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Determinants of Life Expectancy at Birth in Iran: A modified Grossman Health Production Function

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Abstract

Health as a prerequisite to perform other activities is considered as both consumption and capital commodity. Views on health production may differ. Sometimes, health is assumed as natural endowment, at times, it is generated by the personal efforts, and sometimes physicians and other health providers provide it. This paper aims to identify the factors affecting the production of health. To analyze the determinants of health production, we focus on life expectancy at birth in Iran over the period 1980-2012, as a dependent variable; and take per capita income, immunization rate and share of expenditure on education(as percent of GDP) as explanatory variables. Then, we estimate the determinants of life expectancy using Johansen-Juselius cointegration method for the long-run and error correction model for the short-run in the Eviews.8 software environment. In the long-run, the elasticity of life expectancy with respect to per capita income is about 0.12. In addition, the elasticities of life expectancy with regard to the rate of vaccination against illnesses and education level are 0.35 and 0.13, respectively. According to error correction model, the coefficient of error correction term (ECT) is estimated at -0.022, which shows that the 2.2% of disequilibrium in life expectancy is adjusted in each period and is approached to its long-run equilibrium. the healthier and longer life require policy-makers to adopt more efficient policies in order to raise purchasing power, to enhance overall education level and to invest on immunization people against infectious and communicable diseases.

Keywords: Grossman model, Health production, Immunization rate, Life expectancy

Introduction

Health as a human capital can be sustained for successive periods, so health production can be regarded as an investment in the health (net increase in the stock of capital health)(Zweifel *et al*., 2009). *Grossman* used the human capital theory to explain the demand for health and health care. His research was the starting point for future research studies. *Grossman* demonstrates that individuals do not actually buy health from market, but they produce health through time allocation to health-improving activities such as physical exercises and buying medical inputs (Folland *et al*., 2013). Except for medical care, some inputs such as diet, physical exercise, environment, socio-economic status also affect the production of health stock. This stock may increase or decrease during the days and years of life. Thus, it can be examined as health outcome in terms of number of healthy days, reduced mortality rate and increased life expectancy (Folland *et al*., 2013).

Life expectancy at birth is used as an indicator of health outcome. It includes all health conditions except for death. In fact, life expectancy suggests that attain a certain age depends on not only probability of surviving at present time but also the survival probabilities after the birth (1). It

shows the number of years that a newborn will survive if prevailing patterns of mortality at the time of his birth remain the same throughout his life (Zweifel *et al*., 2009).

One of the main objectives of the national health care systems is to prolong the life expectancy by reducing the mortality rate to the possible minimum rate. Residents of countries having higher living standards experience the lower mortality rates (Bilas *et al*., 2014).

In empirical researches, various measures such as mortality rate or life expectancy are used to estimate health output of a society. In *Auster et al*. views, life expectancy depends on environmental variables, such as wealth, education, and security regulations and infrastructure quality, lifestyle factors (smoking cigarettes or drinking alcohol), and medical and pharmaceutical expenses (Auster *et al*., 1969). *Fayissa and Gutema* focus on socioeconomic and environmental factors such as income per capita, illiteracy rate, food availability, and ratio of health expenditure to GDP, urbanization rate, and carbon dioxide emission per worker as determinants of life expectancy at birth in the Sub-Saharan Africa during 1990-2000. The results suggest that an increase in income per capita, a decrease in illiteracy rate, an increase in food availability are associated with improvement in life expectancy at birth(Fayissa & Gutema, 2008). According to *Gulis*, access to safe drinking water affects life expectancy (Gulis, 2000). *Shaw et al* show that decreasing tobacco consumption and increasing fruit and vegetable consumption increases life expectancy(Shaw *et al*., 2005). *Keita* using a panel dataset on sub-Saharan Africa countries (SSA) concludes that adult literacy, access to improved sanitation and safe water are positively correlated health gain, however the high incidence of extreme poverty is negatively correlated with heath gain(Keita, 2014).

Urbanization plays an essential role in life expectancy. In developed countries, citizens, mainly use more advanced medical care, better education and improved socio-economic facilities, which positively affect health status. Gender is the other determinant of life expectancy. Generally, women live longer than men do.

The life expectancy at birth increased from 55 to 74 years in Iran over the period 1980-2012. While, it is nearly better than that of world standard, however it is less than that of low-income countries.

The aim of this study is to estimate the Grossman health production function and to determine the factors affecting the life expectancy in Iran during 1980-2012.

Materials and Methods

Theoretical Basics

The theoretical basics of this study are taken from *Grossman* study (Grossman, 1972) with some modifications of the net investment in health model. He defines net investment in health as follows:

$$H_{t+1} - H_t = I_t - \delta_t H_t \qquad (1)$$

where, *H, I,* δ represent the stock of health, gross investment in health and the depreciation rate, respectively, and t indicates time (period). The depreciation rate can be exogenous, but it may dependent on the other variables such as initial health status, age, environment, diet, etc. According to Grossman model, gross investment in health (I) is defined in the following form:

$$I_t = M_t^{\alpha} TH_t{}^{\beta} E_t{}^{\theta} \qquad (2)$$

In which, *M, TH* and *E* are medical expenses, input time (healthy periods) and human capital (e.g. education), respectively. The parameters α, β, and θ represent the elasticities of investment with respect to health care, the healthy times and stock of human capital, respectively.

Grossman divides a set of individual consumption expenditure (over time) into two parts: one part is allocated to buy health care M at unit price P and other part is equal to the opportunity cost of being healthy with shadow price w (wage rate). Hence, the set of individual consumption possibilities (C) in relation to medical expenses is considered as follows:

$$C_t = p_t M_t + w_t TH_t \qquad (3)$$

In equation (3), we take derivative of consumption to gross investment to obtain the marginal cost of gross investment in health (π):

$$\pi_t = \frac{dC}{dI_t} = p_t \frac{dM_t}{dI_t} + w_t \frac{dTH_t}{dI_t} \qquad (4)$$

From equation (2) and replacing $\frac{dM_t}{dI_t}$ and $\frac{dTH_t}{dI_t}$ in equation (4), another expression is obtained for π:

$$\pi_t = p_t \left[\frac{1}{\alpha}\frac{M_t}{I_t}\right] + w_t \left[\frac{1}{\beta}\frac{TH_t}{I_t}\right]$$

or

$$\pi_t = \frac{1}{I_t}\left[\frac{p_t M_t}{\alpha} + \frac{w_t TH_t}{\beta}\right] \qquad (5)$$

Assuming $\frac{p_t M_t}{C_t} = k_t$, $\frac{w_t TH_t}{C_t} = 1 - k_t$, and defining $\sigma_t = (k_t/\alpha + (1 - k_t)/\beta)$, we get

$$\pi_t = \frac{\sigma_t C_t}{I_t}$$

With taking the logarithm of equation (5), we have:

$$\ln \pi_t = \ln(\sigma_t C_t) - \alpha lnM_t - \beta lnTH_t - \theta lnE_t \qquad (6)$$

Grossman suggests that if an individual maximizes his utility subject to his constraints on production and the total wealth, the marginal rate of return on the money invested in health (γ) is calculated as follows:

$$\gamma_t = \frac{w_t . G_t}{\pi_t} \qquad (7)$$

where G = ∂h / ∂H is the marginal product of the stock of health in the healthy period (days). The equilibrium condition is:

$$\gamma_t = r - \tilde{\pi}_t + \delta_t$$

Which means the marginal rate of return on investment in health (γ) is equal to the sum of net interest rate (interest rate *r* minus the marginal cost of gross investment in health *π*) and the depreciation rate. Taking the logarithm of equation (7) results in equation (8):

$$ln\gamma_t = lnG_t + lnw_t - ln\pi_t \qquad (8)$$

In the Grossman's net investment model, the health production function (in terms of the individual healthy days) is:

$$h_t = 365 - bH_t^{-c} \qquad (9)$$

The subscript *t* indicates time and *H* denotes the stock of health, which differs among individuals and over times of a person the life span. The parameters *b* and *c* are positive and constant. Investing in the stock of health continues until the marginal benefit of investing one additional unit is equal to its marginal cost. By definition of G, we have:

$$G_t = \frac{\partial h_t}{\partial H_t} = bcH_t^{-c-1} \quad (10)$$

Therefore:

$$lnG_t = \ln(bc) - (c+1)lnH_t \quad (11)$$

Inserting (11) into (8) yields the following equation:

$$ln\gamma_t = \ln(bc) - (c+1)lnH_t + \ln W_t - ln\pi_t \quad (12)$$

By solving equation (12) with respect to lnH_t and replacing $r - \tilde{\pi}_t + \delta_t$ for γ_t, the demand for health function can be derived in the following form:

$$lnH_t = B' + \varepsilon \ln w_t - \varepsilon ln\, \pi_t - \varepsilon \ln(r - \tilde{\pi}_t + \delta_t) \quad (13)$$

Where,

$$\varepsilon = 1/(1+c) \text{ و } B' = \ln(bc)/(1+c)$$

Assuming that $\tilde{\pi}$ is constant and positive; real interest rate is zero, and depreciation rate is constant at different periods, then $r - \tilde{\pi}_t + \delta_t$ will be constant, φ, hence, equation (13) is reduced to the following form:

$$lnH_t = B' - \varepsilon ln\varphi + \varepsilon\, ln\, w_t - \varepsilon ln\pi_t \quad (14)$$

For further simplicity, we can define the depreciation rate as equation (15):

$$\delta_t = \exp(\rho Age)\, Q_t{}^{\omega} \quad (15)$$

The depreciation rates usually increase with age - at least after a few steps in the life cycle. Therefore ρ is positive. The rate of depreciation is also dependent on the environmental quality (Q), so that, depreciation in health resulting from environment-related diseases rises with urbanization and air pollution. ω can be either positive or negative with respect to the various parameters of environmental quality. The logarithm of equation (15) is:

$$ln\delta_t = \rho \text{Age} + \omega_t lnQ_t \quad (16)$$

Assuming that $TH_t = H_t^{\emptyset}$ and $w_t H_t = \sigma_t C_t$, if we put relation (6) in equation (14) and rearrange the result, we will obtain:

$$lnH_t = a_0 + a_1\, ln\, w_t + a_2 lnM_t + a_3 lnE_t \quad (17)$$

Factors affecting the production of health

According to equation (17), the health production, as measured by life expectancy at birth, is a function of income, health care received by the person, and human capital. Therefore, health production can be specified as follows:

H = f (Income, Health care, Human capital)

The effects of these variables on health production are explained in the following:

1. Income: the higher income levels allow greater access to high-quality consumer goods and services; better housing and medical services, which they all have a positive effect on health. On the one hand, as income increases, the general tendency is to avoid tense efforts that adversely affect the health status. But, beyond a threshold level of income, an increase in income may no longer lead to better health (Zweifel *et al*., 2009). *Wilkinson* finds a weak correlation between income at the threshold level and life expectancy. In his view, increases in per capita GDP no longer appear to be associated with life expectancy gains(Wilkinson, 1996). *Rogers* found a non-linear relation between income and life expectancy in the developed countries. He observed that life expectancy rises at a declining rate as income grows(Rogers, 1979). *Peltzman*, using a regression GLS, regressed life

expectancy at birth on wealth and public expenditure on health and concluded that only wealth is of significant effect on life expectancy(Peltzman, 1987). *Bilas et al.* confirmed the positive effect of GDP per capita on life expectancy at birth among 28 EU countries during 2001-2011(Bilas *et al*., 2014). *Mondal and Shitan* found that gross national income per capita is significantly correlated with life expectancy in 91 low- and lower-middle-income countries (Mondal & Shitan, 2013). According to *Keita* analysis on the socioeconomic determinants of life expectancy gain, GDP per capita is strongly and positively correlated with life expectancy gain in 45 sub-Saharan Africa countries (SSA)(Keita, 2014).

2. Health care: all forms of investing in health result in higher productivity and the longer life of a person. Hence, the overall health and life style of individuals are reflected in the life expectancy. Generally, the health care is measured in terms of private and public expenditure on health; however, the health care has dual effects. On one hand, the higher health care contributes to longer life expectancy; while on the other hand, the increased health care may squeeze the spending on food, clothing and housing, which are crucial for subsistence (Zweifel *et al*., 2009). The greater reliance on health care may reduce the individual health-improving and preventive efforts. The increased life expectancy raises the health care expenditure. An older population than the younger population consumes likely higher health care services, which is called Sisyphus syndrome (Zweifel & Ferrari, 1992).

The medical care is mainly taken in order to improve health status or recovery initial health conditions, but medical expenses may be inefficient in some diseases such as cancers. In contrast, primary care in the form of immunization against diseases has longer impact on individual health and hinders the hazardous and contagious diseases in the lifespan.

Using premature mortality rate, as health outcome, in the OECD countries over the period 1970-1992, *Or* found that the health production depends on the health-care system and its resource input(Or, 2000).

3. Human capital: this variable is reflected in level of education, which can be measured by literacy rate, enrollment rate in schools, the number of university students, etc. *Grossman et al*. argue that education affects the majority of decisions that influence on quality of life (e.g., the choice of job, healthy diet, avoidance of unsafe habits and efficient use of health care)(Grossman, 1972).

According to *Mondal and Shitan*, mean years of schooling has significant correlation with life expectancy(Mondal & Shitan, 2013). *Bilas et al.* provide empirical evidence of positive effect of attained education level on life expectancy at birth among 28 EU countries during 2001-2011(Bilas *et al*., 2014).

Many studies have empirically confirmed that education is a major influential determinant of life expectancy, which explains the differences in health status. They emphasize that life expectancy relates to education (Grabauskas & Kalediene, 2002; Kalediene & Petrauskiene, 2000).

Model, variables and data

According to the theoretical model presented, as well as literature on the health production function, the production function is specified in the following multivariate linear regression:

$$log(LE_t) = a_0 + a_1\, log(Y_t) + a_2\, log(IMUN_t) + a_3\, log(EDU_t) + \varepsilon_t \qquad (18)$$

Where, *t* is time log denotes natural logarithm to base *e=2.718281*, *LE* is the life expectancy at birth. *Y* measures per capita income, which is positively related to life expectancy; *IMUN* means immunization rate of children against contagious diseases, in particular, diphtheria, pertussis and tetanus (*DPT*), and measles that affect directly life expectancy. *EDU* represents the education level. The term ε indicates the residual term, which includes unobservable changes in the variables; hence, it behaves stochastically with constant mean and variance.

Selection of variables

In order to analyze the determinants of health production, we focus on life expectancy at birth as a dependent variable. In addition, per capita income, immunization rate and share of expenditure on education as percent of *GDP* are treated as explanatory variables.

1) Per capita income (*Y*)

This variable is obtained by dividing gross domestic product into population. It gives purchasing power of a person at national level. Higher income guarantees high standard of life, boosts the well-being and finances individual in confronting illnesses.

2) Immunization rate (*IMUN*):

According to the WHO, early childhood is the most important phase for overall development throughout the lifespan, since many challenges faced by adults, such as mental health issues, obesity, heart disease, criminality, and poor literacy and numeracy, can be traced back to early childhood (WHO, 2009). Hence, immunization is viewed as an important investment in health in earlier years. This gives rise to the healthy, productive and active population in the long-run. By the World Bank definition, child immunization measures the percentage of children ages 12-23 months who received vaccinations before 12 months or at any time before the survey. A child is immunized against diphtheria, pertussis (or whooping cough), tetanus (*DPT*) and measles after receiving vaccines. In this paper, the IMUN variable is the average of two immunization rates against DPT and measles.

3) Expenditure on education as a share of GDP (*EDU*)

This gives the ratio of expenditure on education to GDP. It is a proxy for human capital, which is the economic value of an employee's set of skills and capacity of the population to drive economic growth (World Economic Forum, 2013). Human capital reflects education, experience and health. Evidently, the more educated people pay more attention to health-producing efforts and habits, for example, safe diets and stop smoking. Hence, the growing expenditure on education enhances people health through increasing literacy level and raises general awareness and sensitivity with respect to incidence and prevalence of diseases. In this manner, individuals that are more literate can well manage to fight against diseases.

Data

Data on life expectancy and immunization against diseases are drawn from the World Bank website. In addition, data on expenditure on education, GDP, and population are collected from Central Bank of Iran (CBI) over the period 1980-2012. The expenditure on education and GDP are converted to real values in constant 2004 Iranian Rial. According to model 18, All variables are entered in logarithmic form into econometric model in order to catch elasticity concept and ignore changes in measurement units of variables.

Results

Since our data are in time-series, so we rely on time-series analyses using Eviews8 software. After specifying an econometric model, we should estimate it. Table 1 gives descriptive statistics of the dependent and independent variables. The life expectancy at birth is nearly 66 years on average. The corresponding figures for per capita income, expenditure on education, as percent of GDP, and immunization rate are 20.38 million Iranian Rial, 4.56% and 83.56% respectively.

The first step in estimating a time-series model is to check the stationary of variables and assure the absence of unit root in them. If a time series is stationary, then mean, variance, and the covariances among various lags will remain constant over time (Gujarati, 2011). If variables of interest are stationary, the hypothesis testing will be valid. There are different methods to test for stationary in time-series models. In this paper, we use the Augmented Dickey-Fuller (ADF) unit root

test as most commonly used method. The results of unit root test on variables are presented in Table 2, which indicate existence of unit root in level of variables. However, all variables turn into stationary series in the first difference form. In this case, it is said that all variables are integrated of order 1, I(1).

Table 1 Descriptive statistics of variables, 1980-2012

	Obs	Mean	Median	Max	Mini	Std. Dev.
Life expectancy at birth(years)	33	65.72	68.20	73.76	53.89	6.77
Expenditure on education (as % of GDP)	33	4.56	4.37	7.47	3.61	0.86
Per capita income (in 2004 million Iranian Rial)	33	20.38	18.78	28.72	14.36	4.01
Immunization rate (% of children ages 12-23 months)	33	83.56	96.50	99.00	35.50	22.96

Table 2 Unit Root Tests

Variables	Level: constant+trend		First difference: constant & trend		Result
	ADF test Stat.	Prob.	ADF test Stat.	Prob.	
Ln(LE)	-2.6302	0.2703	-5.7292	0.0002	I(1)
Ln(Y)	-1.8340	0.0965	-3.8363	0.0270	I(1)
Lng(IMUN)	-1.2919	0.8713	-7.2141	0.0000	I(1)
Ln(EDU)	-2.1552	0.4976	-4.6528	0.0038	I(1)

The cointegration theory states that if two or more time series are I(1), then a linear combination of them may be I(1), in this case, they would be conitegrated, i.e., a long-run and converging relationship among them will be formed (Gujarati, 2011). To explain cointegration concept, consider the general autoregressive (AR) model as follows:

$$\Delta x_t = \Omega \mathrm{x}_{\mathrm{t}-1} + \sum_{i=1}^{m-1} \Psi_i \, \Delta x_{t-i} + \eta_t$$

If Ω is equal to zero, there is no cointegration. The variables may be I(1); but they will be cointegrated by taking differences. If Ω has full rank then all x_t must be stationary since the left hand side and the other right hand side variables are stationary. When Ω has less than non-zero full rank, the cointegration will be generated. In the case of I(1) variables, the standard Johansen-Juselius cointegration test is used to examine the existence of conitergariong vectors (Johansen, 1990). In this method, the maximum eigenvalue test and trace test are used to evaluate the long-term cointegration relationships among variables under study. These tests determine the number of long-term relationships. Table 3 gives results of cointegration test using Eviews 8 software. According to the test results, the existence of two cointegrating vectors is accepted at significance level of 5% with regard both trace test and maximum eigenvalue test.

Table 3 Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)		Trace Test			Maximum Eigenvalue Test		
	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.8504	108.3393	47.8561	0.0000	62.68774	27.58434	0.0000
At most 1 *	0.6090	45.6516	29.7971	0.0004	30.99093	21.13162	0.0015
At most 2	0.2887	14.6607	15.4947	0.0665	11.24406	14.26460	0.1424
At most 3	0.0983	3.4166	3.8415	0.0645	3.416598	3.841466	0.0645

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis(1999) p-values (No. 25 in references)

The long-run effects

Based on Johansen-Juselius cointegration method, the significant cointegrating vector is reported in the following:

$$log(LE_t) = 0.1152\, log(Y_t) + 0.3516\, log(IMUN_t) + 0.1310\, log(EDU_t)$$
$$(7.7838) \qquad (40.4138) \qquad (5.4357)$$

Values of t-statistic are in parentheses**.**

The cointegrating equation shows a significant positive effect of per capita income on life expectancy. In other words, the life expectancy will increase by about 0.12 % for one percent increase in per capita income in the long-run, if other things being equal.

As well, immunization affects directly life expectancy. This finding is compatible with theoretical expectations. In terms of immunization coefficient, if the rate of vaccination against illnesses increases by 1%, the life expectancy will rise nearly 35%. Interestingly, IMUN coefficient is of the biggest magnitude in the model, which indicates more effectiveness of children vaccination and preventive health care in raising the longevity of life.

The level of education is the other factor influencing on life expectancy. As expected, education affects positively life expectancy. The elasticity of life expectancy with respect to education variable is about 0.13, which means one percent increase in educational expenditure, as share of GDP, improves life expectancy by 0.13%.

Table 4 Error Correction model

variable	***Coefficient***	***t-stat.***
C	*0.001585*	*(21.5615)*
$\Delta log(LE_{t-1})$	*1.598650*	*(78.7756)*
$\Delta log(LE_{t-2})$	*-0.748095*	*(-39.4506)*
$\Delta log(Y_{t-1})$	*0.000437*	*(2.72898)*
$\Delta log(Y_{t-2})$	*-0.000746*	*(-0.92741)*
$\Delta log(IMUN_{t-1})$	*-0.001459*	*(-2.81947)*
$\Delta log(IMUN_{t-2})$	*-0.001661*	*(-4.01842)*
$\Delta log(EDU_{t-1})$	*-0.000368*	*(-0.59674)*
$\Delta log(EDU_{t-2})$	*-0.001344*	*(-2.38375)*
ECT(-1)	*-0.022067*	*(-12.0154)*
Adj. R-squared= 0.999, Log Likelihood=227.06		

The short-run effects

According to the cointegration theory, the short-run relationship among cointegrated variables is obtained by estimating the error correction model (ECM) (Gujarati, 2011). This bridges the short-run effects to the long-run ones through an adjustment component, which is called error correction term (ECT). For a simple bivariate model with variables x and y, the error correction model is specified as follows:

$$\Delta y_t = \alpha + \beta \Delta x_t + \gamma u_{t-1} + v_t$$

Where u_t denotes the residual terms of the long-run model, and its coefficient γ, if negative, indicates the speed of correction in errors and approaching long-run equilibrium. Table 4 reports the short-run relationship among life expectancy and its determinants. Since the error correction term is negative and significant at 1% level, then we conclude that 2.2% of disequilibrium is corrected in each period.

Discussion

With regard to per capita income, our finding is similar to results of the other empirical cases, for example, *Bilas et al*, *Fayissa and Gutema, Keita, Peltzman* , and *Yavari and Mehrnoosh* (Bilas *et al*., 2014; Fayissa & Gutema, 2008; Keita, 2014; Peltzman, 1987; Yavari & Mehrnoosh, 2006); hence, the positive effect of personal income on life expectancy is confirmed in Iran.

As mentioned in the literature review, most of empirical researches rely on health and medical care expenditure, either public or private, in analyzing the overall performance of national health systems. Our findings confirm generally the direct and indirect effects of health expenditure on life expectancy, for instance, *Fayissa and Gutema, Gulis*, *Phelps* and *Kabir* (Fayissa & Gutema, 2008; Gulis, 2000; Phelps, 1997; Kabir, 2008).

Nevertheless, there is no guarantee that health expenditure will be always effective. The expenditure on health is of dual conflicting effects. On one hand, the increased health expenditure can be translated as the expansion of health networks in urban and rural areas, which in turn provides more health services in different kinds and phases of care including health care services, treatment services, and educational and counseling services. These may finally result in longer lives. In contrary, higher expenditure on health may reduce the financial resources allocated to consumption expenditure particularly in public sector, since there is a permanent trade-off among various national development goals. *Emadzadeh et al* report a negative effect of per capita health expenditure on life expectancy in Iran. They justify this effect by huge self-consumption of medicines, lack of spending on research and development in health sector and less investing in medical equipment (Emadzadeh *et al*., 2013).

The immunization is one of the efficient actions in preventing infectious ailments especially for children. Indeed, no medical care is perfect by itself, but vaccination turns out immunity in most of diseases over time. Although, better health standards, such as improved hygiene, easy access to safe drinking water and high-quality environment, hinder the extent of diseases, but the germs, microbes and viruses are always around us. Therefore, we should consider possible negative effects of these microorganisms by vaccination on time.

Normally, the more educated people are more responsible for securing healthy life styles, which may be realized as better dwellings, good nutrition habits, spending on recreational activities, not smoking, and not alcohol drinking, and working in proper jobs. The whole outcome of these styles is summarized in longer life expectancy. Some researchers have focused on literacy rate in examining the determinants of life expectancy, e.g. *Mondal and Shitan, Yavari and Mehrnoosh Som*, *Rosen*, *Chen and Ching*, and *Lleras-Muney* (Mondal & Shitan, 2013; Yavari & Mehrnoosh, 2006; Som, 1977; Rosen, 1982; Chen & Ching, 2000; Lleras-Muney, 2005). Generally, they found direct

effect from literacy rate on longer life. The effective private and public expenditure on education imply literate, aware, and responsive individuals in the national perspective. Thus, educational expenditure may cover overall achievements in education system, when it targets various social classes in a non-discriminative manner.

Conclusion

This study investigated the roles played by main socioeconomic and health factors in prolonging the life in Iran. As expected, key factors including personal income, education and immunization well support our cause and effect relationships. In other words, any effort by private or public sectors in order to improving and upgrading educational attainments raises the life expectancy. These efforts range from self-study, enrollment in schools and investment in educational infrastructure to advertise healthy lifestyles in mass media. For instance, any recommendation to not-smoking and protecting clean air is of long-run effects on life expectancy. These suggestions are more relevant for literate and educated people. The positive effect of education on life expectancy is of great importance because preventive efforts may be effective than curative ones. In addition, the real purchasing power, as measured by per capita GDP, affects positively long life. This variable is influenced by monetary, fiscal and income policies. Consequently, any change in interest rate, tax rate and minimum wage rate are capable in creating significant adjustments in personal income. Finally, the more attention should be paid to the effectiveness of health care expenditure. In this regard, the immunization of the children is envisaged as a main effective health policy because of longer effect on hinder communicable diseases. This research may entail results that are more exact if researchers reproduce it with longer time-series and inclusion lag structure of immunization and education effects on life expectancy.

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