

Analyzing the Effects of Insuring Health Risks: On the Tradeoff between Short Run Insurance Benefits vs. Long Run Incentive Costs

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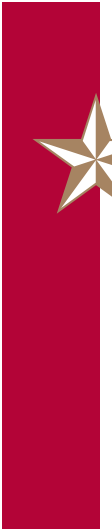
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Becker Friedman Institute for Research in Economics
September 2016

Bad Things are Happening to US Health

- ① More people are obese.
 - ▶ The share of the obese ($BMI = kg/m^2 \geq 30$) has gone from 23% in 1990 to 34% in 2010 (highest in OECD).
 - ▶ Even the US military has begun to panic.
- ② More people are living with diabetes.
 - ▶ The share of population with diagnosed diabetes increased from 2.5% in 1990 to 7.0% in 2010.
- ③ Even Hal and Dirk are on a diet.


Bad Things are Happening to US Health



Too Fat to Fight

Retired Military Leaders Want
Junk Food Out of America's Schools

A Report by



MISSION: READINESS
MILITARY LEADERS FOR KIDS

Bad Things are Happening to US Health

- ① e.g. More people are obese.
 - ② e.g. More people are living with diabetes.
- ▶ These changes are mainly due to changes in behavior.
 - ▶ This change in behavior could come from a variety of factors.
 - ▶ But one factor might be a reduced incentive to be healthy.

- ▶ Good health is economically beneficial as it increases labor income, and reduces health insurance premia.
- ▶ People can affect (stochastic) evolution of their health by exerting effort.
- ▶ Recent U.S. policy changes provide additional insurance against economic impacts of poor health.
 - ▶ Labor market: Americans with Disability Act (ADA) and amendment (ADAAA) in 2009 tightens regulations on **wage discrimination** against workers with poor health.
 - ▶ Health insurance market: Patient Protection and Affordable Care Act (PPACA) prohibits health insurance companies from charging **different premia** for workers with different initial health conditions (started in 2014).

Paper in a Nutshell: Health, Income, and Medical Expenditure

- ▶ Good health is beneficial (among other things) because it:
 - ▶ increases a workers' productivity and thus labor income; and
 - ▶ reduces health expenditure risks and thus health insurance premia.

Table: Average Labor Income and Medical Expenditure by Health Status

	Labor Income		Medical Expenditure	
	Mean	Median	Mean	Median
Fair	32,752	26,483	5,821	1,977
Good	45,970	36,665	2,344	733
Very Good	55,541	41,604	1,601	558
Excellent	70,826	48,695	1,227	363
Total	55,075	40,797	2,157	599

Paper in a Nutshell: Effort and Health Dynamics

- ▶ People can affect (stochastic) evolution of their health by exerting effort.

Table: Effort and Health Dynamics over 6 years

	Change in Health Status		
	Worsened	Unchanged	Improved
Bad Initial Health			
Effort < average	29.20	54.24	16.56
Effort > average	27.71	50.21	22.08
Good Initial Health			
Effort < average	38.77	47.67	13.56
Effort > average	30.24	53.22	16.54

Paper in a Nutshell

- ▶ Good health is economically beneficial as it increases labor income, and reduces health insurance premia.
- ▶ People can affect (stochastic) evolution of their health by exerting effort.
- ▶ Recent U.S. policy changes provide additional insurance against economic impacts of poor health.
 - ▶ Labor market: Americans with Disability Act (ADA) and amendment (ADAAA) in 2009 tightens regulations on **wage discrimination** against workers with poor health.
 - ▶ Health insurance market: Patient Protection and Affordable Care Act (PPACA) prohibits health insurance companies from charging **different premia** for workers with different initial health conditions (started in 2014).

Research Objective and Approach

What are **static** and **dynamic** effects of these policies intending to provide social insurance against health status risk?

- ▶ Short-Run (Insurance) vs. Long-Run (Incentive) Trade-Off
 - ▶ **Insurance**: Policies lower consumption risk due to higher health insurance premia and lower wages.
 - ▶ **Incentives**: Policies reduce incentives to maintain healthier lives emanating from higher wages and lower insurance premia.
- ▶ Construct and estimate a dynamic model with endogenous effort, health expenditure, and evolution of health.
- ▶ Quantitatively assess the relative magnitudes of short run insurance benefits and long run incentive costs of the policies.

Preview of Results

- ▶ In the **short run** (static model), implementing *both* policies in conjunction provides households with **full consumption insurance** against health risk.
- ▶ In the **long run** (dynamic model), insurance benefits might be offset by **negative incentive effects**.
- ▶ Policies improve welfare relative to competitive equilibrium without government intervention.
- ▶ **With both policies**, negative effects are large, resulting in a worsening of the health distribution and a **welfare loss** relative to one policy alone.

- ▶ Model Description
- ▶ Static Insurance Analysis
- ▶ Dynamic Analysis
- ▶ Estimation and Calibration
- ▶ Quantitative Results
- ▶ Conclusion

The Model

Endowments and Preferences

- ▶ We follow one cohort of workers of measure 1
- ▶ Endowments
 - ▶ One unit of time for productive work in every period $t \leq T$.
 - ▶ Initial Health: $h \in H$
 - ▶ Cross-cohort health status distribution: $\Phi_0(h)$
- ▶ Preferences
 - ▶ Period utility from consumption and disutility from effort:
 $u(c) - q(e)$
 - ▶ $u' > 0, u'' < 0$, twice differentiable, and satisfies the Inada conditions
 - ▶ $q' > 0, q'' > 0$, twice differentiable, and $q(0) = q'(0) = 0$
 - ▶ Time discount factor β

- ▶ With probability $g(h)$ workers do not get any health shock ε in the current period.
 - ▶ With probability $1 - g(h)$, a health shock $\varepsilon \in (0, 1]$ is drawn from the distribution $f(\varepsilon)$.
 - ▶ Over time, health evolves stochastically according to $Q(h'|h, e)$.
- ⇒ Effort does not have static benefits, but alters health transitions.

Production Technology

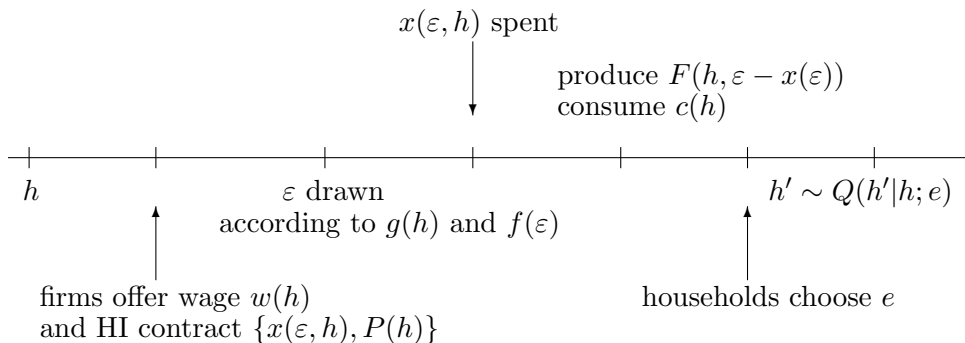
- ▶ Output of a worker given by

$$\mathbf{F}(\mathbf{h}, \varepsilon - \mathbf{x})$$

+ -

- ▶ Health expenditures x offset the negative impact of a health shock ε .
- ▶ The larger the uncured health shock, the more severe its marginal impact: $\mathbf{F}_{22}(\mathbf{h}, \varepsilon - \mathbf{x}) < 0$.
- ▶ Health expenditures $x > \varepsilon$ don't have any effect on production: $\mathbf{F}_2(\mathbf{h}, \varepsilon - \mathbf{x} < 0) = 0$.
- ▶ The largest health shocks will be insured: $-\mathbf{F}_2(\mathbf{h}, \varepsilon = 1) > 1$.
- ▶ The worse is initial health \mathbf{h} , the more negative is the impact of a given net health shock: $-\mathbf{F}_{12}(\mathbf{h}, \varepsilon - \mathbf{x}) < 0$.

Timing of the Model



Static Analysis

Efficient Allocation

Social planner chooses $c(\varepsilon, h)$ and $x(\varepsilon, h)$ to maximize utilitarian (or ex ante) social welfare subject to a resource constraint, taking health distribution $\Phi(h)$ as given:

$$U^{SP}(\Phi) = \max \sum_h \left\{ g(h)u(c(0, h)) + (1 - g(h)) \int f(\varepsilon)u(c(\varepsilon, h))d\varepsilon \right\} \Phi(h)$$

subject to

$$\begin{aligned} & \sum_h \left\{ g(h)[c(0, h) + x(0, h)] + (1 - g(h)) \int f(\varepsilon)[c(\varepsilon, h) + x(\varepsilon, h)]d\varepsilon \right\} \Phi(h) \\ & \leq \sum_h \left\{ g(h)F(h, -x(0, h)) + (1 - g(h)) \int f(\varepsilon)F(h, \varepsilon - x(\varepsilon, h))d\varepsilon \right\} \Phi(h) \end{aligned}$$

- ▶ Full consumption insurance: $c^{FB}(\varepsilon, h) = c$
- ▶ Medical Expenditure solves

$$\max_{x(\varepsilon, h)} F(h, \varepsilon - x(\varepsilon, h)) - x(\varepsilon, h)$$

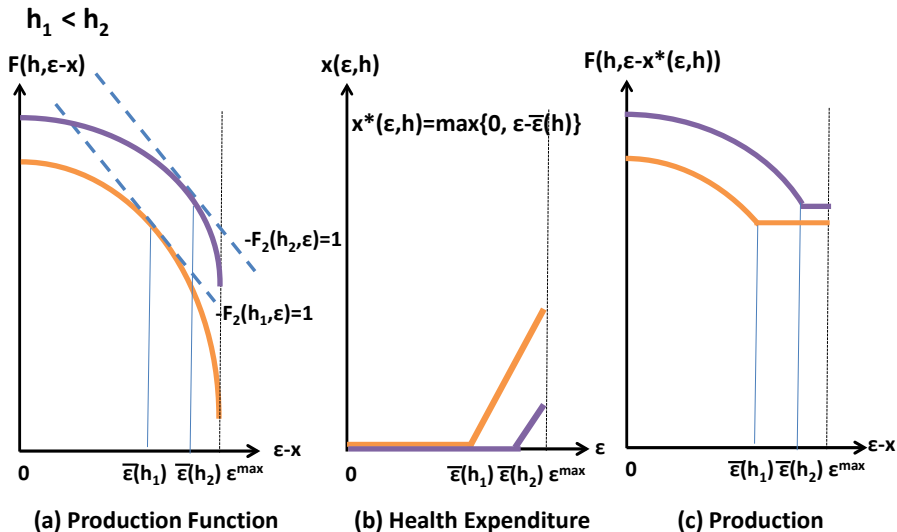
- ▶ Thus $\forall h \in H$, \exists a cutoff shock $\bar{\varepsilon}^{FB}(h)$ such that

$$x^{FB}(\varepsilon, h) = \begin{cases} 0 & \text{for } \varepsilon \leq \bar{\varepsilon}^{FB}(h) \\ \varepsilon - \bar{\varepsilon}^{FB}(h) & \text{for } \varepsilon > \bar{\varepsilon}^{FB}(h) \end{cases}$$

$$\text{with } -F_2(h, \bar{\varepsilon}^{FB}(h)) = 1$$

\Rightarrow Health expenditures dictated by productivity concerns.

Efficient Allocation



Competitive Equilibrium

- ▶ Equilibrium contract solves:

$$\begin{aligned} U(h) &= \max_{x(\varepsilon, h)} u(c(h)) \\ \text{s.t.} \quad &c(h) = w(h) - P(h) \end{aligned}$$

where

$$w(h) = g(h)F(h, -x(0, h)) + (1 - g(h)) \int f(\varepsilon) [F(h, \varepsilon - x(\varepsilon, h))] d\varepsilon$$

$$P(h) = g(h)x(0, h) + (1 - g(h)) \int f(\varepsilon)x(\varepsilon, h)d\varepsilon$$

- ▶ Equilibrium health insurance contract is efficient:

$$x^{CE}(\varepsilon, h) = x^{FB}(\varepsilon, h)$$

Competitive Equilibrium with Policies

Equilibrium contract solves:

$$U(\Phi) = \max_{x(\varepsilon, h)} \sum_h u(c(h))\Phi(h)$$

subject to

$$c(h) = \begin{cases} w(h) - P, & \text{for No prior conditions law} \\ w - P(h), & \text{for No wage discrimination law} \\ w - P, & \text{for Both policies} \end{cases}$$

where

$$P = \sum_h P(h)\Phi(h) \qquad w = \sum_h w(h)\Phi(h)$$

CE with Non-Discrimination Policies

- ▶ Under NP and NW, cutoffs $\bar{\varepsilon}^{NP}(h)$ and $\bar{\varepsilon}^{NW}(h)$ satisfy

$$\begin{aligned}-F_2(h, \bar{\varepsilon}^{NP}(h)) &= \frac{\mathbb{E}u'^{NP}(h)}{u'^{NP}(h)} \\ -F_2(h, \bar{\varepsilon}^{NW}(h)) &= \frac{u'^{NW}(h)}{\mathbb{E}u'^{NW}(h)}\end{aligned}$$

- ▶ NP and NW alone distorts medical expenditure provision, in order to provide back-door insurance.
- ▶ Under both policies, $\bar{\varepsilon}^{Both}(h)$ satisfies

$$-F_2(h, \bar{\varepsilon}^{Both}(h)) = 1$$

- ▶ Efficiency in medical expenditure is restored!

Static Analysis in a Nutshell

A. Competitive equilibrium

- ▶ Efficient medical expenditures
- ▶ Imperfect consumption insurance (through w and P).

B. No-prior-conditions law and No-wage-discrimination law

- ▶ Partial consumption insurance through P and w .
- ▶ Distortion in medical expenditures

C. Both policies

- ▶ Socially efficient medical expenditures
- ▶ Full consumption insurance
- ▶ Restores efficient allocation as (heavily regulated) competitive equilibrium.

Dynamic Analysis

Dynamic Model

- ▶ Health status tomorrow (h') is determined by health status today (h) and effort (e) through $Q(h'|h, e)$.
- ▶ Effort incurs disutility of $q(e)$.
- ▶ Effort is chosen to equate the marginal cost (disutility) with the benefit (better future health).
- ▶ Government policies impact the benefit of better health in the future, and thus affect current incentive to exert effort to remain healthy.
- ▶ Under the restriction to static contracts and for a given $(h, \Phi(h))$, the within-period analysis of the health insurance contract and resulting consumption allocation is the same as in the static model.

Constrained Social Planner's Problem

The social planner solves

$$\begin{aligned} \max_{\{c_t(h), e_t(h)\}} \quad & V(\Phi_0) = \sum_h V_0(h) \Phi_0(h), \\ \text{s.t.} \quad & \sum_h c_t(h) \Phi_t(h) \leq Y(\Phi_t) \text{ (Resource)} \\ & q'(e_t(h)) = \beta \sum_{h'} \frac{\partial Q(h'; h, e_t(h))}{\partial e_t(h)} V_{t+1}(h') \text{ (IC)} \end{aligned}$$

with

$$V_t(h) = u(c_t(h)) - q(e_t(h)) + \beta \sum_{h'} Q(h'; h, e_t(h)) V_{t+1}(h')$$

$$v_t(h; \Phi) = u(c_t(h, \Phi)) + \max_{e_t(h)} \left\{ -q(e_t(h)) + \beta \sum_{h'} Q(h'; h, e_t(h)) v_{t+1}(h', \Phi') \right\}$$

- ▶ Optimal effort is given by

$$q'(e_t(h)) = \beta \sum_{h'} \frac{\partial Q(h'; h, e_t(h))}{\partial e_t(h)} v_{t+1}(h', \Phi')$$

- ▶ Now $v_t(h, \Phi)$ reflects (via $c_t(h, \Phi)$) past effort choices in population through P_t and w_t which are functions of Φ_t .

Estimation and Calibration

Taking the Model to the Data

- ▶ Use PSID for income and effort and MEPS for medical expenditure data
- ▶ A model period lasts 6 years and working life lasts from 24 to 65.
- ▶ We enrich the model by adding more heterogeneity
 - ▶ Labor productivity depends on education and age
 - ▶ Health shock probabilities and distribution depend on age
 - ▶ Health transition is education-specific
 - ▶ Introduce catastrophic health expenditures
 - ▶ Preference heterogeneity for effort (in health)
 - ▶ Terminal payoff to health in retirement
- ▶ Use light and heavy physical exercise and (not) smoking as our measure of effort e .

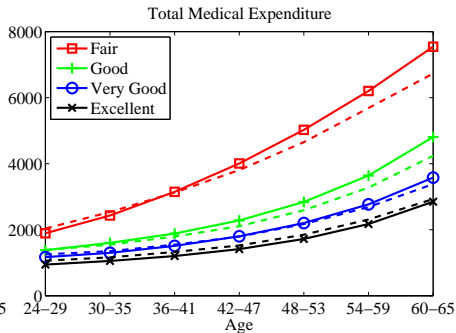
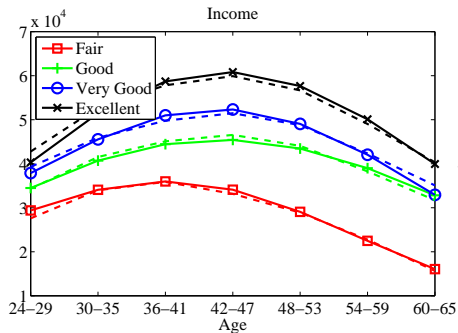
Detail

Calibration and Estimation Strategy

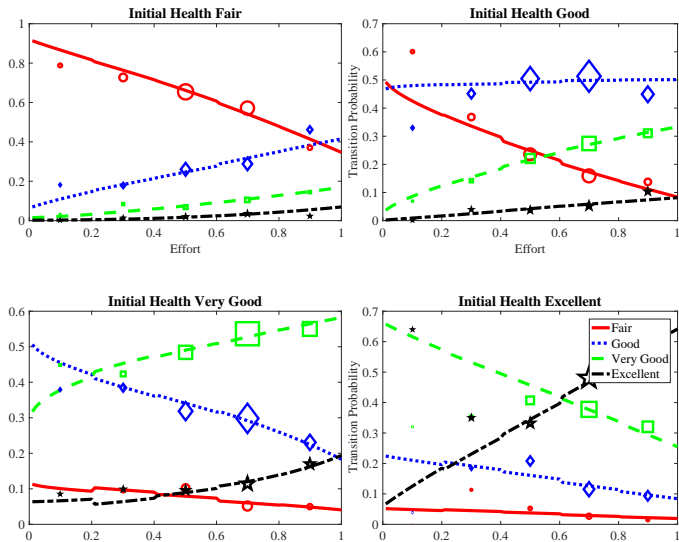
- ▶ Three step procedure
 - 1 The risk aversion parameter and discount factor are set *a priori* to $\sigma = 2$, and $\beta = 0.96$ per annum.
 - 2 Estimate the health transition function and catastrophic medical expenditures directly from the PSID data.
 - 3 Calibrate remaining parameters - those governing the production function; health shocks; and preference for exercise - by matching selected moments of the model to their empirical counterparts.
- ▶ Model moments: equilibrium in absence of policy.
- ▶ Data moments: Six year averages from PSID and MEPS

Detail

Goodness of Fit: Income and Medical Expenditure



Goodness of Fit: Health Transition Function

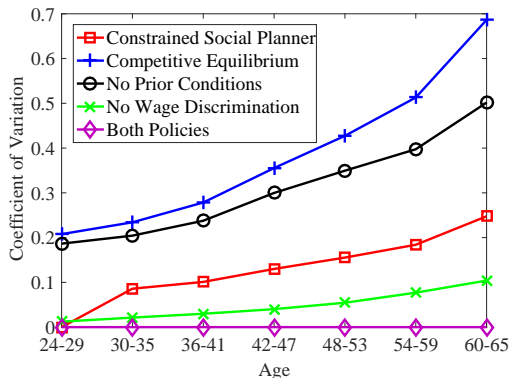


Quantitative Results

Insurance Benefits of Policies

- ▶ The insurance benefits of policies are measured by the coefficient of variation of consumption over the life cycle.

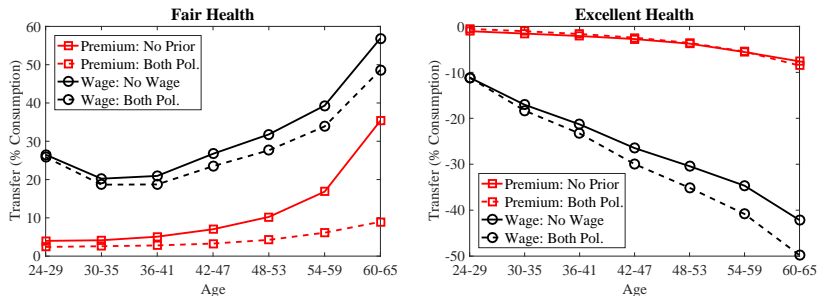
Figure: Coefficient of Variation in Consumption



Insurance Benefits of Policies

- ▶ Workers with excellent health cross-subsidize those with fair health.

Figure: Cross-Subsidies by Health Status



Incentive Costs of Policies

- ▶ The disincentive effect of the policies are manifested through lower effort choices, and worse health distribution as a result.

Figure: Average Effort

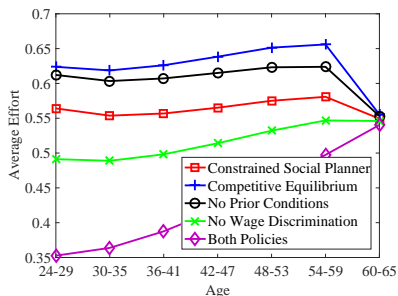
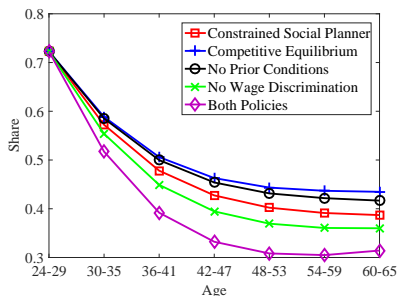


Figure: Very Good and Excellent



- Worsening health distribution leads to higher aggregate medical expenditure and lower aggregate consumption.

Figure: Medical Expenditure

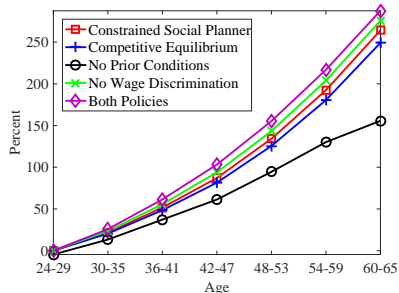
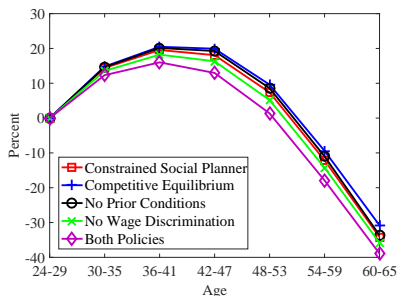


Figure: Consumption



Welfare Consequences

- ▶ Statically, $CSP = Both > NW > NP > CE$,
but dynamically, $NW > Both > NP > CE$.

	Static CEV^i	Dynamic CEV^i
Constrained Social Planner	1.257	5.587
Competitive Equilibrium	0.000	0.000
No Prior Conditions Law	0.192	2.904
No Wage Discrimination Law	1.252	5.055
Both Policies	1.257	2.973

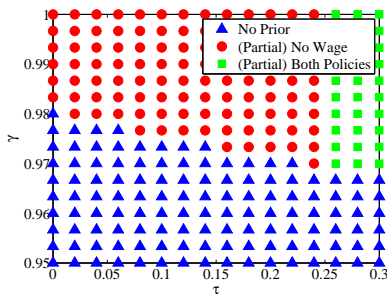
- ▶ Healthier workers prefer less insurance through the government.

	Fair	Good	Very Good	Excellent
Constrained Social Planner	21.403	10.351	5.552	0.119
Competitive Equilibrium	0.000	0.000	0.000	0.000
No Prior Conditions Law	4.989	3.515	2.952	2.041
No Wage Discrimination Law	22.147	10.574	5.053	-1.053
Both Policies	21.448	8.798	2.942	-3.421

Incorporating Implementation Costs of the ADA

- ▶ The ADA does not eliminate all health related wage variation, nor is it cost free.
- ▶ Let the resource cost be γ , and the law's effectiveness, τ :

$$c(h) = \tau w(h) + (1 - \tau)\gamma W - (P(h) \text{ or } P)$$



- ▶ Implementation costs are 2-5% of average income in the model:
No Prior is superior to No Wage!

- 1 There is a lot of health risk; especially with respect to earnings.
- 2 While adverse incentive effects are important, the optimal level of social consumption insurance is large. Makes no-wage discrimination preferred policy.
- 3 However, very modest resource costs associated with no-wage discrimination leads to a robust policy preference for no-prior.

- ▶ We analyze the effects of recent US legislations restricting the extent to which **wages and health insurance premia can be conditioned on health status**.
- ▶ Government policies create trade-off between static consumption insurance and dynamic incentives to exert effort to remain healthy
- ▶ In the long run, labor market and health insurance market regulation **individually** are welfare-improving.
- ▶ But both policies **in conjunction** result in welfare losses due to the severe deterioration of the societal health distribution.

Appendix

- ▶ Affordable Care Act

- ▶ The purpose of the law is insure individuals against pre-existing conditions, expand insurance, and regulate the insurance market so as to get an efficient outcome.
- ▶ **Focus on insurance against pre-existing conditions**

- ▶ Americans with Disability Act

- ▶ Prevents discrimination against workers who can perform the “essential” features of the job with respect to hiring, firing, and compensation.
- ▶ Employer must make a reasonable accommodation for any qualified employee.
- ▶ **Interpret law as providing wage compression**

Wage and Health Insurance Contracts

- ▶ Perfect Competition
 - ▶ Restriction to static contracts. h observed, contract, then ε realized.
 - ▶ Risk-neutral firms offer contract $\{w(h), x(\varepsilon, h), P(h)\}$ with implied consumption $c(h, \varepsilon) = w(h) - P(h)$.
 - ▶ Assume: Health insurance premium $P(h)$ is actuarially fair.
- ▶ Contracting with No-Prior Conditions Law
 - ▶ Purpose: prevent differential pricing of health insurance by h .
 - ▶ To succeed, law must:
 - ▶ Legislate that $P(h) = P$. Perfect competition among IC implies that $P(h) = P$ is actuarially fair.
 - ▶ Regulate $x(\varepsilon, h)$. Assume it is regulated efficiently.
 - ▶ Enforce mandatory participation.
- ▶ Contracting with No-Wage Discrimination Law
 - ▶ Purpose: prevent differential compensation of workers by h .
 - ▶ To succeed, law must:
 - ▶ Legislate $w(h) = w$ and prevent differential hiring by h .
 - ▶ Regulate $P(h)$. Assume $P(h)$ is regulated to be actuarially fair conditional on h .

- ▶ Utility from consumption:

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma},$$

- ▶ σ : Relative risk aversion (value of consumption insurance)

- ▶ Disutility of exercise:

$$\gamma(h)q(e) = \gamma(h) \left[\frac{1}{1-e} - e - 1 \right]^\psi.$$

- ▶ $\gamma(h)$: Health-dependent preference parameter for effort
- ▶ ψ : Elasticity of utility cost with respect to effort

Functional Forms: Health Transition, $Q(h'|h, e; educ)$

- ▶ Baseline health transition probabilities $G(h, h')$, absent exercise e .
- ▶ Exercise e increases probability to maintain or improve health, lowers probability of health deterioration.

$$Q(h'; h, e) = \begin{cases} (1 + \pi(h, e)^{\alpha_i(h)})G(h, h') & \text{if } h' = h + i, i \in \{1, 2\} \\ (1 + \pi(h, e))G(h, h') & \text{if } h' = h, h > 1 \\ \left(\frac{1 - \sum_{h' \geq h} Q(h'; h, e)}{\sum_{h' < h} G(h, h')} \right) G(h, h'), & \text{otherwise} \end{cases}$$

- ▶ All parameters are education-dependent.

Functional Forms: Production, $F(t, educ, h, \varepsilon - x)$

$$F(t, educ, h, \varepsilon - x) = A(t, educ)h^{\alpha(t)\alpha(educ)} \left\{ 1 - \phi(educ) \frac{(\varepsilon - x)^{\xi(educ)}}{h^{1+\alpha(t)\alpha(educ)}} \right\}$$

- ▶ The direct effect of health is captured by $A(t, educ)$
- ▶ Time- and education- specific marginal effect of health is captured by $\alpha(t)$ and $\alpha(educ)$.
- ▶ Health indirectly affects the marginal benefit of medical expenditures x .
- ▶ A marginal dollar spent on a healthy individual (high h) is less effective than that spent on an unhealthy individual ($-F_{12} < 0$)

Functional Forms: Health Shock, $g(t, h)$ and $f(t, \varepsilon)$

- ▶ Probability of NOT getting an ε shock is health- and time-dependent:

$$g(t, h) = \frac{\tilde{g}(h)}{\exp(\alpha_g \times t)}.$$

- ▶ We parametrize ε -shock distribution to match increasing medical expenditure over the life-cycle. In particular, we use log-normal distribution with mean $\mu_\varepsilon(t)$ and variance $\sigma_\varepsilon^2(t)$, where

$$\begin{aligned}\mu_\varepsilon(t) &= \mu_\varepsilon \exp(\alpha_\mu \times t) \\ \sigma_\varepsilon^2(t) &= \sigma_\varepsilon^2 \exp(\alpha_\sigma \times t)\end{aligned}$$

Back

Plausible Estimates: Effort to Health Update?

We are using the correlation of effort and health update conditional on health to infer the effect of effort.

How sensitive are health updates to effort?

- ▶ Exercise is found to reduce likelihood of future hypertension by 2-3 percentage points (high vs. medium vs. low exercise groups). (Coleman and Dave NBER 2013)
- ▶ We divide health types into 3 exercise groups. Compute update probability distribution for each group.
- ▶ Use data on hypertension by health type by health type to infer incidence difference for hypertension.
- ▶ Find its about 2-5% for high vs. low exercise groups.

Back

Parameters Calibrated within the Model

Parameters	Description	No.
Production		
h_1, \dots, h_4	Health Levels	4
$A(t, educ, \tilde{h})$	Age-Educ-Health Effect in Production	28
$\alpha_t(t)$	Health Effect over Time	7
$\alpha_e(educ)$	Health Effect across Education	2
$\phi(educ)$	Health Shock Effect in Production, Level	2
$\xi(educ)$	Health Shock Effect in Production, Exponent	2
Health Shock		
$g(h)$	Probability of not having a health shock	4
α_g	Age effect on Probability	1
$\mu_\varepsilon, \sigma_\varepsilon^2$	Distribution of ε Shocks	2
$\alpha_\mu, \alpha_\sigma$	Age effect on Mean/Var of Distribution	2
Effort		
$\gamma(h)$	Health-dependent preference for Effort	4
ψ	Curvature of cost function	1
Terminal Value		
$v_{T+1}(h, educ)$	Terminal Value of health	8
Normalization		
	$\alpha_e(1) = 1$	3
	$v_{T+1}(1, educ) = 0$	
Remainder		67-3 = 64

Generating Income Moments

- ▶ Run $\ln w_i = \beta_0 + \beta(t, educ, h)D_i(t, educ, h) + \beta_z Z_i$, where
 - ▶ $D_i(t, e, h)$: Agebin ($t = 1, 2, 3, \dots, 7$), education ($educ = 1, 2$) and health status ($h = 1, 2, 3, 4$) dummy for individual i
 - ▶ Z_i : Dummy variables for male, ethnicity, and whether job is union
- ▶ Use the coefficients to back out the joint effect of $(t, educ, h)$ on labor income. Let

$$\ln \tilde{w}(t = \hat{t}, e = \hat{e}, h = \hat{h}) = \hat{\beta}_0 + \hat{\beta}(t = \hat{t}, e = \hat{e}, h = \hat{h}) + C,$$

where C ensures that average of $\ln \tilde{w}$ is equal to the average of $\ln w$ from data.

- ▶ Smooth out the wage schedules by fitting them to a quadratic function in age:

$$\ln \tilde{w}(t, educ, h) = \gamma_0 + \gamma_1 t + \gamma_2 t^2,$$

for each $(educ, h)$ group.

- ▶ Our targets are the smoothed wage profiles.

Calibration Targets

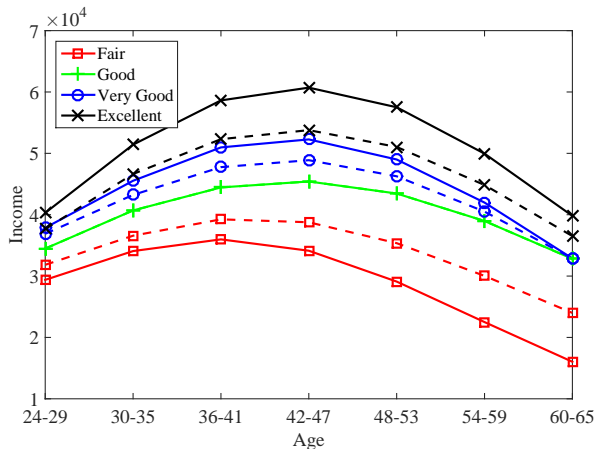
- Income and medical expenditure in the model are determined jointly by production and medical expenditure distribution parameters, thus we cannot pin down a one-on-one mapping between moments and parameters.

Parameters	Moments	No. Moments
Income and Medical $A(t, educ, \tilde{h}), h, \alpha_t(t),$ $\alpha_e(e), \phi(educ), \xi(educ)$ $\tilde{g}(h), \alpha_g$ $\mu_\varepsilon, \sigma_\varepsilon^2, \alpha_\mu, \alpha_\sigma$	Smoothed $w(t, educ, h)$ and $x(t, educ, h)$ moments % with zero med exp by health, by age Mean, Var of ε -expenditure	$7 \times 2 \times 4 = 56$ $7 \times 2 \times 4 = 56$ $4 + 7 = 11$ 2
Effort $\gamma(h), \psi$ $v_{T+1}(h, educ)$	$\mathbb{E}(\text{eff} \text{age}, educ, h),$ $\text{age} \in \{t \leq 4, t > 4\}$	$2 \times 2 \times 4 = 16$
Number of Moments		141

- We use efficient GMM to calibrate the parameters.

Plausible Estimates: Health to Earnings?

We conduct robustness check of our results with respect to income gradient of health.



Plausible Estimates: Health to Earnings?

We conduct robustness check of our results with respect to income gradient of health.

- ▶ We lower the income gradient of health by half, while keeping the average income the same – Excellent health earns about 30% more than Fair health.
- ▶ Our policy rankings are still robust:

$$NW(1.05) > NP(0.71) > Both(0.07)$$

- ▶ In earlier literature, arthritis is estimated to reduced earnings by 35% (Mitchell and Butler J. Health Econ. 1986) If we use different frequency of arthritis by health status, this gives us an earnings difference of 15%. (Arthritis correlated with other health conditions.)

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Welfare Consequences Conditional by Age Group

Table: Welfare for Ages 24-29

	Fair	Good	Very Good	Excellent
Constrained Social Planner	21.403	10.351	5.552	0.119
Competitive Equilibrium	0.000	0.000	0.000	0.000
No Prior Conditions Law	4.989	3.515	2.952	2.041
No Wage Discrimination Law	22.147	10.574	5.053	-1.053
Both Policies	21.448	8.798	2.942	-3.421

Table: Welfare for Ages 54-59

	Fair	Good	Very Good	Excellent
Constrained Social Planner	70.689	14.844	-5.034	-14.682
Competitive Equilibrium	0.000	0.000	0.000	0.000
No Prior Conditions Law	29.619	10.210	-1.252	-5.257
No Wage Discrimination Law	85.272	12.850	-10.134	-22.654
Both Policies	86.645	6.881	-16.896	-29.679

Dynamic Welfare Results with Sensitivity Analyses

Table: Dynamic Welfare Results from Sensitivity Analyses

	BM	IG	PL	QM	FX	Incomplete NW		
						PP	Cost	PP, Cost
CSP	5.587	1.086	2.893	4.115	5.587	5.587	5.587	5.587
CE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NP	2.904	0.710	0.564	2.170	1.920	2.904	2.904	2.904
NW	5.055	1.045	2.718	3.697	5.010	5.409	0.010	1.652
Both	2.973	0.066	0.945	1.734	2.973	5.510	-2.081	3.121

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