THE ECONOMICS OF HEALTH AND HEALTH CARE: Assessing health determinants and impacts on an aging population

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TESE DE DOUTORAMENTO EM ECONOMIA

Orientada por:

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Biographical Note

Luís Francisco de Gouveia Durão Pina Rebelo was born on 31 March, 1981, in Porto, Portugal.

He finished high-school at *Colégio Luso-Internacional do Porto* (C.L.I.P.), where in 1999 he completed, with Distinction, the *Advanced International Certificate of Education* (A.I.C.E.), from the University of Cambridge.

In 2004 he concluded his licentiate degree in Business Management (*licenciatura*) at the Portuguese Catholic University (*U.C.P.*), Porto, as a top graduate student (*17 valores*). Performed a Summer Internship at *BCP-Millenium*, Wall Street delegation, New York.

He then performed a brief internship at Roland Berger – Strategy Consultants in Lisbon, before being admitted as an Assistant Teacher at the Portuguese Catholic University, Faculty of Business Management and Economics, where he remains until today.

In October 2005 he was admitted to the PhD program in Economics, at the Faculty of Economics of the University of Porto (F.E.P.). After successfully concluding the curricular part of the program (*16 valores*), he presented several articles in prestigious international scientific meetings ("International Health Economic Association (IHEA) 8th World Congress", Toronto; "3rd Advanced Summer School – Discrete Choice Modelling, with William Greene", Crete; "15th World Congress of the International Economic Association", Istambul); "10th Portuguese Economic Association Conference (APES)", Lisbon; "2007 History of Economic Thought Conference", Belfast).

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Abstract

This thesis is organized in two independent parts.

The first part (Essay 1) is a dissertation on the origins and evolution of Health Economics, under a history of economic thought perspective of the discipline. It describes the main forces behind its creation and explains how, by the end of World War II, both the intellectual and financial resources were being made available to answer the emerging empirically-driven questions for this new applied branch of economic analysis. It also discusses how the discipline split itself, at birth, into two distinct streams of health economic thought, whilst discussing the effects of this over its evolution, and today's literature.

The second part (Essays 2 and 3) is of an empirical nature. Firstly, a methodological improvement is proposed to evaluate the distribution and state of public health, allowing for the comparability across heterogeneous individuals in a multi-cultural context; secondly we extend the use of this methodology to assess health across a diversity of socio-economic and psycho-cognitive backgrounds and then evaluate the role health plays in determining retired Europeans' (in)activity and quality of life. A future for the E.U., dominated by an escalating population of retired citizens, has long been foreseen, representing a major challenge to social and health policy in European countries. The results of this paper point out the effective role health policies might play on retired citizens' participation in economy and society and therefore hints a route for policy

makers to take, in contouring an aging and unproductive European population, transforming what could be a “social burden” into an asset.

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Introduction

This thesis is organized in two independent parts. The first part (Essay 1) is a history of economic thought perspective on Health Economics. It digs into the origins of the discipline and describes the main forces behind its creation, and how it developed there since into the two streams of thought: a *market* and a *health capital* approach. The second part (Essays 2 and 3) involves the assessment of such a *health capital* and is more of an empirical nature. Firstly, a methodological improvement is proposed to evaluate the distribution of public health across heterogeneous individuals in a European context; secondly we use this methodology to assess the role health plays in determining retired Europeans' (in)activity and well-being, namely quality of life.

Health has become a dominant economic and political issue over the past 40 years, with nations experiencing rapid rises in health care spending, and the health sector presenting high levels of expansion, rationalization and organization, having the concept of health itself been redefined. In my first essay I describe how by the end of World War II, both the intellectual and financial resources were being made available in the U.S. to answer the emerging empirically-driven questions for a new applied branch of economic analysis: Health Economics.

I also discuss how the discipline split itself, at birth, into two distinct paths of health economic thought, as identified in the 1987 Palgrave dictionary entry (Eatwell et al., 1987), while discussing the effects of this over its evolution, and today's literature: the first, a *health care market* approach, with its source in Kenneth Arrow's (1963) characterization of the medical care market and its specificities, ended up by taking a more empirical turn, strongly based on econometric techniques, mainly as a direct response to the demand for empirical studies, rising very much from practitioners,

institutional and political forces, focusing on health market failures and the role of public intervention to assure health care to citizens. The second, a more theoretical *health capital* perspective, was rooted in Grossman's work (1972), considering the general state of health (and its determinants) as a necessary investment, essential not only to sustain any productive economy but also indispensable for the enjoyment of a utility from any other product of any other market.

Blaug stated, in 1998, that: "health economics would seem to be a perfect topic for heterodox dissent and yet, surprisingly enough, radical economists and Marxists have not on the whole been attracted to health economics". I conclude this could have been because the context was favourable to these "mathematical economists" to step forward and challenge themselves to solve problems such an unorthodox market posed.

In my second essay, I address the issue of evaluating the state of public health. Self-reported health is a commonly used measure which has, however, been questioned in several studies. They argue against the comparability of such survey measurements across groups of individuals. I therefore propose a methodological improvement in assessing 'true' health status, with higher predictive power, by controlling for heterogeneity in reporting behavior, whilst assessing the impacts of each determinant of health. This possibility of comparison across groups is exemplified by allowing for the direct effects of country origins on health, whilst also controlling for simultaneous impact on reporting behavior.

Finally, the purpose of my third essay is two-fold. Firstly, I make use of the methodology tested in the second essay to build a health indicator which enables identification of how each of the health determinants (endowment, access or choice factors) acts upon the activity of retirees, across a diversity of socio-economic backgrounds, psycho-cognitive behavior, and multi-cultural perspectives, thus controlling for individual heterogeneity in self-rated health responses. Secondly I

evaluate the role health plays in determining retired Europeans' (in)activity and well-being, namely quality of life.

A future for the E.U., dominated by an ever-increasing population of retired citizens, has long since been predicted, representing a major challenge to social and health policy in European countries. However, does this population in fact represent a burden, or can it be an active asset to the economy and society? I believe the questions which should be raised by policymakers is how (in)active is in fact this population, and what exactly determines its (in)activity. I find clear evidence on the effective role health policies might play on retired citizens' participation in economy and society, well-being and happiness. The results of this paper hint a route for policy makers to take, in contouring an aging and unproductive European population, transforming what could be a "social burden" into an asset.

Essay 1

The Origins and Evolution of Health Economics:

Led by economists, practitioners or politics?

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1.1 Introduction

After the end of the Second World War in 1945, the health sector experienced high levels of expansion, rationalization and organization, with health care suffering a genuine "revolution", particularly staged in the U.S., with dramatic increase in the knowledge of means for diagnosing and treating illness and a much greater availability of sophisticated drugs. Health had been regarded upon as a worthless discommodity before the 1900, an optional luxury good in the 20s, and a pressing necessity by 1950 (Hanchett, 1965). Health was redefined as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (World Health Organization, 1947). With this definition health began to be seen in its social context, as a human capacity to cope with the environment and everyday life. " "Better health" (Weisbrod) today is no longer merely one commodity beside others in the chain of necessities but an indispensable pre-condition of efficient production and of the enjoyment in consumption of all commodities. Health care has now become part of the framework of economizing, interacting usually in a positive sense, with all production, consumption and exchange" (Hanchett, 1965). Naturally, both this redefinition and these technological advances had not only the consequence of improving general public health but also considerably increased the financial burden for governments, making health, and its better management a priority.

In a U.K. context of inevitable financial restrictions, typical of a centrally funded service, shifting management dogmas, and political beliefs, the National Health Service (NHS) was created, on the 5th July 1948. Its relevance inspired many other countries to follow a similar course. The NHS's main principle was to provide universal coverage and equity of access according to needs and has since continually developed in response to wider social, economic, political, technological and environmental pressures.

In the meantime, in the U.S., a much less consensual process was taking place, with Medicare being finally created after an American Medical Association (AMA) and U.S. politician's "tug-of-war". In 1947, a post war-sensitive President Truman stated "[o]f all our national resources, none is of more basic value than the health of our people." In his 1948 address, he said "[t]he greatest gap in our social security structure is the lack of adequate provision for the Nation's health".[1] His support for this reform "evolved from his dismay that one-third of the men reporting for the draft during World War II were physically unfit to serve. What's more, Truman's populist foundation was shaken by the economic inequalities of medical care" (Greenberg, 1993). Meanwhile, the American Medical Association[2], a very powerful force who dominated "interest-group activity in the health policy arena" (Mayes 2004), attacked with endless funds Truman's proposals as Communistic, during a Cold War era, and ultimately destroyed any chance of success. It would only be in 1960 that the AMA would develop national policy on health care for *older* patients. It allowed for the building of foundations for the creation of Medicare. Though AMA managed to delay it, through its vehement 1950s and 1960s campaign against Medicare, it was finally signed into law on July 30, 1965 by President Johnson, as part of his *Great Society* programs[3]. The AMA lobby still campaigns to raise Medicare payments to physicians, arguing that increases will protect seniors' access to health care[4]. Today, the United States is alone among developed nations with the absence of a universal healthcare system, presenting, however, significant publicly funded components: Medicare for the elderly and disabled, with a historical work record

[1] Truman's State of the Union Message: 1947, 1948

[2] The *American Medical Association (AMA)* was created in 1848, having as main goals scientific advancement, creation of standards for medical education, launching a program of medical ethics, and obtaining improved public health. Yet, it was only in 1931 that economic concerns came to the agenda, with the creation of the *AMA Bureau of Medical Economics*, established to study all economic matters affecting the medical profession.

[3] At the bill-signing ceremony President Johnson enrolled former President Truman as the first Medicare beneficiary and presented him with the first Medicare card, as a recognition for all of his effort.

[4] In http://www.ama-assn.org

and Medicaid, for indigents, provide taxation-financed coverage. Employer benefit based health insurance remains quite common with larger employers.

Given this more agitated political debate in the U.S., it was only natural that the definition of health economics as a discipline would find its route or, as Blaug called it, its *centre of gravity* in the U.S., somewhere around the 60s. The take-off and development of British health economics would only come about in the 70s, the date for the founding of the UK Health Economists' Study Group (Blaug, 1998).

Blaug (1999) attributed this to the US's dominance in the scale of production of academic intellectuals, and the fact that medical care was (and still is) privately provided and financed, as opposed to the UK, easing the applications of standard economic concepts such as market-clearing and utility-maximizing economic agents. Since these are rather a-temporal characteristics, one could surely add to the equation the stimulating role of the political agenda, in a health technological progress setting. However, since *motive* and *opportunity* alone don't suffice in convincing the grand jury of guilt in a 'crime', in explaining the establishment of health economics as a discipline in the U.S., and the subsequent proliferation of literature on the matter, it is crucial to further discuss the *means* for it: both intellectual and financial. It is for this purpose that I further discuss the crucial role two U.S. institutions played in providing them both: the *RAND Corporation* and the *Ford Foundation*.

Furthermore, while discussing the driving forces of this new field, I identify two distinct paths in *health* economic thought: the first developed by Grossman (1972) at the National Bureau of Economic Research (NBER); the second of which stemming from Arrow's 1963 paper *Uncertainty and the Welfare Economics of Medical Care*, a singularity amongst his mathematical economics work.

1.2 A contour begins to define the appearance of a new discipline: *Health economics*

Little work had been done on the economics of health in the first five or six decades of the XX century. Klarman (1965) argued that the literature prior to 1963 was primarily institutional and descriptive and that contributions revolved around discussions on US medical care institutions (Davis and Rorem, 1932, Ginzberg, 1954, and Somers and Somers, 1961), mental illness (Fein, 1980 [1958]), public health (Weisbrod, 1961) or the British National Health Service (Lees, 1961).

Milton Friedman had, from 1929-1936, studied some issues concerning differences in inequality of incomes of such professions as dentists and physicians, he considered them amongst many other jobs, though in this case emphasizing the highly individualized nature of the service and the qualitative range in the performance of these functions. Yet he focused mostly on statistical issues in his research[5], referring to medical professionals amidst other examples of independent professionals, and so one could hardly consider that a *discipline* of Health Economics was being defined, as an applied branch of economics *per se*, concerned with issues related to scarcity in the allocation of health and health care. The same reasoning is true for such other economists, who since then did refer to Health market intervenients and institutions (pretty much as they would refer to any other sector), such as Anderson and Feldman (1956), Faulkner (1960), Dickerson (1963) and Lees and Cooper (1963), amongst others who addressed issues concerning the medical profession or health insurance.

The truth of the matter was that by the late 1950s and beginning of the 60s, Economics was beginning it's incursion on Health issues. For instance, in the U.K., the Institute of

[5] As exemplified by his dissertation on *Incomes from Independent Professional Practice* published with co-author and thesis advisor Simon Kuznets, in the National Bureau of Economic Research Bulletins,1939.

Economic Affairs in London published in 1961 a Hobart Paper by Dennis Lees called *Health Through Choice*. Lees (1961) wrote about medical care and he argued that medical care was not very different from the generality of goods that are supplied in the market. However, the *Magna Carta* of health economics (Blaug, 1998), considered by many as the seminal paper which officially launched the discipline, would only come 2 years later, authored by Kenneth Arrow. Lees himself said "I left the matter there, and the running was taken up in US by Arrow's famous 1963 AER article *Uncertainty and Welfare Economics of Medical Care*, and a good bit later by Culyer in Britain" (Lees, in Williams, 1998).

1.3 The RAND Corporation and its sponsor, the Ford Foundation: *Influences over the political agenda and the rise of a new discipline*.

In a post-WWII context, with conflicts and tensions accumulating towards the *Cold War*, a RAND Corporation recently resulting from a split, sponsored by the Ford Foundation in 1948, between Project RAND and the Douglas Aircraft Company, was focusing on issues of national security, pioneering in the development and use of war-gaming, making wide use of rational choice theory[6]. It was considered to have been the very first *think tank*, and represented, to the Soviets "[a]n American Academy of Death and Destruction" (Kraft, cited by Amadae, 2003). Eventually, RAND expanded its intellectual reserves to offer insight into other areas, such as business, education, law, science and health. The new science of study of human interaction and choice, developed at RAND, spread to all kinds of different areas, from political science,

[6] Numerous analytical techniques were invented at RAND, including dynamic programming, game theory, the Delphi method, linear programming, systems analysis, and exploratory modeling, many of which have made their way into economics, namely health economics.

sociology and psychology to biology, becoming this "rationality project" instituted as a study of collective or individual decision-making, where the actors' individual interaction could be equated through mathematical formalism, producing collectively rational outcomes (Amadae, 2003; Mirowski, 2002). The expansion of the state's role in society at this time, for which the creation of a major insurance scheme as Medicare is a paradigmatic example, made the matter even more pertinent. It led certain scholars concerned with individual liberty to focus their efforts on the study of governmental processes, and diffuse public choice throughout economic literature (Medema, 2000). Though retaining fundamental elements of the neoclassical approach, public choice was perceived as an important departure from strict neoclassical economics (Medema, 2000). Representing an "escape from psychology", it meant cleansing neoclassical theory from any psychic concepts of economic behavior such as pleasure or motivation, among others (Giocoli, 2003). Also, it seemed that "the major players in the field were indeed to remake or supplant political science (already under "Virginian" school), or at least render it irrelevant" (Medema, 2000). Though Marxian and institutional traditions had lengthy histories of attempting to link up political and economic processes (Medema, 2000), the incursion of public (and rational) choice into political science and economic literature represented a clear diffusion of "elegant mathematical flourishes" across these fields (Medema, 2004). It even persuaded some economists with clear radical sympathies, as was the case of John Roemer and Jon Elster, who developed rational choice Marxism (Backhouse, 2006).

Meanwhile, in 1947 the Ford Foundation, chartered in 1936 "to receive and administer funds for scientific, educational and charitable purposes, all for the public welfare"[7], commissioned a report to determine how the foundation should continue. The committee, headed by California attorney H. Rowan Gaither, former assistant director of MIT's Rad Lab, recommended that the foundation should commit to "promoting

[7] In www.fordfound.org.

peace, freedom, and education throughout the world".[8] The board of directors then decided to diversify its portfolio and gradually divested itself of its substantial Ford Motor Company stock between 1956 and 1974. Ford was clearly the richest American philanthropy, and this was clearly a time where the Foundation redefined itself, both in terms of independence and goals, which now transcended the mere charitable purpose, clearly acquiring a more political dimension, and of leadership, gradually cutting its ties to the Company[9], and having Gaither become chairman of the board, whilst also chairman for RAND, undisputedly proving the strong links between the sponsor giant and the 50s *think tank* icon of Cold War America.

Furthermore, during this time, Gaither was invited by President Eisenhower to head a committee to study the American civil defense program, having he produced the top secret "Gaither Report", which in the end gave origin to the (fallacious) assertion of a 'missile gap' between the U.S. and the Soviet Union, validating the civilian control of the Pentagon, which started off with a complete reform of the defense department based on the tools of *rational* management. This meant both the institutions were not only linked together (Backhouse, 2006) but also clearly articulated with the State[10], and its military concerns on a Cold War era, Ford contributing with the money, RAND with the brains for the operations[11].

[8] In www.fordfound.org.

[9] Note that in the beginning of the 60s the Foundation was still strongly connected to Ford Motor Company, then presided by Secretary of Defense Robert S. McNamara. (see also note 13).

[10] Roelofs (2003) reports that former Assistant Secretary of War, during World War II, advisor to several U.S. Presidents John J. McCloy, while chairman of the Ford Foundation's board of trustees, from 1958 to 1965, "...thought of the Foundation as a quasi-extension of the U.S. government. It was his habit, for instance, to drop by the National Security Council (NSC) in Washington every couple of months and casually ask whether there were any overseas projects the NSC would like to see funded."

[11] RAND has since then had numerous notable participants, ranging from Nobel prize winning economists, namely Arrow, Simon, Nash, Schelling, and Phelps to politicians, namely modern-day ones, such as Donald Rumsfeld (former Chairman), Secretary of Defense for the U.S., and Condoleezza Rice, Secretary of State for the U.S, both former members of RAND's *board of trustees.*

Also, the profound overlap between the two worlds of academic choice theory and public and social policy (namely in the Health department) remained yet too evident. The network of RAND scientists and researchers involving rational choice theorists (RCT) such as Schelling, Ellsberg and Raiffa, was strongly imbedded both in the military departments, as was the case of the first two, who incorporated McNamara's Department of Defense team[12], and in the intellectual, academic world, both Schelling and Raiffa occupying prominent academic posts in the Harvard University's John F. Kennedy School of Government, 'molding' the intellects of future public policy makers. In the late 40s and the 50s, there was sharing of resources by RAND and the Chicago-based Cowles Commission (Backhouse, 2006), and by the 60s this network was actively participating in Public Choice Society meetings, and giving shelter to political science students from the University of Rochester, who participated in Summer workshops held at RAND.

The developments in game theory at RAND during the Cold War period solved most of the theoretical constructs relevant for public choice analysis (Medema, 2000). Rational policy analysis, including Planning-Programming-Budgeting and cost-effectiveness analysis, also became confirmed as decision-making methods as they became institutionalized as "social practices carrying the weight of social decision", rather than actually having been demonstrated their credibility and worthiness (Amadae, 2003). This reflected itself directly in domestic policymaking, namely in the Health department, with President Johnson's 1960s *Great Society* programs, with Medicare and Medicaid having been a product of them, as previously mentioned. Cost-effectiveness analysis, in particular, since then proliferated amongst the literature in applications to all

[12] McNamara was chosen by President Kennedy to serve as his Secretary of Defense, after he had assumed the presidency of Ford Motor Company one day following the election. Therefore, though McNamara's takeover of the Pentagon was actually made possible by the set of decision-theoretic and management tools supplied to him by RAND staff, besides the 'Gaither Report', he was already familiarized with rational management techniques he used at Ford (he had joined the Company in 1946 as manager of planning and financial analysis).

sorts of medical technologies and health care services (e.g. Culyer and Maynard, 1981), used in evaluating health care outcomes and comparing them to their costs.

Arrow is most certainly one of the most relevant examples of the sharing of intellectual resources (and influences), which allowed for mathematics, game theory and such other rational 'tools' to find their way into economics, social and public choice policy making. In his 1972 autobiography he wrote:

" *The brilliant intellectual atmosphere of the Cowles Commission, with eager young econometricians and mathematically-inclined economists under the guidance of Tjalling Koopmans and Jacob Marschak, was a basic formative influence for me, as was also the summers of 1948 and subsequent years at the RAND Corporation in the heady days of emerging game theory and mathematical programming. My work on social choice and on Pareto efficiency dated from this period*."

Rational choice theory, developed at RAND, claimed to be based solely on scientific standards, devoid of ideology. This was the perspective with which policy questions of equity and distributive fairness were addressed. Arrow's impossibility theorem (1951), for example was rooted on a conception of social justice based on carefully argued principles and articulated in mathematical terminology. He argued that social preferences (social welfare) should come as a result of aggregated individual interpersonal comparisons of preferences, and that the "political procedure of majority ballot will generally produce social rankings of alternatives that violate that 'social welfare function'" (Mirowski, 2002). It is clear that at this time, in a Cold War *game* context, Arrow's motivations had a source in RAND, as he himself proclaimed (1988): "The problematic nature of social ordering flickered several more times, to be disregarded each time, until the summer of 1948, which I spent at the RAND Corporation. The US Air Force was supporting research on game theory as a potential tool for analysis of military and foreign policy. One of the staff, Olaf Helmer, asked me

how nations, which are collectivities, not individuals, could be regarded as having utility functions, as demanded by the theory of games. In an attempt to explain the answers of welfare economics, I realized that, from an ordinalist viewpoint, the problem was much the same as that of voting; and, in a few days, I worked out the impossibility of a general solution."; and later (in Bowen, 2006): "If Olaf Helmer had not asked me the question about game theory, I would never have used my background in logic and developed my theory".

This was thus what motivated Arrow to begin his incursions in understanding how a collectivity could act as a player, when composed of various individuals with varying values. Whilst welfare economists, particularly Abram Bergson, had discussed that question in the context of justifying economic policies, Arrow forced himself to formulate the social choice problem so as to answer Helmer's intriguing question and established the impossibility of a general solution satisfying certain very natural assumptions. Previously, whilst at the Cowles Commission, and together with Gerard Debreu (Arrow and Debreu, 1954), Arrow had produced the first rigorous proof of the existence of a market clearing equilibrium, given certain restrictive assumptions. Arrow then went on to extend the model to deal with issues relating to uncertainty, stability of the equilibrium, and whether a competitive equilibrium was efficient (for instance, Arrow and Enthoven (1956), Arrow and Hurwicz (1958) or Arrow et al. (1959)).

It was after this that he made his incursion into health economics through what was to be considered the launch of such a discipline, by Arrow himself: his 1963 paper "Uncertainty and the Welfare Economics of Medical Care". This paper most certainly reflected his research interests developed at the Cowles Commission, but also his knowledge of the (health) insurance industry obtained when previously working as an actuary, acting as a "profound influence" before Koopmans dissuaded him to join

Cowles[13], a place where he "really learned", particularly about moral hazard and adverse selection (Arrow in Dubra, 2005). Also, his RAND motivated discoveries on how social choice emerged from individual preferences and on Pareto efficiency, together with previous studies of competitive equilibrium under uncertainty, revealed themselves indispensable in the thorough analysis of the medical care market he performed in this essay, which was directly financed by the Ford Foundation, interested in collecting papers in this developing, both technologically and politically, Health sector.

This was the scenery in the 60s, when policymakers were engaged in a vigorous debate about how health care should be financed, that these issues became a priority in the agenda of such strongly articulated institutions as the U.S. State, RAND and Ford, as well as the academic world. It was in the light of this context, that Arrow's paper was published in 1963, officially setting the milestone for the launch of a discipline, and standing as a reference to most of the literature which came thereafter. This was also the setting for the creation of *RAND Health,* dedicated to these issues as an autonomous department at RAND, thought to continue the tradition of improving policy and decision-making through research and analysis. Furthermore, to provide a factual basis for the debate, in 1971 the U.S. government[14] funded the RAND Health Insurance Experiment, a 15-year, multimillion-dollar effort that to this day remains the largest health policy study in U.S. history, and possibly throughout the world. This was to have a major influence in the development of Health Economics post-cold war literature of the 80s, whilst encouraging the restructuring of private insurance and helping increase the stature of managed care.

[13] According to Arrow himself, the matter of leaving the actuarial business in exchange for a more academic career was decided when he asked Koopmans about his experience on the insurance industry and he answered "oh no, there is no music in it" (Arrow in Dubra, 2005).

[14] This was done through the Department of Health, Education, and Welfare, now the *Department of Health and Human Services*, of the *United States Public Health Service*.

1.4 Health (Care) Economics *Magna Carta* and Rational Choice Theory

Uncertainty and the Welfare Economics of Medical Care was to be integrated in a series of papers on the economics of health, education and welfare, and was intended to address specifically the *medical* market. In the second paragraph Arrow explicitly states "It should be noted that the subject [of his paper] is the *medical-care industry*, not *health*". Therefore, it is clear Arrow narrowed his field of research into a sub-branch of the broader Health issue: health care, as a *market* (or industry). This article's impact derived from the complete and rigorous analysis that was made to the health care market, though most of the mathematical analysis on market equilibrium or optimal insurance policies were left to footnotes, or the appendix. Arrow started off by evaluating the distance of this industry to the "norm", that is, "perfect competitiveness", whilst making use of his recently developed social choice theory to explain how social welfare could be optimal, even though deviating from Pareto equilibrium: "It does not follow that if we are at an allocation which is optimal in the Pareto sense, we should not change to any other. We cannot indeed make a change that does not hurt someone; but we can still desire to change to another allocation if the change makes enough participants better off and by so much that we feel that the injury to others is not enough to offset the benefits. Such interpersonal comparisons are, of course, value judgments. The change, however, by the previous argument ought to be an optimal state." However, he would conclude government intervention would be warranted for two reasons: either upon an absence of Pareto Optimality; or it would exist with a socially inequitable health outcome. Therefore, provided the allocation mechanism in the market worked, social policy would only need to confine itself to redistribution, that is, public policies. This was consistent with Arrow's later redefinition of rationality: "the major

meaning of *rationality* is a condition of *consistency* among choices made from a different set of alternatives" (Arrow, 1996). [15]

However, what is interesting to note, and in fact has been the focus of all later references in health economics literature, is that when further characterizing this potentially allocating efficient market, Arrow (1963) addresses issues such as the non-marketability of goods, which results from *spillovers* or externalities inherent to them, due to market imperfections, as well as issues such as the omnipresent *uncertainty*. This uncertainty would be present in the numerous agency relationships (the physician-patient, with physicians detaining privileged information, insurance schemes-physician and patient-insurance schemes) which are dominated by asymmetric information, therefore sustaining moral-hazard situations, in the evaluation of the quality of the simultaneously produced and provided medical service, in pricing policies, and in the unpredictable nature of demand itself. This ever present uncertainty thus would turn vain any attempt to characterize individuals' behavior as the maximizing of an objective function, or any effort to draw conclusions about policy from static models. Arrow (1963) concludes as to the impossibility of a competitive equilibrium, even controlling for uncertainty, in such a singular market, and clearly, implicitly (and at times explicitly) recognizes the influence of 'irrationalities', ranging from politics to emotions and the role of an individual's private network in assuring credibility and reputation (later, in 1988, Pauly addresses this). Consistently, an interesting aspect he considers in this article is the exceptional characteristics and ethical duties of the medical profession, which should have a collectivist orientation given the necessary existence of a trust relationship with both patient and insurance schemes. What seems obvious to the

[15] This would mean that the conditions to *rationality* would have evolved from the traditional *maximization* approach (i.e., the reasoned pursuit of self-interest) to the *consistency* view, translating this *consistency* into extra, non-economic restrictions placed upon the agent's behaviour, this agent being redefined through a purely formal representation, as any kind of decision-maker: human, individual, collective, institutional or even as a computer. In the words of Nicola Giacoli (2003), the rise of this *consistency* approach had "forced neoclassical economics to abandon no less than its major theoretical goal, namely, the explanation of the individual's behaviour" (also consistent with Mirowski, 2002).

unbiased reader is that the *magna carta* for health economics can be found filled with prolific examples of the important role of non-market institutions such as trust, norms and conventions, leaving most of the mathematics of optimization to footnotes and appendixes. This was emphasized by Blaug (1998) when he stated 'some early readers of Arrow failed to notice that the thrust of his essay was to show that health care markets invariably fail and that the best we can do is to minimize the consequences of market failure in health by various norms and conventions…'. Only recently, one can find in the *Munich Personal RePEc Archive* Arrow enforcing the idea of the singularity of the health care market which makes it "intrinsically a problem", as a direct result of "three elements": its highly risky nature, strong asymmetry of information (which underlies the adverse selection problem, better solved for by government intervention when insurance is compulsory, as in Medicare for the old aged), and "our social judgment that health is different from other commodities" (Arrow in Dubra, 2005). Health is thus compared by Arrow to Education as to this last aspect, because both differ from other goods in the sense that there is a presumption of society that makes it unreasonable that access to them should be denied on the basis of income limitations (Arrow in Dubra, 2005).

The effects on seminal health economics literature of a strong influence of rational choice and public choice theory are yet too evident in a second seminal paper I'd like to discuss. Pauly's[16] *The Economics of Moral Hazard: Comment*, published in 1968, also sponsored by the U.S. government, and written under the supervision of James Buchanan[17] was precisely a comment on Arrow's 1963 paper. The rise of a public choice school of thought is very much attributed to Buchanan's (and Gordon Tullock's) entrepreneurial effort, staged during this time, in promoting "the development of the

[16] Interestingly, since 2003, Pauly integrates the National Advisory Council of the Agency for Healthcare Research and Quality from the *U.S. Department of Health and Human Services*, and is part of the *Medicare* Technical Advisory Panel.

[17] James Buchanan won the 1986 Nobel Prize in Economics, mostly for his work on public choice theory.

centers, conferences and publications, and the training of students", which all together "created the critical mass of human and financial resources that sustained the development of the field" (Medema, 2000).

Arrow had identified uncertainty as a source of market failure, to be countered by insurance against medical care expenses, in order to assure social welfare, either to be provided through government intervention, or by the market. Yet, competitiveness and optimality would still encounter a barrier in uncertainty, which would allow for moral hazard, since the lowering of marginal cost of care to the patient, due to insurance, could increase unnecessary usage. In his comment, it is clear that Pauly comes with an attempt to "salvage" Arrow from his (conscious, or not) "escape from Rational Choice Theory" when describing the non optimal health care market. Under the supervision of a public choice theorist, Buchanan, he seems to attempt to restore the optimality framework, while stating that in certain cases, insurance may be non-optimal, even when individuals have risk-aversion, proving that in certain cases the market has actually been efficient when not intervening, thus preventing moral hazard. According to him, these 'non-insurable' medical care services would be those with price-elastic demand, and non-random nature (such as is the case of preventive medicine), therefore subject to moral hazard, due to demand being inflated by the existence of insurance coverage (which reduces point-of-service price for the patient). Thus, Pauly (1968) would then recommend that compulsory social insurance, as had been conceived by Arrow[18], would only be possible, and therefore should be restricted, to certain medical care services, with perfectly (price) inelastic demand[19]. Later, in 1988 Pauly would

[18] While certain authors(Lees and Rice, 1965) have counter-argued against Arrow's case for government intervention, presenting selling and transaction costs as the reason for the absence (at the time) of commercial (private sector) insurance, Arrow defended his argument on the basis that these where dead-weight losses anyway, to be eliminated by compulsory social insurance.

[19] Citing Buchanan (1964), he argues as a rational choice theorist (following Arrow) would, for the existence of an *inconsistency* if these non-insurable services were to be covered by market or government provided insurance. The nature of this *inconsistency* would reside on the fact that before 'purchasing' insurance, the individual (or government) would have to account for the "indirect" cost of it (which

argue that a significant proportion of medical care procedures are sufficiently routine to consider them analytically equivalent to other consumer-initiated purchases.

What is of noticeable interest, is the relationship between the publishing dates and authors of these articles with the creation of Medicare (and Medicaid), in 1965, as a governmental institution providing insurance coverage only for the elderly and disabled (and indigents), with a historical work record. Pauly's 1968 paper was conducted under the supervision and unequivocal influence of James Buchanan's 'rationality project', and was then funded by the *United States Public Health Service,* which administered Medicare since its creation. Pauly is, today, an advisor of Medicare's board.

This clearly represented another victory of the rational (public) choice theory framework on health economic literature development, at the time. Pauly (1968) actually repudiated the "rather strongly emotive approach" of some previous authors[20], when regarding these overuses as a moral or ethical problem of "malingering" individuals suffering from "hypochondria", rather than as pure rational economic behavior. The fact of the matter is that, today, such authors' writings on this subject can be considered rather marginally, as well as those who had taken a more institutional and descriptive tone, particularly when compared to Pauly, a consecrated Health Economist. He actually criticized Arrow for considering *moral hazard* as a market imperfection, "a defect in physician control, rather than as a simple response to price reduction", which should be equated in the welfare proposition. The drift of health economics towards orthodox economics couldn't have been made more explicit by Pauly's manifest

should reflect expected excess use, due to *moral hazard*). This, resulting from a "prisoners' dilemma" equilibrium, in which the strategy of "retaining use to prevent a rise in the insurance premium" would be strictly dominated by that of "excess use of care", even though a better outcome would prevail from all beneficiaries cooperating and "retaining use". Therefore, given inelastic demand, this *inconsistency* would imply inefficiency if individuals (or governments for them) were forced to purchase insurance. Notice the strong influences of RCT and other analytical tools developed at RAND, only a few years before (he actually cites Raiffa's 1957 *Games and Decisions*).

[20] He is referring to "O.D.Dickerson, *Health Insurance,* rev. ed. Homewood, Ill, 1963" and "E.J. Faulkner, *Health Insurance*, New York 1960".

intention to show that "the problem of "moral hazard" in insurance has, in fact, little to do with morality, but can be analyzed with orthodox economic tools".

In sum, descriptive and institutional approaches to health had been somewhat abandoned by the end of the 60s, with Health Economics having established itself as a perfectly 'rational' respectable discipline. This was triggered by rational choice theorists, in a post-military context, with the support of the RAND Corporation and the Ford Foundation. Furthermore, after the end of the War in 1945 the deep institutional restructuring and the increased international proximity had also reflected itself in profound changes in the economics profession and the academic world (Backhouse, 2006). Academic systems became more open and competitive, with a tendency of movement towards the American model and a pressure to publish in ever more international journals, with rising mathematical demands and competitiveness between students (Backhouse, 2006), and this most certainly contributed to the aforementioned change in research nature. Health Economics had been established by rational choice theorist Kenneth Arrow, but had, nonetheless been considered a singular offspring when he recognized most of its particular, 'irrational' forces.

1.5 Health Economics and Human Capital Theory

More or less parallel to what was happening under RAND, governmental, and AMA influence, other things where happening in the academic world.

Michael Grossman was obtaining wide recognition for his 1972 article based on his earlier Columbia University PhD dissertation, published by the *National Bureau for Economic Research* (NBER) and sponsored by the Commonwealth Fund and the National Center for Health Services Research and Development: *On the concept of*

health capital and the demand for health. The first contributions on human capital (Schultz, 1962) had contained significant discussions on education, on the job training, migration, and health. However, while human capital dimensions of education and training where explored in a countless number of works, fewer attention was given to health as human capital (Becker, 2007). A major step toward the incursion of human capital on health matters occurred with Grossman's work, which modelled the demand for health through a Beckeresque perspective, regarding health as stock of a commodity possessing both investment and consumption properties. In order to maintain health stock above a minimum (death) level, generating a certain utility, one would have to invest in it by buying market goods (like medical *care*, nutrition, pharmaceuticals, etc), besides your own time. The model related health stock depreciation with age, subject to constraints such as income and education. The genesis of his ideas came from the Economics of Education. Grossman himself when asked about all possible diverse types of motivations behind this paper stated he was simply motivated by Gary Becker, who "inspired (him) to construct and estimate a model of the demand for health using human capital theory". (Grossman, personal communication, February 3, 2011). He cited 4 previously written works by Becker, namely *Human Capital (1964).*

Grossman referenced the Woytinsky lecture, where a paper written by Becker was presented, and even though unpublished, circulated in 1967 (Becker, 1993). This paper was in fact later included in the second edition of Human Capital, with Becker (1993) stating it opened a very promising line of work. Grossman's model, in particular, drew a lot from this paper. The then new approach to "household behavior" (Becker, 1993) considered the household utility as a function of market-purchased commodities, the production of human capital (i.e. investment) and time. Time would be allocated into three activities: the production of nonmarket commodities, the production of earnings, or labour market and the production of human capital or investment time. Grossman's model revisited this idea of household production functions of investment in health and other commodities which would enter a inter-temporal utility function. He derived

market equilibriums, to explain health and health care differentials in terms of variations in supply and demand curves for health capital, the later directly dependent on education. The conceptual framework to examine why education might lead to better health, for instance was routed in Robert Michael's 1972 and 1973 works (Grossman, 2004).

Grossman followed Becker's *Human Capital* (1964) perspective of human capital accumulation over the life cycle, with higher investment in early ages differing across individuals, generating different age-earning profiles and personal distribution of earnings. However, the Grossman model predicted that demand for *health* capital would decline over the life cycle, as the rate of health depreciation would increase with age, as a result of a formalization following Beckers' Woytinsky lectures where decline in investment over time was explained by his model for wealth maximization (in the 1964 first edition of *Human Capital*, well-being maximization was assumed but not explicitly modeled). Furthermore, Grossman (1972) concluded demand for health and medical care should be correlated with wage and that education increases efficiency with which health is produced.

Both Arrow (1963) and Grossman (1972) started from the same premise, maintaining that health care is just one of the variables that explains health, yet follow different approaches. Arrow (1963) argued that the health care market differs from the competitive model due to its "irrational" peculiarities. He tried to evaluate these differences, leaving policy inferences for further research. Therefore, the attention dedicated to demand was residual. He singled the demand for medical services as being unique, in the sense that consumers could only derive satisfaction from *health care* in case of illness, which would make individual's demand for health care "irregular and unpredictable". Arrow (1963) was not concerned with the concept of *demand* for *health*, as was Grossman, but rather for the *supply* of *health care* services.

Without doubt Grossman performed a formalization of rational choice over an extended time frame (McMaster, 1997). However, though it seems clear rational choice was making another incursion into health nearly a decade after Arrow's 1963 paper, in 22 references Grossman did in fact not cite Arrow's seminal paper and made it clear that the relevant social concern was *health*, and not *health care*, as was Arrow's. It seems therefore unequivocal that he was proposing a different approach over a broader concern, *health* rather than *health care*, the latter a mere input partially determining the former. He based himself on a consumption and *demand* theoretical framework, thanking and referring the works on consumption theory of Gary Becker (his PhD program teacher)[21], Lancaster, Muth, Michael, and Ghez, all published between 1965 and 1970. By that time, he clearly wasn't a health economist, having this article consecrated him as one, with Victor Fuchs employing him at the NBER shortly after, in 1966, conditional on him writing specifically on health economics (Grossman, 2004).

On the second paragraph of his paper, Arrow (1963) clearly affirms that "it should be noted that the subject [of his paper] is the *medical-care industry*, not *health*". In 1972, Grossman would be interested in a broader subject, stating "the demand for medical care must be derived from the more fundamental demand for 'good health'".

[21] Becker's (and Mincer's) human capital influence was candidly expressed by Grossman (2004) himself as he wrote "When I entered Columbia, I was going to specialize in public finance. Then I met Gary Becker and decided to specialize in whatever interested him. He and Jacob Mincer taught me 80% of what I learned about economics at Columbia …"

1.6 Since the 1980s: Unraveling into two paths

1.6.1. Arrow's Health Care Market Approach: *RAND again, the AMA, the Insurance Industry and the U.S. Government*

Though rational choice was clearly trying to establish itself also on the Economics of Health, it seems that the theoretical emphasis initially given by Arrow (1963), and momentarily revitalized by Pauly (1968), set the foundations to unravel an entire path in the 80s. Very different in spirit to the existing theoretical framework, but rather much more empirical, it is quite evident that this path outlined itself as a result of the interactions between the major institutions demanding for practical responses to shorter-term problems. I briefly describe the main forces behind this demand for studies.

The *health care* stream of followers contributed with a vast number of research very much under the impulse of the political demand for ideas, concerned with health care provision, systems, their funding and efficiency. Weisbrod (1991) [22] describes the exponential post-World War II growth of health care expenditure in the U.S., attributing it more to the development of new technologies than to an inefficient, large utilization incentive from insurance (moral hazard), which would drive up both costs of care and of insurance. At the same time, expanding insurance coverage, which included more people as well as a wider definition of coverage, had provided an increased incentive to the R & D sector to further develop new technologies, resulting in an interactive, virtuous circle. Funding of this sector had shifted from retrospective, cost-based insurance coverage to prospective, exogenously determined pricing. This was similar to what had happened much earlier in Education, and for Weisbrod, was the reason why, contrary to Health, it presented a slower development. In sum, development issues were driving the focus of attention to insurance policies.

[22] In his article he starts off by thanking several participants of his seminar at the RAND Corporation.

Besides the important role it played in the delay of Medicare creation, in the 50s and 60s, the American Medical Association (AMA) did continue to play an important role in influencing Health policy issues. Yet it took also a part in the stimulus of further literature and the development of health economic thought. This explains why Health Economics did develop, since the late 70s, into a practitioner driven subject, as we shall further address. In 1979, Milton Friedman saw his and his wife's *Free to Choose* published, later developing into a TV series aired by the Public Broadcasting Service (funded and founded with the help of Ford Foundation, in 1970). In it, he heavily criticized the AMA, asserting that it acted as a government-sanctioned "guild"[23] which had attempted to increase physicians' wages and fees limit, by influencing limitations on the supply of physicians and non-physician competition, therefore making illegitimate use of its privileged information and access to the health market, and exclusive know-how which allowed them to work as a lobby, exerting political pressure. With this, Friedman characterized the asymmetry of information described by Arrow (1963), an asymmetry which allows for practitioners prosecution of self-interest, making this sector deviate from the norm of perfect competition, and Pareto optimality. Friedman also asserted that these actions had not only inflated the cost of healthcare in the United States, but had also caused a decline in the quality of healthcare. Undoubtedly, and beyond this example, Arrow's (1963) ideas on asymmetry of information in the various type of health care relationships he identified, as well as non-market peculiarities, set the foundations for most of the literature which came thereafter with a tendency towards modeling patient-physician interactions as principal-agent (e.g., Dranove and

[23]Traditionally, this word was used to describe an association of craftspeople, possessing a certain exclusive know-how and expertise. Consider Friedman's description of the guild's operations:

"One effect of restricting entry into occupations through licensure is to create new disciplines: in medicine, osteopathy and chiropractic are examples. Each of these, in turn, has resorted to licensure to try to restrict its numbers. The AMA has engaged in extensive litigation charging chiropractors and osteopaths with the unlicensed practice of medicine, in an attempt to restrict them to as narrow an area as possible. Chiropractors and osteopaths in turn charge other practitioners with the unlicensed practice of chiropractic and osteopathy."

Satterthwaite, 2000), where the physician-agent gains utility directly from either acting in a patient's best interest or from observing a patient's recovery. Furthermore, his references to original non-market institutions were not unnoticed, namely as to what concerned health-care providers' ethics, though they were then regarded under a rational choice, Utilitarian perspective up to today. In fact, medical ethics began to be considered as a "humanitarian spillover" (Culyer, 1976) or a "caring externality" (McGuire, *et al*., 1982), and progressed towards Utilitarian perspective, appearing amongst the arguments of a physician's utility function (e.g., Mooney and Ryan, 1993; McGuire, 2000). The literature considers that different physicians may have different propensities, suggesting that health care is an experience good where the "consumer" faces an adverse selection problem (McMaster, 2007). Indeed the rationality project hadn't been completely let down, and McGuire (2000), for example, argued that differences in physicians' "caring" are analogous to brand differentiation. As McMaster (2007) very candidly put it: "Of course, the foregoing is subject to constraints, and the "caring externality" is potentially tradable should the circumstances dictate". Furthermore, the remains of the rationality project are too well described by him in the following passage: "That there is an overtly normative element in health economics (in its own terms) is well recognized by health economists (Culyer and Newhouse, 2000; Fuchs, 2000). This adopts a particular appearance, being shaped by utilitarianism and Paretianism. Sen's (1987) discussion of ethics in economics characterizes utilitarianism as: consequentialist; welfarist, and as sum-ranking. Of course, mainstream discourse has arguably retained its consequentialist credentials through instrumental rationality, whilst shifting away from sum-ranking and welfarism following the rejection of interpersonal comparability, the adoption of ordinal and revealed preferences, and Pareto optimality. Nevertheless, as argued above, such a retraction is not as marked in health economics, where there is evidence of sum-ranking via the persistent invocation of cardinal utility (Forget, 2004)".

The debate that was lit in the 1990s in the U.S, for and against a universal health system, still remained strongly. On the other hand, in the U.K., the issues brought up by a national health system were those mainly concerning rationing, efficiency and, at times, equity in health care provision. Jones-Lee (1969) valuation of human life and Alan William's (1985) repercussive contribution with the QALY measure represented some of the efforts to allow for direct comparisons across diverse health care procedures and interventions, an attempt to furnish measures for the quantity and quality of life, fundamental to the rationalization decision. Blaug (1998) presents a comprehensive view of all contributions made concerning cost-benefit analysis, cost-effectiveness analysis and cost-utility analysis, "corresponding respectively to locative efficiency, technical efficiency and something like productive efficiency". Furthermore, Arrow (1963) had planted the seed for a well-known health economics phenomenon, supply–induced-demand, when referring to moral hazard and adverse selection issues in the medical, insurance, and generally in the health care sector. Such issues could not even be entirely banished from universal health systems such as the NHS, due to the existence of rationing by waiting times and non-provision, much less in the US "private health" system. However, all attempts to quantifying these issues have nevertheless suggested that it is a minor problem in such tax-financed health systems with salaried doctors (Blaug (1998)). Therefore, it was only natural for the blossoming of this literature, very much driven by policy-makers, to be staged particularly in the US. In fact, in his 1998 manifested characterization of *British* Health Economics, *Where are we now in British Health Economics*, Blaug (1998) couldn't prevent himself from wondering towards the US context and literature when discussing such issues, explaining himself: 'it is inevitable that supplier-induced demand issues rouses more furious controversy in the US' (Blaug, 1998).

Moreover, on an institutional setting, in the U.S., as the Cold-War dimmed, a number of intellectual and financial resources were now without a purpose, and as usually happens, institutions such as RAND had to find a justification for its existence. RAND started to

diversify its research portfolio, beyond national security issues, namely investing and creating the Health "department"[24]. As referred to earlier on, the RAND *Health Insurance Experiment (HIE)* was a rigorous, major multi-million dollar investment which motivated several empirical studies, namely on insurance effects and aimed at answering policy questions in health *care*, in a employer-based insurance context. This stimulus on the development of empirical research, which conferred an entirely new dimension, depth and presence to the discipline didn't quite happen in the UK. Using the words of Blaug (1998), the RAND HIE "contrasted with what was never thoroughly pursued in universal health systems as the UK … when the US governments under presidents Nixon and Carter became alarmed about American health care costs, they promoted the Rand Health Insurance Experiment … incidently, the largest, longest-running social science research ever completed – we in Britain launched a serious overhaul of a forty-year-old system of health care provision and finance with little preparation, no research whatever, and pell-mell over a period of two years from start to finish." In fact, as he states, in Britain the reforms over the health systems where instituted with very little experimental evidence.

Manning et al. [25] (1987), then affiliated at RAND[26], presented the final results of the HIE, examining the effects of varying levels of cost sharing (coinsurance plans) on the demand for medical care and other health services, clearly proving their existence and strength of a nonzero elasticity of demand. Yet, this was now being done with a strong statistical and econometrical approach, based on a large scale HIE database, to what had been theoretically brought up by economists such as Arrow and Pauly during the Cold War.

[24] See, in Apendix, Figures 1.1 and 1.2.

[25] J. P. Newhouse and W.G. Manning are currently editor and associate editor, respectively, for the leading journal in this subject: the *Journal of Health Economics.*

[26]This research was conducted under the governmental grant 016B80, again from the *Department of Health and Human Services.*

This empirical trend, very much fed by the institutional setting, practitioners and the political debate, was recognized by Victor Fuchs in his 1987 encyclopaedia entry on "Health Economics" in *The New Palgrave: A Dictionary of Economics:* 'Health economics is an applied field in which empirical research dominates… Some of the most useful work employs only elementary economic concepts, but requires detailed knowledge of health technology and institutions.' It also read: 'Policy-oriented research plays a major role and many important policy-relevant articles are published in journals read by physicians and others with direct involvement in health'

1.6.2. The development of Grossman's Human Capital Theory approach

When comparing the Economics of Education to Health Economics, Blaug (1998) sustained that the human capital theory prevalence on the economies of education resumed pretty much all of which was to be the added to the subject, and that 'one is struck by how little has been added to the subject since the 1960s', apart from a couple of papers which 'add a new emphasis on equity to the older interests in efficiency'. He states 'We are driven to the cruel conclusion that the economics of education is now moribund as a subject to study' and that 'By way of contrast, I believe that there has been steady theoretical and empirical progress in health economics ever since 1970'. He attributes this to Arrow's legacy by stating "Arrow's seminal 1963 paper inspired budding health economists almost as much as did papers by Jacob Mincer and Gary Becker" to economists of education. By 1998, Blaug was also recognizing that "To be sure, there was nothing in health economics quite like the human-capital concept in the economies of education that sparked off what has been called "the human investment revolution in economic thought" in 1960 or thereabouts". He still added " (…) Michael Grossman's application of human capital theory to health attracted few adherents and has been more often attacked than endorsed." and summed that "although health

economics made use of human capital theory as did the economics of education, it soon took a different route inspired by Arrow's work on medical insurance."

There is, however, evidence that this might not really be the case. At least for one trend of Health Economics. Ever since 1987 (Eatwell et al., 1987), one could read in that year's edition of *The New Palgrave: A Dictionary of Economics*, that: "the field divides naturally into two distinct, albeit related, subjects: the economics of health *per se*, and the economics of medical care". Whilst Blaug's 1998 article clearly refers to "Arrow's legion ofempirical research followers", this must have meant that Grossman's economics of *health* had established itself as a separate trend, possibly a more theoretical one as we will discuss, with its own followers at least until this 1987 Palgrave entry. If one proceeds with a careful survey of the literature, one can indeed find a continued stream of followers of Grossman's heritage, back in the 70s and 80s, and also a reinforcement of it in more recent literature

Since Grossman's 1972 article, a series of articles have followed. Cropper (1977) recognized that in recent years (prior to 1977), expenditures on medical services, nutrition, and exercise had been regarded upon as investments in health capital and analyzed using the tools of capital theory, allowing economists to derive propositions about the pattern of medical expenditures over an individual's lifetime and to describe the behavior of health capital over the life cycle. He based himself on Grossman's model (and thanked him for his input) of investment in health, though altering it according to the argument that individuals do this to avoid the disutility of illness, rather than for monetary return. Muurinen (1982) also performed a generalization of the model, a seminal article published in the launching of the *Journal of Health Economics*. Culyer (1981) recognized the Grossman's human capital model of the demand for health as one of the major theoretical innovations to have emerged from health economics. It provided a framework for analyzing issues such as socioeconomic inequalities in health, the design of prevention policies and the impact of unemployment

'on health (e.g., Maynard (1983), Muurinen and Le Grand (1985), Wagstaff (1986a)) .However, it appealed more to theoretical analysis, with a wide range of potential policy applications, and comparatively fewer empirical studies (Wagstaff, 1986b), contrasting with Arrow's "legion of empirical research followers". Adam Wagstaff, currently a worldwide recognized health economist with a wide range of publications in the field, in his Ph.D. dissertation made important theoretical extensions on Grossman's demand for health model, thanking him for his comments, with subsequent publication in the *Journal of Health Economics* (Wagstaff, 1986b). In it, and in 1987 (here, together with Valentino Dardanoni) he was recognizing economists to suggest "Grossman's model of the demand for health as a useful analytical framework" to study socio-inequalities in health distribution (rather than in the distribution in income, as Becker (1964, 1993)), whether, for instance, they stemmed more from inequalities in wealth, rather than from inequalities in access to medical care. Dardanoni and Wagstaff (1987) themselves are an example for this, clearly following Grossman's human capital perspective, introducing uncertainty into the Grossman model to prove that an individual's health investment decisions at each stage in the lifecycle would not be independent of his initial wealth. They also showed that if individuals displayed decreasing absolute risk aversion, wealthier individuals would invest more in health capital than individuals who start life with relatively small stocks of financial capital.

Theoretical literature following Grossman's footsteps, continued to proliferate ever since 1972. Selden (1993) and Chang (1996) are just other examples of the revisitation of the human capital model and the investment in health argument in the 90s.

Recently, in January 2003, a joint AEA/iHEA session was organized for the ASSA Meetings in Washington, DC, celebrating 30 years since Micheal Grossman's 1972 article and in recognition to his path-breaking work on the demand for health, the production of health, and health capital (Mullahy, 2004). This session evaluated the development of the literature on health capital, and is undoubtedly a recognition of

Grossman's Human Capital legacy on Health Economics. Amongst the contributions to that session were well-recognized health economists such as Leiwobitz, Schultz, Wagstaff, amongst many others.

Adam Wagstaff, further explored the idea of health stock adjustments through optimal investment paths (Wagstaff, 1993; Grossman, 2000). Recently, Arleen Leibowitz (2004) exposed recent empirical health research literature as focusing primarily on personal medical care, and neglecting other inputs to health, restoring Grossman's argument that health production requires both goods and time. She stressed the need of giving a greater emphasis on the role of non-medical consumption goods, population level inputs and time in producing health capital, and how education promotes efficiency in the combination of these factors.

A large number of work continues to be made in this field, ranging from more empirical incursions into the human capital model, with estimations of these effects, based on quasi-natural experiments (e.g. Lleras-Muney (2005) Adams (2002)) to continuously more sophisticated dynamic programming models (for instance, Gilleskie (1998), Yang et al. (2009), Lucarelli (2006)), where insurance, or education and labor are articulated with temporal evolutions of health stock, and health inputs. Even in more multi-disciplinary studies, the contribution of Economics in explaining health behaviors follows Grossman's investment model (see for instance the modeling of the dynamics between health and education in Ding et al. (2009)). In every single one of these cases, Grossman's 1972 paper is cited as a reference. An excellent comprehensive synthesis, formulating and extending all of which has contributed to the theory of health as human capital, has recently been presented by Gary Becker (2007), whilst at the same time giving some empirical support. In it he implicitly refers to the major practitioners and institutions which have acted as precursors for this line of thought, namely the role of pharmaceutical companies as well as governments when framed under Grossman's analysis of optimal investments in health or insurance companies under the literature of

self protection (see Ehrlich and Becker, 1972; and Ehrlich, 2000). Becker (2007) also refers to a series of further examples of literature which regards health as human capital, namely the value of life literature that analyzes how much people are willing to pay for improvements in their probabilities of surviving different ages (for instance Rosen, 1988; and Murphy and Topel, 2006), or the importance given to complementarities in linking health to education and other types of human capital investments, and in linking investments in health to discount rates, to progress in fighting different diseases (for example, Dow et al., 1999; and Murphy and Topel, 2006) and to other sources of overall changes in survivorship rates.

1.7 Conclusion

I explain how Health Economics, as a consecrated discipline, arose as an applied field in the U.S., given post-World War II preeminent health issues and technological development, but also as a consequence of 'intellectual diversification', stemming from Cold-War developed rational (and public) choice theory and analysis. Yet, history of health economic thought seems to have had a rather drastic redirection by the end of the Cold-War, which made both the intellectual and financial resources available to answering empirically-driven questions, with empirically-based studies, in a socio-political context in which Health had become a priority, and the 'optimal' allocation of resources for the care of the sick and the promotion of health was found to be a complex matter, imbricated in a network of conflicting interests and a singular market .

Furthermore, one of the purposes of this paper was precisely to expose and explain how and why Health Economics has always been effectively a discipline sub-divided into two branches, as recognized since the 1987 Palgrave entry (Eatwell et al., 1987). Grossman's 1972 article presented a complete model of demand for health, in which medical care was included as an input. This is basically what solely interested followers

of the health care *market* approach started off by Arrow (1963), which revealed itself very much empirically based, as noted by Fuchs (1987) and Blaug (1998), and empirically demanded. As a matter of fact, this demand for practical responses to questions very much focused in the provision of health services was probably what sustained an entire empirical path, which did not find necessary the broader theoretical framework that was being developed in parallel, looking upon health as something transverse across any market in an economy. The *health capital* approach of Grossman which incorporated the health care analysis as part of a general model is what has motivated researchers towards more theoretical frameworks, even if afterwards sustained by empirical evidence.

The existence of these two different branches of Health Economics seems unequivocal: the health care *market* and sector approach, and the more general *human capital* economics of health. The first with its source in Kenneth Arrow's (1963) characterization of the health care market and its specificities, ended up by taking a more empirical turn, strongly based on econometric techniques, mainly as a direct response to the demand for empirical studies, rising very much from practitioners, institutional and political forces, focusing on health market failures and the role of public intervention to assure health care to citizens. The second, rooted in Grossman's work (1972), which regards the general state of health (and its determinants) as a necessary investment, essential not only to sustain any productive economy but also indispensable for the enjoyment of a utility from any other product of any other market.

Health has been compared to Education as a singular commodity, by both Arrow, to the extent that there is "a social judgement that everyone should have access to them irrespective of their income" (in Dubra, 2005) and by Grossman (1972), through the idea that one can invest in oneself and generate future returns. In 1998, Blaug had remarked that "health economics would seem to be a perfect topic for heterodox dissent and yet, surprisingly enough, radical economists and Marxists have not on the whole

been attracted to health economics". I show evidence this was because the discipline was launched and very quickly developed in a time and place where the reassessment of the economic role of government was being made with mathematics making major incursions into the academic world (Backhouse, 2006) and into political science – namely through Arrow, very much linked to RAND in the early Cold War period, despite previous extensive Marxian and institutionalist contributions on the matter (Medema, 2000, 2004), which had a weaker voice then – and mathematical economists, such as Arrow, Grossman and their followers stepping forward and challenging themselves to solve problems such an unorthodox market posed, in either a rational (or public) choice or human capital theory perspective.

Appendix

Figure 1.1 RAND overview briefing slides containing information on research conducted. (Source: RAND, 2007

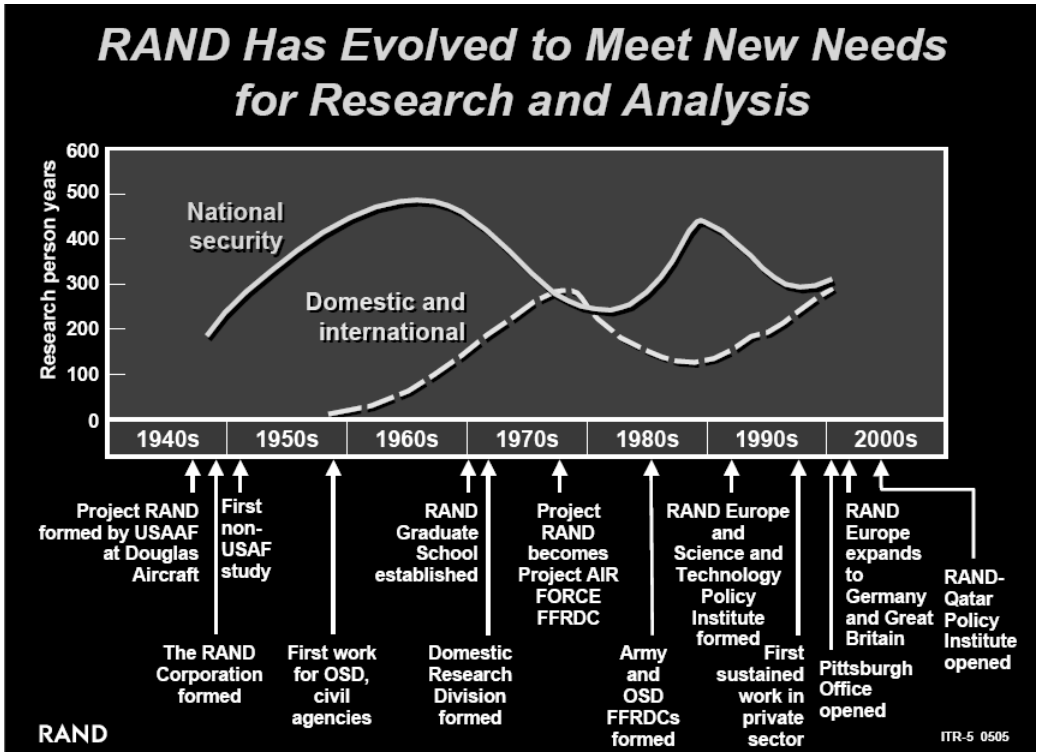
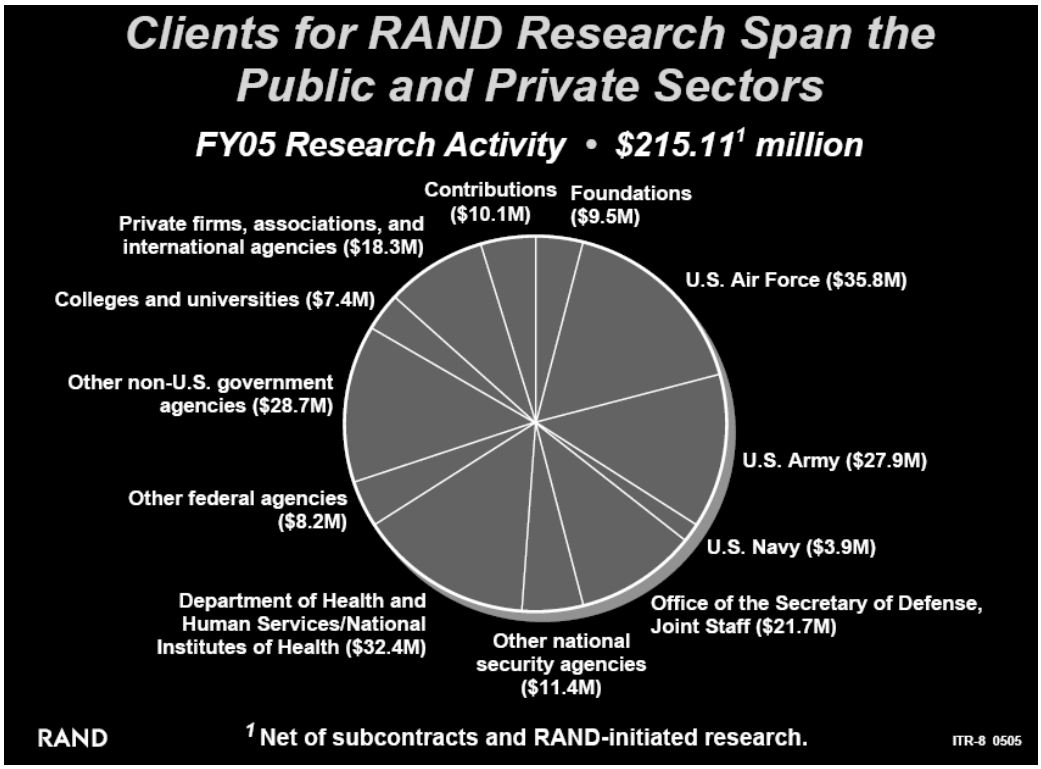


Figure 1.2 RAND overview briefing slides containing information on research conducted. (Source: RAND, 2007)



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Essay 2

Disentangling 'true' underlying health from response styles:

A separate identification of direct health effects from self-categorization effects

* A first Version of this paper was accepted at the 3rd Advanced Summer School in Economics and Econometrics, August, 2008, with Distinguished Guest Professor William H. Greene lecturing on the topic of "Discrete Choice Modeling". I am very grateful to him for his comments and all the constant support which he has given since then. I am also very grateful to Professor Steven Lehrer for his insightful comments which helped very much improve this paper.

2.1 Introduction

Self-reported health is a widely used measure of general health. However, its validity has been questioned in several studies which argue against the comparability of such survey measurements across groups of individuals (Groot, 2000; Sen, 2002; Lindeboom and Van Doorslaer, 2004; King et al., 2004). As Jurges (2007) states "one major concern with self-assessed health is that respondents do not perceive the health self-assessment scale given to them as absolute. Individuals with the same true health status may have different reference levels against which they judge their health". Based on a Generalized Ordered Probit methodology proposed by Terza (1985) and King et al. (2004) - that allows for cross-cultural comparability of measurement in survey research, Jurges (2007) concludes that failing to account for differences in reporting styles yields misleading results. Furthermore, his innovation is particularly relevant in that it enables the construction of a continuous, comparable measure for health, based on the latent variable of a discrete ordered choice model – a health index – which reveals a whole new "ranking" for the state of health for all the countries involved in the survey.

However, his methodology restricts him to consider country influences only to the self-report level, ignoring possible differences in health baseline effects across countries. The importance of country specific characteristics on health levels, for reasons such as the characteristics of the health care system or the diversity of levels of social support, is widely recognized by health economists and not taking it into consideration may certainly bias the results.

We build up on this methodology using the recently developed Hierarchical Ordered Probit model (Greene, 2007, Eluru, Bhat and Hensher, 2008 and Greene and Hensher, 2010a), which will allow for the separate identification of country specific effects both

on the threshold levels and on the health index. We conclude that in reality the difference of these effects across countries on health *per se* are fairly insignificant, but we also conclude as to the relative unimportance of what Jurges (2007) had reported as cross-cultural linguistic differences.

Section 2 explores the limitations of the previously used methodology and presents the proposed alternative to assess 'true' health status while allowing for the separate identification of country specific effects both on the threshold levels and on the health index. Section 3 briefly describes the data, whilst section 4 presents and compares the results obtained with those computed with the previous procedure. Finally, section 5 presents our concluding remarks.

2.2 Methodology: **separate identification of direct health effects and self-categorization effects from self-rated health.**

Following Jurges (2007), we propose a discrete choice index model, with self-perceived health as the dependant variable with five ordinal outcomes, ranging from poor to excellent. It is based on the assumption that when respondents answer survey questions about their health, they assess their true health (H*), a latent continuous variable (possibly captured with a *measurement error* - ε - (Crossley and Kennedy, 2002)), and project this value onto the ordinal scale provided (H). However, the criteria each individual uses when dividing this real line into segments, by thresholds (μ) which define these categories, will depend on individual heterogeneity.

Following Jurges (2007), the latent variable for health (H*) is regressed against quasi-objective[1] physical or chronic conditions (Q), and the way it is categorized by individuals when they reveal their self-perceived state (the thresholds) will depend solely on individuals' cultural and linguistic background, which will be represented by country dummies (D). This latent variable (H*) will serve for the creation of a 0-to-1 health index, a 'proxy' for true health, where 0 represents the worst observed health state ('near death') and 1 represents 'perfect health'. The presence of a condition reduces the health index by some given amount or percentage, a *disability weight* (Jurges, 2007). These will be equal to estimated coefficients divided by the difference between highest and lowest predicted health level (corresponding to 'near death' and 'perfect health', respectively). Jurges (2007) uses the "generalised ordered probit model" which "makes threshold parameters dependent on covariates (Terza, 1985; King et al., 2004)."

The fully general case presented in Terza's (1985) generalization of the ordered model[2], with a vector of Country dummies – D - as sole influences on the thresholds and latent health also dependant on D, and on the already referred quasi-objective measures -Q- , would result in:

$$\boldsymbol{H^* = \alpha + \beta^{D\prime} D + \beta^{Q\prime} Q + \varepsilon} \qquad (1.1)$$

[1] Quasi-objective because we base ourselves in self-reports of disabilities objectively diagnosed by physicians.

[2] For direct applications of Terza's approach, see, e.g., Kerkhofs and Lindeboom [1995], Groot and van den Brink [1999] and Lindeboom and van Doorslayer [2003].

$$H = \begin{cases} 0, & if \quad H^* \le \mu_0 \\ 1, & if \quad \mu_0 < H^* \le \mu_1 \\ 2, & if \quad \mu_1 < H^* \le \mu_2 \\ 3, & if \quad \mu_2 < H^* \le \mu_3 \\ 4, & if \quad \mu_3 < H^* < \mu_4 \end{cases} \tag{1.2}$$

where,

$$(\varepsilon \mid \boldsymbol{D}, \boldsymbol{Q}) \sim N(0,1) \ldots\ldots \ldots \tag{1.3}$$

and

$$\begin{aligned} &\mu_0 = 0 \\ &\mu_j = \bar{\mu}_j + \delta_j' \boldsymbol{D}, \quad j = 1, 2, 3 \\ &\mu_4 = +\infty \end{aligned} \tag{1.4}$$

In Terza's (1985) application with only 3 possible outcomes, there was an ambiguity in the model, as specified. In principle, a model for J outcomes should have J-1 thresholds. This is because with a nonzero overall constant (α), it is always necessary to normalize the first threshold in (1.4), $\mu_0 = 0$ (Greene and Hensher, 2010b)[3], obtaining the following implied probabilities:

$$\begin{aligned} P(H = 0 \mid \boldsymbol{D}, \boldsymbol{Q}) &= \Phi(-\alpha - \beta^{D\prime} \boldsymbol{D} - \beta^{Q\prime} \boldsymbol{Q}) = 1 - \Phi(\alpha + \beta^{D\prime} \boldsymbol{D} + \beta^{Q\prime} \boldsymbol{Q}) \quad , \\ P(H = j \mid \boldsymbol{D}, \boldsymbol{Q}) &= \Phi(\bar{\mu}_j + \delta_j' \boldsymbol{D} - \alpha - \beta^{D\prime} \boldsymbol{D} - \beta^{Q\prime} \boldsymbol{Q}) - \Phi(\bar{\mu}_{j-1} + \delta_{j-1}' \boldsymbol{D} - \alpha - \beta^{D\prime} \boldsymbol{D} - \beta^{Q\prime} \boldsymbol{Q}) \\ &= \Phi(\alpha_{j-1} + \beta_{j-1}^{D\prime} \boldsymbol{D} + \beta^{Q\prime} \boldsymbol{Q}) - \Phi(\alpha_j + \beta_j^{D\prime} \boldsymbol{D} + \beta^{Q\prime} \boldsymbol{Q}) \quad , \ j = 1, 2, 3, 4 \end{aligned} \tag{1.5}$$

with,

$$\begin{aligned} \alpha_j &= \alpha - \bar{\mu}_j \\ \beta_j^D &= (\delta_j - \beta^D) \end{aligned} \tag{1.6}$$

[3] Note that Jurges (2007) does not make this normalization, and therefore reports α_j, with the first threshold being equal to the constant in the model.

However, for Jurges (2007), the crucial assumption maintained is that "disability weights are the same for each individual in each country". The assumption that disability effects are the same across countries is what concerns us the most. It seems fairly obvious that this is neither a very reasonable nor realistic assumption, particularly in contexts where health systems or lifestyles may differ substantially. We do not know whether this will be the case for the European reality, but we still believe these differences must be contemplated. Furthermore, as Jurges (2007) correctly identifies, the nationality of the respondent might produce a cultural or linguistic bias over self perception. He implicitly assumes that this effect is over self-perception alone, and not over health (i.e., he imposes the constraint $\beta^D = 0 \Rightarrow \delta_j = \beta_j^D$, given that maximum likelihood only produces aggregate estimates). However, we believe this is insufficient and the analysis is incomplete. Imputing conceptually the whole of the (generalized ordered probit) estimated effect, associated to country dummies, to an influence over the thresholds is, at the very least, biased. By doing so, the model would be suffering from omitted variable bias, ignoring the undeniable direct impact over health a country's health system (captured by a country dummy) would have.

Jurges (2007) had to assume this because he was under the restriction imposed by the Generalized Ordered Probit model (following both Terza, 1985 and King et al., 2004), which makes threshold parameters dependent on covariates, but cannot separately identify influences which work upon both the latent variable and the thresholds[4], i.e., when they are a common vector. We will explore this in detail.

Terza's heterogenous thresholds model therefore allows deltas to differ across outcomes, but not the betas. The motivation was to work around the parallel-regressions assumption. At this point this generalization of Terza is similar to Williams's 2006

[4] King et al (2004) could solve at least part of this problem by the use of vignettes. However, they are not available, and therefore Jurges (2007) did not use them.

"Generalized Ordered Probit" model (Greene and Hensher, 2010b). Furthermore, as Terza (1985) notes, on p.6, this model formulation does not impose an ordering on the threshold coefficients. It has produced a model which is internally inconsistent at least for some data vectors; i.e, it cannot ensure that probabilities are always positive (Greene and Hensher, 2010a). So, in sum, Williams' "Generalized Ordered Probit" Model (GOPROBIT) presents two problems: (1) an ordering of the thresholds, which is not guaranteed; and (2) an identification problem, which renders the deltas indistinguishable from the betas associated to the country dummies.

Jurges (2007) solves problem (2) by conceptually defending the idea that effects do not vary between countries. He makes use of the extension made by King et al, 2004, specifically to solve problem (1), "in order to ensure a well-defined probability function" (Jurges, 2007). The model is similar to the one presented above[5], but heterogeneity and ordering of the thresholds are imposed with the introduction of a non-linearity, which can be formulated as follows:

$$\boldsymbol{H}^* = \boldsymbol{\beta}_0 + \boldsymbol{\beta}^{\boldsymbol{D}\prime}\boldsymbol{D} + \boldsymbol{\beta}^{\boldsymbol{Q}\prime}\boldsymbol{Q} + \boldsymbol{\varepsilon} \tag{1.7}$$

$$\boldsymbol{H} = \begin{cases} 0, & \boldsymbol{if} \quad \boldsymbol{H}^* \le \boldsymbol{\mu}_0 \\ 1, & \boldsymbol{if} \quad \boldsymbol{\mu}_0 < \boldsymbol{H}^* \le \boldsymbol{\mu}_1 \\ 2, & \boldsymbol{if} \quad \boldsymbol{\mu}_1 < \boldsymbol{H}^* \le \boldsymbol{\mu}_2 \\ 3, & \boldsymbol{if} \quad \boldsymbol{\mu}_2 < \boldsymbol{H}^* \le \boldsymbol{\mu}_3 \\ 4, & \boldsymbol{if} \quad \boldsymbol{\mu}_3 < \boldsymbol{H}^* < \boldsymbol{\mu}_4 \end{cases} \tag{1.8}$$

where,

$$(\boldsymbol{\varepsilon} \mid \boldsymbol{D}, \boldsymbol{Q}) \sim \boldsymbol{N}(0, 1) \ldots\ldots \ldots \tag{1.9}$$

[5] Originally, King et al. (2004) assume that there is no overall constant term in the latent regression - $\boldsymbol{\beta}_0$, nor in the threshold equations - $\boldsymbol{\lambda}_j$. We have isolated the constants, in order to maintain consistency and compare models (see Greene and Hensher, 2009a on this, pp. 178). Furthermore, we have made a trivial change of notation, from Y= 1,….J to Y= 0,…,J-1, in order to ease comparison.

and,

$$\begin{aligned} : \quad & \mu_0 = \lambda_0 + \gamma_0' D \\ & \mu_j = \mu_{j-1} + \exp(\lambda_j + \gamma_j' D), \quad for\ j = 1, 2, 3 \\ & \mu_4 = +\infty \end{aligned} \tag{1.10}$$

This was the model used by Jurges, following King et al (2004). However, Greene and Hensher (2010a) rewrite this model, normalizing the first threshold to 0, in order to highlight an identification problem:

$$H^* = (\beta_0 - \lambda_0) + (\beta^D - \gamma_0)' D + \beta^Q' Q + \varepsilon \tag{1.11}$$

$$H = \begin{cases} 0, & if \quad H^* \le \mu_0 \\ 1, & if \quad \mu_0 < H^* \le \mu_1 \\ 2, & if \quad \mu_1 < H^* \le \mu_2 \\ 3, & if \quad \mu_2 < H^* \le \mu_3 \\ 4, & if \quad \mu_3 < H^* < \mu_4 \end{cases} \tag{1.12}$$

where,

$$(\varepsilon \mid D, Q) \sim N(0, 1) \ldots\ldots \ldots \tag{1.13}$$

and,

$$\begin{aligned} & \mu_0 = 0 \\ & \mu_j = \mu_{j-1} + \exp(\lambda_j + \gamma_j' D), \quad for\ j = 1, 2, 3 \\ & \mu_4 = +\infty \end{aligned} \tag{1.14}$$

The problem is fairly evident. Because the first threshold was specified linearly by Jurges (following King et al, 2008), for all variables present in any vector D, common to both the latent and the threshold equations, the respective parts of β^D and γ_0 cannot be separately estimated, as well as the constant terms (Greene, 2008), unless vignettes are used (as proposed by King et al (2004). However, Jurges does not have this option

available, and presented the argument for "common effects across countries", i.e., the vector D was not added to the latent regression.

We now propose to contemplate a vector of country dummies also affecting the latent health index, besides the thresholds, and therefore follow Greene and Hensher (2010a), taking the "Hierarchical Ordered Probit" model as a means to address both original GOPROBIT limitations, with the introduction of the non-linear exponential function in all the thresholds, and the normalization of the first threshold to 0: (1) the thresholds are assured to be always positive and ordered, with the introduction of some "curvature" in the threshold definition; (2) the threshold are mathematically distinct from the regression, and may be separately identified in the maximization process of the log-likelihood function, thus solving the identification problem. This, when applied to our case, results in:

$$\boldsymbol{H}^* = \boldsymbol{\alpha} + \boldsymbol{\beta}^{\boldsymbol{D}}\boldsymbol{D} + \boldsymbol{\beta}^{\boldsymbol{Q}\prime}\boldsymbol{Q} + \boldsymbol{\varepsilon} \tag{1.15}$$

$$\boldsymbol{H} = \begin{cases} 0, & \boldsymbol{if} \quad \boldsymbol{H}^* \le \boldsymbol{\mu}_0 \\ 1, & \boldsymbol{if} \quad \boldsymbol{\mu}_0 < \boldsymbol{H}^* \le \boldsymbol{\mu}_1 \\ 2, & \boldsymbol{if} \quad \boldsymbol{\mu}_1 < \boldsymbol{H}^* \le \boldsymbol{\mu}_2 \\ 3, & \boldsymbol{if} \quad \boldsymbol{\mu}_2 < \boldsymbol{H}^* \le \boldsymbol{\mu}_3 \\ 4, & \boldsymbol{if} \quad \boldsymbol{\mu}_3 < \boldsymbol{H}^* < \boldsymbol{\mu}_4 \end{cases} \tag{1.16}$$

where,

$$(\boldsymbol{\varepsilon} \mid \boldsymbol{D}, \boldsymbol{Q}) \sim \boldsymbol{N}(0, 1) \ldots\ldots \ldots \tag{1.17}$$

and,

$$\begin{aligned} &\boldsymbol{\mu}_0 = 0 \\ &\boldsymbol{\mu}_{\boldsymbol{j}} = \boldsymbol{\mu}_{\boldsymbol{j}-1} + \exp(\boldsymbol{\lambda}_{\boldsymbol{j}} + \boldsymbol{\gamma}_{\boldsymbol{j}}{}'\boldsymbol{D}), \quad \boldsymbol{for}\ \boldsymbol{j} = 1, 2, 3 \\ &\boldsymbol{\mu}_4 = +\infty \end{aligned} \tag{1.18}$$

Thus, we will obtain a separate vector of estimates for country effects on the health index β^D, for the other disability effects on health index β^Q, and for country reporting-style effects, i.e., on thresholds- γ_j.

2.3 Data Description

In order to compare with Jurges' results, we use data from the first wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) collected in 2004, as he did. However, we replicated his methodology on the available complete data of the first wave, even though he had only then available release 1 of this first wave[6]. SHARE is a multidisciplinary, cross-national micro data base containing information on health and socioeconomic status of some 22,000 Continental Europeans aged above 50. Consistent sampling frames and survey design across all participating countries result in a high degree cross-national comparability of the SHARE data which is essential for a comparative research such as ours. We use the data collected from ten European countries - Austria, Denmark, France, Germany, Greece, Italy, the Netherlands, Spain, Sweden and Switzerland. After accounting for missing data, out sample amounts to a total of 22600 individuals.

Figure 2.1 shows the age-sex standardized distributions of self-reported general health[7] for the 22600 individuals, across the 10 considered countries, i.e., the health distribution

[6] Release 1 was still an incomplete version of the first wave of data, which rendered a total of 21321 individuals involved in Jurges' estimation procedure. Our sample, including the same individuals, is slightly larger, summing up to 22600 individuals.

[7] Our dependent variable is a self-perceived health measure with 5 ordinal outcomes, ranging from 'poor' to 'excellent', following the usual self-rated health (SRH) U.S. scale, already used in a wide range of

across the 5-point ordinal scale if each country had the same age and sex distribution of individuals, as reported by Jurges (2007). We observe that the health distribution and ranking across countries for this sample is very similar to Jurges' initial 21231 individuals sample from the preliminary release of SHARE, wave 1. The healthiest retired respondents live in Northern European Countries such as Denmark and Sweden (with Germany being an exception), and the least healthy mainly in Mediterranean Countries such as Italy and Spain.

As to the independent variables influencing the index equation, SHARE contains a broad variety of different health (both physical and mental) conditions, and information which allowed us to build certain health indicators (e.g., Body Mass Index - BMI). To ease comparisons, we used the same quasi-objective measures of health, or disabilities (vector of dummies, Q), as Jurges (2007) did, those referred to in table 2.1. A vector of country dummies (D) was used as an influence on both the thresholds (as Jurges, 2007, did) and the index equation.

studies on U.S. reality. We chose this, though the E.U. equivalent (ranging from 'very poor' to 'very good') was also available, because of a greater symmetry in responses across the 5 categories, and following a SHARE study conducted by Jürges, Avendano, Mackenbach (2007), which has proven non-significant differences between the U.S. versus E.U. scale, who present similar associations with demographics and health indicators, and showed a similar pattern of variation across countries. They do not find evidence that the EU version is preferable to the US version as standard measure of SRH in European countries.

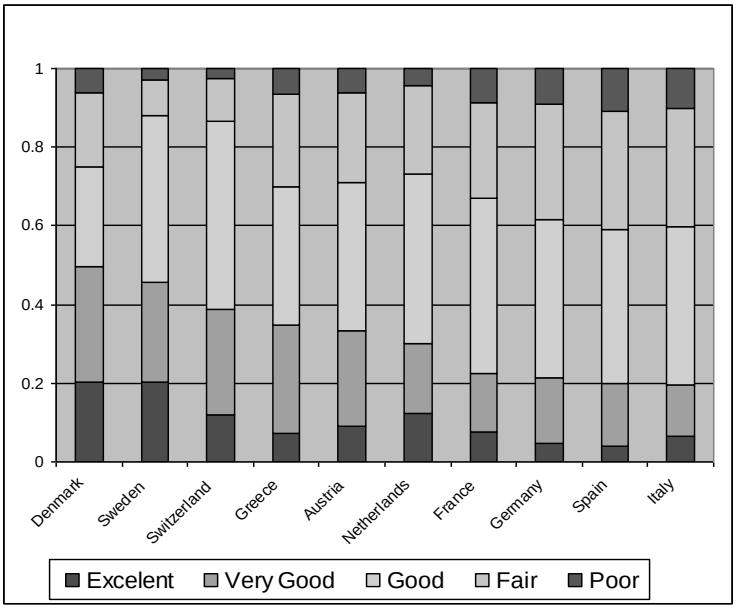

Figure 2.1 Age-Sex Standardized Self-reported General Health, by country, for the 22600 individuals

2.4 Results

A first estimation procedure according to Generalized Ordered Probit - framework (as in Jurges, 2007; King et al, 2004; Terza, 1985)) was conducted, followed by estimation of our model, using Hierarchical Ordered Probit (following Greene and Hensher, 2010b). The results of both estimation procedures are presented in Table 2.1. The restriction that countries do not have an influence on the health index equation was conceptually imposed by Jurges (i.e., $\beta^D = 0$) and therefore the estimates from GOPROBIT, associated to the country dummies (D), are solely imputed to threshold

Table 2.1 Generalized Ordered Probit and Hierarchical Ordered Probit regressions of self-assessed health on health indicators and implied disability weights.

	GOPROBIT				HOPIT			
DISABILITY	Coef	Std. Dev.		Implied Disability Weight [a]	Coef	Std. Dev.		Implied Disability Weight [a]
Heart attack or other heart problems	0.649	0.023	***	11.10%	0.656	0.023	***	10.21%
High blood pressure	0.283	0.017	***	4.85%	0.280	0.017	***	4.36%
High blood cholesterol	0.112	0.020	***	1.91%	0.110	0.020	***	1.71%
Stroke or cerebral vascular disease	0.772	0.036	***	13.21%	0.785	0.036	***	12.20%
Diabetes	0.505	0.025	***	8.65%	0.498	0.025	***	7.75%
Chronic lung disease	0.612	0.031	***	10.48%	0.608	0.031	***	9.45%
Asthma	0.284	0.034	***	4.87%	0.297	0.034	***	4.62%
Arthritis	0.552	0.020	***	9.45%	0.540	0.020	***	8.40%
Osteoporosis	0.386	0.029	***	6.61%	0.377	0.029	***	5.86%
Cancer or Malignant Tumor	0.542	0.029	***	9.28%	0.548	0.029	***	8.53%
Stomach, duodenal or peptic ulcer	0.307	0.031	***	5.25%	0.307	0.031	***	4.78%
Parkinson disease	1.076	0.091	***	18.42%	1.073	0.091	***	16.69%

Cataracts	0.119	0.028	***	2.03%	0.129	0.028	***	2.01%
Hip fracture or femoral	0.353	0.052	***	6.05%	0.376	0.051	***	5.85%
Other conditions	0.557	0.019	***	9.54%	0.568	0.019	***	8.84%
Depressed	0.357	0.015	***	6.11%	0.351	0.015	***	5.46%
Low Grip Strength[b]	0.242	0.017	***	4.14%	0.242	0.017	***	3.76%
No Grip Strength[b]	0.735	0.027	***	12.57%	0.730	0.027	***	11.35%
Low Walking Speed[c]	0.425	0.047	***	7.28%	0.413	0.048	***	6.42%
Underweight[d]	0.124	0.037	***	2.12%	0.127	0.037	***	1.97%
Overweight[d]	0.289	0.022	***	4.95%	0.110	0.016	***	4.42%
Obese[d]	0.112	0.016	***	1.91%	0.284	0.022	***	1.71%
Austria						0.151		2.97%
Germany						0.147	*	4.01%
Sweden						0.151	**	-5.83%
Netherlands						0.150		-0.76%
Spain						0.148		2.55%
Italy						0.148		2.56%
France						0.147		2.75%
Denmark						0.152		0.20%
Greece						0.150		0.29%

Threshold significance	**TH1-2**	**TH2-3**	**TH3-4**	**TH1-2**	**TH2-3**	**TH3-4**
Austria	***				*	
Germany	***	***	***		**	

Sweden	***	***	***				
Netherlands	***	***			**		
Spain	***	***	***		**		
Italy	***	***			**		
France	***	***					
Denmark	**	***	***			***	***
Greece	***		*		**		

Notes: *** significant to the 1% level; ** significant to the 5% level.; * significant to the 10% level. *Source*: SHARE, wave 1

[a] Disability weights are equal to generalized or hierarchical ordered probit coefficients divided by the difference between the highest and the lowest predicted latent health level.

[b] Binary variable indicating that from 4 measurements (2 in each hand) with a dynamometer, the largest is below the bottom tertile, in the case of "low grip strength" or the individual wasn't able to complete the test ("no grip strength"). Hand grip strength in middle age has been shown to be predictive of the incidence of functional limitations, disability and even mortality in old age (Frederiksen et al., 2002; Rantanen et al., 1998).

[c] Low walking speed is measured by a timed walk over a short distance (2.5 m). Two measurements were made, of which we take the fastest. A walking speed of 0.4 m/s or slower is used as the cut-off point for 'low walking-speed' (Steele et al., 2003). Unsuccessful attempts – independent of the reason – are also coded as having low walking speed. Respondents younger than 75 who were not eligible for the test are coded as having a normal walking speed.

[d] BMI (*Body Mass Index*= weight in kg/squared height in meters) was created and coded in four categories: <20 (underweight), 20–25 (normal weight), 25–30 (overweight), and more than 30 (obese).

coefficients (δ). Threshold coefficient estimates are not reported, only their significance on the self-response mechanism is, given that they are of no interpretative value (i.e., only used later on the re-categorization process).

A simple likelihood ratio test was taken, to ensure our model (HOPIT) to be an improved specification in relation to Jurges' (GOPROBIT)[8]. One of the first things we notice is the expected similarities between estimates obtained through both methods, for each condition of impairment. However, the implied disability weights do result somewhat smaller. This comes as a consequence of both the re-dimension of the latent predicted health index, which in the HOPIT case now depends on countries themselves (GOPROBIT could in fact had been suffering from omitted variable bias), and the re-shifting of the thresholds, upon which countries now may have a different (less significant or not) effect. In fact, a striking outcome obtained by the HOPIT procedure is the large insignificance of the coefficients associated to country "disability" effects, which are relative to the base country, Switzerland. As such, disabilities seem to have the same average effect across most countries, with the fairly significant exception of the ones in the extreme states of public self-rated health: Sweden at one end, Germany at the other end. Jurges (2007) had assumed this, but it wasn't yet proven. These results come to establish that country dummies, which could capture European health systems effect on improving or aggravating average disabilities, are not significant influences on health, as one might think they would be. If this seems reasonable as to the means of diagnosis and treatment from health providers, which in such developed countries

[8] This test is possible due to the fact that Jurges' model is nested in ours, given that it is a similar model under the constraint that $\beta^{D} = 0$. The likelihood ratio (LR) statistic will follow a qui-squared distribution with 9 degrees of freedom, for which the observed 128.98 LR value represents a null p-value. We therefore conclude as to an improvement of our specification and reject the generalized ordered specification with a very high significance level.

should not represent significant distinctions, it is an interesting finding in what refers to the financial implications over health conditions, these different health systems could have, and apparently don't, for most of the cases. It does seem true, however, that a couple of countries distance themselves from European reality in this matter. An average Swedish citizen seems to have his/her objectively determined health conditions fairly attenuated, whilst a German might find them aggravated by the mere condition of living in Germany. This is fairly consistent with the more generally accepted health indicators used. If we take disability-adjusted life expectancy for our sampled countries, from the latest World Health Report available (2002), Sweden is clearly at the forefront of the distribution, with a 73.3 expected age, whilst Germany occupies a place at the tail of the distribution, with 71.8. (see European Health for All database (HFA-DB), 2002). Generally life-expectancy differs very little across the considered nations, which supports our results pointing towards insignificant differences across country influences on health.

However, the most interesting finding, after the implementation of the new methodology, concerns the significance of cultural and linguistic backgrounds, captured by country dummies, on thresholds. Jurges (2007) methodology had a conceptual constraint imposed on all countries having the same disability effects, i.e. country disability effects being null $(\beta^D = 0)$, which meant the whole of the coefficient estimated would be imputed to the threshold coefficient ($\beta_j^D = \delta_j$). This might in fact have been the reason why he reached the conclusion that cultural and linguistic differences produced biased self-revealed rankings of state of public health across countries, which was central to his paper. We now find this somewhat diluted. Country influences on self-perceptions (i.e. categorization thresholds) seem to have severely lost significance after their possible influence directly on health *per se* is accounted for, particularly with respect to the higher self-assessed health level cutting-points. If there is a significant linguistic distortion on self-categorization into health status, it manifests

itself solely in the distinction between the intermediate categories "fair" and "good", and even this influence looses significance. There is a striking exception, which is Denmark, for which there is a clear linguistic or cultural distortion on self-perceived higher levels of health (from "good to "excellent"). Curiously, Denmark (as well as Germany), now found to be of relevance in explaining categorization into health status (or health *per se*), were in fact the Anglo-Saxon examples given by Jurges (2007) with linguistic particularities prone to have influence on self-assessment of health.

This loss of significance of country dummies to explain the self-categorization process into health status, which Jurges (2007) had accounted for, obviously has huge implications in terms of the revealed ranking for the state of health across countries.

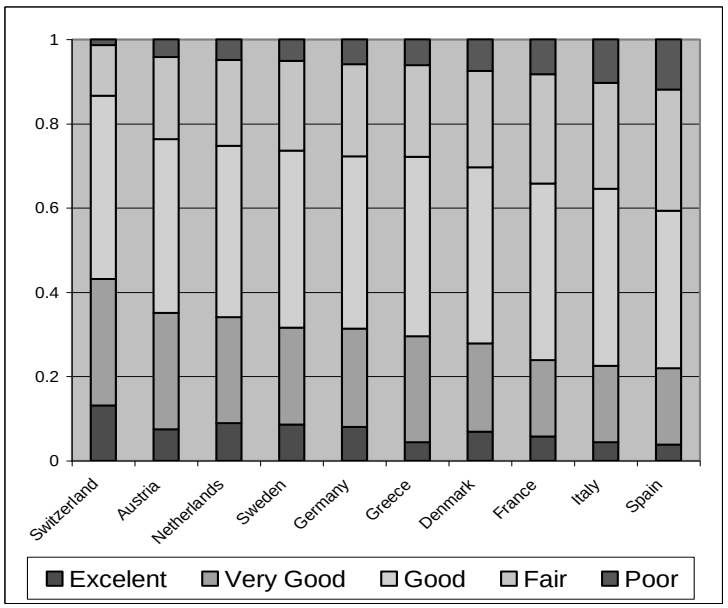

Figure 2.2 Age-Sex Standardized SRH by country, after country heterogeneity control (using GOPROBIT), for 22600 individuals

Jurges' (2007) *adjusted* ranking reflected a strong re-arrangement in terms of re-categorization of individuals into discrete health status, after accounting for his reported strong linguistic or cultural influences on self-reporting of health. Figure 2.2 reports what would be the ranking after adjustments, had we maintained Jurges' proposed methodology (GOPROBIT).

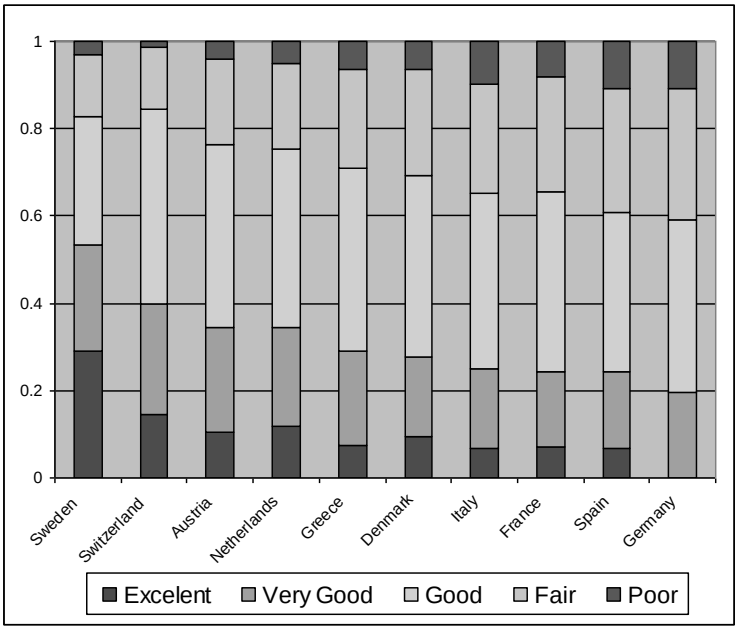

Figure 2.3 Age-Sex Standardized SRH by country, after country heterogeneity control (using HOPIT), for 22600 individuals

Alternatively, Figure 2.3 reports the revealed ranking after results from our 'unrestrained' methodology (HOPIT) are considered. This adjustment, or re-classification of individuals into discrete health levels, was done as Jurges (2007) did, by taking the original aggregate health distribution of our entire European sample as a reference. The value of the health index corresponding to each quantile level for each ordinal category is found, and this produces threshold levels for the underlying health

index. These threshold levels where then used to re-classify individuals from every country in the ordinal health categories, so as to maintain global European self-rated health original distribution. Global response frequencies are maintained, but because linguistic or cultural heterogeneity in response may exist, an individual from a certain country which initially perceived her or himself as being in a poor state of health may very well end up classified as in a good state.

After adjustments, the ‘true’ ranking of objective public health of citizens across Europe is revealed. Jurges’ procedure most stunning result is the fact that Central European countries such as Switzerland and Austria move straight across the chart to occupy lead positions, whereas Scandinavian countries such as Sweden and Denmark are found to have drastically worse realities. Although Mediterranean countries maintained their relative low position, Germany leaped to a much better place. These discoveries come directly as a result of the strong influences which are attributed by the estimation procedure to country dummies significance on reporting thresholds.

However, with HOPIT, we find these influences to be quite immaterial in most cases, with the exception of Denmark. In consequence, the ranking which results after adjustment shares this deteriorated relative position of Denmark with Jurges’ revealed ranking. It does, however, present some strong differences, both relative to Jurges’ (GOPROBIT) and to the originally reported rankings. Sweden and Switzerland improve to the top positions, whilst Germany is found to still occupy a tail position. Countries such as Greece (or Italy) deteriorate (or improve) considerably in the health distribution across countries. These results are remarkably consistent with the distribution of disability-adjusted life expectancy, from the latest World Health Report available. Sweden and Switzerland are ahead, with a 73.3 and 73.2 life expectancy, respectively, Italy reports a high 72.7, whilst Germany, Greece and Denmark are definitely in the

lower end of the distribution with 71.8, 71 and 69.8, respectively (European Health for All database (HFA-DB), 2002).

2. 4. 1 Quality of Prediction

To evaluate the prediction accuracy of the original Jurges' (2007) model and compare it with our HOPIT-based proposed modification, our sample of 22,600 individuals was separated into two subsamples: an estimation subsample and a prediction subsample. The estimation sample was an 80% sample randomly drawn from all SHARE respondents. The survey responses given by these 18,080 individuals were used to estimate the parameters of both alternative models. The remaining 4,520 individuals (i.e., the prediction sample) were excluded from the estimation sample and were used to evaluate prediction accuracy for the alternative model specifications. The same estimation and prediction subsamples were used for each alternative specification. Consequently, any variation in prediction accuracy cannot be attributed to differences in the underlying sample, but solely to model specification.

Table 2.2 provides descriptive statistics for all individual pathologies and country representativeness in each sample. Summary statistics are provided for both the estimation and prediction subsamples. Both groups present similar sample country compositions, with fairly similar percentage incidence for each disability. Percentage correctly predicted were computed for each model specification, both within the estimation sample, and also for the predictions made for the 4520 individuals based in the estimates for the 18080 individuals composing 80% of the subsample. A clear increase in predictive power from the alternative model specification was obtained.

Table 2.2 Estimation and Prediction subsample composition and Percentage Correctly Predicted

	Estimation subsample (n=18080)		Prediction subsample (n=4520)	
VARIABLE	Mean	Std. Dev	Mean	Std. Dev.
Self-Rated Health (1-5)	3.035	1.069	3.027	1.056
Austria	0.079	0.270	0.080	0.271
Germany	0.130	0.337	0.128	0.334
Sweden	0.128	0.334	0.130	0.337
Netherlands	0.121	0.326	0.125	0.331
Spain	0.099	0.299	0.095	0.293
Italy	0.117	0.321	0.107	0.309
France	0.125	0.331	0.129	0.335
Denmark	0.068	0.251	0.070	0.256
Greece	0.114	0.318	0.117	0.322
Heart attack or other heart problems	0.114	0.318	0.120	0.325
High blood pressure	0.319	0.466	0.316	0.465
High blood cholesterol	0.189	0.391	0.191	0.393
Stroke or cerebral vascular disease	0.038	0.191	0.038	0.191
Diabetes	0.098	0.297	0.097	0.296
Chronic lung disease	0.051	0.220	0.050	0.219
Asthma	0.051	0.219	0.047	0.211
Arthritis	0.199	0.399	0.188	0.391
Osteoporosis	0.076	0.264	0.071	0.258
Cancer or Malignant Tumor	0.053	0.224	0.053	0.224
Stomach, duodenal or peptic ulcer	0.058	0.235	0.055	0.228
Parkinson disease	0.007	0.083	0.006	0.078
Cataracts	0.079	0.269	0.078	0.268
Hip fracture or femoral	0.020	0.140	0.018	0.133
Other conditions	0.169	0.375	0.171	0.376

Ever treated for depression	0.365	0.482	0.371	0.483
Low Grip Strength	0.341	0.474	0.335	0.472
No Grip Strength	0.070	0.255	0.077	0.266
Low Walking Speed	0.024	0.152	0.023	0.149
Underweight	0.035	0.184	0.037	0.188
Overweight	0.431	0.495	0.430	0.495
Obese	0.174	0.379	0.167	0.373
Percentage Correctly Predicted				
GOPROBIT		37.4%		37.0%
HOPIT		44.1%		43.0%

Source: SHARE, wave 1

Because this out of sample prediction could come only as a lucky result of the sample selection, 30 random draws for both the estimation and prediction subsamples where made, the estimation and prediction process repeated, and percentage correctly predicted (PCP) computed. Table 2.3 shows the 95% confidence intervals calculated for the average PCP using both HOPIT and GOPROBIT. The results are clear as to the greater predictive power of the HOPIT approach, which not only produces better prediction in average, but also presents less variability or dependency on the sample drawn.

Table 2.3 Percentage Correctly Predicted (PCP) confidence intervals based on 30 random draws for Estimation and Prediction subsamples

	Sample	Average PCP	Std. Dev of PCP	95% Confidence Interval for PCP
GOPROBIT	Estimation	37.5%	1.0%	[37.1; 37.8]
	Prediction	37.3%	1.3%	[36.8; 37.7]
HOPIT	Estimation	44.8%	0.4%	[44.6; 44.9]
	Prediction	44.5%	0.5%	[44.3; 44.7]

2.5 Conclusions

We build up on Jurges' (2007) proposed econometric methodology to enable comparability across groups of individuals when trying to evaluate health reported in a survey. We are convinced the application of such a discrete choice model with endogenous thresholds to model self-rated health, with the self-categorization process depending on a series of covariates, is the solution to building a continuous, comparable measure for health – a health index – which will prove itself useful in a number of ways. It is a finding in terms of rigorously evaluating health across heterogeneous groups of individuals, which is fundamental to a number of papers. In this case, it enabled the revelation of a more precise underlying "ranking" for the state of health for all the countries involved in the SHARE survey.

However, we propose a less constrained alternative to the model initially used, which has been recently developed by Greene, 2007, Eluru, Bhat and Hensher, 2008 and Greene and Hensher, 2010a: the 'Hierarchical Ordered Probit'. We have showed it allows for the separate identification of certain covariate (in this case, country) specific effects both on the threshold levels and directly on the health index. We conclude that in reality the country specific effects on health *per se* are generally fairly insignificant in such a European context, but prove, however, how dangerously misleading the 'Generalized Ordered Probit' (Terza, 1985; King et al., 2004; Williams, 2006) methodology can be, when one imposes country to have effects solely on threshold definition. We do in fact observe the relative unimportance of what Jurges (2007) had reported as cross-cultural linguistic differences, and present a new ranking for the sampled countries' public health status, very much consistent with other health indicators generally used (e.g., disability-adjusted life expectancy). Finally, we verify a considerable increase in predictive power from our proposed alternative model specification.

Nonetheless, we still find the consideration of self-categorization heterogeneity across individuals, raised by Jurges' in a context of health status, of incredible foresight. We found linguistic or cultural differences to be of residual significance in most cases, but remain however certain that this is the proper way to model self-perceived differences in self-rated health. The control for the true influences on self-rating or self-perception of health will be accounted for and object of our future research.

This new methodology raises a number of further research possibilities, such as the consideration of country-specific disabilities, given that it now enables the disaggregate estimation of effects from covariates which simultaneously influence index and threshold levels.

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Essay 3

Health Endowment, Access and Choices:

impact on retired Europeans' (in)activity and quality of life

3.1 Introduction

For the first time in most developed countries we observe more people dying than being born. Low fertility rates, and lower mortality rates resulting from high levels of expansion, rationalization and organization experienced by the health sector (Weisbrod, 1991) have brought about one of the largest demographic challenges. An aging population is choosing early retirement from regular employment, with predictions for 60+ year olds comprising up to one-third of the population in several countries in the next two decades, (Siegrist et al., 2006). This predicts a future dominated by an ever-increasing population of retired citizens, without enough younger workers to fund (via taxes or social contributions) retirement programs or other state welfare agendas, representing a major challenge to social and health policy in European countries. However, to what extent does this population represent a burden, or can it be an active asset to the economy and society? Under the latter perspective the question which should be raised by policymakers is how (in)active is in fact this population, and what exactly determines its (in)activity. Health has been proposed as one of its main determinants (see recently, for instance, Siegrist et al., 2006), and the evaluation of this proposition and the dimension of this phenomenon is part of what constitutes the subject of interest of this paper. Furthermore, we take a step further and identify how each of the health determinants acts upon the activity of retirees.

Nonetheless, in the matter of assessing the welfare state, policymakers should not only be concerned about the distribution of resources and health, but also with the general well-being of this ever-growing 'third age' population. A further innovation of this paper is the evaluation of the impact that health (and its determinants) may have, not only in the activity of older citizens, but also on their quality of life. Thus quality of life in early old age was measured by using the CASP-12 (Knesbeck et al., 2005), intended

to identify and quantify those aspects of quality of life in early old age that are specific to a stage in the life course characterized by transition from work to retirement, by an increase of personal freedom and by new options of social participation. *Quality of life* is therefore regarded as the degree to which human needs are satisfied, which in this stage of the life course translates itself into four domains of need which seem to be particularly relevant: control, autonomy, self-realization, and pleasure (Patrick et al., 1993; Turner, 1995; Doyal and Gough, 1991)

However, in order to fully explore health distributions and the weight of each of its determinants, it becomes essential to find a reliable, continuous measure for health, which maps individual stock of health as a function of each person's personal (genetic) endowment status, access and choices. The difficulty, one could argue, and many have, is in measuring and comparing health outcomes across individual heterogeneity (see, for instance, Bago d'Uva et al. (2006)).

This finds support in Amartya Sen's (2004) argument that health is a complex matter with many dimensions, and as such cannot be measured based solely on the mere *status*, but should also take into account the *access* to opportunities. This reflects Sen's well-known distinction between achievement and the *capability* of achieving, in this case, good health, raising a question of social justice in health: "the factors that can contribute to health achievements and failures go well beyond *health care*, and include many influences of many different kinds, varying from genetical propensities, individual income, food habits, and lifestyles, on the one hand, to the epidemiological environment and work condition, on the other." (Sen, 2004).

We have therefore decided to assess the relative influences of endowment, access and choices on health, whilst taking into account individual heterogeneous psychological, cognitive and socio-economic realities, across countries.

However, a further complication in evaluating health states arises from the fact that a person's own understanding of his or her health may interfere in their self-assessment of their objective 'true' status. In health economics literature, there is a conceptual contrast between "internal" views of health (based on the patient's own perceptions) and "external" views (based on the observations of doctors or pathologists) (Sen, 2002). Major tension often exists between evaluations based respectively on the two perspectives, although we firmly believe the two views can certainly be combined (a good practitioner would be interested in both).

A mere sum of objective measures is limited to the extent of not assessing the gravity of each unique condition, and the different impacts it might have over individuals with different socio-economic backgrounds or lifestyle choices. Self-assessed general health measures, on the other hand are subjective, may come biased by heterogeneity of perspectives, character or personality, which reflect different reference levels against which individuals possibly in the same state of health judge their health and categorize it in an ordinal response. Their comparability across groups of individuals, with different norms and expectations, has been questioned in a number of studies (Kerkhofs and Lindeboom, 1995; Groot, 2000; Sen, 2002; Lindeboom and Van Doorslaer, 2004; Jurges, 2007). For instance, a common finding is that older respondents tend to have a 'milder' view of their health, i.e. they tend to rate their health as better than otherwise comparable younger respondents (Groot, 2000; Van Doorslaer and Gerdtham, 2003). Additionally, comparisons across diverse socio-economic or cultural groups, using self-reported morbidity, which is widely used as part of social statistics, have proved in certain cases to entirely mislead public policy on health care and medical strategy. There are abundant examples in the literature of how a patient's internal assessment may be seriously limited by his or her access to the proper means, knowledge and social experience. Sen (2002) famously quoted evidence from India, where Kerala, the state

with the highest life expectancy and levels of literacy (thus possibly with greatest awareness) consistently shows the highest rates of self-reported morbidity.

One of the purposes of this essay is to compute a continuous health measure or index, based on a 5-point scale self-rated health, that enables the assessment of the impact of health (and each of its determinants) on activity and quality of life, across a multi-cultural European reality, with heterogeneous health systems and socio-economic disparities, whilst also adjusting for individual self-perception and cognitive bias. The basic assumption underlying the analysis is that there is such thing as a 'true' and comparable, continuous, latent (i.e. unobservable) health status. This can be found by expunging (through 'moving' thresholds) self-perceived health from biases resulting from personality traits (pessimism, optimism, etc), cultural or linguistic and educational heterogeneity and cognitive functioning; thus leaving only the objective effects on health, of various natures: chronic disabilities and physical limitations, behavioral risks resulting from lifestyle choices and socio-economic 'abilities' to 'access' health.

The control for heterogeneity in response can be made by letting the thresholds vary across individuals according to their cultural or linguistic background, personality traits, cognitive abilities, education, and so forth, whilst afterwards reclassifying them. Differences in individuals' self-perception and projection on the discrete scale can be interpreted as differences in their 'psychological' or perceived cut points which define their perception of each discrete health status.

Before evaluating the effects of health in retired Europeans' well-being, our purpose is to create a health indicator, that enables us to go further than the mere testing and recognition of the existence of reporting heterogeneity across different (age, educational, income, linguistic, cultural) groups (as did Lindeboom and van Doorslaer, 2004), but to actually quantify the effects of these *capabilities*.

Section 2 presents our model and conceptual framework to assess 'true' health status and each of its determinants, followed by section 3 which addresses some issues concerning our empirical strategy. Section 4 describes our dataset, and the set of variables used and created, whilst section 5 presents the results obtained for our evaluation of 'true' health strategy. Section 6 proceeds with analyzing the effects of health in participation rates and quality of life of elder Europeans, and finally section 7 presents our concluding remarks.

3.2 Creating a comparable Health Index, accounting for self-perception heterogeneity.

One of the purposes of this paper is to compute a continuous health measure or index, based on a 5-point scale self-rated health, that enables the assessment of the impact of health (and each of its determinants) on activity and quality of life, across a multi-cultural European reality, with heterogeneous health systems and socio-economic disparities, whilst also adjusting for individual self-perception and cognitive bias. The basic assumption underlying the analysis is that there is such a thing as a 'true' and comparable, continuous, latent (i.e. unobservable) health status. This can be found by expunging (through 'moving' thresholds) self-perceived health from biases resulting from personality traits (pessimism, optimism, etc), cultural or linguistic and educational heterogeneity and cognitive functioning; thus leaving only the objective effects on health, of various natures: chronic disabilities and physical limitations, behavioral risks resulting from lifestyle choices and socio-economic 'abilities' to 'access' health.

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Following Essay 2and Jurges (2007), we propose a discrete choice index model, with self-perceived health as the dependent variable with five ordinal outcomes, ranging from poor to excellent. It is based on the assumption that when respondents answer survey questions about their health, they assess their true health (H*), a latent continuous variable (possibly captured with a *measurement error* $\boldsymbol{\varepsilon}$ (Crossley and Kennedy, 2002)), and project this value onto the ordinal scale provided (H). However, the criteria each individual uses when dividing this real line into segments (by thresholds ($\boldsymbol{\mu}$) which define these categories) will depend on individual heterogeneous perceptions.

The latent variable for health (H*) is regressed against two vectors which include influences solely on health *per se* (***Q***) and influences which simultaneously act upon health and self-perception (***D***). As in Jurges (2007), quasi-objective[1] physical or chronic ($\boldsymbol{Ph} \subset \boldsymbol{Q}$) and mental conditions ($\boldsymbol{Mh} \subset \boldsymbol{D}$) are considered. This latent variable (H*) will serve for the creation of a 0-to-1 health index, a 'proxy' for true health, where 0 represents the worst observed health state ('near death') and 1 represents 'perfect health'. The presence of a condition reduces the health index by some given amount or percentage, a *disability weight* (Jurges, 2007). These will be equal to estimated coefficients divided by the difference between the highest and lowest predicted health level (corresponding to 'near death' and 'perfect health', respectively). However, as

[1] Quasi-objective because we base ourselves in self-reports of disabilities objectively diagnosed by physicians.

previously mentioned, health is a complex matter which may not be simply described by the mere presence of physical conditions. We know these can be attenuated (or potentiated) by access (or lack of it) to health facilities (Sen, 2002, 2004), according to individuals' characteristics as to exposure to certain country ($\boldsymbol{C} \subset \boldsymbol{D}$) health systems, socio-economic or educational backgrounds ($\boldsymbol{Se} \subset \boldsymbol{D}$). Thus, we further extend Jurges analysis to include this type of information, as well as other dimensions of health which are directly influenced by lifestyle choices, as to behavioral risks ($\boldsymbol{Bh} \subset \boldsymbol{Q}$) undertaken by each individual (e.g. alcohol drinker, smoker). This addresses one of the limitations associated to most objective measures (mere sum of conditions), which are usually limited to the extent of not assessing the gravity of each unique disability, and the different impacts it might have over individuals with different socio-economic backgrounds or lifestyle habits.

As to influences over individual self-perception we model these as influences on the thresholds which delimit health self-assessed categories. The main value added by the proposed model in Essay 2 is the possibility of now considering influences which act simultaneously on the health index and threshold level, and separately identify them. We now thus allow for socio-economic, cultural and linguistic differences to also act upon self-perceptions, besides on health *per se,* whilst being considered in a common vector ($\boldsymbol{Se},\boldsymbol{C} \subset \boldsymbol{D}$), as previously specified. We based ourselves in the works of Dewey and Prince (2005) on the SHARE database to create a number of measures on mental health ($\boldsymbol{Mh} \subset \boldsymbol{D}$), personality traits such as pessimism, and cognitive functioning ($\boldsymbol{SP}$) which we have used as covariates on the threshold equations.

This represents an advance in dealing with group heterogeneity in reporting behavior, which researchers have long attempted to. Tandon et al. (2002) have proposed the use of vignettes to rescale individual threshold criteria, by comparison to how they perceive fictitious individuals' (with certain attributes) health status. However they do not deal

directly with cultural nor socio-economic differences, which is a crucial aspect of our European reality. Others deal with the latter, ignoring the former. Kerkhofs and Lindeboom (1995), van Doorslaer and Jones (2003) and Lindeboom and van Doorslaer (2004) follow diverse empirical strategies which have in common the estimation of *separate* ordered response models for sub-groups in their sample stratified according to age, sex, education, income and language. They present a framework for individual reporting behavior that merely enables them to formally test, via straightforward likelihood ratio tests (comparing the sum of likelihood values for two sub-groups with the sum of the likelihood for total group), whether variations in responses to health questions reflect true health differences or reporting behaviour. However, by doing this estimation procedure over sub-groups of their sample, they loose the ability to actually estimate and quantify two important effects: the actual effect of the stratifying variables (socio-economic characteristics, e.g., income) on health *per se*; and their effect (e.g. high versus low income) on self-perception. Our proposed methodology solves for these problems, and the model becomes as follows:

$$\boldsymbol{H}^* = \boldsymbol{\alpha} + \boldsymbol{\beta}^{\boldsymbol{D}}{}'\boldsymbol{D} + \boldsymbol{\beta}^{\boldsymbol{Q}}{}'\boldsymbol{Q} + \boldsymbol{\varepsilon} \tag{3.1}$$

$$\boldsymbol{H} = \begin{cases} 0, & \textit{if} \quad \boldsymbol{H}^* \le \boldsymbol{\mu}_0 \\ 1, & \textit{if} \quad \boldsymbol{\mu}_0 < \boldsymbol{H}^* \le \boldsymbol{\mu}_1 \\ 2, & \textit{if} \quad \boldsymbol{\mu}_1 < \boldsymbol{H}^* \le \boldsymbol{\mu}_2 \\ 3, & \textit{if} \quad \boldsymbol{\mu}_2 < \boldsymbol{H}^* \le \boldsymbol{\mu}_3 \\ 4, & \textit{if} \quad \boldsymbol{\mu}_3 < \boldsymbol{H}^* < \boldsymbol{\mu}_4 \end{cases} \tag{3.2}$$

where,

$$(\boldsymbol{\varepsilon} \mid \boldsymbol{D}, \boldsymbol{Q}) \sim \boldsymbol{N}(0, 1) \ldots\ldots \ldots \tag{3.3}$$

and

$$\begin{aligned} &\boldsymbol{\mu}_0 = 0 \\ &\boldsymbol{\mu}_j = \boldsymbol{\mu}_{j-1} + \exp(\boldsymbol{\lambda}_j + \boldsymbol{\gamma}_j{}'\boldsymbol{D} + \boldsymbol{\theta}_j{}'\boldsymbol{SP}), \quad \textit{for } \boldsymbol{j} = 1, 2, 3 \\ &\boldsymbol{\mu}_4 = +\infty \end{aligned} \tag{3.4}$$

Through HOPIT estimation (Greene and Hensher (2010a)) we will obtain a vector of estimates for the effects on the health index, β^D (separate estimates for variables common to the health index and threshold), for the other disability effects on health index β^Q, and for reporting-style effects, i.e., on thresholds- γ_j and θ_j .

In sum, we improve on Jurges (2007) in finding an appropriate health measure in three ways: (1) we use the methodology proposed in Essay 2, which allows influences to act simultaneously upon health and the self-perception mechanism implicit in every individual's self-categorization; (2) we go beyond the mere dimension of health pathologies with which each individual is endowed, by considering access and behavioral determinants for health; (3) after we have found in Essay 2that cultural and linguistic differences, represented by country dummies, really don't explain most of the self-assessment of health process, we find what other factors n fact might vary across individual health perception.

3.3 Identification problem and empirical strategy

Our method quantifies and expunges self-perception bias from self-reported health, and thus estimates an unbiased impact of each health determinant. However, the creation of our continuous health index, calculated based on estimated *disability weights* and through a 0-1 normalization of the latent values from a generalized ordered probit regression, may raise some identification concerns.

We need to control for and estimate the effects on health of socio-economic variables such as income and education. However, these variables are likely to be influenced by

health themselves. We solve this issue by restricting our sample to the retired population of the SHARE database. Since one can hardly argue that for this population, health status may influence either their future educational achievements or their generating income ability (which is now a pension), the direction of the causality relationship with health seems unquestioned.

3.4 Data and Variable description

We use data from the first wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) collected in 2004. SHARE is a multidisciplinary, cross-national micro data base, containing information on health and socioeconomic status for 22,000 Continental Europeans aged above 50. We select retired individuals from ten European countries - Austria, Denmark, France, Germany, Greece, Italy, the Netherlands, Spain, Sweden and Switzerland, which after accounting for missing data, reduced the sample to 10,191 individuals. One of the merits of this database is that it relies in consistent sampling frames and survey design across all participating countries, resulting in a high degree cross-national comparability.

Our main goal is to assess the importance of health issues on activity levels for retired people, controlling for extensive information on psychological and socio-economic diverse realities. Hence, our first dependent variable is a self-perceived health measure with 5 ordinal outcomes, ranging from 'poor' to 'excellent', following the usual self-rated health (SRH) U.S. scale. [2]

[2] Jürges, Avendano, Mackenbach (2007) showed that there are non-significant differences between the U.S. and the E.U. scale (ranging from 'very poor' to 'very good'). The two scales presented similar correlations with demographics and health indicators, and a very similar pattern of variation across

Figure 3.1 shows the age-sex standardized distributions of self-reported general health across the 10 considered countries, i.e., the health distribution across the 5-point ordinal scale if each country had the same age and sex distribution of individuals, but only for the retired individuals. As reported by Jurges (2007), we observe that the distribution of health levels, according to self-reports, presents strong differentials across Europe, which seems inconsistent with other well-known indicators such as life-expectancy at birth (see Human Mortality Database, 2002). The highest proportion of retired respondents that classify themselves as healthy live in Northern European Countries such as Denmark and Sweden, while the lowest live mainly in Mediterranean Countries such as Italy and Spain, though Germany is the country with the poorest results.

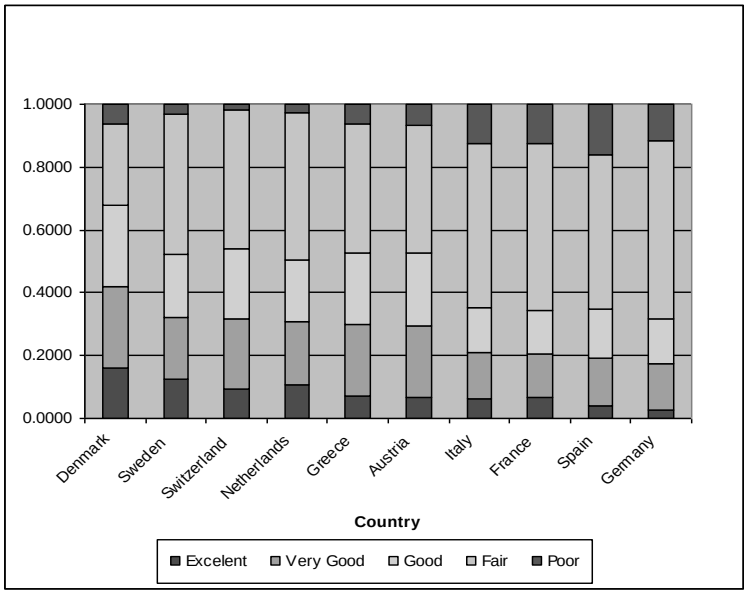

Figure 3.1 Age-Sex Standardized Self-reported General Health, by country for the 10,191 retired individuals.

countries. The authors did not find evidence that the EU version is preferable to the US version as standard measure of SRH in European countries. We ended up opting for the US scale because it exhibited a greater symmetry in responses across the 5 categories.

Our aim is to determine the 'true' underlying state of health, and whether these conclusions remain after we account for self-perception bias and reporting heterogeneity. As independent variables, we include *endowment* determinants of health such as self reported diagnosed chronic conditions, functional limitations, activities of daily living (ADL) limitations, physical measurements (hand grip strength and gait speed) and mental health indicators (we use the Euro-D scale for depression). We also consider behavioral risk indicators, which result from voluntary *choices* such as smoking behavior, nutrition, alcohol abuse, and physical inactivity and finally socio-economic dimensions such as income, wealth and educational attainment, which act in the sense of enabling (or limiting) *access* to health care and prevention.

Finally, variables included in the vector of influences over the thresholds (***D*** and ***SP***) were country dummies to account for linguistic and cultural bias in self-rating behavior (Jurges, 2007) but also a number of cognitive and psychological individual characteristics, and socio-economic variables, *per se*, to control for individual socio-economic stratifyers which might influence individual ability to correctly perceive and evaluate health status.

Appendix A presents a more thorough description of all variables used and details on their construction.

3.5 Health Endowment, Access and Choices: a first set of results

A first estimation procedure according to the conceptual framework presented was conducted to the sample of 10191 retired individuals, and the results are in table 3.1. The fourth column shows the implied disability weights used in the rest of the paper. They are computed as the regression parameters from the HOPIT model divided by the range of its linear prediction. Amongst the highest disability weights are Parkinson's disease, stroke, heart attack, and chronic lung disease, as in Jurges (2007) and Essay 2. However, comparing with them, after self-perception bias is accounted for, cancer and malignant tumor has leaped to a fourth position, which seems only reasonable. As to all other common disability weights on the latent health index, they have generally decreased in proportion, which is only natural since we are considering a wider combination of possible influences. Interestingly, behavioral risks seem to have a relatively strong and significant impact on the state of health, not only the previously considered nutritional behavior indicators (bmi) but also choices related to smoking behavior (1.13%) or particularly the practice of sports or physical activities (6.22%) and mobility (10.70%).

As previously found (Essay 2) country disability effects proved to be all largely insignificant, suggesting that disabilities should have the same average weight in all countries. Surprisingly, however, is the finding that socio-economic determinants of the *access* to health care in older age proved mostly insignificant. Nonetheless this might not come as astonishing if one remembers that in such a developed country European context access to health and the health care system for the *retired* is somewhat guaranteed. The finding that socio-economic status has no particular relevance in determining the health of older Europeans is extremely important in establishing there is

no circularity between those variables, before we proceed with analyzing impacts health may have upon other activity dimensions of elderly European.

Finally, our model identifies the true significant influences on the self-categorization process of the average SHARE respondent when assessing his/her own health, and thus revealing our population's true latent health status. Contrary to Jurges (2007), it is not with linguistic or cultural differences that one should be concerned when trying to disintricate the true state of public health from the self-revealed state (Essay 2), across a diverse European reality (with the exception of Denmark) , but rather with factors which might influence self-awareness and perception, particularly within an older population. We find cognitive measures to have a strong significant influence on the self-categorization process, namely verbal fluency. Furthermore, pessimism, a personality trait which reveals how people cope with potentially stressful situations (Aspinwall & Taylor, 1992), is found to play a very significant role in explaining how people use different standards when revealing and projecting their state of health on a qualitative ordinal scale. It is particularly influent in explaining the lower health thresholds, i.e., a stressful situation, which is only natural. As we will show, accounting for these perception bias will most certainly produce a very different and more realistic health distribution across our sampled Europeans.

We also find that with that the methodological modification (after Greene and Hensher (2010a)), now allows a regressor to simultaneously act upon threshold and index values and be separately identified (even if found to be insignificant in some cases). However insignificant as determinants of health *per se*, socio-economic characteristics such as education have an active influence in the way individuals reveal their state of health.

Table 3.1 HOPIT Regressions of self-assessed health on endowment, access and choice factors, controlling for heterogeneity in self-perception for retired proportion of the sample (10,191 individuals).

DISABILITY	Coef		Std. Error	Implied Disability Weight [a]
Heart attack or other heart problems	0.516	***	0.030	8.74%
High blood pressure	0.212	***	0.024	3.59%
High blood cholesterol	0.138	***	0.028	2.34%
Stroke or cerebral vascular disease	0.441	***	0.048	7.47%
Diabetes	0.401	***	0.034	6.79%
Chronic lung disease	0.415	***	0.042	7.04%
Asthma	0.218	***	0.048	3.70%
Arthritis	0.328	***	0.029	5.55%
Osteoporosis	0.216	***	0.042	3.66%
Cancer or Malignant Tumor	0.468	***	0.039	7.92%
Stomach, duodenal or peptic ulcer	0.239	***	0.042	4.05%
Parkinson disease	0.637	***	0.122	10.79%
Cataracts	0.004		0.034	0.07%
Hip fracture or femoral	0.047		0.070	0.80%
Other conditions	0.338	***	0.028	5.74%
Depressed	0.336	***	0.043	5.69%
Poor Mobility	0.631	***	0.031	10.70%
Low Grip Strength	-0.008		0.026	-0.13%
No Grip Strength	0.282	***	0.045	4.78%
Low Walk. Speed	0.017		0.059	0.29%
Underweight	0.135	**	0.057	2.29%
Overweight	0.040	*	0.024	0.68%
Obese	0.098	***	0.033	1.65%
Current smoker	0.048	*	0.026	0.81%

Former smoker	0.066	**	0.032	1.13%
Alcohol	-0.025		0.031	-0.43%
Physical inactive	0.367	***	0.036	6.22%
ADL	0.316	***	0.039	5.36%
IADL	0.344	***	0.034	5.83%
Austria	0.259		0.281	4.39%
Germany	0.425		0.279	7.20%
Sweden	0.210		0.283	3.55%
Netherlands	0.016		0.287	0.26%
Spain	0.338		0.285	5.73%
Italy	0.352		0.281	5.96%
France	0.427		0.279	7.24%
Denmark	0.107		0.283	1.82%
Greece	0.135		0.286	2.29%
Low Educ	0.002		0.057	0.04%
High Educ	-0.041		0.078	-0.70%
Low Income ppp	0.079		0.054	1.34%
High Income ppp	0.048		0.059	0.82%
Low net-worth ppp	0.093	*	0.050	1.57%
High net-worth ppp	-0.016		0.058	0.26%

Threshold significance	**TH0-TH1**	**TH1-TH2**	**TH2-TH3**	**TH3-TH4**
Austria				
Germany				
Sweden	*			
Netherlands				
Spain				
Italy				
France				
Denmark		***	**	
Greece				
Poor_orienti	**			
Poor_numeracy		**		
Poor_memory_initial				
Poor_memory_final		**		

Poor_verbalfluencyscore	***	***	***
Poor_srwritingskills			**
Poor_srreadingskills			***
Pessimism	***	***	*
Depressed			**
Low Educ		**	*
High Educ	*		
Low Income ppp			
High Income ppp			
Low net-worth ppp			
High net-worth ppp			

Notes: *** significant to the 1% level; ** significant to the 5% level.; * significant to the 10% level.
Source: SHARE, wave 1

A detailed description of the variables used and their construction is given in Appendix A.

[a] Disability weights are equal to generalized or hierarchical ordered probit coefficients divided by the difference between the highest and the lowest predicted latent health level.

After estimating each of these individual endowment, access and choice contributions on health, we proceeded to compute a *continuous* health index measure for each individual according to his/her characteristics, subtracting each average disability weight from the 'perfect health' value of 1. Note that since these average disabilities have been computed for an average individual from this sample, controlling for the diversity in response, the health index will now come free of any socio-economic, cultural or psico-cognitive self –perception bias, and thus comparable across all individuals in our sample. Our continuous measure for health, varying in the 0-1 interval, will prove extremely useful in analyzing the impact on retired individuals' (in)activity.

In order to compare the aggregate distribution in each country (which results from a sum of every individual citizen's corrected health status) with the self-revealed one of the SHARE questionnaire (in Figure 3.1), a re-classification was done. We took the original aggregate health distribution of our entire sample (irrespective of country or socio-economic origin) as a reference. We found the value of the health index corresponding to the quantile level of each ordinal category, and thus established threshold levels as illustrated in Table 3.2 and Figure 3.2.

Table 3.2 Computing health index quantiles to establish threshold levels for SRH

Obs	SRH	Freq.	Cumulative Freq.	Centile
10, 191	1	6.87	6.87	0.563
	2	26.54	33.41	0.790
	3	41.79	75.2	0.935
	4	17.23	92.43	0.989
	5	7.57	100	1.000

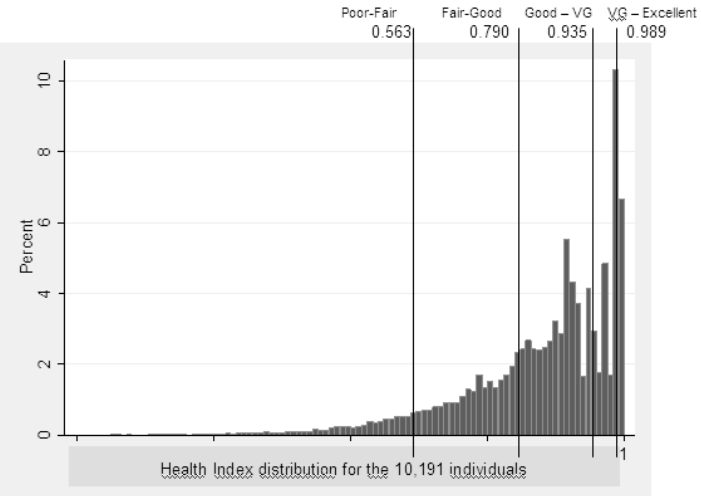

Figure 3.2 Health Index distribution, and SRH thresholds

The established threshold SRH response levels according to the aggregate distribution of SHARE respondents' health index were then used to re-classify individuals in ordinal categories, in order to maintain global European SRH frequencies (as in Table 3.2). We emphasize the fact that global response frequencies will be maintained, but because of psychological, socio-economic and response heterogeneity control, an individual which initially perceived herself as being in a poor state of health may very well end up classified as in a good state (after, for instance, her pessimism and educational level is controlled for). These values were then age-sex standardized (i.e., the weights of each self-response category in each country were recalculated as if all countries had the same age-sex distribution) and the results obtained by country were then ranked as presented in Figure 3.3.

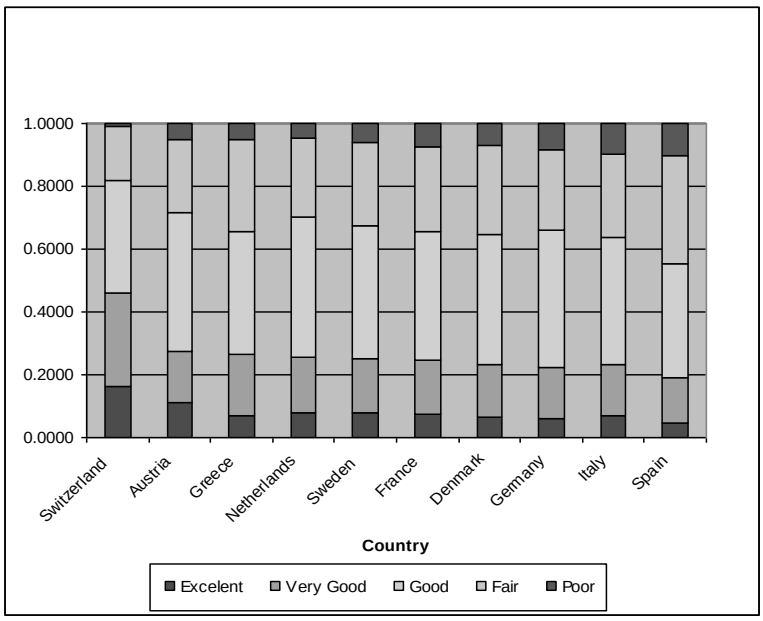

*Figure 3.3 Age-Sex Standardized **Adjusted** SRH by country, after heterogeneity control (using HOPIT), for the 10,191 individuals*

The 'true' ranking according to public health of *retired* citizens across Europe is revealed. The most obvious result is that Central European countries such as Switzerland and Austria move straight across the chart to occupy better positions, whereas our results reveal not so optimistic realities for Northern/Scandinavian countries such as Sweden and Denmark. Although Mediterranean countries maintain at the lower end, some rather drastic changes are observed, in cases such as Germany, or Greece which unveil a much better health status than the one initially revealed.

However the most interesting fact is the 'leveling' down of disparities. According to original self-rated health (as in Figure 3.1), there seemed to be a much wider gap in health distribution than we actually find.

3.6 Can older Europeans be active? Health implications on (in)activity and quality of life

3.6.1 Activity

After creating our 'true' health index, free from bias of any sort, we were finally able to proceed with the study of the precise impact health may have upon older Europeans' activity. To assess activity, we considered two dimensions from the SHARE survey. Retired individuals may have opted to continue work, after retirement, or/and may be involved in some kind of activity (see appendix B). If they do none of these, they were considered inactive.

Table 3.3 presents the results for probit regressions on the probability of total inactivity post-retirement, using both our health index (recalculated to the 0-100 interval for ease

Table 3.3 Marginal Effects on the P(Inactivity)

	Health index			SRH		
P(Non-Participation)	Mg Effects		Std Dev.	Mg Effects		Std Dev.
Austria	0.028		0.042	0.024		0.042
Germany	0.002		0.041	-0.015		0.042
Sweden	-0.129	***	0.039	-0.102	***	0.040
Netherlands	-0.089	**	0.041	-0.085	**	0.041
Spain	0.206	***	0.040	0.207	***	0.040
Italy	0.206	***	0.039	0.204	***	0.039
France	0.003		0.041	-0.002	***	0.041
Denmark	-0.136	***	0.041	-0.124	***	0.041
Greece	-0.143	***	0.040	-0.141	***	0.040
Ln(Net Worth ppp)	-0.016	***	0.003	-0.015	***	0.003
Ln(Income ppp)	-0.026	***	0.007	-0.025	***	0.007
Low Educ	0.041	***	0.013	0.032	***	0.014
High Educ	-0.095	***	0.017	-0.092	***	0.017
Gender	-0.032	***	0.011	-0.026	***	0.011
Age	0.009	***	0.001	0.009	***	0.001
Health Index (100)	-0.004	***	0.000			
Poor Health				0.294	***	0.024
Fair Health				0.166	***	0.022
Good Health				0.086	***	0.021
Very Good Health				0.070	***	0.023
Number Obs	9632			9632		
% Corr. Predicted	64.39			64.94		

Note: The basis country, for which each marginal effect is reported to, is Switzerland, as 'Excellent' is the reference for the discrete health dummies. *Source*: SHARE, wave 1

A detailed description of the variables used and their construction is given in Appendix A.

*** significant to the 1% level; ** significant to the 5% level.; * significant to the 10% level.

of interpretation) and the original self-rated health discrete measure, which is commonly used. The difference in results is extraordinary. The role of health is evidently significant, with a 0.4 percentage point decrease in probability of participating in the community for each percentage point deterioration in the health index. This represents an average differential in the probability of participating, for someone in the poor threshold, as opposed to someone in the excellent threshold, of almost 15%, for the average SHARE retired respondent[3]. However, this differential would be close to an overwhelmingly twofold 30% value had we used the original self-rated health indicators, without accounting for perception bias, as we did.

All other common independent variables have similar estimated impacts and expected signs. Men present lower participation probability rates, whilst age obviously assumes a significant role, with a decrease in participation probability of approximately 1% for each additional year of life. Countries also present significant differences in participation rates, with Mediterranean, Southern country citizens presenting higher probabilities of inactivity, whilst individuals from Northern and Scandinavian countries have a clearly higher propensity to engage in some kind of activity. Also significant, is the role of Socio-Economic stratifiers, in particular education, with a 13.6% average differential, between higher and lower educated citizens, in the probability of actively participating in any kind of activity.

We proceeded with estimating the impacts this set of covariates would have in each specific activity, and the results where those presented in table 3.4. The results for the positive impact of (each p.p. of) better health on the probability of engaging in a certain activity were particularly significant and very large for working after retirement (7.8%),

[3] The average differential in the health index, when comparing these two types of individual health, is around 37.5 p.p.

Table 3.4 Marginal Effects on the P(Participating in Activity j)

Activity j:	Work after Retirement		Voluntary or Charity		Cared Sick & Disabled		Family, Friends & Neighbours	
P(Participating in Activity j)	0.029		0.102		0.049		0.178	
	Mg Effects	Std Dev	Mg Effects	Std Dev	Mg Effects	Std Dev	Mg Effects	Std Dev
Austria	-0.026 ***	0.005	-0.024	0.022	-0.002	0.016	0.060	0.042
Germany	-0.013 *	0.008	0.010	0.027	-0.013	0.014	0.035	0.039
Sweden	0.005	0.012	0.118 ***	0.038	-0.004	0.016	0.248 ***	0.049
Netherlands	-0.018 ***	0.006	0.137 ***	0.041	0.002	0.017	0.162 ***	0.048
Spain	-0.021 ***	0.006	-0.067 ***	0.016	-0.023 *	0.012	-0.110 ***	0.025
Italy	-0.015 **	0.007	-0.005	0.025	-0.030 ***	0.011	-0.004	0.036
France	-0.034 ***	0.004	0.071 **	0.033	-0.006	0.015	0.163 ***	0.046
Denmark	-0.001	0.011	0.080 **	0.037	-0.026 **	0.011	0.162 ***	0.049
Greece	-0.013 *	0.008	-0.076 ***	0.015	-0.003	0.016	0.041	0.041
Ln(Net Worth ppp)	0.000	0.001	0.006 ***	0.002	0.000	0.001	0.005 *	0.003
Ln(Income ppp)	0.012 ***	0.002	0.004	0.004	0.007 ***	0.003	0.014 ***	0.005
Low Educ	0.000	0.004	-0.039 ***	0.008	-0.018 ***	0.006	-0.027 ***	0.010
High Educ	0.020 ***	0.006	0.055 ***	0.011	0.002	0.006	0.024 *	0.013
Gender	-0.015 ***	0.003	0.007	0.006	0.025 ***	0.004	0.013 *	0.008
Age	-0.002 ***	0.000	-0.003 ***	0.000	-0.002 ***	0.000	-0.009 ***	0.001
Health Index (100)	0.078 ***	0.016	0.159 ***	0.029	0.000	0.019	0.101 ***	0.036
Number Obs.	9619		9628		9628		9628	
% Corr. Predicted	95.55		87.35		94.55		79.62	

Activity j:	**Educ. &Training**		**Sports &Social**		**Religious**		**Political & Community**	
P(Participating in Activity j)	0.020		0.169		0.102		0.029	
	Mg Effects	Std Dev	Mg Effects	Std Dev	Mg Effects	Std Dev	Mg Effects	Std Dev
Austria	-0.019 ***	0.003	-0.107 ***	0.018	0.114 ***	0.037	0.022	0.021
Germany	-0.018 ***	0.004	-0.025	0.026	-0.002	0.024	0.002	0.015
Sweden	0.002	0.008	-0.034	0.025	-0.042 **	0.018	0.025	0.021
Netherlands	-0.013 ***	0.004	-0.025	0.026	0.007	0.025	0.000	0.014
Spain	-0.023 ***	0.002	-0.133	0.014	-0.008	0.024	-0.016	0.010
Italy	-0.025 ***	0.003	-0.162 ***	0.013	-0.067 ***	0.015	-0.001	0.014
France	-0.019 ***	0.004	-0.060 ***	0.023	-0.050 ***	0.018	-0.005	0.013
Denmark	-0.013 ***	0.004	0.048	0.033	-0.052 ***	0.017	0.005	0.016
Greece	-0.013 ***	0.005	-0.150 ***	0.013	0.304 ***	0.048	0.033	0.024
ln(Net Worth ppp)	0.002 **	0.001	0.014 ***	0.003	0.003	0.002	0.001	0.001
ln(Income ppp)	0.004 **	0.002	0.008	0.005	-0.005	0.004	0.003	0.002
Low Educ	-0.007 **	0.003	-0.043 ***	0.010	0.010	0.008	-0.009 *	0.004
High Educ	0.029 ***	0.006	0.013	0.012	0.060 ***	0.012	0.033 ***	0.007
Gender	0.007 ***	0.003	-0.045 ***	0.008	0.056 ***	0.006	-0.019 ***	0.003
Age	-0.001 ***	0.000	-0.003 ***	0.001	0.002 ***	0.000	0.000	0.000
Health Index (100)	0.027 **	0.012	0.201 ***	0.035	0.067 **	0.028	0.004	0.015
Number Obs.	9628		9628		9628		9628	
% Corr. Predicted	96.74		80.89		87.43		96.4	

Note: The basis country, for which each marginal effect is reported to, is Switzerland. *Source*: SHARE, wave 1. A detailed description of the variables used and their construction is given in Appendix A. *** significant to the 1% level; ** significant to the 5% level.; * significant to the 10% level.

voluntary or charity work (15.9%), contributing within personal network of family, friends and neighbors (10.1%), and sports and social activities (20.1%), which is particularly understandable. However, they were fairy insignificant in the case of educational, religious, political and community activities, which seems reasonable, as they involve motivations of a different sort, concerning personal achievements, beliefs and convictions, which are not as sensitive to health disabilities. Curiously, health seems to matter very little for the caring of the sick and disabled, which may be explained by the fact that most regressors are insignificant in this case, hinting for omitted underlying variables which, once again, could specifically explain this type of choices.

It is also noticeable the fact that individuals from higher socio-economic backgrounds (either given by Income or Education), present higher probabilities of enrolling in activities post-retirement. This propensity to activity, is consistent with current literature's findings that higher education, for instance, in later stages in life, increases the likelihood of participating in the labour force (Hirao, 2001).

3.6.2 Quality of Life

As to quality of life, we distinguished it from standard of living, and thus rather than addressing it through the mere measurement of socio-economic indicators, life-styles or any material dimension of it, it was evaluated through a socio-psychological approach, and then we analyzed how this individual state-of-mind or well-being could be affected by socio-economic, health and other individual characteristics. Quality of life in older age is thus regarded here as the degree to which human needs are satisfied, which in this stage of the life course translates itself into four domains of need which seem to be particularly relevant: control, autonomy, self-realization, and pleasure (following Knesbeck et al., 2005; Patrick et al., 1993; Turner, 1995; Doyal and Gough, 1991).

Control is interpreted as the ability to actively intervene in one's environment (Patrick et al., 1993). Autonomy is defined as the right of an individual to be free from the unwelcome interference of others (Patrick et al., 1993). Self-realization and pleasure mean to capture the active and reflexive processes of being human (Turner, 1995). Following Doyal and Gough (1991) and Knesbeck et al. (2005), the CASP-12 was used, treating these four domains as equal rather than hierarchically organized.

Table 3.5 presents the results obtained for the influences of that set of regressors on the probability of an individual self-positioning herself as having a poor quality of life, again considering the traditional SRH measure and our indicator. The dummy 'poor quality of life' was created considering individuals below the 30th percentile of the CASP-12 indicator's distribution. Because the CASP-12 is based on the SHARE drop-off questionnaire, our sample size decreased to 6463 individuals, which we still believe to be fairly significant for a study of such a matter. The results were that a variation of the average differential of 37.5 percentage points in our health indicator (between the average poor and excellent health SHARE retired respondent) would represent a 11.25% differential in probability of having a poor quality of life[4] However, what seems of particular interest is the significant role health does play in explaining self-reported quality of life in older age European individuals, assessed throughout the already described 4 dimensions. When compared to socio-economic dimensions, such as income, wealth and even, to some extent, education, which were found to be insignificant, health does seem to play a crucial role. Of these factors, only high education did seem to have a significant effect, which is comprehensible in the light of the self-realization dimension of CASP-12. Again, the results for the effect of health are milder than those we'd obtain, had we used SRH (18.2% probability differential), without accounting for reporting heterogeneity bias.

[4] If the marginal effect were to maintain across all the domain of the variables.

Table 3.5 Marginal Effects on the P(Poor Quality of Life)

	Health index			SRH		
P(Poor Qlty Life)	Mg Effects		Std Dev	Mg Effects		Std Dev
Austria	-0.099	***	0.036	-0.096	***	0.036
Germany	-0.116	***	0.035	-0.106	***	0.035
Sweden	0.036		0.042	0.017		0.041
Netherlands	-0.119	***	0.035	-0.120	***	0.034
Spain	-0.076	*	0.039	-0.075	*	0.039
Italy	-0.179	***	0.030	-0.175	***	0.030
France	-0.161	***	0.031	-0.157	***	0.031
Denmark	0.011		0.043	0.002		0.042
Greece	-0.117	***	0.035	-0.118	***	0.034
ln(Net Worth ppp)	0.004		0.004	0.003		0.003
ln(Income ppp)	-0.010		0.008	-0.011		0.007
Low Educ	-0.009		0.015	-0.004		0.014
High Educ	0.048	***	0.018	0.045	***	0.018
Gender	-0.006		0.012	-0.010		0.011
Age	-0.007	***	0.001	-0.007	***	0.001
Health Index (100)	0.003	***	0.001			
Poor Health				-0.182	***	0.021
Fair Health				-0.106	***	0.021
Good Health				-0.056	***	0.021
Very Good Health				-0.034		0.022
Number Obs	6463			6463		
% Corr. Predicted	69.80			69.57		

Note: The basis country, for which each marginal effect is reported to, is Switzerland, as 'Excellent' is the reference for the discrete health dummies. *Source*: SHARE, wave 1

A detailed description of the variables used and their construction is given in Appendix A.

*** significant to the 1% level; ** significant to the 5% level.; * significant to the 10% level.

3.7 Conclusions

We present an empirical strategy and conceptual framework which allows us to truly assess individual state of health of retirees across a diversity of socio-economic backgrounds, psycho-cognitive behavior, and multi-cultural perspectives, by controlling for individual heterogeneity in self-rated health responses. This allowed us not only to characterize *retired* citizens' health across ten different European countries, but also to estimate a weight (or disabilities) associated to each type of health determinants, whether derived from endowment, access or individual choices. We find somewhat different results from those initially revealed by SHARE respondents, not only in terms of different individual health status' (from those reported), but also to the aggregate country level, with an apparent leveling down of European disparities, and a new 'ranking' emerging, quite different from the one reported. Interestingly, and contrary to what could have been previously hypothesized, we find evidence that *access*, or socio-economic determinants are not very significant in explaining individual health, but act rather at the *perceptive* level biasing self-reports of health, together with other psycho-cognitive dimensions. Dimensions which must, crucially, be taken into account when the measure for health is based on a self-report of an elderly retired population. The finding that socio-economic determinants are not found to be influential enforces the idea that health provision systems for the elderly in Europe are fairly general, and equalitarian, even across countries.

As to influences on (in)activity and quality of life of retired Europeans, there is no doubt health plays a predominant role. We do find, however, how crucial a good measure of health is, since these influences would have been largely over-estimated, had we based ourselves in the common SRH measure. Furthermore, our health indicator allows for the assessment of the role of each of health determinants in influencing both

participation and quality of life probabilities. This may easily be done by multiplying each of the disability weights presented (in p.p.) by the estimated impact of each p.p. of extra (or lower) health over the referred probabilities, which may give inestimable information to policymakers in establishing priorities to tackle.

Clear evidence is found on the effective role health policies might play on retired citizens' participation in economy and society, well-being and happiness, a role which may at times surpass traditional socio-economic determinants as education, and no doubt income and wealth in a European context of economic development and shrinking disparities. This paper thus hints a route for policy makers to take, in contouring an aging and unproductive European population, transforming what could be a "social burden" into an asset.

Appendix A – Definition of variables

Ph - Physical Health; chronic disabilities and functioning limitations

Disability	Description
Heart attack or other heart problems	Circulatory
High blood pressure	Circulatory
High blood cholesterol	Circulatory
Stroke or cerebral vascular disease	Digestive/ulcers; Genitourinary
Diabetes	Endocrine
Chronic lung disease	Musculoskeletal
Asthma	Musculoskeletal
Arthritis	Musculoskeletal
Osteoporosis	Neoplasms
Cancer or Malignant Tumor	Nervous System
Stomach, duodenal or peptic ulcer	Nervous system
Parkinson disease	Poor Vision
Cataracts	Respiratory
Hip fracture or femoral	Respiratory
Other conditions	Other chr. Cond.
Low Grip Strength[(a)]	< bottom tertile
No Grip Strength[(a)]	Test not completed
Low Walk. Speed [(b)]	< 0.4 m/s
Poor Mobility [(c)]	more than 2
ADL [(d)]	1 or more
IADL [(e)]	1 or more

[(a)] binary variable indicating that from 4 measurements (2 in each hand) with a dynamometer, the largest is below the bottom tertile, in the case of "low grip strength" or the individual wasn't able to complete the test ("no grip strength"). Hand grip strength in middle age has been shown to be predictive of the incidence of functional limitations, disability and even mortality in old age (Frederiksen et al., 2002; Rantanen et al., 1998).

[(b)] it is measured by a timed walk over a short distance (2.5 m). Two measurements were made, of which we take the fastest. A walking speed of 0.4 m/s or slower is used as the cut-off point for 'low walking-speed' (Steele et al., 2003). Unsuccessful attempts – independent of the reason – are also coded as having low walking speed. Respondents younger than 75 who were not eligible for the test are coded as having a normal walking speed.

[(c)] this variable re-categorizes the categorical variable 'mobility' into the following values: (0) Less than three limitations & (1) three or more limitations with mobility, arm function & fine motor function

[(d) , (e)] ADL (activities of daily living) comprises information on limitations individuals have with daily activities, i.e., dressing, getting in/out of bed, bathing/showering, using the toilet and eating. IADL (Instrumental activities of daily living) comprises data on limitations with activities such as preparing a meal, shopping, taking medication, making telephone calls, doing housework, or managing money; the binary variables created and used reclassify the variable 'ADL' (or 'IADL') into two categories: (0) no ADL/IADL limitations and (1) one or more limitations with ADL/IADL.

MhSP - Mental health and Self-Perception; depression, personality traits, cognitive functioning.

All of the following where included in vector Z, of regressors over the thresholds:

"Disability"
Mh - Depressed [(e)]
SP- Pessimism[(f)]
Poor_orienti [(g)]
Poor_numeracy [(h)]
Poor_memory_initial [(i)]
Poor_memory_final [(j)]
Poor_verbalfluencyscore [(k)]
Poor_srwritingskills [(l)]
Poor_srreadingskills [(m)]

[(e)] Depression was measured using the Euro-D scale, which has been validated in an earlier cross-European study of depression prevalence, EURODEP (Prince et al. 1999a, Prince et al. 1999b). For the purposes of this contribution we defined a binary variable indicating clinically significant depression as a EURO-D score greater than 3. This cut-point had been validated in the EURODEP study, across the continent, against a variety of clinically relevant indicators. Those scoring above this level would be likely to be diagnosed as suffering from a depressive disorder, for which therapeutic intervention would be indicated.

Major depression is forecast by 2020 to have risen from the fourth to the second most burdensome health condition world-wide, taking into account both associated disability and premature mortality (Murray and Lopez 1997). Late-life depression, when defined according to the broad criterion of clinical significance, is a common disorder affecting 10 to 15 percent of the over 65 year old population (Beekman et al. 1999).

(f) Dummy indicating weather an individual is a pessimist. Based on Micheal Dewey and Martin J. Prince's (2005) works on SHARE module from the main questionnaire (CAPI). A high level of optimism is typically an indicator of well-being, e.g., psychological functioning, effective coping with stress, psychological well-being and physical health. Pessimism, on the other hand, has been found to be linked to learned helplessness, apathy and depressions (Ek et al. 2004).

(g)- (m) **Cognitive functioning:**

Cognition can be divided into different domains of ability, which can be tested separately; the most important of these are orientation, memory, executive function (planning, sequencing) and language. In SHARE, cognitive ability has been measured using simple tests of orientation, memory (registration and recall of a list of ten words), verbal fluency (a test of executive function) and numeracy (arithmetical calculations). Respondents were also asked to rate subjectively their reading and writing skills.

Cognitive test scores (based on Micheal Dewey and Martin J. Prince (2005)) used**:**

(g) based on orientation to time (to date, month, year and day of week) score, ranging from 0(bad)-4(good). Dummy representing poor orientation if one or more errors where made (orientation score<=3)

(h) based on numeracy score from 1-5. Dummy representing poor numeracy if score is less than 4.

(i) based on *Cerad* memory recall test, a word list memory test from the Consortium to establish a registry for Alzheimer's disease (CERAD) neuropsychological battery (Morris et al 1989). Score ranges from 0-10. This dummy represents poor memory recall if score is less or equal to 4.

[j] similar to [j], only taken at the end of the interview.

[k] based on the number of animals listed per minute. Considered poor if less or equal to 18.

[l] rated on a scale from 1(poor)-5(excellent). Dummy indicating poor writing skills if rated as poor (1)

[m] rated on a scale from 1(poor)-5(excellent). Dummy indicating poor reading skills if rated as poor (1)

Bh – Behavioral risks/lifestyle choices

Disability	Description
Underweight	BMI<20
Overweight	25<BMI<30
Obese	BMI>30
Current smoker	
Former smoker	
Alcohol	more 2 glasses/day or 5/6 days/week
Physical inactive	neither moderate nor vigorous activity

BMI (*Body Mass Index*= weight in kg/squared height in meters) was created and coded in four categories: <20 (underweight), 20–25 (normal weight), 25–30 (overweight), and more than 30 (obese).

Se – Socio-economic characteristics

Low Income ppp	below 1st quartile
High Income ppp	above 3rd quartile
Low net-worth ppp	below 1st quartile
High net-worth ppp	above 3rd quartile
Low Educ	ISCED-97 classif
High Educ	ISCED-97 classif

Income and Net Worth were calculated per capita, according to household information, and using the *OECD-modified equivalence scale,* which assigns a value of 1 to the household head, of 0.5 to each additional adult member and of 0.3 to each child. Furthermore, these variables include some imputed values, where imputations were performed by the SHARE panel of researchers. All values were converted to Euros and purchasing parity adjusted.

Education embodies human capital, which is an important determinant of health care utilization, besides acting as a good proxy for knowledge of means to deal (and prevent) health problems.

The educational level was based on self-reported highest level of education, and reclassified using the UNESCO International classification of education (ISCED-97) (Organization for Economic Cooperation and Development, 1999). The ISCED-97 classification scheme has 7 different levels (0 to 6), ranging from pre-primary level of education (e.g. kindergarten) to the second stage of tertiary education (Ph.D.). The original ISCED were recoded into three broader education levels: "low" (pre-primary to lower secondary education; ISCED 0 to 2), "medium" (upper secondary and post-secondary, non-tertiary education; ISCED 3 and 4), and "high" (first and second stage of tertiary education; ISCED 5 and 6).

C – country dummies

Appendix B – Possible activity enrollment

1. Done voluntary or charity work
2. Cared for a sick or disabled adult
3. Provided help to family, friends or neighbors
4. Attended an educational or training course
5. Gone to a sport, social or other kind of club
6. Taken part in a religious organisation (church, synagogue, mosque etc.)
7. Taken part in a political or community-related organisation
8. None

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Database

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