Journal of Applied Economics and Business

OPEN ACCESS ARTICLE

HEALTH SERVICES COSTS, HOUSEHOLD INCOME AND HEALTH EXPENDITURE IN SOUTH AFRICA

Elvis Munyaradzi Ganyaupfu

Maxima Research Analytics, South Africa

Abstract

The aim of this study was to estimate the effects of the changes in health services costs and household income on health services expenditure by households in South Africa, and assess if disturbances follow a linear autoregressive moving average structure. Using time-series data for the sample period 1976-2017 and controlling for households' disposable income, the ARIMAX method was used for estimation using Stata software. Results show that a rise in health services costs had a statistically significant negative effect on health expenditure by households, whereas household disposable income had a significant positive effect. Based on the sizes of estimates, health expenditure's strong positive reaction to increases in household disposable income and low responsiveness to increases in health services costs provide evidence that households indeed regard health as a necessity as opposed to being a luxury.

Keywords: Health services costs; Household; Consumer; Disposable income.

INTRODUCTION

Health services costs and households' disposable incomes have critical implications for health of populations. Thus, technical discussions around whether health can be regarded as a luxury or necessity have key implications for government's role in the financing of health care (Costa-Font et al., 2012; Tsai, 2014; Ganyaupfu, 2014). Based on the orthodox microeconomic theory of consumer behavior, consumer choices on health care utilization are modeled based on two key approaches (Jack, 1999). The first approach considers health as key part of a set of several commodities over which consumers have defined preferences. Since demand for health care is derived demand in the sense that health care utilization is valued subject to the degree to which it improves health, consumer preferences are for health rather than health care per se. The second approach uses an inter-temporal model of consumption decisions and considers health as a stock variable within the human capital investment framework (Jack, 1999).

Consistent with Grossman (1972), the intertemporal model states that household consumption expenditure on health care occurs not because of the value ascribed to health per se, but rather because of the gains in the stock of health due to health care utilisation. Based on household disposable income levels, consumer preferences for health and health care are made subject to the budget constraint in which consumption choices are bundled into a composite consumption good (c) given by the utility function $u(c, h)$, where h is the level of health, and not the amount of health care consumed (Jack, 1999). When an individual gets sick, additional units of health care (θ) are needed such that θ varies with the level of sickness. Thus, an individual consumer with a health status (θ) and disposable income level (y) faces the budget constraint $c + \theta h \leq y$.

Ceteris paribus, individuals who suffer increased illnesses usually increase their demand for health care services. If the price elasticity of demand for health care services lies between 0 and 1, a proportionate increase in cost of health care can lead to a less than proportionate drop in the preferred amount of health. When the price elasticity of demand for health reveals evidence of health as a normal good, it implies that for an individual with a health status characterized by $\theta = 1$, each additional unit of health would require one additional unit of health care. Household income and price elasticities of demand for health care therefore remain central in determining the allocation of resources devoted for health care services. If household demand for health care appears to be responsive to variations in costs of health services, some user fees should be imposed to induce rationality in consumption of health care services. Similarly, if variations in disposable incomes show a significant direct effect on demand for health care, some form of special subsidization of specific health care services would be desirable (Ganyaupfu, 2019).

LITERATURE AND THEORETICAL FRAMEWORK

Several previous empirical studies that used macro-level and household-level data to analyze the impacts of variations in incomes on health care expenditure present mixed results, where certain studies consider health as a necessity while some regard heath as a luxury. Some studies which include Okunade et al., (2004), van Elk et al., (2009) and de Mello-Sampayo & de Sousa-Vale (2014) regard health as a necessity. From an empirical standpoint, studies which confirm health as a necessity include Culyer (1989), Blomqvist & Carter (1997), Di Matteo (2003), Baltagi & Moscone (2010), Moscone & Tosetti (2010), Duarte (2012), Tsai (2014), Caporale et al., (2015) and Khan et al., (2016). Based on income elasticities greater than one, research studies that conversely find health as a luxury include Kleiman (1974), Newhouse (1977), Gbesemete & Gerdtham (1992), Roberts (1999), Okunade & Murthy (2002), Gerdtham & Lothgren (2002), Freeman (2003), Tsai (2014) and Zeng et al., (2018).

Households are consumers of health services and non-medical goods (Koijen, Philipson & Uhlig (2016), whose preferences over health and consumption follow the utility function:

$$U = E\left[\sum_{t=0}^{\infty}\theta^{t}\frac{\left(c_t^{\lambda}h_t^{1-\lambda}\right)^{1-\eta}}{1-\eta}\right] \quad (1)$$

where c_t represents consumption at time period t, h_t denotes health at time period t, $\lambda \in (0,1)$ measures the trade-off between health and consumption, $0 < 1/\eta < 1$ signifies the inter-temporal elasticity of substitution, and $\theta \in (0,1)$ represents the time discount factor.

For each given household consumer, the level of health at time period t is produced according to the Cobb-Douglas production function specified in equation (2):

$$h_t = \underbrace{\underline{h}\sigma^{t}}_{\text{exogenous health}} + \underbrace{x_t}_{\text{health due to medical treatments}} \quad (2)$$

where $\underline{h}\sigma^{t}$ denotes the household's base level of health, and x_t represents a health input in terms of medical treatments which increase the level of health beyond the base level. The upper bound of health $(\bar{h}\sigma^{t})$ gets realized only when medical treatments adopted reach an optimum level.

The manner in which health care service markets operate is determined by the economic choices, decisions and actions taken by household consumers of health services, health care firms, and the government. Given the dualistic nature of health care markets, prices of medical treatments paid by consumers in the private health care services sector are largely driven by the nature and degree of competition in the sector, subject to some form of government intervention. Three major forms in which government intervenes in the health market include (i) regulation of prices which private health care providers charge to health care consumers, (ii) proportional subsidization of some medical treatments to ensure that consumers pay for a fraction $(1-\pi)$ of the market price or cost of medical treatments such that $0 < \pi < 1$, and (iii) proportional subsidization of research and development undertaken by firms to ensure that such firms privately pay for a fraction $1-\gamma$ of research and development costs such that $0 < \gamma < 1$ (Koijen et al., 2016).

Given that consumers enjoy subsidies from government for purchase of medical treatments and pay taxes (τ), they maximize utility (u) specified in equation (1) by choosing an optimal bundle of consumption goods (c_t) and medical care (x_t) subject to equation (2), and sequence of the budget constraint given by equation (3):

$$c_t + (1-\pi)\int_0^1 p_{jt}\, x_{jt}\, d_j + \tau_t = \vartheta\sigma \tag{3}$$

where p_{jt} denotes the prices (costs) for medical treatments of type j at time period t, x_{tj} denotes medical treatment of type j at time t, d_j signifies the amount of investment in research and development of type j-knowledge, τ_t denotes lump sum taxes paid by households, ϑ represents households labor income, and σ represents the increase in labor productivity.

The maximization of utility based on parameters specified in equation (2) are subject to consumer preferences for health care utilization, which are made based on several factors which include the decision of whether to seek healthcare service or not and type of facility to visit. Since decisions on types of medical treatments adopted are based on recommendations of medical specialists, final demand for healthcare services is modelled subject to the budget constraint with regards to variations in disposable incomes and prices of the desired health care services. The household aggregate demand for health care services can be derived from the inter-temporal optimization problem defined by the function:

$$\max_{x_t} \frac{\left(c_t^{\lambda}\, h_t^{1-\lambda}\right)^{1-\eta}}{1-\eta} \tag{4}$$

subject to equation (2) and the household budget constraint (equation 3).

METHODOLOGY

Data

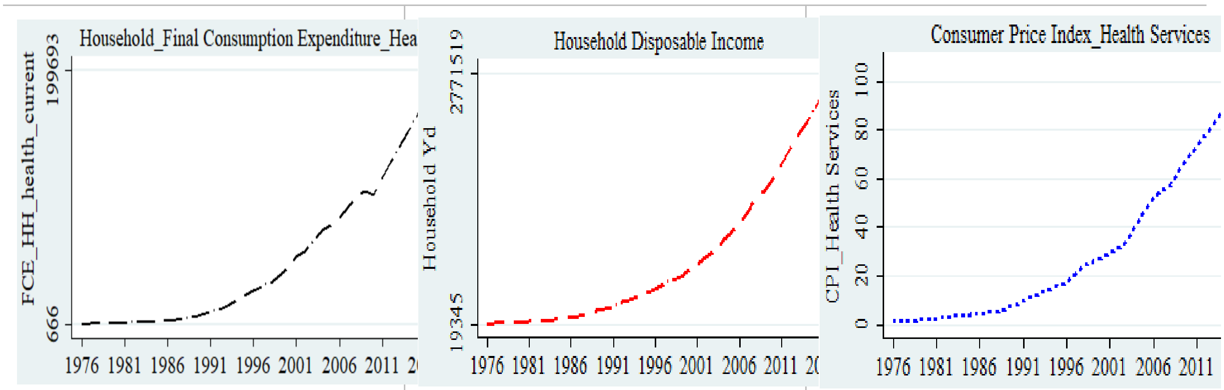


FIG 1. GRAPHICAL EXPOSITION OF DATA SERIES TRENDS

Source: South African Reserve Bank

Annual time-series data for household final consumption expenditure on health at current prices, index of consumer prices of health services (proxy of health services costs) and disposable income of households for the period 1976-2017 was obtained from the South African Reserve Bank (2020) macroeconomic statistical historical online database. Trend plots of the variable used in the econometric estimation are depicted in Figure 1.

Stationarity Tests

Unit root tests were performed against three assumptions that a series should have a constant mean over a given time horizon such that a transitory deviation of the mean reverts to the long-run mean $E(x_t) = E(x_{t-k}) = \mu$, the variance must be constant and finite $E(x_t - \mu)^2 - E(x_{t-k} - \mu) = \sigma^2$, and covariance must depend on the chosen lag length $E(x_t - \mu)(x_{t-k} - \mu) = E(x_{t-h} - \mu)(x_{t-h-k} - \mu) = \sigma_k$.

Since the Augmented Dickey-Fuller (ADF) method performs satisfactorily even when the sample size is fairly small (Dickey & Fuller, 1979), univariate unit root tests were conducted using the ADF criterion which uses an AR(p) process defined by $X_t = \pi + \gamma_1 X_{t-1} + \gamma_2 X_{t-2} + \ldots + \gamma_p X_{t-p} + \varepsilon_t$. The stationarity tests on an AR (p) process thus modelled the regression based on the function:

$$\Delta X_t = \pi + \beta X_{t-1} - \sum_{i=1}^{p-1} \alpha_i \Delta X_{t-i} + \varepsilon_t \tag{5}$$

where ε_t is a pure white noise error term, $\Delta X_{t-i} = X_{i-1} - X_{i-2}$ and p is the class of autoregression. Given the trends exhibited in the series (Figure 1), stationarity tests were performed in levels and first differences using the trend in regression model at 1%, 5% and 10% significance levels.

Estimation Method

The ARIMAX dynamic regression method was used to estimate the impacts of the variations in the index of consumer prices of health services (proxy for health services costs) and household disposable incomes on household final consumption expenditure on health services. The ARMA component was used to determine whether time-dependent disturbances significantly followed a linear autoregressive moving average process, estimated parameters specified in the model:

$$y_t = z_t \varphi + \mu_t \tag{6}$$

$$\mu_t = \varrho \mu_{t-1} + \omega \varepsilon_{t-1} + \varepsilon_t \tag{7}$$

where z_t is a matrix of the AR and MA terms, and φ is a vector of coefficients for z_t parameters.

Operationally, equation (6) is the structural equation, while equation (7) denotes the disturbance ARMA (p, q); where ϱ represents the first order autocorrelation parameter, ω denotes the first order moving average parameter and $\varepsilon_t \approx \text{IID}, N(0,\sigma^2)$ implying that ε_t represents a white noise disturbance. Combining equations (6) and (7), the ARMA (p, q) in the disturbance process was modeled based on the function specified in equation (8):

$$y_t = z\varphi + \rho_1 (y_{t-1} - z_{t-1}\varphi) + \omega_1 \varepsilon_{t-1} + \varepsilon_t \quad (8)$$

Inclusion of the stationary independent variables, namely index of consumer prices on health care services (x_1) and household disposable income (x_2), resulted in formulation of an ARIMAX (transfer function) model defined by equation (9):

$$y_t = v(\beta)X_t + \alpha + z\varphi + \mu_t \quad (9)$$

where y_t is the dependent variable (household final consumption expenditure on health), X_t is a matrix of the exogenous variables (the index of consumer prices of health services, and disposable income of households), β is a vector of coefficients of exogenous variables, $v(\beta)X_t$ denotes the transfer function (impulse response function) that permits exogenous variables to influence the dependent variable via a distributed lag, α is a constant term, z_t is a matrix of the AR and MA terms, and φ is a vector of coefficients for z_t parameters and $\mu_t = \varrho\mu_{t-1} + \omega\varepsilon_{t-1} + \varepsilon_t$ denotes the stochastic disturbance of the structural equation that is autonomous of exogenous variables.

RESULTS AND DISCUSSION

Stationarity Tests Results

Stationarity tests statistics (Table 1) of variables at first difference with a trend term in equations rejected the null hypothesis of presence of a unit root in al variables at 5% significance level.

TABLE 1. ADF STATIONARITY TESTS, MODEL: TREND TERM†

Variable	Critical Value			Test Statistic
	$\alpha = 1\%$	$\alpha = 5\%$	$\alpha = 10\%$	τ_t
Household final cons exp_health	-4.242	-3.540	-3.204	2.120
log(Household final cons exp_health)	-4.242	-3.540	-3.204	-0.101
dlog(Household final cons exp_health)	-4.242	-3.540	-3.204	-4.210**
Household disposable income	-4.242	-3.540	-3.204	3.461
log(Household disposable income)	-4.242	-3.540	-3.204	-0.105
dlog(Household disposable income)	-4.251	-3.544	-3.206	-6.365***
Consumer price index_health services	-4.242	-3.540	-3.204	0.478
d(Consumer price index_health services)	-4.251	-3.544	-3.206	-4.203**

[***] (**) * represent significance at [1%], (5%) and 10% levels, respectively

τ_t denotes ADF test statistics with a trend term (t) included in the equation

† the ideal lag order equal to 1 was chosen based on the optimal lag order selection criteria (Appendix 1)

Regression Estimates

TABLE 2. ARIMAX ESTIMATES

Sample: 1977 – 2017					No. of obs	= 41
					Wald ch2(4)	= 88.28
Log pseudolikelihood = 71.335					Prob > ch2	= 0.000
dlog(hh_final cons exp_health)	Coeff.	Semirobust Std Err	z	P >|z|	[95% Conf. Interval]	
d(CPI_health services)	-0.010	0.004	-2.76	0.006	-0.017	-0.003
dlog(hh_disposable income)	0.450	0.203	2.22	0.026	0.053	0.847
_cons	0.109	0.021	5.14	0.000	0.067	0.150
ARMA						
ar(L1)	0.752	0.223	3.37	0.001	0.314	1.189
ma(L1)	-0.513	0.210	-2.44	0.015	-0.924	-0.101
/sigma	0.042	0.005	8.02	0.000	0.032	0.053

The ARIMAX regression results (Table 2) reveal that both health service costs (index of consumer prices of health services) and households' disposable income had statistically significant impacts on households' final consumption expenditure on health services over the period 1977 to 2017. The significant (t-statistic = -2.76; $p < 0.05$) cost of health services elasticity (coefficient = -0.01) far less than one confirm that household expenditure on health services was insensitive to changes in costs of health care services over the period 1977 to 2017. In addition, the significant (t-statistic = 2.22; $p < 0.05$) households' disposable income elasticity of health expenditure less than one (coefficient = 0.450) confirm that households indeed regarded health services as a necessity over the period under review. The log differenced series of households' health expenditure shown by AR (1) was highly correlated at a level of 0.752, while the innovations shown by MA (1) had a significant (z-statistic = -2.44; $p < 0.05$) negative impact (coefficient = -0.513) in the succeeding period, with a standard deviation of the white noise disturbance of 0.042.

Diagnostic Tests of ARIMAX Estimates

The eigenvalues of autoregressive (AR) and moving average (MA) parameters were examined to determine whether they satisfied the stability condition and invertibility condition; respectively.

TABLE 5. STABILITY AND INVERTIBILITY OF ARIMAX ESTIMATES

Parameters	Eigenvalue	Modulus
AR parameters	0.752	0.752
MA parameters	0.513	0.513

The eigenvalues for AR parameters and MA parameters reveal that ARIMAX estimates satisfy the stability and invertibility conditions; respectively. The analytic plot for the inverse roots of ARMA polynomials (Appendix 2) with AR roots and MA roots that lie inside the unit circle confirm that the ARIMAX estimates indeed satisfy the stability and invertibility conditions.

CONCLUDING REMARKS

Enjoyment of the highest standard of health remains as one of the fundamental rights of every human being, paramount to fulfilment of other basic human rights. The relatively substantial contribution to total health care spending in South Africa largely comes from the private sector in form direct out-of-pocket payments, voluntary payments and medical schemes. Results in this study reveal that households regard health as a necessity, while they are inelastic to changes in costs of health services. In order to reduce the burden of bearing high costs for accessing health services and medical treatments, government should consider subsidization of health services and also prioritize financing of health investment programs towards attainment of the goal of universal health coverage.

Given the empirical evidence that health is regarded as a necessity in the country, government should continuously develop and scale-up implementation of health-access initiatives and health improvement interventions that prevent certain illnesses, or provide for early treatment to avoid high downstream health care costs associated with illnesses and subsequent complications. Such interventions can reduce health-care burdens on households and government, thus saving public funds for capital investments on other quality-life enhancing streams, economic growth and human development streams such as infrastructure and education.

APPENDIX

APPENDIX 1

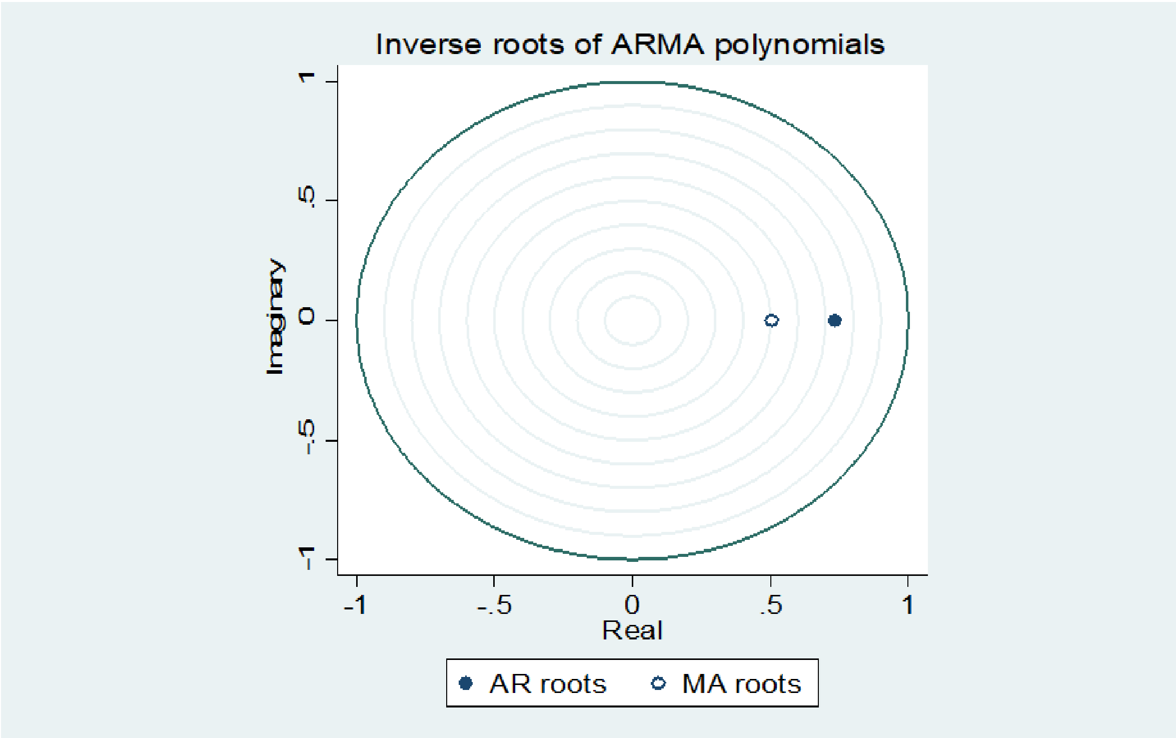
VAR LAG ORDER SELECTION

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1084.19	-			8.1e+19	54.3596	54.4054	54.4863
1	-859.296	449.79*	9	0.000	1.7e+15*	43.5648*	43.748*	44.0714*
2	-852.446	1.402	9	0.133	1.9e+15	43.6723	43.9929	44.5589

* Indicates the optimal lag order selected by the respective criterion.

APPENDIX 2

ANALYTIC PLOT FOR THE INVERSE ROOTS OF ARMA POLYNOMIALS



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