Social Health Insurance: A Quantitative Exploration

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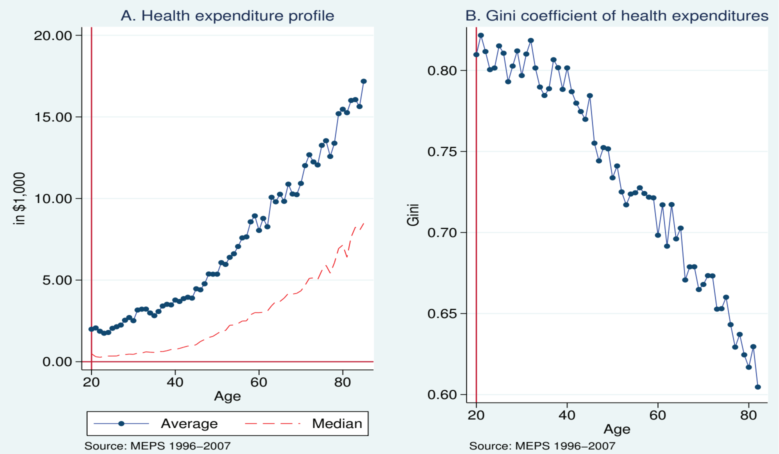
Introduction

U.S. Health Expenditures over the Lifecycle



Health Risk and Insurance Systems

- Health is a source of risk over the lifecycle
- Different insurance arrangements:
  1. Self-insurance: precautionary saving
  2. Private insurance: limited due to nature of risk and asymmetric info
  3. Public insurance: trade off between insurance and incentive effects
- Mixed designs of health insurance systems
  - More public-based or more private-based

Healthcare Financing by Sources

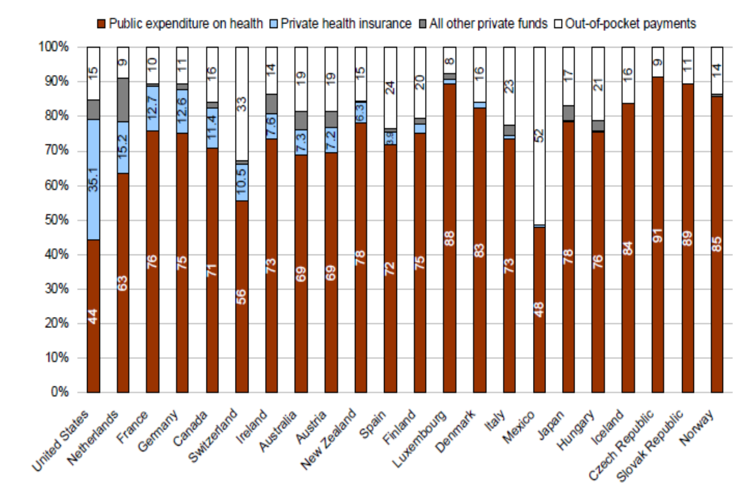


Figure 1: Healthcare Financing in OECD Economies (OECD (2004))

This Paper

This Paper

- Investigate the social insurance role of different health insurance systems
- Analysis based on general equilibrium heterogeneous agent OLG model
  - Health and income risk over the lifecycle
  - Endogenous health expenditure and insurance choice
  - More realistic structure of health insurance system
- Quantify insurance effect of:
  1. Mixed system of private + public health insurance: US system
  2. Universal public health insurance system (UPHI): European system
  3. Private health insurance system with and without regulation

Results

- Welfare gains in all systems with insurance contracts (over benchmark: self-insurance only)
  1. Mixed system of private + public health insurance (US)
  2. UPHI (Europe)
  3. Private health insurance system with and without regulation

- Welfare effects vary across agent types
  - UPHI system creates welfare losses for high income groups
  - US and purely private systems lead to gains for all types (but more for the rich)

- UPHI system leads to highest welfare gains (+7.3%)
  - But largest output loss (-6.3%)
  - Optimal coinsurance rate about 28.5%

The Mechanism: Insurance-Incentive Trade Off

1. Insurance/Redistribution Effect
    - Improves risk sharing (income and health risk)
    - Redistributes income across agents and over the lifecycle
    - $\uparrow$ welfare

2. Incentive Effect
    - Tax and price distortions
    - Incentives to save and work
    - Incentives to consume (medical vs. non-medical)
    - $\downarrow$ welfare

3. Welfare outcome driven by net effect
    - Positive effect is dominant for most systems and types

Related Literature i

1. Micro-health economics
   - ???
   - ?, ?
   - ?, ?, ?

2. Quantitative macroeconomics/public finance
   - ?, ?, ?
   - ?, ? and ?

Related Literature ii

3. Macro-health economics
   - **Exogenous** health expenditure shocks: **?**, **?**, **?**, **?**, **?**,**?**, **?**, **?**, **?**, **?**
   - **Endogenous** health expenditures and insurance: **?**, **?**, **?**, **?**, **?** and **??**

The Model

Model

The Model: Bewley (1986) and Grossman (1972a)

- Overlapping Generations (OLG) Model
- Heterogeneous agents
  - Lifespan: age 20 to 90
    - Idiosyncratic shocks: labor productivity and health shocks
  - Health capital accumulation
    - Health as consumption and investment goods
    - Endogenous health spending
    - Choice of private health insurance
    - Imposed public health insurance with eligibility criteria
- Market structure: consumption goods, health care goods, capital, labor markets, and incomplete financial markets
- Progressive income tax, social security, minimum consumption program
- Dynamic stochastic general equilibrium

The Model: Preferences and Technology

- Preferences:

$$u\left(c,l,h\right)=\frac{\left(\left(c^{\eta}\times\left(1-l-1_{[l>0]}\bar{l}_j\right)^{1-\eta}\right)^{\kappa}\times h^{1-\kappa}\right)^{1-\sigma}}{1-\sigma}$$

- Health capital:

$$h_j=\overbrace{\phi_j m_j^{\xi}}^{\text{Investment}}+\overbrace{\left(1-\delta_j^h\right)h_{j-1}}^{\text{Trend}}+\overbrace{\epsilon_j^h}^{\text{Disturbance}}$$

- Human capital ("labor"): $e_j=e\left(\vartheta,h_j,\epsilon_j^l\right)$

- Health, labor income and employer insurance shocks:

$$\Pr\left(\epsilon_{j+1}^h|\epsilon_j^h\right)\in\Pi_j^h\ ,\ \Pr\left(\epsilon_{j+1}^l|\epsilon_j^l\right)\in\Pi_j^l\text{ and }\Pr\left(\epsilon_{j+1}^{GHI}|\epsilon_j^{GHI}\right)\in\Pi_{j,\vartheta}^{GHI}$$

The Model: Health Insurance Arrangements

- Private health insurance: group (GHI) or individual (IHI)
- Public (social) health insurance: Medicaid or Medicare
- Health insurance status:

$$in_j = \begin{cases} 0 & \text{if no insurance} \\ 1 & \text{if private GHI} \\ 2 & \text{if private IHI} \\ 3 & \text{if public insurance} \end{cases}$$

The Model: Out-of-pocket Health Spending

- Agent's out-of-pocket health expenditures depend on insurance state

$$o\left(m_j\right) = \begin{cases} p_m^{in_j} \times m_j, & \text{if } in_j = 0 \\ \rho^{in_j}\left(p_m^{in_j} \times m_j\right), & \text{if } in_j > 0 \end{cases}$$

The Model: Technology and Firms

- Final goods C production sector for price $p_C = 1$:

$$\max_{\{K,\ L\}} \{F(K, L) - qK - wL\}$$

- Medical services M production sector for price p_m:

$$\max_{\{K_m,\ L_m\}} \{p_m F_m(K_m, L_m) - qK_m - wL_m\}$$

- p_m is a base price for medical services
  - Price paid by households depends on insurance state:

$$p_j^{in_j} = \left(1 + \nu^{in_j}\right) p_m$$

- ν^{in_j} is an insurance state dependent markup factor
- Profits are redistributed to all surviving agents

The Model: Household Problem - Timing

12.5cm6cm

../Graphs/cjTiming2.pdf

Recursive Formulation

Remaining Parts

- Insurance companies GHI and IHI clear zero profit condition Details
- Government budget constraint clears Details
- Pension program financed via payroll tax Details
- Accidental bequests to surviving individuals Details
- Competitive Equilibrium Details

Calibration

Calibration

Parameterization and Calibration

- Goal: to match U.S. data pre-ACA (before 2010)
- Data sources:
  - MEPS: labor supply, health shocks, health expenditures, coinsurance rates
  - PSID: initial asset distribution
  - CENSUS: demographic profiles
  - Previous studies: income process, labor shocks, aggregates

More Calibration Details

Moment Matching: Health Expenditures

../Graphs/cjMedicalSpendingModelvsData.pdf

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Moment Matching: Insurance Take-up Rates

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Income Distribution

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Calibration: Matched Moments

Moments	Model	Data	Source
Medical Expenses HH Income	17.6%	17.07%	CMS communication
Workers IHI	6.7%	7.6%	MEPS 1999/2009
Workers IHI	62.2%	63.6%	MEPS 1999/2009
Workers Medicaid	9.0%	9.2%	MEPS 1999/2009
Capital Output Ratio: K/Y	2.9	$2.6-3$	NIPA
Interest Rate: R	4.2%	4%	NIPA
Size of Social Security: SocSec/Y	5.9%	5%	OMB 2008
Medicare/Y	3.1%	$2.5-3.1$%	U.S. Department of Health 2007
Payroll Tax Social Security: τ^{Soc}	9.4%	$10-12$%	IRS
Consumption Tax: τ^{C}	5.0%	5.7%	Mendoza et al. (1994)
Payroll Tax Medicare: τ^{Med}	2.9%	$1.5-2.9$%	Social Security Update (2007)
Total Tax Revenue/Y	21.8%	28.3%	Stephenson (1998) and Barro and Sahasakul (1986)
Medical spending profile		see figure	

Analysis

Experiments

Experiments

1. Construct a benchmark economy with no health insurance system for comparison (Self-insurance only)

2. Quantify the social insurance provided by three insurance regimes
   1. A mix of private and public health insurance (US)
   2. A universal public health insurance (Europe)
   3. A private insurance system with and without regulation

3. Characterize an optimal health insurance policy (along one dimension so far: coinsurance rate)

The US Mix of Private and Public Insurance

	[1] No Insurance	[2] US System
Workers Insured (%):	0.00	77.46
• IHI (%)	0.00	6.37
• GHI (%)	0.00	61.43
• Medicaid (%)	0.00	9.65
Medicare (%)	0.00	17.68
Med. cons. (M)	100.00	107.71
Output (Y_c)	100.00	93.09
Welfare (CEV):	0.00	+3.79
• Inc. Gr. 1 (low)	0.00	+4.45
• Inc. Gr. 2	0.00	+5.29
• Inc. Gr. 3	0.00	+1.73
• Inc. Gr. 4	0.00	+0.80

Without price markup for No-Insurance

Public Insurance

- UPHI System
- Mandatory membership
  - Open enrollment
  - Community rating (if premium contributions are made)
  - Financed by payroll or consumption tax
- In the model: UPHI system with NO private option fully financed with taxes and mandatory enrollment

Public Insurance: Aggregate and Welfare

	[1] No Ins.	[3] UPHI ($\rho^{Med} = 0.2$)	
		(a) UPHI via τ_C	(b) UPHI via τ_V
Insured (%):	0.00	100.00	100.00
• Public health insurance (%)	0.00	100.00	100.00
Cons. tax - τ_C (%)	4.31	19.59	3.60
Payroll tax - τ_V(%)	0.00	0.00	13.49
Med. consumption (M)	100.00	117.09	111.57
Output (Y_c)	100.00	91.78	86.90
Welfare (CEV):	0.00	+4.06	+4.06
• Income Group 1 (low)	0.00	+18.69	+25.52
• Income Group 2	0.00	+6.19	+5.22
• Income Group 3	0.00	−8.1	−11.96
• Income Group 4	0.00	−13.13	−16.50

Different Coinsurance Rates

	[3c] UPHI with τ_C/τ_V adjusting							
	ρ^{Med}=**0.1**		ρ^{Med}=**0.2**		ρ^{Med}=**0.3**		ρ^{Med}=**0.4**	
Tax: τ_C/τ_V (%)	31.0	20.6	19.6	13.49	16.6	11.3	14.1	9.10
Med.cons. (M)	148.8	133.5	117.1	111.6	108.3	105.4	104.3	03.1
Output (Y_c)	88.3	80.7	91.8	86.9	93.7	89.6	95.2	91.9
Welfare (CEV):	-7.0	-4.7	+4.1	+4.1	+7.3	+6.9	+7.1	+6.6
• Inc. Gr.1 (low)	+10.1	+24.8	+18.7	+25.5	+20.2	+25.2	+18.0	+21.0
• Inc. Group 2	-5.1	-4.6	+6.2	+5.2	+9.4	+8.4	+9.3	+8.2
• Inc. Group 3	-20.6	-25.0	-8.1	-12.0	-4.0	-7.2	-2.4	-5.1
• Inc. Group 4	-26.5	-30.9	-13.2	-16.5	-6.7	-12.0	-6.7	-9.0

Optimal Coinsurance Policy

- The government maximizes the ex-ante lifetime utility of an agent born into the stationary equilibrium implied by the chosen coinsurance rate

$$WF\left(\rho^{Med}\right) = \max_{\rho^{Med}} \int V\left(x_{j=1}\right) d\Lambda\left(x_{j=1}\right)$$

- The government lets consumption tax or payroll tax adjust
- Optimal coinsurance rates near 0.3

Private Insurance

- No regulation (IHI for workers)
- Price discrimination: age and health status $prem = prem(j, h_j)$
  - No government subsidy
  - No Medicaid/Medicare
- Regulation and subsidy (GHI for workers)
  - No price discrimination: community rating
  - Premium payment is tax deductible
  - No Medicaid/Medicare

Private Insurance: Aggregates and Welfare

	[1] No Ins.	[4] Private Health Insurance	
		Unregulated - IHI	Regulated - GHI
Insured (%)	0.00	0.00	82.90
• IHI (%)	0.00	0.00	0.00
• GHI (%)	0.00	0.00	82.90
Med. consumption	100.00	100.00	104.60
Med. spending	100.00	100.00	83.12
Capital (K_c)	100.00	100.00	98.57
Output (Y_c)	100.00	100.00	100.45
Welfare (CEV)	0.00	0.00	+0.97
• Income Group 1 (low)	0.00	0.00	+1.11
• Income Group 2	0.00	0.00	+0.93
• Income Group 3	0.00	0.00	+0.60
• Income Group 4	0.00	0.00	+2.84

Private Insurance: GHI for Retirees

	[4c] GHI for retirees				
	ρ^{GHI}=**0.1**	**0.2**	**0.25**	**0.3**	**0.4**
Insured retirees(%):					
• GHI	18.79	24.65	26.22	27.50	0.03
Med. consumption (M)	104.97	104.52	104.49	104.45	104.59
Med. spending ($p_m M$)	83.29	83.01	82.99	82.96	83.11
Capital (Y_c)	101.86	100.74	100.66	100.59	100.45
Output (K_c)	99.20	98.97	98.85	98.73	98.58
Welfare (CEV):	+4.08	+4.33	+4.14	+3.92	+0.99
• Income Group 1 (low)	+1.26	+1.38	+1.35	+1.27	+1.13
• Income Group 2	+3.36	+3.78	+3.65	+3.49	+0.95
• Income Group 3	+6.37	+6.55	+6.19	+5.38	+0.62
• Income Group 4	+10.30	+10.13	+9.62	+9.12	+2.89

Out-of-Pocket Health Spending Variation

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../Graphs/Fig_StandardDeviation_OOP_NoIns.pdf

Health Capital Variation

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Coefficient of Variation: H

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Conclusion

Conclusion

1. Construct a heterogeneous agents macro-model with health capital accumulation
2. Account for lifecycle patterns of health risk and expenditures and insurance take-up rates
3. Quantify the welfare effects of different health insurance systems

Extensions

1. Identify (quantitatively) the insurance, incentive and financing effect
2. Relax some assumptions
   - Endogenize survival probability $\rightarrow$ affects assets accumulation
3. Additional experiments
   - Push Medicare eligibility to 66, 67, etc.
   - Increase/decrease public insurance eligibility in current US system

References

References

Supplementary Material

Supplementary Material

Worker's Dynamic Optimization Problem

$$V(x_j) = \max_{\{c_j, l_j, m_j, a_{j+1}, in_{j+1}\}} \left\{ u(c_j, h_j, l_j, m_j) + \beta \pi_j E\left[V(x_{j+1}) \mid \epsilon_j^l, \epsilon_j^h, \epsilon_j^{GHI} \right] \right\}$$

$s.t.$

$$\left(1+\tau^C\right) c_j + (1+g)\, a_{j+1} + o(m_j)$$

$$+1_{\{in_{j+1}=1\}} \text{prem}^{\text{IHI}}(j,h) + 1_{\{in_{j+1}=2\}} \text{prem}^{\text{GHI}}$$

$$= y_j^W - tax_j + t_j^{\text{SI}}$$

$$0 \le a_{j+11}$$

$$0 \le l_j \le 1$$

Worker's Dynamic Optimization Problem

$$
\begin{aligned}
y_j^W &= e\left(\vartheta, h_j, \epsilon_j^l\right) \times l_j \times w + R\left(a_j + t^{\text{Beq}}\right) + \text{profits} \\
tax_j &= \tilde{\tau}\left(\tilde{y}_j^W\right) + tax_j^{SS} + tax_j^{\text{Med}} \\
\tilde{y}_j^W &= y_j^W - a_j - t^{\text{Beq}} - 1_{[in_{j+1}=2]}\text{prem}^{\text{GHI}} - 0.5\left(tax_j^{SS} + tax_j^{\text{Med}}\right) \\
tax_j^{SS} &= \tau^{\text{Soc}} \times \min\left(\bar{y}_{ss},\ e\left(\vartheta, h_j, \epsilon_j^L\right) \times l_j \times w - 1_{[in_{j+1}=2]}\text{prem}^{\text{GHI}}\right) \\
tax_j^{\text{Med}} &= \tau^{\text{Med}} \times \left(e\left(\vartheta, h_j, \epsilon_j^l\right) \times l_j \times w - 1_{[in_{j+1}=2]}\text{prem}^{\text{GHI}}\right) \\
t_j^{\text{SI}} &= \max\left[0,\ \underline{c} + o\left(m_j\right) + tax_j - y_j^W\right]
\end{aligned}
$$

Retiree's Dynamic Optimization Problem

$$V(x_j) = \max_{\{c_j, m_j, a_{j+1}, in_{j+1}\}} \left\{ u(c_j, h_j) + \beta \pi_j E\left[V(x_{j+1}) \mid \epsilon_j^h \right] \right\} \ s.t.$$

$$\begin{aligned} \left(1+\tau^C\right) c_j + (1+g) a_{j+1} + o(m_j) + 1_{\{in_{j+1}>0\}} \text{prem}^{\text{in}} &= y_j^R + t_j^{\text{SI}} - tax_j, \\ a_{j+1} &\geq 0, \end{aligned}$$

where

$$\begin{aligned} y_j^R &= t_j^{\text{SS}} + R\left(a_j + t^{\text{Beq}}\right) + \text{profits}^M, \\ tax_j &= \tilde{\tau}\left(\tilde{y}_j^R\right), \\ \tilde{y}_j^R &= y_j^R - a_j - t_j^{\text{Beq}}, \\ t_j^{\text{SI}} &= \max\left[0, \underline{c} + o(m_j) + tax_j - y_j^R\right]. \end{aligned}$$

Back to Worker Problem

Insurance Sector

$$
\begin{aligned}
&\left(1+\omega_{j,h}^{\text{IHI}}\right)\sum_{j=2}^{J_1}\mu_j\int\left[1_{\left[in_j\left(x_j\right)=1\right]}\left(1-\rho^{\text{IHI}}\right)p_m^{\text{IHI}}m_{j,h}\left(x_{j,h}\right)\right]d\Lambda\left(x_{j,h}\right)\\
=\quad & R\sum_{j=1}^{J_1-1}\mu_j\int\left(1_{\left[in_{j,h}\left(x_{j,h}\right)=1\right]}\mathbf{prem}^{\mathbf{IHI}}\left(j,h\right)\right)d\Lambda\left(x_{j,h}\right)
\end{aligned}
$$

$$
\begin{aligned}
&\left(1+\omega^{\text{GHI}}\right)\sum_{j=2}^{J_1}\mu_j\int\left[1_{\left[in_j\left(x_j\right)=2\right]}\left(1-\rho^{\text{GHI}}\right)p_m^{\text{GHI}}m_j\left(x_j\right)\right]d\Lambda\left(x_j\right)\\
=\quad & R\sum_{j=1}^{J_1-1}\mu_j\int\left(1_{\left[in_j\left(x_j\right)=2\right]}\mathbf{prem}^{\mathbf{GHI}}\right)d\Lambda\left(x_j\right),
\end{aligned}
$$

Back to Remaining Parts

Government Budget

$$G + T^{\mathrm{SI}} + T^{Med} = \sum_{j=1}^{J} \mu_j \int \left[\tau^C c(x_j) + tax_j(x_j)\right] d\Lambda(x_j),$$

where

$$T^{\mathrm{SI}} = \sum_{j=1}^{J} \mu_j \int t_j^{\mathrm{SI}}(x_j)\, d\Lambda(x_j)$$

$$T^{\mathrm{Med}} = \sum_{j=1}^{J} \mu_j \int \left(1 - \rho^{Med}\right) p_m^{Med} m_j(x_j)\, d\Lambda(x_j) - \sum_{j=1}^{J} \mu_j \int \mathrm{prem}^{Med}(x_j)\, d\Lambda(x_j)$$

Back to Remaining Parts

Pensions and Bequests

- Pensions:

$$\sum_{j=J_1+1}^{J} \mu_j \int t_j^{\text{Soc}}(x_j)\, d\Lambda(x_j)$$

$$= \sum_{j=1}^{J_1} \mu_j \int \tau^{\text{Soc}} \times (e_j(x_j) \times l_j(x_j) \times w)\, d\Lambda(x_j)$$

- Accidental Bequests:

$$\sum_{j=1}^{J_1} \mu_j \int t_j^{\text{Beq}}(x_j)\, d\Lambda(x_j) = \sum_{j=1}^{J} \int \tilde{\mu}_j a_j(x_j)\, d\Lambda(x_j)$$

Back to Remaining Parts

A Competitive Equilibrium

1. Given the transition probability matrices and the exogenous government policies, a competitive equilibrium is a collection of sequences of distributions of household decisions, aggregate capital stocks of physical and human capital, and market prices such that

- Agents solve the consumer problem
- The F.O.Cs of firms hold
- The budget constraints of insurances companies hold
- All markets clear
- All government programs and the general budget clear
- The distribution is stationary

Competitive Equilibrium Definition

- Given $\left\{\Pi_j^l, \Pi_j^h, \Pi_{j,\vartheta}^{\text{GHI}}\right\}_{j=1}^J$, $\{\pi_j\}_{j=1}^J$ and
- $\left\{tax\left(x_j\right), \tau^C, \text{prem}^R, \tau^{SS}, \tau^{\text{Med}}\right\}_{j=1}^J$,

a competitive equilibrium is a collection of sequences of:

- distributions $\{\mu_j, \Lambda_j\left(x_j\right)\}_{j=1}^J$
- individual household decisions $\{c_j\left(x_j\right), l_j\left(x_j\right), a_{j+1}\left(x_j\right), m_j\left(x_j\right), in_{j+1}\left(x_j\right)\}_{j=1}^J$
- aggregate stocks of capital and labor $\{K, L, K_m, L_m\}$
- factor prices $\{w, q, R, p_m\}$
- markups $\left\{\omega^{\text{IHI}}, \omega^{\text{GHI}}, \nu^{in}\right\}$ and
- insurance premiums $\left\{\text{prem}^{\text{GHI}}, \text{prem}^{\text{IHI}}\left(j, h\right)\right\}_{j=1}^J$

such that:

Competitive Equilibrium

(a) $\{c_j(x_j), l_l(x_j), a_{j+1}(x_j), m_j(x_j), in_{j+1}(x_j)\}_{j=1}^{J}$ solves the consumer problem

(b) the firm first order conditions hold:

$$
\begin{aligned}
w &= F_L(K, L) = p_m F_{m,L}(K_m, L_m) \\
q &= F_K(K, L) = p_m F_{m,K}(K_m, L_m) \\
R &= q + 1 - \delta
\end{aligned}
$$

Competitive Equilibrium

(c) markets clear

$$
\begin{aligned}
K + K_m &= \sum_{j=1}^{J} \mu_j \int (a(x_j))\, d\Lambda(x_j) + \sum_{j=1j}^{J} \int \tilde{\mu}_j a_j(x_j)\, d\Lambda(x_j) \\
&+ \sum_{j=1}^{J_1-1} \mu_j \int \left(1_{[in_{j+1}=2]}(x_j) \times \text{prem}^{\text{IHI}}(j,h) \right) d\Lambda(x_j) \\
&+ \sum_{j=1}^{J_1-1} \mu_j \int \left(1_{[in_{j+1}=3]}(x_j) \times \text{prem}^{\text{GHI}} \right) d\Lambda(x_j)
\end{aligned}
$$

$$
T^{\text{Beq}} = \sum_{j=1j}^{J} \int \tilde{\mu}_j a_j(x_j)\, d\Lambda(x_j)
$$

$$
L + L_m = \sum_{j=1}^{J_1} \mu_j \int e_j(x_j) l_j(x_j)\, d\Lambda(x_j)
$$

Competitive Equilibrium

(d) the aggregate resource constraint holds

$$G + (1+g)\,S + \sum_{j=1}^{J} \mu_j \int \left(c\,(x_j) + p_m^{in_j(x_j)} m\,(x_j) \right) d\Lambda\,(x_j) + \text{Profit}^M = Y + (1-\delta)\,K$$

(e) the government programs clear

(f) the budget conditions of the insurance companies hold, and

(g) the distribution is stationary

$$(\mu_{j+1}, \Lambda\,(x_{j+1})) = T_{\mu,\Lambda}\,(\mu_j, \Lambda\,(x_j))\,,$$

where $T_{\mu,\Lambda}$ is a one period transition operator

Back to Remaining Parts

Health Capital

- Health capital accumulation:

$$h_j = \overbrace{\phi_j m_j^{\xi}}^{\text{Investment}} + \overbrace{\left(1 - \delta_j^h\right) h_{j-1}}^{\text{Trend}} + \overbrace{\epsilon_j^h}^{\text{Disturbance}}$$

- Health capital measure in MEPS: SF 12-v2
- $\delta^h \rightarrow$ MEPS$|$insured & 0-medical spenders $\rightarrow \bar{h}_j = \overbrace{\left(1 - \delta_j^h\right) \bar{h}_{j-1}}^{\text{Trend}}$
- ϵ^h and Π^h from MEPS

Approaches

1. Data Restriction Approach

- Use $m = 0$ types in data and directly calculate ϵ_j^h
  - Creates sample selection bias

1. Estimation of health production function $\rightarrow$ back out ϵ_j^h
   - Data limitation, MEPS is rotating panel

2. Estimation and Calibration:
   - Starting with estimate of ϵ^h
   - Match model to data adjusting ϕ, ξ
   - Use ϕ, ξ and MEPS to calculate new ϵ_l^h and Π^h, then repeat
   - Convergence problem

Current Approach for Calibration of Health Shocks

- MEPS data split each cohort j into 4 risk groups
- Average health capital per risk group: $\left\{\overline{h}^{\max}_{j,d} > \overline{h}^{3}_{j,d} > \overline{h}^{2}_{j,d} > \overline{h}^{1}_{j,d}\right\}$
- Define shock magnitude:

$$\epsilon^h_j = \left\{0, \frac{\overline{h}^{3}_{j,d} - \overline{h}^{\max}_{j,d}}{\overline{h}^{\max}_{j,d}}, \frac{\overline{h}^{2}_{j,d} - \overline{h}^{\max}_{j,d}}{\overline{h}^{\max}_{j,d}}, \frac{\overline{h}^{1}_{j,d} - \overline{h}^{\max}_{j,d}}{\overline{h}^{\max}_{j,d}}\right\} \times h^{max}_m$$

- Assumption: Associate resulting health shock with risk group by age
- Non-parametric estimation of transition probabilities health shocks

Human Capital Formation

- Human capital:

$$e = e_j\left(\vartheta, h_j, \epsilon^l\right) = \epsilon^l \times \left(\overline{wage}_{j,\vartheta}\right)^{\chi} \times \left(\exp\left(\frac{h_j - \overline{h}_{j,\vartheta}}{\overline{h}_{j,\vartheta}}\right)\right)^{1-\chi}$$

- $\overline{wage}_{j,\vartheta}$ from MEPS
- ϵ^l and Π^l from prior studies using Tauchen (1986) procedure

Parameterization: Production Function

- Final goods production:

$$F(K,L) = AK^{\alpha}L^{1-\alpha}$$

- Medical services production:

$$F_m(K_m,L_m) = A_m K_m^{\alpha_m} L_m^{1-\alpha_m}$$

- Parameters from other studies

- $A = 1$ and A_m calibrated to match aggregate health spending

Calibration: Price of Medical Services

- Medicare/Medicaid reimbursement rates (to providers) are about 70% of private HI rates (CMS)
- Average price markup for uninsured around 60% (**?**)
- Large GHI can negotiate favorable prices (**?**)
- Price vector:

$$\left[p_m^{\text{noIns}}, p_m^{\text{IHI}}, p_m^{\text{GHI}}, p_m^{\text{Maid}}, p_m^{\text{Mcare}}\right] = (1 + [0.70, 0.25, 0.10, 0.0, -0.10]) \times p_m$$

Calibration: Group Insurance Offers

- Offer shock: $\epsilon^{GHI} = \{0, 1\}$ where
  - 0 indicates no offer and
  - 1 indicates a group insurance offer
- MEPS variables OFFER31X, OFFER42X, and OFFER53X
- Probability of a GHI offer is highly correlated with income
- $\Pi^{h}_{j,\vartheta}$ with elements $\Pr\left(\epsilon^{\mathrm{GHI}}_{j+1} | \epsilon^{\mathrm{GHI}}_{j}, \vartheta\right)$
- ϑ indicates permanent income group

Calibration: Coinsurance Rates

- Coinsurance rates from MEPS
- Premiums clear insurance constraints
- Markup profits of GHI are zero
- Markup profits of IHI are calibrated to match IHI take up rate
- IHI profits used to cross-subsidize GHI

Calibration: Pension Payments

- L is average/aggregate effective human capital and
- $w \times L$ average wage income
- Pension payments: $t^{\text{Soc}}(\vartheta) = \Psi(\vartheta) \times w \times L$
- where $\Psi(\vartheta)$ is replacement rate that determines the size of pension payments
- Total pension amount to 4.1 percent of GDP

Calibration: Public Health Insurance

- Premium for medicare at 2.11% of GDP (Jeske and Kitao (2009))
- Coinsurance rates for Medicare and Medicaid from MEPS
- Calibrated: Medicaid eligibility FPL_{Maid} at 60% of FPL to match % on Medicaid
- Calibrated: Asset test for Medicaid to match Medicaid take-up profile

Calibration: Taxes

- Gouveia and Strauss (1994) for federal progressive income tax

$$\tilde{\tau}\left(\tilde{y}\right) = a_0\left[\tilde{y} - \left(\tilde{y}^{-a_1} + a_2\right)^{-1/a_1}\right]$$

- Medicare tax is 2.9%
- Social security tax is 9%
- Consumption tax is 5%

Calibration: External Parameters

Parameters:		**Explanation/Source:**
Periods working	$J_1 = 9$	
Periods retired	$J_2 = 6$	
Population growth rate	$n = 1.2\%$	CMS 2010
Years modeled	$years = 75$	from age 20 to 95
Total factor productivity	$A = 1$	Normalization
Capital share in production	$\alpha = 0.33$	KydlandPescott1982
Capital in medical services production	$\alpha_m = 0.26$	Donahoe (2000)
Capital depreciation	$\delta = 10\%$	KydlandPescott1982
Health depreciation	$\delta_{h,j} = [0.6\% - 2.13\%]$	MEPS 1999/2009
Survival probabilities	π_j	CMS 2010
Health Shocks	see appendix	MEPS 1999/2009
Health transition prob.	see appendix	MEPS 1999/2009
Productivity shocks	see appendix	MEPS 1999/2009
Productivity transition prob.	see appendix	MEPS 1999/2009

Calibration: Calibrated Parameters

Parameters:		**Explanation/Source:**
Relative risk aversion	$\sigma = 3.0$	to match $\frac{K}{Y}$ and R
Prefs c vs. l	$\eta = 0.43$	to match labor supply and $\frac{p \times M}{Y}$
Disutility of health spending	$\eta_m = 1.5$	to match health capital profile
Prefs c, l vs. health	$\kappa = 0.89$	to match labor supply and $\frac{p \times M}{Y}$
Discount factor	$\beta = 1.0$	to match $\frac{K}{Y}$ and R
Health production productivity	$\phi_j \in [0.7 - 0.99]$	to match spending profile
TFP in medical production	$A_m = 0.4$	to match $\frac{p \times M}{Y}$
Production parameter of health	$\xi = 0.175$	to match $\frac{p \times M}{Y}$
Effective labor production	$\chi = 0.26$	to match labor supply
Health productivity	$\theta = 1$	used for sensitivity analysis
Pension replacement rate	$\Psi = 40\%$	to match τ^{soc}
Residual Gov't spending	$\Delta_C = 12.0\%$	to match size of tax revenue
Minimum health state	$h_{\min} = 0.01$	to match health spending
Internal parameters		

Back to Calibration

US vs No Insurance with and without Price Markups

	[2] US System vs. No-Insurance	[2b] US vs. No- Insurance w/o p_m markups
Workers Insured (%):	77.46	
• IHI (%)	6.37	
• GHI (%)	61.43	
• Medicaid (%)	9.65	
Medicare (%)	17.68	
Med. cons. (M)	107.71	107.21
Med. spend. ($p_m M$)	88.35	114.04
Capital (K_c)	87.47	87.59
Output (Y_c)	93.09	92.74
Welfare (CEV):	+3.79	+4.16
• Inc. Gr. 1 (low)	+4.45	+2.51
• Inc. Gr. 2	+5.29	+5.43
• Inc. Gr. 3	+1.73	+4.06