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Health nutrition and economic growth nexus: Evidence from panel Granger causality test

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Abstract---The study investigates the causal relationship between healthcare expenditure, nutrition and economic growth in 10 countries representative of the Middle East & North Africa over the period 2000:2024. Bootstrap panel Granger causality test approach is used taking into account the cross-sectional dependency and the heterogeneity in these countries. The empirical results support a bi-directional causality between economic growth and nutrition in Tunisia and Iran. The same a bi-directional causality is supported in empirical results of economic growth and health care expenditure in Algeria and way granger causality is supported in economic growth and health care expenditure in Tunisia, Saudi Arabia and Jordan. We concluded a way granger causality is supported in health care expenditure and economic growth in Morocco and Iran. We also found way granger causality in the economic growth and nutrition in Egypt, Morocco, Jordan and Lebanon. The result of the causality tests reveal a way granger causality in nutrition and economic growth in Oman.

Keywords---Nutrition, Economic Growth, health care expenditure, bootstrap panel causality test, Cross-sectional dependence, Heterogeneity.

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1. Introduction

The increase of healthcare costs improved the health of the population. Health is one of the important factors of human capital which plays a central role in socioeconomic development (Zafar, 2011). New growth theories considered human capital as important determinant of economic growth.

There is general consensus among the policy makers that good health is one of the key elements of socioeconomic development. Good health improvements reflects level of human capital and increases labor productivity which eventually accelerates the pace of economic growth. Good health also creates opportunities for individuals in obtaining better paid work and is expected to improve the levels as well as quality of education (Casasnovas and Rivera 2003). The role of the healthcare costs has for object to improve the access to health services. Income certainly gives an idea of the effort that a government provides for the health of her population but it is the public spending on health that allows measuring this effort (Rivera, 2001). The demand for health care expenditures is determined by the increase in the income per capita; on the other hand the increase in health care expenditure is estimated to improve health status. Growth of health care expenditure increases economic development and advancements in quality of life.

According to the World Health Organization (1999), the economic gains of good health had higher economic growth, while flee of ill-heath traps in poverty. (Ainsworth & Over, 1994) reported that disease is rampant in young workers which disturbed efficiency and domestic saving rates.
(Barro, 1996) (Barro R. , 1996) discussed that health is an investment productive advantage and a locomotive of economic growth. There is another knock-on effect of good health is that the resources used for health and preventive treatments are freed to be used for alternatives and cushion negative externalities

2. Literature review:

2.1 Health care expenditure and economic growth

In the literature, there are some studies, theoretical and empirical, which put the accent on the relationship between healthcare expenditure and economic growth (Granger, 1969). Empirically it has been attempts to find the direction of causality between healthcare expenditure and economic activities for some countries employing the Granger Test, ECM and other techniques. In recent papers, (Erdil & Yetkiner, 2009) (Chantzaras & Yfantopoulos, 2018) (Fogel, 1994) investigated the Granger causality approach to panel data with fixed coefficients in order to conclude the relationship between GDP and health expenditures per capita. The results verify that the dominant type of causality is bidirectional, which cast doubt on the performance ordinary least squares (OLS) estimates in the literature. Moreover, one-way causality patterns are not similar for different income groups. One-way causality generally runs from income to health in lower- and middle-income countries, but the opposite holds true for higher-income countries. (Elmi & Sadeghi, 2012) studied the causality and co-integration relationships between economic growth and health care expenditures in developing countries during 1990 to 2009.

Their conclusions specified that income is an important factor across developing countries in the level and growth of healthcare expenditure, in the long-run. Moreover, the health-led growth hypothesis in developing countries is confirmed. (Wang, 2011) examined the international total healthcare expenditure data of 31 countries from 1986 to 2007 to search the causality between an increase in healthcare expenditure and economic growth. The estimation of the panel regression identifies that, health expenditure growth will stimulate economic growth; however, economic growth will reduce health expenditure growth.

(Taban, 2006) examined the causal relationship between health and economic growth in Turkey for the period 1980 to 2000. They identified two-way causality relationship was seen between life expectancy at birth and economic growth, no causal relationship was found between health expenditures and economic growth.

(Mehrara & Musai, 2011) studied the relationship between health expenditure and economic growth in Iran for the period 1970 to 2007, based on the autoregressive distributed lag (ARDL) approach. The study identified a co-integrating relationship between real GDP, health expenditure, capital stock, oil revenues and education, although among them health spending accounts for just a small part of the economic growth. They concluded that healthcare expenditures did not make a significant marginal contribution to the economic growth in Iran.

(AK, 2012) studied the existence of a long-term causality relationship between health expenditures, economic growth and life expectancy at birth for the Turkish economy. As a result of the analysis, it was concluded that there isn't a short-term causality, although there is a long-term causality between health expenditures and economic growth.

(Odubunmi, Saka, & Oke, 2012) examined the relationship between healthcare expenditure and economic growth in Nigeria for the period 1970 to 2009. They used the multivariate co-integration technique proposed by Johansen and initiate the existence of at least one co-integrating vector describing a long run relationship between economic growth, foreign aid, health expenditure, total saving and population. The co-integrating equation, however, presented some deviations in terms of the signs of the coefficients of health expenditure

(Bakare & Olubokun, 2015) studied the relationship between health care expenditures and economic growth in Nigeria. There utilized ordinary least squares multiple regressions analytical method was used to examine the relationship between health care expenditures and economic growth. The data analysis presented a significant and positive relationship between health care expenditures and economic growth.

(Mehrara & Firouzjaee, 2011) examined the causal relationship concerning the health expenditure and the GDP in a panel of 11 exporting countries oil by using panel unit root tests and panel cointegration analysis. A three variable model is formulated with oil revenues as the third variable. There concluded a strong causality from oil revenues and economic growth to health expenditure in the oil exporting countries. However, health spending does not have any significant effects on GDP in short- and long-run. The results imply high vulnerability of oil dependent countries to oil revenues volatility. To separate the economy from oil revenue volatility requires institutional mechanisms de-linking health expenditures decisions from current revenue (Bukhari & Butt, 2007).

Chor Foon (Tang, 2009) employed the Granger causality test within a multivariate cointegration and error-correction framework to observed the relationship between health spending, income, and health price in Malaysia, by using data over a period from 1970 to 2009. As results of the analysis is that in the short-run there are uni-directional Granger causality running from health spending and health price to income in Malaysia. However, in the long-run health spending, income and health price are bi-directional Granger causality.

2.2 Human Health and Nutrition

Good health is important to living a productive life, meeting basic needs and contributing to community life. Good health is an enabling condition for the development of human potential. Earlier, (BERG, 1968) confirmed that malnutrition may obstruct economic growth of developing countries in many ways: Primary, by decreasing life expectancy, which reduces the productive years expected from newly born children; second, by decreasing resistance to illnesses which reduces available labor time; and third, by inhibiting the mental and physical development of children, which reductions their potential productivity as adult.

2.3 Nutrition and economic

Good nutrition contributes economic growth in a remarkable way so that, the contribution of nutrition to the impact of education on economic growth. Nutritionists and epidemiologists have demonstrated that the capacity of individuals to benefit from education depends on overcoming malnutrition, since the malnutrition diminishes the effective operation of the central nervous system. Much remains to be done in measuring the contribution of nutrition to economic growth.

Fogel indicates that "the increase in the number of calories available for work over the last 200 years has probably made a significant contribution to the economic growth of per capita income of countries like France and Great Britain". (Fogel R. , 1997) focused on nutrition as a key determinant of long-term decline in mortality as well as effects on productivity. However, an increasing number of data show that, in the long term, other health-related variables have a significant effect on macroeconomic growth. (Ogundari & Abdulai, 2013) investigate the causal relationship between nutrition and economic growth in sub Saharan Africa (SSA). The results of the causality tests reveal evidence of long and short-run bi-directional causality between nutrition and economic growth.

3. Data description

The data used in the analysis is annual. The data covers ten countries representative of the Middle East & North Africa namely Algeria, Egypt, Morocco, Tunisia, Iran, Saudi Arabia, Jordan, Lebanon, Oman, and Qatar for the period 1980:2014. It includes both health measured in health care expenditure, nutrition measured in food production index and economic growth measured by GDP per capita in constant 2010 US dollars. The data is derived from World Development Indicators (WDI). All the variables are expressed in per capita terms and converted in logarithmic series. Table1, Table 2 and Table 3 display the summary statistics of health care expenditure, real GDP and food production index.

Table 1: Summary statistics of healthcare expenditure

	Min	Max	mean	Median	sd	skew	kurtosis
Algeria	2.90	7.21	3.78	3.36	1.15	1.73	2.11
Egypt	3.54	5.97	4.41	4.61	0.88	0.17	-1.72
Morocco	3.49	6.15	4.36	3.71	0.99	0.55	-1.48
Tunisia	5.14	7.26	5.69	5.46	0.59	1.73	1.55
Iran	3.55	8.02	4.75	4.00	1.46	0.70	-0.97
Saudi Arabia	2.35	4.68	3.23	2.93	0.71	0.42	-1.17
Jordan	7.23	9.90	8.37	8.88	0.57	-0.33	0.43
Lebanon	6.39	13.44	10.34	9.88	2.23	-0.12	-1.26
Oman	2.01	3.70	3.16	3.24	0.44	-0.89	-0.27
Qatar	2.12	6.08	3.83	3.13	1.56	0.17	-1.85

Source: https://ar.tradingeconomics.com/

Table 2: summary statistics of gross domestic product

	Min	Max	mean	Median	sd	skew	kurtosis
Algeria	2297.10	3390.93	2780.70	2706.69	327.58	0.37	-1.24
Egypt	670.57	1475.13	1051.30	1001.13	258.18	0.38	-1.22
Morocco	1066.16	2546.59	1670.28	1553.08	445.99	0.56	-0.99
Tunisia	1844.20	3953.42	2680.87	2486.21	728.77	0.44	-1.37
Iran	1917.39	3850.84	2766.51	2554.04	546.43	0.49	-1.08
Saudi Arabia	11485.65	21320.70	13863.84	12730.47	2535.23	1.43	1.39
Jordan	1608.82	2878.22	2207.28	2148.48	376.40	0.53	-1.02
Lebanon	2688.77	7256.51	5285.23	5331.16	1074.87	0.20	-0.10
Oman	6954.62	14220.35	11512.82	11595.80	1776.56	-0.68	-0.07
Qatar	3700.80	8864.74	5916.36	5725.89	1537.09	0.37	-1.06

Source : https://ar.tradingeconomics.com/

Table 3: summary statistics of food production index

	Min	Max	mean	Median	sd	skew	kurtosis
Algeria	34.74	157.69	77.37	69.78	34.73	0.84	-0.30
Egypt	31.97	118.75	74.70	76.18	30.07	0.07	-1.48
Morocco	39.69	133.65	81.34	77.62	27.94	0.42	-0.92
Tunisia	39.91	118.95	81.11	81.35	24.42	0.01	-1.47
Iran	29.87	113.29	74.24	75.23	27.16	-0.04	-1.47
Saudi Arabia	22.70	110.18	77.28	77.22	24.93	-0.49	-0.72
Jordan	29.58	136.66	77.89	71.62	32.64	0.36	-1.04
Lebanon	30.48	116.59	87.73	96.08	19.78	-1.07	0.29
Oman	36.09	126.47	77.75	72.22	26.88	0.30	-1.21
Qatar	62.32	129.79	91.47	87.39	19.56	0.53	-0.69

Source : https://ar.tradingeconomics.com/

From these tables, we find that Oman and Lebanon have the lowest and highest levels of health care expenditure. The same Jordan and Saudi Arabia have the lowest and highest levels of real GDP. Respectively, Iran and Qatar have the lowest and highest mean of food production index.

4. Methodology

In order to investigate the causal relationship between health care expenditure, food production index and economic growth, we follow the method so-called the bootstrap panel causality test proposed by Konya (2006). The bootstrap panel causality approach is able to account for both cross-section dependence and cross-country heterogeneity.

To decide whether the slope coefficients are treated as homogeneous or heterogeneous to impose causality restriction on the estimated parameters, three statistical tests was selected: the Breusch and Pagan (1980) LM test, the Peasaran CD test, and (Pesaran & Yamagata, 2008) bias-adjusted LM test. The cross-country heterogeneity is tested by using the test for slope homogeneity proposed by (Pesaran, 2004) .

4.1 Cross-section dependence test

To test for cross-sectional dependency, the Lagrange multiplier (LM) test of (Breusch & Pagan, 1980) is used in empirical studies where $T < N$. In the case of large N panels, (Peasaran) studies a modified version of LM test called CD test. (Pesaran, Ullah, & Yamagata, 2008) suggests a bias-adjusted normal approximation version of Lagrange multiplier test of error cross section independence of Breusch and Pagan (1980). In this subsection, we describe these three tests.

Consider the following panel data model:

$Y_{it} = \alpha_i + \beta'_{it} + X_{it} + \varepsilon_{it}$ for i = 1; 2……… N and t = 1; 2……… T (1)

Where the cross-section dimension, t is is the time dimension, X_{it} is k X 1 vector of explanatory variables, $\alpha_i and\ \beta_i$ are respectively the individual intercepts and slope coefficients that are allowed to vary cross states.

a. Breursh and Pagan LM test

In the LM test, the null hypothesis of no-cross section dependence $H_0: cov(\varepsilon_{it}; \varepsilon_{jt}) = 0$ for all t and i≠ j - is tested against the alternative hypothesis of cross-section dependence $H_1: cov(\varepsilon_{it}; \varepsilon_{jt}) \neq 0$, for at least one pair of i ≠j. The test is based on the following LM statistic

$$LM = T \sum_{t=1}^{N-1} \sum_{t=i+1}^{N} \rho\hat{}\,_{ij}^{2}$$

where $\rho\hat{}\,_{ij}^{2}$ is the sample estimate of pairwise correlation of the residuals from ordinary least squares(OLS) estimation of Equation 1 for each i. Breusch and Pagan (1980) show that under the null hypothesis the LM statistic is asymptotically distributed as chi-squared with

N(N -1) = 2 degrees of freedom.

b. Pesaran CD test

It is well known that the standard Breusch-Pagan LM test statistic is not appropriate for testing in large panels. To address this shortcoming, (Peasaran) proposes an alternative statistic based on the average of the pairwise correlation coefficients $\rho\hat{}\,_{ij}^{2}$

$$CD=\sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{t=i+1}^{N} T_{ij}\, \widehat{\rho_{ij}} \quad (3)$$

Which is asymptotically standard normal for $T_{ij} \rightarrow \infty$ 1 and N → 1 in any order.

c. The bias-adjusted LM test

Pesaran et al. (2008) proposes a bias-adjusted test which is a modified version of the LM test by using the exact mean and variance of the LM statistic. The bias-adjusted LM test is

$$LM_{agj} = \sqrt{\left(\frac{2T}{N(N-1)}\right)} \quad \sum_{i=1}^{N-1} \sum_{t=i+1}^{N} \widehat{\rho_{ij}} \frac{(T-K)}{\sqrt{V_{Tij}^{2}}} \ \rho\hat{}\,_{ij}^{2} \ (4)$$

Where μ_{Tij} and V_{Tij}^{2} are respectively the exact mean and variance of (T –K) $\rho\hat{}\,_{ij}^{2}$, that are provided in Pesaran et al. (2008). Under the null hypothesis with first T → ∞ 1 and then N → 1, LMad j statistic is asymptotically distributed as standard normal.

4.2 Test of slope homogeneity

The second issue in panel data analysis is to decide whether or not the same coefficients are applied to each individual. It is a standard F test, based on the comparison of a model obtained for the full sample and a model based on the estimation of an equation for each individual. The F test is valid for the case

where the cross section dimension (N) is relatively small and the time dimension (T) of panel is large; the explanatory variables are strictly exogenous; and the error variances are homoscedastic.
In the case where (N; T)→ ∞, (Pesaran and Yamagata, 2008) propose a $\tilde{\Delta}$ test, without any restriction on the relative expansion rate of N and T when the error terms are normally distributed. The $\tilde{\Delta}$ test approach includes two steps. First step is to compute the following statistic:

$$\tilde{s} = \sum_{i=1}^{N} (\widehat{\beta\iota} - \widehat{\beta}\,)' \frac{X_i' \, M_\tau X_i}{\hat{\sigma}_i^2} (\hat{\beta}_{ij} - \hat{\beta}_{\,WFE})$$

Where $\widehat{\beta\iota}$ is the pooled OLS estimator, $\hat{\beta}_{\,WFE})$ is the weighted fixed effect pooled estimator, M_τ is an identity matrix, the $\hat{\sigma}_i^2$ is the estimator of σ_i^2. The second step develops the standardized dispersion statistic as

$$\tilde{\Delta} = \sqrt{N} \left(\frac{N^{-1}\tilde{S} - K}{\sqrt{2K}}\right) \quad (6)$$

Under the null hypothesis with the condition of the normality of the error terms and of (N, T) → ∞ so long as $\frac{\sqrt{N}}{T}$ → ∞ the $\tilde{\Delta}$ test has asymptotic standard normal distribution. The small sample properties of the dispersion tests can be improved under the normally distributed errors by considering the following mean and variance bias adjusted version:

$$\tilde{\Delta}_{adj} = \sqrt{N} \, \frac{N^{-1}\tilde{S} - E(\tilde{Z}_{it})}{\sqrt{var\tilde{Z}_{it}}} \quad (7)$$

Where the mean $E(\tilde{Z}_{it})$ = k and the variance $\tilde{Z}_{it}$= 2K (T-K-1)/ (T+1)

4.3 Panel causality test

The panel causality method depends on the existence of cross-section dependency and/or heterogeneity across countries or not. The bootstrap panel causality approach proposed by (Kónya, 2006) takes account for both cross-section dependence and region specific heterogeneity. This approach is connected with Seemingly Unrelated regression (SUR) estimation of the set of equations and the Wald tests with individual specific region bootstrap critical values. The bootstrap panel causality approach does not require any pre-testing for panel unit root test and cointegration analyses.
The system to be estimated in bootstrap panel causality approach can be written as:

$$\begin{cases} y_{1t} = \alpha_{1,1} + \sum_{i=0}^{l_{y1}} \beta_{1,1,i} y_{1,t-i} + \sum_{i=0}^{l_{x1}} \gamma_{1,1,i} x_{1,t-i} + \sum_{i=0}^{l_{z1}} \delta_{1,1,i} z_{1,t-i} + \varepsilon_{1,1,t} \\ y_{2t} = \alpha_{2,1} + \sum_{i=0}^{l_{y2}} \beta_{1,2,i} y_{2,t-i} + \sum_{i=0}^{l_{x2}} \gamma_{1,2,i} x_{2,t-i} + \sum_{i=0}^{l_{z2}} \delta_{1,2,i} z_{2,t-i} + \varepsilon_{1,2,t} \\ \dots\dots\dots\dots\dots\dots \\ \dots\dots\dots\dots\dots\dots \\ \dots\dots\dots\dots\dots\dots \\ y_{Nt} = \alpha_{N,1} + \sum_{i=0}^{l_{yN}} \beta_{1,N,i} y_{N,t-i} + \sum_{i=0}^{l_{xN}} \gamma_{1,N,i} x_{N,t-i} + \sum_{i=0}^{l_{zN}} \delta_{1,N,i} z_{N,t-i} + \varepsilon_{1,N,t} \end{cases} \quad (8)$$

$$and \begin{cases} x_{1t} = \alpha_{1,1} + \sum_{i=0}^{l_{y1}} \beta_{1,1,i} y_{1,t-i} + \sum_{i=0}^{l_{x1}} \gamma_{1,1,i} x_{1,t-i} + \sum_{i=0}^{l_{z1}} \delta_{1,1,i} z_{1,t-i} + \varepsilon_{1,1,t} \\ x_{2t} = \alpha_{2,1} + \sum_{i=0}^{l_{y2}} \beta_{1,2,i} y_{2,t-i} + \sum_{i=0}^{l_{x2}} \gamma_{1,2,i} x_{2,t-i} + \sum_{i=0}^{l_{z2}} \delta_{1,2,i} z_{2,t-i} + \varepsilon_{1,2,t} \\ \dots\dots\dots\dots\dots\dots \\ \dots\dots\dots\dots\dots\dots \\ \dots\dots\dots\dots\dots\dots \\ x_{Nt} = \alpha_{N,1} + \sum_{i=0}^{l_{yN}} \beta_{1,N,i} y_{N,t-i} + \sum_{i=0}^{l_{xN}} \gamma_{1,N,i} x_{N,t-i} + \sum_{i=0}^{l_{zN}} \delta_{1,N,i} z_{N,t-i} + \varepsilon_{1,N,t} \end{cases} \quad (9)$$

$$
and \begin{cases} z_{1t} = \alpha_{1,1} + \sum_{i=0}^{l_{y1}} \beta_{1,1,i} y_{1,t-i} + \sum_{i=0}^{l_{x1}} \gamma_{1,1,i} x_{1,t-i} + \sum_{i=0}^{l_{z1}} \delta_{1,1,i} z_{1,t-i} + \varepsilon_{1,1,t} \\ z_{2t} = \alpha_{2,1} + \sum_{i=0}^{l_{y2}} \beta_{1,2,i} y_{2,t-i} + \sum_{i=0}^{l_{x2}} \gamma_{1,2,i} x_{2,t-i} + \sum_{i=0}^{l_{z2}} \delta_{1,2,i} z_{2,t-i} + \varepsilon_{1,2,t} \\ \dots\dots\dots \\ \dots\dots\dots \\ \dots\dots\dots \\ z_{Nt} = \alpha_{N,1} + \sum_{i=0}^{l_{yN}} \beta_{1,N,i} y_{N,t-i} + \sum_{i=0}^{l_{xN}} \gamma_{1,N,i} x_{N,t-i} + \sum_{i=0}^{l_{zN}} \delta_{1,N,i} z_{N,t-i} + \varepsilon_{1,N,t} \end{cases} \quad (10)
$$

Where y denotes GDP, x indicates Health expenditure, z refers to food production index, l is the lag length and Ɛ is the error term. For each system there are maximal lags for GDP, Health expenditure and food production index, which are the same across equations. The optimal joint lag represents the lag for which the Akaike Information Criterion (AIC) and Schwartz Bayesian Criterion (SBC) have minimal levels.With respect to these systems, in country i there is one-way Granger causality running from x to y (z) if not all $\gamma_{1,i}$are zero but all $\beta_{2,i}$ $\delta_{2,i}$are zero, there is one-way Granger causality from y (z) to x if not all$\gamma_{1,i}$ are zero but not all $\beta_{2,i}$ $\delta_{2,i}$ are zero, there is two-way Granger causality between x and y (z) if neither all $\gamma_{1,i}$ nor all $\beta_{2,i}$ $\delta_{2,i}$ are zero, and there is no Granger causality between x and y (z) if all $\gamma_{1,i}$ and $\beta_{i,l}$ $\delta_{2,i}$ are zero.

5. Empirical results and discussion

To investigate the existence of cross-section dependence four different tests (LM, CDLM, CD and LM adj) were carried out and the results are figured in Table 4. From Table 4, we conclude to strongly reject the null hypothesis of no cross-sectional dependence across the countries at the conventional levels of significance. This result implies that a shock occurred in one of the Middle East & North Africa countries seems to be transmitted to other countries.

Table 4 also present the result from the slope homogeneity tests of both standard F-test and Pesaran and Yamagata (2008).This test reject the null hypothesis of the slope homogeneity at conventional levels of significance. This result implies that a significant economic relationship in one country is not replicated in others.

The existence of the cross-sectional dependence and the heterogeneity across countries support evidence on the suitable of the bootstrap panel Granger causality technique[1]1. The results from the bootstrap panel Granger causality approach[2] are reported in Table 5-10

Table 4: Cross-section dependence and slope homogeneity test

Tests	Statisc	p-value
Breusch-Pagan LM	468.2	0.0000
Pesaran scaled CDLM	44.609	0.0000
Pesaran CD	8.7846	0.0000
LMad j	5.94	0.0000
F test	771.48	0.0000
Delta.tilde	28.11	0.0000
Delta.tilde.adj	29.81	0.0000

Source : https://ar.tradingeconomics.com/

[1] We refer to Konya (2006) for the bootstrap procedure on how the country specific critical values are generated.
[2]The bootstrap critical values are obtained from 2000 replications.

Table 5: GDP does not Granger cause Health expenditure

Country	Wald statistics	Bootstrap critical values			p-value
		1%	5%	10%	
Algeria	6.189*	12.070	6.596	4.497	0.0548*
Egypt	0.706	11.075	6.135	4.127	0.4861
Morocco	0.199	11.555	6.087	4.176	0.7150
Tunisia	5.446*	10.926	6.118	4.283	0.0642*
Iran	0.121	11.925	6.351	4.240	0.7763
Saudi Arabia	10.399*	21.605	13.486	9.725	0.0885*
Jordan	13.310**	13.497	7.199	4.913	0.0103**
Lebanon	0.510	11.459	6.330	4.434	0.5637
Oman	2.858	10.196	5.747	4.157	0.1682
Qatar	0.093	15.383	7.700	5.290	0.8191

Source : https://ar.tradingeconomics.com/

***Indicates significance at the 0.01 level.

** Indicates significance at the 0.05 level.

*Indicates significance at the 0.1level.

Table 6: Health expenditure does not Granger cause GDP

Country	Wald Statistics	Bootstrap critical values			p-value
		1%	5%	10%	
Algeria	4.276*	10.657	5.796	4.064	0.0913*
Egypt	3.402	12.916	6.684	4.566	0.1524
Morocco	7.187**	10.705	5.962	4.100	0.0332**
Tunisia	0.550	12.766	7.108	5.093	0.5824
Iran	7.908**	9.693	5.781	4.052	0.0205**
Saudi Arabia	1.029	13.655	7.874	5.342	0.4581
Jordan	0.488	10.853	5.913	4.069	0.5650
Lebanon	3.015	11.709	6.368	4.477	0.1775
Oman	0.916	12.670	6.873	4.589	0.4516
Qatar	2.957	12.167	6.608	4.536	0.1764

Source : https://ar.tradingeconomics.com/

***Indicates significance at the 0.01 level.

** Indicates significance at the 0.05 level.

*Indicates significance at the 0.1level.

Table 7: GDP does not Granger cause food production index

country	Wald Statistics	Bootstrap critical values			p-value
		1%	5%	10%	
Algeria	2.201	13.392	7.497	5.102	0.2825
Egypt	18.938***	11.259	6.120	4.200	0.0007***
Morocco	0.342	11.383	6.047	4.082	0.6264
Tunisia	11.489**	13.462	7.029	4.846	0.0155**
Iran	9.314**	10.183	5.792	3.909	0.0133**
Saudi Arabia	3.747	14.810	8.003	5.686	0.1772
Jordan	19.044***	16.500	9.577	6.895	0.0064***
Lebanon	5.113*	13.227	7.301	4.988	0.0970*
Oman	2.424	14.356	7.417	4.968	0.2520
Qatar	0.942	12.917	7.408	5.156	0.4998

Source : https://ar.tradingeconomics.com/

***Indicates significance at the 0.01 level.

** Indicates significance at the 0.05 level.

*Indicates significance at the 0.1level.

Table 8: food production index does not Granger cause GDP

country	Wald Statistics	Bootstrap critical values			p-value
		1%	5%	10%	
Algeria	2.971	10.561	5.860	4.062	0.1581
Egypt	4.047	14.969	7.950	5.507	0.1558
Morocco	0.055	13.384	7.524	5.194	0.8651
Tunisia	14.778**	19.754	12.031	8.987	0.0274**
Iran	13.502**	10.026	5.492	3.776	0.0033***
Saudi Arabia	0.369	11.524	6.237	4.231	0.6261
Jordani	3.966	15.352	8.122	5.636	0.1663
Lebanon	0.956	13.863	7.608	5.206	0.4843
Oman	14.520**	15.576	7.189	4.830	0.0119**
Qatar	1.068	13.576	7.584	5.007	0.4450

Source : https://ar.tradingeconomics.com/

***Indicates significance at the 0.01 level.

** Indicates significance at the 0.05 level.

*Indicates significance at the 0.1level.

Table 9: Health expenditure does not Granger cause food production index

Country	Wald Statistics	Bootstrap critical values			p-value
		1%	5%	10%	
Algeria	4.130	16.565	9.343	6.673	0.1998
Egypt	0.218	17.223	9.838	6.940	0.7728
Morocco	8.126	26.672	16.627	12.775	0.2309
Tunisia	1.042	14.307	8.187	5.698	0.4814
Iran	1.996	16.232	9.072	6.360	0.3400
Saudi Arabia	2.542	19.724	11.946	8.767	0.4104
Jordan	1.293	21.805	12.144	8.666	0.5533
Lebanon	3.595	17.098	9.549	6.715	0.2363
Oman	2.981	17.019	9.548	6.826	0.2766
Qatar	1.592	12.512	7.008	4.636	0.3186

Source : https://ar.tradingeconomics.com/

***Indicates significance at the 0.01 level.
** Indicates significance at the 0.05 level.
*Indicates significance at the 0.1level.

Table 10: Food production index does not Granger Health expenditure

Country	Wald Statistics	Bootstrap critical values			p-value
		1%	5%	10%	
Algeria	1.045938e+01	14.196	8.430043	5.748437	0.0293**
Egypt	3.083333e-01	16.064	9.2549	6.491705	0.7083
Morocco	1.161970e+00	12.04291	6.387	4.369360	0.3813
Tunisia	5.429698e+00	11.797	6.496566	4.585903	0.0737*
Iran	6.336663e+00	13.860	7.562475	5.144360	0.0707*
Saudi Arabia	1.029900e+00	13.79090	7.831976	5.273967	0.4621
Jordan	5.583981e-05	12.85217	7.146544	4.819476	0.9945
Lebanon	4.487156e+00	16.25471	8.50548	5.744042	0.1379
Oman	1.160342e+01	14.25879	8.0311	5.491396	0.0204**
Qatar	4.249339e-01	15.76459	8.796	5.945191	0.6571

Source : https://ar.tradingeconomics.com/

***Indicates significance at the 0.01 level.
** Indicates significance at the 0.05 level.
*Indicates significance at the 0.1level.

The empirical results support a bi-directional causality between economic growth and nutrition from Tunisia and Iran table 7 and table 8. The same a bi-directional causality between economic growth and health expenditure from Algeria table 5 and table 6 and way granger causality running from economic growth to health expenditure for Tunisia, Saudi Arabia and Jordan table 5. The same we concluded a way granger causality running for health expenditure to economic growth for Morocco and Iran table 6. We also found a way granger causality running for economic growth to nutrition for Egypt and Jordan table 7. The result of the causality tests reveal a way granger causality running for nutrition to economic growth for Oman.

The results for testing of the existence and direction of causality between nutrition and health expenditure are reported in Table 9 and Table 10. The findings from these tables indicate the existence of reverse relationship from nutrition to health expenditure for Algeria, Tunisia, Iran and Oman and neither nutrition nor health expenditure is sensitive to Egypt, Morocco, Saudi Arabia, Jordan, Lebanon and Qatar.

6. Conclusions

This study re-examines causal link between economic growth, nutrition and health care expenditures of the Middle East & North Africa in countries for the period 1980-2014. We use the bootstrap panel causality approach, which take into account the cross-sectional dependence and heterogeneity across countries. The empirical results support a bi-directional causality between economic growth and health expenditure from Algeria and way granger causality running from economic growth to health expenditure for Tunisia, Saudi Arabia and Jordan. The same we concluded a way granger causality running for health expenditure to economic growth for Morocco and Iran. The empirical results have indicated that economic growth is an important factor for explaining the difference in healthcare expenditure between countries. When economic growth occurs, the proportion of healthcare expenditure in total GDP also increases. Theoretically, a healthy person can not only work more effectively and efficiently but also allocate more time to productive activities. Since healthcare expenditure is a center factor of human capital investment, the increasing trend of healthcare expenditure would tend to increase labor productivity, quality of life and general welfare. Healthcare spending has also been credited for prolonging life expectancy, reducing morbidity and infant mortality rates. Therefore, the growth in healthcare expenditure has a positive influence on GDP. For that reason, it can be confirmed that healthcare expenditure can be a determinant to preserve sustainable growth for the Middle East & North Africa. The same we concluded a bi-directional causality between economic growth and nutrition from Tunisia and Iran and a way granger causality running for nutrition to economic growth for Oman.

The result has profound policy implications for the Middle East & North Africa. For example, it shows that economic growth can improve nutrition poverty, which is consistent with the Engels Curve framework (see World Bank 1986) and that improvement in nutrition status can improve economic growth, which is consistent with Stiglitz's (1976) Efficiency wage Hypothesis.

Also the results of this study provide an approaching into the important link between food security defined by the food production index and economic growth for the Middle East & North Africa. Consequently, policies that promote food security and nutrition by ensuring adequate physical, economic and social access of all segments of the population to food are likely to significantly enhance per capita income and reduce poverty. The results of the existence and direction of causality between nutrition and health expenditure indicated the reverse relationship from nutrition to health expenditure for Algeria, Tunisia, Iran and Oman.

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