Health Risk and Insurance Over the Lifecycle

Juergen Jung
Towson University, Maryland

Chung Tran
Australian National University

CBE - Conference
May 2015

Disclaimer

This project was supported by the Agency for Healthcare Research and Quality (AHRQ, Grant No.: R03HS019796), the Australian Research Council (ARC, Grant No.: CE110001029), CBE-Towson University Summer Research Support, and funds from the Centers for Medicare & Medicaid Services, Office of the Actuary (CMS/OACT).

The content is solely the responsibility of the authors and does not represent the official views of the funding institutions.

U.S. Medical vs. Non-Medical Consumption

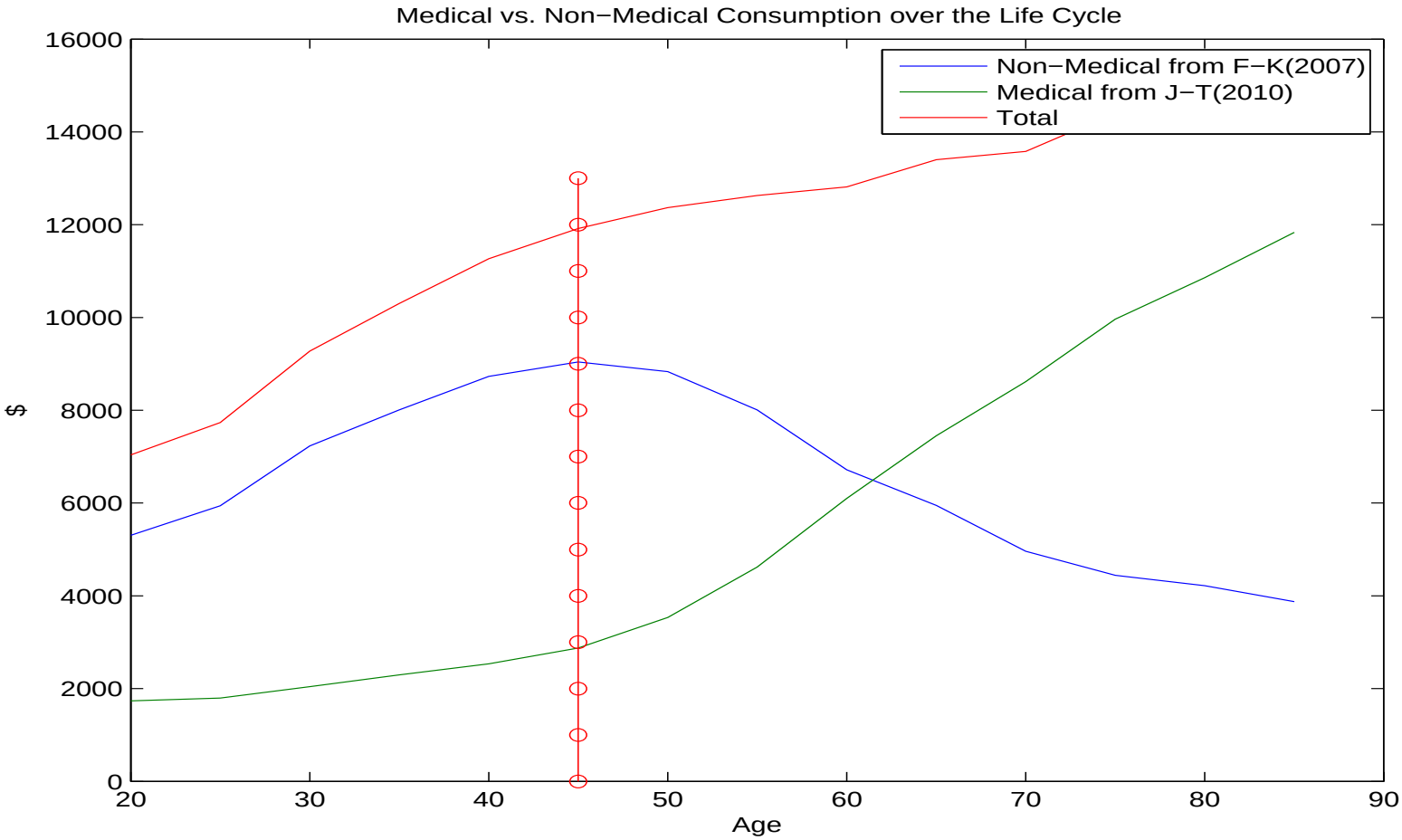


Figure 1: MEPS 1996-2007

Healthcare Financing in OECD Economies

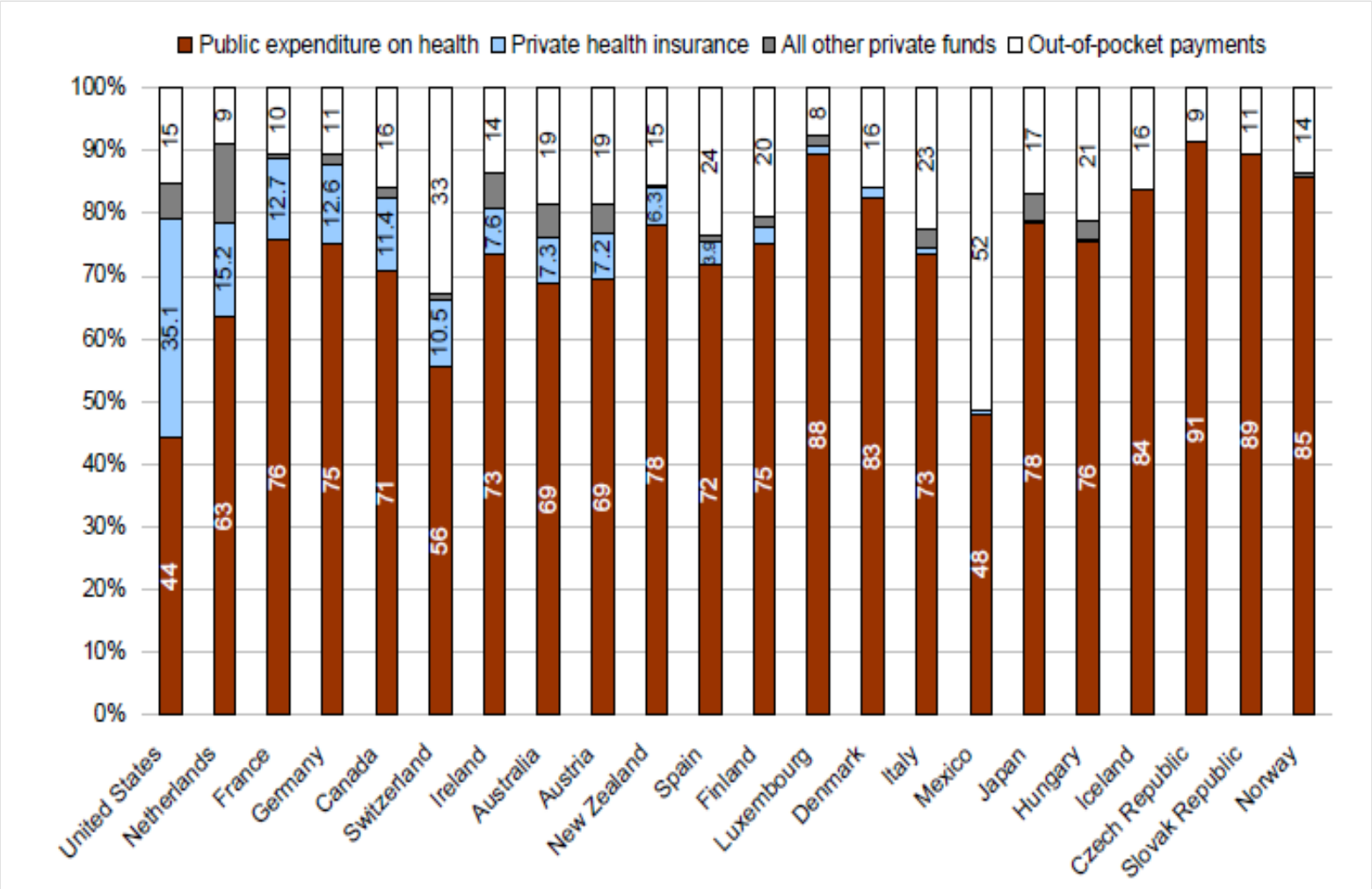


Figure 2: OECD (2004)

U.S. Health Spending

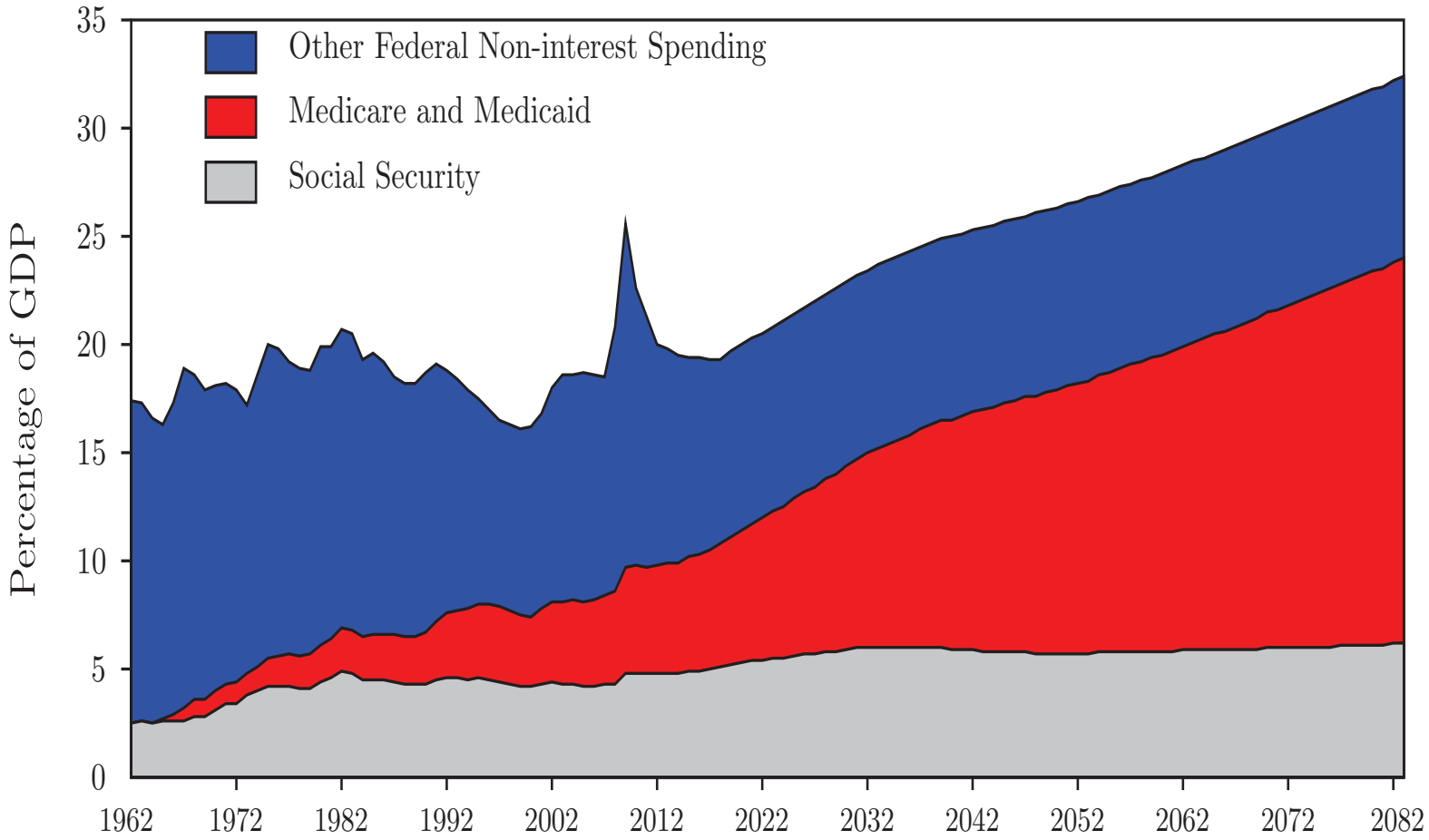


Figure 3: CBO (2010)

Our Research Program

1. Develop macroeconomic models with micro-foundations of health
2. Analyze economic aspects of health-related behavior
3. Study implications of healthcare policies
   - The distributional effects: health inequality and wealth inequality
   - The macroeconomic aggregates and welfare.

This Paper

1. Develop a stochastic dynamic general equilibrium **overlapping generations model** with
   1. endogenous health expenditures and insurance choice
   2. and a realistic structure of health insurance systems

   that accounts for the patterns of

   1. health expenditures and insurance over the life cycle
   2. the distribution of income and health expenditures observed in the data

2. **Goal**: quantify the effects of social health insurance on
   1. macroeconomic aggregates and
   2. welfare.

Results Preview

- **Lifecycle health risk induces demand for health insurance**
- **Private health insurance: very limited**
  - Competitive markets fail to insure lifecycle health risk
  - Introduction of market regulations improves
    - insurance coverage (up to 70%)
    - small welfare gains(2.3%)
- **Public (social) health insurance: important**
  - The European-style heath insurance system
    - Aggregate output loss (9%)
    - but large welfare gains (5.5%)
  - The American-style insurance system: Mix of public and private insurance
    - Aggregate output loss (7.5%)
    - and welfare gain (between 3 and 4%)

Related Literature

1. Micro-health economics
   - Grossman (1972a,1972b), Grossman (2000)
   - Pauly(1974), Rothschild and Stiglitz (1976)
   - Besley (1989), Selden (1993), Blomqvist and Johansson (1997)

2. Quantitative macroeconomics/public finance
   - Ayagari (1994), Imrohoroglu et al (1995), Hugget (1996)

3. Macro-health economics:
   - Exogeneous health expenditure shocks: Kotlikoff (1988), Leven (1985), Palumbo (1999), Attanasio, Kitao and Violante (2008), Jeske and Kitao (2009), Pashchenko and Porapakkarm (2010), Janicki (2011)
   - Endogenous health expenditures and insurance: Suen (2006), Feng (2009), and Jung and Tran (2008, 2010, 2013)

MODEL

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

- Overlapping generations model with
  - 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
    - endogenous health insurance choice
- Maket structure: goods, capital, labor markets, and incomplete financial markets
- Government-run health insurance systems
- Dynamic stochastic general equilibrium

The Model: Preferences and technology

- Preferences:

$$u\left(c_j, l_j, h_j\right)$$

- Health capital:

$$h_j = h\left(m_j, h_{j-1}, \delta^h, \epsilon_j^h\right)$$

- Human capital ("labor"):

$$e_j = e\left(\vartheta, h_j, \epsilon_j^l\right)$$

- Health and labor income shocks:

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

The Model: Health Insurance Arrangements

- Private health insurance
- Public (social) health insurance
- Health insurance status:

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

The Model: Out-of-pocket Health Spending

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

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

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:

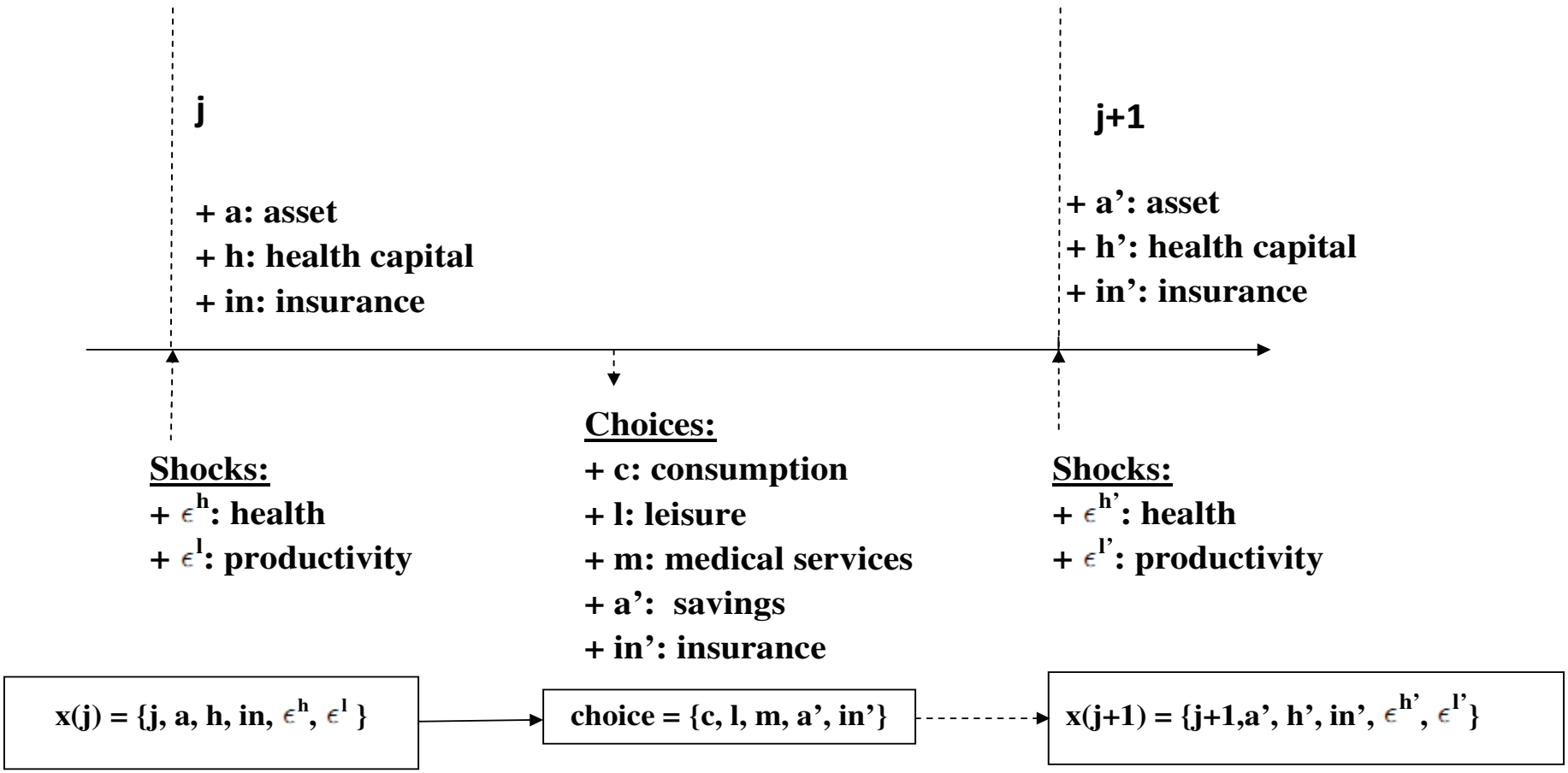
$$\max_{\{K_m,\ L_m\}} \{p_m F_m(K_m, L_m) - qK_m - wL_m\}$$

- 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



Insurance Sector

$$\left(1+\omega^{\text{in}}\right)\sum_{j=1}^{J}\mu_j\int\left[1_{\left[in_j\left(x_j\right)=1\right]}\left(1-\rho^{\text{in}}\right)p_m^{\text{in}}m_j\left(x_j\right)\right]d\Lambda\left(x_j\right)$$

$$= \quad R\sum_{j=1}^{J}\mu_j\int\left(1_{\left[in_j\left(x_j\right)=1\right]}\text{prem}^{\text{in}}\right)d\Lambda\left(x_j\right),$$

Government Budget

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

where $T^{\mathsf{SI}} = \sum_{j=1}^{J} \mu_j \int t_j^{\mathsf{SI}}\left(x_j\right) d\Lambda\left(x_j\right)$ and

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

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:

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

A Competitive Equilibrium

Given the transition probability matrices and the exogeneous 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

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

The U.S. Health Insurance System

- Mixed system:
  - Private health insurance for working population
    - Individual based health insurance (IHI)
    - Group based health insurance (GHI)
  - Public health insurance
    - Medicare for retirees
    - Medicaid for the poor: 2/3 is retirees
- Key Facts:
  - Low coverage: 47 million uninsured in 2010 ($\approx 15\%$)
  - High cost: 16% of GDP on health in 2010 and close to 20% by 2015

Moment Matching: Health Expenditures

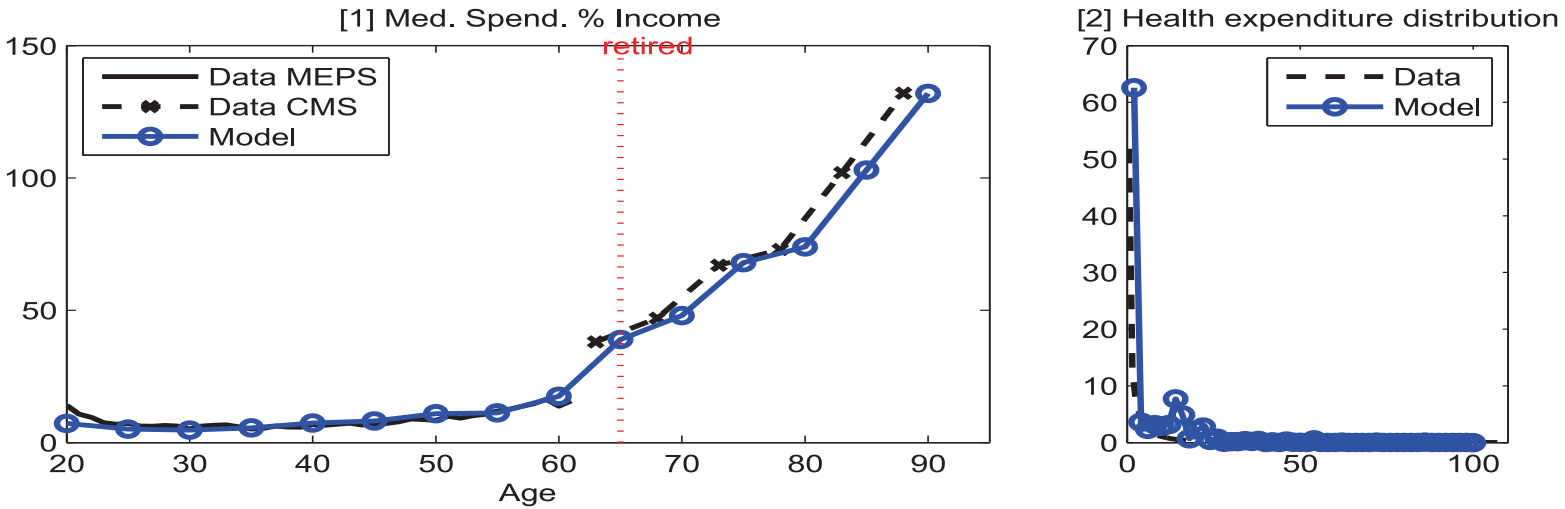


Figure 4: Moment matching: Model vs. Data

Moment Matching: Insurance Take-up Rates

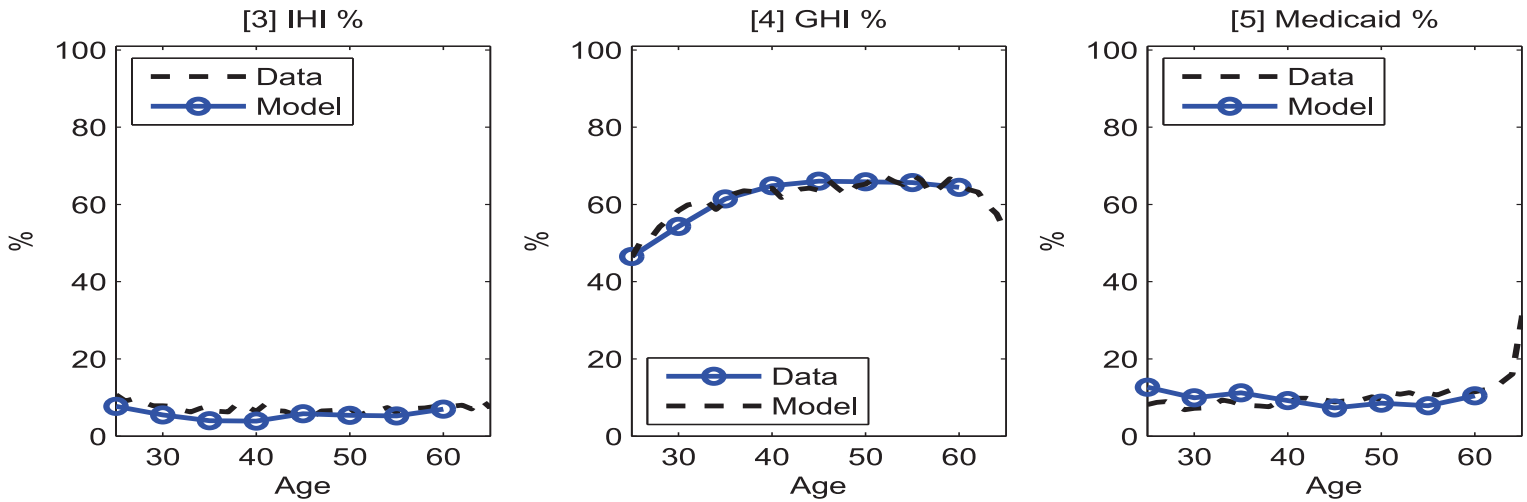


Figure 5: Moment matching: Model vs. Data

Income Distribution

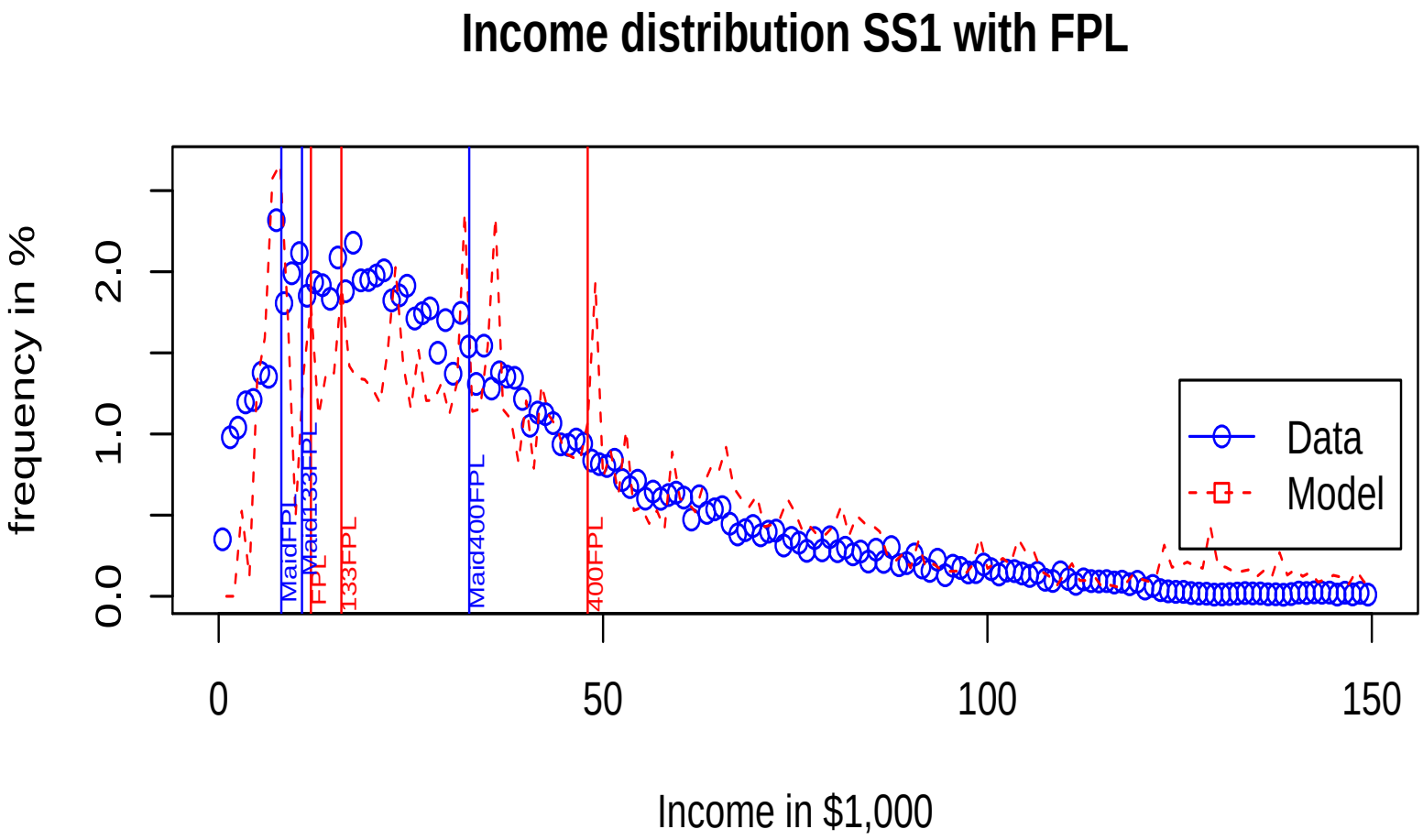


Figure 6: Moment matching: Model vs. Data

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
- Size of Medicare: $Medicare/Y$	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 BarroSahasakul (1986)
- Medical spending profile		see figure	
- Medical spending distribution		see figure	
- Insurance take-up ratios		see figure	
Total number of moments			

EXPERIMENTS

Experiments

1. Construct a benchmark economy with no health insurance for comparison
2. Introduce alternative insurance regimes
   1. Private insurance
   2. Public health insurance
   3. A mix of private and public health inusurance
3. Quantify the macroeconomic and welfare imiplications

Private Insurance

- Unregulated market (IHI)
  - Price discrimination: age and health status $prem = prem(j, h_j)$
  - No government subsidy
- Regulated market (GHI)
  - No price discrimination: community rating
  - Premium payment is tax deductible

Private Insurance: Aggregates and Welfare

	[1] No Ins.	[2] Private Health Insurance Only	
		(a) Unregulated	(b) Regulated
Insured (%)	0.00	8.03	70.62
+ IHI (%)	0.00	9.76	0.00
+ GHI (%)	0.00	0.00	70.62
Capital (K)	100.00	100.15	99.40
Output (GDP)	100.00	100.36	100.75
Welfare	0.00	−0.26	2.31

Table 1: The Effects of Private Health Insurance.

Public Insurance

- The European/Canadian/Australian health insurance system
  - Mandatory membership
  - Open enrollment
  - Community rating
  - financed by payroll or consumption tax

Public Insurance: Aggregate and Welfare

	[1] No Ins.	[3] Public Health Insurance Only	
		(a) Medicaid for all	(b) Medicare for all
Insured (%):	0.00	100.00	100.00
+ Medicaid (%)	0.00	100.00	00.00
+ Medicare (%)	0.00	00.00	100.00
Cons. tax - τ_C (%)	4.31	23.36	17.02
Capital (K_c)	100.00	86.11	86.71
Output (Y_c)	100.00	90.42	91.41
Welfare	0.00	5.59	5.81

Table 2: The Effects of Social Health Insurance

Mix of Private and Public Insurance

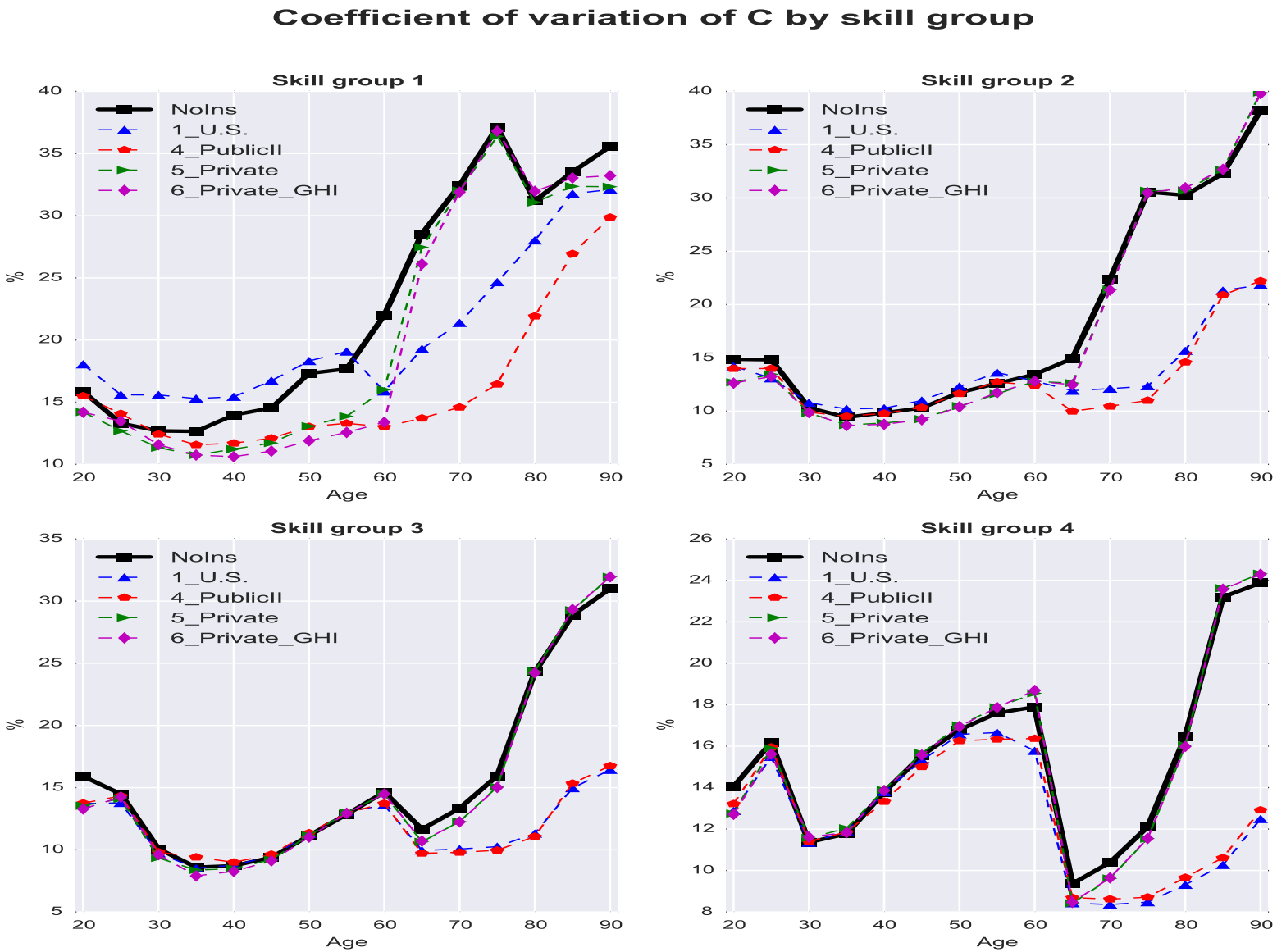
- The U.S. health insurance system
  - Partial coverage
  - Private insurance for workers
  - Public insurance for retirees and the poor
- Two arrangements
  - Pre-ACA
  - Post-ACA

Mix of Private and Public Insurance

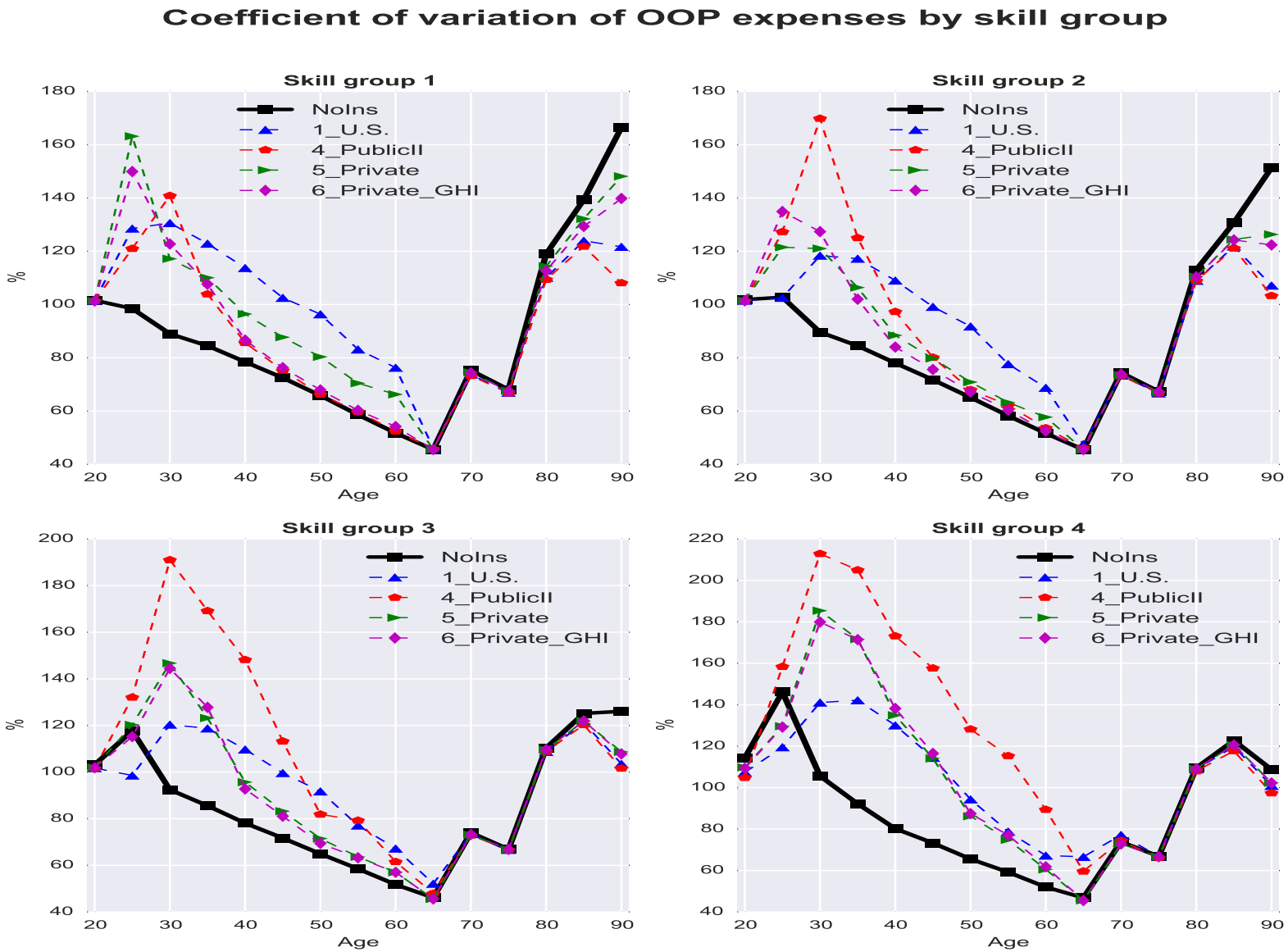
	[1] No Ins.	[4] Public and Private Ins.	
		(a) Pre-ACA	(b) After-ACA
Insured (%):	0.00	80.42	92.09
+ IHI (%)	0.00	4.56	10.19
+ GHI (%)	0.00	20.23	49.70
+ Medicaid (%)	0.00	7.91	14.52
+ Medicare (%)	0.00	17.68	17.68
Capital (K_c)	100.00	85.72	84.86
Output (Y_c)	100.00	92.40	90.55
Welfare	0.00	4.06	3.71

Table 3: The effects of mixed public and private health insurance systems

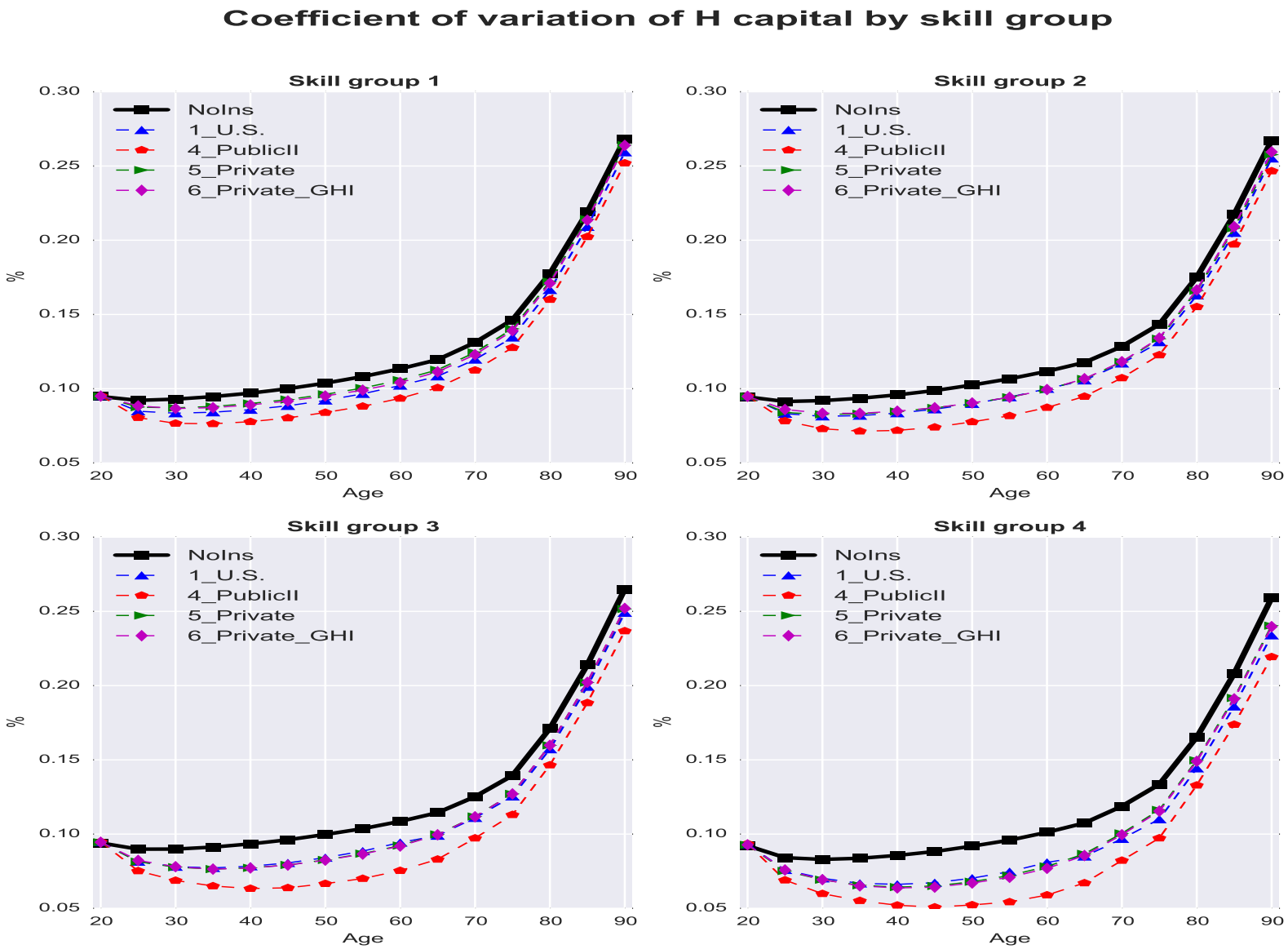
Consumption Variation



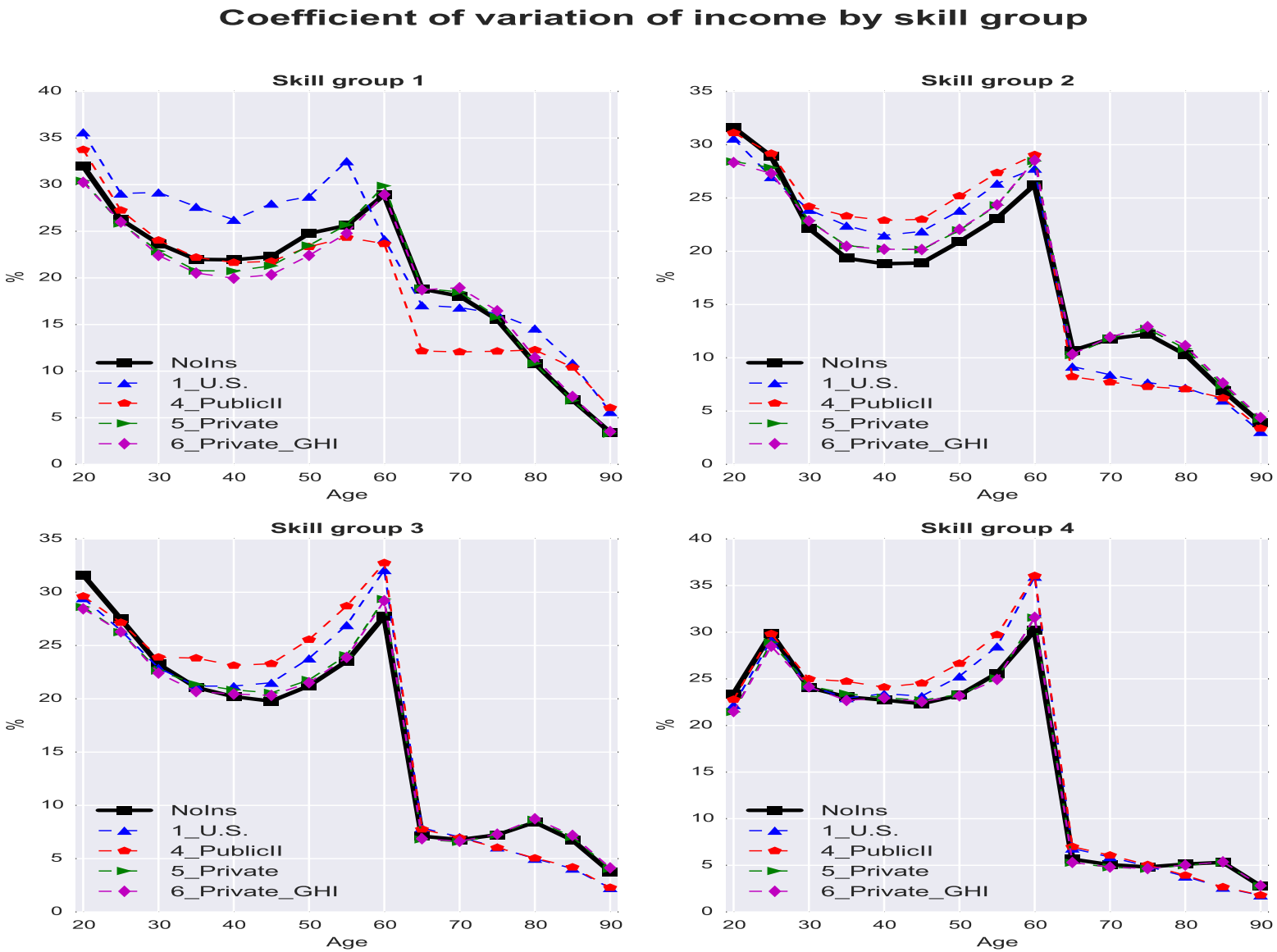
Out-of-Pocket Health Spending Variation



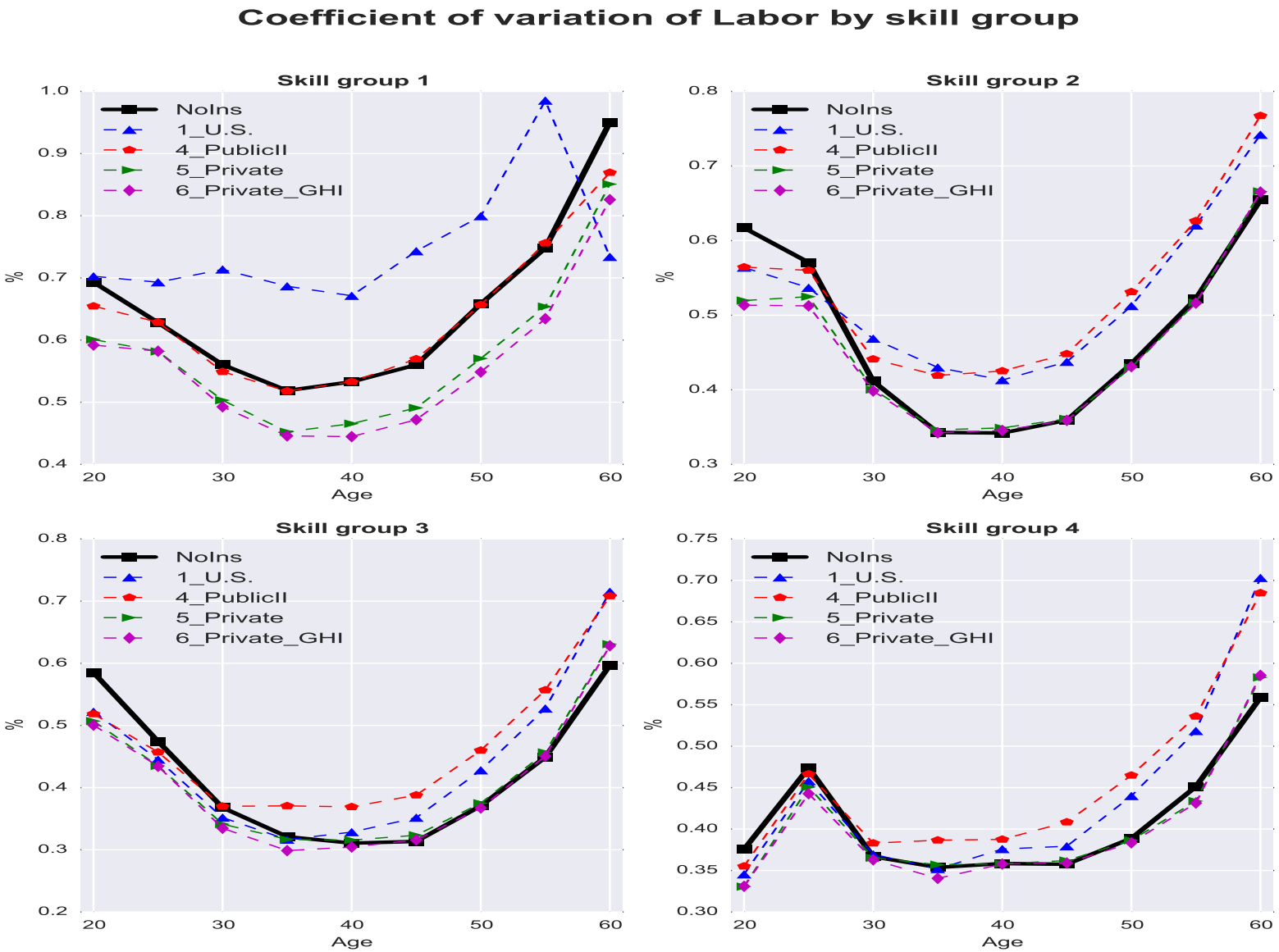
Health Capital Variation



Insurance Take-up Variation



Labor Variation



Conclusion

1. Construct a heterogeneous agents macro-model with health as a durable good
2. Account for lifecycle patterns of health expenditures and private insurance take up rates
3. Quantify the macroeconomic and distributional effects of different health insurance systems