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HEALTH AND ECONOMIC BEHAVIOUR: A CRITICAL SURVEY OF THE LITERATURE

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Abstract

The purpose of this paper is to give a brief overview of the relevant literature on health economics. Theoretical and empirical researches are reviewed to examine the traditional perception of health and provide some general intuition of why the study of the individual economic behaviour is important in the field of health. Health, wealth and lifestyles are intimately linked through a complex bidirectional relationship. Economists have contributed much at its understanding and have overcome the limits of the medical and epidemiological approaches. This survey concentrates on the main estimation problems found in the health production function approach. Econometric methods that take account of reverse causation, unobservable heterogeneity and endogeneity are needed to recover the genuine causal effect of socio-economic factors and health-related behaviours on health. Finally, this survey looks at inequality in health as an urgent public interest issue and suggests to disentangle the causes of health inequalities from an economic perspective.

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1 Why Health Economics

Interest in the economic aspect of health issues and in economists' opinion about how to deal with problems related to health and the health care sector has strongly grown during the last forty years.

In the early sixties the classic article of Arrow (1963) announced the entry of health economics as a new discipline in economics. Some years later, in a study that tried to figure out the importance of the health care sector in the US economy, Fuchs (1966) wrote "Good health is one of man's most precious assets". Health is considered one of the most valuable personal and universal rights: "The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being..." as stated in the preamble to the World Health Organization (WHO) Constitution.

The concept of health is so complex that any attempt to define and measure health *in se* could be wrong and unsuitable. Nevertheless, economists are widely reckoned to give an important added value, with respect to other disciplines, in the field of health. The role of economists is clearly understood once health is assumed to be a relative scarce resource. Economics is the study of the allocation of scarce resources among competing wants. In a typical economic framework of supply and demand, health can be found both in the supply side, if the interest is in the technology and production of health, and in the demand side, if individual choices and preferences are the major concerns. Grossman's seminal work (1972) , which represents the first relevant theoretical and empirical work after Arrow's theoretical approach (1963) , defined health as a good desired to enhance well-being and utility, and emphasized also its function in improving individual labour productivity and production in the economy.

In general, a rational approach facilitates the solving of the decision-making process; analytical and scientific tools used in economics guarantee a deeper analysis. The economic apparatus provides a valuable input into health policies and health services research (Fuchs, 2000). However research is not exclusively interested in the the cost evaluation of the hospital activity (Propper, 2004): economic analysis in health and health care also makes a contribution in understanding other important issues, such as health inequalities in the population and the increasing individual risk of undertaking unhealthy behaviours (e.g., smoking, drinking, obesity).

Last decades have been characterized by a strong development of health economics. Interest in this field is growing exponentially in the Universities and institutions of many countries. Research on health is expected to widen and to enhance substantially the knowledge of economic behaviour. Health researches contribute to the advancement of economic theory and to the evolution of analytical and quantitative methods.

The next section will give a brief overview on the definitions of health and the use of different health indicators.

Section 3 will concentrate on the first seminal model of the demand for health. Afterwards, the controversial topic of the relationship between health, socio-economic status and lifestyle will be introduced. The epidemiological approach is compared to the economic approach to show that, according to the medical and epidemiological literature, there exists an exclusive one-direction causation from income, social class and education to health. Whilst, most of the health economics literature on health inequality contributes to the debate on the possibility of a reverse causation from health to socio-economic status. The issue of reverse causation arises also in many health economics studies on the correlation between health and lifestyle. The main theoretical debate here is about individual responsibility in the choice of the behaviours.

Section 4 will review the main empirical researches that use an health production function approach and focuses on the problems arising in the estimate of the causal effect of the inputs on health. Reverse causation and unobservable heterogeneity are the main cause of biased estimates. Instrumental Variables (IV) approaches have been used for a long time to recover the genuine causal effects. Substantial differences in health and health care do exist across individuals in the population. Health inequality has been of major interest in the economic literature in recent years (see e.g., Deaton, 2003).

Section 5 will review the main researches on health inequalities. The last section concludes.

2 Health and Indicators of Health

The definition of health has been long questioned because of the difficulty to find a unique concept that could be used in each area of health economics.

Culyer (1983) distinguished among a pathological, a sociological and a positive concept of health. These three concepts respectively describe health as complete absence of a disease, as absence of illness and as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". The first definition stems from the medical approach, which looks at medical labels assigned by doctors to patients' problems in some body function. The second definition recovers the drawback of the medical definition of health, that fails in considering the individual's perception of his (her) health status, which is important especially in the study of the demand of health care services. According to that, the idea of good and bad health would be solely related to what causes pain, discomfort and limitation in the normal daily activity. The third definition, much more concerned with a narrow idea of welfare, was published in the Constitution of the WHO in 1946 and still offers the broader and useful concept of health for health economists.

Once we agree on a definition of health, still the choice of a reliable measure of health remains problematic, since this strongly depends on the context

of the analysis and its targets. Moreover, since health has a particular multidimensional nature, various factors (such as genetic, physiological, mental but also cultural and social factors) play a role in the determination of health conditions and might partially influence the value given by the individual to a certain disease. To investigate variations in health, researchers use mortality, morbidity and self-evaluation measures. Different kind of indicators are available at this purpose.

Mortality rates (crude and age or sex-specific, death rates) are widely appreciated in the literature because they are objectively measured, easily available and quite accurate. For example, mortality data on the British population can be easily obtained: deaths are officially registered together with personal data for each individual. The merit of death rates is to allow comparisons between countries and over time. However they have drawbacks. First, mortality does not vary substantially between countries or over time, nothing can be said about actual health changes. Secondly, mortality measures do not capture pain, discomfort and limitation of activities. Lastly, they fail to describe changes in some health inputs, in particular when the individual has a chronic or a fatal disease, as well as potential subsequent health improvements. Despite mortality data are universally understood, often other indicators of health seem to be more meaningful.

While mortality measures are usually used to assess the validity of programmes that aim to improve health and the health care system, morbidity measures are preferred to describe the demand for health and whenever the researcher is interested in capturing the severity of a disease. They are equally measured with accuracy, especially if they come from clinical trials or hospital records.

Nevertheless, morbidity indicators show limitations when they are derived from self-assessed responses. If individuals are asked to evaluate the degree of their health, or the degree of limitation in their job given by the illness, they will be more likely to evaluate the extent of the loss of well-being caused by the illness as they perceive it. Self-evaluation, especially when it is asked by means of a face-to-face interview, is very likely to generate biased responses. Bad health can be either overevaluated or underevaluated depending on environmental influences, such as the occupational status, the role in the society, the cultural background. This problem is very common to all branches of economics which rely on individual survey data. Reliability of the answers should be investigated. The design of the questionnaire and the *ad hoc* formulation of the key questions are decisive.

Even though morbidity measures are more suitable to estimate the level of health in each socio-economic group, the most used health indicator seem to be the mortality rate. Applied analytical tools are sometimes quite crude, but empirical research is developing new original techniques of modelling that overcome the limits of the variables used.

3 An economic perspective on health

To understand the extent to which income, education, social position, age, ethnicity, use of health care and health-related behaviours contribute to modify the individual health status, an economic framework is needed. This section introduces the Grossman model of the demand for health and the relationship between health, socio-economic status and lifestyle.

3.1 The demand for health

In the last thirty years, the health economics literature has used the concept of a technology adopted by individuals to produce and modify their own health status. Health is reckoned to be both a consumption commodity and the outcome of a production process, which involves medical care and depends on individual behaviors and choices. The most recent literature is particularly interested in the relationship between style of life and health. I will give a brief overview of the theory underlying health economics and I will show how the literature is progressively including the lifestyles in the models for health.

In line with the original economic perspective which recognizes human capital as a determinant of investment and growth, several studies began to consider health not only as a good that individuals consume to enhance their personal satisfaction, but also as a capital stock that allows to increase the number of healthy days useful to work, to earn money and to consume other commodities.

The Nobel Prize in Economics, Gary Becker, famous for his contribution to the study of the household production function, is also often quoted for the extension of the conceptual framework in the context of health given by Michael Grossman. In Becker's theory (1965) of the allocation of time, households consume and produce commodities, using goods and time as inputs. Investments in human capital and knowledge should be measured in terms of market goods and of the opportunity cost of time lost for competing and alternative uses (Becker, 1967).

Following this idea, the Grossman's model of the demand for health (Grossman, 1972) defines health both as a pure consumption good, that increases utility, and a pure investment good and states that the demand for health care is derived from the demand for health.

His model defines health as a choice variable demanded by the consumer for its intrinsic utility. In order to have the desired level of health (the level that maximizes individual satisfaction), the consumer demands market goods and services. The derived demand for these inputs depends on a vector of variables such as income, prices, preferences, efficiency in production and health endowments. The model emphasizes the fundamental distinction between human capital and health: although it is not a tradable good, health can increase the possibility of consuming market goods because it affects the quantity of time available to individuals for working, producing income and commodities. Time has an important function in the model since health is a stock which

generates a flow of healthy days.

The household production process is defined by

$$I_{Hi} = I_i(M_i, TH_i, E_i)$$
$$C_i = C_i(X_i, T_i, E_i)$$

where I_{Hi} is the investment in additional health stock that depends on medical care M_i, on time spent enhancing health TH_i and on the stock of human capital E_i, education, and C_i is the composite home good that depends on the market purchased goods X_i and on time spent producing and consuming T_i. Hence, people invest in health by using health care and health-related behaviors as inputs, in order to to reduce spells of illness and be able to consume more when ill. The capital stock of health depreciates over time, suggesting that the age effect should be taken into account. In the model, education has a role once we consider that it could affect health by simply influencing the level of health achievable given a fixed vector of inputs or the endogenous health inputs. The better educated are more productive in the production of health and other commodities. The shadow price of investment in health would be lower for the better educated, so they take more care of their health and they are more likely to invest in its improvement.

This model offers an original support for policy and improvement of the level of health. However, it is often criticized because it is far from Arrow's approach to considering uncertainty and incomplete information in a model for health. Furthermore, it has the drawback of being deterministic in the event of death: death is chosen by the individual.

Becker and Grossman's works provided the framework for further studies, which have developed the concept of the health production function, including time, health-related behaviors and environmental factors as inputs.

3.2 Socio-economic status and health

From an economic perspective health depends on a list of different factors. Not only the use of medical services, but also genetic and biological factors, the socio-economic environment and personal behaviours affect health. The socio-economic context is usually defined by the occupational position of the individual, his (her) role in the society, educational level and income.

The link between health and wealth has been long investigated. British research studies often use the social class classification as proxy of wealth, particularly because survey data do not always provide precise and reliable information about the income distribution. In general, poor persons are more likely to suffer bad physical conditions. Marmot et al. (1984) showed a steep inverse relationship between employment grade and mortality in the Whitehall study, with a sample of people followed over a period of 10 years after the first interview. Later on, Marmot et al. (1991) also noted a steep positive relationship between employment and morbidity measures of health. Subsequent studies confirmed that, after controlling for age, education, race, marital status, income and health condition, a strong link exists which positively cor-

relate wealth and health. However, this relationship might have an opposite direction: it is very likely that people who are experiencing a period of illness have less capacity than others to generate income: ill health reduces income and ability to work.

Some of the literature considers that even though initial endowments of health and income are likely to be positively correlated, and to influence strongly the health pattern during life, people are also partially responsible of the job they get and the way they spend money. The individual is a rational economic decision-maker, who can decide to accumulate for future consumption over retirement, or to spend his (her) assets for a healthier present life. According to Fuchs (1993), work and consumption decisions are both choices that affect health. Increasing income and better job can determine improvement of the health status. Nevertheless, it is also true that ill health can cause a rapid change in the occupational status - some diseases do not allow to get jobs that require particular physical strength or full time commitment - and, consequently, an income reduction. High income levels are expected to generate a higher demand for medical services and then a better health status. However, more money can make more appealing the consumption of other commodities. Consumption of goods that are detrimental for health, like tobacco and alcohol, might be desired more than medical treatments. The wealth elasticity of the demand for health determines the extent to which more earnings lead to a reduced medical services utilization and to a greater consumption of other commodities.

Most of the literature devoted to the explanation of the causes of health inequalities, tries to solve the long debate concerning the nature of the relationship between socio-economic status and health. The point is whether poor health is determined by a low socio-economic condition or, by contrast, it is one of the causes of a low socio-economic condition. The link between health and wealth has been long investigated in order to design the best policy to target inequality: an improvement of the health care sector or a reduction of the disparity between social classes. In a recent article, Gardner and Oswald (2004) give an updated list of references on this topic and extend the debate, decomposing the influence of socio-economic factors into two main parts: income and marital status. The main finding is that income only marginally affect mortality, whilst marriage has a larger positive impact on longevity especially for males[1]. The time spent not married is detrimental on men's longevity since marriage has a cumulative positive effect on health. Stress levels are included in the analysis to conclude that, even if it is not clear why marital status affects longevity, it is at least quite sure that it is not through a reduction of mental strain or an improvement of psychological well-being. Other works in the literature show that mental strain can be easily associated to socio-economic

[1]The empirical analysis is carried out on a sample of individuals over 40 years old in 1991 up to 2001 from the British Household Panel Survey (BHPS). After controlling for initial health conditions, they find that income can only have a long term effect on health: health status in 1991 can be influenced by income in early ages. The negative effect of marriage on the risk of mortality partially offsets the positive effect of smoking for males.

status and reflect the level of health risk in a social group.

The last issue of the Annals of the Journal of Econometrics, covering analysis of data on health, present an interesting study on US data by Adams et al. (2003). This work offers a new perspective on the relation connecting health to the socio-economic status and generates further discussion in the literature. The authors tested for the presence of a causality in the relationship between socio-economic status, innovation in health, and mortality. Probit models for the incidence of a health condition are estimated: demographics, past and present health conditions are included to measure more robust marginal effects of the socio-economic factors. They found that, once initial health status is controlled for, there is no direct causal link from socio-economic factors to mortality and onset of acute and sudden health conditions. By contrast, causality exists in the link with most of the chronic and mental conditions, since they need higher out of pocket payments and are only marginally covered by the health system. On the other hand, they showed that the socio-economic status can be caused by poor health but the extent of this effect largely depends on the socio-economic indicator used. However, Adda et al. (2003), argued that even if the access to health care for these conditions was free, like in the UK and Sweden context, the causality link would remain. Criticisms to Adams et al. (2003) can be moved from the statement that the relationship between socio-economic status and health is not constant over the individual lifetime but it is likely to change depending on a host of exogenous or endogenous factors, which can even be hidden to the researcher.

In a study on mortality rates, Silver (1972) had already introduced the idea of education as a factor influencing wealth and health. He argued that it was still not clear whether there was a direct effect of schooling on individual tastes and behaviours, or schooling health only through its impact on income, occupation and wealth. To allow for the hypothesis of reverse causation in the correlation between wealth and health, Fuchs (1993) suggested to consider social variables, as schooling, and genetic endowments as a third factor influencing health.

The first main work recognizing a kind of association between schooling and health is by Grossman (1975), who had already focused on this correlation in his previous model of the demand for health (Grossman, 1972). Additional years of education make people more efficient in the production of health, at any given level of income: people use more medical services, in a more conscious way, and they choose a healthier style of life. However, also in this case the hypothesis of reverse causation cannot be ignored: people in good health are more likely to complete their education process.

Fuchs (1982) gave an important contribution to the understanding of the impact of education and individual behaviours on health. In a paper that investigates the relationship between intertemporal choice, health behaviour and health status, he suggested that the individual rate of time preferences has an important role in individual health decisions. This should be reckoned as a third meaningful variable influencing health, in addition to health-related behaviours and education. When the rate at which people discount the future

is low, they tend to invest more in both education and behaviours enhancing health. The concept of time preferences allow us to better understand variations in health-related behaviours. From an economic point of view, good health practices involve a trade-off between current costs and future benefits. Costs may be physics like the effort to pass up a cigarette, and financial (or not). The direct benefit is the reduction of the probability of morbidity and mortality. People decide to pay a cost to get a future benefit and this is a sort of investment in health. Their willingness to invest in health-related behaviours, for example through education, tells us something about individual time preferences. Investing in more schooling is likely for people with low rate of time discount. Still it has not been empirically proven if the hypothesis of schooling determining the level of time preference and then of health, dominates the hypothesis of the opposite relation for which schooling has a direct effect on health.

3.3 Lifestyle and health

In the 1970s with his book *Who Shall Live*, Fuchs (1974) was one of the first authors to show that the style of life had a greater impact than medical treatments on health outcomes.

Belloc and Breslow (1972), used data from the Alameda County survey, carried out in California in 1965, to investigate the relationship between physical health status and health practices. This epidemiological study analyzed the impact of seven behaviours on health, known as "Alameda Seven", about eating habits, tobacco and alcohol consumption, physical activity and sleeping habits. Assuming that only a unidirectional relationship between health and the health-related behaviours, as explicative variables, can exist, they found that the bigger is the number of good practices followed, the better the individual physical health status is. One year later, Belloc (1973) extended this work to the relationship between mortality and day-by-day practices. The highest mortality rates were found in those who followed only a few practices, independently on their income position.

Newhouse and Friedlander (1980) explored the relationship between medical resources and physical health status. They found consistent evidence of the central role of the style of life in the determination of health. Health is dominated more by individual personal care than by the medical care system[2]. The idea is that even if economic, environmental and social circumstances can bind the decisional process, each individual has a margin of action and choice. Epidemiological studies, for example McGinnis and Foege's work (1993) showed that the risk for most causes of death in the adult population increases due to lifestyle choices. However, epidemiological and medical studies usually attribute to lifestyles only a marginal role in the health production function relative to the socio-economic factors.

[2]They use education as best available proxy of healthy style of life. The finding is that education has a noticeable effect on mortality, while additional medical care has not.

Kenkel (1995), strongly criticized the epidemiological literature because epidemiologists usually miss the analytical tools necessary to carry out multivariate analysis, which allow to learn something about the association between health-related behaviours and health, and the correlations among lifestyles. They only concentrate on the causality issue from inputs of the health production function to its outcome, while an economic approach to the health production function provides the advantage of using only structural equations and accounting for unobservable heterogeneity, omitted variables bias and endogeneity. In his research, Kenkel re-examined the importance of the "Alameda Seven". Health is expressed as a function of lifestyle, schooling and other exogenous variables (such as age, gender and so on) influencing the productivity of the gross investment in lifestyle and schooling. The importance of lifestyles in adult health and the role of schooling are emphasized: people combine market and non market inputs to have good health.

More recent studies also argue that non-genetic modifiable behavioural risk factors, such as tobacco and alcohol consumption, are the major responsible for the incidence of particular causes of death in United States (Mokdad et al., 2004).

It is largely accepted that health is sensible to changes in individual lifestyles and consumption habits and individuals' decisions contribute to determine their own health status. If each person partly controls his (her) own state of health, then also the choice of little health must be admitted. Going to the doctor, or making a screen test, for example, implies time and monetary cost: being healthy depends on the trade-off between health and other commodities. Therefore, health economics is also the study of the trade-offs individuals make when they compare benefits and costs of consumption choices.

However, two points must be borne in mind. Firstly, health is not a priority *in se*. People desire health to get happiness and well-being, but other goods can give the same level of satisfaction, depending on the indifference curves representing individual preferences. The problem here is always one of utility maximization and maximizing health does not mean maximizing utility. Secondly, freedom of choice is often subject to constraints depending on genetic endowments, social origin, earnings, health knowledge and available information. Consequently, if on one hand, lifestyles reflect individual preferences, on the other hand, they might just reflect the constraints of personal circumstances. In the former case, individuals responsibly choose to undertake a behaviour while, in the latter, they are non-responsible.

There is a host of models both in the health and epidemiological literature, that, according to the biomedical approach, focus on individual responsibility in the choice of the health-related behaviours. Other models disagree with the concept of free choice. Individuals would not be able to choose freely because economic conditions, environmental and social circumstances considerably influence the decision process. In particular, Duncan et al. (1996) and Lynch et al. (1997) offered a exhaustive review of the literature: although for some authors the impact of socio-economic status on health is hard to measure without considering health-related behaviours, for many others free choice of

the behaviours is limited by the socio-economic environment. No all possible choices are really available to every individual. So, looking at the social and educational background might be useful to understand how health-related behaviours are distributed between groups in the population.

According to Duncan et al. (1996), structural constraints, created by circumstances and environment, do not allow the theory of free choice to hold. They used a multilevel approach to capture the impact of context on lifestyle choices. Many factors, often unknown to the researcher, can influence the decision making process. Social theory supports this idea, emphasizing the role of the context in which people live. Roemer (1998) suggested that if we look at a particular social group, there is still space for individual responsibility in the variation of the lifestyle relative to the fixed level of the behaviour in the respective group. A certain level of smoking is associated to a social or working group but changes in the consumption of tobacco within that group are attributable to individual decisions.

In line with the approach that does not accept individual responsibility, Jones et al. (2000) sought to explain why persons with similar characteristics experience different health outcomes depending on where they live. Data from the Health and Lifestyle Survey were used to analyze the relation between death and deprivation, the main socio-economic feature of the area in which the individual lives. First using a logit model for a binary indicator of death, they found that social variables keep their effect on mortality even after inclusion of lifestyle variables, but no significant interactions between lifestyle and social terms exist. Using a Cox-proportional hazard model for mortality they found significant interaction terms between deprivation and specific social classes. Survival increases with decreasing deprivation in the highest social classes and decreases for skilled non-manual occupations in the most deprived areas. However, important differences between social classes have been found only at high deprivation values. They concluded that the odds of dying do not depend uniquely on individual characteristics, such as demographic, socioeconomic and health-related behaviours: the deprivation index, that measures what they define "ecology of mortality" is reckoned to play a fundamental role in mortality.

As well as contextual factors, the presence of potential risky behaviours should be considered when dealing with individual choice. People can make an unhealthy risky decision because the cost of being fully informed about the health consequences is too high. Incomplete or incorrect information may characterize the decision process. In addition, the rate at which people discount the future, especially when the decision is made at a time far from the time when it will have its effect on health, can influence the choices about health. Time preferences, as presented by Fuchs, and information problems should be taken into consideration but it still remains the problem that these two elements are likely to be unobservable to the researcher.

4 The health production approach and the causal effect of the health inputs

One of the first health production approach in the literature is offered by Auster et al. (1969). The motivation of their work is the concern that, since governmental decisions affect resource allocation and health improvements, it is important to correctly evaluate the economic value of benefits arising from health policies. In this study, medical services are only an intermediate product in the production process that "changes the health status of the population". The rate of mortality is explained by both medical care utilization and environmental factors, such as race, income, education, geography, smoking and drinking. They use a Cobb-Douglas production function for health, like the following:

$$H = AM^{\alpha} \prod_{i=1}^{k} X_i^{\beta_i} e^{\varepsilon}$$

where M is the amount of medical services, X_i is the family of environmental factors and ϵ is a random error normally distributed. Potential endogeneity of the demand for doctors and medical services is taken into account: additional utilization of M leads to better health, but people ask for more health care if they are sick, so that bad health would determine M. This kind of simultaneity is corrected by using a two stages least squares approach (2SLS) for the estimation of the elasticity of health with respect to medical services.

Many other important works on aggregated data have largely shown the relationship between health and medical input, cigarettes, alcohol, environmental pollution, maternal behavior, and other health-related behaviors. They show how some methodological and econometric issues arise in the estimation of the health production function. The main problems are unobservable individual heterogeneity in the population, endogeneity in the regressors and self-selection bias. The estimates of the parameters of the population are therefore biased: econometric methods that correct for this biasness and recover the real causal effect of the health inputs on the health outcome are needed. Many studies have largely contributed to improve the analysis of health data.

Lave and Seskin (1977) published a pioneering work on the relationship between air pollution and health. Pollution is partially responsible for illnesses and deaths; its damages are worse in oldest persons and in those who already suffer of respiratory diseases. As in Auster et al. (1969), the analysis has been conducted on aggregate data. The big problem with these data is that they did not allow to consider the influence of individual's specific characteristics (nutrition behavior, sport activities, smoking and alcohol habits, sleeping, housing conditions, work environment) on the health outcome. An attempt to overcome this lack is due to Ostro (1983), who combined data about air quality in US with individual information collected in a health survey. The effect of individual behavior on health is definitely better captured by studies on survey data. Two morbidity variables were used as proxies of the health status: the number of days of restricted activity due to every kind of illness,

and the number of workdays lost during the fortnight previous to the survey. Only one health-related behavior, smoking, was taken into account. However, smoking is used as a control variable to estimate the effect of air pollution on the subsample of non-smokers male, and not to estimate its causal effect on health. As expected, the result was that the better is the air quality, the lower is the probability of increasing the number of workdays lost because of illness.

The idea of introducing a measure of smoking behavior was better exploited in subsequent studies which analyzed more in depth the role of individuals in the determination of health. Ostro's study will be very relevant for Mullahy and Portney results.

In Rosenzweig and Schultz's work (1983) on child health production, the number of cigarettes smoked is finally in the right hand side of the health production equation, with other endogenous variables (working, prenatal medical care, age of the mother and birth order). A strong emphasis is put on individual heterogeneity in the population. The authors also offered a constructive criticism of previous theoretical models and of the classical assumptions of least squares in this context. Results of past researches are based on equations that account for unobservable heterogeneity but still ignore endogeneity, assuming that the population does not differ with respect to exogenous health endowments. Whereas a problem of endogeneity in the health production function evidently exists. For example, the individual decision to smoke may be correlated with the health status. Frailer people are more likely to consume less tobacco or to quit. Hence, the researcher should control for the presence of reverse causation in the relationship between smoking and health. Individual heterogeneity, generally due to differences in genetics and in past experiences, in this context can mask the positive effect that preventive medical care during pregnancy has on birth weight. Mothers who had experienced sickness during pregnancy are more likely to demand prenatal medical care than mothers who have never given birth or who didn't have complications in past pregnancies. Health technology should be estimated from a behavioral model where inputs are chosen by the individual. A structural equation for the health production function is estimated

$$H = f(y, z, \mu)$$

where y represents the goods affecting child health; z is the health input, and μ represents every factor unobservable to the researcher. Because collecting data on health inputs is not easy, reduced-form equations may be preferred

$$H = h(p, F, \mu)$$

where p is the price and F is the budget constraint (money income). It is trivial that the limit of this specification is that still the household health technology is not formally defined. More often the following "hybrid equation" has been estimated in the literature:

$$H = \psi(z, p, F, \mu)$$

where z is the one input medical care; the other factors are determinants of all other inputs. Efficient estimates of the technological parameters need information about all important behavioral inputs and exogenous factors related to

health. But since the latter can be hidden to the researcher, it can be difficult to estimate the derivative

$$dH/dz = \Gamma_z + (dz/d\mu)^{-1} \tag{1}$$

which is the sum of the direct effect of medical care on health plus a bias term, that mainly depends on the indirect effect of z on H through μ. If the ordinary least squares (OLS) classical assumption of independence of the regressors from the disturbance term is not satisfied, then parameter estimators are biased and inconsistent. An instrumental matrix, say W, whose columns corresponds to the instrumental variables for the parameters, and which is in the limit uncorrelated with the error term and correlated with the regressor matrix, is necessary. The generalized least squares method (GLS), gives finally consistent and unbiased estimates. However, 2SLS are preferred in order to have consistent estimates. Price, income and education, uncorrelated with the health endowment, are the instruments. In the first stage each variable in the regressors matrix is regressed on W; in the second stage, H is regressed on the matrix of fitted values $\hat{X}$ previously obtained. The authors conclude that still their estimates can be biased, due to the omission of important determinants of birth not available in the data-set, and to the possibility that instruments, used to identify the health technology, are correlated with the unobservable health endowments.

Mullahy and Portney (1990), particularly inspired by Rosenzweig and Shultz, stressed that unobservable factors might influence personal choices. They focused on the relationship between environment and health, using an indicator of disability for health. That is, the number of days of limited activity due to some respiratory condition in the fortnight before the interview[3]. The answer is associated to a specific type of respiratory illness according to an official classification. The choice of this health indicator is justified by the ease of obtaining it by directly asking to individuals, and by the intuitive interpretation of its variations as result of environmental and smoking habits changes. However, it might not capture the severity of illness or might be too sensitive to individual perception of limitation so that the true respondent's health status would not be represented. They estimated a simple technology for the production of respiratory diseases, where the inputs are cigarettes smoking, air pollution, climatological conditions and other risk factors.

Data for smoking behaviors and chronic respiratory diseases are individual survey data from the National Health Interview Survey (NHIS), conducted in US in 1979, the same used by Ostro (1983). Official information about individual illness registrations is not available. The original sample size of 110000 units, was drastically reduced for reliability reasons. Only persons aged 17 or older were asked to give information about previous and present smoking behavior. About a half of the observations related to persons living in rural areas were cut off, because no official information on pollution is available for those places. Because of this sort of geographical restriction problem of

[3]This morbidity measure seems more informative than the measure used by Ostro, since it focuses on respiratory diseases as causes of disability.

sample selection are likely to arise. Furthermore, the sample was restricted to adults aged 59 years old or more because respiratory illness can be related to age. The remaining sample was reduced one more time because in some cases information about cigarettes price or socioeconomic characteristics was missing. The final sample size was of 2331 individuals. Any comparative analysis was carried out to establish if it was still representative of the original sample. But, from a statistical point of view, the reduced sample size does not cause a worrisome loss of information. Robustness of results is proved by making inference on different sub-samples and using different matrix W. The underlying theoretical model is based on the maximization of the utility function

$$U_i = U_i(H_i, S_i, C_i) \quad \text{s.t.} \quad H_i = \rho(EN, S_i, \Omega, \mu), \quad P_c C + P_s S = I_{Hi}.$$

where respiratory diseases are produced by an endogenous input S_i, a composite commodity C_i, exogenous environmental factors EN, other observable individual influences on health Ω, and by unobservables. S_i is measured by the number of cigarettes smoked per day at the time of the interview and the model is not linear in smoking. However, the smoking indicator does not capture the cumulative effect of smoking over time and does not discriminate between heavy old smokers and new smokers. The authors tried to use also the number of cigarettes consumed during all respondent's lifetime, which is more informative and captures the intensity of smoking, however it was not statistically significant. Here tobacco consumption enhances utility, whereas the fact that the marginal utility of smoking might be negative is ignored. Two variables are used for EN: the average across the target period of the highest hourly ozone readings, and the simple average of daily sulfates readings. Individual utility is supposed to decrease in H_i and to increase in S_i and C_i.

To evaluate the effect in (1), they present a comparison of OLS and GMM estimates from the simple regression model

$$y_i = \beta X_i + u_i$$

where y_i can be either binary[4] or continuous. The decision of smoking can be influenced by the individual perception of his (her) health status. There are unobserved factors, potentially known to the individual but unknown to the researcher, that can influence both the smoking behaviour and health. This makes it difficult to have an unbiased estimate of (1). Here, the generalized method of moment (GMM) is preferred to the 2SLS method because a χ^2 test (Hansen and Newey test) detects overidentification of the parameters[5]. The matrix W for smoking is composed by all the set of regressors X_i (age, gender, chronic health limitation, rain, temperature, ozone, sulfate, except the number of cigarettes), some exogenous socio-economic determinants of smoking, and

[4]It takes value one if the number of sick days is greater than one.

[5]The IV method is a particular case of the GMM. Overidentification arises if r, the number of column of W is greater than k, the number of column of X. But, if r=k, then the GMM estimator is identical to the 2SLS one.

some interaction terms (education and age, education with marital status). Once smoking is treated as an endogenous determined choice variable, its impact (also with respect to the quadratic term) on the number of sick days is higher and significant. However, the variable ozone is statistically significant only in the version of the continuous dependent variable model and the number of sick days increases less than proportionally with respect to the ozone concentration.

Mullahy and Sindelar (1996) extended the GMM approach to the estimation of a two equation system (for employment and unemployment), where the endogenous variable was an indicator of drinking. GMM has the advantage to encompass the IV method especially when the designed instrument matrix does not predict well the endogenous variable, that is when it does not satisfy the fundamental conditions of consistency and efficiency.

Another important study, by Grossman and Joyce (1990), concerning the first infant health production function, control for self-selection in the resolution of pregnancy, as live births or induced abortions, and in the use of prenatal medical services. they define selection as favourable either if women are more likely to give a birth because willing to invest in their infants, or if they are more likely to obtain an abortion because of the bad health status of the fetus. On the other side, they talk about a kind of adverse selection if women decide to give birth even though they are less willing to invest in their infants. Unobservable factors or behaviors influence the pregnancy of women who choose to give birth in the model. The increased use of medical care may produce variations in these characteristics leading to effects on the infant's health. The model considers unobservable biological characteristics relative to each individual, such as health endowments and hard-to-measure endogenous inputs. However, controlling for factors that influence the decision of the mother to initiate prenatal care is not always sufficient, because the researcher can omit factors related to prenatal care (a better diet, more physical activity, less stress). This bias is corrected by IV method, but self-selection is still a problem. The best way to deal with self-selection in pregnancy is to hypothesize that unobservable variables influence directly the decision to give birth or to abort, the infant health status and the mother behavior during pregnancy. Three equations describe the model, estimated by the two-steps Heckman procedure: one is for the probability of giving a birth Π_i , another is for the production function of birth weight b_i, the last is for the demand for prenatal medical services m_i

$$\begin{aligned} \Pi_i &= \alpha_1 y_i + \alpha_2 c_i + \alpha_3 a_i + \alpha_4 \varepsilon_i, & u_{1i} &= \alpha_2 c_i + \alpha_3 a_i + \alpha_4 \varepsilon_i \\ b_i &= \beta_1 x_i + \beta_2 m_i + \beta_3 q_i + \beta_4 \varepsilon_i, & u_{2i} &= \beta_3 q_i + \beta_4 \varepsilon_i \\ m_i &= \gamma_1 p_i + \gamma_2 c_i + \gamma_3 a_i + \gamma_4 \varepsilon_i, & u_{3i} &= \gamma_2 c_i + \gamma_3 a_i + \gamma_4 \varepsilon_i \end{aligned}$$

where y_i represents household or mother characteristics, c_i is the cost of contraception, a_i is the cost of abortion, ε_i is the unknown health endowment of the fetus, x_i is the gender of the infant and mother's prior fetal loss, q_i represents lifestyle determinants, p_i reflects the presence of health insurance and the number of prenatal services provided in the area of residence. While all

the equations refer to all pregnant women, the second and the third equation are valid just for women who give birth. Pairwise covariances between the error terms are studied to highlight the difficulties related to the measurement of determinants of birth outcome. The Heckman procedure corrects for the bias of the OLS estimates that occurs when u_{1i} and u_{2i} are correlated. From a probit model of the first equation, the inverse of the Mill's ratio (λ_i), for each woman who gives birth, is obtained. λ_i is added to the set of regressors in the remaining equations, which are then estimated by OLS procedure. A 2SLS probit method for simultaneous equations models with selectivity (as developed by Lee, Maddala and Trost) is applied when prenatal care is treated as endogenous, because of computational problems in the maximization of the likelihood function. As in Rosenzweig and Schultz (1983), Grossman and Joice move from OLS to 2SLS to improve the efficiency and consistency of the estimates; however, in their work the size of the variation is less important. They do not show any empirical evidence that prenatal care is endogenous.

In conclusion, the specification and the estimation of the health production function are limited by various methodological problems. The most recent works in health economics use econometric tools and develop new methodologies useful to measure the role of individual behaviors in the demand and production of health.

5 Health inequalities

Health economics is reckoned to have the important task of clarifying to what extent people experience different health conditions and why well-being is not the same for each individual in the population. Economists should help to understand at which point the distribution of health starts to become unequal and which factors contribute more to overall health inequality. Economic theory should also suggest the best way to tackle these inequalities.

Defining health inequalities has taken up a relevant space in the literature up to now. Culyer and Wagstaff (1993) emphasized that since the demand for health care is derived from the demand for health, it is straightforward to conclude that also the concern of equity in health care is derived from the concern of equality in health. Four definitions of equity in health care exist, which seem to be mutually incompatible, concerning equality of expenditure per capita, distribution according to needs, equality of access and equality of health. The author found that the latter represents the dominant principle and that "an equitable distribution of health care is simply one which gives rise to an equal distribution of health". Fairness in the distribution of health means that everyone is guaranteed to have the same opportunity to succeed and become strong and 'flourishing'. Culyer and Wagstaff stressed that, according to the moral philosophy literature, individuals are human beings with the right to 'flourish', in the sense that every individual should have the same chance of improving their well-being and having success in life. Regardless of which

definition of need or equality of access is adopted, both distributions according to people's need and equality of access, either in their horizontal or vertical meaning, hardly lead to equality in health because they do not care about the flourishing argument[6].

The idea of equity as equality of opportunity is especially supported by the Nobel prize Sen (1992). He argued that people are characterized by 'functionings', that is what they are and do, and by 'capabilities', that is the opportunity of choice among 'functionings' and the real possibility to function. Every inequality in health preventing individuals from succeeding in life and being what they really are, can then be judged as inequitable. Hence, equality of 'capabilities' should be pursued.

The Handbook of Health Economics dedicates one entire chapter to the issue of equity in health. In the last section of this chapter, Wagstaff and van Doorslaer (2000) stated that equity in the health care system is important because it implies a more relevant question: equality in the distribution of health itself. Eliminating health inequalities is a hard and even impossible goal, whilst reducing them can be an attainable objective if the proper tools are used. If only equity in the health care system is undertaken, it will be possible to ensure fairer health to everybody.

The definition of the ideal health distribution is still a matter of concern to the literature. For some authors, equality of access is fundamental to guarantee equality in health, but this view is too much reductive. Others, like Grand (1991) with is "equality of choice sets" , believe that access to medical treatments must be different according to individual health-related behaviors. Only inequalities in the constraints faced in the decision-making process are inequitable, whilst inequalities between smokers and no-smokers for example, as they are considered in a way 'wanted' by the individual, turn out to be equitable. Given the studies quoted above, Bommier and Stecklov (2002), proposed a social justice approach that identifies the ideal equitable society as one where individual socio-economic characteristics must not determine either access to health care or the shape of the health distribution in a population. Evaluating the theoretical framework at the basis of the measurement of health inequality, Bommier and Stecklov also tried to justify the need for a new approach that overcomes the limits of the classical social welfare (SW) function approach. The latter is the most useful and appropriate approach for income inequality analysis but also for multi-dimensional inequality, which includes health. However, it is open to criticism since it does not seem to match with the definition of an equitable distribution of health: it is not able " to reject income-based discrimination in the access of health".

The literature distinguishes between pure inequalities and socio-economic inequalities in health. As far as concern pure inequalities, the focus is on the

[6]Equality is said to be horizontal if people in equal health problems receive the same treatment. Aside, according to the concept of vertical equality, not all patients deserve the same care and the same treatments, but people more in need deserve more consideration and care: to say it briefly, people with unequal health conditions, or who are different in some relevant aspects, must be treated in an unequal way.

possibility that the whole distribution of health is unequal within the population. In this case, the socio-economic dimension of inequality is not considered, unless the decomposition approach is adopted. The analytical tools used by researchers are originally provided by the income economic literature. They are mainly the Lorenz Curve and the Gini coefficient. Empirical applications of the Gini index to age at death show that it is neither bigger than 0.24 or smaller than 0.11 (Illsley and Grand, 1987). The socio-economic inequality approach is more sensitive to differences in the distribution of income, education or social position within the population and relates them directly to inequalities in health. What really matter is whether or not poor people, for example, experience worse health than rich people. The most used analytical tools are the concentration curve, the concentration index and the (relative) slope index of inequalities. These measurements overcome the drawbacks of unsophisticated and simple indicators such as the range. socio-economic inequalities in morbidity and mortality have been investigated in several studies. A critical appraisal on the available measurements of inequalities is given by Wagstaff et al. (1991). The concentration index of inequality offers also the advantage of easiness in the interpretation: Koolman and van Doorslaer (2003), suggested a Robin-Hood type specification of the index, that permits to make considerations of policy making in favour of a linear redistribution of health from rich to poor people. It has also been shown that the Gini coefficient is directly proportional to the concentration index. Thanks to this relationship the application of the Gini coefficient to the analysis of total health inequality is getting more and more interesting.

Recent works aim to decompose inequality in health in order to reveal the contribution of each determinant of health. Wagstaff et al. (2001) stressed the importance of "unpacking" the causes of socio-economic inequalities, by decomposing the CI. Inequalities depend both on the direct impact that the various determinants of health (e.g., lifestyles, parental factors, geography, income, education, ethnicity) have on the health outcome and on the distribution of these determinants across socio-economic groups. Morris et al. (2003) decomposed both the CI and the Gini coefficient for the use of health care in England. Also van Doorslaer and Jones (2003) decomposed both indexes, using SAH and the Health Utility Index (HUI).

6 Conclusion

This paper proposed an overview of the existing relevant literature on health economics. It focused on some significant theoretical and empirical research contributions to explain why economists should be concerned about health and why an economic approach to health is needed. Health inequalities was seen as a urgent public interest issue. In particular, the British experience was used as an example of major concern for health issues and involvement in tackling health inequalities in the population. Emphasis was given to the

role of the economic theory in the understanding of health inequalities and to the relationship between health, socio-economic status and lifestyle. Seminal researches that focused on the methodological problems arising in the estimate of this relationship were reviewed.

In the most recent literature, new researches are orientated towards the use of econometric methodologies that can control for individual unobservable heterogeneity, reverse causation and endogeneity. The Instrumental Variables approaches have long been criticized for their limits in recovering the genuine causal effect of the health-related behaviours, the use of medical care, and the exogenous socio-economics factors on health (see Auld, 2005, while other methods are more desirable. Recent works propose the use of a structural equation for the health production function and reduced form equations for the inputs. They also suggest to control for unobservable heterogeneity and endogeneity by allowing for a multivariate distribution of the error terms as in Contoyannis and Jones (2004) and Balia and Jones (2004).

Much of the current health research projects are mainly concerned with inequalities in health. Public health policies, aiming to achieve improvements in the overall health status of the population, should be decided considering the contribution of each determinants of health to inequality. This paper briefly showed that the theoretical concern for inequalities is moving into practice and that many health economists are concentrating their analysis and efforts in this direction.

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