This is a pre print version of the following article:

The Influence of Health on Gross Domestic Product and National Income / Mattioli, A.v., Ballerini Puviani, M.. - In: TRANSYLVANIAN REVIEW. - ISSN 1221-1249. - XXV:23(2017), pp. 1-4.

Terms of use:

The terms and conditions for the reuse of this version of the manuscript are specified in the publishing policy. For all terms of use and more information see the publisher's website.

26/11/2026 10:51

(Article begins on next page)

The Influence of Health on Gross Domestic Product and National Income

[a]; Matteo Ballerini Puviani [b] Anna Vittoria Mattioli MD PhD
[a] Istituto Nazionale per le Ricerche Cardiovascolari, U.O. University of Modena and Reggio Emilia, Modena, (Italy)
[b] Department of Surgical, Medical and Dental Department of Morphological Sciences related to Transplant, Oncology and Regenerative Medicine, University of Modena and Reggio Emilia, Modena, (Italy)I

Total word count: 3,440

No conflict of interest

Address for correspondence:
Anna Vittoria Mattioli, MD
Department of Surgical, Medical and Dental Department of Morphological Sciences related to Transplant, Oncology and Regenerative Medicine University of Modena and R.E.
Via del pozzo, 71
41100 Modena (Italy)
Phone: 0039/59/4224043 Fax: 0039/59/4224323 E-mail: annavittoria.mattioli@unimore.it

Structured Abstract

Background and aim. It is beyond question how the Gross Domestic Product and the other National Income and Product Accounts (NIPA) have been groundbreaking in the economic studies, nevertheless they are often targets of criticism as a result of their failure in including non-market activities in their estimates.
Since the beginning of the last century the technophysio evolution has enabled a fivefold increase of the average retirement period, an increase of seven times of individuals who lives to retire and a fourfold increase of the leisure time of those who are still in the labor force.
Methods. The present paper compare the works of two researcher, Fogel RW and Nordhaus WD who believed that health improvements have influenced economic growth in the past and it will affect our lives in the future..
Results. First, we explained the "technophisyo" evolution from the nineteenth century until now using the concepts researched by R.W. Fogel and other scholars. Then, we reported the estimates of health income. We also evaluated the economic impact of Mediterranean Diet .
Conclusions. The correct approach would be to reconsider the role of health care. If it is true that social productivity has been influenced by health income as much as by other types of income then the idea of an inefficient health care system would become at least unwise. Moreover, health is not only hospitals and physicians, it goes from pollution abatement to antismoking campaign, from safer highways to drugs eradication and again from dietary education to physical activities.

Key words: health cost, gross domestic product, national income

Background.

It is beyond question how the Gross Domestic Product (GDP) and the other National Income and Product Accounts (NIPA) have been groundbreaking in the economic studies of the last century, nevertheless they are often targets of criticism as a result of their failure in including non-market activities in their estimates. Countless activities are indeed excluded from these accounts, ranging from volunteering work and inequalities of income to even whether certain economic indicators are positive or negative. Similarly national resources, leisure time, health improvements and the environment are left out (Fogel 2004, Mattioli et al 2017, Kawai 2017, Ding 2017). During the last decades many efforts have been made to improve the way these indexes are created to better evaluate such non-market sectors. However almost no attempt has been made to include in these accounts the major improvements human health is experiencing (Nordhaus 2002). In 1890 getting through the pension was really rare, almost every worker at that time was somehow still part of the labor force in the event of his death. Nowadays half of those people in the labor force is able to retire before the age of fifty relying on adequate sources of income. Since the beginning of the last century the technophysio evolution has enabled a five-fold increase of the average retirement period, an increase of seven times of the portion of individuals who lives to retire and a four-fold increase of the leisure time of those who are still in the labor force (Fogel 2011).

Aim.

Methods

We analyzed the extension of life expectancy and the we calculated the average daily workload in terms of hours with respect of discretionary hours, which are the hours of the day remained after excluding the ones devoted to sleep and physiological needs. Discretionary hours were divided in "earnwork hours" dedicated to primary paid work and "volwork hours" including activities done voluntarily even if occasionally paid.

Then we analyzed the Nordhaus' analysis that focuses on estimating the real value of health status improvements weighted by appropriate prices.

The production-based model of income quantification proposed by J. R. Hicks defined income as "the maximum amount which can be spent during a period if there is to be an expectation of maintaining intact the capital value of prospective returns[...]; it equals Consumption plus Capital accumulation." [Nordhaus 2002] The Hicksian model is adopted as a standard in national income accounts worldwide, where consumption and investment are bound to the market. These measures neglect whether the health of the population is good and it is almost impossible to extract any welfare implication from them.

The utility-based model, created by Irving Fisher, defines income as the level of consumption that would give the equivalent level of utility in dissimilar situations. [Nordhaus 2002] When life duration is not changing income becomes the equivalent consumption of current assets and current and future technologies.

Results

According to Fogel studies (Fogel 2004, Fogel 2002) we, first, analyzed the extension of life expectancy in different Countries. As shown in Table 1 the increase of life expectancy is strongly related to industrialization. In Italy the life expectancy increased from 69.12 year in the 1960 to 83.49 years in 2015 according to data from the "Osservatorio della Salute" an Italian registry on health and disease [http://www.osservatoriosullasalute.it/osservasalute/rapporto-osservasalute-2016]

Table 1

The extension of life expectancy in different Countries [modified from Fogel, 2004.The Escape from Hunger and Premature Death, 1700-2100: Europe, America, and the Third [1])

Years	1725	1750	1800	1900	1950	1990	2050?	2100?
UK	32	37	36	48	69	76		
France		26	33	46	67	77		
U.S.A.	50	51	56	48	68	76	(87)	(98)
Egypt					42	60		
India				27	39	59		
Japan					61	79		

Table 2 shows how the average daily workload in terms of hours has diminished for males in the US during the last hundred years by illustrating the increase of discretionary hours.

Years	1880	1995	2030
Lifetime discretionary hours	225,900	298,000	319,900
Lifetime earnwork hours	182,100	122,400	74,900

Table 2 legend
Distribution of Lifetime discretionary hours
(modified from Robert William Fogel, 2002. *The Fourth Great Awakening and the Future of Egalitarianism*. Edition. University Of Chicago Press)

Table 3 show the future division of the average day, indicating that by 2040 more than half of our discretionary time will be devoted to leisure activities.

AVG. hours per day	1880	1995	2040
Sleep	8	8	8
Meals and essential hygiene	2	2	2
Chores	2	2	2
Travel to and from work	1	1	0.5
Work	8.5	4.7	3.8
Illness	0.7	0.5	0.5
Residual for leisure activities	1.8	5.8	7.2

Table 3 legend.
Distribution of activity time (modified from Robert William Fogel, 2002. *The Fourth Great Awakening and the Future of Egalitarianism*. Edition. University Of Chicago Press)

Then we evaluated the Model proposed by Nordhaus. In his research Nordhaus settles $3.0 million per fatality prevented, a value that he derives from the vast scientific literature about the topic. [Norhaus 2002]

Then calculated the increment to sustainable consumption of an additional life-year, (LY). Calculating e $3.0 million to the value of a life-year ranging from $1,828 per LY at a discount rate equals to zero to $6,757 per LY at a 3% discount rate. These estimates concern labor market decisions of working men at age 40. The present value consequently yields a value that ranges among $75,000 and $162,000 at zero discount rate and three percent discount rate respectively.
To sum up established national income report are determined by consumptions of goods and services but they do not care about the quality or the length of life of the population. Nordhaus proposes an alternative view where income is corrected by mortality and morbidity and wondering how much consumption a person would trade for better health conditions.

Discussion

By looking at data from table 2 and table 3 a question certainly arises: why is this so that many people are willing to give up on work which would allow them to buy more goods? The answer lies partly on the remarkable technological advancement that had occurred during the past century. We are in fact able to work less than our ancestors did to afford the basic necessities we need in our daily life, such as shelter, food and clothing and we are so wealthy that we can buy goods that were once considered luxurious goods. We are reaching the saturation of consumption of needs and commodities. A survey held in 1995 further confirm this hypothesis as 48% of American male "earnworkers" had either cut back on working hours, turned down a promotion, diminished their commitment to the job, lessened basic expectations, or moved to a more pacific neighborhood during the preceding 5 years. [Marks 1995]
Up to thirty years ago companies were skeptical about nontraditional work contracts. Today they see them with more indulgence as they understand that allowing more freedom and spare time to employee benefit both the workers as well as the company which enjoys less space expenditures, lower absenteeism and more labor turnover. This is ideal to improve productivity and employees morale. (Kawai 2017)
Moreover a greater attention is given to health and the relationship between Health and food. The impact of geography and climate on macroeconomics has been described (Xi 2011, Arrow 2013 Nordhaus 2006) however little information are available on the impact of local diet (i.e. Mediterranean diet) on macroeconomics. It is well demonstrated that Mediterranean diet is associated with reduced mortality for cardiovascular disease and cancer (Mattioli 2017, Farinetti 2017), A recent paper evaluated the impact of Mediterranean Diet on environment and sustainability. The MedD resulted to produce a lower environmental impact than the current food consumption of the Italian population. They concluded that the monthly expenditure of the MD was slightly higher in the overall budget compared to the current expenditure allocated to food by the Italian population. Moreover, Germani and coworker found that there was a substantial difference in the distribution of budget according to the different food groups.(Germani 2014, Mattioli 2013)

Another relevant observation involves the nine-fold increase of health care spending. Notwithstanding historical trends the most relevant column to study to better foresee our future is the last one where long-term income elasticities are listed for each category. While the elasticities of basic necessities are low, the elasticity of leisure, education and health care are greater than 1, confirming the tendency of the new growing sectors of the market. According to these numbers it is very likely that consumption of health care will be of about 21% in 2040. This is not necessarily a bad news and this trend should not be contrasted. The ease at which we are able to provide for our basic necessities will release the resources needed to supply proper health services.

Including health status into economic accounts may be perceived as an unconventional way to embody noneconomic and sociological measures that might alter the statistics. Nothing could be

further from the truth since health care expenditures are already counted in national income indexes and they account for a large part of the US GDP. The real challenge consists in calculating the value of the output of the health care sector and implementing it correctly to these economic measures. At present the accounts just include the number of physician visits, the total hospital days and so rather than the delivery of service or the improving of health status. Needless to say, actual innovations in products, new drugs, vaccinations, microsurgery, exercise and anti-smoking campaign are entirely omitted in the count. The likelihood that these economic accounts are underestimating the contribution provided by health improvements is very high, for this reason William D. Nordhaus has undertaken the effort to amend to this mismeasurement. [Xi 2011, Nordhaus 2002]

Nordhaus' model aims at measuring the gains derived from improved life expectancy in a simple life-cycle model in which he assumes that an individual will evaluate whether to prefer "health or wealth" basing his decision on a utility function that evaluate consumption and the probability of survival. This decision will account for "a change in welfare equal to the number of years of life times the goods value of life for a uniform change in mortality rates at every age. The major obstacle for him was to determine the correct health "prices". At last Nordhaus chose the most common approach in valuing risk of the "willingness to pay" based on labor market studies which examine the risk-wage tradeoff. Nordhaus highlights the fact that the tradeoff examined is a *"current risk-current income"* choice between current occupational hazards and current wages. From these tradeoffs (which involve comparing income per year against mortality risk per year) we derive an implicit dollar cost per unit mortality risk."

The next and final question Nordhaus tries to answer is how expenses on health improvements relate to actual increase in health income. First he noticed that during the 1980-1990 period increase in non-health consumption and health income has gone hand in hand. Supposing that half of the per capita of increased expenditures, or $600, was life-extending this would be a good investment for the increase in health income of between $2,300 and $3,100 per capita over the 1980-90 period." (Nordhaus 2002)

At a first glance the value of an improved life-expectancy almost matches the value of growth in health unrelated consumption. In fact health income probably had a major impact at the beginning of the last century and increasingly less after 1950. Keeping in mind that innovations in health related sectors include new drugs, polio vaccine, new interventions, better sanitation, driving safety and others, which contributed to an increase in life-expectancy of 8 years (from 68 to 76 y.o.), while non-health technological progress means air travel, television, internet access, et cetera, what would a reasonable individual choose if obliged. "To live under 1948 health conditions and 1998 non-health living standards or 1998 health conditions and 1948 non-health living standards?".

Certainly many issues are still at stake and it will be hard to resolve them, for example it is not feasible yet to attribute growth in health income to specific investments, or understanding if health income increases come from advancement in knowledge and scientific research like antibiotics, DNA discovery or investment in resources and infrastructures. What these new ideas about health income should provide for is a modern way of administering health policy without being caught in the general concept that health care system is wasteful and a threat to national competitiveness. As the CPI for medical goods has grown of about 60% in the last decades the wrong solutions, as controlling spending and reducing services, were implemented to face this increasing demand.

Conclusions

Nothing has been more remarkable than the extension of life expectancy, which has increased by about 30 years since 1900 in England, France, and the US. This increase has been alike in such countries as India, China, and Japan. Among the nations of the Third World, this rate has increased nearly twice as fast as among the nations in the Organization for Economic Cooperation and Development (OECD).

The correct approach would be to reconsider the role of health care. If it is true that social productivity has been influenced by health income as much as by other types of income then the

idea of an inefficient health care system would become at least unwise. Moreover, health is not only hospitals and physicians, it goes from pollution abatement to antismoking campaign, from safer highways to drugs eradication and again from dietary education to physical activities. Even when resources are misallocated, wasted or lost in bureaucracy loopholes it is undeniable how health improvements in the U.S. have brought "prodigious increases in economic welfare" and will continue to do that as long as we will keep on working for this end.

REFERENCES

Arrow K, Cropper M, Gollier C, Groom B, Heal G, Newell R, Nordhaus W, Pindyck R, Pizer W, Portney P, Sterner T, Tol RS, Weitzman M. 2013 Environmental economics. Determining benefits and costs for future generations. Science. Jul 26;341(6144):349-50. doi: 10.1126/science.1235665

Ding B, Small M, Bergström G, Holmgren U. 2017. COPD symptom burden: impact on health care resource utilization, and work and activity impairment. Int J Chron Obstruct Pulmon Dis. Feb 21;12:677-689. doi: 10.2147/COPD.S123896. eCollection 2017.

Fogel RW, 2002. *The Fourth Great Awakening and the Future of Egalitarianism*. Edition. University Of Chicago Press

Fogel RV. 2004 from "The Escape from Hunger and Premature Death, 1700-2100: Europe, America, and the Third World (Cambridge Studies in Population, Economy and Society in Past Time)". Cambridge University Press.

Fogel RW, Grotte N. 2011. Major Findings from The Changing Body: Health, Nutrition, and Human Development in the Western World since 1700. J Econ Asymmetries. 8(2):1-9.

Farinetti A, Zurlo V, Manenti A, Coppi F, Mattioli AV. 2017 Mediterranean diet and colorectal cancer: A systematic review. Nutrition. 2017 Nov - Dec;43-44:83-88. doi: 10.1016/j.nut.2017.06.008. Epub 2017 Jul 8.

Germani A, Vitiello V, Giusti AM, Pinto A, Donini LM, del Balzo V 2014. Environmental and economic sustainability of the Mediterranean Diet. Int J Food Sci Nutr. Dec;65(8):1008-12. doi: 10.3109/09637486.2014.945152. Epub 2014 Aug 4.

Kawai K, Kawai AT, Wollan P, Yawn BP. 2017 Adverse impacts of chronic pain on health-related quality of life, work productivity, depression and anxiety in a community-based study.
Fam Pract. Apr 22. doi: 10.1093/fampra/cmx034

Marks J, 1995 *Time out, U.S. News and World Report,* pp. 85-96

Mattioli AV, Miloro C, Pennella S, Pedrazzi P, Farinetti A. Adherence to Mediterranean diet and intake of antioxidants influence spontaneous conversion of atrial fibrillation. Nutr Metab Cardiovasc Dis. 2013 Feb;23(2):115-21. doi: 10.1016/j.numecd.2011.03.005. Epub 2011 Jul 27

Mattioli AV, Palmiero P, Manfrini O, Puddu PE, Nodari S, Dei Cas A, Mercuro G, Scrutinio D, Palermo P, Sciomer S, Di Francesco S, Novo G, Novo S, Pedretti RFE, Zito A, Parati G, Pedrinelli R, Farinetti A, Maiello M, Moscucci F, Tenaglia RL, Sucato V, Triggiani M, Cugusi L, Scicchitano P, Saba PS, Ciccone M., 2017. Mediterranean diet impact on cardiovascular diseases: a narrative review. J Cardiovasc Med. Sep 12. doi: 10.2459/JCM.0000000000000573

Nevin S. Scrimshaw, 1968. from "Malnutrition, Learning, and Behavior". The MIT Press;

Nordhaus WD 2002, *The Health of Nations: The Contribution of Improved Health to Living Standards,* NBER Working Paper No. 8818

Nordhaus WD. 2006. Geography and macroeconomics: new data and new findings. Proc Natl Acad Sci U S A. Mar 7;103(10):3510-7. Epub 2006 Feb 10.

Xi C, Nordhaus WD 2011.
Using luminosity data as a proxy for economic statistics PNAS 108; 8589–8594