The Macroeconomics of Universal Health Insurance Vouchers

Juergen Jung
Towson University

Chung Tran
University of New South Wales

Jul-Aug 2009
Dysfunctional U.S. Health Care System

- **Issues:**
  1. Low Coverage: 47 million in 2006 (15%)
  2. High Cost: 16% of GDP in 2006 and close to 20% by 2015

- **Causes:**
  1. Market failure
  2. Wrong government intervention

- **Market Based Reform:** Universal Health Insurance Vouchers (UHIV)
  1. Increase the number of insured individuals
  2. Control total health expenditure
What are Health Insurance Vouchers?

1. Government
   - issues medical vouchers to all individuals
   - vouchers are calculated individually based on the amount of the expected health expenditures for next year
   - keeps individual health records (like in Medicare)
   - fixes annual budget for vouchers as percentage of GDP

2. Individuals
   - purchase health insurance from private insurance companies using the voucher

3. Participating insurance companies
   - have to accept vouchers
   - contracts must provide a 'base insurance'
   - can offer additional insurance
   - compete and monitor to keep premiums and prices for health care services low
Objectives of the Paper

- Develop an analytical framework to study the implications of a health insurance voucher program

Our key contributions

1. A macro model with endogenous health production and health insurance choice

2. Quantify the short-run and long-run effects of introducing the voucher program
The Model: Key Features

- **Standard stochastic overlapping generations model**
  - Sectors: household, firm and government
  - Endowments: random lifetime and ability to work
  - Markets: consumption, labor and capital

- **New features**
  - Health: a consumption and investment good
  - Health: fixable, risky, and insurable
  - Private health insurance market
The Model: Preferences and Capital Accumulation

- Preferences:
  \[ u(c_j, s_j) \]

- Health capital:
  1. **service flow from health capital**
     \[ s_j = s(h_j) \]
  2. **health production**
     \[ h_j = h(m_j, h_{j-1}, \varepsilon_j) \]
  3. **health shocks**
     \[ P_j(\varepsilon_j, \varepsilon_{j-1}) = \text{Pr}(\varepsilon_j|\varepsilon_{j-1}, j) \]

- Human capital:
  1. **accumulation**
     \[ e_j = e(j, h, \varepsilon_j) \text{ for } j = \{1, ..., J_1\} \]
  2. **productivity shocks**
     \[ \Pi_j(\varepsilon_j, \varepsilon_{j-1}) = \text{Pr}(\varepsilon_j|\varepsilon_{j-1}, j) \]
The Model: Health Insurance and Expenditures

- Insurance plans: individual and group insurance

- Group insurance offers provided by employers: no rating and lower price

\[ \Omega_{income}(i_{GI,j}, i_{GI,j-1}) = \Pr(i_{GI,j}|i_{GI,j-1}, income) \]

- Health insurance choice: endogenous

- Health insurance states:
  - \( in_j = 1 \): no insurance
  - \( in_j = 2 \): individual health insurance
  - \( in_j = 3 \): group health insurance

- Health expenditures depend on individuals’ health insurance state
The Model: Worker’s Program

- Agent state vector \( x_j = \{ a_j, h_{j-1}, in_j, \varepsilon_j, \epsilon_j, i_{GI,j} \} \)
- Agents receive income (wage, interest income, accidental bequests, 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 \( i_{GI,j} = 1 \) then agents can either buy individual insurance \( in_j = 2 \) or group insurance \( in_j = 3 \)
  5. If \( i_{GI,j} = 0 \) then agents can only buy individual insurance \( in_j = 2 \)
\[ V_j(x_j) = \max_{\{c_j, m_j, a_{j+1}, i_{n+1}\}} \left\{ u(c_j, h_j) + \beta \pi_j E_{\epsilon_{j+1}, \epsilon_{j+1}, i_{G_{l}, j+1} | \epsilon_{j}, \epsilon_{j}, i_{G_{l}, j}} [V(x_{j+1})] \right\} \]

s.t.

\[ \left(1 + \tau^c \right) c_j + (1 + g) a_{j+1} + \omega (m_j) + \tilde{p} = \tilde{w}_j + R \left(a_j + T_{Beq} \right) - Tax_j + T_{j}^{SI} + v_j \]

\[ \tilde{p}_j < \tilde{w}_j + R \left(a_j + T_{j}^{Beq} \right) - \omega (m_j) - Tax_j \]

\[ 0 \leq a_j \]
The Model: Retiree’s Program

- Agent state vector $x_j = \{a_j, h_{j-1}, \varepsilon_j\}$
- Agents receive income (pension, interest income, accidental bequests, and social insurance)
- Pay taxes (progressive income tax)
- Forced into Medicare $\rightarrow$ pay $p_j^{Med}$

Agents simultaneously choose:
1. Consumption $c_j$ and asset holdings $a_j$
2. Health expenditures $m_j$
The Model: Retiree’s Dynamic Programming Formulation

\[ V_j(x_j) = \max_{\{c_j, m_j, a_j+1\}} \left\{ u(c_j, h_j) + \beta \pi_j E_{\varepsilon_{j+1}|\varepsilon_j} [V_{j+1}(x_{j+1})] \right\} \]

s.t.

\[ c_j + a_j + o^R(m_j) + p_j^\text{Med} \]

\[ = R \left( a_{j-1} + T^{\text{Beq}} \right) + R^m a_{j-1}^m + T_j^{\text{Soc}} + T_j^{\text{Sl}} - T_{ax_j} \]

\[ 0 \leq a_j \]
The Model: Firms and Insurance Companies

- **Firms:**

  \[
  \max_{\{K, L\}} \{ F(K, L) - qK - wL \}, \ \text{given} \ (q, w)
  \]

- **Insurance Companies:**

  \[
  (1 + \omega) \sum_{j=2}^{J_1+1} \mu_j \int \left[ 1_{\{in_j(x_j) = 2\}} (1 - \rho) \max(0, p_{m,ins}m_j(x_j) - \gamma) \right] d\Lambda(x_j)
  \]

  \[
  = (1 + r) \sum_{j=1}^{J_1} \mu \int \left( 1_{\{in_j(x_j) = 2\}} p(j, h) \right) d\Lambda(x_j)
  \]

  \[
  (1 + \omega) \sum_{j=2}^{J_1+1} \mu_j \int \left[ 1_{\{in_j(x_j) = 3\}} (1 - \rho) \max(0, p_{m,ins}m_j(x_j) - \gamma) \right] d\Lambda(x_j)
  \]

  \[
  = (1 + r) \sum_{j=1}^{J_1} \mu \int \left( 1_{\{in_j(x_j) = 3\}} p \right) d\Lambda(x_j)
  \]
The Model: Government I

- Bequests:
  \[
  \sum_{j=1}^{J} \mu_j \int T_{j}^{Beq}(x) \, d\Lambda_j(x) = \sum_{j=1}^{J} \tilde{\mu}_j \int a_j(x) \, d\Lambda_j(x)
  \]

- Social Security:
  \[
  \sum_{j=J_1+1}^{J} \mu_j \int T_{j}^{Soc}(x) \, d\Lambda_j(x) \\
  = \sum_{j=1}^{J_1} \mu_j \int \tau^{Soc} \left( we(j, h_j, \epsilon) - 1_{\{in_{j+1}=3\}} p \right) \, d\Lambda_j(x)
  \]
The Model: Government II

- Medicare:
  \[
  \sum_{j=J_1+1}^{J} \mu_j \int (1 - \rho^{Med}) \max (0, m_j (x) - \gamma^{Med}) \, d\Lambda_j (x)
  \]
  \[
  = \sum_{j=1}^{J_1} \mu_j \int \tau^{Med} \left( we (j, h_j, \epsilon) - 1_{\{in_{j+1} = 3\}} p \right) \, d\Lambda_j (x)
  \]
  \[
  + \sum_{j=J_1+1}^{J} \mu_j \int p_j^{Med} \, d\Lambda_j (x)
  \]

- Government budget is balanced:
  \[
  G + \sum_{j=1}^{J} \mu_j \int T_j^{SI} (x_j) \, d\Lambda (x_j) + \sum_{j=1}^{J} \mu_j \int v (h_j (x_j)) \, d\Lambda (x_j)
  \]
  \[
  = \sum_{j=1}^{J} \mu_j \int T_j^{x} (x_j) \, d\Lambda (x_j) + \sum_{j=1}^{J} \mu_j \int \tau^{C} c (x_j) \, d\Lambda (x_j).
  \]
Calibration

- Preferences:
  \[ u(c_j, h_j) = \left( \frac{c_j^{\eta}s_j^{1-\eta}}{1-\sigma} \right) \]

- Health services:
  \[ s_j = h_j \]

- Health Production:
  \[ h_j = \phi m_j^\xi + (1 - \delta(h_j)) h_{j-1} + \varepsilon_j \]

- Markov switching probabilities between income shocks and group insurance offer states are estimated from MEPS 2004-2005 data.

- Human Capital:
  \[ e_j = e(\varepsilon_j)^\chi (h_{j-1}^{\theta})^{1-\chi} \text{ for } j = \{1, \ldots, J_1\}, \]
  where \( e(\varepsilon_j) \) are estimated efficiency profiles from MEPS 2004-2005 for 3 separate income quantiles

- \( \beta_0, \beta_2 < 0, \beta_1 > 0, \chi \in (0, 1) \) and \( \theta = 0 \) in benchmark version.
## Baseline Parameters

<table>
<thead>
<tr>
<th>Demographics:</th>
<th>Health Production:</th>
<th>Insurance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J_1 = 9$</td>
<td>$\phi = 1$</td>
<td>$\gamma = 26%$ of spending</td>
</tr>
<tr>
<td>$J_2 = 5$</td>
<td>$\xi = 0.35$</td>
<td>$\rho = 33%$</td>
</tr>
<tr>
<td>$n = 1.2%$</td>
<td>$\delta_h = [3%, \ldots, 90%]$</td>
<td>$\gamma^{Med} = 90%$ of private deductible</td>
</tr>
</tbody>
</table>

### Preferences:
- $\sigma = 2.5$
- $\beta = 0.99$

### Health Productivity:
- $\theta =$?

### Technology:
- $\alpha = 0.33$
- $\delta = 10\%$
- $g = 1.5\%$

### Exogenous premium growth depending on age and health
Steady States vs. Data (NO Human Capital Effect)

Insurance Coverage in %

Medical Spending in % of Income

% Insured Spending Below Deductible

Average Savings

Average Consumption

Average Health

Jung and Tran (TU and UNSW)

Health Vouchers

2009 17 / 28
# Experiment 1: NO Human Capital Effect

<table>
<thead>
<tr>
<th></th>
<th>Benchmark 1</th>
<th>Vouchers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output:</strong> $Y$</td>
<td>100.000</td>
<td>101.578</td>
</tr>
<tr>
<td><strong>Capital:</strong> $K$</td>
<td>100.000</td>
<td>104.445</td>
</tr>
<tr>
<td><strong>Human capital:</strong> $H$</td>
<td>100.000</td>
<td>100.000</td>
</tr>
<tr>
<td><strong>Med. spending:</strong> $pm \cdot M/Y$</td>
<td>12.9%</td>
<td>12.6%</td>
</tr>
<tr>
<td><strong>Vouchers in % of GDP</strong></td>
<td>0.0%</td>
<td>3.5%</td>
</tr>
<tr>
<td><strong>Interest rate:</strong> $R$</td>
<td>6.0%</td>
<td>5.4%</td>
</tr>
<tr>
<td><strong>Wages:</strong> $w$</td>
<td>100.000</td>
<td>101.578</td>
</tr>
<tr>
<td><strong>Consumption tax:</strong> $\tau_C$</td>
<td>0.050</td>
<td>0.085</td>
</tr>
<tr>
<td><strong>Soc. sec. tax:</strong> $\tau_{SS}$</td>
<td>0.109</td>
<td>0.103</td>
</tr>
<tr>
<td><strong>Medicare tax:</strong> $\tau_{Med}$</td>
<td>0.039</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Income tax in % of GDP:</strong></td>
<td>0.179</td>
<td>0.194</td>
</tr>
<tr>
<td><strong>$K/Y$</strong></td>
<td>2.656</td>
<td>2.731</td>
</tr>
<tr>
<td><strong>$C/Y$</strong></td>
<td>0.408</td>
<td>0.453</td>
</tr>
</tbody>
</table>
Replacing Medicare by Vouchers results in income and substitution effects.

- Removing insurance premium increases income (income effect)
- ↓ payroll tax increases income (income effect) while ↑ consumption tax increases price of consumption (substitution effect).

↑ savings and ↑ physical capital $K$

- affects wage and interest rates
- increases household income (G.E. income effect)

These increase the demand for health care services

Net result: ↑ total health care expenditure increases, but as fraction of GDP health expenditure decreases
Steady States vs. Data (WITH Human Capital Effect)

- **Insurance Coverage in %**
  - Model: \(\circ\)
  - Voucher: \(\times\)
  - Data: \(\cdot\)

- **Medical Spending in % of Income**

- **% Insured Spending Below Deductible**

- **Average Savings**

- **Average Consumption**

- **Average Health**
### Experiment 2: WITH Human Capital Effect

<table>
<thead>
<tr>
<th></th>
<th>No Human Capital Effect</th>
<th>Human Capital Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Benchmark 1</td>
<td>Vouchers</td>
</tr>
<tr>
<td><strong>Output: ( Y )</strong></td>
<td>100.000</td>
<td>101.578</td>
</tr>
<tr>
<td><strong>Capital: ( K )</strong></td>
<td>100.000</td>
<td>104.445</td>
</tr>
<tr>
<td><strong>Human capital: ( H )</strong></td>
<td>100.000</td>
<td>100.000</td>
</tr>
<tr>
<td><strong>Med. spending: ( pm \times M/Y )</strong></td>
<td>12.9%</td>
<td>12.6%</td>
</tr>
<tr>
<td><strong>Vouchers in % of GDP</strong></td>
<td>0.0%</td>
<td>3.5%</td>
</tr>
<tr>
<td><strong>Interest rate: ( R )</strong></td>
<td>6.0%</td>
<td>5.4%</td>
</tr>
<tr>
<td><strong>Wages: ( w )</strong></td>
<td>100.000</td>
<td>101.578</td>
</tr>
<tr>
<td><strong>Consumption tax: ( \tau_C )</strong></td>
<td>0.050</td>
<td>0.085</td>
</tr>
<tr>
<td><strong>Soc. sec. tax: ( \tau_{SS} )</strong></td>
<td>0.109</td>
<td>0.103</td>
</tr>
<tr>
<td><strong>Medicare tax: ( \tau_{Med} )</strong></td>
<td>0.039</td>
<td>0.000</td>
</tr>
<tr>
<td><strong>Income tax in % of GDP:</strong></td>
<td>0.179</td>
<td>0.194</td>
</tr>
<tr>
<td><strong>( K/Y )</strong></td>
<td>2.656</td>
<td>2.731</td>
</tr>
<tr>
<td><strong>( C/Y )</strong></td>
<td>0.408</td>
<td>0.453</td>
</tr>
</tbody>
</table>
Key Mechanism: Human Capital Effects

- Savings effect

- Human capital effect
  - Vouchers induce households to spend more on health (moral hazard).
  - $\downarrow$ health and therefore $\downarrow$ human capital depending on whether health is productive
  - Increases wage and interest rates, household income and again the demand for health care services

- Result: $\uparrow$ the demand for health care, but as fraction of GDP health expenditure decreases
Transitions WITH human capital effect

- Output
- Capital
- Consumption
- Medical Expenditure
- Human Capital
- Interest
- Wages
- Consumption Tax
Welfare Analysis: WITH Human Capital Effect

Compensating Consumption per Lifetime Consumption (in %)

Compensating Consumption per GDP (in %)

Old Regime Agents

New Regime Agents

Winners

Losers

Jung and Tran (TU and UNSW) Health Vouchers 2009 26 / 28
Conclusion

- Health vouchers seem promising in being able to sustainably finance health care expenditures while providing full health insurance coverage to the entire U.S. population.

- The decrease in health care expenditure as fraction of GDP is primarily due to a general equilibrium savings effect.

- The human capital effect is potentially important.

- Welfare gain.
Extensions

- **Empirical**
  - structurally estimate health production parameters $\phi, \xi, \delta(h)$ and health shock process

- **Modelling**
  - the supply of health care services $m$ and prices $p_m$
  - insurance firm competition and its effect on price of health care services and insurance premiums

- **Issues**
  - privatization of public health insurance programs
  - financing health costs in an aging economy