the existence of cointegration H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = 0$, and alternative hypothesis as H_1 $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8 \neq 0$; explaining in Table 4. We apply the Bounds Test in third step based on lower critical bounds and upper critical bounds, Pesaran et al. (2001). The idea was that our F-statistic should be falls between lower and upper critical bounds to make sure that there are cointegration between variables. In step five, we move to ARDL model estimation to analyze the impact of public health spending and the rest of variables on GDP per capita. In final step, we use the CUSUM and CUSUMSQ to verify the stability of model.

After verifying the existence of cointegration among the variables, we use the VECM Granger causality approach, which is a restriction of VAR to examine the way of causality between them. The VECM Granger causality approach covers an error correction term (ECT) defined a cointegration term and ensures that endogenous variables of model converge to cointegration relationships by admitting short-run dynamic adjustments. ECT implies that the variations of endogenous variables follow the level of imbalance existing in the cointegrating relationship that it covers. However, the VECM makes possible to estimate the relations in the short term and through the

ECT, it makes possible to check the existence of long-term relations. This procedure can be summarizing in two steps. The first step was to estimate our model (5) and to determine the residuals defining the deviations from equilibrium. The second step was to estimate equation (7) containing the determined residues. In this step, we obtain the coefficients of the short-term adjustments, in addition the long-term adjustment rates. The VECM equation was modeling as follows:

$$\begin{aligned} D\ln GDPpercapita = {} & \beta_0 + \sum_{i=1}^{p} \gamma_i D\ln GDPpercapita_{t-i} + \sum_{i=1}^{q} \delta_i D\ln PHS_{t-i} \\ & + \sum_{i=1}^{q} \theta_i DCorruption_{t-i} + \sum_{i=1}^{q} \vartheta_i DGERS_{t-i} + \sum_{i=1}^{q} \mu_i D\ln LEB_{t-i} \\ & + \sum_{i=1}^{q} \eta_i DTO_{t-i} + \sum_{i=1}^{q} \pi_i DMR_{t-i} + \sum_{i=1}^{q} \tau_i DInflation_{t-i} + \partial ECT_i + \varepsilon_t, \end{aligned} \quad (7)$$

where D is the first-difference operator; β_0 is the constant; γ, δ, θ, ϑ, μ, η, π and τ are coefficients to be estimated, while ∂ was the long-term coefficients of the ECT. Finally, ε was the error term of the white noise.

5. RESULTS AND DISCUSSION

We apply the stationarity test to determinate the order of integration of variables used for estimation. We use the ADF and PP tests to check the presence of unit root to the logarithm of our variables in level and in first difference. The results in Table 2 show that Corruption, DTO and MR are stationary at level for Tunisia and Morocco. However, we can confirm that these three variables are integrated of I(0) in both countries. Inflation was integrated of I(0) only in Moroccan case.

Table 2. Stationarity at Level

Stationarity at level								
Variables / Countries	GDP per capita	PHS	Corruption	GERST	LEB	DTO	MR	Inflation
ADF test								
Tunisia	2.502	2.651	-2,770***	2.031	4.778	-2,001*	-2.423**	-0.727
	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)
Morocco	1.668	2.382	-1,893*	4.179	1.582	-1,996*	-1.938*	-1,873
	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)
PP test								
Tunisia	2.230	2.037	-2,812**	3.262	3.069	-2,881*	-1,815*	-0.772
	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)
Morocco	1.392	2.188	-1,853*	2,900	6,387	-2,890*	-4.184***	-2,078**
	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)

Note: *, ** and *** denote significant at 10%, 5% and 1% respectively. t-statistics is stated in parentheses.

Table 3. Stationarity in First Difference

Stationarity in first difference								
Variables / Countries	GDP per capita	PHS	Corruption	GERST	LEB	DTO	MR	Inflation
ADF test								
Tunisia	-3.926***	-3.397***	-6.779***	-2.261**	-2.207**	-4.772***	-3.873***	-10.998***
	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)
Morocco	-4.319***	-4.431***	-4.857***	-2.966**	-2.446**	-3.884***	-3.743***	-9.204***
	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)
PP test								
Tunisia	-3.918***	-3.393***	-9.099***	-2.170***	-2.971***	-4.667***	-3.809***	-6.084***
	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)
Morocco	-4.330***	-4.431***	-4.866**	-2.804**	-2.224**	-3.896**	-3.295**	-9.748***
	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)	(-1.950)

Note: *, ** and *** denote significant at 10%, 5% and 1% respectively. t-statistics is stated in parentheses.

The results in Table 3 indicate all variables are stationary in first difference, so we can conclude that our variables are integrated of I(1). In this case, we reject the null hypothesis of presence of unit root and we accept the alternative hypothesis.

The Wald test was using to identify the existence of a long-term cointegration relationship between the endogenous variable and the set of explanatory variables. In our case, the objective of this test is to verify whether GDP per capita has long-term cointegration links with PHS, Corruption, GERST, LEB, DTO, MR and Inflation. The null hypothesis (H_0) and the alternative hypothesis (H_1) are showing as follows:

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0,$$
$$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0,$$

with: H_0 indicates the absence of long-term co-integration relationships and H_1 indicates the existence of long-term co-integration relationships. The results of Wald test in Table 4 show that F-statistic values are significant for the two countries. More precisely, the Tunisian F-value at 7.79801 and the Moroccan F-value at 18.33851 are significant at 10%, 5% and 1% thresholds. In this case, we reject H_0 and we accept H_1. Therefore, we can confirm that long run relationships exist among variables.

Table 4. Wald Test

	Test Statistic	Value	df	P-value
Tunisia	F-statistic	7.79801	(6, 12)	0.001 ***
	Chi-square	32.42260	6	
Morocco	F-statistic	18.33851	(6, 14)	0.000 ***
	Chi-square	43.26602	6	

Note: *, ** and *** denote significant at 10%, 5% and 1% respectively.

The Table 5 shows the results of Bounds testing approach. We found the existence of long run relationships between variables in Tunisian and Moroccan case. This conclusion has based on F-value at 5.60896 for Tunisia and at 9.44906 for Morocco exceeding the upper bound values at 1%, 2.5%, 5% and 10%. In this case, we reject the null hypothesis of no cointegration relationships and we accept the alternative hypothesis, which suppose the existence of long run relationships between the different variables of our econometric model.

Table 5. ARDL Bounds Test and Critical Bounds

Dependent variable	Tunisia		Morocco	
$F_{GDPpercapita}(PHS, Corruption, GERST, LEB, DTO, MR, Inflation)$	5.60896***		9.44906****	
Critical Value Bounds				
Significance level	I0	I1	I0	I1
10%	2.12	3.23.	2.12	3.23
5%	2.45	3.61	2.45	3.61
2.5%	2.75	3.99	2.75	3.99
1%	3.15	4.43	3.15	4.43

Note: The asterisks *, **, *** and **** denote the significance respectively at the 10% thresholds, 5%, 2.5% and 1%.

After determination of order of integration for the different variables (stationarity tests), checking the presence of long run cointegration (Wald test) and verifying the existence of long run relationships (Bounds test), we can now estimate our econometric model using the ARDL approach. The different results are classified in Table 6.

Table 6. Long-run ARDL Dynamic Analysis

Long run ARDL estimations							
GDP per capita (dependent variable)	PHS	Corruption	GERST	LEB	DTO	MR	Inflation
Tunisia	2.552***	-0.942	1.908**	2.665***	1.734*	-0.545***	-1.820**
	(2.256)	(-0.638)	(2.331)	(3.727)	(1.904)	(-5.419)	(-2.302)
Morocco	1.551*	-0.734**	1.009**	-0.120*	2.446*	-1.298*	-0.293**
	(2.321)	(-3.971)	(3.553)	(-2.172)	(1.393)	(-2.448)	(-3.001)

The asterisks *, ** and *** denote the significance respectively at the 10%, 5% and 1%.

The results of ARDL estimation indicate that public health spending have a significant and positive relationship with GDP per capita in long-term in Tunisia and Morocco, but more intensively in Tunisia. Mushkin et al. (1962), Nelson and Phelps

(1966) were founded the same result. An increase of one unit in public health spending will increase the GDP per capita in Tunisia by 2.552 units and by 1.551 units in Morocco. Corruption, MR and Inflation have negative relationships with GDP per capita in both countries. Gupta et al. (2002) was also founded a negative impact of Corruption on GDP per capita. The increase of Corruption, MR and Inflation by one unit will decrease Tunisian GDP per capita respectively by 0.942 units, 0.545 units and 1.82 units. In Morocco, an increase of Corruption, MR and Inflation by one unit will decrease GDP per capita respectively by 0.734 units, 1.298 units and 0.293 units. We note that corruption has important negative effects on Tunisian and Moroccan GDP per capita, so these two governments need to be more serious in the fight against corruption. In addition, the Tunisian government should review its monetary policy of which purpose to reduce the massive tendency of the inflation, especially in course of five last years, where the Tunisian inflation rate attained 7.6 % in March 2018; according to Tunisian Central Bank report (2018). GERST leads to increase Tunisian GDP per capita by 1.908 units and an increase of the Moroccan GDP per capita by 1.009 units. The results revolts also that DTO affect positively GDP per capita in both countries but more intensively in Morocco than in Tunisia. The results for Tunisia reveal that LEB has a significant positive impact on GDP per capita. However, in Morocco an increase of LEB by one unit will decrease GDP per capita by 0.896 units. In addition, Lorentzen (2008) founded this result.

To determine the significance in addition to the intensity of short-term relationships and to determinate the degree of long-term adjustment, we use the VECM Granger causality approach. The results of the VECM Granger estimates revolt in Table 7. The results show that in Tunisia case there are four positive bidirectional causal relationships between GDP per capita and PHS, GDP per capita and GERST, GDP per capita and DTO and finally between LEB and DTO. The results indicate also that there are six unidirectional causal relationships; two of them are negative between MR and GDP per capita and between Corruption and PHS. While, the four causal relationships remaining are positives, where PHS and GERST influence LEB. The two other causal relationships are between GERST and DTO and between LEB and GDP per capita.

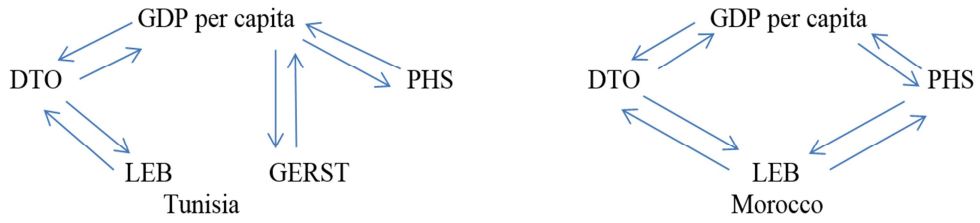
Finally, in Morocco, there are four positive bidirectional causal relationships between GDP per capita and PHS, GDP per capita and DTO, PHS and LEB and between LEB and DTO. The results show also those are four positive unidirectional causal relationships, where GERST and LEB affect GDP per capita and the other unidirectional causal relationships are between GERST and LEB, and between DTO and PHS. Through the results of causal relationships, we can conclude that Tunisia and Morocco have the same bidirectional relations between GDP per capita and PHS, between GPD per capita and DTO and between LEB and DTO. In addition, these two countries have the same unidirectional causal relationships where GERST influence LEB, and where LEB influence GDP per capita.

Table 7. Results of Granger Causality Test

	Causality direction									
		Short term								Long term
	Dependent variable	$D\ln GDP\ percapita$	$D\ln PHS$	$D\ln Corruption$	$D\ln GERST$	$D\ln LEB$	$D\ln DTO$	$D\ln MR$	$D\ln Inflation$	ECT
Tunisia	$D\ln GDP\ percapita$	---	0.052* (0.948)	-0.278 (-0.758)	2.641** (0.483)	0.848 (0.437)	0.190** (0.827)	-0.102 (-0.903)	-3.915 (-0.030)	-0.991** (-0.882)
	$D\ln PHS$	0.622** (0.543)	---	-1.772 (-0.186)	0.998 (0.379)	0.134* (0.874)	5.077 (0.012)	-1.139 (-0.332)	-1.139 (-0.515)	-0.772* (-0.565)
	$D\ln Corruption$	-0.553 (-0.056)	-1.221* (-0.111)	---	-0.538 (-0.066)	-1.765 (-0.551)	-1.712 (-0.633)	-0.113 (-0.785)	-1.975 (-1.012)	1.989 (0.145)
	$D\ln GERST$	1.155* (3.651)	1.886 (0.434)	-0.967 (-0.034)	---	2.661* (0.678)	1.998* (0.678)	-0.781 (-0.762)	1.780 (0.435)	-0.954* (-0.233)
	$D\ln LEB$	2.771** (0.782)	1.801 (0.391)	0.973 (0.034)	0.569 (0.055)	---	1.117** (0.707)	2.223 (0.009)	0.993 (0.078)	-2.190 (-0.711)
	$D\ln DTO$	1.119* (0.788)	1.890 (0.020)	0.989 (0.556)	2.435 (0.234)	2.879** (0.772)	---	-1.996 (-0.078)	-6.564 (-0.878)	-0.080** (-0.007)
	$D\ln MR$	-2.334* (-0.045)	2.812 (0.890)	-1.402 (-0.226)	-0.991 (-0.561)	1.677 (0.390)	-1.030 (-0.023)	---	-2.909 (-1.955)	-1.887 (-0.600)
	$D\ln Inflation$	-1.908 (-0.008)	2.880 (0.056)	-1.905 (-0.467)	1.093 (0.443)	1.230 (0.515)	-0.991 (-0.440)	1.117 (0.340)	---	-2.800 (-0.091)
Morocco	$D\ln GDP\ percapita$	---	1.115** (0.565)	-2.180 (-0.867)	1.009 (0.244)	1.010 (0.333)	1.909* (0.021)	0.970 (0.026)	-1.091 (-0.345)	-0.887** (-0.771)
	$D\ln PHS$	0.951*** (0.877)	---	-3.760 (-0.014)	0.779 (0.299)	1.996** (0.230)	1.870 (0.019)	0.996 (0.012)	-0.892 (-0.258)	-0.022* (-0.794)
	$D\ln Corruption$	-1.871 (-0.002)	-0.878 (-0.980)	---	-1.991 (-0.887)	-1.870 (-0.015)	-4.771 (-0.014)	2.909 (0.127)	-2.887 (-4.761)	-0.955 (-0.008)
	$D\ln GERST$	2.882* (0.765)	2.991 (0.007)	-1.996 (-0.065)	---	1.800* (0.562)	2.020 (0.459)	0.981 (0.089)	1.900 (0.771)	0.901* (0.544)
	$D\ln LEB$	1.881** (0.661)	2.870* (0.001)	-0.900 (-0.120)	1.178 (0.335)	---	1.880* (0.215)	-0.987 (-0.661)	3.881 (3.178)	0.901* (0.887)
	$D\ln DTO$	4.770* (0.887)	2.980** (0.542)	-2.776 (-0.561)	3.700* (0.006)	1.799** (0.022)	---	-2.881 (-0.110)	-1.891 (-0.787)	1.677 (0.221)
	$D\ln MR$	0.870 (0.099)	1.900 (0.333)	1.768 (0.024)	3.551 (0.044)	2.996 (0.560)	1.693 (0.980)	---	-3.232 (-0.646)	-2.803 (-0.039)
	$D\ln Inflation$	-2.770 (-0.335)	2.178 (0.008)	-2.990 (-0.221)	0.872 (0.322)	1.557 (0.005)	-1.676 (-0.089)	2.322 (0.381)	---	-0.310* (-0.011)

Notes: The asterisks *, ** and *** denote the significance respectively at the 10%, 5% and 1%. t-statistics is stated in parentheses.

Finally, in Morocco, there are four positive bidirectional causal relationships between GDP per capita and PHS, GDP per capita and DTO, PHS and LEB and between LEB and DTO. The results show also those are four positive unidirectional causal relationships, where GERST and LEB affect GDP per capita and the other unidirectional causal relationships are between GERST and LEB, and between DTO and PHS. Through the results of causal relationships, we can conclude that Tunisia and Morocco have the same bidirectional relations between GDP per capita and PHS, between GPD per capita and DTO and between LEB and DTO. In addition, these two countries have the same unidirectional causal relationships where GERST influence LEB, and where LEB influence GDP per capita.In the case of relationship between PHS and GERST, the results revealed the absence of unidirectional and bidirectional causal relationships for Tunisia and Morocco, and the absence of unidirectional and bidirectional causal relationships between PHS and DTO. We can thus conclude that the health policy and the educational policy is independent also; health policy does not depend on trade policy in these two countries.



Note: (→) indicates direction of causality.

Figure 3. Bidirectional Causal Relationships

Using the errors correction term (ECT), we can confirm the existence of long-run causal relationships in both countries. If the coefficient is the same time negative and significant, so it is means that there is at least one relationship between variables and the independent variable (in our case it the GDP per capita) has an essential function as an adjustment factor when the econometric model keep away from equilibrium. The results of ECT coefficients show that GDP per capita, PHS, GERST and DTO are the elements of adjustment of long run of equilibrium in Tunisia with speed respectively 0.99%, 0.77%, 0.95% and 0.08%. In Morocco, we look that GDP per capita, PHS and Inflation are the elements of adjustment of long run of equilibrium with speed respectively 0.88%, 0.022% and 0.31%.

Generally, the VECM estimation gives some similar results in Tunisia and in Morocco. For example, we can see clearly that GDP per capita and PHS have some causal relationships in short and long run in both countries. It is means that PHS is an

essential factor to determinate GDP per capita and vice versa.

In final step, we use diagnostic tests to assess the robustness of our empirical model. The Cumulative Sum of Recursive Risiduals (CUSUMSQ) and Cumulative Sum of Recursive Risiduals (CUSUM) have used to analyze the stability of model over time estimated by the ARDL approach. These two tests are in the form of figures. If both the CUSUM and CUSUMSQ curves are within two critical terminals at the 5% threshold; we therefore accept the null hypothesis, which indicates the stability of the coefficients of the regression, and subsequently the model is stable over time. Figure 4 and Figure 5 indicate that the two Tunisian and Moroccan curves of CUSUM and CUSUMSQ are within two bounds of confidence interval at 5%. These results confirm that our econometric model is stable over time for the two countries studied.

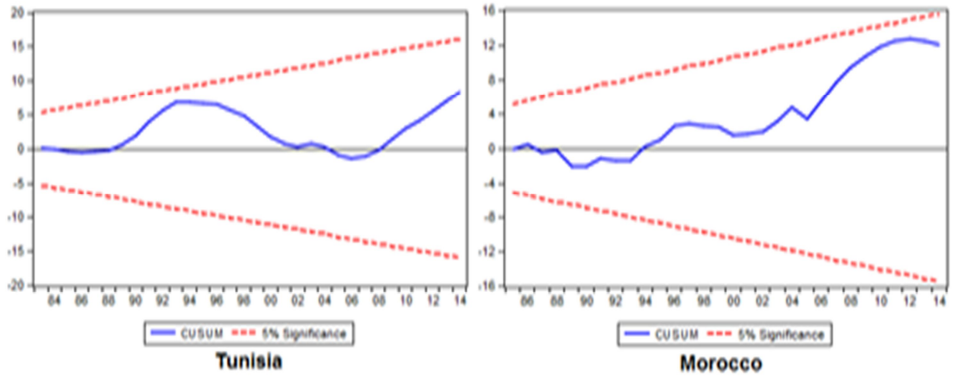


Figure 4. Plot of Cumulative Sum of Recursive Residuals (CUSUM)

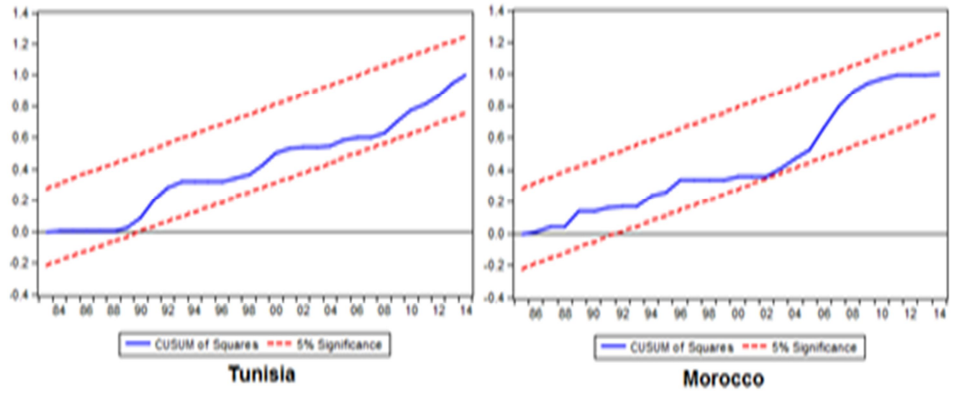


Figure 5. Plot of Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ)

Table 8. Structural Breaks Test

Tunisia			Morocco		
Structural breaks			Structural breaks		
	Sequential	Repartition		Sequential	Repartition
1	1992	1992	1	2008	2008
2	2011	2011	2	2016	2016

The year 1992 was the first break during our study period. In 1986, Tunisia implemented an economic reform program through the implementation of the structural adjustment program (SAP), controlled by International Monetary Fund (IMF). This strategy has enabled Tunisia to obtain new foreign financing resources in the form of loans. While, 1992 year represents the due date for repayment of a set of loans. Therefore, it is constituted a rather heavy financial burden on government budget. As a result, the Tunisian economic growth rate increased from 7.8% in 1992 to 2.2% in 1993 (according to World Bank). The second break was in year 2011, date of popular revolution against the government of President "Ben Ali". This demonstration has caused a situation of political instability that has direct consequences on the economic situation through the considerable drop in the performance of tourism sector and the decline in private and foreign investment.

However, in Morocco case, the first break was in 2008, date of financial crisis or "subprime crisis" which has directly and negatively affected Moroccan economy. In effect, economic disruptions in partner countries (the European Union) are transmitted to the Moroccan economy through lower foreign direct investment, lower numbers of incoming tourists and lower export volumes. The second structural break was in 2016. During this year, Morocco experienced a severe drought that led to a drop in the agricultural sector's yield, which represents 12.4% of GDP and offers 37% of total employment (World Economic Outlook Database, 2018).

6. CONCLUSION AND POLICY IMPLICATION

The main objective of this investigation study is to examine the relationship between GDP per capita and PHS in Tunisia and in Morocco. Corruption, GERST, LEB, DTO, MR and Inflation were using as control variables. To determine the type of these relationships, we used annual data during period 1980-2017 by applying different steps. We started by stationarity test to detect the unit root and to identify the order of integration of our variables by means of ADF and PP tests. Secondly, we use the Wald test to verify the existing of long run relationships between variables. In third step, we apply the Bounds test for cointegration, and then we estimate our model by ARDL approach. In final step, we use the VECM approach. The results of stationarity test show that Corruption, DTO and MR are stationary at level in Tunisia and in Morocco, and

only Inflation was stationary at level in Morocco case. However, all variables are stationary in first difference in both countries. The Wald test indicates the existence of relations of long run and the Bounds test confirm also the existing of relations of cointegration in two countries. By applying the ARDL approach, we found that PHS has significant and positive impacts on Tunisian and Moroccan GDP per capita, but more intensely in Tunisia than in Morocco. Corruption, MR and Inflation have negative impact on GDP per capita in two countries. In this case, Tunisian and Moroccan governments need to be more serious in fighting against corruption. However, these two states should revise their policy monetary to reduce the increases of prix to conserve the purchasing power of households. LEB has a negative influence on Moroccan GDP per capita growth. The Moroccan Kingdom should investigate more in health sector and ameliorate live conditions of their households to upgrade the health indicator and to augment LEB in order to reduce mortality rate at the individuals. GERST and DTO have significant and positive effects on GDP per capita in Tunisia and in Morocco.

The VECM results for Tunisian and Moroccan countries give diversified relationships among variables. The results of short run causal relationships indicate that in Tunisian case, GDP per capita has three positive bidirectional causal relationships with PHS, GERST and with DTO. The fourth bidirectional causal relationship are positive and between LEB and DTO. The results indicate also that there are four positive unidirectional causal relationships between PHS and LEB, GERST and LEB, GERST and DTO and between LEB and GDP per capita. The causal relationships between MR and GDP per capita and between Corruption and GDP per capita are negative. In Morocco, the results reveal that there are four positive causal relationships between GDP per capita and PHS, between GDP per capita and DTO, between PHS and LEB and finally between LEB and DTO. The overall results show four positive unidirectional causal relationships that are between GERST and GDP per capita, between GERST and LEB, between DTO and PHS and between LEB and GDP per capita.

The different results of ARDL approach and VECM Granger causality test reveals that PHS effect positively in short run and in long run the Tunisian and the Moroccan GDP per capita. We can conclude that PHS is an essential factor to determinate the GDP per capita in these two countries. In addition, DTO has positive effect on the increases of GDP per capita in Tunisia and in Morocco in short run then in long run. This result confirms the success of the business policy of two countries with the outside and show that their economics are dependent on rest of world. In this case, Tunisia and Morocco should develop their external transaction through access to new external markets.

To summarize, we can conclude that the two countries selected to study the effect of public health spending on economic growth are very close to being economically similar. The results of the ARDL estimate show that public expenditure on health has the same sign on the Tunisian and Moroccan economy and that all the variables used have the same sign except for life expectancy variable. In addition, Granger's causal results show that there are two bidirectional relationships between public health spending and economic growth and between the degree of trade openness and economic growth in

Tunisia and Morocco.

The spatial study shows that both countries suffer from regional inequality in terms of the distribution of health infrastructure and medical personnel.

As policy implications of this study, these two countries that want sustainable economic growth can achieve it by investing and improving the stock of human capital in health sector, especially if current stocks are low. In other words, the results indicate that public spending on health is a major factor for long-term economic growth. However, we must not forget that these two countries are developing countries that will have to make a number of similar decisions in order to achieve their objectives for the health of their peoples. First, they need to decide in which value they see health as an end in itself or as an element of economic growth. Secondly, Tunisia and Morocco should put in place strategies that protect the poor from rising care costs at a time when the private sector is becoming increasingly dominant. Regional inequality in terms of health infrastructure and personnel has become a massive problem for both countries. Therefore, it is necessary to rebalance the regions through investment in infrastructure and the recruitment of medical personnel, especially in the inland regions of two countries. Finally, these countries and especially Tunisia must improve the efficiency and management of their social security funds to deal with their financial problems. These decisions or strategies can ensure a good state of care and even improve people's confidence in their political system.

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