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AN EMPIRICAL MEASUREMENT OF HEALTH STATUS

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Abstract

A problem facing health economics is how to measure health, given that health is a latent variable, not directly observable or directly measurable. For many public and private health decisions, the health economics literature recognizes that best measures of health status are morbidity measures that indicate how ill people are. This general recognition of the superiority of morbidity measures contradicts the relevant Nigerian literature which seems to prefer mortality rates as measures of health status (possibly due to measurement or data difficulties). This paper presents an empirical method of measuring of health status from the types of survey data available to economists. The basic idea is to conceptualize health in terms of illness. The level of a person's health (or health status) can be measured in terms of the severity of the person's illness which is ascertainable empirically. 'Aggregate severity' can then be obtained to measure population health status. Conceptually, the severity of a person's illness is obtained by comparing the person's level of health when sick with the same person's level of health when healthy. This paper uses household survey data from the United States to illustrate the empirical method.

Key words: Measurement, Health Status

1. Introduction

A persistent problem in health economics is how to measure health, health outcomes; in short, health status. This problem arises because health is a latent variable, not directly observable or directly measurable. The present paper presents an empirical method of measuring health status for the individual as well as for the population. The method is similar to what health professionals do when they diagnose an illness. They ascertain by how much the person's health has fallen from some norm. So conceptualized, a morbidity measure of health status can be ascertained empirically from the types of survey data available to economists. The basic idea is to view the level of a person's health in terms of the severity of his or her illness obtained by comparing the person's level of health when sick with the level of health when healthy.

Possibly because of measurement or data problems, a large number of Nigerian health economics analyses measure health status with mortality rates. Mortality rates are easier to measure and interpret and more widely available but there are many public and personal health decisions for which the best measures of health status are related to how ill people are (or morbidity measures). With that in mind, distinctions can be made between population health status (where mortality rates can be useful proxies) and personal health status (for which mortality rates are meaningless). This suggests a role for microeconomics that can be used to conceptualize health status in terms of illness (morbidity); and can even help suggest appropriate types of data to seek. The superiority of morbidity measures can be understood notionally by the fact that the demand for health care involves two inter-related decisions: a binary decision whether or not to seek care and a decision (conditional on

the first decision) about how much care to demand. Each demand decision is based on how ill the person is rather than on the person's death or otherwise. Moreover, a large proportion of Nigerian health care expenditures are personal, in which case, personal health status is more useful than population health status in explaining Nigerian health care expenditures, thereby suggesting the inferiority of mortality rates.

Nigerian hospitals and clinics have large quantities and varieties of diagnostic and other patient data accumulated over decades. Much economics research materials can be gained if the contents of such hospital files were transcribed, and if the patients were traced in order to ascertain and incorporate their socioeconomic and other information. A national or regional household survey would be the ideal if conducted to acquire relevant health, socioeconomic, and qualitative data. With such data, empirical models and programs such as Multiple-Indicators-Multiple-Causes (MIMIC, Joreskog and Goldberger) or Linear Structural Model for Latent Variables (LISREL, Joreskog and Sorbom) regressions can be employed to obtain various model coefficients (see also Kiiskinen 2002). The coefficients can then be used to predict health status for each person in the sample as well as to calculate the 'aggregate severity' for the population. This paper uses household survey data from the United States to illustrate the methodology.

The relevant literature is summarized in section 2. Section 3 operationalizes of the relationship between health and health care; and presents an empirical model in order to illustrate the methodology. The discussion is in section 4. Conclusion is in section 5 and section 6 has the references.

2. The Literature

Riman and Akpan (2012) measures health status with a ratio of mortality rates; Olaniyan and Lawanson (2010) use infant and under-five mortality rates. Onisanwa (2014) uses infant and maternal mortality rates as well as life-expectancy at birth. Yacub, Ojapinwa and Yussuff (2012) use infant and under-five mortality rates plus life-expectancy. *Eneji et al. (2013) express an initial* desire to adopt "the general health indicators which include mortality and morbidity rates, life expectancy at birth, and various indicators of diseases burden, example; disability adjusted life span and quality adjusted life span." But in actual fact, the "authors use infant mortality as a proxy for health status" (p.258).

The use of mortality measures raises questions about the most appropriate concept of health status? Wolfe and van der Gaag (1981, p.283) suggests that measures of health status are best designed for specific purposes. What, for example, would be considered the best measures of health status in an analysis of relationships between health care expenditures, health status and economic growth? Following Wolfe and van der Gaag, the best measure in models of economic growth might differ from the best measure in models of hospital inpatient care, for example. Even so, most health economists recognize the conceptual superiority of morbidity measures even though mortality rates are easier to measure and interpret. For example, severity of illness and case-mix indices such as the United States Medicare's diagnosis related groupings (DRGs) suppose that the more severe illnesses require larger medical resources to 'cure' (see Eze and Wolfe, 1993; Horn and Sharkey, 1983); in which case mortality measures are relatively inadequate. In order to highlight the relative superiority of morbidity measures, consider that recent advances in medicine have led to the ability to control many diseases, even incurable or irreversible diseases, which leads to postponement of death. In many cases death is not inevitable and even when death occurs, its relation to productivity, economic growth and even medical care utilization is at best more difficult to establish. It is illness (morbidity) rather than death (mortality) that determines utilization, productivity, etc.

Consider also that most cross-sectional data indicate zero medical care usage for many persons even among the wealthiest persons and even in societies with free access to health care. Likewise, most time-series data show that many persons utilize medical care in some periods but not in some other periods (Aaron, 1981). One explanation for such observed zero medical care usage is the absence of illness (Arrow, 1963). In general, people are willing to spend resources on their health because people are risk-averse. People do not want to risk the quality or length of their life each of which is a function of the health status. Health status is presumed dependent on health care utilization (Grossman 1972, Riman and Akpan, 2012). Ataguba, Ichoku and Fonta (2007, p.4) considers "how much individuals are willing to part with to restore their health state in event of deterioration." Following this logic, it is reasonable to assert that illness (which can lead to death) is an appropriate concept of health status. In the health professions, the diagnosis of an illness is more or less an attempt to ascertain how ill a person is. This is accomplished by taking into account diagnostic conditions, illness symptoms and other indicators of disease and disability. Likewise, explanatory variables in empirical models of medical care utilization usually include proxies for health status. For example, Wedig (1988) includes work-loss days, number of sick days in bed, activity limitations and the person's perception of his own health. van de Ven and van Praag (1981) use an 'index of unhealthiness'. In the Nigerian literature, Ataguba (2008) employs a morbidity proxy for health outcome with integers to represent poor, fair, good, etc. health. Weisbrod (1991) suggests that incurable diseases are expensive mainly because of 'half-way technologies'.

In order to put the analysis in its historical context, consider that for centuries health care providers (physicians, hospitals, etc.) did not have many effective tools with which to help persons with acute illnesses (Aaron, 1981). This is because the process of illness and the causes of disease were not well-understood. In African societies as in Europe, for example, a major medical methodology included a crude therapy termed 'bleeding' (called 'usé' in Igbo) used to suck out a patient's 'bad blood' thought to be the cause of ill health. Community health improvements came mostly from public health investments, spread of knowledge regarding sources or causes of disease, plus improvements in lifestyle and nutrition (McKeown, 1976). With so much public goods and externality dimensions of the public health investments, many societies viewed health care as a (non-excludable) right. For example, Aaron (1981) believes that much of the rise in health care expenditures in developed countries since World War II arose from the fact that health care was viewed as a right (and a need). Under such circumstances, the private market was not seen as an appropriate institution for the allocation and distribution of health care. Possibly for these reasons, the study of the health care sector was left to fields such as public administration (Folland et al. 1993).

Consider also the history of hospitals as institutions. Hospitals developed during the industrial revolution in Europe essentially to serve as a place where poor people could go to die with some dignity compared with their crowded and squalid urban residences. Most hospitals were owned and operated by philanthropies who did not charge much of a fee and whose patients could not afford to pay much, almost by definition. Persons who could afford to pay were attended to in their homes by visiting doctors. It was only in the twentieth century that medical therapies became sufficiently advanced to offer real physical benefits to patients. Only then was individual choice relevant (see, for example, Folland et al. 1993, chapter 4). Then market solutions came to be seen as viable, legitimate or even desirable. Only then did economists get interested enough and health economics developed as a separate field.

Arrow (1963) advocated the applicability of individual optimization, common in neoclassical economics; thereby implicitly distinguishing between population health status (the object of public health programmes) and

personal health status. Such distinction has implications for measures of (individual versus population) health status. For example, in measuring health status, mortality rates have the disadvantage of not accounting for aspects of quality of life such as pain and suffering. Also, mortality rates have little meaning for the individual. Alternatively, morbidity measures such as physiological indicators, functional limitations, etc. can take into account the quality of life of either the population or the individual.

3. Concept and Measurement of Severity of Illness

Illness is caused by 'random events of illness and injury' (Phelps 2013, p.35) and is a deviation of a person's level of health from a personal benchmark level. This idea can be formalized in terms of a real-valued variable called 'severity of illness' that measures how ill the person is. See Equation 3.1.

3.1 $\mathbf{S_i = H_i^* - H_i \geq 0.}$

S_i is 'an index of un-healthiness' (van de Ven and van Praag 1981, p.127) or severity of illness. H_i^* is a personal benchmark that indicates the person is healthy. H_i denotes the person's actual level of health whether he is healthy or sick. $S_i = 0$ if the person is healthy; $S_i > 0$ if the person is sick. As long as $H = H^*$, a person is healthy even if H^* is low.

The empirical method of estimating severity of illness using equation 3.1 is a multiple indicator, multiple cause (MIMIC) model with observed proxies used as effects or indicators, as causes or as both causes and effects of the latent variables (Joreskog and Goldberger, 1975 p. 631).

3.2. $\mathbf{H^* = g(CHRONIC, AGE, PI, GENDER, EDUC, LIFEST) + e_1}$

3.3. $\mathbf{H = g(CHRONIC, AGE, PI, GENDER, EDUC, LIFEST, DIAGN) + e_2}$

g(.) is a health function (Grossman, 1972). CHRONIC is a vector of dummies for the presence of chronic health conditions. Permanent income PI measures how easy a person's life is; itself a latent variable. (see van de Ven and van der Gaag, 1982). LIFEST is a vector of the person's lifestyle measures (Lillard et al. 1986). Education EDUC is an index of access – access to better jobs, better medical information, etc. DIAGN is a vector of indicators of the presence and intensity of disease. The terms e_1 and e_2 are residuals with appropriate distributional assumptions. Equations 3.2 and 3.3 can be combined to obtain S from equation 3.1.

3.4. $\mathbf{S = H^* - H = g(DIAGN) + e}$

Equation 3.4 implies distributional and separability assumptions. S is a measure of the aggregate severity of the person's illnesses combined.

4. Discussion of Estimated Results

The data and methods are described more fully in Eze (2016, forthcoming). It is cross-sectional and taken from the PERSON file of the public use tape of the United States National Medical Care Utilization and Expenditures Survey (NMCUES). NMCUES is a national household probability sample (augmented with samples drawn from Medicaid) of 17231 observations collected between early 1980 to mid 1981, and is published by the National Centre for Health Statistics and Health Care Financing Administration. The same data set was used by, for example, Wedig (1988) with adults 17 years and older; Haveman, Stone and Wolfe (1989) studies adult males aged 22 to 71 years.

The model is estimated by Maximum Likelihood methods using the statistical package LISREL 7 (Kiiskinen, 2002). 'Potential' SOI estimates would use the full sample to obtain coefficient estimates are shown below (see Duan et al. 1984, Hensher and Milthorpe, 1987):

$$4.1. \quad S = \underset{(3.7)}{0.036 \times C1} + \underset{(18.1)}{0.208 \times C2} + \underset{(4.4)}{0.044 \times C3} + \underset{(3.8)}{0.038 \times C4} + \underset{(7.9)}{0.080 \times C5}$$

$$+ \underset{(8.8)}{0.088 \times A1} - \underset{(-0.9)}{0.009 \times A2} + \underset{(11.1)}{0.114 \times A3} + \underset{(10.7)}{0.109 \times A4} + \underset{(4.7)}{0.046 \times A5}$$

$$+ \underset{(2.5)}{0.025 \times A6} + \underset{(17.5)}{0.243 \times AGE} - \underset{(-4.8)}{0.050 \times HED} + \underset{(28.7)}{0.519 \times MCARE} + \underset{(15.4)}{0.168 \times MCAID} + \omega$$

$$4.2. \quad DEAD = \underset{(5.0)}{0.078 \times S} + \eta_2$$

$$4.3. \quad L1 = \underset{(31.6)}{0.662 \times S} + \eta_3$$

$$4.4. \quad L2 = \underset{(11.9)}{0.191 \times S} + \eta_4$$

$$4.5. \quad PH = 0.514 \times S + \eta_1$$

$$4.6. \quad PE = \underset{(-36.5)}{-0.844 \times S} + \eta_5$$

Each variable in equations 4.1 to 4.6 is measured as a deviation from the respective mean, with the mean normalized to zero. The solutions are standardized. That is, the latent variable SOI is scaled to unit variance (see Joreskog and Sorbom, 1989, p.38). t-values of the individual coefficients are shown in parenthesis. The goodness-of-fit of the model is assessed with respect to the following. The total coefficient of determination is $R^2 = 0.785$, which is a measure of the strength of several linear relationships jointly. It measures how well the observed variables serve jointly as measurement instruments for the latent variable. $R^2 = 0.845$ for the structural equation model. Note that these R^2 values are only illustrative. Appropriate test statistic requires R^2's derived from models with intercepts. Estimated coefficients of determinants of SOI in equation 4.1 can be used to predict SOI for any individual in the data set. That task is left to the future.

5. Conclusion

The present study illustrates how a person's health status can be estimated from the types of data sets available to economists. Given the symptoms, diagnostic conditions, and other indicators of a person's illness, it is possible to ascertain empirically the severity of a person's illness. The predicted severity of illness can then be used to as regressor variables in medical care utilization or economic growth models. In such models, persons with higher severity of illness would contribute less to economic growth through lower productivity and higher absenteeism; and would also utilize larger medical care, all else equal. Also, a person demands zero medical care if he or she is not ill and does not expect to be ill.

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