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MODELING LIFE EXPECTANCY IMPROVEMENTS AMONG KUWAITI POPULATION

ABSTRACT

Similar to other Gulf Cooperation Council (GCC) countries, Kuwait has experienced a tremendous decline in mortality rates in recent decades. During this time period, life expectancy increased only moderately. Positive socioeconomic changes caused by greater prosperity are believed to have greatly contributed to the increase in longevity of the Kuwaiti population. However, the extent to which each socioeconomic indicator has contributed to the decline in mortality among Kuwaitis should be identified and quantified. This study investigates the factors underlying the observed increase in Kuwaiti life expectancy using time-series data for specific socioeconomic variables from 1970 to 2014, and a linear model is then developed for life expectancy at birth. The results confirm that better literacy rate and more government expenditures on health care and greater caloric intake are important factors that contributed to the increase of life expectancy at birth among Kuwaitis. In addition, *per capita* GDP income produced mixed results in respect to the short and long runs.

Keywords: Socioeconomic Factors, Life Expectancy at Birth, Kuwait
JEL Classification: C32, C51, I15, J11

RIASSUNTO

Modellizzazione dei miglioramenti nelle aspettative di vita nella popolazione del Kuwait

Al pari di quanto accaduto negli altri paesi del Consiglio di Cooperazione del Golfo (GCC), anche nel Kuwait si è registrata un'importante diminuzione nei tassi di mortalità negli ultimi decenni. I positivi cambiamenti socio-economici causati dalla maggiore prosperità sono ritenuti una delle cause dell'aumento della longevità tra la popolazione del Kuwait.

Questo studio esamina i fattori alla base di questo incremento nell'aspettativa di vita in Kuwait utilizzando dati time-series per variabili socioeconomiche specifiche nel periodo 1970-2014, sviluppando altresì un modello lineare per l'aspettativa di vita alla nascita. I risultati confermano

che un maggior tasso di scolarizzazione, na maggior spesa pubblica destinata alla sanità e un'alimentazione più calorica sono fattori importanti che hanno contribuito all'aumento dell'aspettativa di vita alla nascita in Kuwait. Inoltre, il PIL pro-capite ha dato risultati misti rispetto al breve ed al lungo periodo.

1. Introduction

Since its first oil export shipment in 1946, Kuwait experienced tremendous changes that have permeated all aspects of life. Foremost, Petrodollars transform the Kuwaiti society from traditional to modern, and the government instituted a new welfare system that elevated the living standards of the population. This welfare system is unique because it provides protection to the population "from cradle to grave" and includes many aspects of life, such as education, health care, housing, utilities, marriage dowries, and food rations, pension, among others.

After decades of harsh living conditions, the generous government instituted welfare system was designed to help citizens by get their share of petrodollars generated from the production and export of oil. As well, the government provided and financed primary social services necessary for citizens to improve their living conditions. For example, the government is responsible for building the country's infrastructure, including roads, electricity networks, water stations and networks, sewage and storm networks, and telecommunication networks. In addition, education is provided free of charge to nationals from kindergarten to college. In fact, each college student is entitled to a monthly allowance of KD 200 ($600) for registering and continuing as a student in any of the public or private universities or colleges in Kuwait, and educational scholarships are provided for scholarly distinguished students. Employment is guaranteed for nationals in the public sector, and housing is provided to nationals at a subsidized rate and in affordable installments. Social services are accessible freely for the needy, and a food ration system is provided by the government for nationals.

The government provides a long menu of health care services nearly free of charge to the population, and lately only for Kuwaitis, through public health care facilities (ExpatFocus, 2016). Although private health care facilities are available, the private sector is relatively accounting for approximately 20% of the health services provided in the country (Kuwait Health Profile, 2012). Kuwait's public health care system consists of three levels: primary, secondary,

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and tertiary. Primary health care provides initial treatment at local neighborhood clinics. These clinics offer general health care services, including maternal, dental, preventive, diabetic, and pediatric care. These facilities are easily accessible and evenly distributed throughout Kuwait. The number of these primary health care centers increased from 136 in 1975 to 409 in 2010 (Burney *et al.*, 2012).

The secondary level of health treatment is supplied by six general hospitals that provide a wide array of modern medical treatment. Each of the six administrative governorates has its own hospital. This secondary level of health treatment is supported by a third level of specialized medical care facilities that include nine specialized hospitals specialized in chronic diseases and their treatment. The number of medical personnel working in public health care has increased between 1975 and 2010, with the number of physicians increasing from 932 to 5,680, the number of nurses increasing from 3,660 to 15,283, and the number of hospital beds increasing from 4,056 to 6,338, respectively (Burney *et al.*, 2012).

Kuwait spent approximately KD 29.2 million ($ 96.4 million) of its annual budget in 1975 on health care. This outlay increased to KD 1,397.5 million in 2014 ($4,611.8 million). The *per capita* share of this expenditure increased from KD 29 ($95.7) in 1975 to KD 334 ($1,102.2) in 2014. The share of government expenditures on public health care hovered around 7% of the total government expenditures over the period 1995 and 2010. Although Kuwait devoted an average of 3.2% of its Gross Domestic Product (GDP) to health care, including private sector health care, 2.5% of the GDP was allocated to public health care between 1995 and 2010 (World Bank, 2016). Nonetheless, Kuwait investment is relatively lower than comparator high-income countries, therefore, needs to increase spending on health care if it wants to match those services of OECD. For example, on average, OECD countries spent 8.9% of their GDP on health care in 2013. During the same year, the USA spent the highest proportion of its GDP on health care (16.4%). The percent of the GDP that was spent on health was 9.1% in Brazil and 8.9% in South Africa. Mexico spent 6%, Turkey spent 5%, while China and India spent each 5.6% of their GDP on health care in 2013 (OECD, 2017).

As a consequence of the investment in social services in Kuwait, the health of the population has improved drastically. Over-time, the mortality among the population has declined, and infant mortality rates have experienced sharp drops from 53.5/1,000 live births in 1970 to 7.3/1,000 in

2014. The crude death rate decreased from 6/1,000 in 1970 to 2.5/1,000 in 2014, and the life expectancy at birth increased from 67.6 years in 1970 to 75.76 years in 2014 (World Bank, 2016). Health care expenditures as a percentage of GDP declined slightly from 1995 (3.7) to 2015 (3.04). However, the ratio of physicians per 1,000 population increased from 1.26/1,000 in 1965 to 2.7/1,000 in 2012 (World Bank, 2016). Furthermore, other development indicators improved; for example, the GDP *per capita* income increased from $3,830.6 in 1970 to $43,593.7 in 2014, and the adult literacy rate among the population (15+) improved from 59.5 percent in 1975 to 95.6 percent in 2013 (World Bank, 2016).

Expenditure on education is another important investment item provided by the government to nationals and it is a pivotal part of the social welfare system adopted in Kuwait. According to the World Bank 2016 dataset, Kuwait spent around 4.59% of its GDP on education at all levels. The government provide free of charge education to its citizens for both general and tertiary education. It is to be noted that there is variation in the percentage education expenditure of the GDP. It reached as high as 14.1% in 1992 due to the huge financial resource required to restore destructed schools to a reasonable operation level. On the other hand, the lowest percentage is reported in 2006 at approximately 3.76% of Kuwait GDP.

Other social government expenditure extended to nationals is the direct cash payments to the needy. These payments cover operating activities to provide goods and services, compensation to employees (wages and salaries), interest and subsidies, grants, social benefit, and other expenses such as rent and dividends (World Bank Data, 2016). Moreover, the government guarantees employment to nationals in the public sector.

Such government expense averaged 53.3% of its GDP during the period 1992-1998. This average declined to 36.84% during the period 2001 and 2006. This item consumes a high percentage of the government annual GDP; however, most of it goes directly to the people in the form of subsidies, grants, and social benefits. This kind of direct payment is expected to have positive impact on the daily social life of ordinary people.

This study investigates the primary factors that have led to life expectancy increases for Kuwaitis and attempts to provide new information regarding the extent to which different socioeconomic factors have contributed to the observed increase in life expectancy at birth. A linear model is developed based on annual time-series data from 1970 to 2014. The outcome of

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this study will help policy makers develop appropriate policies to improve life expectancy for Kuwaitis, and the results are anticipated to be relevant for other GCC countries because they share similar conditions and experiences. This study is subdivided into the following sections. After the introduction, recent mortality developments in Kuwait are described. Subsequently theoretical background and method are provided, the regression model is presented along with data sources, and then empirical results are presented and discussed. The final section of the paper provides a brief conclusion and discussion.

Similar to other GCC, population composition of Kuwait is comprised of migrant workers (expatriates) who represent two third of the total population in Kuwait. This percentage also remained constant during the last 5 years. Migrants in Kuwait are highly heterogeneous made up from different nationalities dominated by south-east Asia, with various languages, ethnic and cultural backgrounds, and deferent religions. As expected, they are mostly young labor, single, low educated and highly mobile. Given the dualistic demographic composition of nationals versus expatriates in Kuwait, it is paramount to focus the analysis on the Kuwaiti population. Indeed, policymakers are preoccupied with socio-economic development programs directed only to Kuwaitis, therefore, all statistical indicators produced is applied to the Kuwaiti population only.

2. RECENT MORTALITY DEVELOPMENT IN KUWAIT

This section analyzes the trend in mortality rates in Kuwait from 1970 to 2014. Mortality is measured by the infant mortality rate (IMR) and life expectancy at birth (e_0), which are the most conventional indicators utilized in prior studies. Kuwait has maintained accurate records on births and deaths since the mid-1950s (Al-Ramadhan, 1993). Mortality data are published annually for numerous indicators, including 5-year age groups, sex, and nationality, cause of death, residence, and place of death. In addition, to augment these records, Kuwait requires all residents to register in a civil record system that is managed, updated, and disseminated by the Public Authority for Civil Information (PACI). This system is calibrated with the vital records of births and deaths collected by the Ministry of Health (MOH).

For this study, the indicators of mortality were calculated using annual time-series data for live births and deaths by the MOH and the Central Statistical Office (CSO) and population data

maintained by the CSO and PACI. Life tables were constructed using the datasets described above. A brief overview of the IMR development in Kuwait is presented in Table 1, which indicates that Kuwait experienced a remarkable decline in the IMR between 1970 and 2014 from 45.2 to 7.3 deaths per 1,000 live births, respectively which is an absolute change of almost 37.9 deaths per 1,000 live births over the forty-four year period and represents an annual decline rate of 0.86 deaths per 1,000. This rate equates to an approximately 1.91% per annum decline, with the sharpest decline occurring during the 1980s (an absolute decline of 16.7/1,000 live births) (Table 1). This decline subsequently decelerated, and from 2000 to 2014, it dropped to only 0.08 deaths per 1,000 live births (Figure 1).

TABLE 1- *Changes in the Infant Mortality Rate (IMR) of Kuwait from 1970 to 2010*

Intervals	Infant Mortality Rate		Absolute Change	Annual Decline	Annual % Change
	IMR_x	IMR_{x+n}			
1970-2014	45.20	7.30	-37.90	-0.86	-1.91
1970-1980	45.20	29.90	-15.30	-1.53	-3.38
1980-1990	29.90	13.20	-16.70	-1.67	-5.59
1990-2000	13.20	10.40	-2.80	-0.28	-2.12
2000-2010	10.40	9.60	-0.80	-0.08	-0.77

Source: calculated by the author using vital statistics on live births and infant mortality obtained from the Central Statistical Office for 1970, 1980, 1990, 2000, 2010, 2014.

Table 2 illustrates the changes in life expectancy at birth (e_0) in Kuwait from 1970 to 2014, and Figure 1 shows the overall trend. The data indicate that Kuwait added 7.76 years to e_0 from 1970 to 2014, which translates to an average annual addition of 18% (equal to 2.18 months). The highest gain in e_0 occurred between 1970 and 1980. During that interval, the population gained 3.62 years in life expectancy, with an average change of 0.54% per annum. As expected, gender differences in life expectancy gains were observed. Al-Ramadhan (2009) reported that females gained almost 4.8 years between 1995 and 2005, whereas males gained only 2 years during the same time period.

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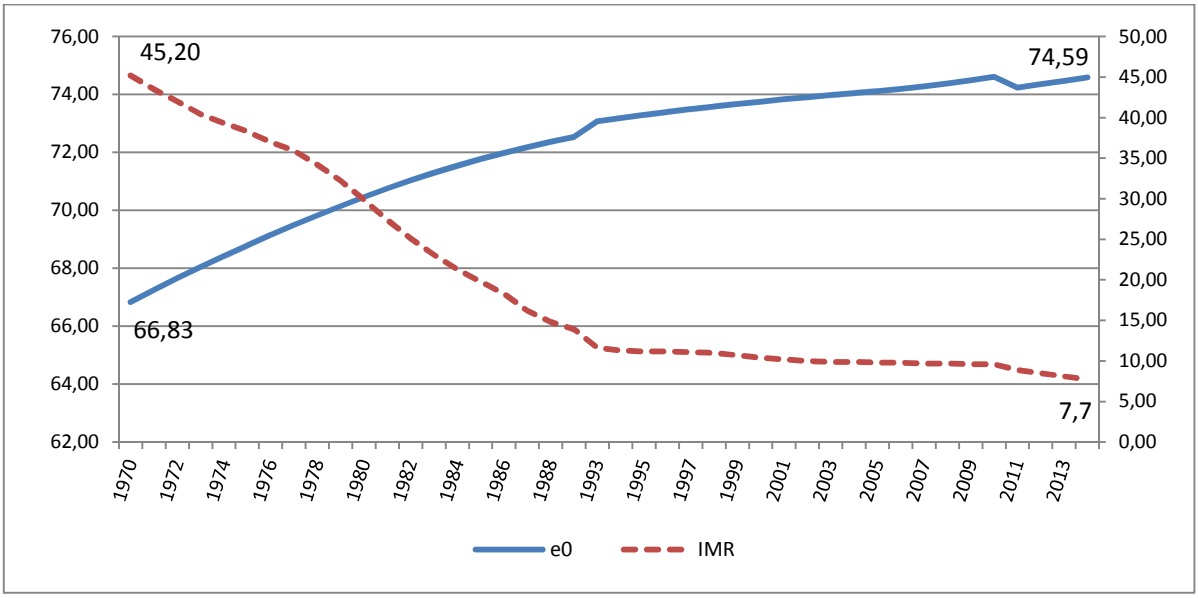
FIGURE 1 - *Development of the Primary Indicators of Mortality in Kuwait from 1970 to 2014*



Source: World Bank (2016).

TABLE 2 - *Changes in Life Expectancy at Birth in Kuwait from 1970 to 2010*

Intervals	Life Expectancy at Birth		Absolute Change	Annual Years Added	Annual % Change
	e_0^t	e_0^{t+n}			
1970-2014	66.83	74.59	7.76	0.18	0.26
1970-1980	66.83	70.46	3.62	0.36	0.54
1980-1990	70.46	72.68	2.23	0.22	0.32
1990-2000	72.68	73.75	1.07	0.11	0.15
2000-2010	73.75	74.60	0.85	0.09	0.12

Source: calculated by the author using life tables for the period from 1970 to 2010.

3. THEORETICAL BACKGROUND AND METHOD

Mortality declines in less-developed countries since the 1950s have led to contentious debates among scholars regarding the driving forces of this phenomenon. It is unclear whether longevity is affected by economics, development, or other exogenous factors that are related to medicine, health care, and nutrition. Numerous scholars have argued that development-related factors, particularly personal income, were the primary cause; however, other scholars have claimed that personal income and development in general play marginal roles. Examples of these perspectives include Preston (1975) and other studies that concluded only 16% of the increase in life expectancy between 1930 and 1960 was attributed to personal income increases. Subsequently, Cutler *et al.* (2006) asserted that the average health of a population is strongly associated with income.

Several studies have investigated factors that affect mortality, which is represented by the infant mortality rate or life expectancy at birth, using different data sets (time-series and cross-sectional data) for either specific countries or groups of countries or regions and focused on different economic, social, medical, and other variables. From these data, two schools of thought have emerged. The first emphasizes the importance of medical advances and treatments that have changed our understanding of diseases and mitigates their influence. McKeown and Record (1962), Stolnitz (1965), Preston (1975; 1976; 1980a; 1980b; 2007), Gwatkin (1980; 1981), Palloni and Wyrick (1981), Arriaga (1981), Meegama (1981), Pendleton and Yang (1985), Palloni (1981; 1985), and Soares (2007) are well known for advancing this school of thought. The second school of thought explains improvements in mortality related to the socioeconomic development of a nation, which can result in better living conditions and increased personal income. This perspective was articulated by Benjamin (1965), Goldscheider (1971), Yong and Pendleton (1980), Sawyer (1983), the United Nations (1984), Schultz (1980), Hill (1985), Jamison *et al.* (2007), Koch *et al.* (2010), Jiménez and Romero (2007), Jahan (2008), Mackenbach *et al.* (2008), and Hertel-Fernandez *et al.* (2007).

In addition, the roles of other possible contributing factors, such as education, nutrition, access to health care and government expenditures on health care, have also been examined. Popkin (2008) investigated the relationship between demographic transitions and nutritional transitions whereby the population moved from one stage to another and its impact on mortality and diseases. Similarly, McKeown and Record (1962), Fogel (2004) and Cutler *et al.* (2006) validated the importance of nutrition to the body's defense system and its positive contribution to a

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decline in mortality, particularly for infants. Additionally, Jamison *et al.* (2007) and Banister and Zhang (2005) confirmed the impact of education on infant mortality, and McGuire (2006) demonstrated the positive effect of national public health initiatives and improvements in personal health and sanitation infrastructures on mortality reduction.

A consensus has not been reached on the importance of government expenditures on public health services and expenditures allocated for various medical services for reducing mortality. Certain studies reported that public health care spending has little to no influence on the mortality of children less than 5 years of age using cross-national data (Barlow and Vissandjée, 1999; Filmer and Pritchett, 1999; and Musgrove, 1996). In this context, McGuire (2006) demonstrated that expenditures on public health care do not have a sizable impact on infant mortality when other factors, such as GDP, *per capita* income, and education, are considered. The amount of money spent on medical care is less relevant than the method by which the money is allocated. In that respect, Thornton (2002) demonstrated that expenditures for medical services contribute marginally to a decline in mortality. For example, a 1% increase in expenditures for medical care leads to a 0.1 to 0.15% decrease in the death rate, which emphasizes the importance of socioeconomic factors and lifestyle as key factors of mortality reduction.

3.1 Regression Model

In selecting the argument and structure of an empirical model for application to Kuwait, we benefitted from the aforementioned literature review. Herein, we selected the model's explanatory variables incorporating a few more empirical studies whose approach and findings are particularly relevant in Kuwait context. Based on the previous theoretical background, factors underlying the decline in mortality must be determined to create national development plans. Accordingly, attempts have been made to develop applied models that explain and quantify changes in mortality in terms of a set of socioeconomic variables. For example, Preston (1976) emphasized the peripheral impact of *per capita* income on declines in mortality rates and demonstrated that increases in *per capita* income and educational levels among the population tend to only marginally increase e_0. In a subsequent study, Preston argued that the relationships among economic growth, nutrition, and mortality cannot sufficiently explain the improvements in life expectancy that were observed during the 20^{th} century, and he concluded that approximately 50% of the changes in life expectancy between 1940 and 1970 were caused by "structural factors" and unrelated to economic development or nutrition (Preston, 1980a).

These conclusions are partially consistent with that of Fogel (2004), who indicated that 50% of the life expectancy increases were simply unrelated to improvements in material conditions. Preston purports that "structural factors" include the diffusion of new medical technologies and production technologies and suggests that health in general is the outcome of household production processes, including household behavior with respect to personal hygiene, food handling and preparation and water treatment. Access to improved sanitation and treated water may be important for explaining the gains in health. In addition, the eradication of major infectious diseases, such as tuberculosis, diphtheria, neonatal tetanus, whooping cough, poliomyelitis, and measles, through large-scale immunization programs have led to significant declines in mortality, particularly among children and the elderly.

Jamison *et al.* (2007) demonstrated that education is important for reducing mortality because any increase in the educational level also increases e_0. Similarly, improved nutritional intake has been shown to have a positive impact on e_0. Thus, the effect of nutrition on body mass and the body's natural defense system is believed to reduce mortality. Cutler *et al.* (2006) determined that higher ratios of nurses and physicians to the population tend to increase e_0. In addition, McGuire (2006) demonstrated that higher government expenditures on health services result in higher e_0. Consistent with the studies mentioned above, a model for mortality is specified as follows:

$$Y = \alpha_0 + \sum \alpha_i \chi_i + \varepsilon_i$$

where Y represents e_0 Kuwaiti life expectancy at birth, and X_i represents a vector of explanatory variables, which generally includes GDP *per capita* income at national level, the literacy rate among Kuwaitis for aged 10 years and over, nutrition intake at national level, and government expenditures on health services at national level. The model was estimated using annual time-series data covering 1970 to 2014. We experimented with linear, log-linear and log form and these runs led us to conclude that the linear form fits the data best since the annual changes in the underlining variables were linear with no reasonable pumps.

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3.2 Data Sources

This study employs annual data from 1970 to 2014 for Kuwaitis. Almost all the data for the variables are collected from local sources. This study uses vital statistics on mortality obtained from the Central Statistical Office (CSO) and data based on annual life tables constructed to derive our dependent variable e_0. Economic variables, including *per capita* income at national level (GDP *per capita* income) and health care expenditures at national level, are extracted for various years from the Annual Statistical Abstract (ASA) published by the CSO. In addition, the literacy rate for Kuwaitis was obtained from the ASA. Finally, nutritional issues are captured by the daily caloric intake at national level according to the Food and Agriculture Organization (FAO) dataset and the daily *per capita* FAO Balance Sheet. Only three data points (years 1990, 1991, and 1992) were missing in the dataset because of the invasion and aftermath. These missing data necessitated interpolation to complete the series.

4. EMPIRICAL RESULTS

4.1 Unit Root Testing

When we plotted the variables in our model against time, the issue of stationarity arose. Generally, time series data are non-stationary and accordingly, if used empirically it may produce spurious regression results. We tested for unit root using standard tests that time series empirical work applies (Stock and Watson, 2011). Stationarity and co-integration has to be met when regressing two sets of time-series data in order to get meaningful causal relationship between variables under consideration. Specifically, in order to analyze the relationship between life expectancy and causal socioeconomic variables, this study begins with the conventional test for the stationarity of our data series and variables using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests.

The results of the analyses indicate that all variables under study are not stationary at their level values. However, stationarity was accomplished after determining the first difference of the following variables: e_0, caloric intake, nurse ratio, *per capita* income, *per capita* health care expenditures and physician ratios are stationary at the 1% confidence level (Table 3). However, the literacy rate is stationary at the second difference at 1%. In conclusion, the implication of the above results suggest that although the variables are not stationary at level values, they are stationary at the first and second difference, which leads us to conclude that our variables are

integrated of order (1) and order (2). The PP test confirms the results of the ADF and ensures the non-stationarity of the indices. The PP test results are similar to the ADF test results and indicate significance for all sample periods. This conclusion allows us to conduct the cointegration test, which will be discussed in the next section.

TABLE 3 - *Unit Root Test with Intercept using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP)*

Variables	ADF	PP
$\triangle e_0$	-8.279389*	-8.633452*
△Calories	-4.220119*	-3.876268*
△Nurse ratio	-6.439858*	-6.472396*
△*Per capita* income	-7.132149*	-7.194983*
△Physician ratio	-3.162499*	-5.735603*
△Health care exp.	-3.817328*	-7.316511*
$\triangle^2$Literacy	-5.960958*	-5.942541*

* At the 1% level of significance, △ represents the first difference, and $\triangle^2$ represents the second difference.

4.2 Cointegration Testing

Cointegration attempts to answer essential questions regarding the occurrence of a long-term relationship between the variables under consideration. The basic concept is to test whether a linear combination of two individually non-stationary time series is stationary. Because the integration of two series is of the same order, whether the two series are cointegrated over the sample period must be tested.

This study conducted the Johansen cointegration test to evaluate long-term relationships among our variables. The results for caloric intake, literacy rate, physician ratio, *per capita* health care expenditures, *per capita* income, nurse ratio, and life expectancy at birth are presented in Table 4 and confirm a minimum of six cointegrating equations (vectors) at the 5% confidence level. To clarify, the likelihood ratio test indicates that the null hypothesis of the

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absence of a cointegration relation (r=0) cannot be rejected at the 5% level of significance. Consequently, our data are cointegrated, have long-term relationships, and vary together.

The Trace test identified 6 cointegrating equations at the 5% significance level as presented in Table 4. These cointegration equations imply that six linear combinations occurred between the variables that drive the relationship among the indices over the studied time period, despite potential deviations from equilibrium levels in the short run. The results of the Maximum Eigenvalue test confirm the results of Johansen's Trace test (Table 4). The results indicate that 6 cointegrating equations occur at the 5% confidence level test, and they confirm the Trace test. Therefore, both tests confirm a cointegrating relationship over the sample period.

As previously mentioned, the model was estimated using the linear functional form with all the explanatory variables because a linear model performs better in terms of the signs and statistical significance according to the estimated coefficients and overall model power. The estimated long-term coefficients of the selected model are presented in Table 5.

To investigate the short-run dynamics of the model, the error-correction model is developed using Autoregressive Distributed Lag (ARDL), and the cointegration procedure was conducted because of the long-run relationships that occur between variables. The proper lag set selection was determined to be 3 to minimize the loss of degrees of freedom. A VAR lag order selection criterion was applied using the following statistical tests: final prediction error (FPE), Akaike information criterion (AIC), and Hannan-Quinn information criterion (HQ).

TABLE 4 - *Johansen Cointegration Test and Unrestricted Cointegration Rank Test (Trace and Max-Eigen Stat., respectively) for Life Expectancy at Birth (e_0)*

H_0	H_1	Trance Test	Critical value at 5%	p-value	Max-Eigen	Critical value at 5%	p-value
r=0	r=1	274.9736	125.6154	0.0000	112.1950	46.23142	0.0000
r≤1	r=2	162.7786	95.75366	0.0000	52.91013	40.07757	0.0011
r≤2	r=3	109.8685	69.81889	0.0000	40.50550	33.87687	0.0070
r≤3	r=4	69.36297	47.85613	0.0002	28.99035	27.58434	0.0328
r≤4	r=5	40.37262	29.79707	0.0021	24.57706	21.13162	0.0157
r≤5	r=6	15.79556	15.49471	0.0450	14.38329	14.26460	0.0479

4.3 Short-Run Dynamics of the Model

The study used Vector Error Correction estimates, and the short-run dynamics of the model are presented in Table 5. The model concludes that the short-run impact of the independent variables on the dependent variable and variables are moving together. The estimated model produced the theoretically expected coefficients' signs which were significant at 5% level for *per capita* health care expenditure, at 10% level for literacy rate and *per capita* income, however, calories *per capita* daily intake was not significant at the specified levels of confidence. The estimated coefficient of the error-correction, ECT, is -0.975 corroborating the expected theoretical sign and is significant at less than 5% level. This implies that when the life expectancy at birth equation is above or below its equilibrium, it adjusts by 97.5% within the first year. The full convergence process to its equilibrium level takes 1.225 per year. Therefore, the speed of adjustment resulting from the model is meaningfully fast in the case of any shocks to life expectancy at birth. The short-run model passed the standard diagnostic test such as Breusch-Godfrey serial correlation, normality, and Breusch-Pagan-Godfrey heteroscedasticity. The results of these tests are not shown for space consideration.

TABLE 5 - *Results of the Vector Error Correction Estimates (Dependent Variable e_0) for the Short-run Estimates*

Regressors	Coefficient	St. error	T-stat.	P-value
Δe_0(-3)	0.402978	0.217353	1.854021	0.0761**
△Calories(-2)	0.001165	0.001455	0.800947	0.4310
△*Per capita* Income(-2)	0.000388	0.000226	1.718250	0.0986**
△Health care Expenditure(-2)	0.009221	0.002763	3.337695	0.0027*
△Literacy(-2)	1.203173	0.607927	1.979142	0.0594**
C	1.160321	0.397550	2.918681	0.0027*
EC	-0.975101	0.362198	-2.692177	0.0127*
R^2	0.726898			
F-Stat.	3.992451			
Prob. (F-Stat.)	0.001153			
DW statistic	1.785065			

△ means difference and numbers between () are the number of lags.
Significance level: * at 5%; ** at 10%.

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Literacy rate showed the highest marginal effect, and it was significant at 10% level, on life expectancy at birth among Kuwaitis compared with other variables in the model. That is to say, a 1% increase in literacy level would cause life expectancy to increase by 1.2 a year when other independent variables are held constant (*ceteris paribus)*. At the same time, the marginal impact of *per capita* health care expenditure was found to be significant at the 1% level for life expectancy increase. The model suggests that a K.D. 100 (equals $330) annual increase in *per capita* health care expenditure is expected to increase Kuwaitis life expectancy at birth by 11 months, when controlling other independent variables. The empirical results, also, showed positive marginal effect of *per capita* GDP income increase on life expectancy at birth among Kuwaitis at 10% confidence level. That is, an increase of K.D. 100 in *per capita* income would alleviate life expectancy at birth by 4.7 months. Similarly, daily *per capita* caloric intake was found to have a theoretical expected effect but not significant at the specified statistical level of confidence in the short run for increasing life expectancy at birth among Kuwaitis.

4.4 Long-Run Dynamic of the Model

The results of the long-run dynamics of the model are presented in Table 6. The explanatory variables that were included in the regression explained approximately 71% of the variation in Kuwaiti's e_0 from 1970 to 2014. The overall explanatory power of the model as indicated by the F-statistic was greater than 99%, which was significant. The explanatory variables had the correct signs and were statistically significant at the 1% and 10% levels, except for *per capita* income, which had non-significant effect and showed incorrect sign. Increase of literacy showed a high marginal effect compared with other variables. A one percentage point increase in literacy would raise longevity among Kuwaitis by 1.6 of a year which is significant. This result should alert policy makers to aim at increasing the level of literacy among the population since it will have a positive impact on many aspects of life and particularly on health.

Per capita health care expenditures by the government were second in terms of their marginal impact on longevity and are highly significant. In other words, a KD 100 increase in *per capita* expenditures on health care would increase life expectancy by approximately 1.76 of a year which implies a significant gain in longevity. This is another consideration that must catch the attention of policy makers. Higher the public expenditure on health services would, among others, lead to better health condition and ultimately to higher longevity among the population.

Caloric intake showed a good marginal impact and found to be significant on increasing longevity among Kuwaitis. The results of the model conclude that an increase of a 100 daily caloric intake would raise life expectancy at birth among Kuwaitis by 8.55 months which is a significant contribution. The model indicated that *per capita* GDP income has an adverse marginal effect on longevity, that is to say an increase of KD 100 in *per capita* GDP would decrease life expectancy at birth among Kuwaitis by 0.0805 of a year (29 days). All the variables (caloric intake, literacy rate, and health care expenditures) were important for increasing longevity in Kuwait; however, an increase in literacy rates followed by *per capita* health care expenditure had the most marginal impact on the long run on increasing life expectancy at birth among Kuwaitis.

TABLE 6 - *Long-term Estimated Coefficients of the* e_0 *Model*

Variables	Coefficient	Std. Error	T-stat.	P-value
Calories	0.007035	0.002019	3.484130	0.0012*
Per capita Income	-0.000805	0.000646	-1.247541	0.2196
Health Care Expenditure	0.017621	0.005629	3.130238	0.0033*
∆Literacy Rate	1.619224	0.834687	1.939917	0.0596**
C	51.61949	5.697632	9.059814	0.0000
R^2	0.712585			
R^2 Adjusted	0.683107			
F-Stat.	24.17310			

Significance level: * at 1%; ** at 10%.

5. DISCUSSION AND CONCLUSIONS

The relationships among economic growth, nutrition, and mortality cannot sufficiently explain the improvements in life expectancy observed in Kuwait during the 20th century. The welfare state played a significant role in improving the living conditions and health status of the population and reducing their mortality levels in general, which led to increased longevity. Petrodollars have had a considerable positive effect on various aspects of life in Kuwait. Socioeconomic conditions improved the overall quality of life and the health of the population. Kuwait's generous and comprehensive welfare system seem to limit and mask the individual impact of numerous factors on health standards including personal income, education

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attainment, health or social service expenditures, and nutritional intake. The overall social situation represents a dynamic interaction among numerous factors that positively affect the quality of life from numerous dimensions in a variety of ways. Increases in the life expectancy at birth in Kuwait were related to the government welfare system, which extended prosperity among the population. All of these variables positively affected the overall living conditions and well-being of the population and have contributed to an increase in life expectancy for Kuwaitis.

Our empirical analysis confirm the importance of improving living conditions as a critical factor for increasing life spans because healthier individuals generally live longer, maintain a healthier lifestyle, and are more likely to be economically productive. The Kuwait *per capita* income (PPP) is among the highest in the world and the life styles and living conditions of Kuwaitis are comparable to that of developed countries. Our findings in this study strongly confirm that remarkable improvements in mortality have occurred in Kuwait since 1970. The life expectancy at birth increased over time, and the e_0 value increased by 7.76 years during the study period. This increase resulted in a remarkable annual addition of 2.34 months (0.18 of a year) to the Kuwaiti life expectancy. The Kuwait life expectancy at birth is comparable to that of the developed world.

The impact of various socioeconomic factors on mortality in Kuwait was assessed via an econometric model for e_0. Because the functional form of the relationship between mortality and socioeconomic variables is an empirical issue, the model was estimated in linear form. Stationarity and cointegration analyses were conducted, and the long-term estimates indicated that an increase in literacy among Kuwaitis and increases in government health care expenditures were significant and had a positive marginal impact on e_0.

Our empirical work agrees with literature findings in certain aspect but disagree in other aspects. To illustrate, our findings on the positive causal relationship between increased literacy levels and life expectancy do agree with the findings of Jamison *et al.* (2007), and Banister and Zhang (2005). The latter demonstrated the importance of literacy level in respect to lower mortality among infants. Similarly, the evidence related to *per capita* health care expenditure impact on life expectancy among Kuwaitis was dove-tails with the similar findings of McGuire (2006). The latter showed a positive impact of health expenditure on the mortality decline. Personal income was significant and marginally effective in increasing life expectancy among Kuwaitis in the short-run, whereas it had an adverse impact in the long run. This could be explained by the fact that when education is provided free of charge up to the graduate level,

medical care is extended to nationals free of charge by the government, and housing are given by the government at a highly subsidized prices, thus dwarfing the magnitude of *per capita* income, i.e. the combined size and scale effect of the education, health and housing subsidy minimize the size and scale impact of *per capita* GDP income.

Our findings ascertain the positive contribution of proper nutrition on longevity. The impact of nutrition on longevity can hardly be overemphasized. Nutitition has a powerful positive marginal impact in both the short and long runs, however more significant on the long-run at the 1% confidence level. Therefore, life expectancy at birth would increase when *per capita* caloric intake increases. This implies that our finding is consistent with the results derived by Popkin (2008), Fogel (2004) and Cutler *et al.* (2006). The model successfully identified and explain 71% of the variations in life expectancy at birth among Kuwaitis from 1970 to 2014. The overall explanatory power of the model was statistically significant at more than 99%.

The results indicate that policy makers in the education sector should work hard in eradicating illiteracy of the national population which will have an adverse impact on the people's life in Kuwait. On other front, policy makers in the health sector in Kuwait should pay attention to the importance of providing more finances to its health care expenditures as a percentage of its GDP because the expenditures for health lag behind that of numerous developed countries. Efforts should be directed to improve the quality of medical services, and resources should be allocated more efficiently. Chronic diseases, such as circulatory system diseases and cancer, should receive a greater allocation of funds because they represent the leading causes of death among Kuwaitis. Moreover, the ratio of facilities and medical staff to the population should be monitored to maintain a comparable and acceptable ratio according to international standards. Therefore, increased spending for health care, such as on facilities, staff, equipment and medication, is essential and directly affects the general health of the public and reduces mortality rates, and such spending is particularly important for mitigating chronic diseases and improving longevity.

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REFERENCES

Al-Ramadhan, M. (1993), "The Pattern of Temporary Life Expectancy Development among the Population of Kuwait during the Period 1965 and 1985", *Arab Journal for the Humanities*, 12(45), 48-81.

Al-Ramadhan, M. (2009), "Decomposing Sex Differentials in Life Expectancy among Kuwaitis in Respect to Age and Cause-Specific Death Rate", *Journal of the Social Sciences,* 37(2), 90-114.

Arriaga, E. (1981), The Deceleration of the Decline of Mortality in LDC: The Case of Latin America, International Population Conference, Manila, vol. II, 21-50, International Union for the Scientific Study of Population: Belgium.

Banister, J. and X. Zhang (2005), "China, Economic Development and Mortality Decline", *World Development,* 33(1), 21-41.

Barlow R. and B. Vissandjée (1999), "Determinants of National Life Expectancy", *Canadian Journal of Development Studies,* 20(1), 9-29.

Benjamin, B. (1965), Social and Economic Factors Affecting Mortality, Mouton: Paris.

Burney, N., M. Al-Enezi, M. Al-Ramadhan, S. Hamada, N. Al-Musallam and R. Al-Hajji. (2012), The Demand for Medical Care Services, Kuwait Institute for Scientific Research, Report No. KISR 11281.

Central Statistical Office (1970), Annual Statistical Abstract, Kuwait.

Central Statistical Office (1980), Annual Statistical Abstract, Kuwait.

Central Statistical Office (1990), Annual National Account Statistics, Kuwait.

Central Statistical Office (2000), Annual Statistical Abstract, Kuwait.

Central Statistical Office (2010), Population Census 1970, Kuwait.

Central Statistical Office (2014), Population Census 1980, Kuwait.

Cutler, D., A. Deaton and A. Lleras-Muney (2006), "The Determinants of Mortality", *Journal of Economic Perspectives*, 20(3), 97-120.

ExpatFocus (2016), Kuwait Healthcare and Medical Treatment. Accessed on January, 18. <http://www.expatfocus.com/expatriate-kuwait-healthcare-medical>

Filmer D. and L. Pritchett (1999), "The Impact of Public Spending on Health: Does Money Matter?", *Social Science and Health,* 49(10), 1309-1323.

Fogel, R. (2004), The Escape from Hunger and Premature Death, 1700-2100, Cambridge University Press: Cambridge.

FAO (various years), FAOSTAT database, Food and Agriculture Organization, Retrieved from <http://www.fao.org/faostat/en/#home>.

Goldscheider, C. (1971), Population, Modernization, and Social Structure, Little and Brown: Boston.

Gwatkin, D. (1980), "Indications of Change in Developing Countries Mortality Trends: The End of an Era?", *Population and Development Review*, 6(4), 615-644.

Gwatkin, D. (1981), "Signs of Change in Developing Country Mortality Trends: The End of an Era?", Overseas Development Council, Development Paper No. 30.

Hertel-Fernandez, A., A. Giusti and J. Sotelo (2007), "The Chilean Infant Mortality Decline: Improvement for whom? Socioeconomic and Geographic Inequalities in Infant Mortality, 1990-2005", *Bulletin of the World Health Organization*, 85(10), 1-10.

Hill, K. (1985), *The Pace of Mortality Decline Since 1950*, in: J. DaVanzo, J. Habicht, K. Hill, S. Preston (Eds), "Quantitative Studies of Mortality Decline in the Developing World", World Bank: Washington DC, pp. 53-95.

Jahan, S. (2008), "Poverty and Infant Mortality in the Eastern Mediterranean Region: A Meta-Analysis", *Journal of Epidemiology and Community Health,* 62(8), 745-751.

Jamison E., D. Jamison and E. Hanushek. (2007), "The Effects of Education Quality on Income Growth and Mortality Decline", *Economics of Education Review*, 26(6), 771-788.

Jiménez, J. and M. Romero (2007), "Reducing Infant Mortality in Chile: Success in two Phases", *Health Affairs*, 26(2), 458-465.

Koch E., T. Romero, C.X. Romero, C. Akel, L. Manríquez, M. Paredes, C. Román, A. Taylor, M. Vargas and A. Kirschbaum (2010), "Impact of Education, Income and Chronic Disease Risk Factors on Mortality of Adults: Does 'A Pauper-Rich Paradox' Exist in Latin American Societies?", *Public Health*, 124(1), 39-48.

Kuwait Health Profile (2012) <http://globserver.cn/en/kuwait/health>. Accessed on January, 18 2016.

Mackenbach, J., I. Stirbu, A. Roskam, M. Schaap, G. Menvielle, M. Leinsalu and A. Kunst (2008), "Socioeconomic Inequalities in Health in 22 European Countries", *New England Journal of Medicine*, 358(23), 2468-2481.

McGuire, J. (2006), "Basic Health Care Provision and under 5 Mortality: A Cross-National Study of Developing Countries", *World Development,* 34(3), 405-425.

McKeown, T. and R.G. Record (1962), "Reasons for The Decline of Morality in England and Wales during the 19th Century", *Population Studies*, 16(2), 94-122.

 © 2018. Camera di Commercio di Genova

Meegama, S. (1981), The Decline in Mortality in Sri Lanka in Historical Perspective, Proceedings, International Population Conference, Manila, Vol. II, 143-163, International Union for the Scientific Study of Population: Belgium.

Musgrove P. (1996), "Public and Private Roles in Health. Theory and Financing Patterns", World Bank Discussion Paper No.339, Health, Nutrition and Population Division, World Bank: Washington, DC.

OECD (2017), Public Spending on Education (indicators) (Accessed on September, 27).

Palloni, A. (1981), "Mortality in Latin America: Emerging Patterns", *Population and Development Review,* 7(4), 623-650.

Palloni, A. (1985), An Epidemio-Demographic Analysis of Factors in the Mortality decline of Slow-Decline Developing Countries, Proceedings, International Population Conference, Florence, Jun 5-12, Vol. II, 329-352.

Palloni, A. and R. Wyrick (1981), "Mortality in Latin America: Changes in the Structure of Causes of Death, 1950-1975", *Social Biology,* 28(3-4), 187-216.

Pendleton, B. and S-O. Yang (1985), "Socioeconomic and Health Effects on Mortality Decline in Developing Countries", *Social Science and Medicine*, 20(5), 453-460.

Popkin, B. (2008), *Nutrition Transition and its Relation to Demographic Change*, in: R.D. Semba, M.W. Bloem (Eds), "Nutrition and Health in Developing Countries", 2nd Edition, Humana Press: Totowa, NJ.

Preston S. (1975), "The Changing Relation between Mortality and level of Economic Development", *Population Studies*, 29(2), 231-248.

Preston S. (1976), Mortality Patterns in National Population: with Special Reference to Recorded Causes of Death, Academic Press: New York.

Preston, S. (1980a), *Causes and Consequences of Mortality Decline in less Developed Countries during the Twentieth Century*, in: R.A. Easterlin (Ed.) "Population and Economic Change in Developing Countries", University of Chicago Press: Chicago, pp. 289-360.

Preston, S. (1980b), Biological and Social Aspects of Mortality and the Length of Life. Proceedings of a Seminar at Fiuggi, Italy, May 13-16, International Union for the Scientific Study of Population, Ordina Editions: Belgium.

Preston, S. (2007), "The Changing Relation between Mortality and Level of Economic Development", *International Journal of Epidemiology*, 36(3), 484-490.

Public Authority for Civil Information (1993-2010), Population and Work Force Statistics. Kuwait.

Sawyer, D. O. (1983), Effects of Industrialization and Urbanization on Mortality in the Developing Countries: The Case of Brazil. Proceedings, International Population Conference, Manila, Vol. II, 255-270, International Union for the Scientific Study of Population: Belgium.

Schultz, P. (1980), Interpretations of Relations among Mortality, Economics of the Household, and the Health Environment. Proceedings of the Meeting on Socioeconomic Determinants and Consequences of Mortality, Mexico City, 19-25 June 1979, 382-422. United Nations and World Health Organizations: New York and Geneva.

Soares, R. (2007), "On the Determinants of Mortality Reductions in the Developing World", *Population and Development Review*, 33(2), 247-287.

Stock J. and M. Watson (2011), Introduction to Econometrics, 3th Edition, Addison-Wesley.

Stolnitz, G. (1965), "Recent Mortality Trends in Latin America, Asia and Africa", *Population Studies,* 19(2), 117-138.

Thornton, J. (2002), "Estimating a Health Production Function for the US: Some New Evidence", *Applied Economics*, 34(1), 59-62.

World Bank (2016), World Databank, Social Indicator KWT, Retrieved from <http://www.worldbank.org>, September 14, 2016 and September 28, 2017.

United Nations (1984), "Mortality and Health Policy", Department of International Economic and Social Affairs, United Nations: New York.

Yong, S. and B. Pendleton (1980), "Socioeconomic Development and Mortality Levels in LDC", *Social Biology",* 27(3), 220-229.

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