

A Life Cycle Approach to the Mechanism Connecting Health Inequality and Earnings Inequality

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[WARNING: THIS IS WORK IN PROGRESS, NOT A COMPLETE DRAFT.]

1 Introduction

Understanding the sources of earnings inequality and the consequences of earnings risk is important for policy. This paper incorporates the health aspect to this problem and studies its implications, which has not so far been done in the strand of the macroeconomics literature that studies and measures sources of inequality and earnings risk.

The premise of this paper is that earnings and health are closely intertwined for any individual through an economic mechanism. On the one hand, health care is important

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from the worker's perspective not only because of the value he assigns to his own health and longevity, but also because of the direct effects that health has over the potential productivity of each individual: sickness takes a toll on physical energy, so unhealthy times decrease productive time for a worker. On the other hand, health care is a private good, so those with higher earnings can afford more health care if desired, than those with lower earnings¹. Access to health care comprises having a regular doctor or clinic where the individual can regularly go to take care of his health, and also the possibility to receive treatment for a given condition (transitory, acute or chronic). In the U.S. the quality and cost of access to health care is strongly conditioned by the worker's insurance coverage. In turn, there is unequal access to health insurance amongst the population, since it depends on whether or not the individual is employed and, if employed, on whether or not he is offered employer-sponsored health insurance and the quality of the plan he has access to². Having a more expensive access to medical care causes less investment on preventive medicine by those uninsured and with little coverage, and this may influence their likelihood of getting health shocks, and their future productivity. The main result of taking into account the health dimension is that income disparities give rise to health disparities, and at the same time, health outcomes shape potential

¹An interesting fact that comes from the data analysis I will discuss below, and that highlights the inequality in access amongst workers, is that only about 20% of workers in the bottom decile of the earnings distribution enjoy paid sick leave or paid leave to visit a doctor, whereas around 85% in the top decile of the distribution do.

²In the U.S., most access to health insurance is done through the employer because it is more convenient for the worker and the insurer than the individual market. On the one hand, when offered group health insurance, the worker is not subject to health screening and the premium does not depend on age. Medical underwriting is not permitted by large firms, so their premiums are generally based in community rating. Also, if a worker takes group health insurance, the premium is tax deductible. The individual market for private health insurance is problematic due to asymmetric information; hence, medical underwriting is allowed in this market and many individuals are denied coverage. In the sample of full time, full year workers from the MEPS (to be described below) who are insured in the individual market are 3% in the top decile of the earnings distribution, and 9% in the bottom decile of the earnings distribution, so this market is sufficiently small for the purpose of this analysis.

earnings.

I build a macroeconomic framework that incorporates these characteristics of health care into a model where workers face risky labor earnings as well as shocks to health. These shocks to health can be better interpreted as chronic medical conditions. The characteristics of these conditions is that lack of prevention is an important determinant of their occurrence, and early detection significantly improves the prognosis, as well as timely treatment does. It is relevant that there is a voluntary component to all these aspects in this case, so they will be included in the model. I will use this model to match cross-sectional moments in the data, and study the following questions:

1. How does the unequal access to health care affect the distribution of earnings?
Does it have amplifying effects on inequality?
2. How much risk does this imply for the workers as they enter their productive lives?
3. What are the welfare effects of making health care more accessible to all workers?

Angus Deaton started a literature that studies the connections between health inequality and earnings inequality, but although there is some empirical evidence (cross-country) that finds that health inequality and earnings inequality are correlated, there is no theoretical micro-founded model that generates this correlation in equilibrium³. The contribution of this paper is to provide a thorough modeling of the health-earnings interaction, and study what this implies for the health inequality - earnings inequality connection.

³See Deaton (2001)

It has been well documented in the health economics literature that measures of health and socio-economic status are positively correlated at the micro level ⁴. It has been studied that the effects of health on socio-economic status appear through the health production framework, and in labor supply (intensive and extensive margin)⁵, and that socio-economic status affects health through access to health insurance and because medical care improves health outcomes⁶.

The model and methodology of this paper is closely related to a strand of the savings literature that considers the life cycle effects of medical expenses of the elderly on savings behavior, like Marshall et al. (2010), De Nardi et al. (2010), Poterba et al. (2010), Lockwood (2011). Unlike that literature, the focus of my project will be mostly on the productivity consequences of health care decisions during the working life, instead of focusing on the post-retirement period. Also, many other macro-health papers do not endogenize health expenditures, and so they miss the channel that goes from earnings to health status, since they either assume exogenous medical expenditure shocks or exogenous evolution of health.

This project is also related to a strand of literature that concerns with welfare evaluation of policies related to health insurance schemes, but those papers usually do not consider the impact on labor market outcomes and earnings dispersion, which will be the main focus of this project. See Jeske and Kitao (2009), Attanasio et al. (2011), Jung and Tran (2011), Feng (2011). Papers that include endogenous investments in health to study the effects of public policy are Ozkan (2011), and Scholz and Seshadri (2010).

⁴See Cutler et al. (2008)

⁵For a survey, see Currie and Madrian (1999). About health on earnings and wages: Lee (1982), Haveman et al. (1994), Haveman et al. (1995), Pincus et al. (1989); Mitchell and Burkhauser (1990), Ettner (1996), Kahn (1998), Michaud and Van Soest (2008). Findings on absenteeism: Herrmann and Rockoff (2011).

⁶Evidence: Newhouse (1993) and Dow et al. (1997)(1997) (from the RAND Experiment), Currie and Gruber (1996, 2001), Doyle (2005), Finkelstein et al (2011).

The literature in quantitative macro that deals with household behavior in the presence of idiosyncratic earnings risk and incomplete markets relies heavily on the characteristics of the process for earnings and the risks that agents bear. The nature of this exercise is to develop a framework that endogenizes part of that idiosyncratic risk, via the effect that health care choices have on a worker's health status. This framework will provide insight about the relevance of health as determinant of lifetime earnings risk and persistence of earnings shocks and allow to analyze the effects that different configurations of the health care sector may have on the idiosyncratic productivity risk that workers face through their lifetimes.

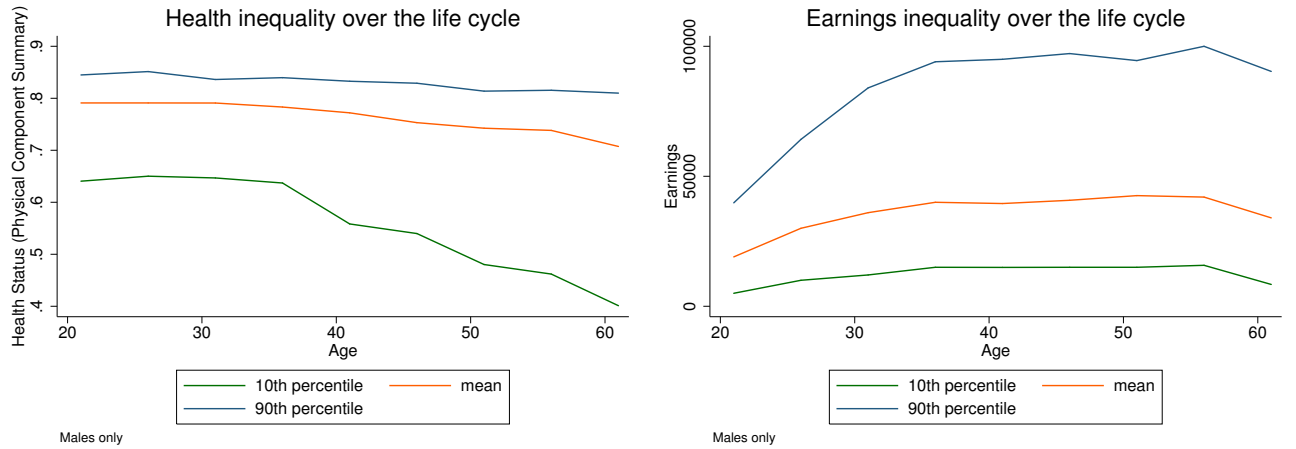
The main facts that emerge from an analysis of data on medical expenditures, health insurance coverage, income, and demographic characteristics from the Medical Expenditure Panel Survey (MEPS) and from the Current Population Survey (CPS)⁷ are the following:

1. There is a large fraction of uninsured amongst adult US population (18% of adults aged 21 to 65 years old in 2008 did not hold private health insurance and did not qualify for public health insurance).
2. There is a strong link between earnings and insurance coverage: 32% of workers in the 10th percentile of the earnings distribution was uninsured in 2008, while this figure is only 3% of those in the upper quarter of the earnings distribution.

⁷The MEPS consists of a series of national surveys, structured as two-year panels, conducted since 1996 by the U.S. Agency for Health Care Research and Quality. The MEPS includes standard demographic and economic variables and a comprehensive set of health-related variables: measures of health status (physical component summary from Short-Form 12 Version 2, and self-reported health status), health insurance status each month of the year, employer offered health insurance or not, medical expenditures, preventive care usage (regular checkups, blood pressure test, routine gynecological exams, etc) and healthy lifestyle variables (smoking, regular physical activity, BMI), medical conditions (detailed).

3. The group of uninsured workers has on average lower earnings than those insured (43% difference, controlling for all observables in a Mincer-type regression), and is relatively more heterogeneous than the insured in terms of earnings and hours worked. The residual -unexplained- dispersion of earnings (usually considered a measure of labor market risk) is 60% higher for the uninsured.
4. Both wage income and a dummy for the uninsured show significant coefficients in explaining frequency of medical and blood pressure checkups (proxies for access to preventive care) in a regression with the usual controls. The uninsured and the poorer are less likely to perform checkups regularly.
5. There is a negative correlation between earnings and total health expenditures, which I interpret as evidence suggestive of low earning workers getting more ER visits, emergency procedures, and hospital admissions- which are expensive components of health costs.

The model will be evaluated with respect to its ability to reproduce the following important features of the data, as seen in Figures 1 and 2.



Source: own from MEPS

Figure 1: Health and earnings inequalities over the life cycle
Deaton and Paxson (1998) documented that dispersion in measures of health grow over the life cycle. These are the patterns against which the outcome of the model will be compared.

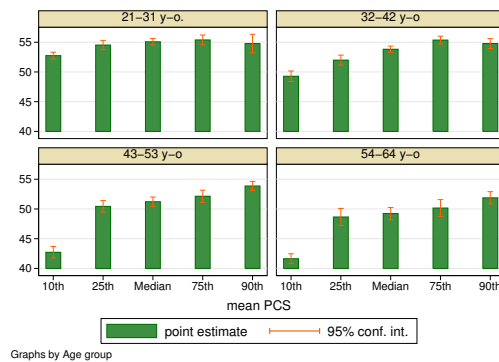


Figure 2: Mean health status and 95% confidence interval by age group and quartile in the earnings distribution.

In Figure 2 we see that the differences in mean health status by earnings are more pronounced for older individuals, but there are significant differences in mean health amongst percentiles even for individuals as young as 32-42 years old. The variable

plotted in this figure is the Physical Component Summary (PCS), which is computed in MEPS using the data from the Short-Form 12 Version 2 of the 2007 Self-Administered Questionnaire. This variable is a summary measure of objective characteristics of the health status of an individual.

2 Model

The economy studied here is a version of a standard life-cycle model with incomplete markets and idiosyncratic risk, augmented to incorporate health and health risk. The main features of this economy are: i) agents face an uninsured earnings risk; ii) an agent's health status affects his amount of available time for productive activities and leisure or his productivity at work.

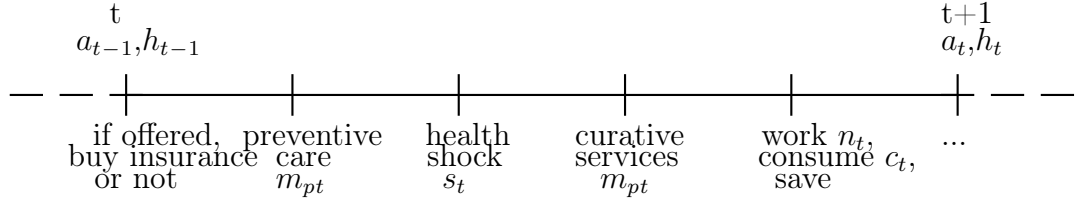
2.1 Population Dynamics and Information

The economy is populated by a constant measure of agents (households) who live for T periods. Until period $T - \underline{t}$ agents supply labor to the labor market. During periods $\underline{t} + 1$ to T agents are retired and they consume out of their savings and a transfer they receive from the government (social security). Each period as many new agents are born as old agents die. Each agent is born with a latent productivity level that determines his maximum productivity, and a stock of health. During their lives, individuals face shocks to their productivity levels and their health stocks. Shocks to the health stock are reversible through medical treatment (curative care).

The timing of decisions is as follows: at the beginning of each period an agent might be offered health insurance. If so, he chooses whether to buy it. When a worker hires

a group health insurance plan through his employer, he might deduct the employer's contribution to the premium and his own contribution to it from his income taxes, τ . If not, he can (try to) purchase insurance in the individual market. After that, each period agents choose how much to consume, save, work, and how much preventive and curative care to obtain in order to maximize the present discounted expected value of his lifetime utility. The effect of these last two variables is described below. Agents face borrowing constraints. The time line of the decisions in each period of the working life is summarized in the following chart:

Figure 3: Timeline



2.2 Insurance

Each period, a worker faces a probability to be offered health insurance through his employer. If he takes group health insurance, the premium is tax deductible. The probability of being offered group health insurance is governed by a Markov chain. The insurance contract consists of a premium p and a co-payment $(1 - \gamma)$, which is the fraction of the total medical charges, m_c , that corresponds the worker to pay. The rest is covered by the insurer. I assume that the policy covers preventive care, m_p , at a

100% rate.⁸

I assume that the health insurance sector is competitive, and the premium is actuarially fair⁹.

2.3 Workers

2.3.1 The role of health

In Grossman's (1972) seminal work, the individual's health capital stock determines a flow of utility directly and also determines the amount of time available for market and non-market production.

A worker's latent productivity level is z_t , where $z_{i,t} = \rho z_{i,t-1} + \varepsilon_{i,t}$.

Health status generates a "flow of healthy time" $h^f(h_t)$ (following Grossman (1972)), such that this flow determines the maximum amount of time available for leisure, l_t , and work, n_t : $T(h_t) = l_t + n_t$.

2.3.2 Evolution of health

The initial health status at age 0 is $h_0(= 1)$.¹⁰

⁸I abstract from access to public health insurance because Medicaid is not only means-tested, but only covers parents and pregnant women, so in the data, a very low fraction of working age males are covered. Some people in the health literature argue that the forms the need to fill out are complex and that many of these people may be deterred from seeking public insurance and they end up "falling through the safety net" (Weissman and Epstein, 1994).

⁹The loading fee of an insurance policy is the proportion by which the premium charged to the consumer exceeds the expected insurance payments to cover the costs of selling and administering the policy and risk bearing by the insurer. In this model, for workers who obtain their insurance through their employer (who by assumption bear the entire burden of the premium but also benefit from section 125 of the IRS code), the loading fee of ESI for them will be negative and equal to the income tax rate $\frac{p(1-\tau)-p}{p} = -\tau$.

¹⁰Although in a future exercise, I will allow for initial inequality in health. One could argue about the presence of some unobservable characteristic that influences both health and earnings (patience,

Each period, health is shocked and curative care might be necessary to treat the condition. At any stage in their lives, their health status evolve according to the following transition equation:

$$h_t = h_{t-1}f(s_t, m_{c,t})$$

where s_t is a health shock, or a measure of health loss¹¹. Curative care m_c helps to partially or totally restore the health status, such that $f'(m_c; s) > 0, f''(m_c; s) < 0$.

Preventive care m_p affects the likelihood of health shocks¹². Health shocks s follow an age-dependent Markov chain with transition matrix $\Pi_{m_p, j}$.

2.3.3 Optimization

$$\max_{\{ins, noins\}, \{c_t\}, \{n_t\}, \{m_{p,t}\}, \{m_{c,t}\}, \{h_t\}, \{a_{t+1}\}} E_s \sum_{t=1}^T u(c_t, n_t)$$

s.t.

$$c_t + a_{t+1} + (1 - \mathbf{1}_{ins}) q_p m_p + (1 - \mathbf{1}_{ins} \gamma_c) q_c m_c + \mathbf{1}_{ins} (1 - \tau) p = (1 - \tau) y_t + (1 + r) a_t$$

and

$$y_t = w_t n_t z_t \varepsilon_t$$

$\mathbf{1}_{ins}$ indicates that the agent has health insurance.

parental upbringing, personal drive), so I will also include a case where there is initial inequality in health and earnings, and the initial values of h and z are jointly distributed.

¹¹The shock s_t is not interpreted as a condition - e.g. diabetes - but as the health loss it represents (early detection of most conditions improves the prognosis, so the size of s indicates the health burden of the pair (condition, opportunity)).

¹²Phelps (1978) develops an expected utility model that explicitly incorporates both preventive and curative medical care. Preventive care changes the probability of illness (self-protection) and may influence the marginal productivity of curative medical care (similar to self-insurance).

2.3.4 Last period

The last period of a worker's life is different than the rest. It is meant to capture in a very stylized way the important aspects of the retirement period for the behavior of savings during the life cycle. Workers receive a transfer from the government when they retire, and their utility is different to reflect the importance of old age medical expenditures and the increased need to buy comfort-enhancing services when old¹³. A bequest motive could be included to better match the data¹⁴.

2.4 Government

The government collects income tax, and uses its revenues to finance social security and Medicare (the last period of each worker's life).

2.5 Equilibrium

A stationary equilibrium in this economy is:

- i) optimality: individual policy functions that solve the agent's optimization problem.
- ii) government's budget constraint:

$$G = \tau \left(wN - \sum_{I_{ins}} \mu(x_i)p \right)$$

- iii) competitive markets:

¹³See DiNardi, French & Jones (JPE, 2010) and Palumbo (REStud, 1999)

¹⁴This is the strategy followed by Di Nardi et al (JPE 2010) and Imrohoroglu and Kitao (2010).

$$p = \sum_i \mu(x_i) \gamma q_c m_c(x_i),$$

$$w = (1 - \alpha) A \left(\frac{K}{L} \right)^\alpha,$$

$$r = \alpha A \left(\frac{L}{K} \right)^{1-\alpha}.$$

iv) feasibility:

$$C + M = \sum_i \mu(x_i) (c(x_i) + m(x_i)),$$

$$K = \sum_i \mu(x_i) a(x_i),$$

$$L = \sum_i \mu(x_i) z_i \epsilon_i n(x_i), \text{ (L are units of effective labor)}$$

$$AK^\alpha L^{1-\alpha} = C + M + G.$$

v) stationary distribution is consistent with policy functions.

$$\mu(x) = \sum_S \Pi(x, S) d\mu$$

3 Numerical Exercise

I calibrated a two period version of the model to perform preliminary exercises. A full calibration is in process.

Calibration

For the period utility I assumed the following functional form:

$$u(c, l) = \frac{c^{1-\sigma}}{1-\sigma} + \nu_n \frac{l^{1-\gamma_n}}{1-\gamma_n}$$

And the effect of curative care:

$$f(s, m_c) = \frac{1}{1 + s * \exp\{-vm_c\}}$$

with $v < 1$.

The following parameters were set exogenously:

σ		2	Risk aversion
β		0.99	Discount rate
τ		0.27	Income tax
$\tau_{social\ security}$		0.104	Soc. Sec. tax
$\tau_{Medicare}$		0.029	Medicare tax

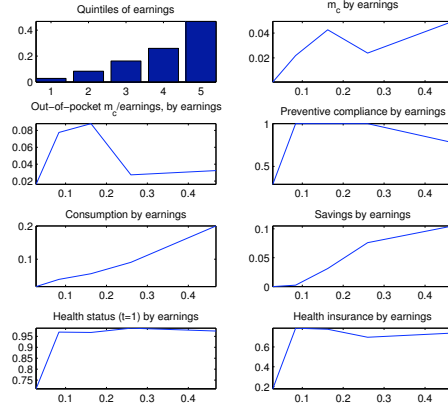
- Effectiveness of preventive care: I approximated from the evidence from the US Preventive Services Task Force and incidence rates from Center for Disease Control and Prevention.
- Severity of health shocks (medical conditions): I used WHO's disability weights (which reflect the severity of each condition on a scale from 0 (perfect health) to 1 (equivalent to death) and merged them to the medical conditions reported in the MEPS to compute a distribution of disability shocks.
- Insurance shock: from MEPS, the transition matrix for the states of not being offered insurance and being offered is $\Pi_{ins} = \begin{bmatrix} 0.7 & 0.3 \\ 0.06 & 0.94 \end{bmatrix}$.
- Copayment: the mean fraction of medical expenditures γ that the insurance pays is 30% in MEPS.

The calibrated parameters are:

ν	26	efficiency m_c
γ_n	4	elasticity of labor supply
q_p	2% earn.	cost of preventive care
η	4	utility of leisure

And these are the calibration results:

Targets				Not targets			
Moment	Data	Model		Moment	Data	Model	
mean hours	0.36	0.38		interest rate		5%	
insured	0.69	0.68		$\frac{prem_{priv}}{avg\ earn}$	0.09	0.09	
Medicare ins	0.97	0.99		$\frac{prem_{MCare}}{avg\ earn}$	0.024	0.024	
$m_{c,1}/avg\ earn$	0.13	0.10		$CV(health_{young})$	0.18	0.20	
$prev_{old}$	0.56	0.60		$CV(health_{ret})$	0.29	0.32	
				$mean(health_{young})$	0.72	0.80	
				$mean(health_{ret})$	0.58	0.68	
				$m_{c,2}/avg\ earn$	0.29	0.38	
				$prev_{young}$	0.45	0.81	
				$m_{c,unins}/m_{c,ins}$	0.32	0.24	



- In the model, 10% of earnings inequality is explained by health channel in isolation.
- The model reproduces 60% increase in health dispersion over lifecycle.
- The model over-predicts the difference in consumption of medical services between insured and uninsured.

Counterfactuals in partial equilibrium:

If insurance covers all preventive care medical expenditures fall by 12% when young and by 22% after retirement, average health improves by 3%, and health inequality declines 18%. Earnings increase, and earnings inequality declines by 1%.

If insurance is offered to everyone, medical expenditures rise by 1%, insurance coverage rate rises 16% for working age, average health status improves by 1%, and earnings dispersion decreases by 2.5%.

Since this is a two period version of the model, all the persistence effects are lost, and this can help explain the low numbers obtained in this exercise. The mechanism is clear in the results, and I am looking forward to having the results for the full model.

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