Preventive vs. Curative Medicine

A Macroeconomic Analysis of Health Care over the Life Cycle

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Heterogenous Agent Models
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Introduction
Motivation

- Low- and high-income households differ greatly in their health outcomes over the life cycle?
**Motivation**

*Figure 1:* Race- and Ethnicity-Adjusted Life Expectancy for 40-Year-Olds by Household Income Percentile, 2001-2014, Source: Chetty et al 2016 JAMA
Motivation

- Low- and high-income households differ greatly in their health outcomes over the life cycle?

- Why do they differ?
**Figure 2**: Average Medical Spending of Bottom Income Quintile Relative to Top Income Quintile
Motivation

- Low- and high-income households differ greatly in their health outcomes over the life cycle?

- Why do they differ?

- Why is it important?
  - Reducing disparities in health outcomes is at the center of health care policy design (e.g., ObamaCare).
  - DeNardi, Pashchenko, and Porapakkarm (2018) and Hosseini, Kopecky, and Zhao (2020) find very large welfare costs of bad health.
Motivation

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  - DeNardi, Pashchenko, and Porapakkarm (2018) and Hosseini, Kopecky, and Zhao (2020) find very large welfare costs of bad health.

- **Goal of this paper:** To develop and estimate a model of endogenous health shocks/outcomes.
What do I do?

I. Empirical Facts on Differences in Health Care Usage

- Medical spending of the poor relative to the rich exhibits humped-shaped pattern over the lifecycle.
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- The distribution of medical expenditures of the poor is more widely spread to the tails (more leptokurtic) and especially right skewed.
  - The poor less likely to incur any medical expenditures in a year (24% vs 10%).
  - Their health spending is more extreme.
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  - Their health spending is more extreme.

3. The poor use less preventive care.
What do I do?

II. A Life-Cycle Model of Health Capital

1. Two distinct types of health capital

- Physical health capital determines the survival probability
- Preventive health capital governs the distribution of health shocks
- Endogenous distribution of health shocks, thereby endogenous life expectancy.
What do I do?

II. A Life-Cycle Model of Health Capital

1. Two distinct types of health capital

2. Important features of the US health care system
   - Non-elderly are offered private health insurance with copayment and deductible.
     - Endogenous insurance premia.
   - Children of the poor are covered by Medicaid
   - All elderly are covered by Medicare.
   - In case of severe health shocks, default is allowed.
1. Two distinct types of health capital

2. Important features of the US health care system

3. Government budget balances
   - Progressive US tax scheme on income
   - Finances social security, Medicaid, Medicare
   - Budget surplus or deficit is distributed in a lump sum fashion
III. Estimate Model Using Micro and Macro Data

1. Set some of the parameter values outside of the model
   - income process
   - deductible - co-payment coverage schemes, etc.
What do I do?

III. Estimate Model Using Micro and Macro Data

1. Set some of the parameter values outside of the model

2. Match model moments to data moments
   - From the MEPS
     - Distribution of medical expenditures
     - Differences in the lifetime profile of health care spending
   - From aggregate data
     - Age profile of conditional survival probability
     - Differences in life expectancy between the rich and the poor
     - Wealth to income ratio, etc.
IV. Counter-Factual Policy Analysis

1. Universal Health Insurance Coverage
   - Increase in life expectancy of the poor by 1.25 years.
   - Increase aggregate medical spending by only 0.8%
   - Welfare gains equivalent to 1.5% of lifetime consumption
IV. Counter-Factual Policy Analysis

1. Universal Health Insurance Coverage

2. 75% of preventive medicine expenditures covered by the private insurance.
   - Increase in life expectancy in the population except for the richest.
   - Aggregate medical spending does not increase
   - Welfare improves
Related Literature

Health Spending as Expenditure Shocks

"Endogenous" Health Expenditures by Income
De Nardi, French and Jones (2010), Yogo (2009), Jung and Tran (2009), DeNardi, Pashchenko, and Porapakkarm (2018), Hosseini, Kopecky, and Zhao (2020)

Health Capital and Dynamic Inefficiencies in Health Care System

Preventive Care
Outline

- Empirical Facts
- Intuition in a Stylized Framework
- Full Model
- Calibration/Estimation
- Model’s Performance
- Policy Analysis
Empirical Facts
Medical Expenditure Panel Survey (MEPS)

- 359,826 observations between ages 0-90.

Definition of medical expenditure (consumption) includes:
- office- and hospital-based care,
- home health care,
- dental services, vision aids, and
- prescribed medicines, etc.

Medical consumption can be paid by:
- out of pocket expenditures
- Private insurance firms
- Government (Medicaid, Medicare, etc.), and others.

Total income: wage, business, unemployment, dividend, interest, pension, social security, etc.
Methodology

- Group individuals into age intervals: 0-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, 85 and older

- Normalize total family income by family-type-specific federal poverty threshold.

- Construct income quintiles with respect to only those families within a particular age bin.

- Study differences in health outcomes between income quintiles.
Humped-shaped average medical spending of low income group relative to high income group.
The distribution of medical expenditures of the poor is more widely spread to the tails.
Preventive Care Consumption by Income

○ Survey question: How long since last ...?

○ Answer: The duration since last...

<table>
<thead>
<tr>
<th>Quantiles</th>
<th>Dentist (Mean)</th>
<th>Cholesterol (Mean)</th>
<th>Flu Shot (Mean)</th>
<th>Prostate Test (Mean)</th>
<th>Mammogram (Mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Income</td>
<td>2.608 (0.00984)</td>
<td>2.863 (0.0235)</td>
<td>4.230 (0.0215)</td>
<td>4.057 (0.0223)</td>
<td>3.293 (0.0149)</td>
</tr>
<tr>
<td>High Income</td>
<td>1.689 (0.00966)</td>
<td>2.207 (0.0180)</td>
<td>3.733 (0.0253)</td>
<td>2.814 (0.0223)</td>
<td>2.433 (0.0184)</td>
</tr>
<tr>
<td>Observations</td>
<td>254445</td>
<td>169552</td>
<td>176935</td>
<td>43337</td>
<td>72777</td>
</tr>
</tbody>
</table>

○ High income consume preventive care more than low income do.

More examples
Life Expectancy by Income

**Figure 3:** Race- and Ethnicity-Adjusted Life Expectancy for 40-Year-Olds by Household Income Percentile, 2001-2014, Source: Chetty et al 2016 JAMA

- Shorter life expectancy for lower income households.
Basic Model
Two distinct types of health capital.

1. **Physical health capital** determines survival probability.

2. **Preventive health capital** governs the distribution of health shocks to **physical health capital**.
A Model of Health Capital: Environment

- Discrete time $t = 1, 2, \ldots T$.
- Cohort size of newborns is normalized to 1.
- Ex-ante two types of households: Rich and poor
- Households are subject to health shocks which affect their endogenous survival probability.
Preferences

\[ u(c_t) = \frac{c_t^{1-\sigma}}{1 - \sigma} \]

- \( c_t \): Consumption
- Value of death is zero.
- \( \sigma < 1 \): Value of being alive is positive.

Preferences will feature an explicit value of being alive in the full model!
Physical Health Capital

\[ h_0 = 1 \]

\[ h_{t+1} = \begin{cases} 
  h_t & \text{if } A_t^c m_{C,t}^{\theta_t^c} \geq \omega_t \\
  h_t - \omega_t + A_t^c m_{C,t}^{\theta_t^c} & \text{otherwise} 
\end{cases} \]

\( h_t \): physical health capital stock

\( m_{C,t} \): curative medicine

\( \omega_t \): health shock

\( A_t^c, \theta_t^c \): curative health production function parameters
**Preventive Health Capital**

\[
x_0 = 1
\]

\[
x_{t+1} = \begin{cases} 
  x_t & \text{if } A^p m_{P,t}^{\theta^p} \geq \delta x_t \\
  x_t (1 - \delta_x) + A^p m_{P,t}^{\theta^p} & \text{otherwise}
\end{cases}
\]

- \(x_t\): preventive health capital stock
- \(m_{P,t}\): preventive medicine
- \(A^p, \theta^p\): preventive health production function parameters
Distribution of Health Shocks

\[ \log(\omega_t) \sim \begin{cases} 
\mathcal{N}(\mu_t^G, \sigma_t^2) & \text{w/p } \pi(x_t) \\
\mathcal{N}(\mu_t^B, \sigma_t^2) & \text{w/p } 1 - \pi(x_t) 
\end{cases} \]

\[ \mu^B > \mu^G \]

\[ \pi(x_t) : x_t \text{ probability of health shocks being drawn from the “good” distribution with mean } \mu^G \]
Survival Probability Function

\[ s(h_t - \omega_t) = h_t - \omega_t \]

- \( h_t \): physical health capital stock
- \( \omega_t \): health shock
No Default

\[ w^i + (1 + r)a_t = c_t + m_{C,t} + m_{P,t} + a_{t+1} \]
\[ a_{t+1} \geq 0 \]

\( w^i \): constant income per period, \( i \in \{\text{rich, poor}\} \)
\( a_t \): wealth at age \( t \)
\( m_{C,t} \): curative care expenditure
\( m_{P,t} \): preventive care expenditure
Budget Constraint

Option to Default  \( (\text{if } \left( \frac{\omega_t}{A_t^c} \right)^{1/\theta_t^c} > w^i + (1 + r)a_t - c_{min}) \)

\[
\begin{align*}
  c_t &= c_{min} \\
  a_{t+1} &= 0 \\
  m_{C,t} &= \left( \frac{\omega_t}{A_t^c} \right)^{1/\theta_t^c} \\
  m_{P,t} &= 0
\end{align*}
\]

\( w^i \): constant income per period, \( i \in \{\text{rich, poor}\} \)
\( a_t \): wealth at age \( t \)
\( m_{C,t} \): curative care expenditure
\( m_{P,t} \): preventive care expenditure
Understanding the Mechanism

- What’s the basic mechanism in the model?

- Simulate the model with the calibrated “full model” parameter values.

- Compare the age profile of medical expenditures of the basic model with:
  - No preventive health capital: $\mu_t^G = \mu_t^B$
  - No default option.
Capable of generating the humped-shaped profile of relative expenditures.
Preventive health capital endogenizes the distribution of health shocks.
Without preventive health capital medical spending of the poor relative to the rich decreases over the lifetime.
Default option hampers incentives of the poor to invest in preventive health.
Option to default amplifies the mechanism.
Full Model
Three phases of lifecycle

1. **Childhood:** \( t = 1, 2, \ldots T_{CHILD} \)
   - Constant stream of income.
   - No asset accumulation.
   - Private insurance is offered.
   - Also households with income lower than poverty threshold are eligible for Medicaid.
Three phases of lifecycle

1. Childhood: \( t = 1, 2, \ldots, T_{\text{CHILD}} \)

2. Working years: \( t = T_{\text{CHILD}} + 1, \ldots, T_{\text{RET}} \)

- Inelastic labor supply in return for idiosyncratic earnings, \( w_t^i \sim AR(1) \) process.
- Labor earnings are also affected by physical health status.
- Accumulate risk-free asset at an interest rate, \( r \)
- Income is subject to the progressive US tax schedule.
- Tax deductible private insurance is offered.
Three phases of lifecycle

1. Childhood: \( t = 1, 2, \ldots T_{\text{CHILD}} \)

2. Working years: \( t = T_{\text{CHILD}} + 1, \ldots T_{\text{RET}} \)

3. Retirement: \( t = T_{\text{RET}} + 1, \ldots T \)

- Government provides retirement pension proportional to last year’s earnings.
- All elderly are covered by Medicare.
Hall and Jones (2007) Preferences

\[ u(c, h) = b + \frac{c^{1-\sigma}}{1 - \sigma} + \alpha \frac{h^{1-\gamma}}{1 - \gamma} \]

- Non-homothetic preferences
  - Value of life is explicitly incorporated, \( b \)
  - \( \sigma > 1 \)
- Household also enjoys the quality of life.
Insurance Plans

- Exogenous Insurance Plans involve both deductible $\iota$, and co-payment, $\varsigma$:

$$\chi^j(m) = \begin{cases} 
0 & m \leq \iota^j \\
\varsigma^j(m - \iota^j) & m \geq \iota^j 
\end{cases}$$

where $j \in \{\text{Private, Medicaid, Medicare}\}$

- All plans cover sum of preventive and curative medicine expenditures.

- Private plans are offered before health shocks are realized.

- Private insurance plans satisfy zero profit condition in each period $t$:

$$\int_{h, p, a, w} I_{t}^{PRV}(h, x, a, w)[p_{t}^{PRV} - (1 + \Delta) \int_{\omega_t} m(h, x, a, w, \omega)d\omega_t(x)]d\Lambda(h, x, a, w) = 0$$

where $I_{t}^{PRV}(.)$ is an indicator for signing up for the private insurance plan.
Government Budget

- US progressive taxation on household income

- Tax revenue is used to finance
  - Social security benefits,
  - Medicaid and Medicare expenditures
  - Medical expenditures due to default
  - Exogenous other government expenditures, $G$

- Budget surplus or deficit is distributed in a lump-sum fashion, $Tr$
Calibration/Estimation
Methodology

1. Fix some of the parameter values outside the model.
   ○ Ex: Insurance plans, retirement pension scheme etc.

2. Choose parameter values using the model to match the moments in the data.
   ○ Ex: Distribution of health shocks, preventive and curative health production function etc.
Model period is 1 year.

\[ T_{\text{CHILD}} = 20, \ T_{\text{RET}} = 65, \ T = 110. \]
Fixed Parameters

- Income process estimates from Storesletten et al. (2000)
- $w(h)$: Estimate the decrease in earnings due to health shock from the MEPS
- Insurance plans, $\chi(x)$, estimated from the MEPS.
- SS mimics the US system (Guvenen, Kuruscu, Ozkan (2010))
## Preference Parameters

<table>
<thead>
<tr>
<th>Param.</th>
<th>Explanation</th>
<th>Identifying Moment</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discounting factor</td>
<td>Wealth/Income ratio</td>
</tr>
<tr>
<td>$b$</td>
<td>Value of being alive</td>
<td>Life expectancy (particularly, of the poor)</td>
</tr>
<tr>
<td>$\alpha, \gamma$</td>
<td>Quality of life coefficients</td>
<td>Quality adjusted life years</td>
</tr>
</tbody>
</table>

Survey Question: Preventive vs. Curative Medicine

Calibration/Estimation
Distribution of Health Shocks

\[ \log(\omega_t) \sim \begin{cases} \mathcal{N}(\mu_t^G, \sigma_t^2) & \text{w/p } \pi(x_t) \\ \mathcal{N}(\mu_t^B, \sigma_t^2) & \text{w/p } 1 - \pi(x_t) \end{cases} \]

- \( \mu_t^B = \mu_t^G + \bar{\mu} \)
- Identifying moment: Differences in the lifetime profile of medical expenditures between the poor and the rich.
Distribution of Health Shocks

\[
\log(\omega_t) \sim \begin{cases} 
\mathcal{N}(\mu_t^G, \sigma^2_t) & w/p \pi(x_t) \\
\mathcal{N}(\mu_t^B, \sigma^2_t) & w/p 1 - \pi(x_t) 
\end{cases}
\]

- Normalize the distribution s.t. \( \omega_{99.9\%} = 1 \)
- \( s(h_t - \omega_t) = h_t - \omega_t \)
- Conditional survival probability from \( t \) to \( t + 1 \).
Distribution of Health Shocks

Figure 4: Histogram of Health Shocks

\[ \mu = -6.90, \sigma = 1.70 \]

\[ s(h-\omega) = 0.999 \]

\[ \mu = -2.10, \sigma = 0.50 \]

\[ s(h-\omega) = 0.86 \]
Let’s suppose that

- we can observe $m_{C,t}$ (even though we only observe $m_{C,t} + m_{P,t}$ in the data)

- households choose to fully recover the shocks
Let’s suppose that
- we can observe \( m_{C,t} \) (even though we only observe \( m_{C,t} + m_{P,t} \) in the data)
- households choose to fully recover the shocks

\[
\omega_t = A_t^c m_{C,t}^{\theta_t^c}
\]
\[
\log \omega_t = \log A_t^c + \theta_t^c \log m_{C,t}
\]
\[
\log m_{C,t} = \frac{\log \omega_t - \log A_t^c}{\theta_t^c}
\]
Let’s suppose that

- we can observe $m_{C,t}$ (even though we only observe $m_{C,t} + m_{P,t}$ in the data)
- households choose to fully recover the shocks

\[
\omega_t = A_t^c m_{C,t}^{\theta_t^c}
\]

\[
\log \omega_t = \log A_t^c + \theta_t^c \log m_{C,t}
\]

\[
\log m_{C,t} = \frac{\log \omega_t - \log A_t^c}{\theta_t^c}
\]

Mean and variance of medical expenditures can identify $\theta_t^c, A_t^c$
## Table 1: Preventive Health Capital Parameters

<table>
<thead>
<tr>
<th>Param.</th>
<th>Explanation</th>
<th>Identifying Moment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\delta_{X})</td>
<td>Prev. health depreciation rate</td>
<td>5% per year</td>
</tr>
<tr>
<td>(A^{p}, \theta^{p})</td>
<td>Prev. health func. params</td>
<td>Increase in relative medical exp. of poor to rich</td>
</tr>
</tbody>
</table>
Model Fit
Model’s Fit

Preventive vs. Curative Medicine

Model Fit

Medical Expenditures

- Model
- Data

Medical Expenditure Ratio of Poor to Rich

- Model
- Data

Age

2006 $
Model’s Fit

Preventive vs. Curative Medicine

Model Fit
<table>
<thead>
<tr>
<th>Life Expectancy</th>
<th>Low Income</th>
<th>High Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 25</td>
<td>45.0</td>
<td>48.5</td>
</tr>
<tr>
<td>Age 45</td>
<td>27.0</td>
<td>30.4</td>
</tr>
<tr>
<td>Age 65</td>
<td>13.8</td>
<td>15.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 25</td>
<td>52.9</td>
<td>53.8</td>
</tr>
<tr>
<td>Age 45</td>
<td>33.9</td>
<td>35.1</td>
</tr>
<tr>
<td>Age 65</td>
<td>17.1</td>
<td>18.1</td>
</tr>
</tbody>
</table>
An Informal Over-Identification Discussion

Preventive vs. Curative Medicine

Model Fit
An Informal Over-Identification Discussion

Empirical Fact II

Preventive vs. Curative Medicine

Model Fit
An Informal Over-Identification Discussion

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Insurance Coverage under age 65</td>
<td>73%</td>
<td>85%</td>
</tr>
<tr>
<td>Medicaid Coverage under age 20</td>
<td>22%</td>
<td>23%</td>
</tr>
<tr>
<td>Share of Medicaid and Medicare</td>
<td>29%</td>
<td>26%</td>
</tr>
</tbody>
</table>
Policy Analysis
Government provides all non-elderly private health insurance.

To finance this policy an additional flat income tax is imposed on household income.

All elderly are still covered by Medicare.
Table 2: Life Expectancy

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benchmark</td>
<td>71.95</td>
<td>75.2</td>
<td>76.3</td>
<td>76.5</td>
<td>76.8</td>
</tr>
<tr>
<td>Policy I</td>
<td><strong>73.2</strong></td>
<td>75.3</td>
<td>76.3</td>
<td>76.5</td>
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</tbody>
</table>

- Aggregate medical spending increases by only 0.8%
- Per capita medical expenditures increase from $4750 to $4755
Health insurance premia decrease 2.5% for 30-year old and younger.

Increase 1.5% for older than 30.
Welfare Analysis

\[ \mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^B - \omega_t) u(c_t^B, h_t^B - \omega_t) = \mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^P - \omega_t) u(\phi c_t^P, h_t^P - \omega_t) \]
Welfare Analysis

\[
\mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^B - \omega_t)u(c_t^B, h_t^B - \omega_t) = \mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^P - \omega_t)u(\phi c_t^P, h_t^P - \omega_t)
\]

- \(1 - \phi = 1.5\%\)
Welfare Analysis

$$\mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h^B_t - \omega_t) u(c^B_t, h^B_t - \omega_t) = \mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h^P_t - \omega_t) u(\phi c^P_t, h^P_t - \omega_t)$$

- $1 - \phi = 1.5\%$
- $1/3$ of welfare gains are due to the increase in life expectancy
Counter-Factual Policy Analysis I

Welfare Analysis

\[ \mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^B - \omega_t) u(c_t^B, h_t^B - \omega_t) = \mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^P - \omega_t) u(\phi c_t^P, h_t^P - \omega_t) \]

- \( 1 - \phi = 1.5\% \)
- \( 1/3 \) of welfare gains are due to the increase in life expectancy

**Table 3: Welfare Gains, 1 − φ**

<table>
<thead>
<tr>
<th>Policy I w.r.t Benchmark</th>
<th>Bottom 2%</th>
<th>Median</th>
<th>Top 2%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.6%</td>
<td>2.1%</td>
<td>-0.88%</td>
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- Mammograms, colonoscopies, cervical screenings, and treatment for high blood pressure etc.
- Patients will still have to pay for doctor visits.
- Not all preventive care is covered
○ Mammograms, colonoscopies, cervical screenings, and treatment for high blood pressure etc.

○ Patients will still have to pay for doctor visits.

○ Not all preventive care is covered

○ Policy Experiment: Private insurance pays 75% of preventive care expenditures.
- Mammograms, colonoscopies, cervical screenings, and treatment for high blood pressure etc.
- Patients will still have to pay for doctor visits.
- Not all preventive care is covered
- Policy Experiment: Private insurance pays 75% of preventive care expenditures.
- Policy change takes place in universal health insurance economy
Fraction of preventive spending in total health care expenditures increase from 22% to 39%.
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**Table 4: Life Expectancy**

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<tr>
<td>Benchmark</td>
<td>71.95</td>
<td>75.2</td>
<td>76.3</td>
<td>76.5</td>
<td>76.8</td>
</tr>
<tr>
<td>Policy I</td>
<td>73.2</td>
<td>75.3</td>
<td>76.3</td>
<td>76.5</td>
<td>76.8</td>
</tr>
<tr>
<td>Policy II</td>
<td><strong>74.65</strong></td>
<td><strong>75.9</strong></td>
<td><strong>76.5</strong></td>
<td><strong>76.6</strong></td>
<td><strong>76.8</strong></td>
</tr>
</tbody>
</table>

Aggregate medical spending **DOES NOT** increase!

Per capita medical expenditures decrease from $4755 to $4738.
Welfare Analysis

\[ \mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^B - \omega_t) u(c_t^B, h_t^B - \omega_t) = \mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^P - \omega_t) u(\phi c_t^P, h_t^P - \omega_t) \]
Welfare Analysis

\[
\mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^B - \omega_t) u(c_t^B, h_t^B - \omega_t) = \mathbb{E} \sum_{t=1}^{T} \beta^{t-1} s(h_t^P - \omega_t) u(\phi c_t^P, h_t^P - \omega_t)
\]

\[1 - \phi = 2.5\%\]

**Table 5: Welfare Gains, 1 − \phi**

<table>
<thead>
<tr>
<th></th>
<th>Bottom 2%</th>
<th>Median</th>
<th>Top 2%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy I w.r.t Benchmark</td>
<td>0.6%</td>
<td>2.1%</td>
<td>-0.88%</td>
</tr>
<tr>
<td>Policy II w.r.t Benchmark</td>
<td>0.35%</td>
<td>3.13%</td>
<td>-1.2%</td>
</tr>
<tr>
<td>Policy II w.r.t Policy I</td>
<td>-0.24%</td>
<td>1.105%</td>
<td>-0.29%</td>
</tr>
</tbody>
</table>
Conclusion
Conclusion

- Subtle differences in the lifetime profile of medical expenditures between low and high income groups.
  - The young rich spend more on health care whereas medical spending of the old poor is larger in absolute terms.
Subtle differences in the lifetime profile of medical expenditures between low and high income groups.

- The young rich spend more on health care whereas medical spending of the old poor is larger in absolute terms.

Public insurance in old ages (Medicaid, Medicare, default option) can be important in explaining these differences:

- enables the poor to incur medical spending higher than their income.
- hampers incentives of the poor to use preventive care.
Subtle differences in the lifetime profile of medical expenditures between low and high income groups.

- The young rich spend more on health care whereas medical spending of the old poor is larger in absolute terms.

Public insurance in old ages (Medicaid, Medicare, default option) can be important in explaining these differences:

- enables the poor to incur medical spending higher than their income.
- hampers incentives of the poor to use preventive care.

Policies encouraging the use of health care by the poor early in life have significant welfare gains.
Misc
### Table 6: Preventive Medicine

<table>
<thead>
<tr>
<th>Inc. Quant</th>
<th>Dentist</th>
<th>Blood Pressure</th>
<th>Cholesterol</th>
<th>Flu Shot</th>
<th>Prostate Test</th>
<th>Brest Exam</th>
<th>Mamogram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>2.608</strong>*</td>
<td>1.573***</td>
<td>2.863***</td>
<td>4.230***</td>
<td>4.057***</td>
<td>2.205***</td>
<td>3.293***</td>
</tr>
<tr>
<td></td>
<td>(0.00984)</td>
<td>(0.0106)</td>
<td>(0.0235)</td>
<td>(0.0215)</td>
<td>(0.0223)</td>
<td>(0.0177)</td>
<td>(0.0149)</td>
</tr>
<tr>
<td>2</td>
<td><strong>2.356</strong>*</td>
<td>1.497***</td>
<td>2.716***</td>
<td>4.151***</td>
<td>7.781***</td>
<td>2.009***</td>
<td>3.011***</td>
</tr>
<tr>
<td></td>
<td>(0.0102)</td>
<td>(0.00905)</td>
<td>(0.0206)</td>
<td>(0.0200)</td>
<td>(0.0215)</td>
<td>(0.0165)</td>
<td>(0.0173)</td>
</tr>
<tr>
<td>3</td>
<td><strong>2.102</strong>*</td>
<td>1.397***</td>
<td>2.538***</td>
<td>4.004***</td>
<td>3.414***</td>
<td>1.850***</td>
<td>2.722***</td>
</tr>
<tr>
<td></td>
<td>(0.00967)</td>
<td>(0.00827)</td>
<td>(0.0208)</td>
<td>(0.0223)</td>
<td>(0.0200)</td>
<td>(0.0158)</td>
<td>(0.0182)</td>
</tr>
<tr>
<td>4</td>
<td><strong>1.883</strong>*</td>
<td>1.332***</td>
<td>2.377***</td>
<td>3.927***</td>
<td>3.140***</td>
<td>1.727***</td>
<td>2.552***</td>
</tr>
<tr>
<td></td>
<td>(0.00953)</td>
<td>(0.00784)</td>
<td>(0.0191)</td>
<td>(0.0216)</td>
<td>(0.0253)</td>
<td>(0.0155)</td>
<td>(0.0183)</td>
</tr>
<tr>
<td>5</td>
<td><strong>1.689</strong>*</td>
<td>1.286***</td>
<td>2.207***</td>
<td>3.733***</td>
<td>2.814***</td>
<td>1.611***</td>
<td>2.433***</td>
</tr>
<tr>
<td></td>
<td>(0.00966)</td>
<td>(0.00615)</td>
<td>(0.0180)</td>
<td>(0.0253)</td>
<td>(0.0223)</td>
<td>(0.0130)</td>
<td>(0.0184)</td>
</tr>
<tr>
<td>Obs</td>
<td>254445</td>
<td>175515</td>
<td>169552</td>
<td>176935</td>
<td>43337</td>
<td>93046</td>
<td>72777</td>
</tr>
</tbody>
</table>
Calibration/Estimation

\[ u(c_t, h_t) = b + \frac{c_t^{1-\sigma}}{1-\sigma} + \alpha \frac{h_t^{1-\gamma}}{1-\gamma} \]

- \( \alpha, \gamma \): Match quality-adjusted life years (QALYs) from surveys (Cutler and Richardson (1997))

\[
\frac{u(c_{20}, \bar{h}_{20})}{0.94} = \frac{u(c_{65}, \bar{h}_{65})}{0.73} = \frac{u(c_{85}, \bar{h}_{85})}{0.62}
\]
Without preventive health capital medical spending of the poor relative to the rich decreases over the lifetime.
Basic Model with Initial Wealth

Medical Expenditures

- Low Inc. Curative
- High Inc Curative
- Low Inc Preventive
- High Inc Preventive

Medical Expenditure Ratio of Low to High Inc.
Comparison with the Literature
Outline

- Empirical Facts ✓
- Intuition in a Stylized Framework ✓
- Full Model ✓
- Calibration/Estimation ✓
- Model’s Performance ✓
- Policy Analysis ✓
- Comparison with the Literature
In the U.S. the increase in health care spending is dramatically more rapid. (Hagist and Kotlikoff (2005))
Comparison with Literature

- The US ranked last in preventable deaths with timely and effective care among 19 peer countries (Nolte and McKee (2007)).

- Avoidable health condition is a particularly pervasive issue for the poor (National Healthcare Disparities Report (2003)).
  - Low-income patients have higher rates of avoidable hospital admissions

- The difference in probability of surviving to age 75 between the top and the bottom wealth tercile
  - 14% in the US
  - 8% in European countries. (Delavande and Rohwedder (2008))
Comparison with Literature

○ Similar to the US healthcare reform
  ○ individual mandate to obtain health insurance

○ Kolstad and Kowalski (2010) find that
  ○ hospitalizations for preventable conditions are reduced
  ○ growth in health care spending did not increase relative to other states