Is There 'Too Much' Inequality in Health Spending Across Income Groups?

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QSPS 2012 Summer Workshop

Health Care Spending in the U.S.

- Aggregate health care spending : large and growing (NIPA)
  - 16.5% of GDP in 2010

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  - 16.5% of GDP in 2010
- Health care spending in the U.S. is unequal (MEPS)
  - Large variations by age and income

Our Questions

'Too much' inequality in health spending across income groups?

1. What is the 'Ex Ante Efficient' amount of inequality across income groups?

2. How far is the inequality across income groups in the U.S. data from 'Ex Ante Efficient'?

3. How far is the inequality across income groups in the U.S. data from 'Laissez Faire'?

What We Do?

- Use a framework similar to Hall and Jones (2007)
  - Health care spending improves survival rate
  - Being alive is valued
- Depart from Hall and Jones (2007) only by assuming
  - Individuals are heterogeneous in their productivity
  - Endogenous labor supply
- Look at – full info – ex ante efficient allocation

What We Find?

Preview of qualitative findings

Under full information, efficiency implies that :

- Before retirement :
  - More productive types receive more health care
  - Health care is more unequal than consumption
- After retirement :
  - All types receive same health care (Medicare?)

What We Find?

How far is data from ex ante efficient?

1. For ages 25 to 35
   - Inequality in ex ante efficient allocation and U.S. data are roughly equal

2. For ages 55 and above
   - Inequality in ex ante efficient allocation is less than U.S. data

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2. For ages 55 and above
   - Inequality in ex ante efficient allocation is less than U.S. data
   - $\frac{\text{Top income quartile}}{\text{Bottom income quartile}} = 1$ in model vs. 1.5 in data

What We Find?

How far is data from 'Laissez Faire'?

- For all ages
  - Inequality in 'Laissez Faire' is significantly more than U.S. data

- For all ages
  - Data is much closer to ex ante efficient than it is to 'Laissez Faire'

What We Find?

How far is data from 'Laissez Faire'?

- For all ages
  - Inequality in 'Laissez Faire' is significantly more than U.S. data
  - $\frac{\text{Top income quartile}}{\text{Bottom income quartile}} = 7$ in model vs. 1.5 in data
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  - Data is much closer to ex ante efficient than it is to 'Laissez Faire'

Related Literature

- **Hall and Jones (2007):** efficiency and aggregate health spending.

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- **Ozkan (2011):** Positive analysis of health spending inequality (incomplete market, moral hazard, etc.).
- **Yogo(2009); De Nardi, French and Jone (2010):** effect of health expenditures on life-cycle asset accumulaiton and portfolio choice.
- **Deaton (1999); Deaton and Paxon (1998, 1999); Wagstaff (2002); Skinner and Zhou (2004):** Document Inequality in health outcomes and its relation to income.

Theory

Model

Individuals

- Large number of finitely lived individuals
- Only differ in their – hump shaped – productivity profiles
  - Each productivity profile is indexed by a number θ
- At age 0, they draw θ from $\pi(\theta)$
- No uncertainty in productivity, $w_a(\theta)$, after θ is realized
- Assume

$$\theta' > \theta \Rightarrow w_a(\theta') > w_a(\theta) \text{ for all } a$$

Model

Health Care and Survival

- Health spending, h, affects survival rates
- $P_a(h)$ is the survival rate at age a with health spending h

Assumption

$P_a(\cdot)$ *is strictly increasing and concave*

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- Let $h_a(\theta)$ be health spending on type θ at age a
- Then type θ survives to age $a+1$ with probability $N_a(\theta)$

$$N_{a+1}(\theta) = P_a(h_a(\theta))N_a(\theta)$$

Model

Preferences and Technology

- Individuals care about consumption and leisure

$$\sum_{a=0}^{A} \beta^a N_a [u(c_a) + v(1 - l_a)]$$

Assumption

$$u(c) + v(1 - l) > 0$$

Model

Preferences and Technology

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Assumption

$$u(c) + v(1 - l) > 0$$

- There is a saving technology R.
- Type θ who works l hours at age a produces $w_a(\theta)l$

Model

Ex Ante Efficient Allocation

$$\max_{c_a(\theta),l_a(\theta),h_a(\theta),N_a(\theta)} \sum_{\theta} \pi(\theta) \sum_{a=0}^{A} \beta^a N_a(\theta)[u(c_a(\theta)) + v(1 - l_a(\theta))]$$

subject to

$$\sum_{\theta \in \Theta} \pi(\theta) \sum_{a=0}^{A} \frac{1}{R^a} N_a(\theta) \left[c_a(\theta) + h_a(\theta) - w_a(\theta) l_a(\theta)\right] \leq 0$$

$$\begin{aligned} N_{a+1}(\theta) &= P(h_a(\theta)) N_a(\theta) \quad \forall\ \theta \\ N_0(\theta) &= 1 \quad \forall\ \theta \end{aligned}$$

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Note: no incentive constraints (yet)!

Properties of Efficient Allocation

- Same consumption for all, higher productivity work more
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  - More high-θ types means more output

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  - Standard under full information and separability
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  $\Rightarrow$ Planner wants more of them around
- After retirement: same health care for all
  - No efficiency reason to have different survival rates
  - Costly to have different survival rates

Alternative Benchmark?

Laissez Fair Allocation

- Ex ante efficient allocation is one extreme benchmark
  - Full insurance against realization of ability
- Another extreme is the one that provides no such insurance
  - Each Individual's spendings do not exceed their output
- We call this benchmark 'Laissez Fair'

Alternative Benchmark?

Laissez Fair Allocation

For each type θ

$$\max_{c_a(\theta),l_a(\theta),h_a(\theta),N_a(\theta)} \sum_{a=0}^{A} \beta^a N_a(\theta)[u(c_a(\theta)) + v(1 - l_a(\theta))]$$

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Lessons from the Model

- If individuals differ in their productivity,

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Lessons from the Model

- If individuals differ in their productivity,

  more productive should receive more health care

- **Question:** How much more?

- **Next:**
  - We compute efficient allocations in the model
  - Compare health spending by income in data and model

Quantitative Exercise

How 'should' healthcare spending vary with ability?

Quantitative Exercise

What do we need?

- In order to solve the model, we need
  1. Productivity profiles – $w_a(\theta)$
  2. Survival function – $P_a(h)$
  3. Parameters for the utility function
- Next: I describe the data we use to estimate 1 and 2
- We use those estimates to calibrate the preference parameters

Calibration

Productivity profiles – $w_a(\theta)$

- Quantiles of wage profiles in MEPS

▸ show wage profiles

- Let $\theta = 1, 2, 3 \ldots, 99$
- We choose $w_a(\theta)$ to be the θth percentile of wages at age a.
- I describe MEPS on the next slide

Health Spending Data

Medical Expenditure Panel Survey 1996-2008

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  - Medicare, Medicaid, TRICARE and Veteran's admin
  - Private insurance
  - Other federal, state and local
  - Worker's compensation

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  - Worker's compensation
- Nursing homes/institutionalized population NOT included

Calibration

Estimating Survival Function – $P_a(h)$

- Survival function - Hall and Jones (2007)

$$P_a(h) = \max\left\{1 - \frac{1}{f_a(h)}, 0\right\}$$

$$f_a(h) = A_a h^{\eta_a}$$

- Estimate A_a and η_a using

▸ estimated values

  - mortality by age, gender, race, census region (CDC)
  - spending by year, age, gender, race, census region (MEPS)
  - control for year, tech. prog., other non health-spending factors

Calibration

Parameters chosen using the model

$$u(c, 1-l) = b + \frac{c^{1-\gamma}}{1-\gamma} + \psi \frac{(1-l)^{1-\epsilon}}{1-\epsilon}$$

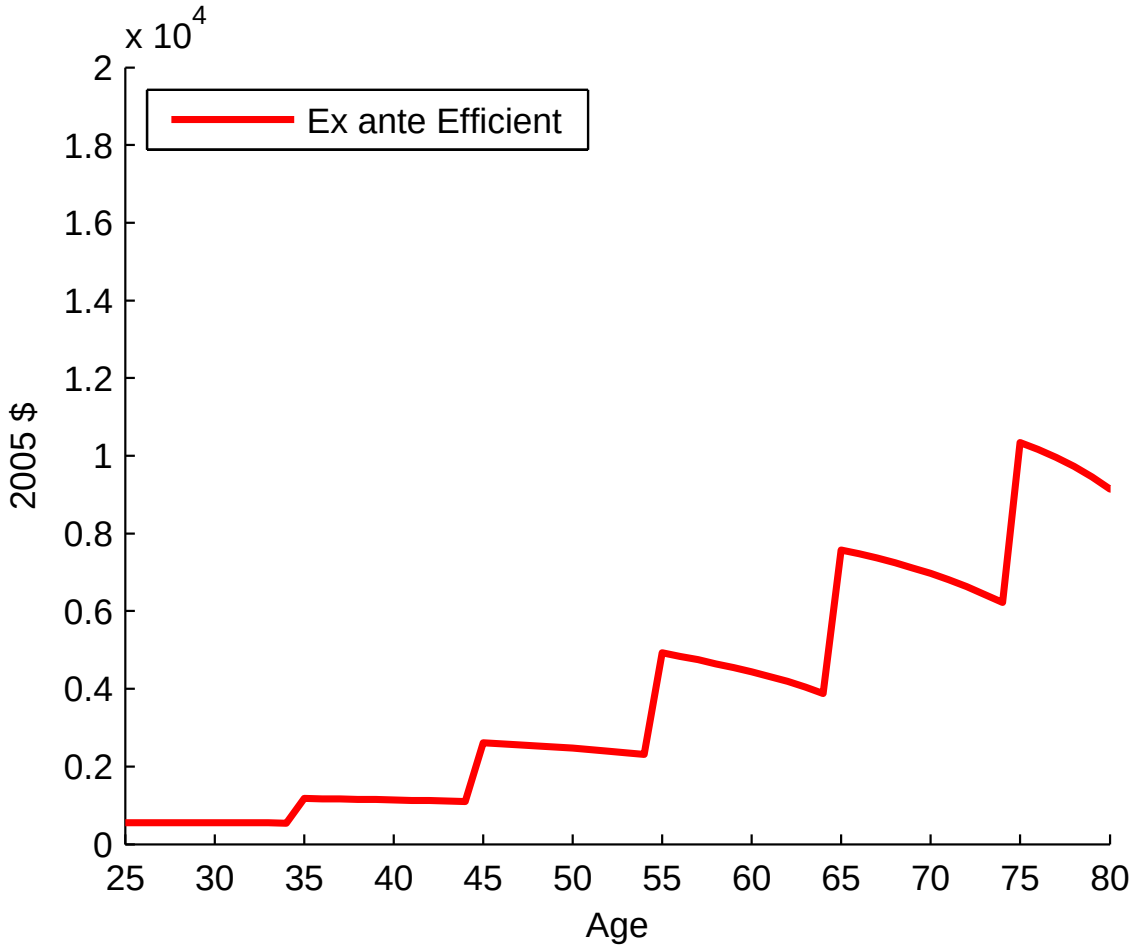
γ	ϵ	ψ	b	β	R
2*	4.442	0.756	7.0	0.97	1.04

Table: *Hall and Jones (2007) benchmark

- b is chosen to match value of saving a life at age 37 = \$3 miln (DOT estimate) ▸ Detail
- ϵ is chosen to match labor supply elasticity = 0.38
- ψ is chosen to match average hours = 0.372

Ex Ante Efficient vs. Laissez Faire

Average Health Spending by Age



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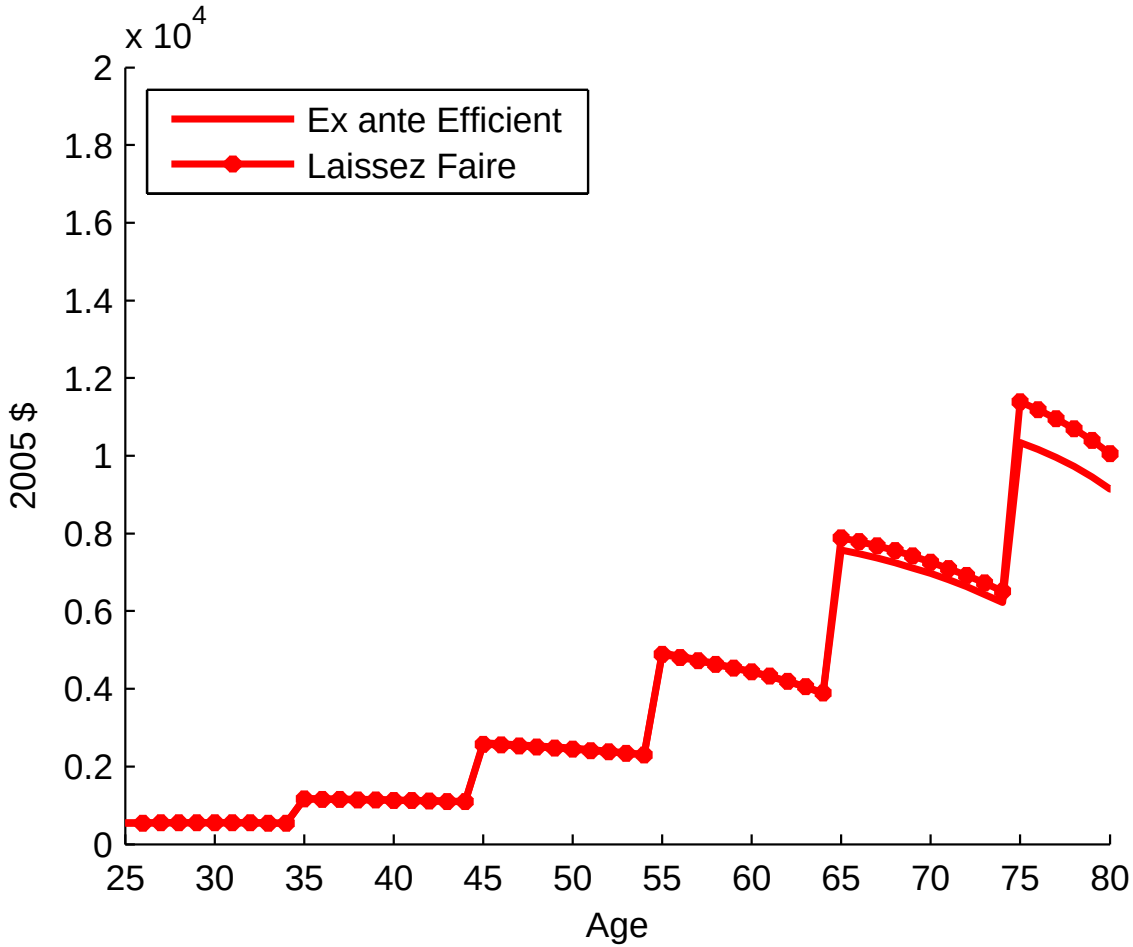

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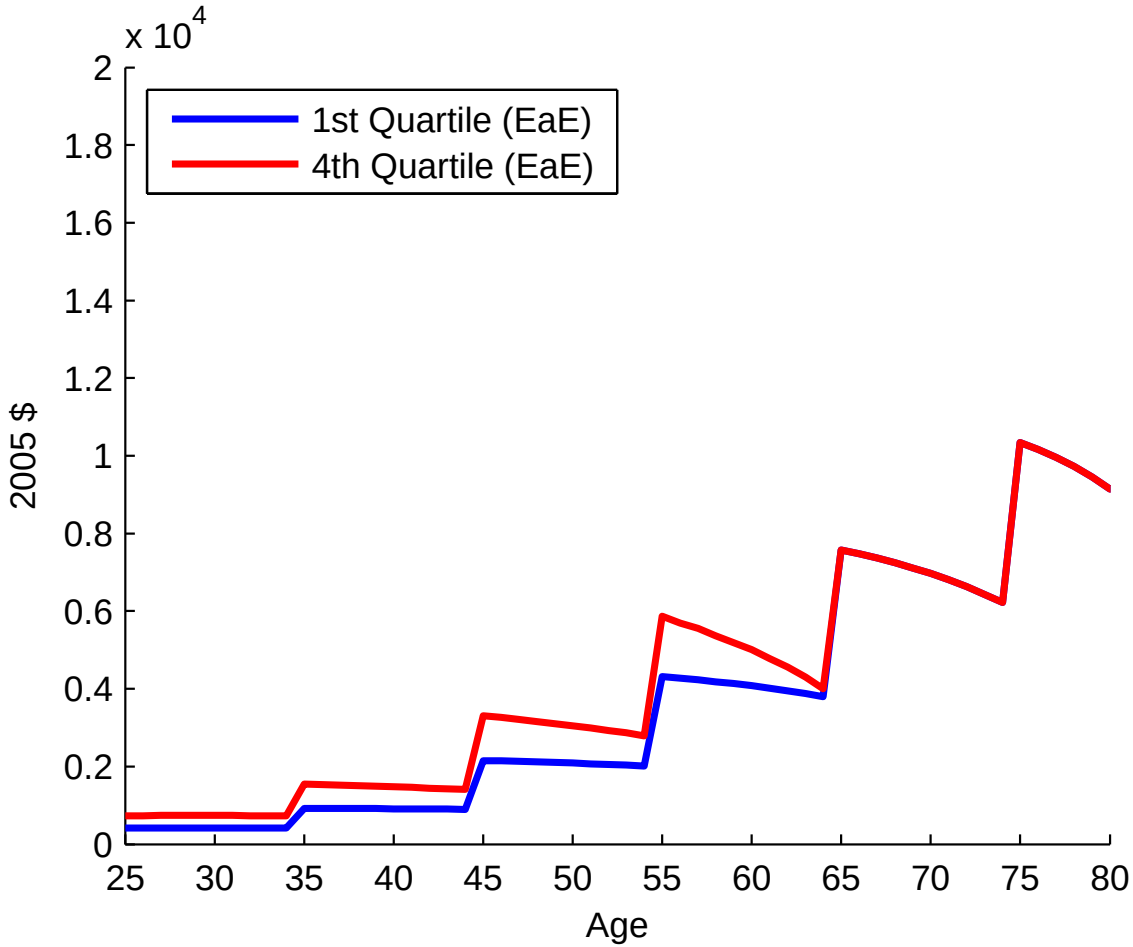
Average Health Spending by Age – Top and Bottom Income Quartile



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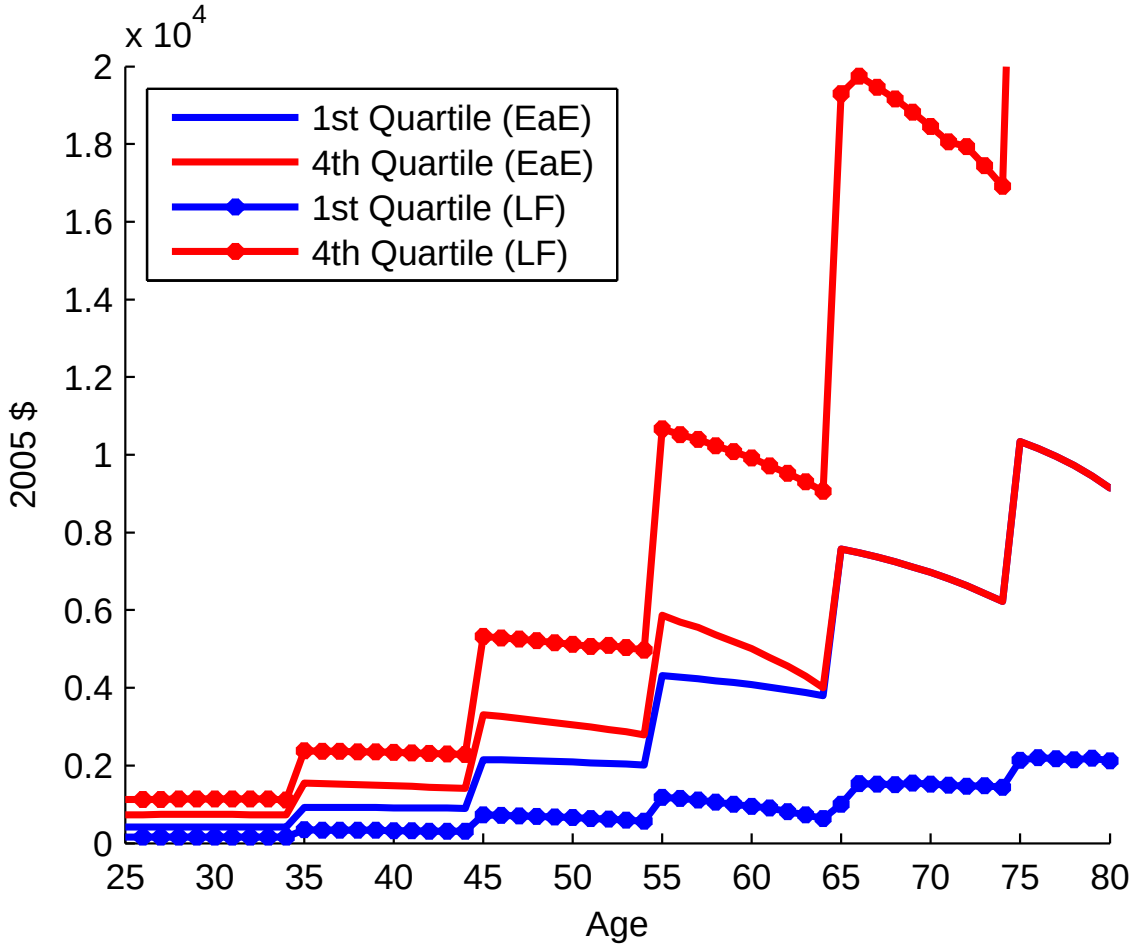

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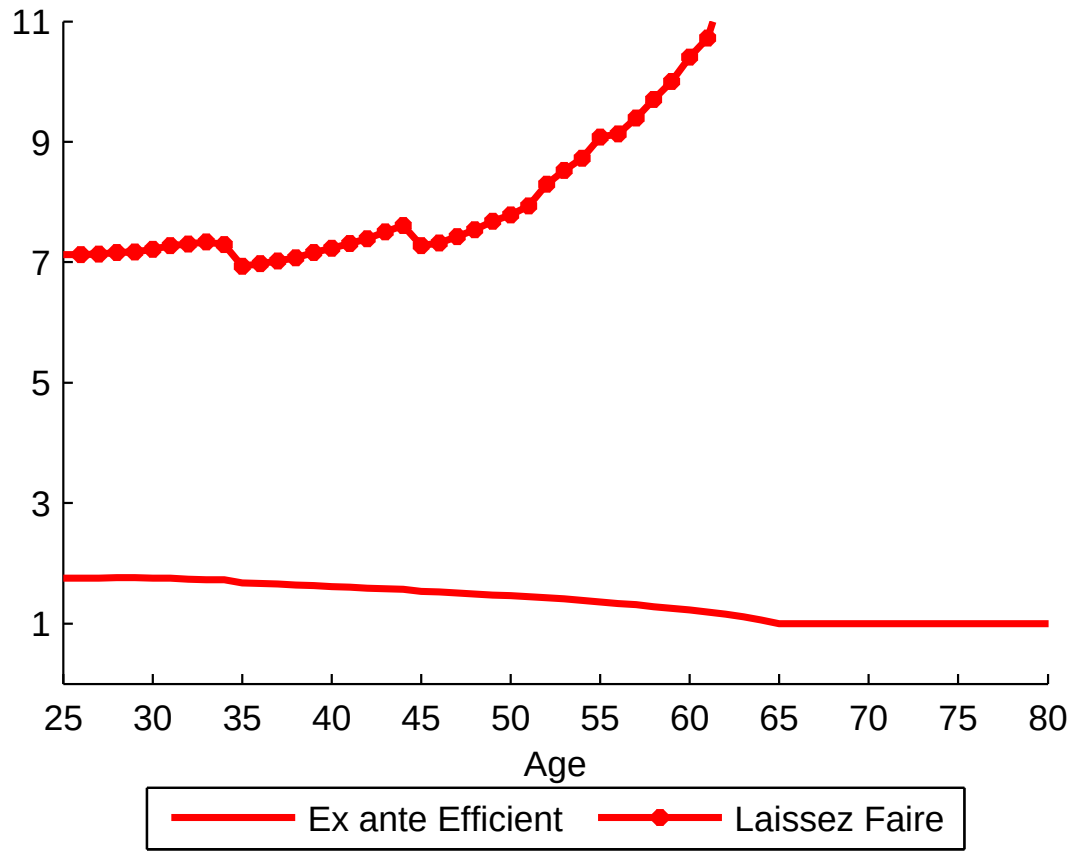
Ratio of Health Spending by Age – Top to Bottom Income Quartile



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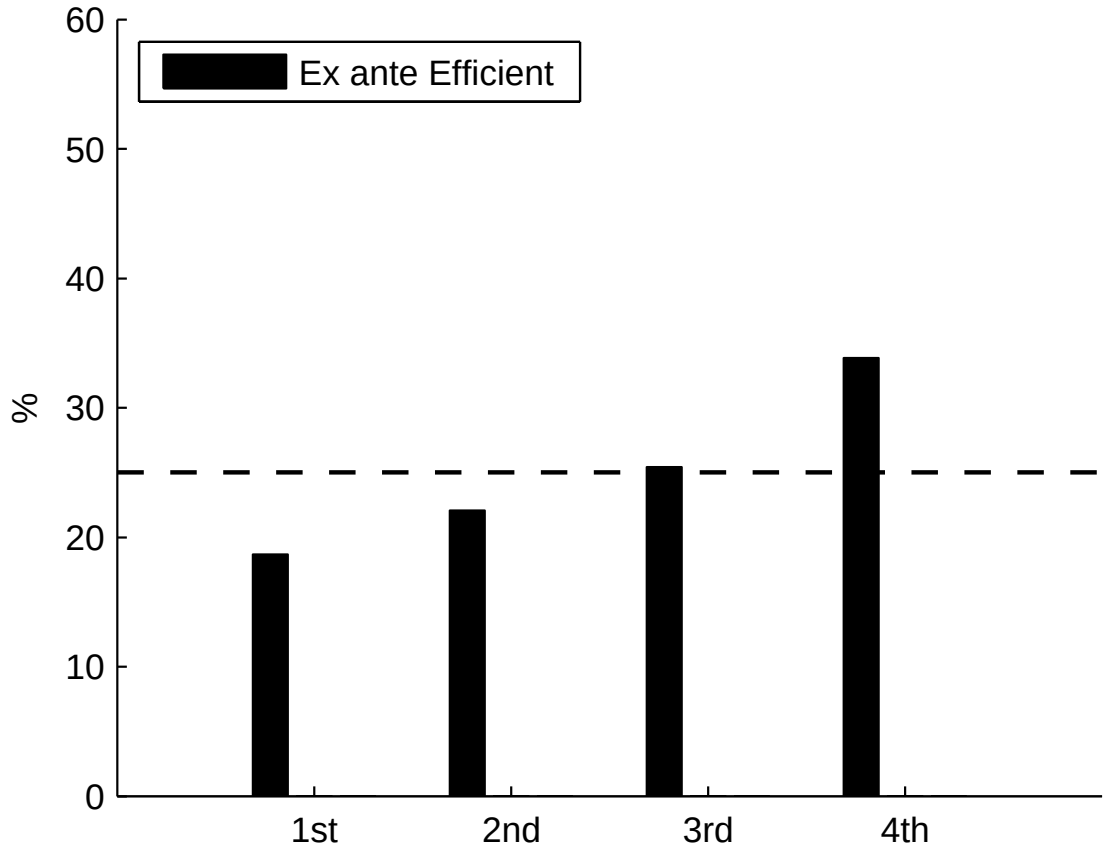
Share of Health Spending by Income Quartile, 25-35yrs old



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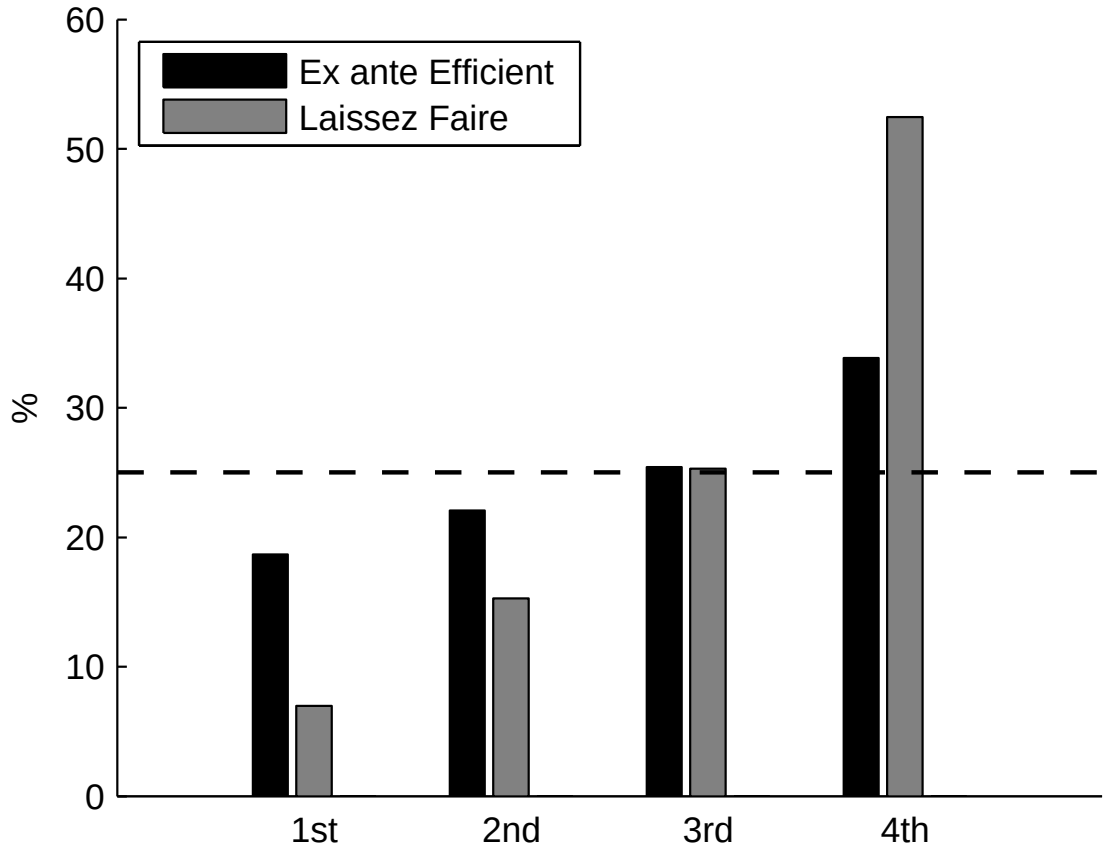

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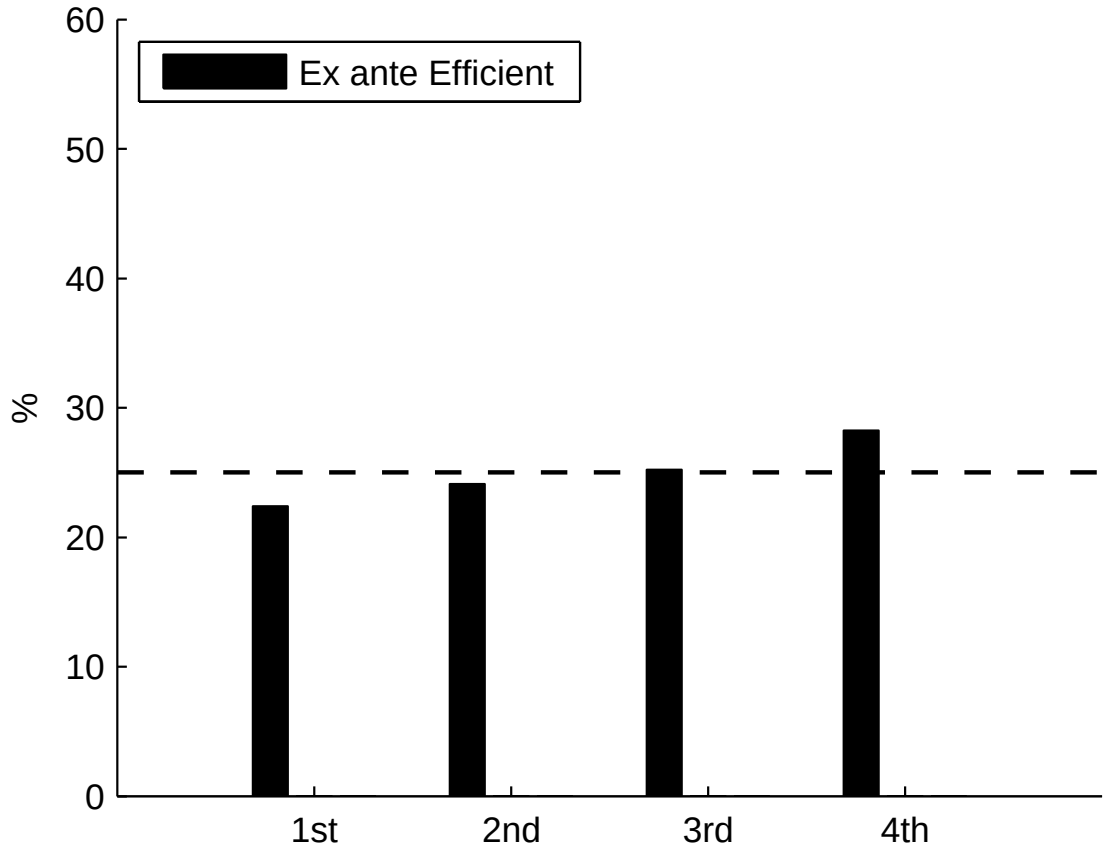
Share of Health Spending by Income Quartile, 55-65yrs old



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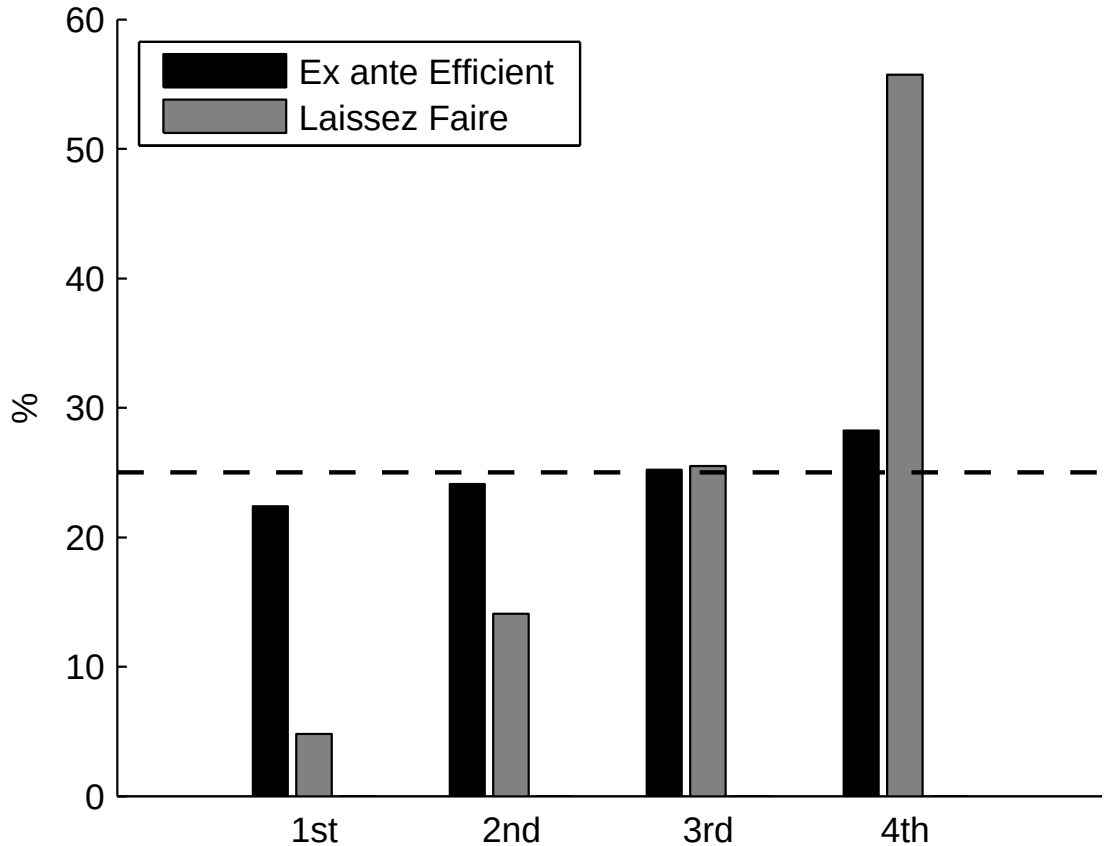
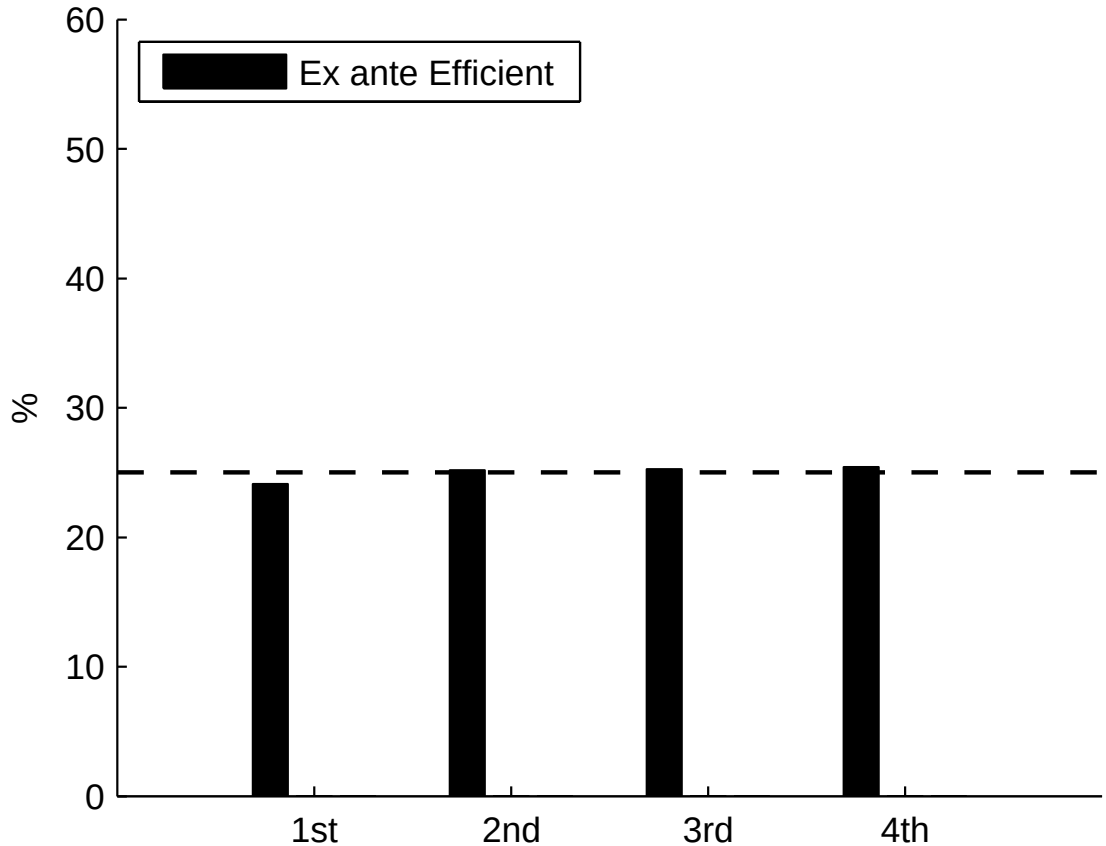


Ex Ante Efficient vs. Laissez Faire

Share of Health Spending by Income Quartile, 70-80yrs old



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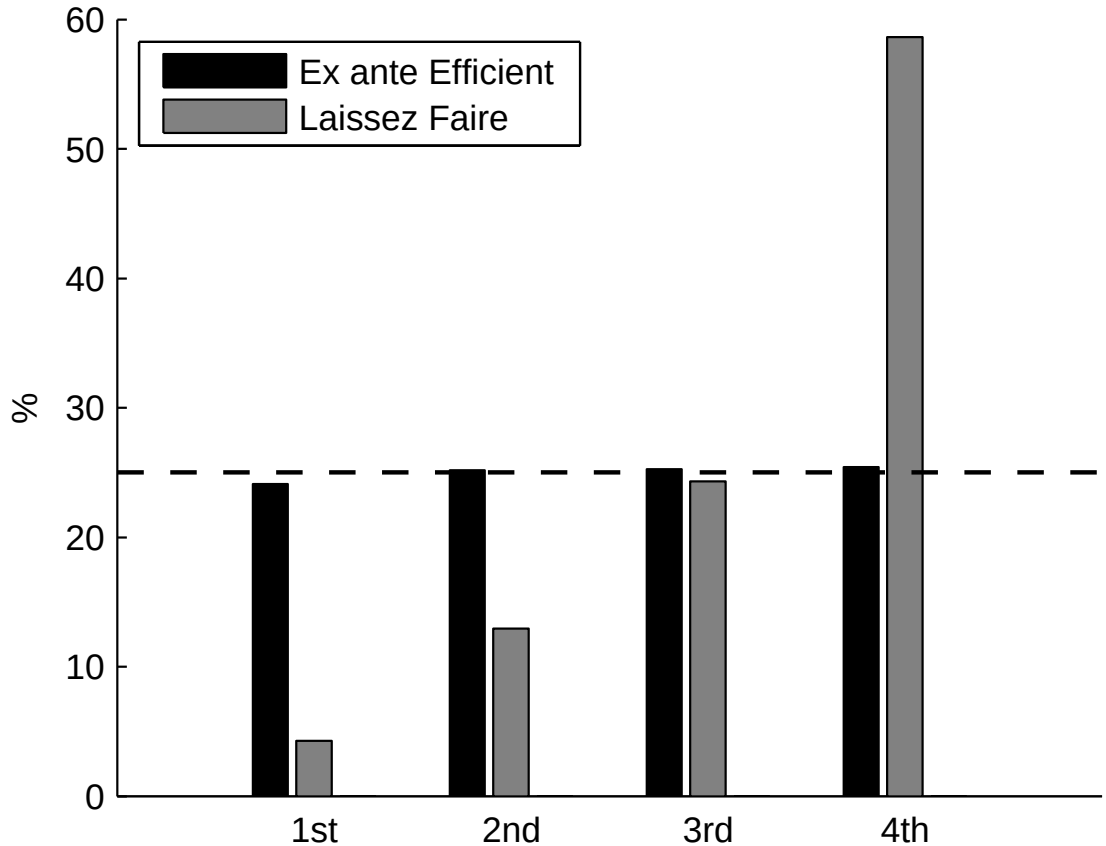


MEPS Data (U.S.)

How does health spending vary with ability?

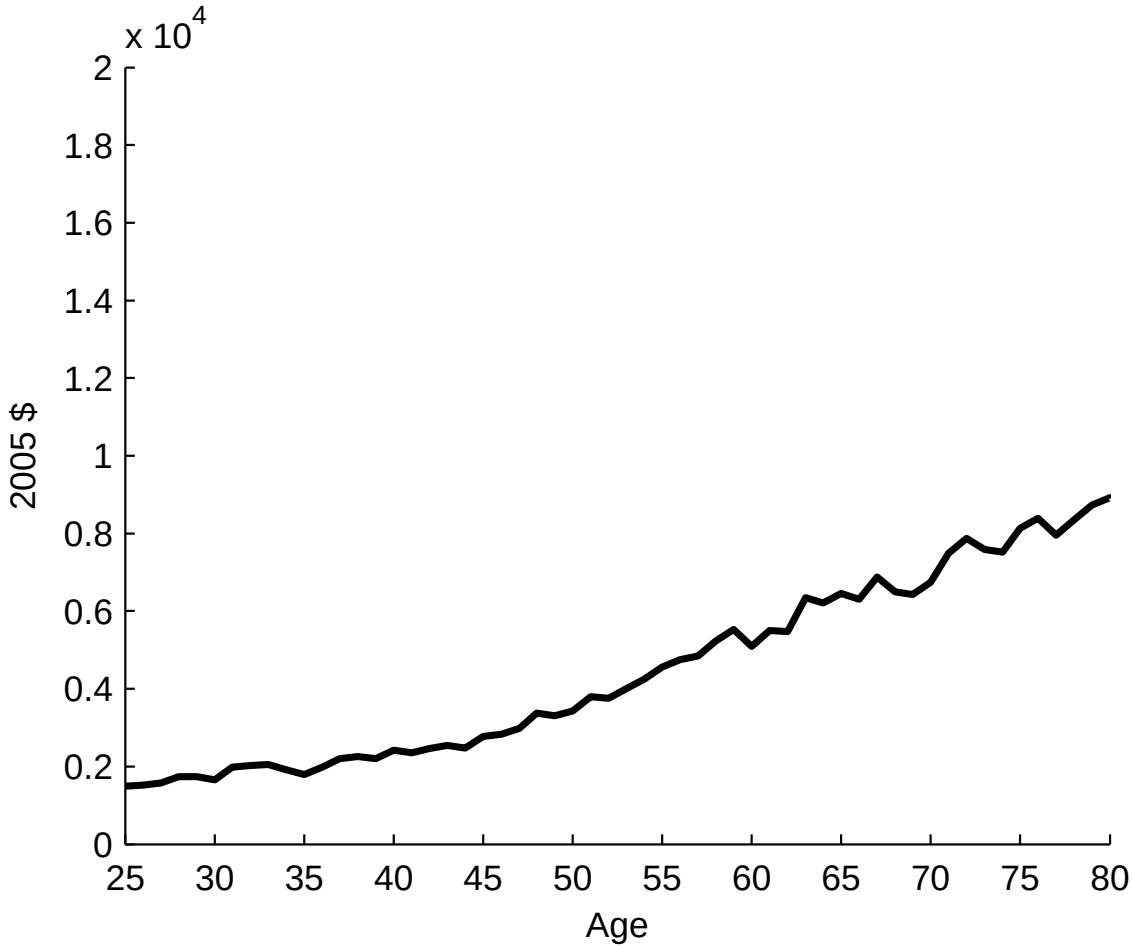
MEPS Data

Constructing Data Summaries Comparble to Model

- People of the same income in MEPS data may have drastically different health spending
    - Some people are sick and some are not sick
- Our model is very stylized and abstracts from various features in data (including sickness)
- To construct data summaries that are comparable with model quantities we look at average health spending over an income group, e.g., top and bottom income quartiles by age

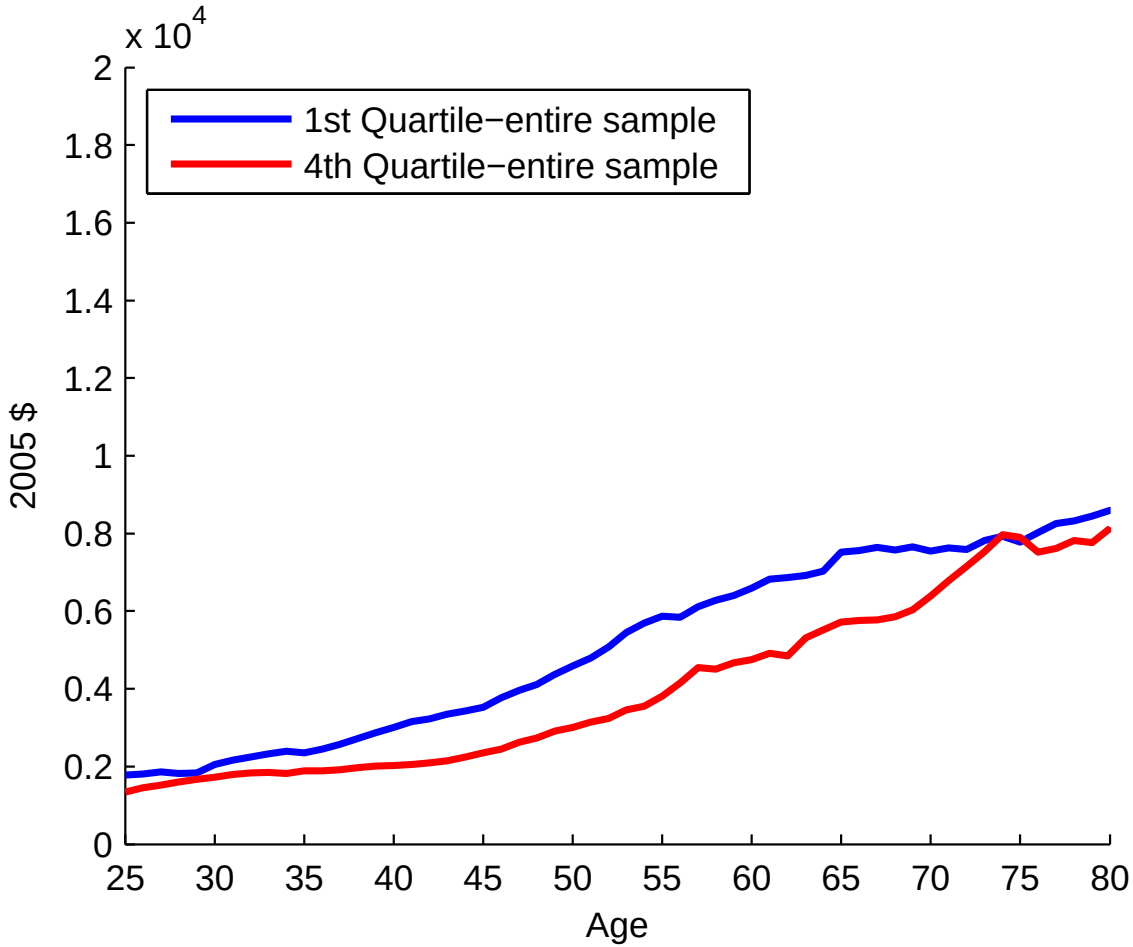
Data

Average Health Spending by Age



Data

Average Health Spending by Age – Top and Bottom Income Quartile



Income Endogeneity Issue

- It appears that in MEPS data spending on poor individuals is higher than spending on rich individuals
- This may be due to an income endogeneity
  - A productive high income individual who does not work due to sickness will show up low income with high spending in MEPS data
  - This causes an upward (downward) bias on poor (rich) types
- In order to partially control for this we restrict our sample

Restricting the Sample

Focus on Median Health Status

- MEPS containts self reported health status: 1-Excellent,..., 5-Poor.
- We construct an individual time average of the reported health status
  - Suppose the report is 1 for the first 6 months in a year and 2 for the next 6 months
  - Then the time average is 1.5
- We restrict the sample to only contain individuals with time average health status between 45th and 55th percentile.

Data: Filtered vs. nonFiltered

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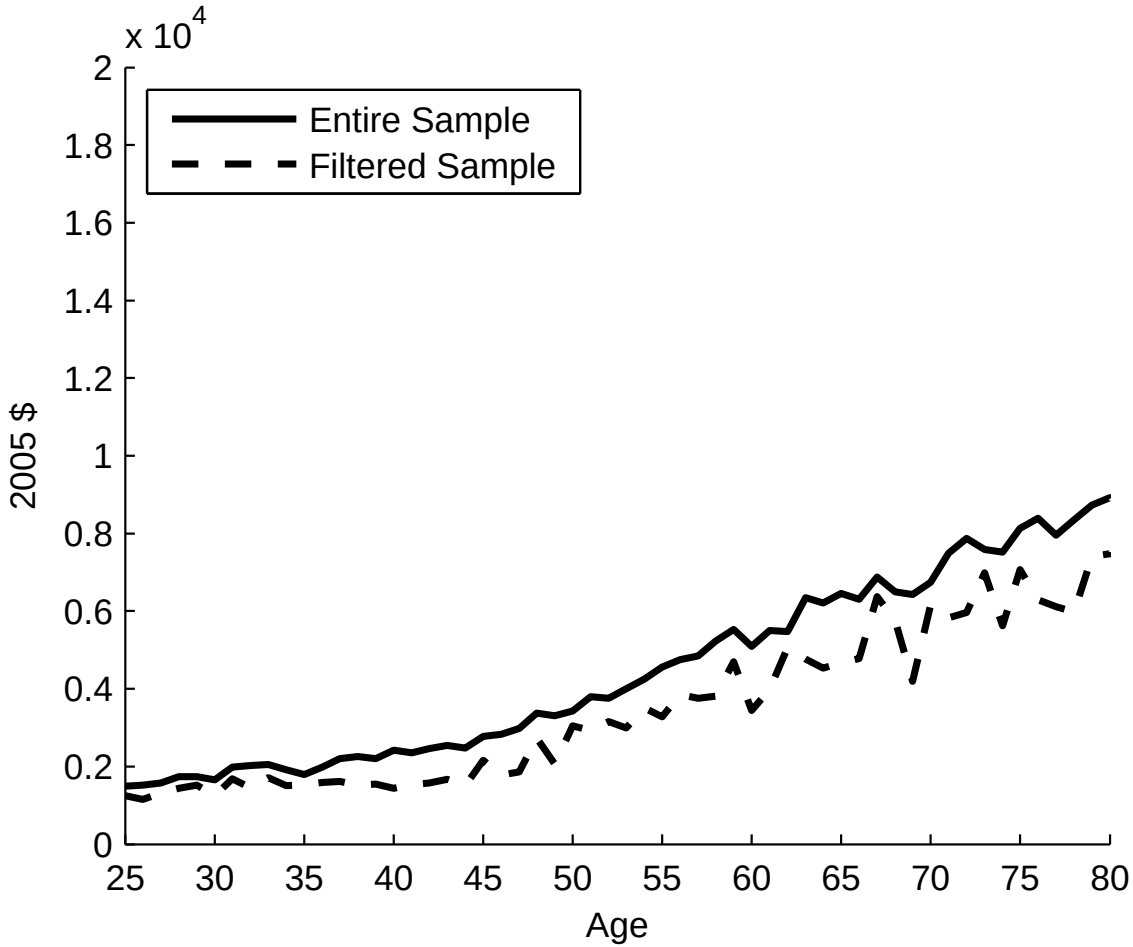

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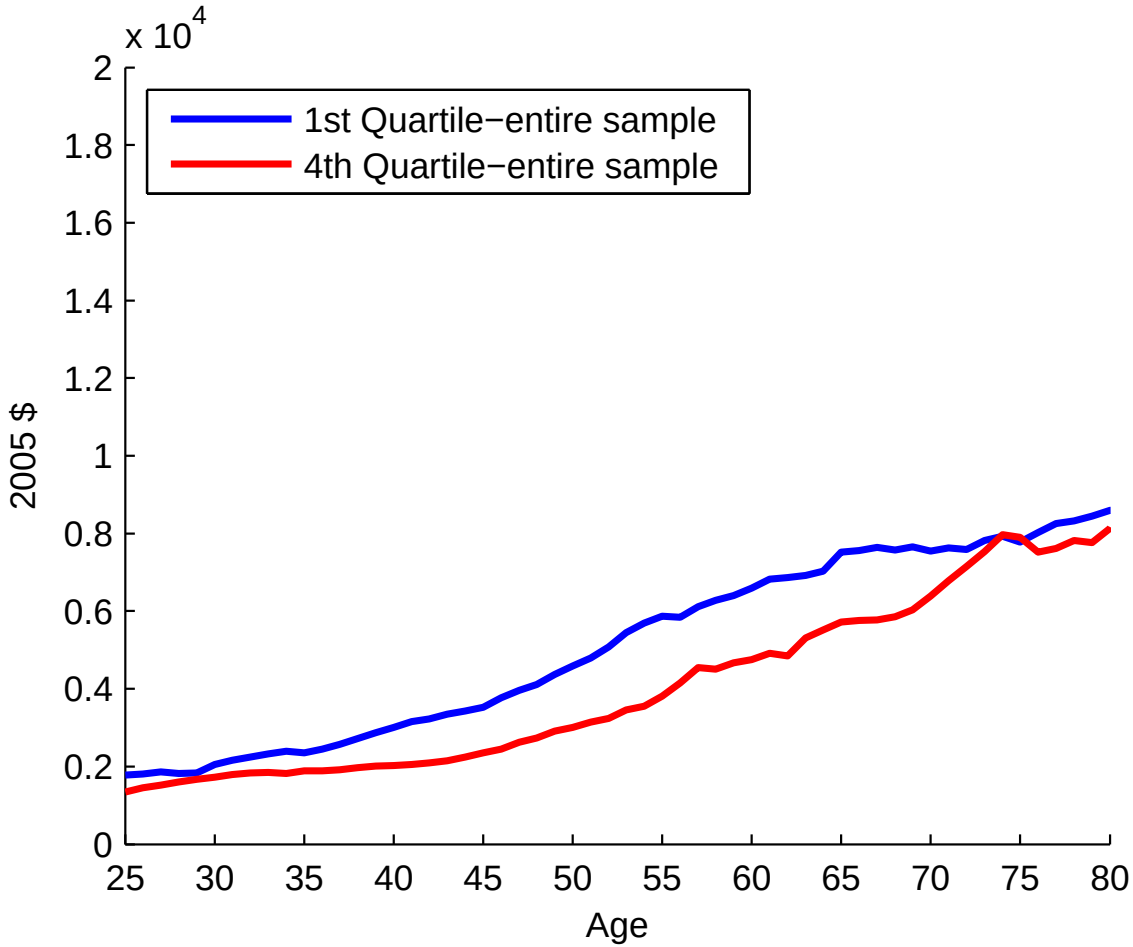

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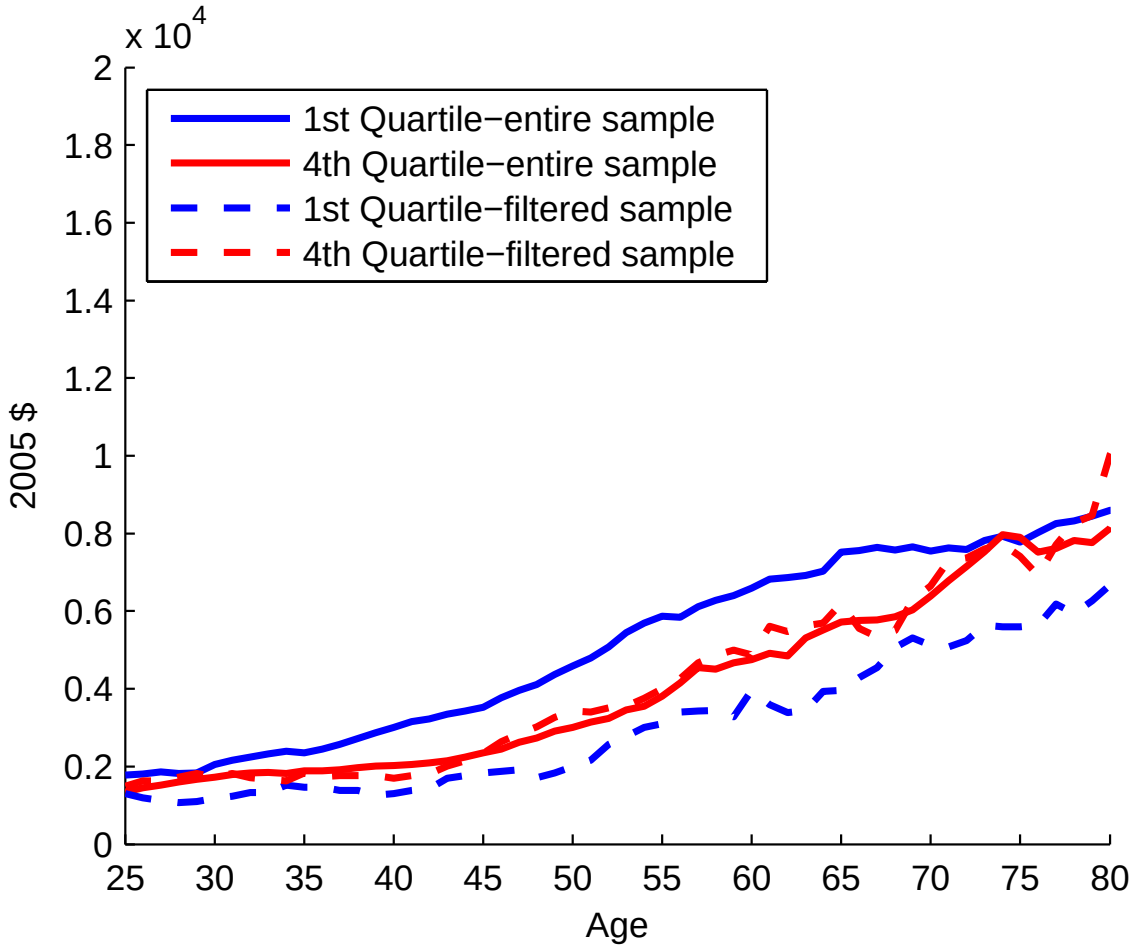

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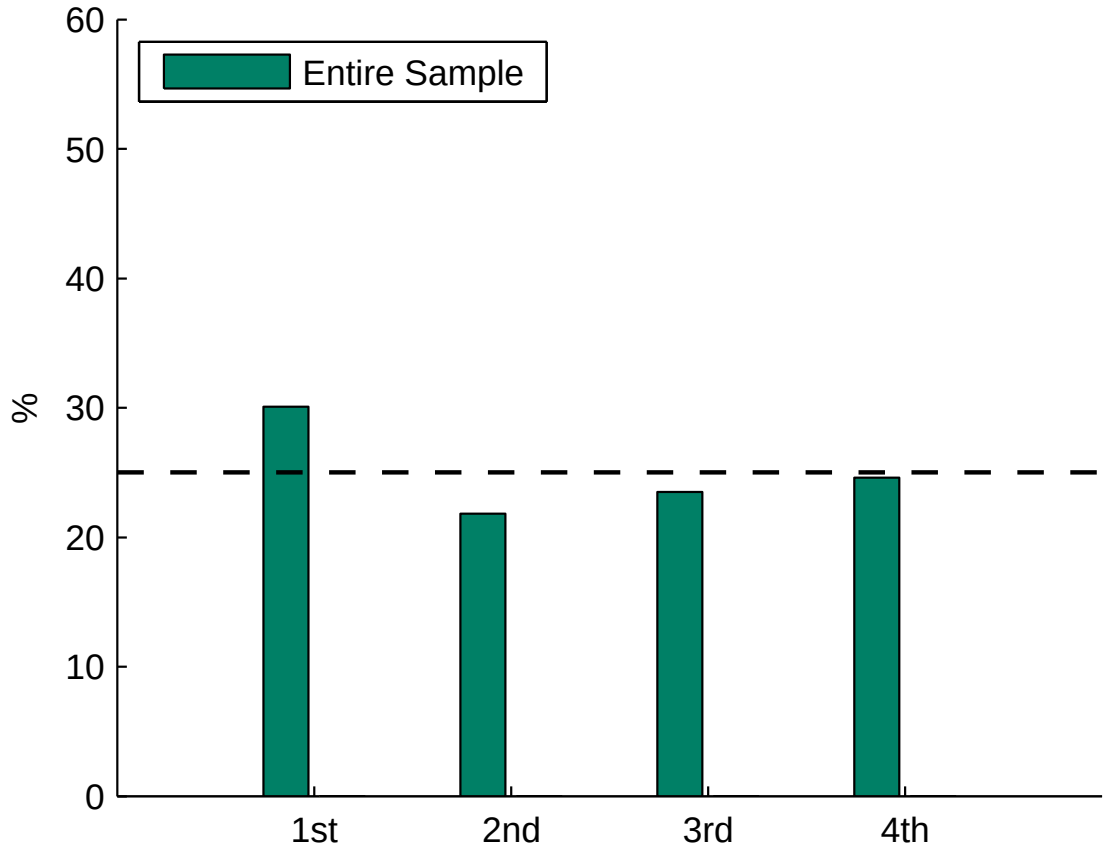
Share of Health Spending by Income Quartile, 25-35yrs old



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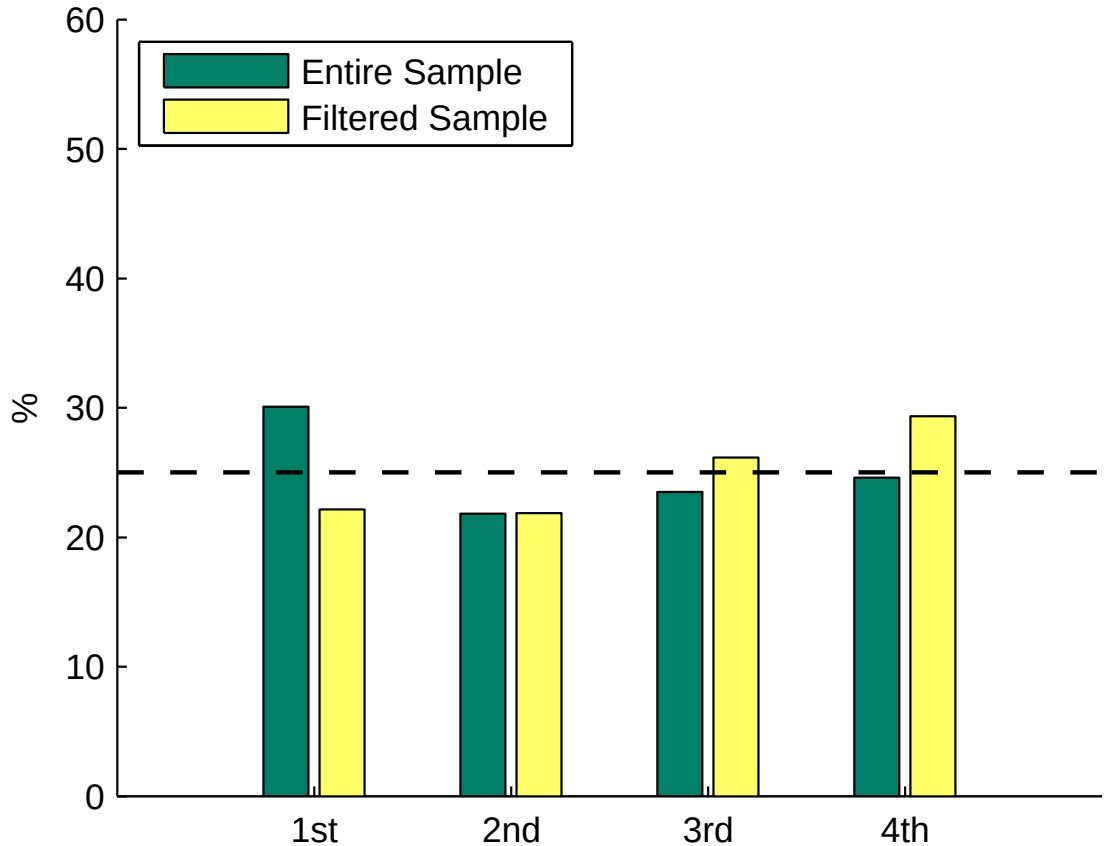

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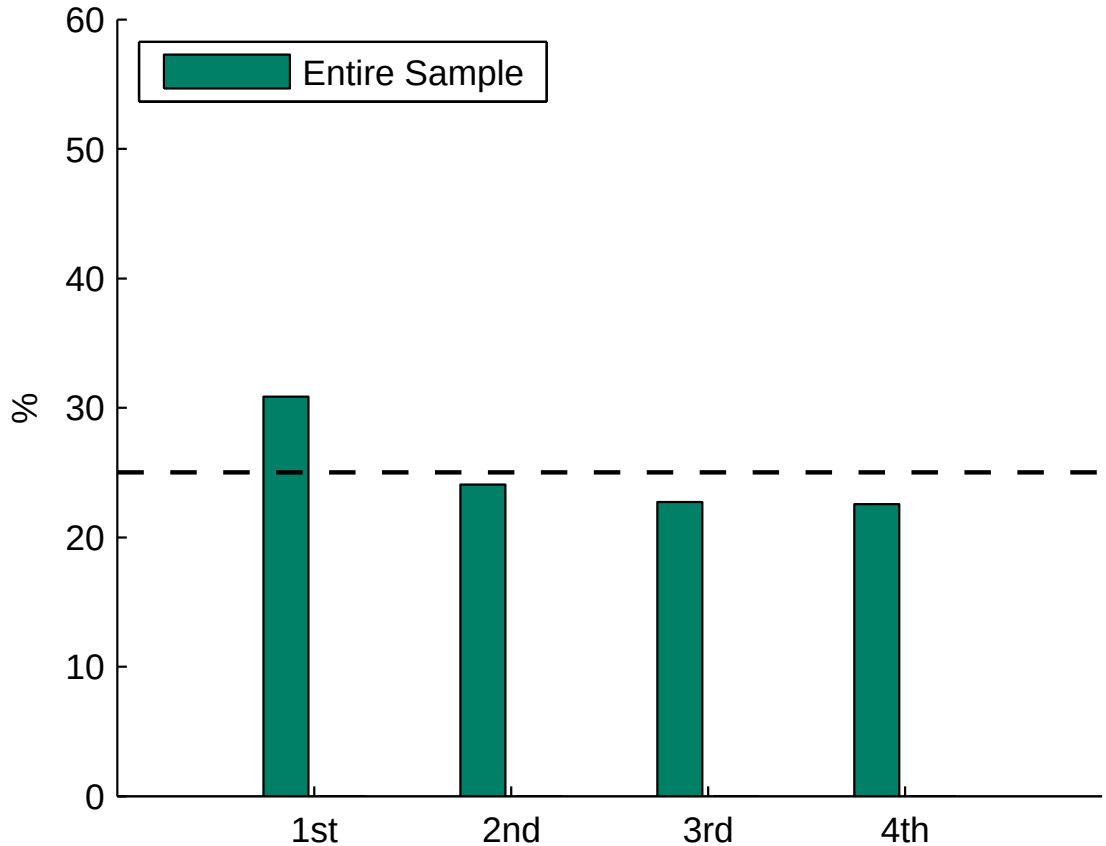
Share of Health Spending by Income Quartile, 55-65yrs old



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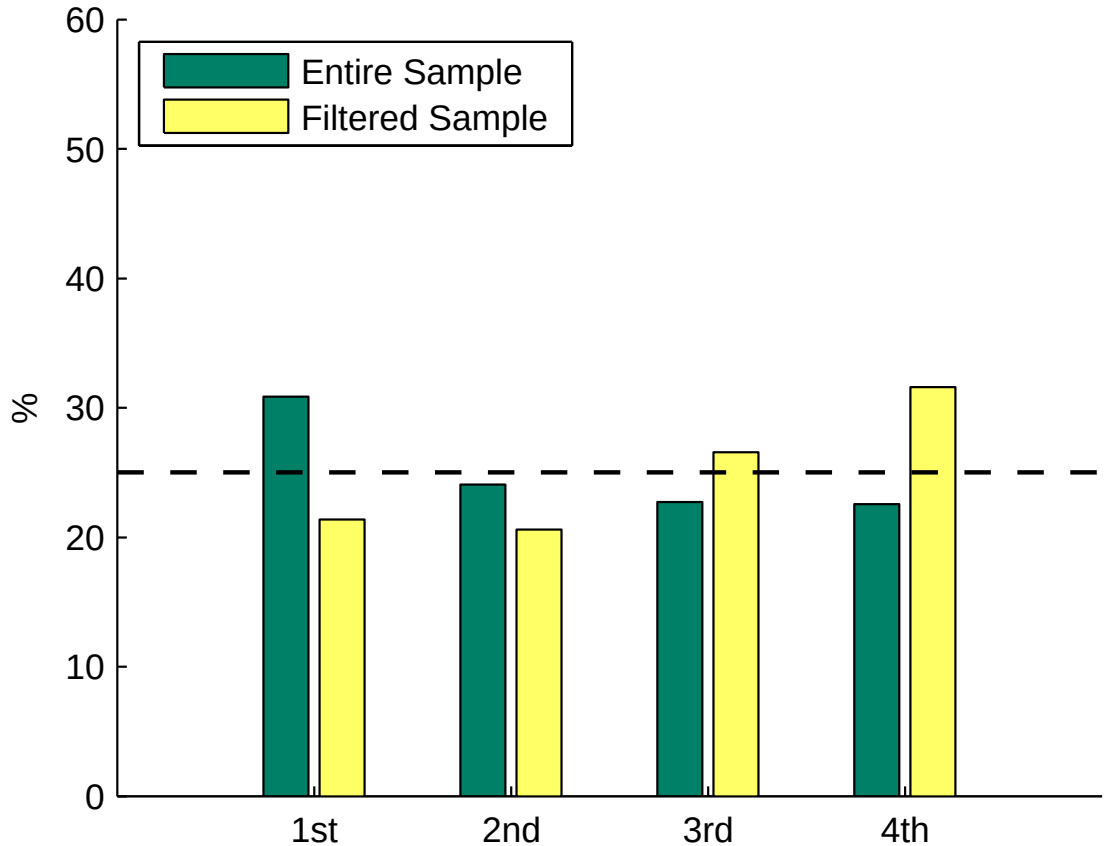

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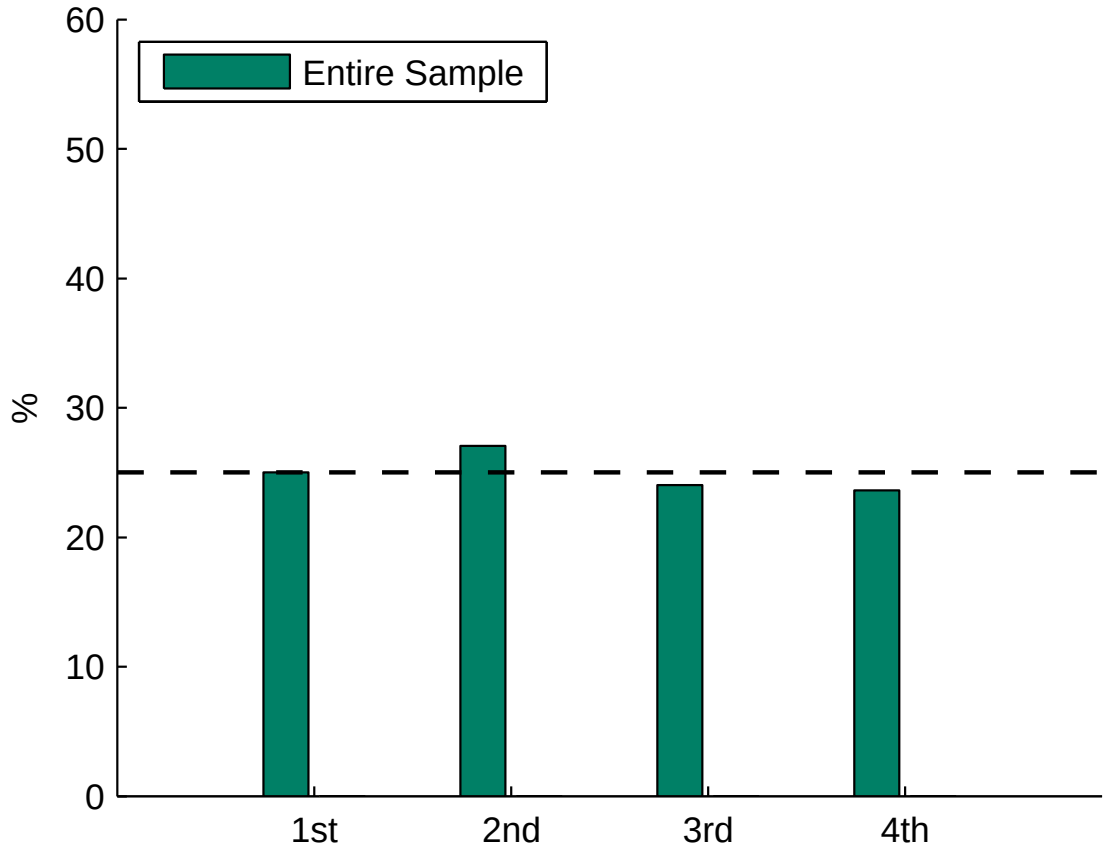

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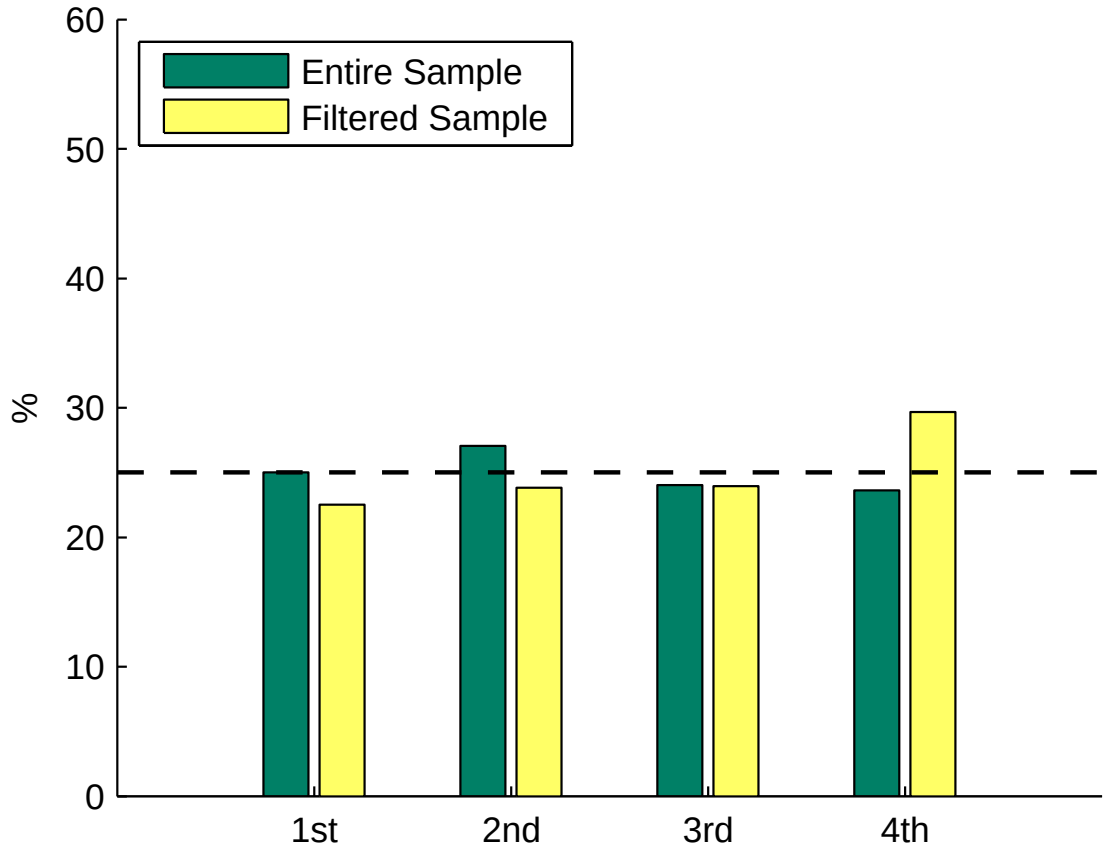

Comparing Model and Data

How Far is U.S. Data from Ex Ante Effificient? Laissez Faire?

Ex Ante Efficient vs. Laissez Faire vs. Data

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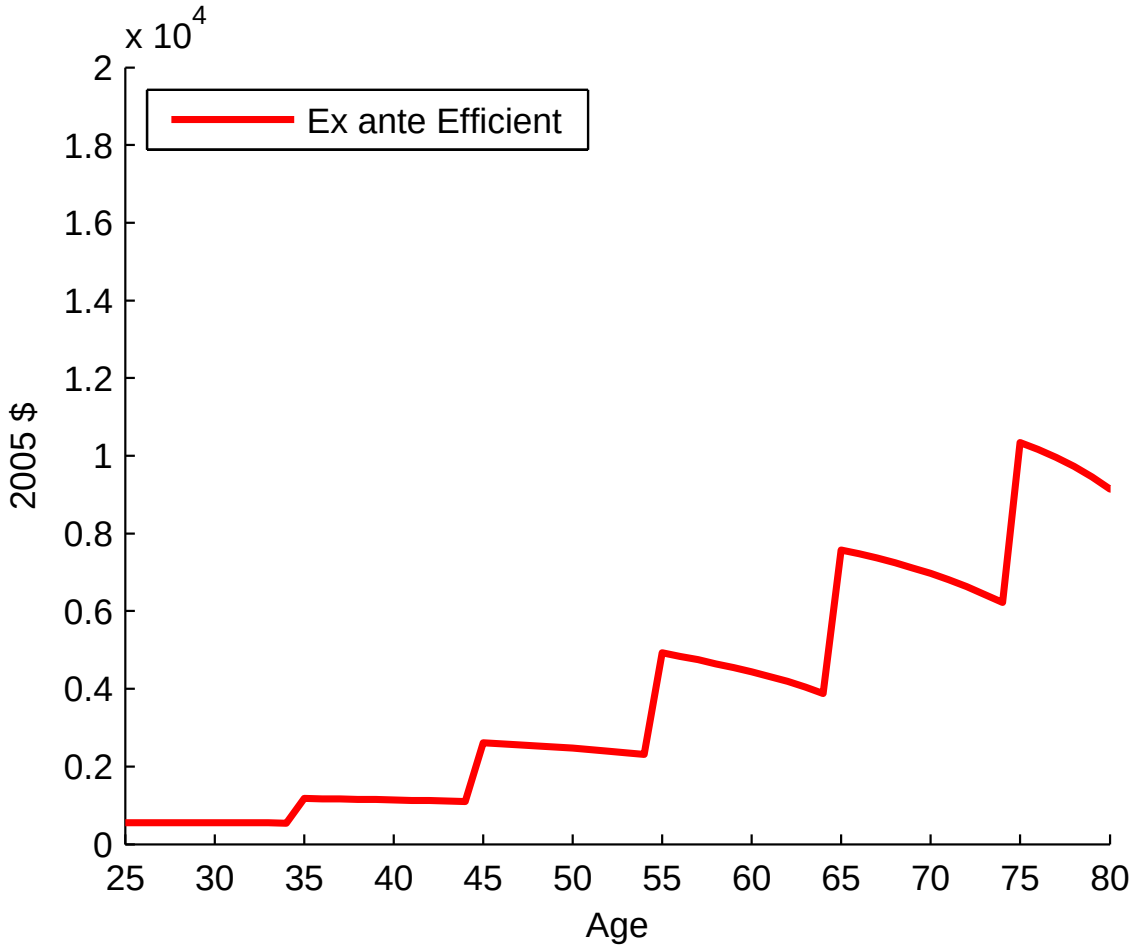

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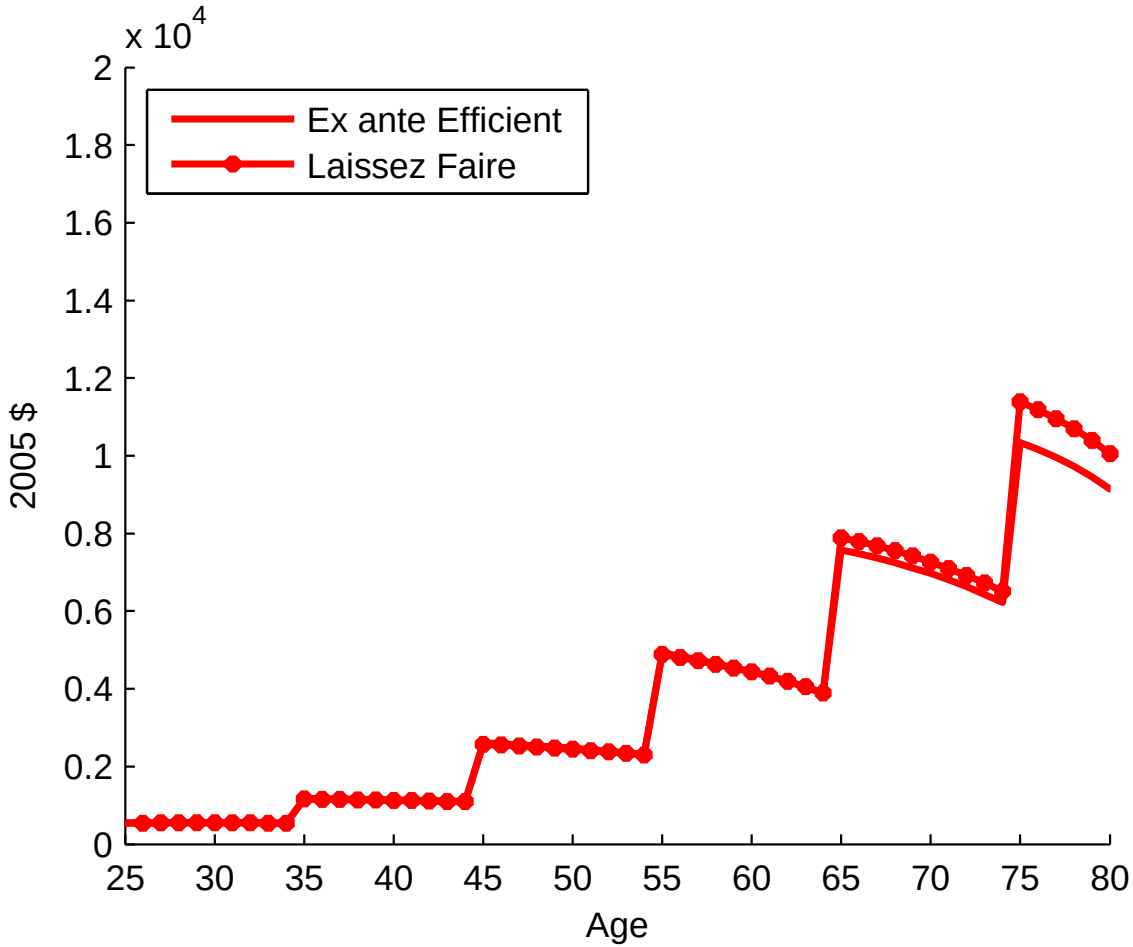

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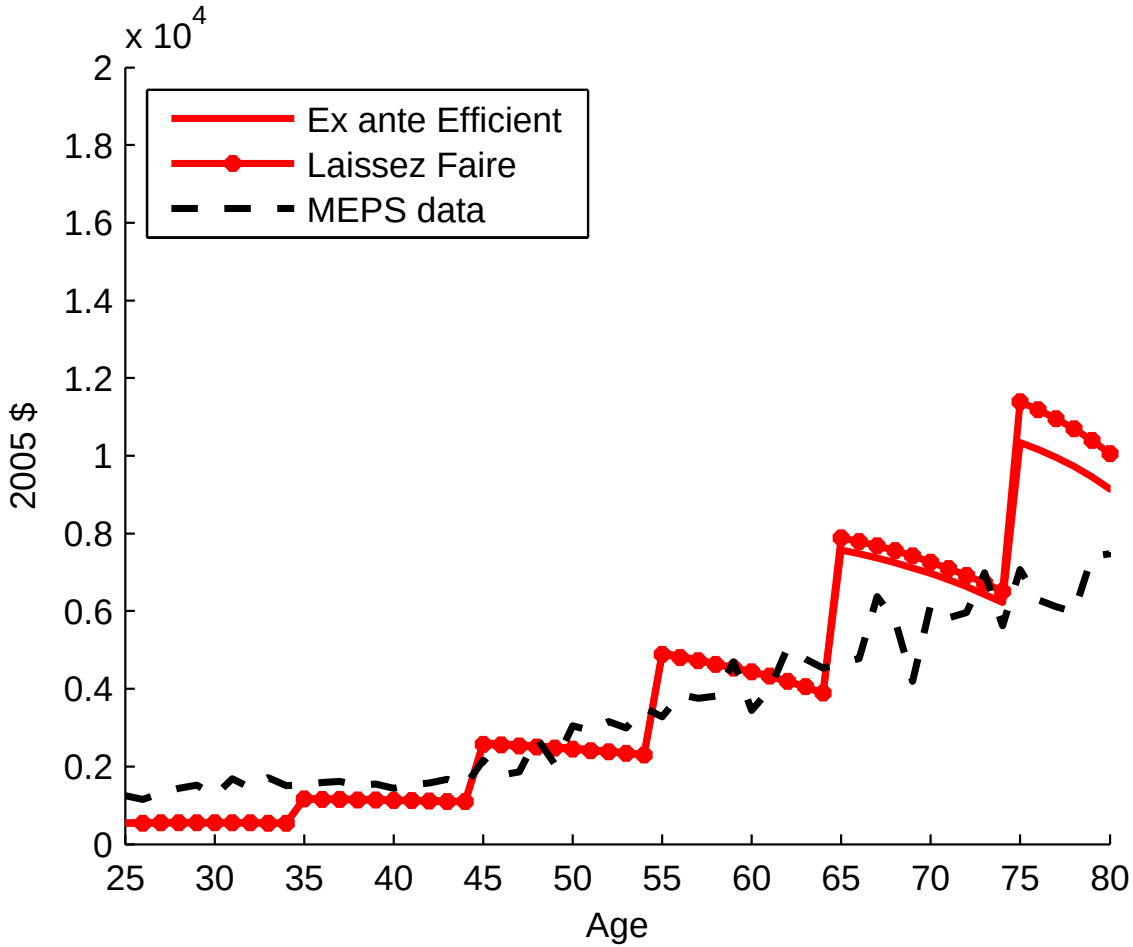

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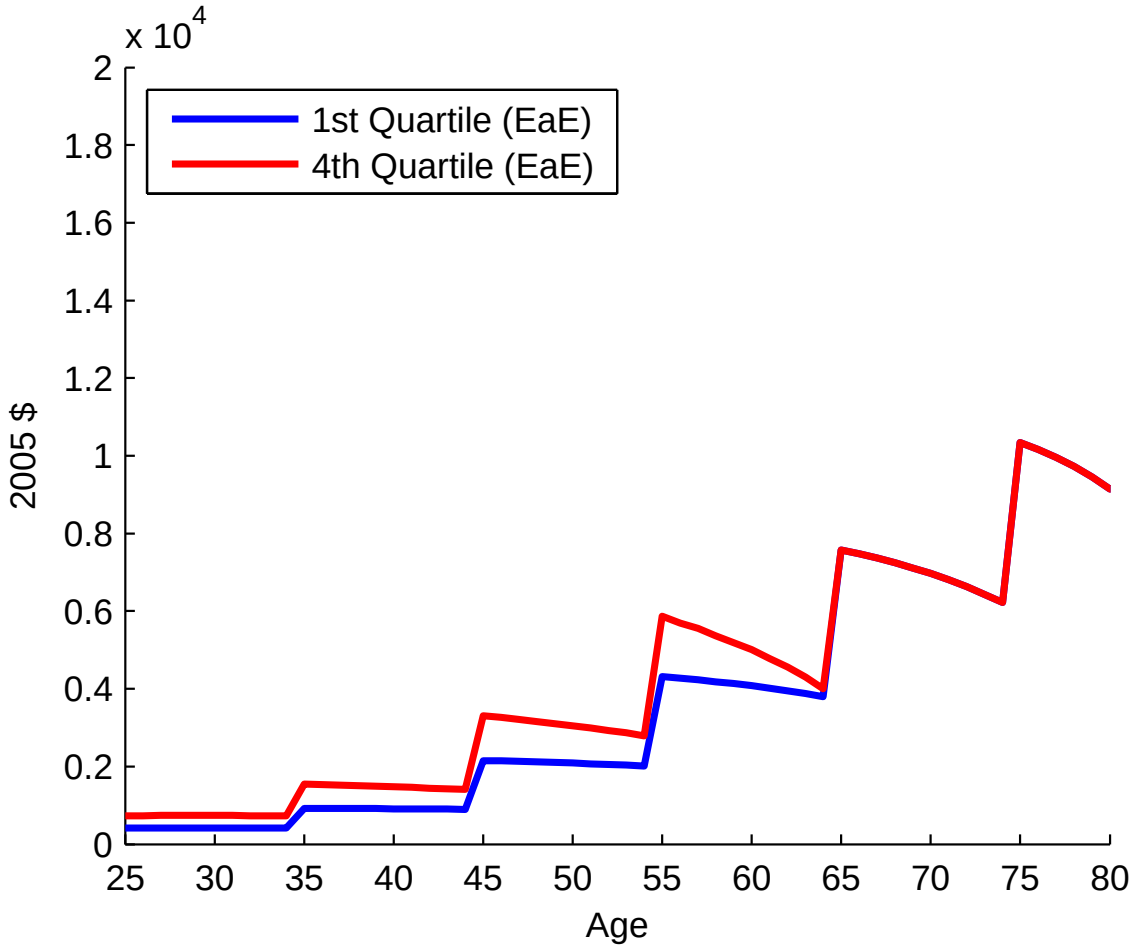

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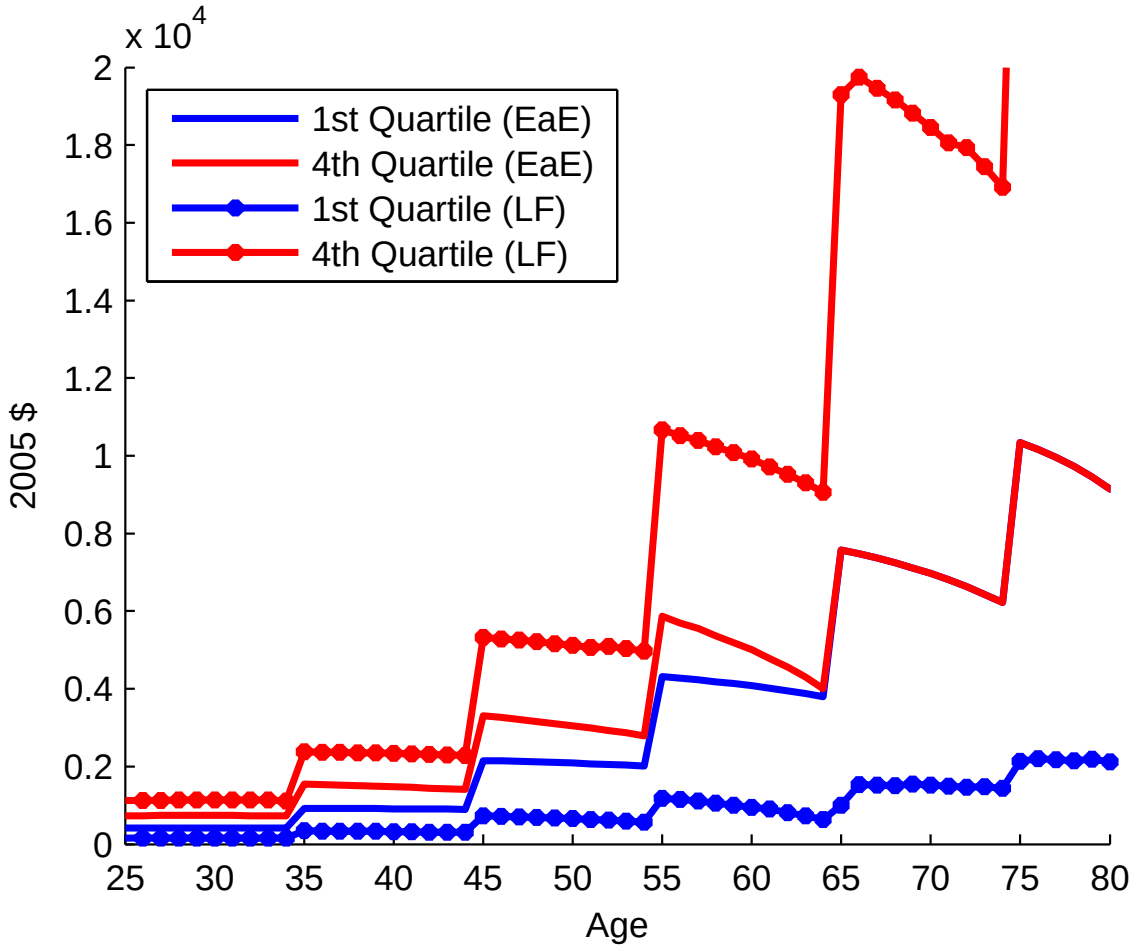

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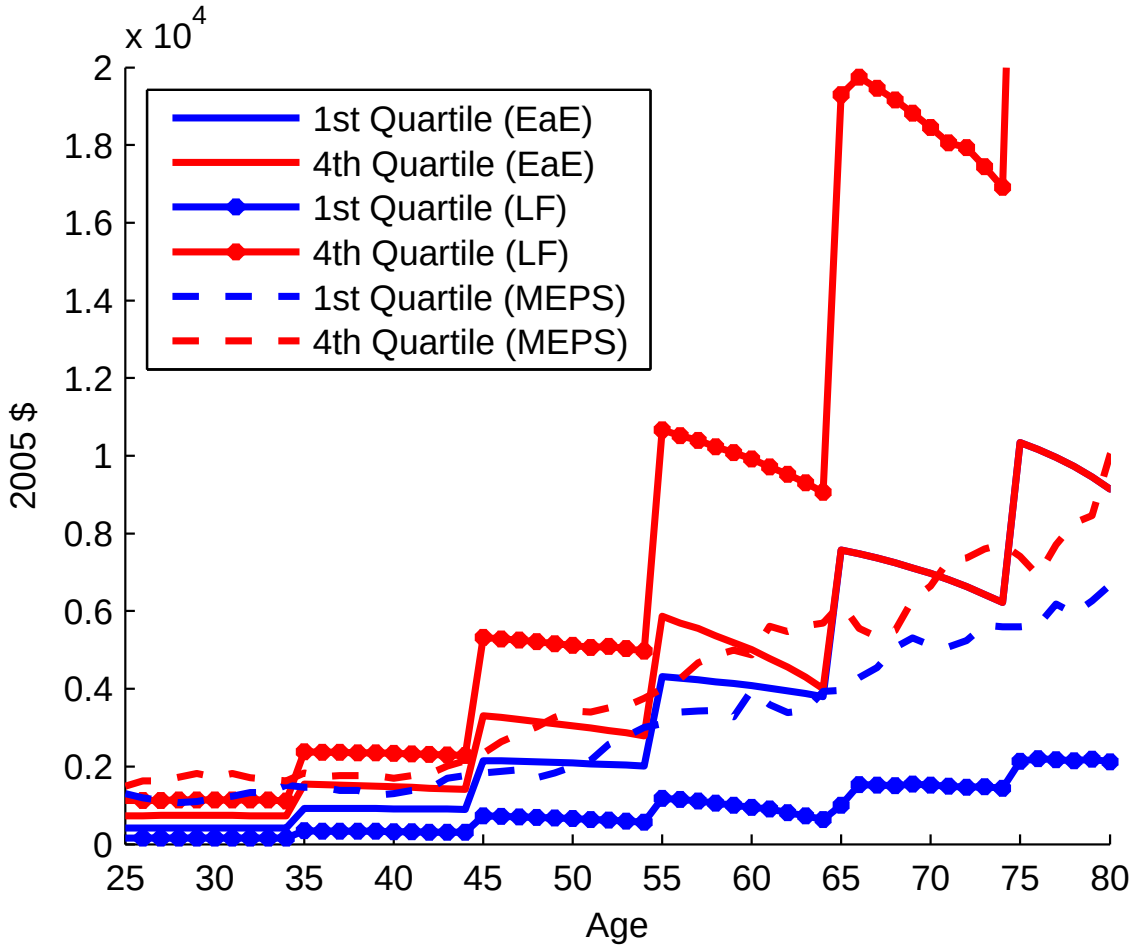
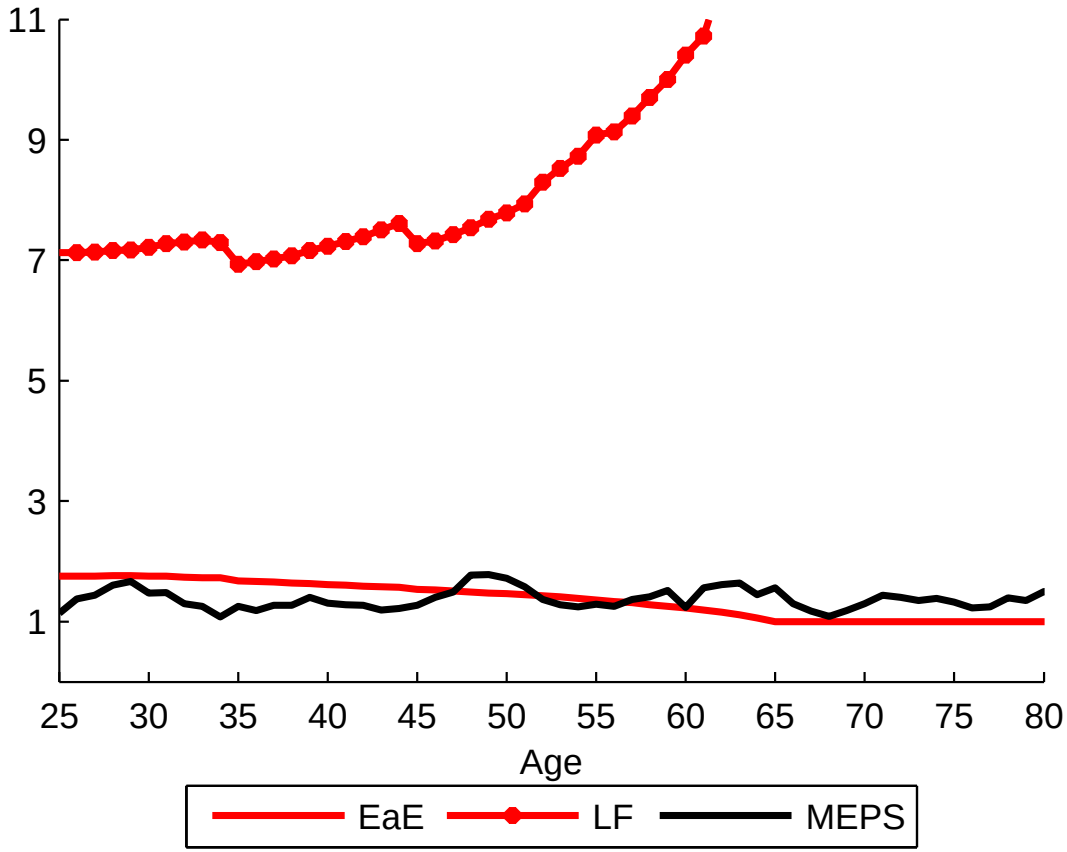
Average Health Spending by Age – Top and Bottom Income Quartile



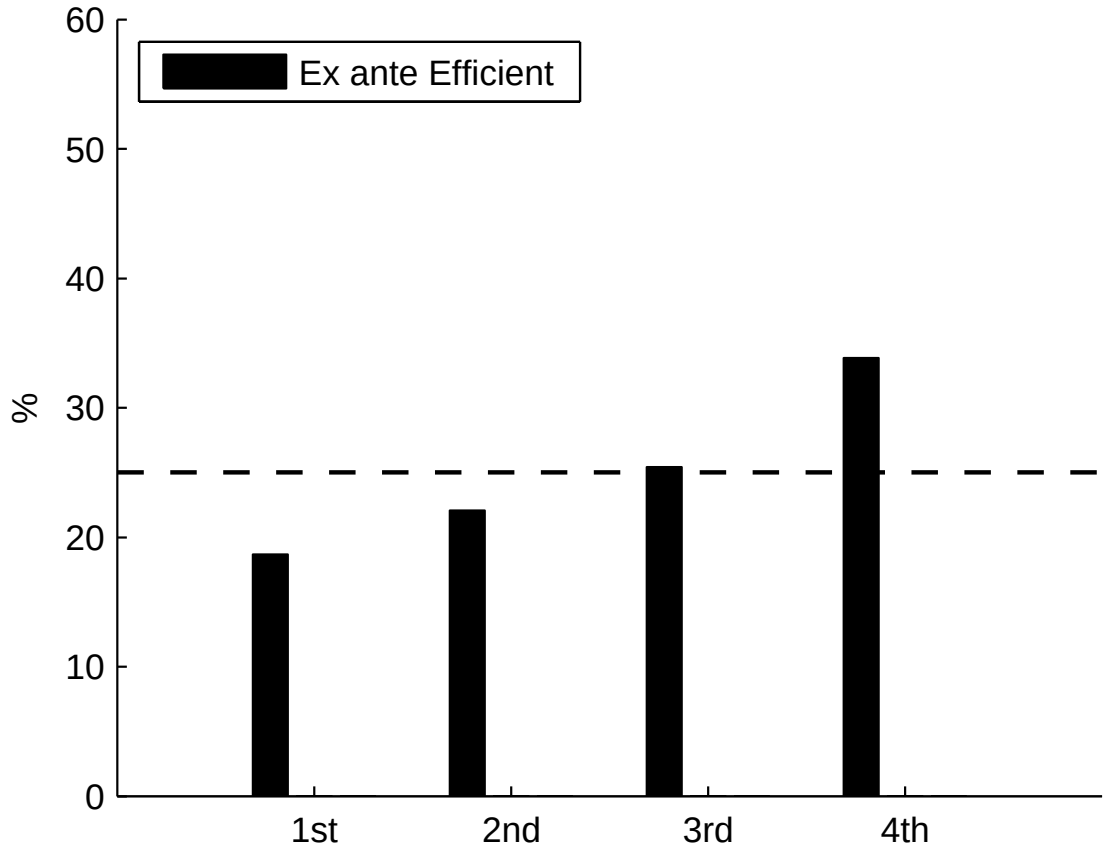
Ex Ante Efficient vs. Laissez Faire vs. Data

Ratio of Health Spending by Age – Top to Bottom Income Quartile



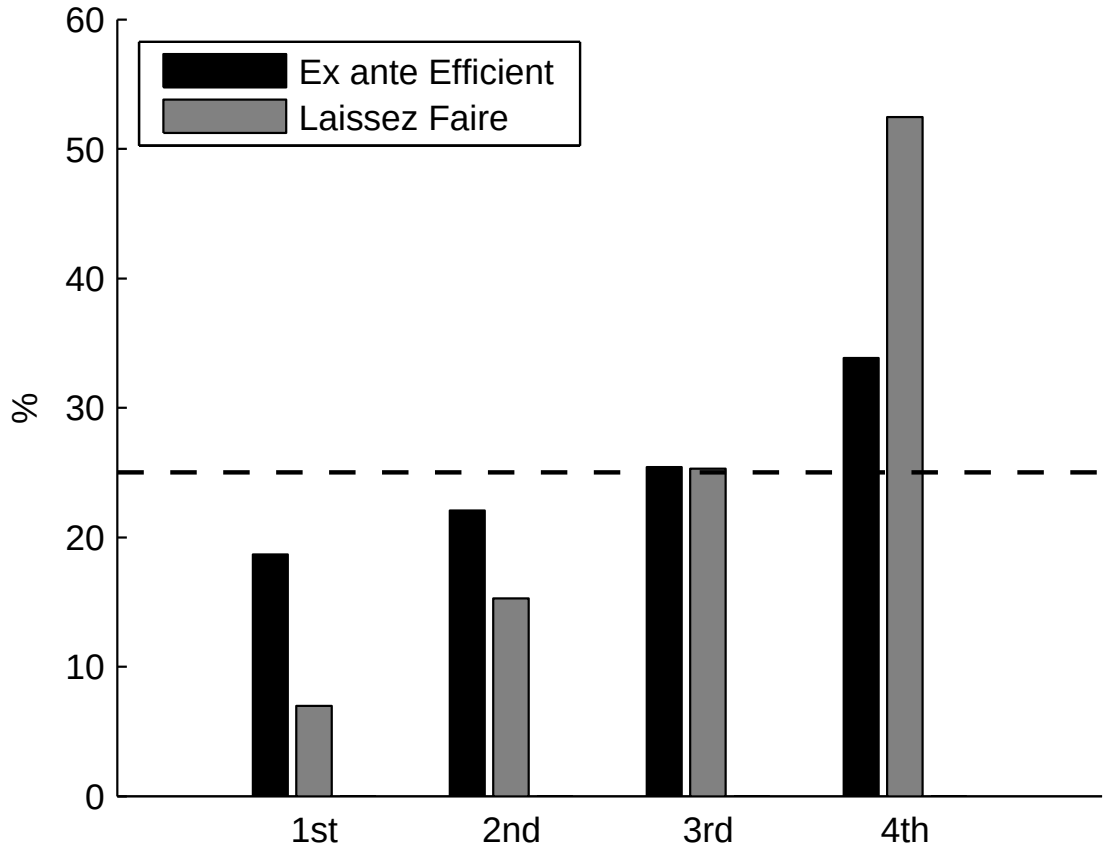
Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Income Quartile, 25-35yrs old



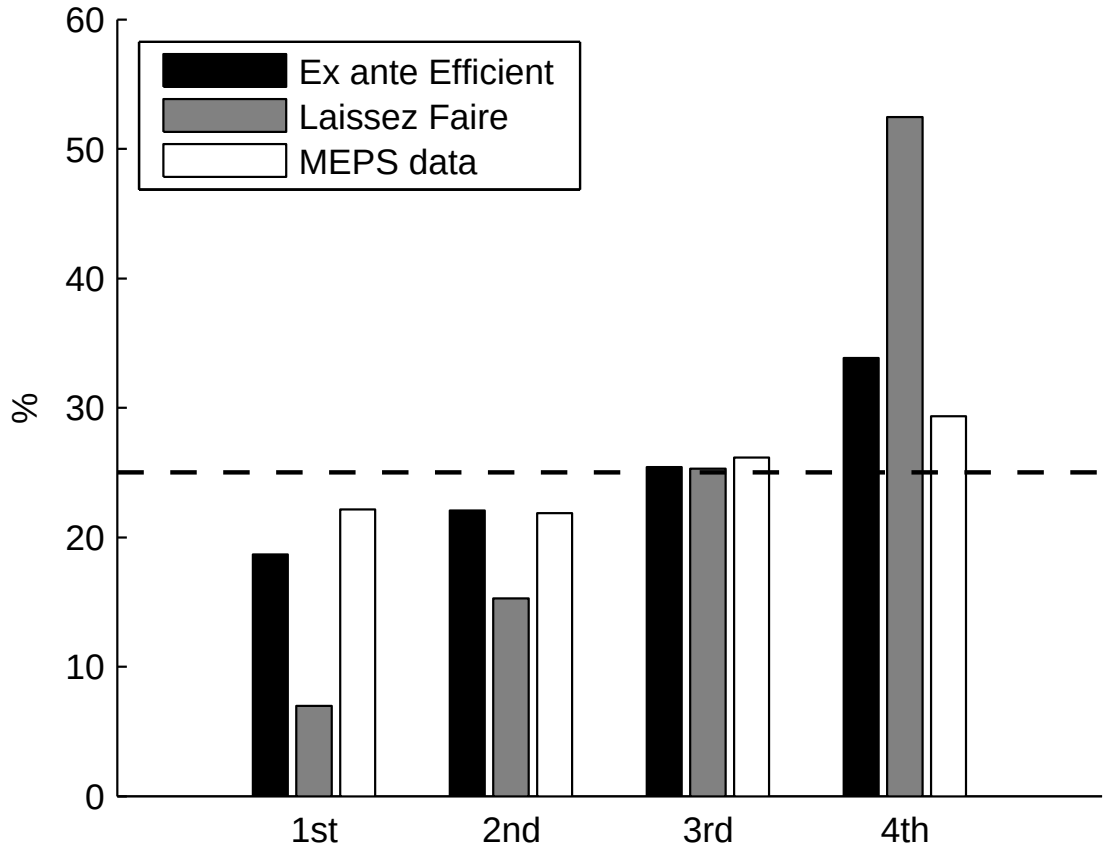
Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Income Quartile, 25-35yrs old



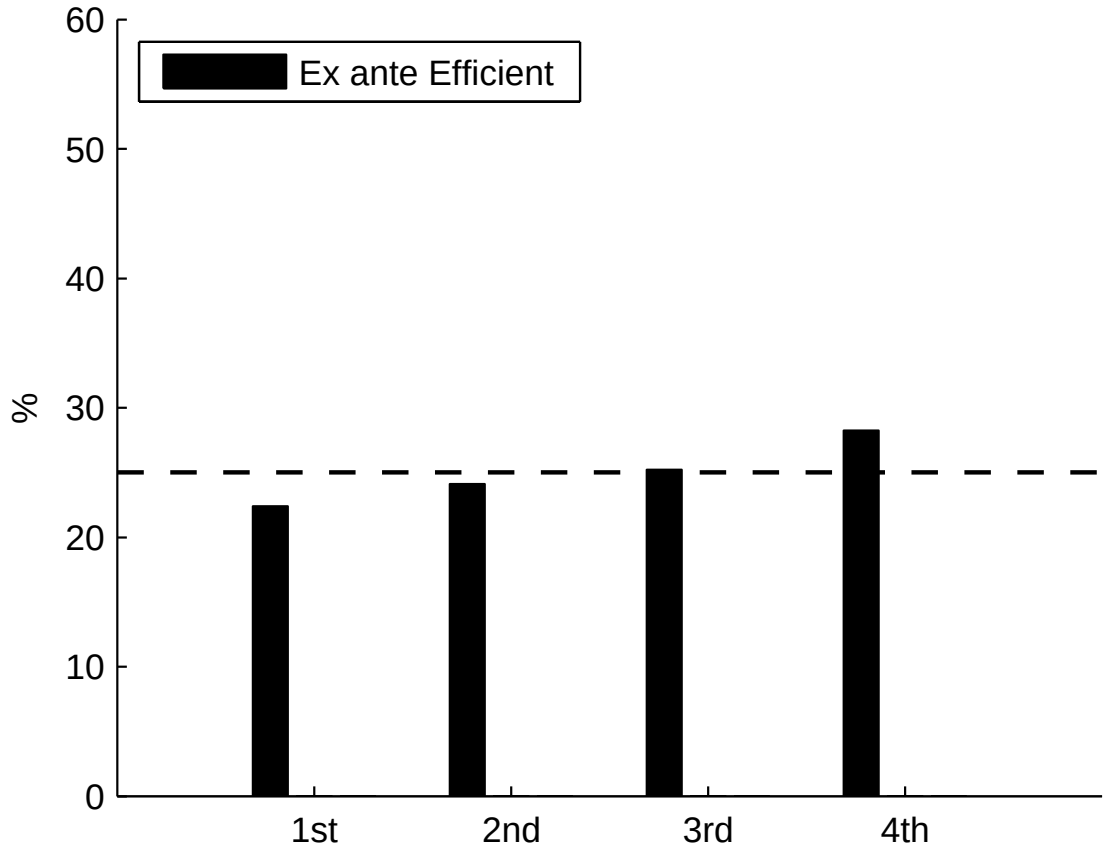
Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Income Quartile, 25-35yrs old



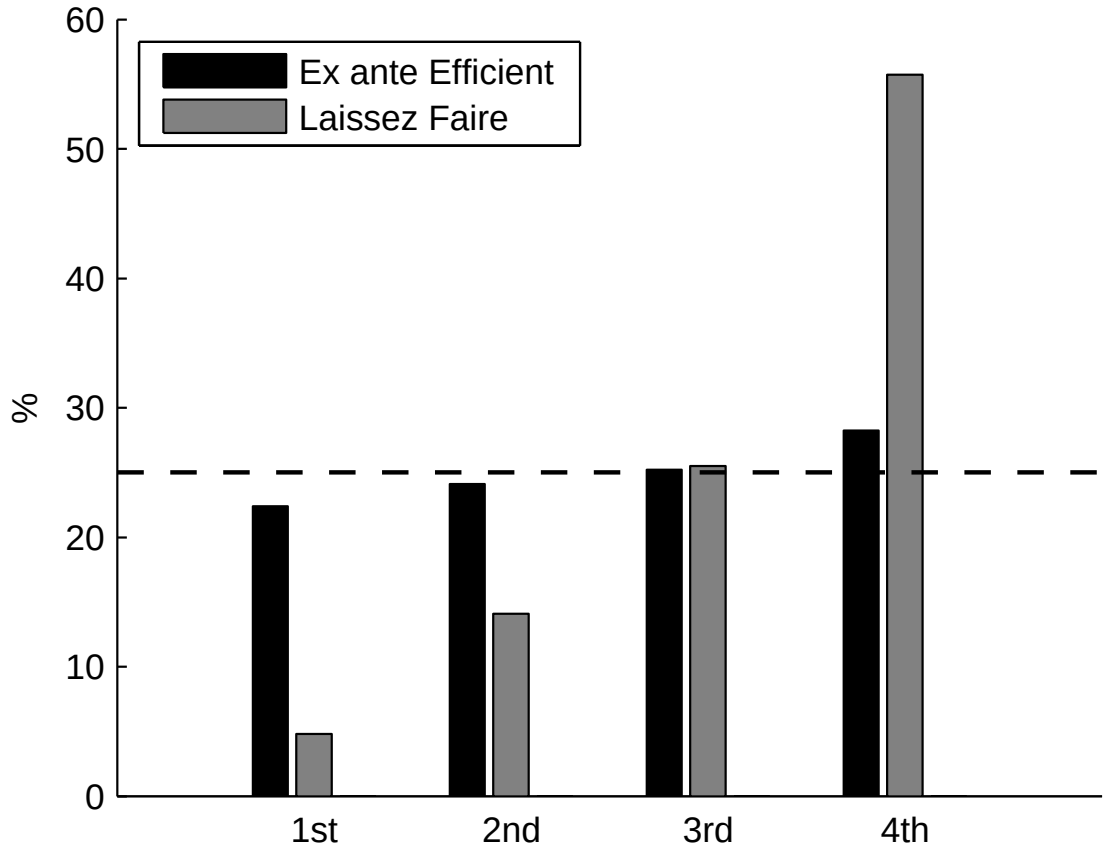
Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Income Quartile, 55-65yrs old



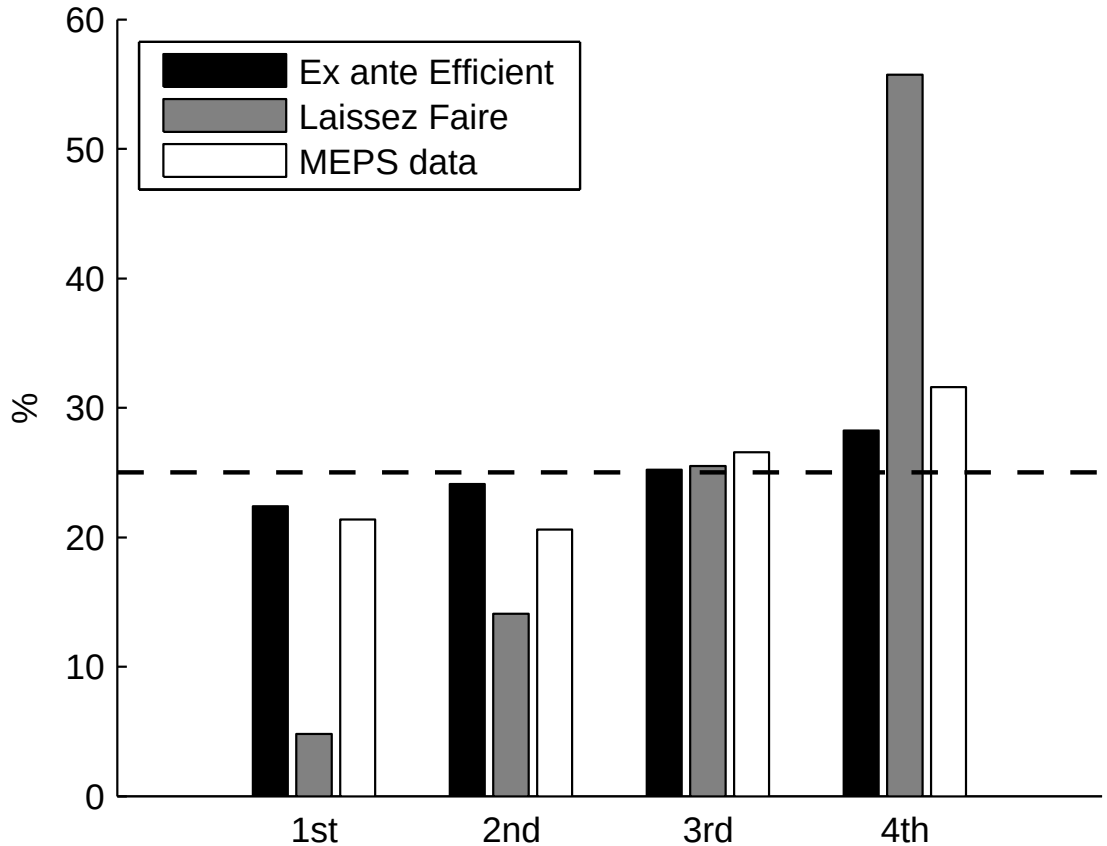
Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Income Quartile, 55-65yrs old



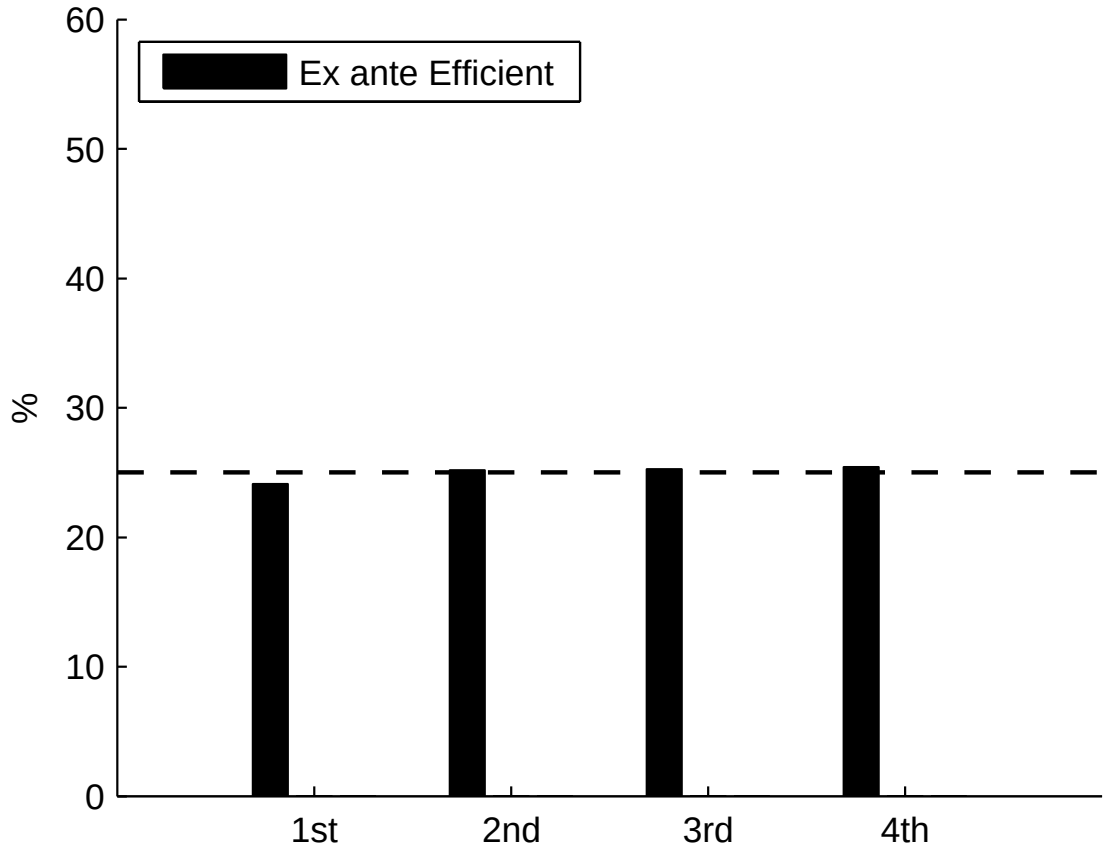
Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Income Quartile, 55-65yrs old



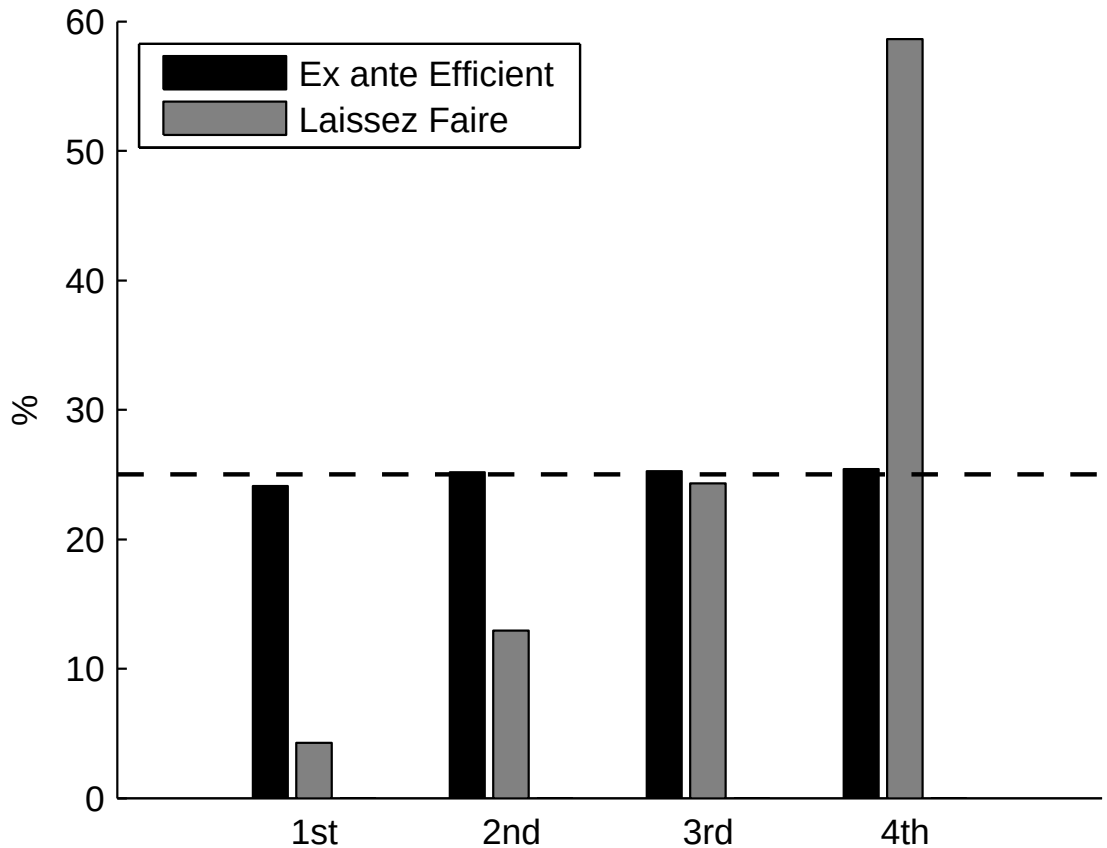
Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Income Quartile, 70-80yrs old



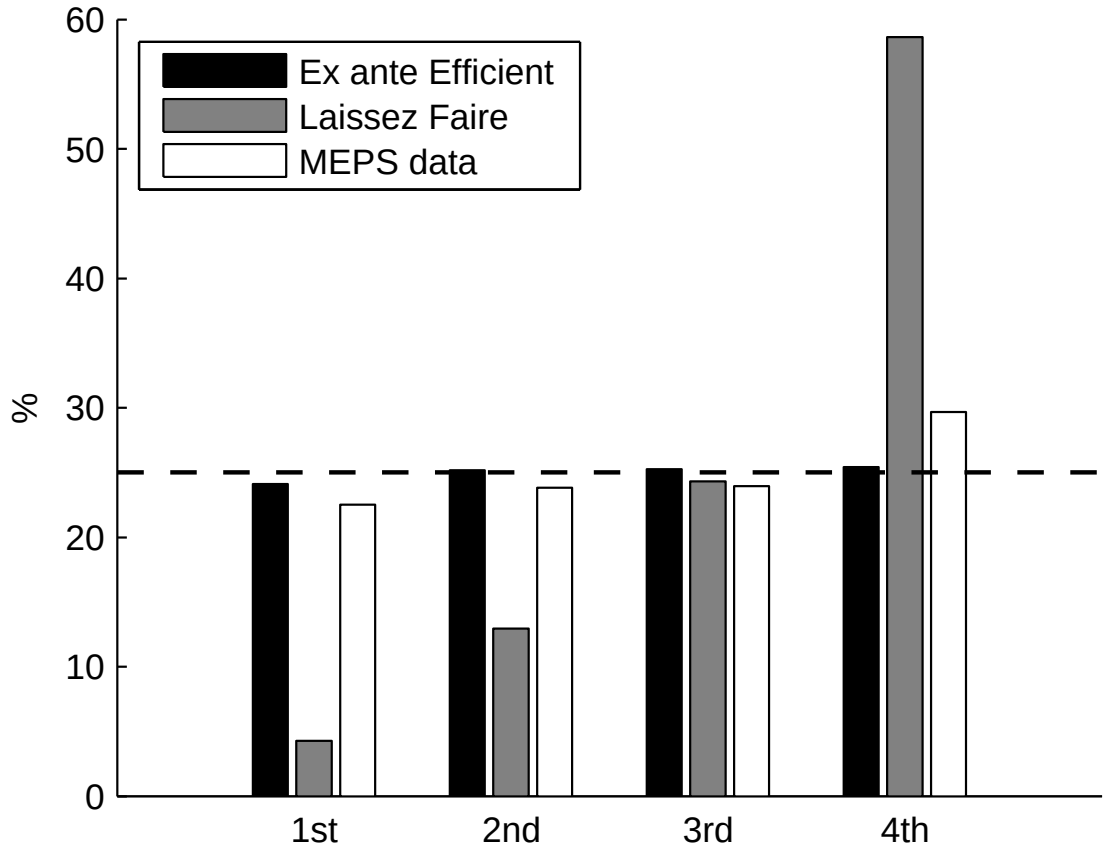
Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Income Quartile, 70-80yrs old



Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Income Quartile, 70-80yrs old



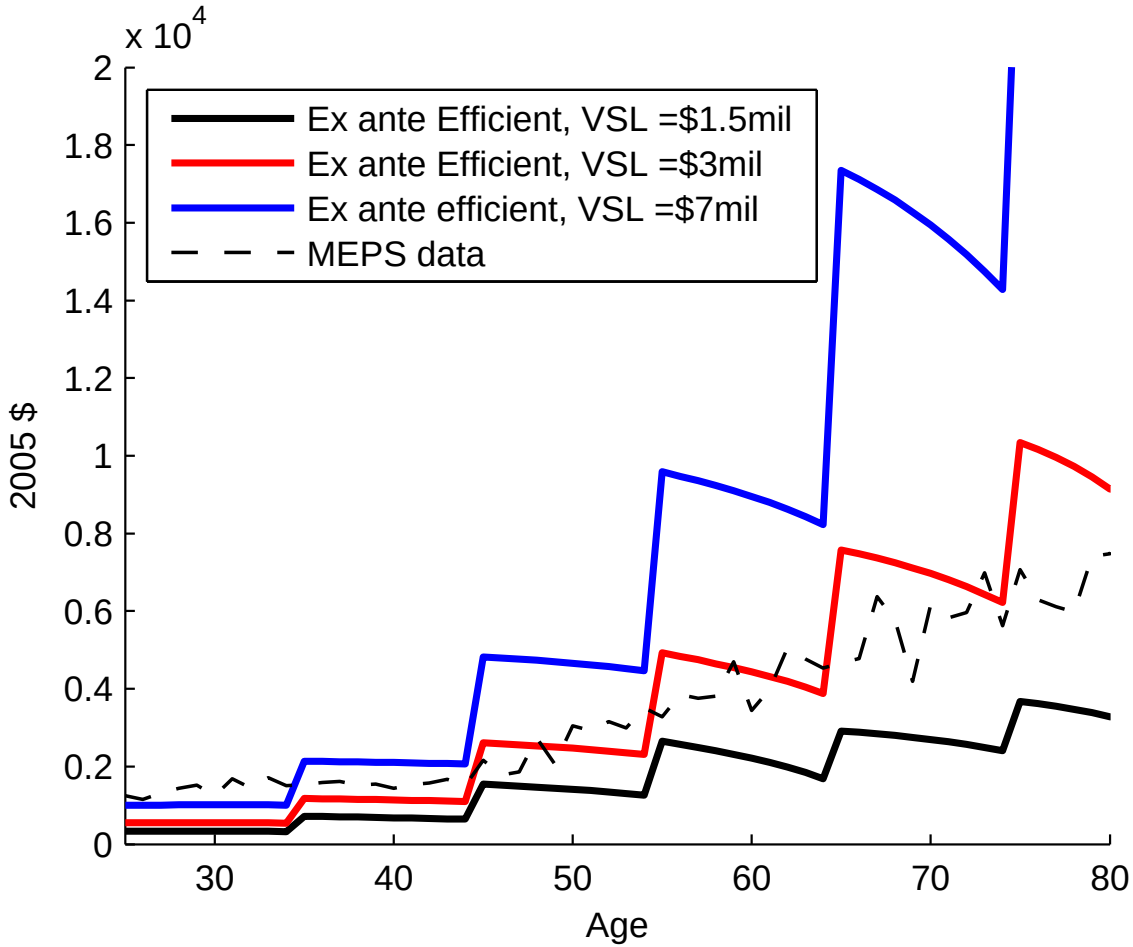
Sensitivity

Sensitivity
Value of Life

- Literature on estimating *Value of Statistical Life*:
  - Large range of estimates
- Our benchmark is $3 million (from DOT). We experiment with
  - $7 million (EPA recommended benchmark)
  - $1.5 million (arbitrary low value)
  - In each case we re-calibrate the model
- In this talk we report results on ex ante efficient alloction for
  - Average spending by age
  - Share of spending by wage quartiles

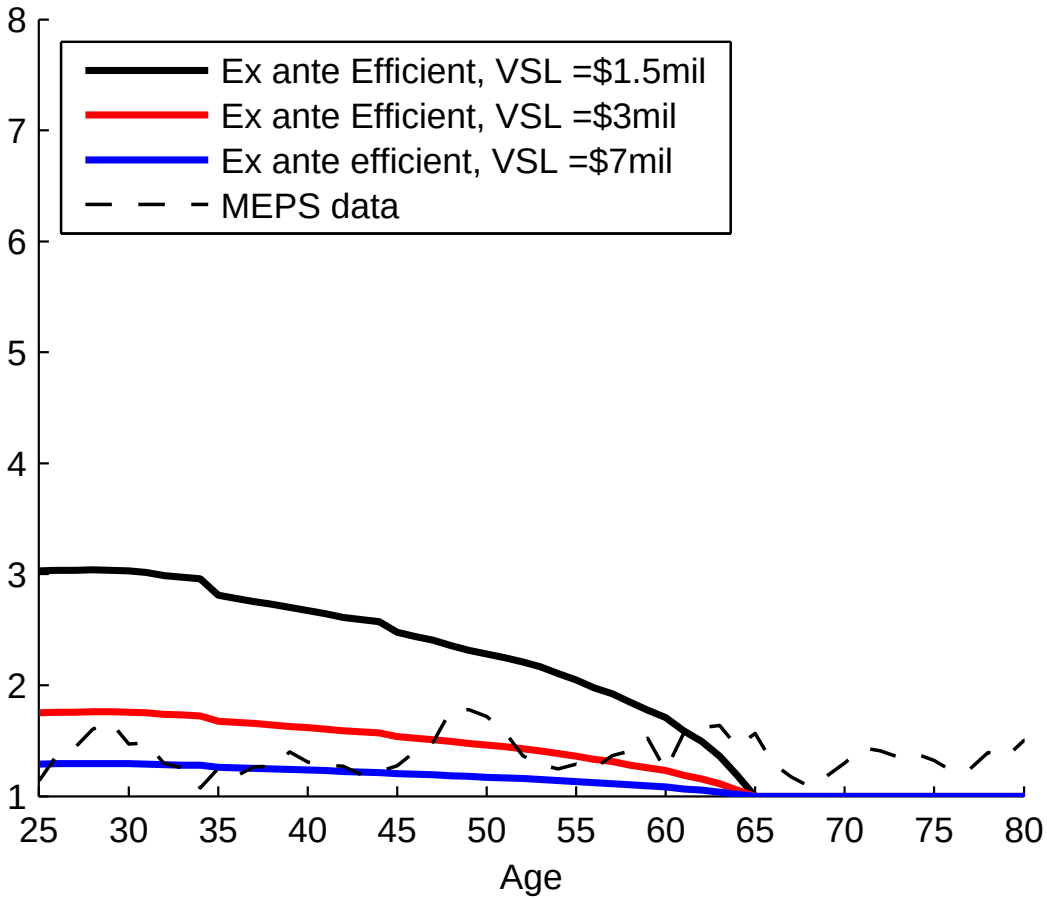
Sensitivity: Ex Ante Efficient vs. Data

Average Health Spending by Age



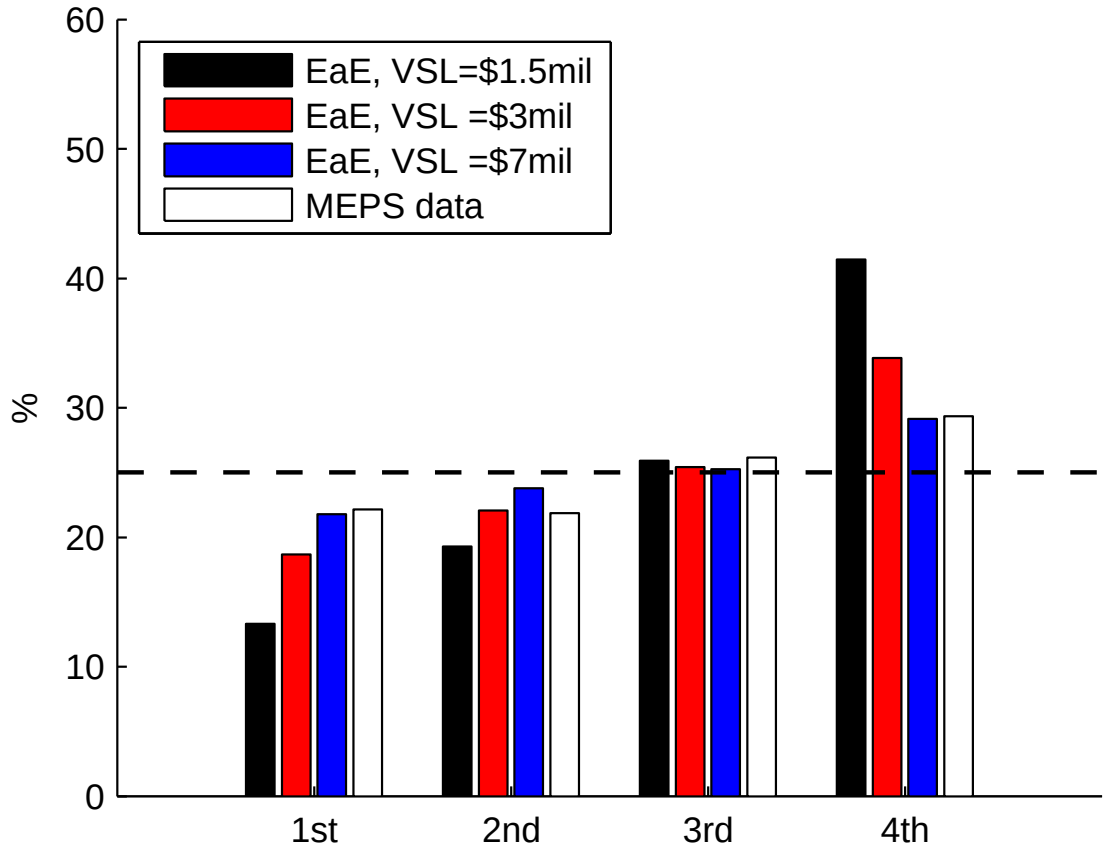
Sensitivity: Ex Ante Efficient vs. Data

Ratio of Health Spending by Age – Top to Bottom Income Quartile



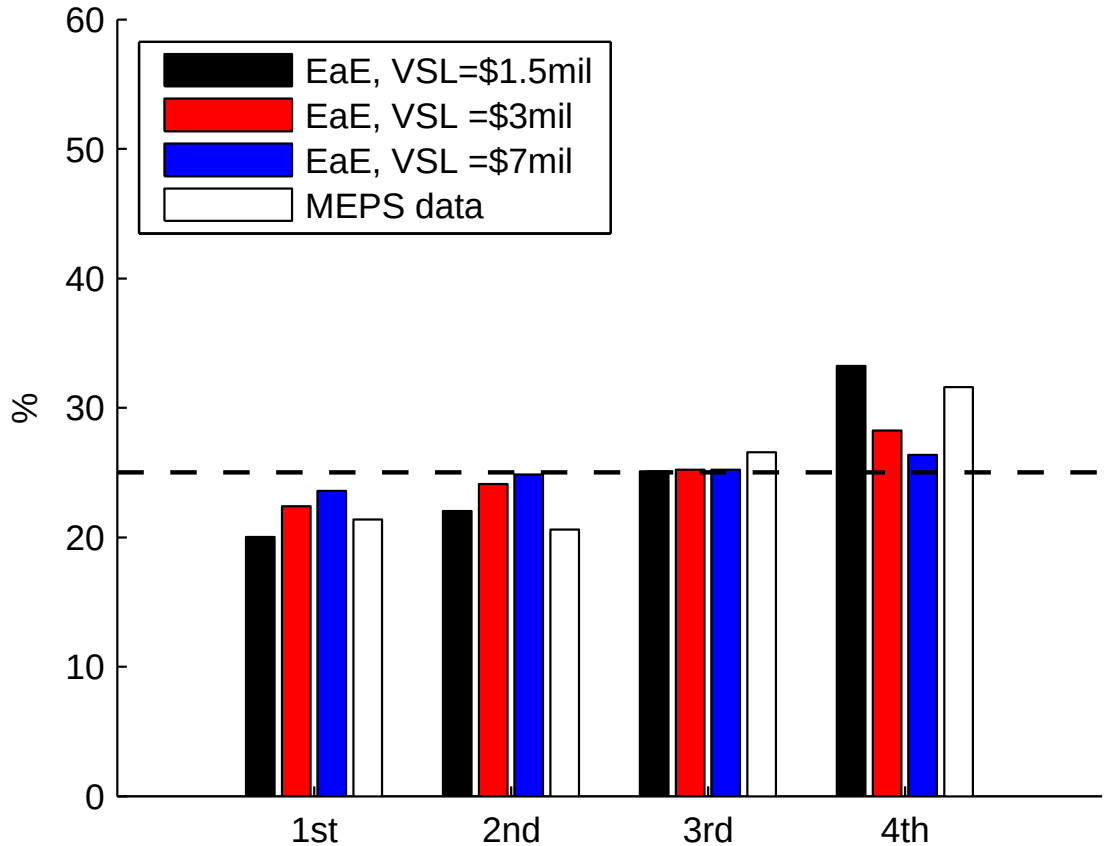
Sensitivity: Ex Ante Efficient vs. Data

Share of Health Spending by Income Quartile, 25-35yrs old



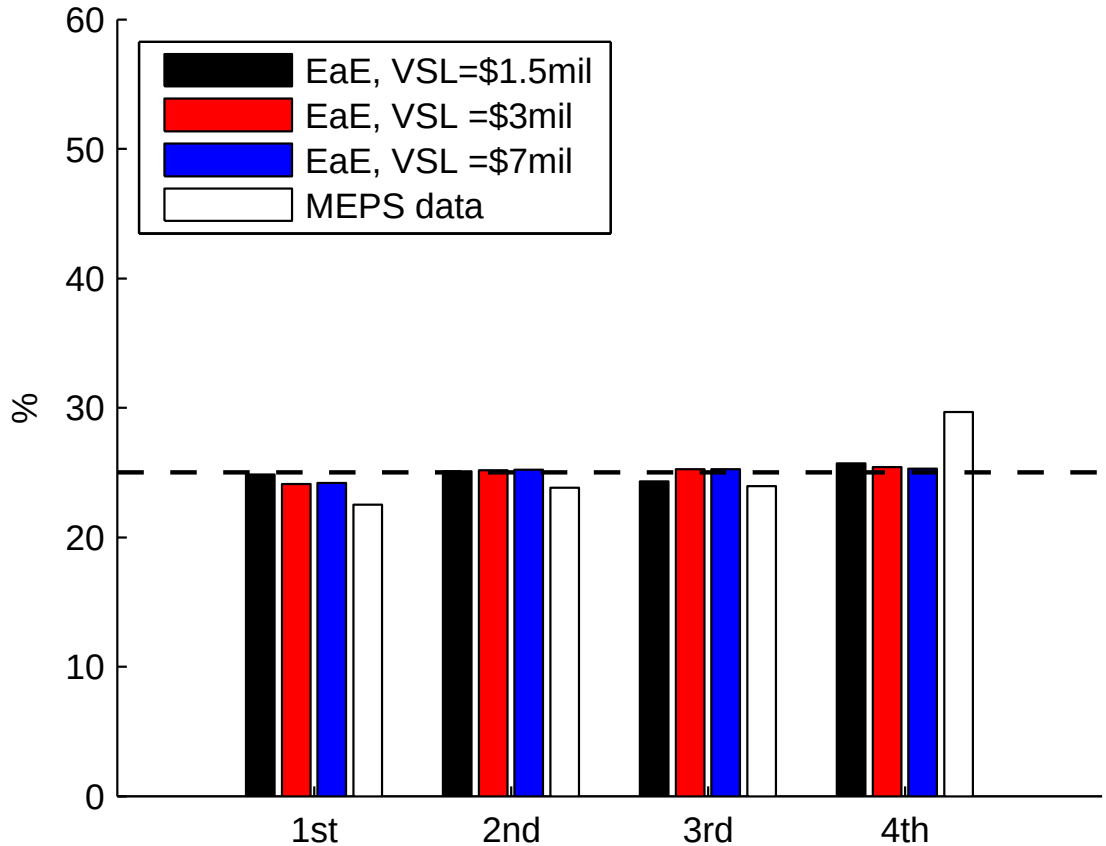
Sensitivity: Ex Ante Efficient vs. Data

Share of Health Spending by Income Quartile, 55-65yrs old



Sensitivity: Ex Ante Efficient vs. Data

Share of Health Spending by Income Quartile, 79-80yrs old



Adding Private Information

(Preliminary)

Adding Private Information

Preliminary example

- When productivity types are private information,
  - More productive types receive more consumption
  - They enjoy higher flow of utility as long as they live
- Gives additional benefit to planner for keeping them around

  $\Rightarrow$ The inequality in health is larger relative to full info case, particularly for post retirment ages

Adding Private Information

Only two productivity types

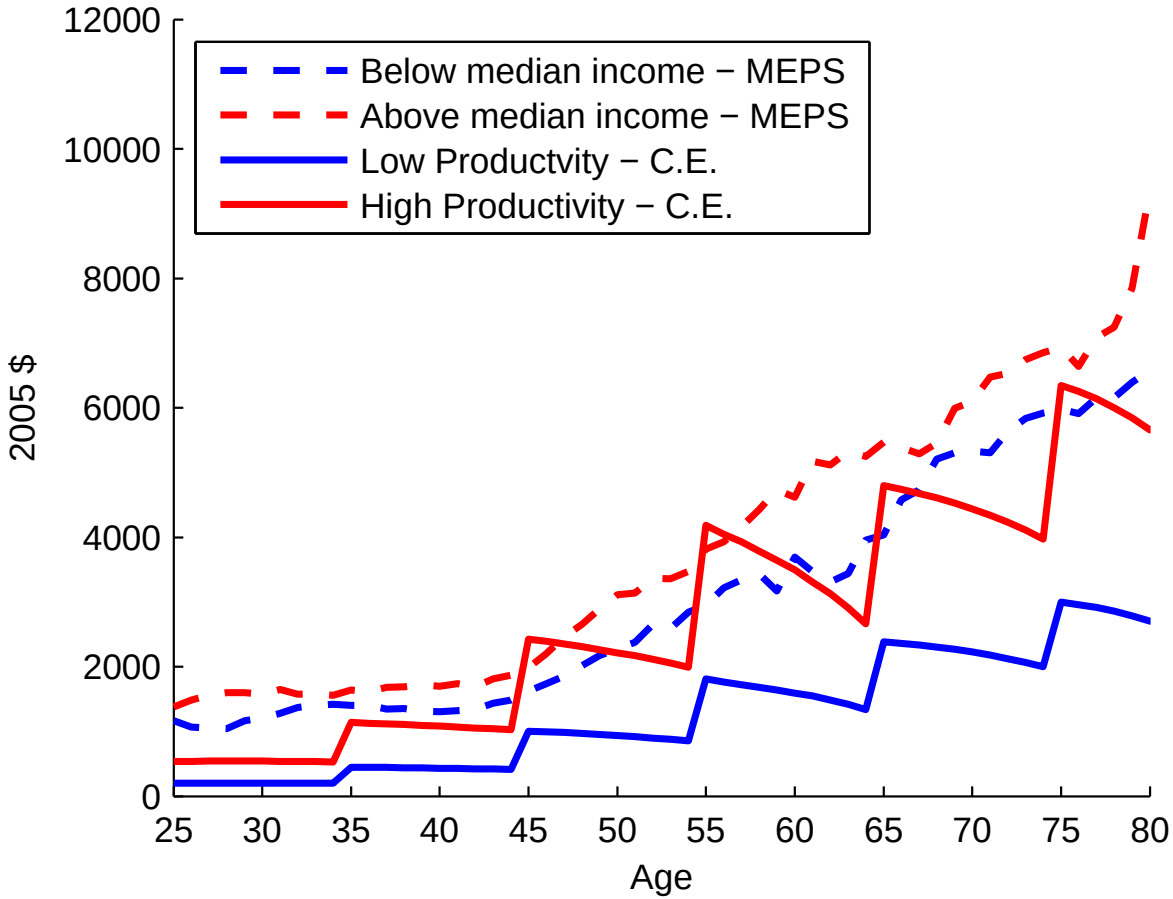
- Suppose there are only two productivity types
- The efficient allocation must be incentive compatible

$$\sum_a \beta^a N_a(\theta_H)\left[b + \frac{c_a(\theta_H)^{1-\gamma}}{1-\gamma} + \phi\frac{(1-l_a(\theta_H))^{1-\epsilon}}{1-\epsilon}\right] \geq$$
$$\sum_a \beta^a N_a(\theta_L)\left[b + \frac{c_a(\theta_L)^{1-\gamma}}{1-\gamma} + \phi\frac{(1-l_a(\theta_L)w_a(\theta_L)/w_a(\theta_H))^{1-\epsilon}}{1-\epsilon}\right]$$

- One consequence is that consumption is no longer equalized

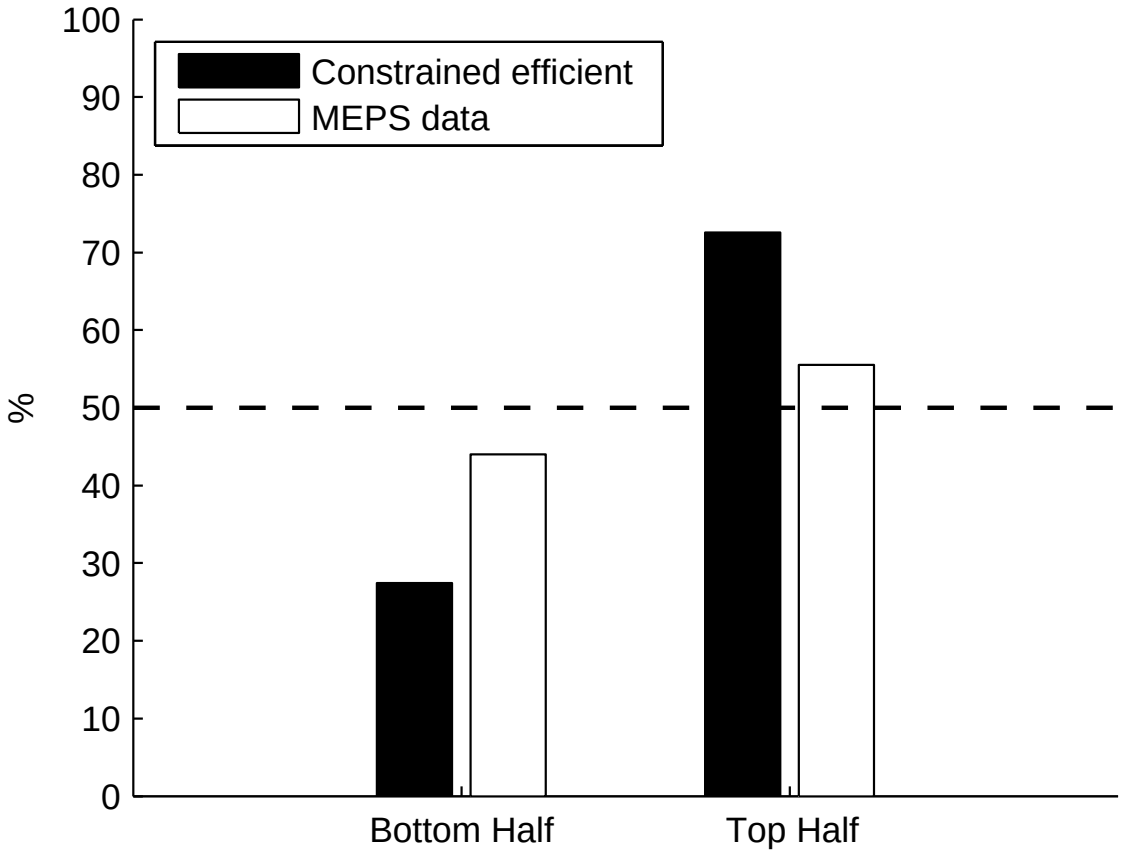
Constrained Efficient vs. Data

Average Health Spending by Age for High and Low Income



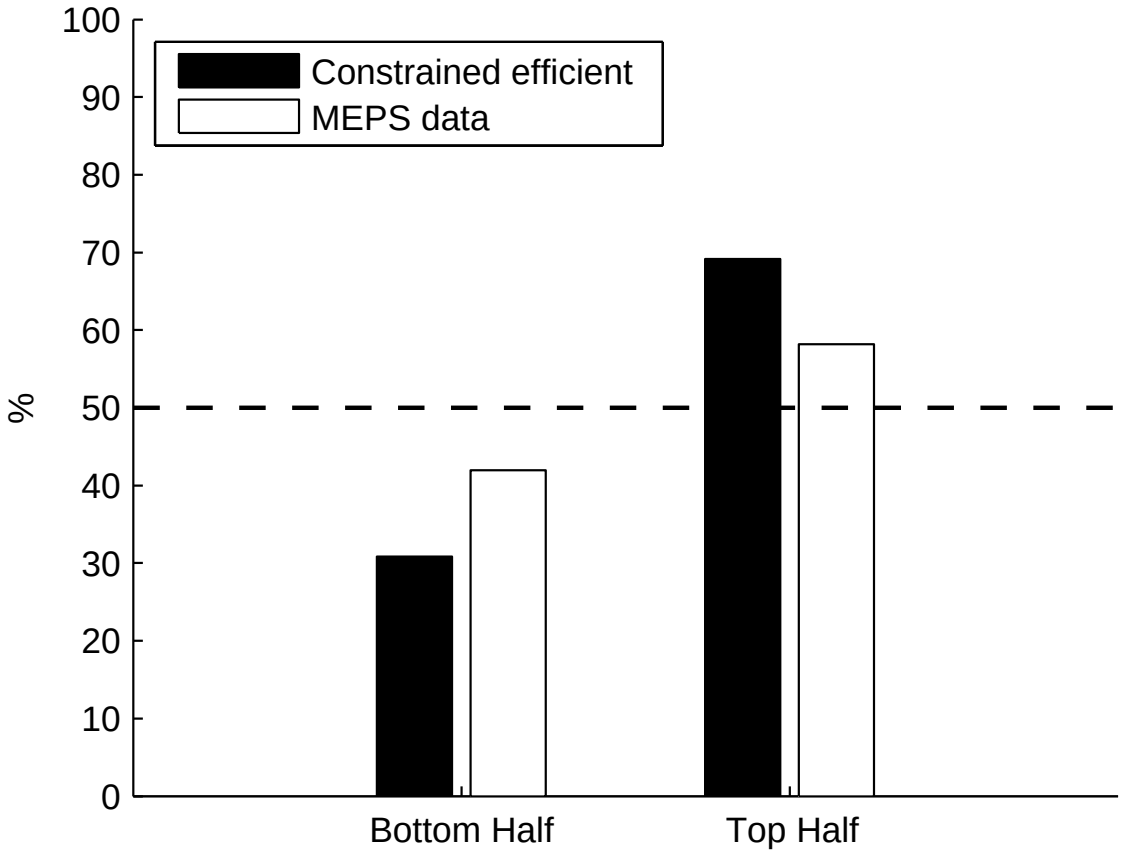
Constrained Efficient vs. Data

Share of Health Spending for High and Low Income, 25-35yrs old



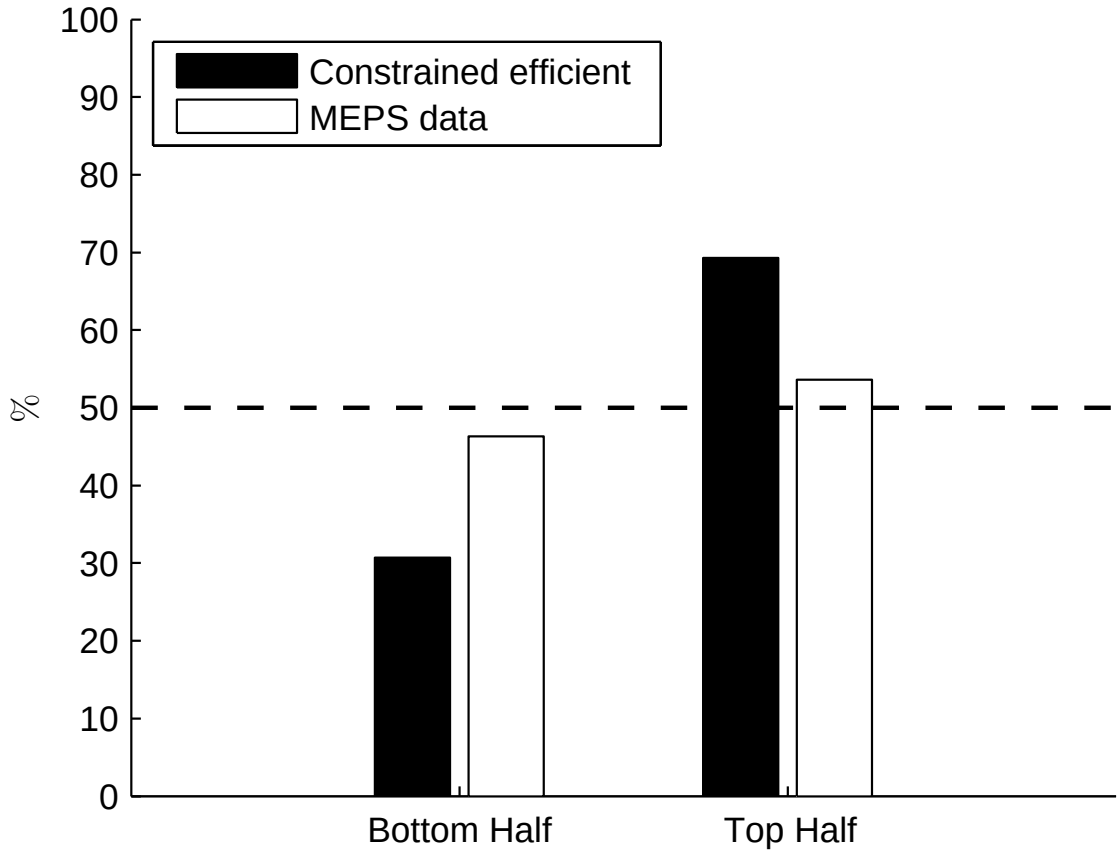
Constrained Efficient vs. Data

Share of Health Spending for High and Low Income, 55-65yrs old



Constrained Efficient vs. Data

Share of Health Spending for High and Low Income, 70-80yrs old



Conclusion

Three Lessons

1. If health spending increases survival probability,
    - It is efficient ('First Best') to spend more on more productive.
2. Data inequality is close to efficient inequality. Specially at younger age.
3. Data inequality is much closer to ex ante efficient, than to Laissez Faire.

Conclusion

Three Lessons

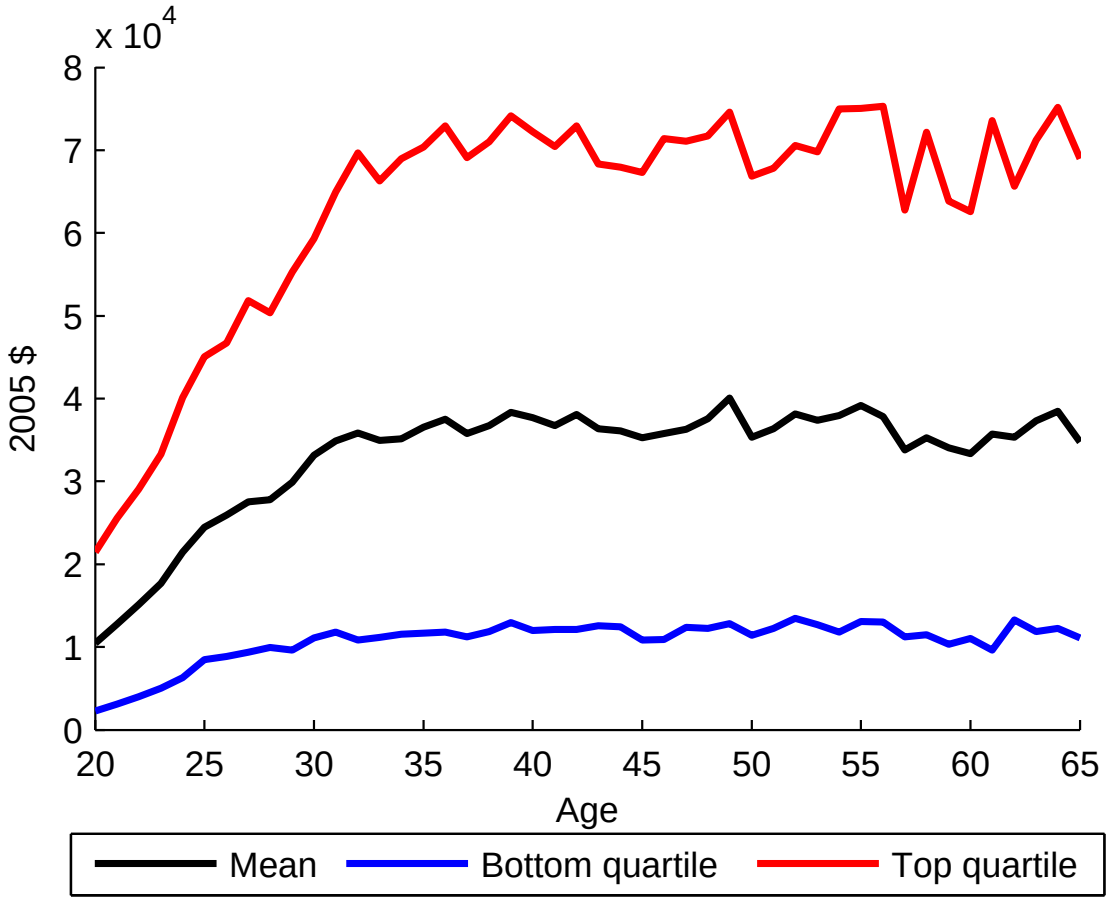
1. If health spending increases survival probability,
    - It is efficient ('First Best') to spend more on more productive.
2. Data inequality is close to efficient inequality. Specially at younger age.
3. Data inequality is much closer to ex ante efficient, than to Laissez Faire.

Current social insurance doesn't look bad!

Back up slides: Supplementary Graphs

Back up Slide

Wage Profiles

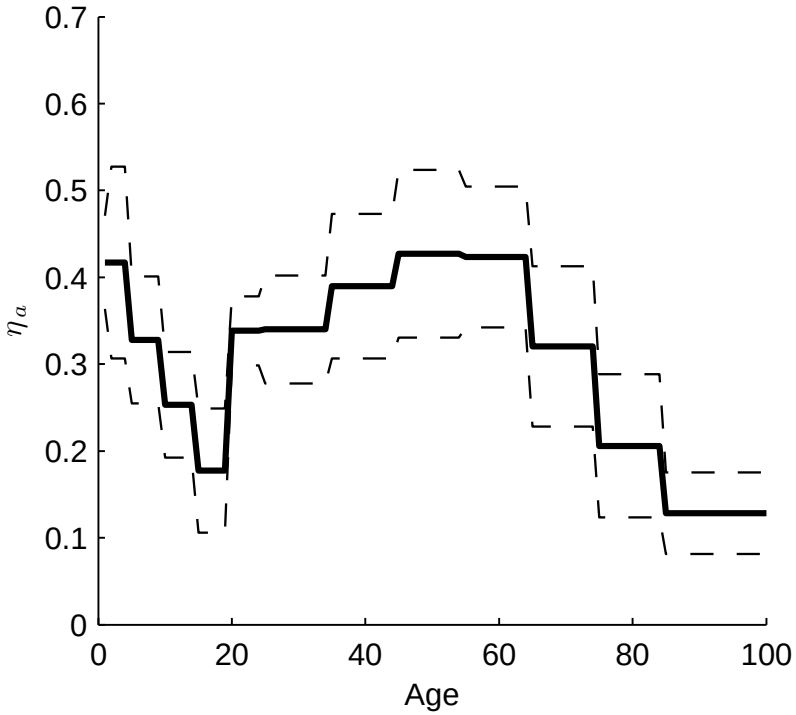


go back

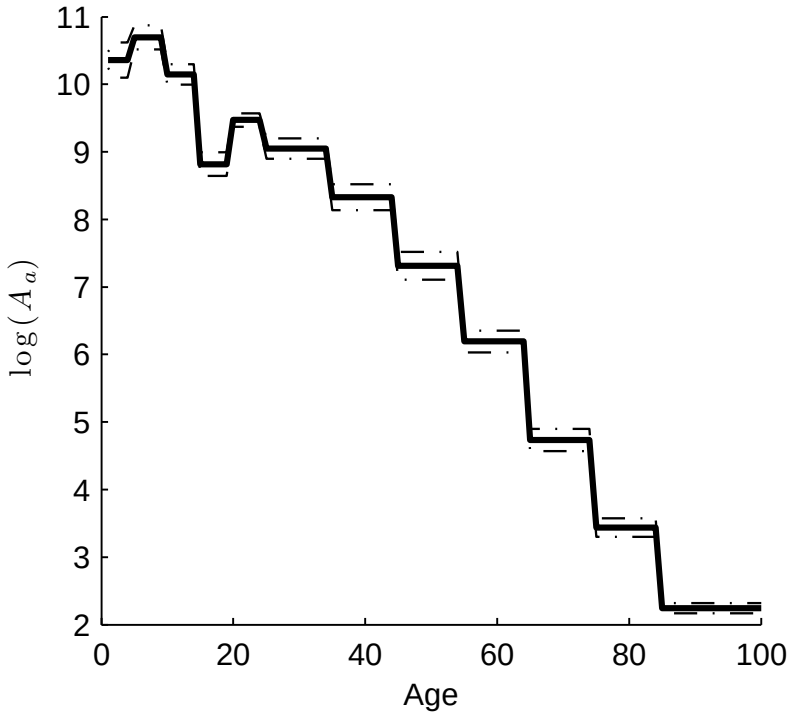
Back up Slide

Survival Production Function Parameters

Elasticity η_a



Survival TFP A_a



$$P_a(h) = \max\left\{1 - \frac{1}{f_a(h)}, 0\right\}, \qquad f_a(h) = A_a h^{\eta_a}$$

▸ back

Back up slides: Calibration of b

Calibration of b

What exactly do we do to choose b?

We choose b such that

$$\$3 \text{ miln} = \underbrace{\qquad\qquad}_{\text{utility from consumption and leisure}} + \underbrace{\qquad\qquad\qquad\qquad}_{\text{extra production beyond use}}$$

▸ Go Back

Calibration of b

What exactly do we do to choose b?

We choose b such that

$$\$3 \text{ miln} = \underbrace{\frac{\sum_{\theta} \pi(\theta) \sum_{a=37}^{A} \beta^{a-37} \frac{N_a(\theta)}{N_{37}(\theta)} [u(c_a(\theta)) + v(1 - l_a(\theta))]}{u'(c_{37})}}_{\text{utility from consumption and leisure}} + \underbrace{\qquad\qquad}_{\text{extra production beyond use}}$$

Go Back

Calibration of b

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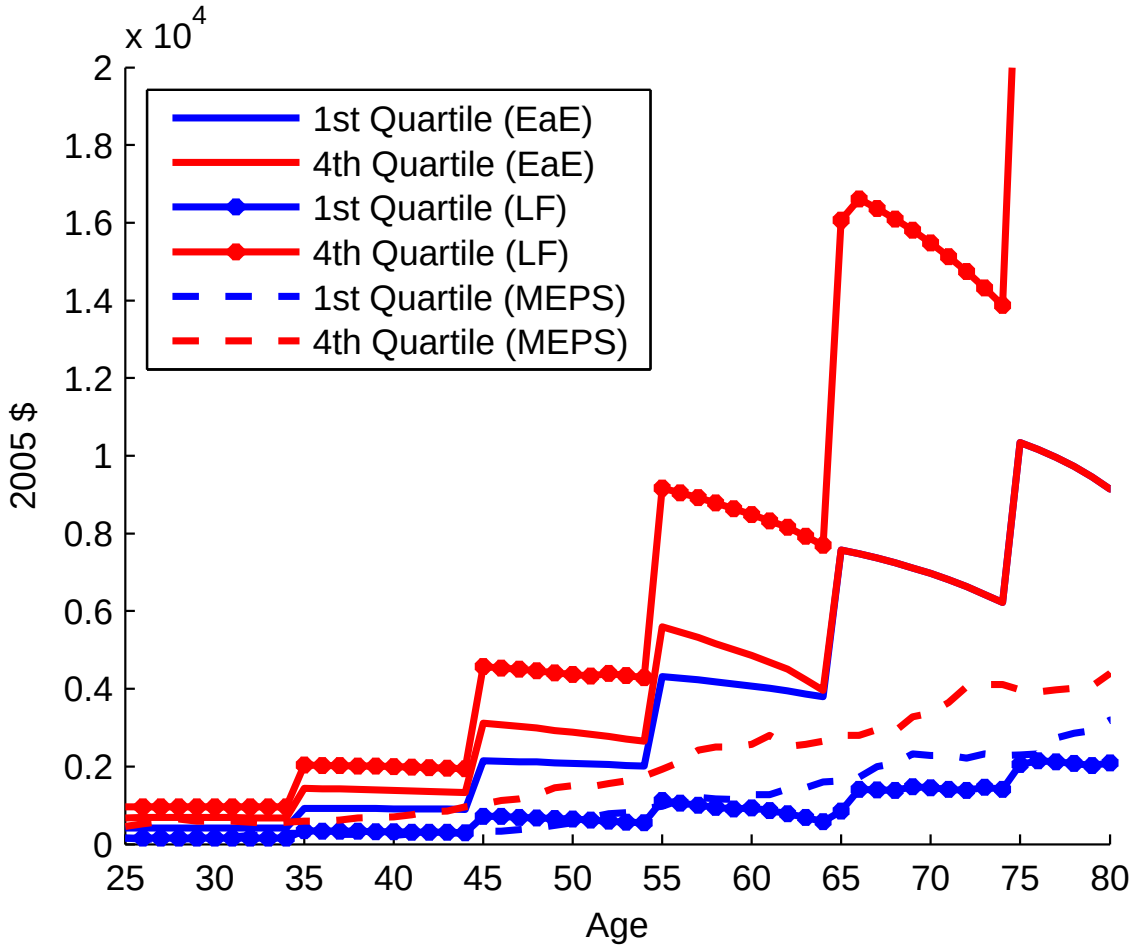
$$+ \underbrace{\lambda \frac{\sum_\theta \pi(\theta) \sum_{a=37}^{A} \frac{1}{R^{a-37}} \frac{N_a(\theta)}{N_{37}(\theta)} [w_a(\theta) l_a(\theta) - c_a(\theta) - h_a(\theta)]}{u'(c_{37})}}_{\text{extra production beyond use}}$$

Go Back

Back up slides: Comparing median spending

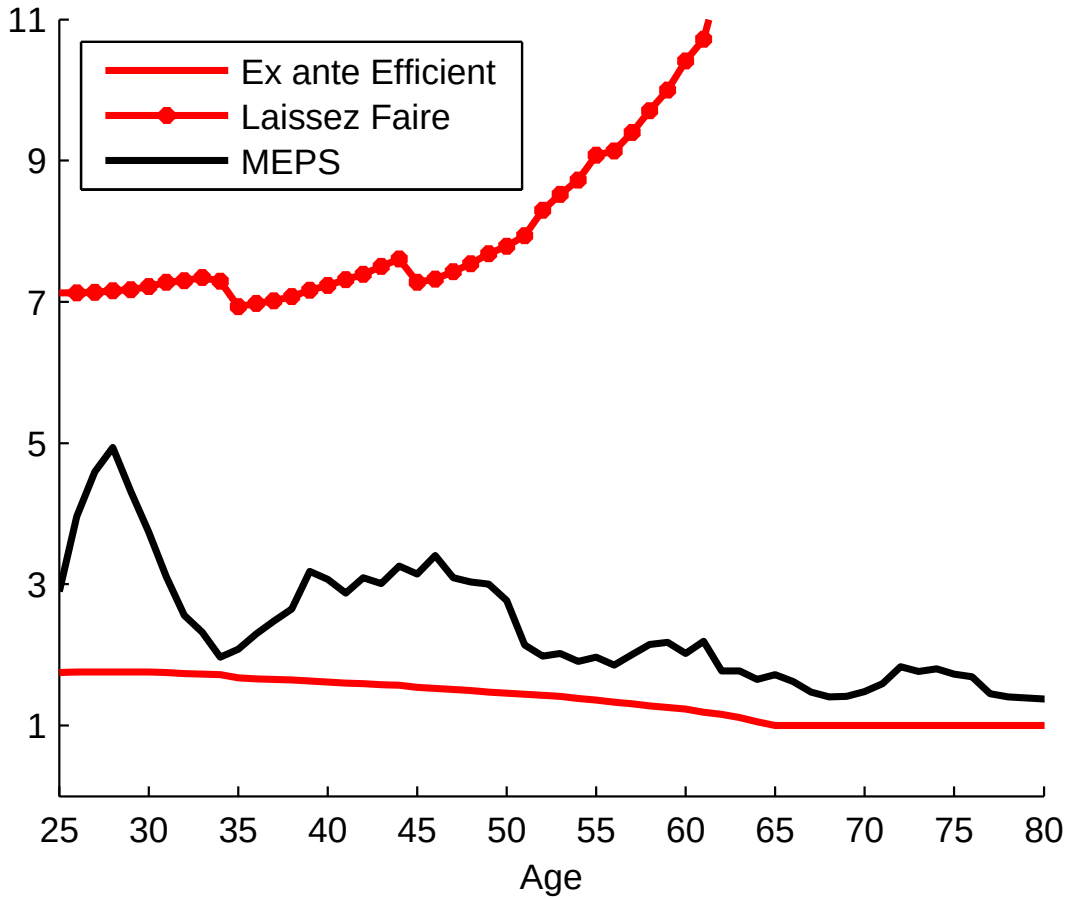
Ex ante efficient vs. Laissez Faire vs. Data

Median health Spending for top and bottom Income quartile



Ex ante efficient vs. Laissez Faire vs. Data

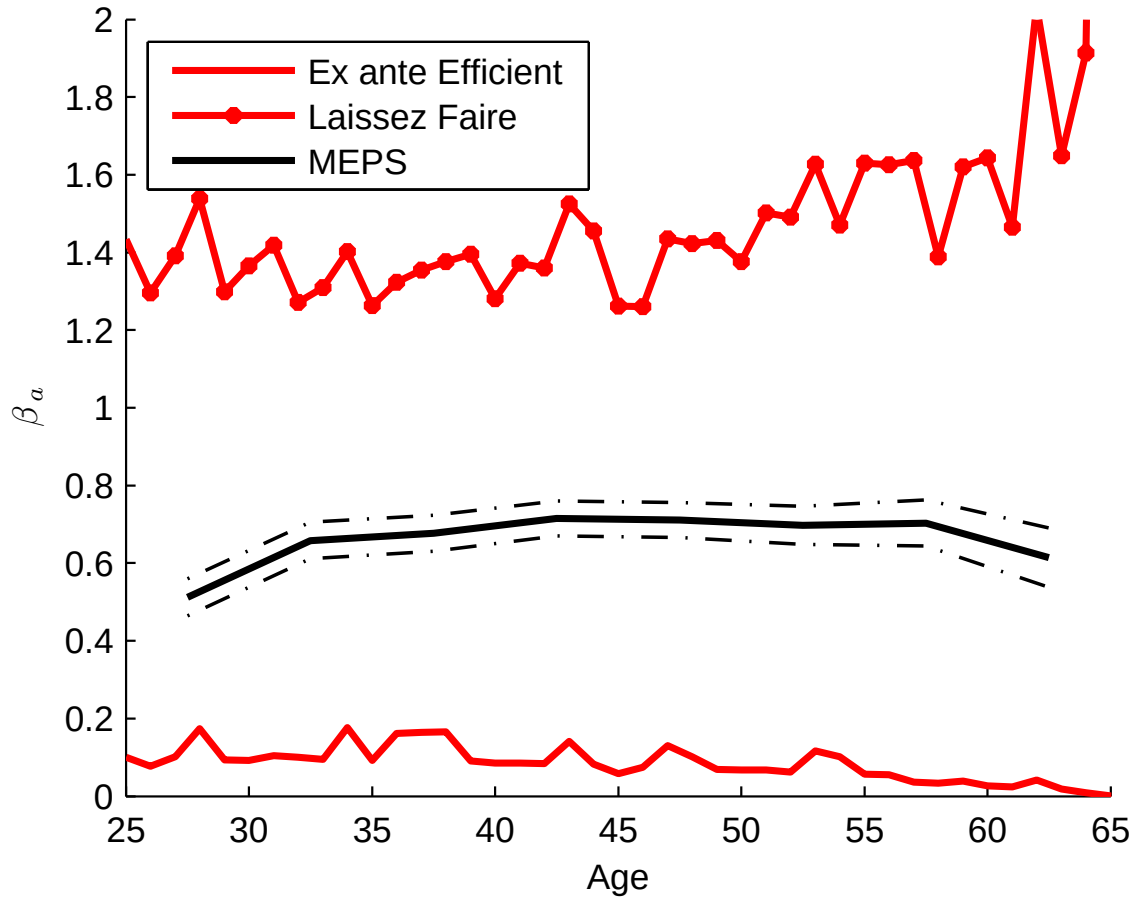
Ratio of Median health Spending for top and bottom Income quartile



Back up slides: Elasticity of Health Spending w.r.t Income

Ex ante efficient vs. Laissez Faire vs. Data

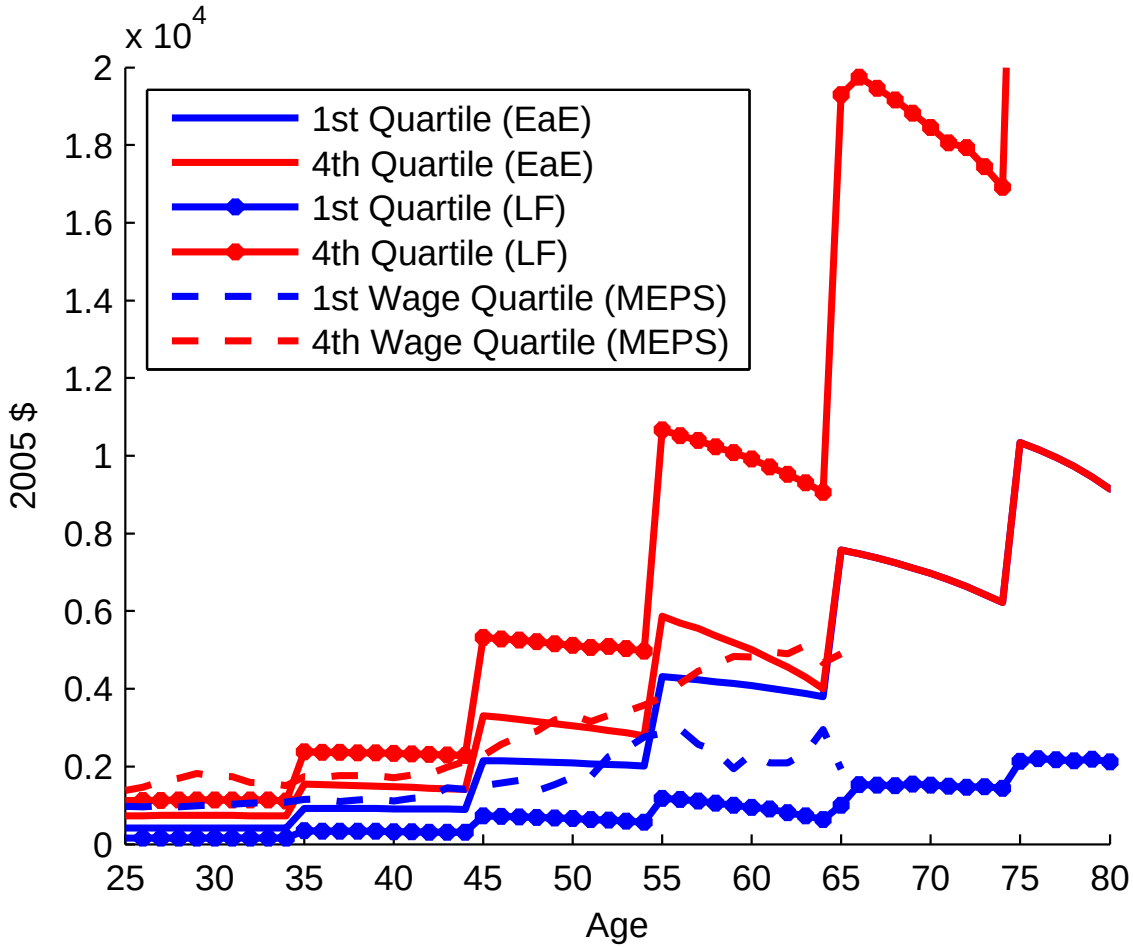
Elasticity of health spending w.r.t productivity



Back up slides: Using wage to rank individual in MEPS

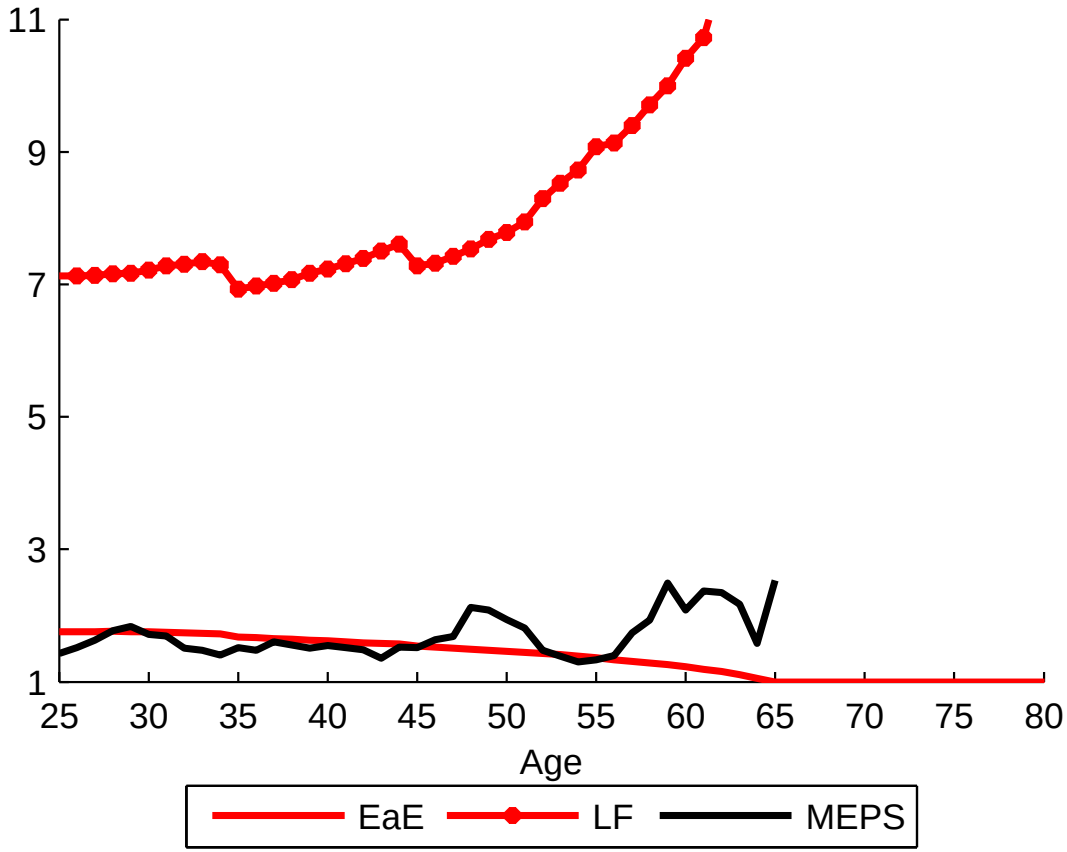
Ex Ante Efficient vs. Laissez Faire vs. Data

Average Health Spending by Age – Top and Bottom Wage Quartile



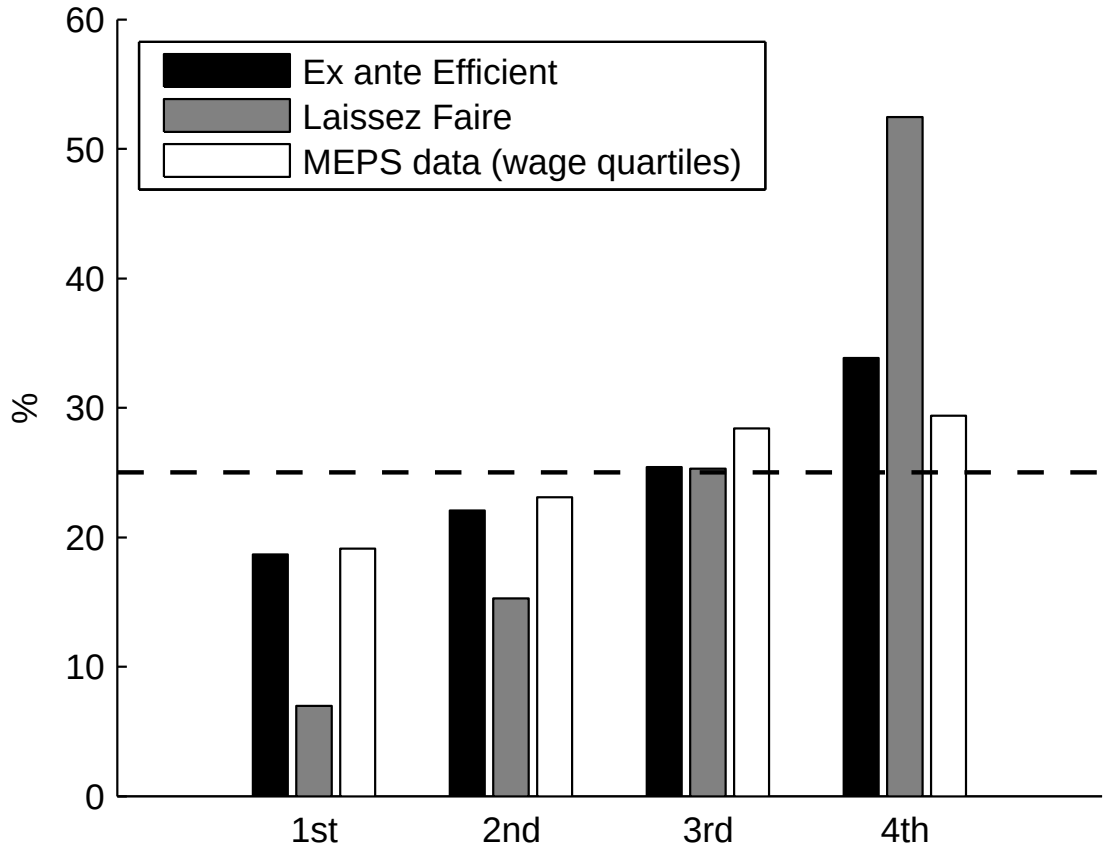
Ex Ante Efficient vs. Laissez Faire vs. Data

Ratio of Health Spending by Age – Top to Bottom Wage Quartile



Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Wage Quartile, 25-35yrs old



Ex Ante Efficient vs. Laissez Faire vs. Data

Share of Health Spending by Wage Quartile, 55-65yrs old