The determinants of health expenditures in Tunisia: An ARDL bounds testing approach

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Abstract: In the current paper, we examine the determinants of health expenditures in Tunisia during the period 1961-2008, using the Autoregressive Distributed Lag (ARDL) approach by Pesaran et al. (2001). The results of the bounds test show that there is a stable long-run relationship between per capita health expenditure, GDP, population ageing, medical density and environmental quality. In fact, on the one hand there are the short-run and long-run results which reveal that health care is a necessity, not a luxury good. On the other hand, results of the causality test show that there is a bidirectional causal flow from health expenditures to income, both in the short and in the long run.

Keywords: Health expenditures; ARDL model; Tunisian context; Income elasticity; Granger causality.

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1 Introduction

Since the 1960s, the increase of health expenditure has caused much concern all over the world. A number of studies have attempted to explain the rise in health expenditures and suggested what variables can be influenced to reduce the costs. All of these studies have considered the approach of the demand function to specify their models. Specifically, health care expenditures are hypothesized to be a function of real per capita income and other non income variables.

The non income factors have been identified in literature. So, what may affect the increase of health expenditures are the following:

- The demographic growth: care consumption and age are clearly linked. Therefore, indicators such as the proportion of the young (e.g., under 15 years old) and old people (e.g., above 65 or 75 years old) over the active or total population have been traditionally flagged as important factors in explaining variations of health care expenditure. However, little evidence exists about the significant effect of these variables (Grossman, 1972; Leu, 1986; Hitiris and Posnett, 1992; Di Matteo, 1998; Felder et al, 2000).

- The technological progress: since the works of Manning et al. (1987) and Newhouse (1992), the rapid technological progress has been seen as a factor of supply and demand who explains the growth of health care expenditure. However, due to the difficulty of finding an appropriate proxy for the changes in medical care technology, very few studies have attempted to study the relationship between the technological progress and health care expenditure. A number of proxies have been considered in literature, such as the surgical procedures and the number of specific medical equipment (Baker and Wheeler, 2000; Weil, 1995), the R&D spending specific to health care (Okunade and Murthy, 2002), life expectancy and infant mortality (Dregen and Reimers, 2005). Some other papers have investigated the effect of the technical changes by adding a time index or time-specific intercepts in the regression specification (Gerdtham and Lothgren, 2000; Di Matteo, 2004).

- The role of the real prices in determining the demand for health care is essential (Grossman, 1972). The various studies on the determinants of health care service noted that "a change in the volume of health expenditure is not sufficient to explain the evolution of the share of expenditure in the GDP" (Bac et Cornilleau, 2002). The increase in this price of health expenditures may result in raising either the quantities of the consumed medical care or the prices of the health sector. The importance of any factor differs from one country to another. However, there is a little empirical consensus on the effect of the real prices on the health care expenditure. This consensus may be explained by the increasing prices of health services compared to other prices since wages in low productivity sectors must keep up with those in high productivity ones (Hartwig, 2008; Okunade et al., 2004), report a positive and statistically significant effect, while (Baumol,1967,Gerdtham et al., 1992; Murthy and Ukpolo, 1994) report an insignificant effect. Hartwig (2008, p.6) asserts that “…we have to recognize that medical care price indices can not probably be relied on as deflators or explanatory variables.” In fact, since the studies argue that given the paucity of data on price, the diverse national schemes of price regulation and the problems in measuring the quality of health care in obtaining this medical price index, we decided not to use this variable in our empirical analysis.

- The medical density, which is defined by physicians as per thousand population and used to account for the supply of healthcare, can be considered a cause of the increase in the health expenditures (Delattre and Dormont, 2005; Murthy and Okunade, 2009). This led to the hypothesis of the induced demand which reflects the excess supply of services due to an increase in demand initiated by patients. Theoretically, induced demand is generated by the monopoly of the medical knowledge of doctors associated with the low sensitivity of patients to prices. The excess supply of care can then contribute
to higher health costs depending on different modes of organization of health care systems.

- Institutional factors: the rise of health expenditure could come from taking the institutional factors into consideration. Two approaches are used. The first distinguishes the effects of instructions of remuneration. The second distinguishes the effects of the type of national health system (e.g., contractual system or integrated system). According to Mahieu (2000), the overall consideration of the specific institutional leads to larger gaps, the time trend is higher for the repayment system (1.52%) than the two other systems (0.59% for the integrated system, 0.68% for the contract system). Azizi and Pereira (2005) confirm that expenditure growth is stronger in countries where the method of repayment is dominant.

To summarize, except for income which has been recognized as an important determinant of health care spending, there are no other factors which explain the variation in per-capita health expenditure. Indeed, this failure can be explained by the limited availability of health care data at the macro level, others studies even blame the weakness of the econometric methods already used (Wilson, 1999).

Therefore, the present paper differs from the existing studies on the determinants of health expenditures in three different ways. Firstly, the proposed methodology for cointegration is the ARDL approach. One reason for preferring the ARDL bounds testing approach is that the critical values produced by Pesaran et al. (2001) allow for the inclusion of a mix of I(0) and I(1) variables in the cointegrating relationship. The statistics underlying this procedure is the familiar Wald or F-statistic in a generalized Dickey-Fuller type regression, which is used to test the significance of the lagged levels of the variables under consideration in a conditional unrestricted equilibrium error correction model (ECM) (Pesaran, et al. 2001, pp. 289-290). Another reason is that the ARDL approach is more robust and performing better for small sample sizes than other cointegration techniques. Secondly, we will introduce and test the relevance of the environmental quality in this study. It is detrimental to human health that affects the society not only in terms of loss of quality of life, but also in terms of expenditure on health care (OECD Environmental Outlook, 2001). Finally, this study attempts to examine the presence of a long run equilibrium relationship and causality between health expenditure and its determinants using the ARDL bounds testing procedure.

The remainder of the paper proceeds as follows: Section 2 provides an analysis of health expenditures in Tunisia. Section 3 provides methodological and data description. Section 4 reports the empirical results of this study. Section 5 gives our concluding remarks.

2 Health expenditures in Tunisia

2.1 Evolution of health expenditures

According to World Health Organization, the total health expenses are the sum devoted to the public and private health sectors. It covers the provision of health services (preventive and curative), the family planning activities, the nutrition activities, and the emergency aid designated for health but does not include provision of water and sanitation.

In Tunisia, like in many other middle-income countries, health expenditures has increased dramatically during the past two decades. Over the period 1961-2008, the total health spending increased threefold from 78 to 2891 million TND.
Not only has health expenditures increased in absolute terms, but in relative terms as well. The share of the GDP allocated to health increased from 4.2 percent in 1985 to 5.6 percent in 2008. The State’s share of the total health expenditures as a percent of the GDP remained relatively stable at around 2 percent for the period (1990-1995); then later it dropped to 1.7 percent in 2000 and 1.6 percent in 2008 as a result of the significant contributions of the National Social Security Fund\(^1\) due to the substantial increase in social and health insurance coverage that went up from 53 percent in 1987 to 92 percent in 2008, thus decreasing considerably the number of indigents that used to be covered by the State.

### 2.2 Financing of health expenditures

There are three major sources of financing for health expenditures:

- **With the financing the budget by the State:** from 2000 to 2008, there has been an average growth rate of health expenditures funded by the State 3 percent. However, despite this increase in financing by the State, the relative contribution by the State to health care has dropped from 38 percent to 26.9 percent.

- **With the financing through the social security schemes:** From 2000 to 2008, there has been an average annual increase rate of health expenditures by social security of 11 percent with an increase in the share of the total spending from 16 to 21.7 percent.

- **With the Private financing includes individual spending (reimbursed and not reimbursed by private insurances or mutuelles) and spending from occupational health and curative health from firms.** The largest portion of the expenses is spent directly by households and because of the lack of information; it is very difficult to separate these. From 2000 to 2008, the estimated average annual increase rate of private health expenditures was 8.3 percent and an increase in total health spending contribution from 46 percent in 2000 to 51.4 percent in 2008.

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\(^1\) Since July 2007, The National Health Insurance fund
3 Methodology

3.1 ARDL Bounds Test

Following Pesaran et al. (2001), we consider the vector auto-regression of order $p$ ($VAR(p)$), for the following determinants of health expenditures function:

$$Z_t = \mu + \alpha_t + \beta_t Z_{t-1} + \epsilon_t, \quad t = 1, 2, ..., T \quad (1)$$

With $\mu$ representing a $(k+1)$-vector of intercepts (drift) and $\alpha$ denoting a $(k+1)$ vector of trend coefficients. Further derived the following vector equilibrium correction model (VECM) corresponding to equation (1):

$$\Delta Z_t = \mu + \alpha_t + \lambda Z_{t-1} + \sum_{i=1}^{p} \Gamma_i Z_{t-i} + \epsilon_t, \quad t = 1, 2, ..., T \quad (2)$$

Where $\Delta$ the first-difference operator, the $(k+1) x (k+1)$-matrices

$$\lambda = I_{k+1} + \sum_{i=1}^{p} \Psi_i \quad \text{and} \quad \Gamma_i = - \sum_{j=i+1}^{p} \Psi_j, \quad i = 1, 2, ..., p - 1$$

contain the long-run multipliers and short-run dynamic coefficients of the VECM. $Z_t$ is the vector of variables $x_t$ and $y_t$, respectively. $y_t$ is an $I(1)$ dependent variable defined as the total health expenditures (HEXP), $x_t = [GDP, MD, POPA, EQ]$ i.e., per capita GDP (GDP), medical density (MD), population ageing (POPA) and environmental quality (EQ) is the vector matrix of ‘forcing’ $I(0)$ and $I(1)$ regressors as already defined with a multivariate identically and independently distributed (i.i.d) zero mean error vector $\epsilon_t = (\epsilon_{1t}, \epsilon_{2t})'$, and a homoskedastic process. Further assuming that a unique long-run relationship exists among the variables, the conditional VECM (equation 2) now becomes:
\[ \Delta y_t = \mu_0 + \alpha t + \beta_{12} y_{t-1} + \beta_{32} x_{t-3} + \sum_{i=1}^{p-1} \gamma_i \Delta y_{t-i} + \sum_{i=1}^{p-1} \phi_i \Delta x_{t-i} + \varepsilon_{yt}, \quad i = 1, 2, \ldots, T \quad (3) \]

On the basis of equation (3), the conditional VECM of interest can be specified as:

\[
\Delta \text{LHEXP}_t = \mu_0 + \alpha t + \beta_{11} \Delta \text{LHEXP}_{t-1} + \beta_{12} \Delta \text{LGDP}_{t-1} + \beta_{13} \Delta \text{LPOP}_t - 1 + \beta_{14} \Delta \text{MD}_{t-1} + \beta_{15} \Delta \text{EQ}_{t-1} + \sum_{i=1}^{p_1} \gamma_i \Delta \text{LHEXP}_{t-i} + \sum_{i=0}^{p_2} \phi_1 \Delta \text{LGDP}_{t-i} + \sum_{i=0}^{p_3} \psi_2 \Delta \text{LPOP}_{t-i} + \sum_{i=0}^{p_4} \psi_3 \Delta \text{MD}_{t-i} + \sum_{i=0}^{p_5} \psi_4 \Delta \text{EQ}_{t-i} + \varepsilon_t \quad (4) \]

Where \( L \) is the natural logarithm, \( \mu_0 \) is the drift, \( \varepsilon_t \) the white-noise error term and \( \beta_i \) are the long run multipliers.

The implementation of the ARDL Bounds test approach (Pearson and al. 2001) requires three steps. The first step is to estimate equation (4) by the OLS method in order to test for the existence of a long-run relationship among the variables. The bounds testing procedure is based on the joint F-statistics (or Wald statistics) of cointegration analysis. The asymptotic distribution of the F-statistics is non-standard under the null hypothesis of no cointegration between the examined variables. The null hypothesis of no cointegration among the variables in equation (1) is \( H_0: \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0 \) against the alternative hypothesis \( H_1: \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0 \). Pesaran et al. (2001) report two sets of critical values for a given significance level. One set of critical values assumes that all variables which are included in the ARDL model are I(0), while the others are calculated on the assumption that the variables are I(1). If the computed test statistic exceeds the upper critical bounds value, then the \( H_0 \) hypothesis is rejected. If the F-statistic falls into the bounds, then the cointegration test becomes inconclusive. If the F-statistic is lower than the lower bounds value, the null hypothesis of no cointegration can not be rejected.

In the second step, once cointegration is established the conditional ARDL \(( p_1, p_2, p_3, p_4, p_5) \) long-run model can be estimated as:

\[
\Delta \text{LHEXP}_t = \mu_0 + \sum_{i=1}^{p_1} \beta_1 \Delta \text{LHEXP}_{t-i} + \sum_{i=0}^{p_2} \beta_1 \Delta \text{LGDP}_{t-i} + \sum_{i=0}^{p_3} \beta_3 \Delta \text{LPOP}_t - 1 + \sum_{i=0}^{p_4} \beta_4 \Delta \text{MD}_{t-i} + \sum_{i=0}^{p_5} \beta_5 \Delta \text{EQ}_{t-i} + \varepsilon_t \quad (5) \]

Where all the variables are as previously defined. This involves selecting the orders of the ARDL \(( p_1, p_2, p_3, p_4, p_5) \) model in five variables using Akaike Information Criterion (AIC) and Schwartz Bayesian Information Criterion (SBC). In the third and final step, we obtain the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. This is specified as follows:

\[
\Delta \text{LHEXP}_t = \sum_{i=1}^{p} \gamma_1 \Delta \text{LHEXP}_{t-i} + \sum_{i=1}^{p} \phi_1 \Delta \text{LGDP}_{t-i} + \sum_{i=0}^{p} \phi_2 \Delta \text{LPOP}_t - 1 + \sum_{i=0}^{p} \psi_3 \Delta \text{MD}_{t-i} + \sum_{i=0}^{p} \psi_4 \Delta \text{EQ}_{t-i} + \theta \text{ECM}_{t-1} + \varepsilon_t \quad (6) \]

Where \( \gamma \) and \( \varphi \) are the short-run dynamic coefficients of the model’s convergence to equilibrium and \( \theta \) is the speed of adjustment.

### 3.2 Granger causality test

Once the existence of a long run cointegrating relationship has been verified, the next step is to examine the short and long-run Granger causality between the health expenditures, GDP, medical density, population ageing and environmental quality. The traditional Granger’s definition of causality is based on the notion that the future can not cause the past, but that the past can cause the future. According to Granger’s definition of causality, a time series \( X_t \), causes another time series \( Y_t \), if \( Y_t \) can be better predicted (in a mean-squared-error sense) when using past the values of \( X_t \). That is, if past values of \( X_t \) significantly contribute...
to forecasting, then $X_t$ is said to Granger cause $Y_t$. Causality from $Y$ to $X$ can also be defined in the same way. That is, when the past values of $X_t$ significantly contribute to the forecast of the future values of $X_t$, then $Y_t$ is said to Granger cause $X_t$.

The conventional Granger causality test involves the testing of the null hypothesis that $X_t$ does not cause $Y_t$ and vice versa by simply running the following two regressions

\begin{align}
Y_t &= \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}Y_{t-i} + \sum_{i=1}^{n} \beta_{1i}X_{t-i} + \varepsilon_t \quad (7) \\
X_t &= \beta_0 + \sum_{i=1}^{n} \alpha_{2i}Y_{t-i} + \sum_{i=1}^{n} \beta_{2i}X_{t-i} + \mu_t \quad (8)
\end{align}

Where $\varepsilon_t$ and $\mu_t$ are the white noise error processes and $n$ denotes the number of lagged variables.

The Null hypothesis that $X_t$ does not Granger cause $Y_t$ is rejected if $\beta_{1i}$ are jointly significant (Granger, 1969). However, according to Odhiambo, 2004, the traditional causality tests suffer from two methodological deficiencies. First, these standard tests do not examine the basic time series properties of the variables. If the variables are cointegrated, then these tests, which incorporate different variables will be mis-specified unless the lagged error-correction term is included (Granger, 1988). Second, we test the series stationary mechanically by differencing the variables and consequently eliminating the long-run information embodied in the original form of the variables. Being opposed to the conventional Granger causality method, the error-correction-based causality test allows for the inclusion of the lagged error-correction term derived from the cointegration equation. By including the lagged error-correction term, the long-run information lost through differencing is reintroduced in a statistically acceptable way. The Granger causality model used in the current study is based on equation (6).

The existence of a long-run relationship between the variables suggests that there must be a Granger causality in at least one direction. It does not indicate the direction of temporal causality between the variables. The direction of the causality in this case can be determined only by the F-statistic and the lagged error-correction term. While the t-statistic on the coefficient of the lagged error-correction term represents the long-run causal relationship, the F-statistics on the explanatory variables represents the short-run causal effect (see Odhiambo, 2008, 2009; Narayan and Smyth, 2006). It is necessary to note that when the null hypothesis is of no cointegration, it is rejected and therefore the equation will be estimated with an error-correction term (see also Narayan and Smyth, 2006; Morley, 2006; Odhiambo 2009).

### 3.3 Data description

The empirical analysis is based on Tunisia. The Time series data are annual and cover the period 1961-2008. The per capita health expenditures and per capita GDP are measured in the Tunisian National Dinar at 1990 constant prices. We also gathered data from the following variables that have been identified in literature as for their role in determining health care expenditure: medical density; population ageing and environmental quality proxied by nitrogen oxide emissions in kilos per capita. All the data obtained from the World Development Indicators (2006) and the National Institute of Statistics of Tunisia are converted into a natural logarithmic form before the empirical analysis.

### 4 Results and Discussions

#### 4.1 Unit root test
Many macroeconomic time series contain unit roots that are characterized by the existence of stochastic trends as developed by Nelson-Plosser (1982). Unit root test is significant in examining the stationary of a time series because the non stationary regressor rejects many empirical results. The existence of the stochastic trend is determined by the unit root test of time series data. In this study, the unit root is tested using the Augmented Dickey-Fuller (1979) and Phillips-Perron tests (1988).

Table 1 and 2 present the results of the ADF and Phillips-Perron tests. The order of integration is tested at 5% significance level and the critical values obtained from Mackinnon (1991) Tables. The results are robust regardless of the lag length.

**Table 1** ADF unit root tests results for stationarity of the variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Intercept</th>
<th>Intercept and trend</th>
<th>Intercept</th>
<th>Intercept and trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHEXP</td>
<td>1.159</td>
<td>-2.360</td>
<td>-7.458***</td>
<td>-7.645***</td>
</tr>
<tr>
<td>LGDP</td>
<td>1.903</td>
<td>-0.344</td>
<td>-5.556***</td>
<td>-5.888***</td>
</tr>
<tr>
<td>LPOPA</td>
<td>-0.139</td>
<td>-3.414*</td>
<td>-3.648***</td>
<td>-3.810**</td>
</tr>
<tr>
<td>MD</td>
<td>3.206</td>
<td>-0.576</td>
<td>-5.855***</td>
<td>-7.845***</td>
</tr>
<tr>
<td>LEQ</td>
<td>-4.638***</td>
<td>-6.279***</td>
<td>-12.822***</td>
<td>-14.262***</td>
</tr>
</tbody>
</table>

***Significant at 1% level,** Significant at 5% level,* Significant at 10% level.

**Table 2** Phillips–Perron (PP) unit root tests results for stationarity of the variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Intercept</th>
<th>Intercept and trend</th>
<th>Intercept</th>
<th>Intercept and trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHEXP</td>
<td>1.423</td>
<td>-2.360</td>
<td>-7.459***</td>
<td>-7.653***</td>
</tr>
<tr>
<td>LGDP</td>
<td>1.764</td>
<td>-0.529</td>
<td>-5.583***</td>
<td>-5.888***</td>
</tr>
<tr>
<td>LPOPA</td>
<td>0.893</td>
<td>-3.021</td>
<td>-2.896*</td>
<td>-2.497</td>
</tr>
<tr>
<td>MD</td>
<td>4.511</td>
<td>-0.009</td>
<td>-6.082***</td>
<td>-8.006***</td>
</tr>
<tr>
<td>LEQ</td>
<td>-6.638***</td>
<td>-5.537***</td>
<td>-12.969***</td>
<td>-16.803***</td>
</tr>
</tbody>
</table>

***Significant at 1% level,** Significant at 5% level,* Significant at 10% level.

The results obtained show that after differencing the variables once, they are confirmed to be stationary. The ADF and Phillips–Perron tests applied to the first difference of the data series reject the null hypothesist of non-stationarity for all the variables except for the environmental quality used in this study. Therefore, it is worth concluding that all the variables used in this study are not I(2).

**4.2 Cointegration test**

The next step is to investigate whether the total health expenditures, GDP, population ageing, medical density and environmental quality share a common long run relationship. To achieve this, as explained earlier, we test the presence of the long run relationship in equation (5). Before we proceed to the calculation of the F-test statistic, an important step is conducted to establish the optimal lag length to be used in the cointegration analysis. In order to find the optimal length of the variables, several lag selection criteria, such as the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC) and Hannan–Quinn Criterion (HQC), are utilized at this stage. Using the SBC, we find that the optimal lag is 1 for this exercise. We find that there is a long run relationship between the variables when health expenditure is a dependent variable because its F-statistic, which turns out to be 5.508, is higher than the upper bound critical
value of 3.74 at 1% level of significance. This implies that the null hypothesis of no cointegration among the variables in equation (5) cannot be accepted. The diagnostic test results of equation (5) are also displayed in table 3.

Table 3  Bounds F-test for cointegration

<table>
<thead>
<tr>
<th>Null hypothesis: no cointegration</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Computed F-statistic</td>
<td>6.65270***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bounds Critical Values</th>
<th>lower</th>
<th>upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% significance level</td>
<td>3.74</td>
<td>5.06</td>
</tr>
<tr>
<td>5% significance level</td>
<td>2.86</td>
<td>4.01</td>
</tr>
<tr>
<td>10% significance level</td>
<td>2.45</td>
<td>3.52</td>
</tr>
</tbody>
</table>

Notes: The reported bounds critical value are taken from Pesaran et al. (2001), Table C1(v) CaseV: unrestricted intercept and unrestricted, p.301

The estimated long run elasticity of the total health expenditures with respect to the real GDP, the population ageing; the medical density; the environmental quality for equation 1, are presented in table 4.

Table 4  Long run elasticities based ARDL model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGDP</td>
<td>0.730241994</td>
<td>0.00009255***</td>
</tr>
<tr>
<td>LPOPA</td>
<td>0.645185376</td>
<td>0.00037836***</td>
</tr>
<tr>
<td>MD</td>
<td>0.041880295</td>
<td>0.53815307</td>
</tr>
<tr>
<td>LEQ</td>
<td>0.329826401</td>
<td>0.00107826***</td>
</tr>
<tr>
<td>Intercept</td>
<td>-3.299712716</td>
<td>0.0015359***</td>
</tr>
<tr>
<td>Trend</td>
<td>-0.006783025</td>
<td>0.16523609</td>
</tr>
</tbody>
</table>

*** Significant at 1% level, ** Significant at 5% level.

Based on the results of model ARDL, our main findings can be summarized as follows.

First, we notice that, except for the medical density, all the variables are statistically significant determinants of the total health expenditures. Although the real GDP appears with a positive and statistically significant elasticity, it significantly allows explaining a high proportion of the variability of the latter, but with elasticity less than 1, where health care is a normal good in Tunisia.

Therefore, by specifically examining the health care as funded by the public sector, we find that on the basis of income elasticity, it is a ‘necessity’ rather than a luxury good. This evidence, which is in line with some previous researches (Di Matteo and Di Matteo, 1998), indicates that when examining health care expenditure, significant differences emerge if expenditure is shared between the public and the private sectors. However, the positive and significant sign of the coefficient for the GDP might be capturing some evidence of the Wagner law, according to which the public expenditure expands with the economic development.
Second, in accordance with literature, the Tunisian population ageing will result in higher real per capita health expenditures with an elasticity of 0.64. This important elasticity can be explained by the demographic and epidemiologic transitions that are underway in Tunisia and which will strain government’s finances over the next several decades. It can be explained by two factors commonly suggested, the compression of morbidity and the institutional rationing of health expenditures. Another explanation is that the proportion of the old people and death rates do not always move in the same direction. For the last 20 years in Tunisia, ageing has been rising, but the crude death rates have been falling. However, to the extent that the health costs are related to the period before death, the falling death rates would have reduced the impact of ageing.

Third, the sign of the coefficient on the medical density is positive. The per-capita health care spending is expected to rise as the number of people per physician rises. The latter result may lead to a potential supply-induced demand problem and the physician-patient agency relationship. In fact, practitioners are paid on a fee-for-service basis; consequently there may be an incentive to expand the number of services provided to patients as physician density goes up.

Finally, our results show that there is a positive and no significance relation between the environmental quality and the health expenditures. It can be concluded that a 1% increment in environmental quality that leads to increase in health expenditures. With the economic growth in Tunisia, the consumption of crude oil, gasoline, kerosene, diesel, and fuel oil will increase. Our findings imply that economic growth will come at the cost of the environmental degradation, thus heightening the risk of pollution-induced health diseases, including mortality. This implies that if the proportion of health expenditure goes to caring for those affected by deterioration in environmental quality, then there are less funds available to cater for upgrading the environmental quality and, if this process continues, it is likely to lead to more pressures on government budgets.

4.3 Granger causality analysis

Having found that there is a long-run relationship between the various variables, the next step is to test the causality between the variables under study. Causality, in this case, is examined through the significance of the coefficient of the lagged error-correction term (ECM) and the joint significance of the lagged differences of the explanatory variables using the Wald test.

Table 5 Granger causality results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long run causality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LGDP(-1)</td>
<td>0.843272257</td>
<td>0.00000524***</td>
</tr>
<tr>
<td>LPOPA(-1)</td>
<td>0.465363579</td>
<td>0.54717818</td>
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<tr>
<td>MD(-1)</td>
<td>-0.117523643</td>
<td>0.21783497</td>
</tr>
<tr>
<td>LEQ(-1)</td>
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<td>0.23284449</td>
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<tr>
<td>ECM(-1)</td>
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<td>0.03102194**</td>
</tr>
<tr>
<td>Intercept</td>
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<td>0.87394690</td>
</tr>
<tr>
<td>Trend</td>
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<td>0.87516454</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Short run causality results (Wald test)</strong></th>
<th>LGDP</th>
<th>LPOPA</th>
<th>MD</th>
<th>LEQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHEXP</td>
<td>3.225**</td>
<td>2.201</td>
<td>2.065</td>
<td>1.679</td>
</tr>
</tbody>
</table>

** Significant at 5% level, ***Significant at 5% level.

Beginning with the short run effects, the population ageing, the medical density and the environmental quality are insignificant at the level of 5% in equation (6) (see Table 5). This implies that the population ageing; the medical density and the environmental quality do not Granger cause health expenditures in the short run. However, in equation (6), GDP and HEXP are statistically
significant at 1% and 5% level, respectively. This suggests that there is bidirectional Granger causality running from health expenditures to GDP in the short run. The short-run causality from the total health expenditures to the GDP is, however, supported by the F-test and the coefficient of the GDP variable, which are both statistically significant. The reverse causality from the GDP to the health expenditures, on the other hand, is supported by the lagged error-correction term, the F-statistic and the coefficient of the GDP variable in the model—which are all statistically significant.

Turning to the long run results we notice that the coefficient on the lagged error correction term is significant with the correct sign in equation (6) at 5% level, which confirms the results from the bounds test for cointegration (see Table 5). Thus, the long run causality from the GDP, the medical density and the environmental quality to the total health expenditures is supported by the coefficient of the lagged error correction term in equation (5), which indicates that there is a long run Granger causality running from income and non income factors to the total health expenditures.

5 Conclusion

This paper aims at revealing the magnitude of the income elasticity and the impact of non-income determinants of health expenditures in Tunisia using the time series on per capita GDP, population aged over 60 years, medical density, environmental quality, over the period 1961-2008. This paper contributes to the literature adopting the ARDL bounds approach of Pesaran et al. (2001) which ensures that our results are robust to uncertainty about the order of integration of the variables. The empirical analysis shows that the used variables present the unit root. On this basis, the cointegration analysis was applied as suggested by bounds –F-test. The results in the short and long run, which indicate that health care is a necessity rather than a luxury in Tunisia, confirms the a priori notion that health care behavior changes with the level of the economic development. Most previous studies of the developed countries empirically found health care to be a luxury good. The GDP variable exerts statistically significant and positive effects on health care. The results also illustrate the importance of the population over age 65 and the environmental quality in the long run. The results of causality test show that there is a bidirectional causal flow from health expenditures to income, both in the short run and in the long run.

However, the policies aiming at encouraging health expenses are required to build up a healthier and productive society to support the Tunisian’s economic growth and development. In addition, the Ministry of Health should minimize the gap of inequality distribution of health care among people considering the spread of emerging chronic diseases and assuring the quality and performance of public health supply. Moreover, the external cooperation of the World Health Organization is also required to make an exchange of expertise and health care information.

Future researches on the topic could consider other determinants of healthcare expenditures such as the relative price, the technological progress, or the measure of morbidity and inference about the trends in the mixed health sector in Tunisia. The structure of this mixture has been the centre of the debate of whether increasing centralization or privatization would yield more efficient outcomes. A larger data set may also be beneficial in future researches.

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References


