The Macroeconomics of Health Savings Accounts

Juergen Jung
Towson University
Chung Tran
University of New South Wales

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Dysfunctional Mess of U.S. Health Care System

- **Low Coverage: number of uninsured increased to 47 million in 2006 (15%)**
- **High Cost: Americans spend about 16% of GDP on Health in 2006 and close to 20% by 2015**

Market Inefficiency and Government Intervention

- Inefficiency in the health care system
- Market Based Reform: Health Savings Accounts introduced 2003
- Goals of Health Savings Accounts (HSAs)
  1. control total health expenditure
  2. increase the number of insured individuals

What are HSAs?

Medicare Prescription Drug, Improvement, and Modernization Act of 2003:

1. HSAs are **tax free** trust accounts to save for medical expenses
2. Interest earnings are not taxable
3. Funds roll over into next period
4. Age < 65 with **high deductible** health insurance is eligible (at least $\$1,100$)
5. 10% penalty if funds are withdrawn for non-medical expenditures
6. After 65 funds can be withdrawn without penalty (income tax applies)
7. Annual contribution limit ($\$2,850$)

How Does It Work?

- Affecting the demand side

$$D = d(price,\ Income)$$

- Micro/Partial equilibrium effects (price and income effects)

- Macro/General equilibrium effects (intertemporal allocation and factor prices)

$$Income = wage(wh) + investment(Rs)$$

Our Contributions

- A general equilibrium analysis of HSAs
- Identify two general equilibrium channels determining the success of HSAs
- Quantify tax revenue loss resulting from HSAs
- Macroeconomic model with health, health insurance and HSAs

The Model

- Standard overlapping generations framework
  1. Random lifetime with exogenous survival probability π_j
  2. Agents live at most J periods: J_1 periods as workers and $J - J_1$ periods as retirees
  3. Stable demographic patterns with constant population growth
- New features
  1. Health as a consumption and investment good
  2. Health risk and health insurance market
  3. Health savings account

The Model

- Preferences:

$$u\left(c_j, s_j\right)$$

- Service flow from health:

$$s_j = f\left(h_j\right)$$

- Health Production:

$$h_j\left(m_j, h_{j-1}, \varepsilon_j\right)$$

- Markov Switching between Health Shocks:

$$P_j\left(\varepsilon_j, \varepsilon_{j-1}\right) = \Pr\left(\varepsilon_j | \varepsilon_{j-1}, j\right)$$

- Human Capital:

$$e\left(j, h\right) \text{ for } j = \left\{1, ..., J_1\right\},$$

The Model: Health Insurance

- Health insurance options:
  - $in_j = 1$: low deductible health insurance, with ρ deductible and γ coinsurance rate
  - $in_j = 2$: high deductible health insurance with ρ' and γ'
  - $in_j = 3$: no insurance

- $\rho' > \$1,100 > \rho$
- Price of medical care for insured: $p_{m,ins}$
- Price of medical care of uninsured: $p_{m,noIns} > p_{m,ins}$
- Retired agents have Medicare, with ρ^{Med} and γ^{Med}

The Model - Features of HSAs

- HSA only with high deductible insurance
- Save a_j^m tax-free in HSAs at the market interest rate
- $age < 65$: penalty tax τ^m applies if spent on 'non-health' items
- $age \geq 65$: no penalty, but income tax
- Maximum contribution $\bar{s}^m$ (e.g. $\$2,850$ for an individual or $\$5,650$ for a family per year)

Worker's Program

- Agent state $= \left\{a_{j-1}, a^m_{j-1}, h_{j-1}, in_{j-1}, \varepsilon_j\right\}$
- Agents receive income (wage, interest income, accidental bequests, profits, and social insurance)

- Pay taxes (payroll and progressive income tax)
- Agents simultaneously choose:
  1. Consumption c_j and asset holdings a_j
  2. Health expenditures m_j
  3. Insurance state for next period $in_j = \{1, 2, 3\}$
  4. If $in_j = 2$, saving a^m_j in HSA is possible

- If net investment into HSA $NI < 0 \rightarrow$ penalty τ^m

Worker's Dynamic Programming Formulation

$$V_j\left(a_{j-1}, a_{j-1}^m, h_{j-1}, in_{j-1}, \varepsilon_j\right) = \max_{\left\{c_j, m_j, a_j, a_j^m, in_j\right\}} \left\{u\left(c_j, h_j\right) + \beta\pi_j E_\varepsilon\left[V_{j+1}\left(a_j, a_j^m, h_j, in_j, \varepsilon_{j+1}\right)|\varepsilon_j\right]\right\}$$

$$\begin{aligned}
s.t. \quad & c_j + a_j + 1_{\{in_j=2\}} a_j^m + o^W\left(m_j\right) + 1_{\{in_j=1\}} p_j + 1_{\{in_j=2\}} p_j' \\
= \quad & \tilde{w}_j + R\left(a_{j-1} + T^{Beq}\right) + R^m a_{j-1}^m + T^{Insprofit} + T_j^{SI} - Tax_j \\
h_j = \quad & \phi_j m_j^\xi + \left(1 - \delta\left(h_j\right)\right) h_{j-1} + \varepsilon_j \\
e_j = \quad & \left(e^{\beta_0 + \beta_1 j + \beta_2 j^2}\right)^\chi \left(h_{j-1}^\theta\right)^{1-\chi} \\
0 \leq \quad & a_j, a_j^m
\end{aligned}$$

Retiree's Program

- Agent state $= \left\{a_{j-1}, a^m_{j-1}, h_{j-1}, in_{j-1}, \varepsilon_j\right\}$
- Agents receive income (pension, interest income, accidental bequests, profits, and social insurance)
- Pay taxes (progressive income tax)
- Forced into Medicare $\longrightarrow$ pay p_j^{Med}

- Agents simultaneously choose:
  1. Consumption c_j and asset holdings a_j
  2. Health expenditures m_j
  3. Funds in HSA a_j^m

- If net investment into HSA $NI < 0 \longrightarrow$ forgone income tax

Retiree's Dynamic Programming Formulation

$$V_j\left(a_{j-1}, a^m_{j-1}, h_{j-1}, in_{j-1}, \varepsilon_j\right) =$$
$$\max_{\left\{c_j, m_j, a_j, a^m_j\right\}} \left\{ u\left(c_j, h_j\right) + \beta \pi_j E_{\varepsilon_{j+1}|\varepsilon_j}\left[V_{j+1}\left(a_j, a^m_j, h_j, in_j, \varepsilon_{j+1}\right)\right] \right\}$$

$$\begin{aligned} s.t. \quad & c_j + a_j + a^m_j + o^R\left(m_j\right) + p^{Med}_j \\ = \quad & R\left(a_{j-1} + T^{Beq}\right) + R^m a^m_{j-1} + T^{Insprofit} + T^{Soc}_j + T^{SI}_j - Tax_j \end{aligned}$$

$$\begin{aligned} h_j &= \phi_j m^{\xi}_j + \left(1 - \delta\left(h_j\right)\right) h_{j-1} + \varepsilon_j \\ NI_j &\leq 0 \\ 0 &\leq a_j, a^m_j \end{aligned}$$

Firms and Insurance Companies

- Firms:

$$\max_{\{K,L\}} \left\{ AK^{\alpha_1} L^{\alpha_2} - qK - wL \right\}, \text{ given } (q, w)$$

- Insurance Companies:

$$(1+\omega) \times \sum_{j=2}^{J_1+1} \mu_j \int \left[I_{\{in_j=1\}} (1-\gamma) \max(0, p_{m,Ins} m_j(x) - \rho) \right] d\Lambda_j(x)$$
$$= (1+r) \sum_{j=1}^{J_1} \mu_j \int I_{\{in_j=1\}} p_j(x) \, d\Lambda_j(x)$$

$$(1+\omega) \times \sum_{j=2}^{J_1+1} \mu_j \int \left[I_{\{in_j=2\}} (1-\gamma') \max(0, p_{m,Ins} m_j(x) - \rho') \right] d\Lambda_j(x)$$
$$= (1+r) \sum_{j=1}^{J_1} \mu_j \int I_{\{in_j=2\}} p'_j(x) \, d\Lambda_j(x)$$

- Profits $T^{Insprofit}(\omega)$ are distributed back to households in a lump-sum payment.

Government I

- Bequests:

$$\sum_{j=1}^{J} \mu_j \int T_j^{Beq}(x)\, d\Lambda_j(x) = \sum_{j=1}^{J} \nu_j \int a_j(x)\, d\Lambda_j(x) + \sum_{j=1}^{J} \nu_j \int a_j^m(x)\, d\Lambda_j(x)$$

- Social Security:

$$\sum_{j=J_1+1}^{J} \mu_j \int T_j^{Soc}(x)\, d\Lambda_j(x) = \sum_{j=1}^{J_1} \mu_j \int \left[\begin{array}{c} 0.5\tau^{Soc} we_j(x) + 0.5\tau^{Soc} \\ \times \left(\tilde{w}_j(x) - 1_{\{in_j(x)=1\}} p_j - 1_{\{in_j(x)=2\}} p_j' \right) \end{array} \right] d\Lambda_j(x)$$

Government II

- Medicare:

$$
\begin{aligned}
&\sum_{j=J_1+1}^{J} \mu_j \int \left(1-\gamma^{Med}\right) \max\left(0, p_{m,Med}\, m_j(x) - \rho^{Med}\right) d\Lambda_j(x) \\
= \; &\sum_{j=1}^{J_1} \mu_j \int \left[\begin{array}{c} 0.5\tau^{Med} we_j(x) + 0.5\tau^{Med} \\ \times \left(\tilde{w}_j(x) - 1_{\{in_j(x)=1\}} p_j - 1_{\{in_j(x)=2\}} p_j'\right) \end{array} \right] d\Lambda_j(x) \\
&+ \sum_{j=J_1+1}^{J} \mu_j \int p_j^{Med} d\Lambda_j(x)
\end{aligned}
$$

- Government budget is balanced:

$$
G + \sum_{j=1}^{J} \mu_j \int T_j^{SI}(x)\, d\Lambda_j(x) = \sum_{j=1}^{J} \mu_j \int Tax_j(x)\, d\Lambda_j(x)
$$

Calibration

- Preferences:

$$u\left(c_j, h_j\right) = \frac{\left(c_j^{\eta_j} h_j^{1-\eta_j}\right)^{1-\sigma}}{1-\sigma}$$

- Health Production:

$$h_j = \phi_j m_j^{\xi} + \left(1 - \delta\left(h_j\right)\right) h_{j-1} + \varepsilon_j$$

- Markov switching probabilities between health shocks estimated from RAND-HRS data.
- Human Capital:

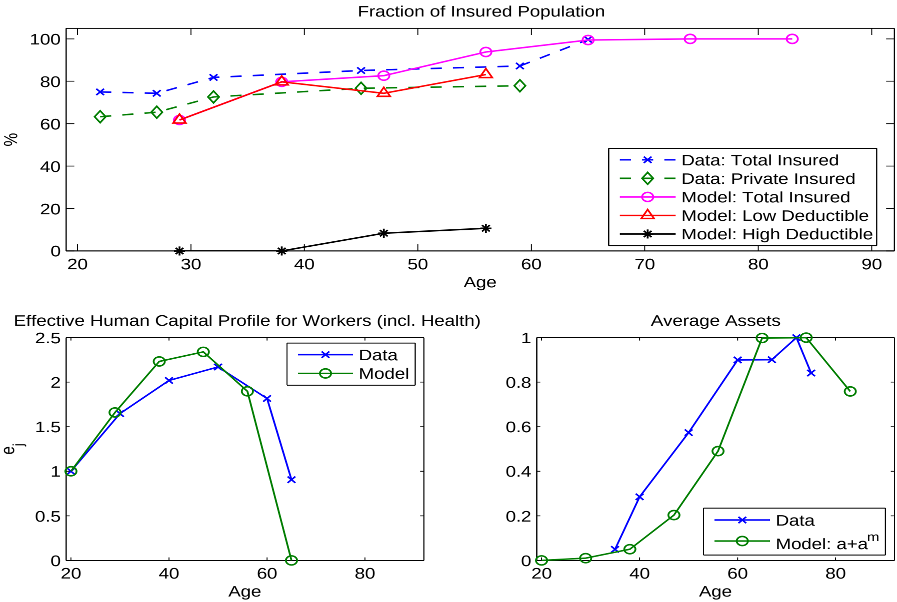
$$e_j = \left(e^{\beta_0 + \beta_1 j + \beta_2 j^2}\right)^{\chi} \left(h_{j-1}^{\theta}\right)^{1-\chi} \text{ for } j = \{1, ..., J_1\},$$

where $\beta_0, \beta_2 < 0,\ \beta_1 > 0,\ \chi \in (0,1)$ and $\theta \in [0,1]$

Calibration

Baseline Parameters		
$J_1 = 5$	Health Production:	Insurance:
$J_2 = 3$	$\phi_j = [1.5, ..., 1.65]$	$\rho^{Med} = \$1,076$
	$\xi = 0.35$	$\gamma^{Med} = 0.25$
Preferences:	$\delta_h = [3\%, ..., 10\%]$	$\rho = \$305$
$\sigma = 1.5$		$\gamma = 0.25$
$\beta = 1.03$	Health Productivity:	$\rho' = \$2,330$
$\eta_j = [0.85, ..., 0.96]$	$\theta = 1$	$\gamma' = 0.20$
Technology:		Exogenous
$\alpha = 0.33$		premium growth:
$\delta = 8\%$		1.5% per year

Model vs. Data



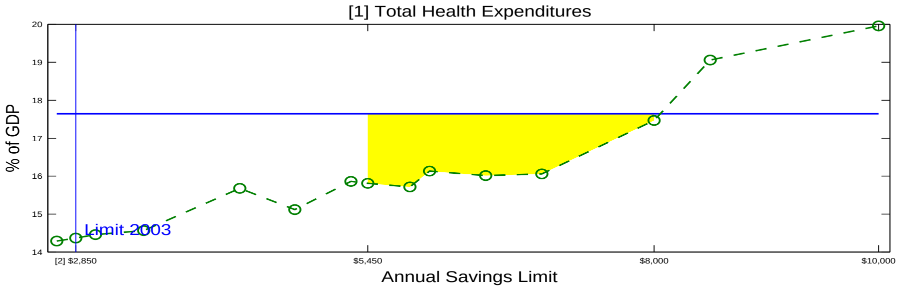
A Snap Shot Experiment

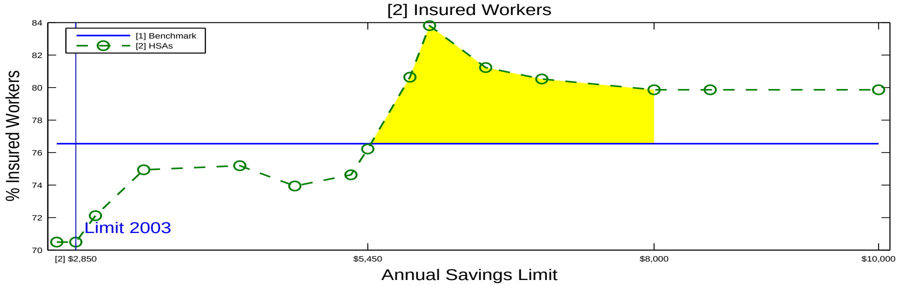
	[1] Benchmark	[2] HSAs
Health Expenditures (in % of GDP):	**17.642**	**14.367**
All Insured (in %):	**80.136**	**75.033**
Output Y :	100.000	97.017
Capital K :	100.000	101.172
Health Capital H :	**100.000**	**84.521**
Insured Workers Low (in %):	**72.955**	**11.107**
Insured Workers High(in %):	**3.594**	**59.387**
Average Insurance Premium p^{Low}:	100.000	73.935
Average Insurance Premium p^{High}:	100.000	87.388
Medicare Premium p^{Med} :	100.000	128.750
Government Size G/Y (in %):	20.277	15.404

General Equilibrium Effects

- Saving effect
  - HSAs induce households to save more.
  - $\Uparrow$ physical capital K depending on contribution limits
  - affecting the wage and interest rates,
  - household income, and the
  - demand for health insurance and for health care services
- Human capital effect
  - HSAs induce households to spend less on health.
  - $\Downarrow$ **health** and therefore $\Downarrow$ human capital depend on whether health is productive
  - affecting wage rates and interest rates
  - household income, and the
  - demand for health insurance and for health care services
- Net result: $\Downarrow$ or $\Uparrow$ the demand for health insurance and the demand for health care

Contribution Limits and Saving Effect





HSAs and Health Expenditures

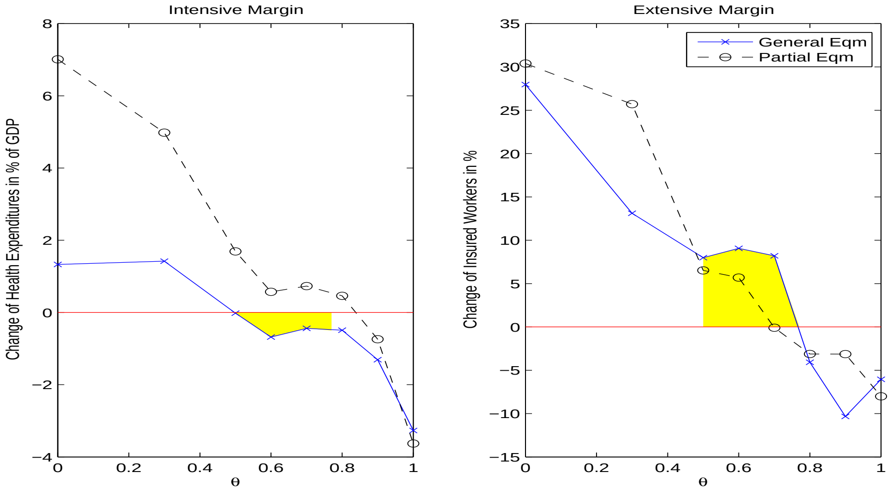
- Partial Equilibrium Effects
  1. $\Uparrow$ effective price of health care services
  2. $\Downarrow$ demand for health care - 'P.E substitution effect'
  3. $\Uparrow$ household income due to tax deductible
  4. $\Uparrow$ demand for health care - 'P.E income effect'
- General Equilibrium Effects:
  1. the saving effect and the human capital effect result in changes in household income - 'G.E. income effect'
  2. $\Downarrow$ or $\Uparrow$ demand for health care depending on 'G.E. income effect'
- The net effect determines health expenditures.

HSAs and Number of Insured Individuals

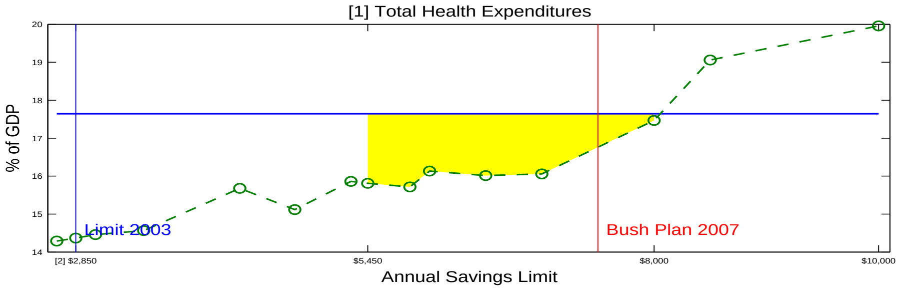
- Partial Equilibrium Effect
  1. $\Downarrow$ price of high deductible insurance
  2. $\Uparrow$ demand for health insurance - 'P.E substitution effect'
  3. $\Uparrow$ household income due to tax deductible
  4. $\Uparrow$ demand for health insurance - 'P.E income effect'
- General Equilibrium Effect
  1. the saving effect and the human capital effect result in changes in household income - 'G.E. income effect'
  2. if income $\Downarrow$, demand for health insurance $\Downarrow$
  3. and number of insured individuals $\Downarrow$
  4. if income $\Uparrow$, demand for health insurance $\Uparrow$
- The net effect determines the number of insured individuals.

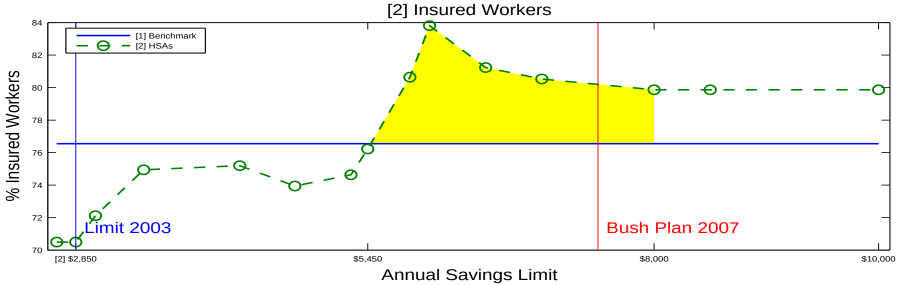
Health Productivity and Human Capital Effect

Human Capital: $e_j = \left(e^{\beta_0+\beta_1 j+\beta_2 j^2}\right)^{\chi}(h^{\theta}_{j-1})^{1-\chi}$



Bush Plan 2007: Increase Savings Limit to $7,500





Conclusion

- The general equilibrium effects do matter in determining the success or failure of HSAs.
- Macroeconomic analysis of health care reform needed
- Methodology: Macro/health model

Extensions

- Empirical
  - structurally estimate health production parameters $\phi, \xi, \delta(h)$ and
  - health shock process
- Modelling
  - transitions
  - the supply of health care services m and prices p_m
  - alternative tax free savings vehicles (e.g. 401k, IRAs,...)
- Issues
  - privatization of public health insurance programs
  - health insurance vouchers
  - financing health costs in an aging economy