Quantifying Efficient Tax Reform

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Question

- How large are welfare gains from efficient tax reform?
  - Baseline:
    - Positive economy matched to administrative data
  - Reform:
    - Pareto improvements on efficient frontier (full)
    - Optima given set of policy tools (restricted)

Idea in a Picture

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- Start with baseline OLG economy:
  - Incomplete markets
  - Heterogeneous households
  - Consumption, labor supply, saving decisions
  - Technology parameters and tax policies
- Compute remaining lifetime utilities (v_j)

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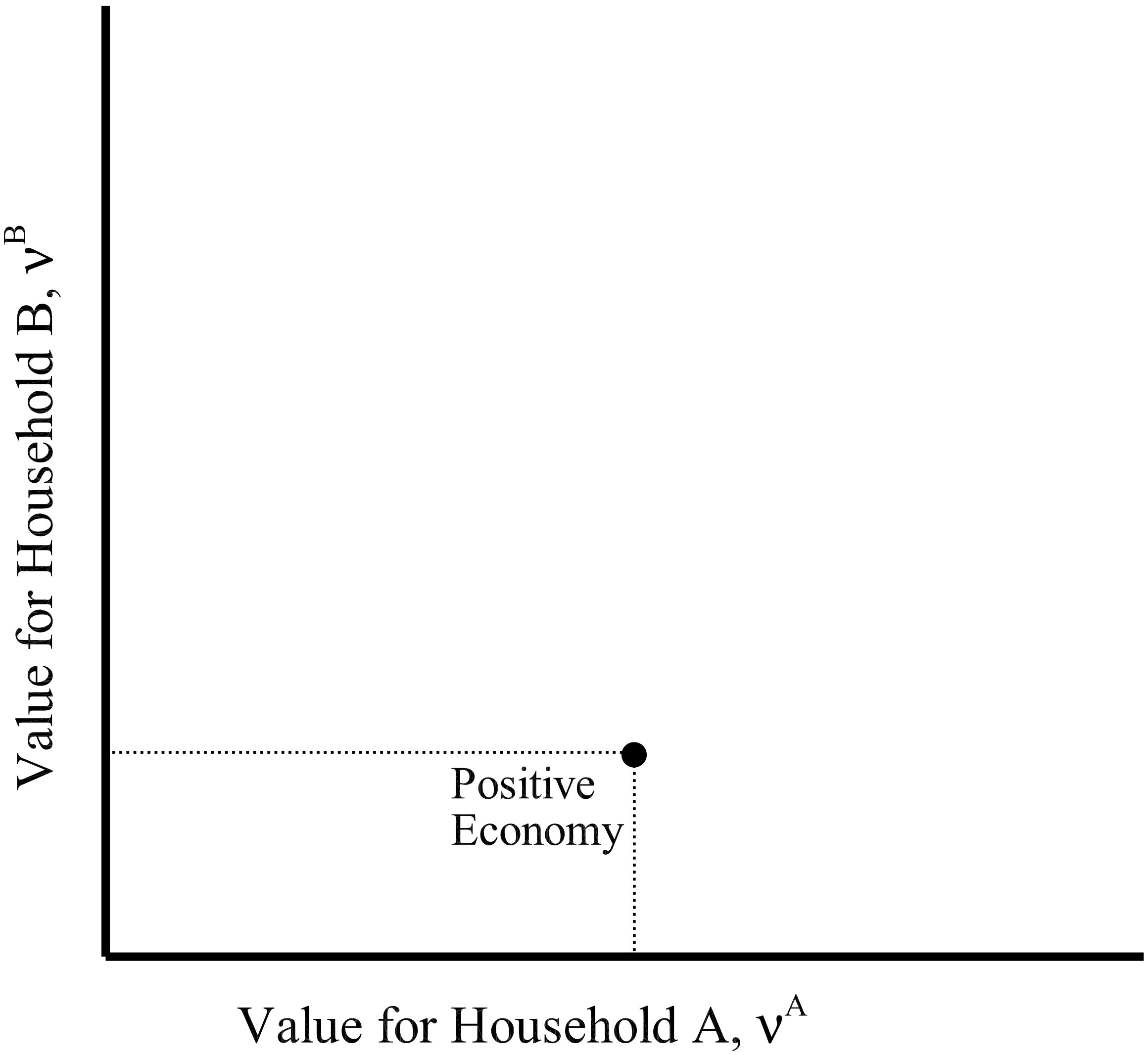
- Let's draw this for 2 households...

Idea in a Picture

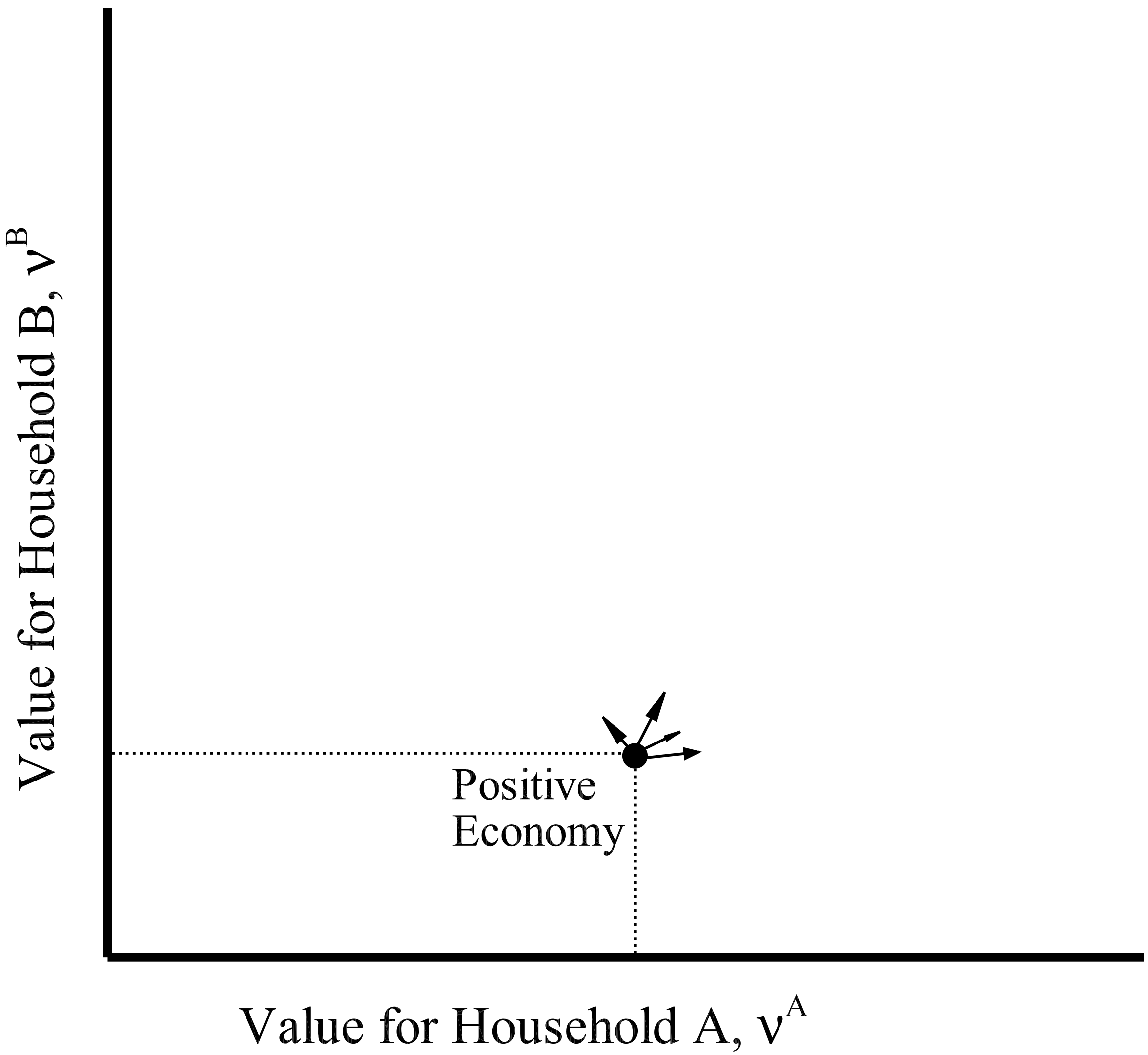


Idea in a Picture

- Typical starting point for most analyses
  - With constraints on policy instruments
  - Do counterfactuals or restricted optimal (“Ramsey”)

- Let’s draw this in the picture

Idea in a Picture

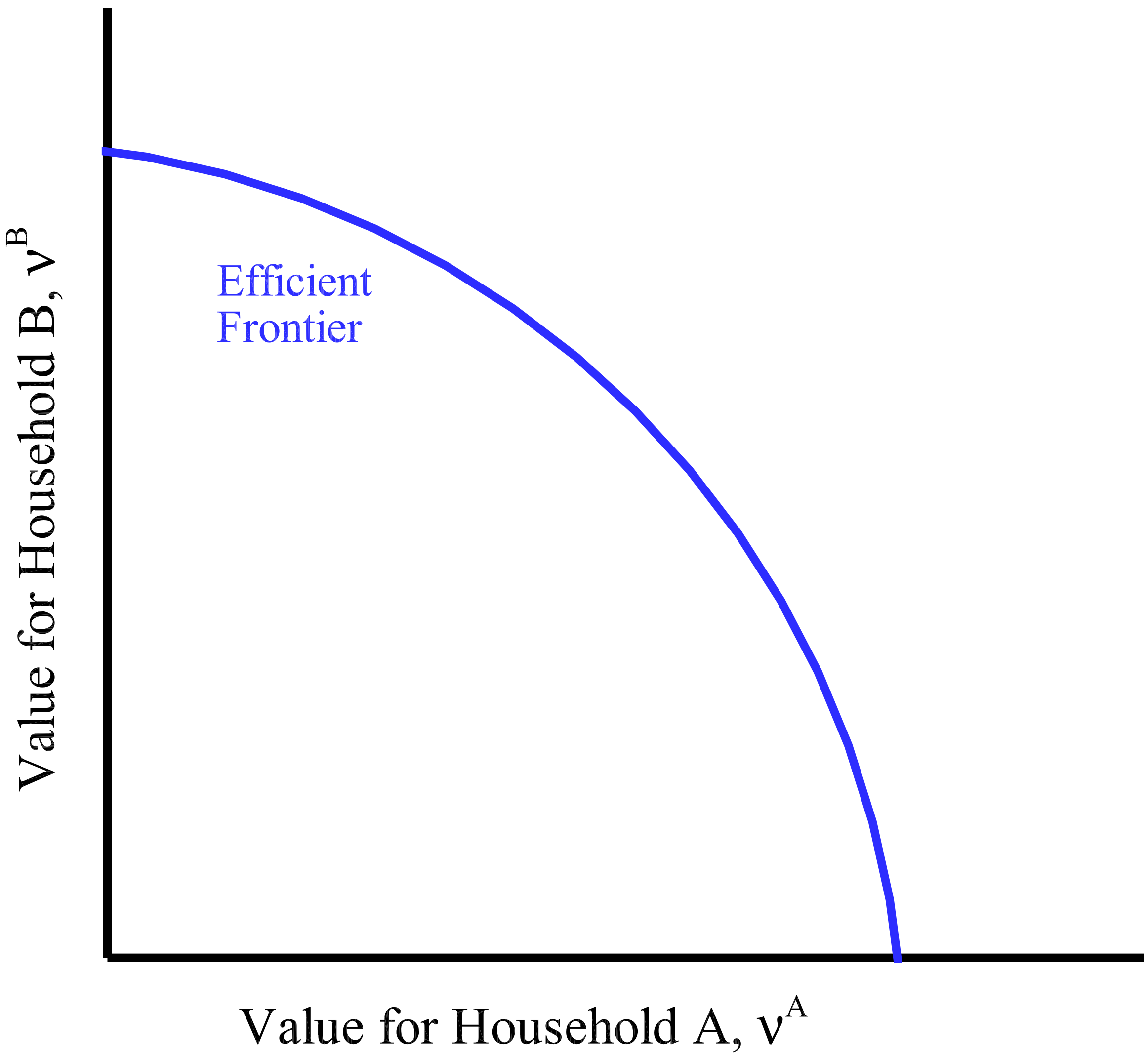


Idea in a Picture

- Not typical starting point for studies in Mirrlees tradition
  - With constraints on information sets
  - Characterize efficient allocations and policy "wedges"

- Let's draw this in the picture

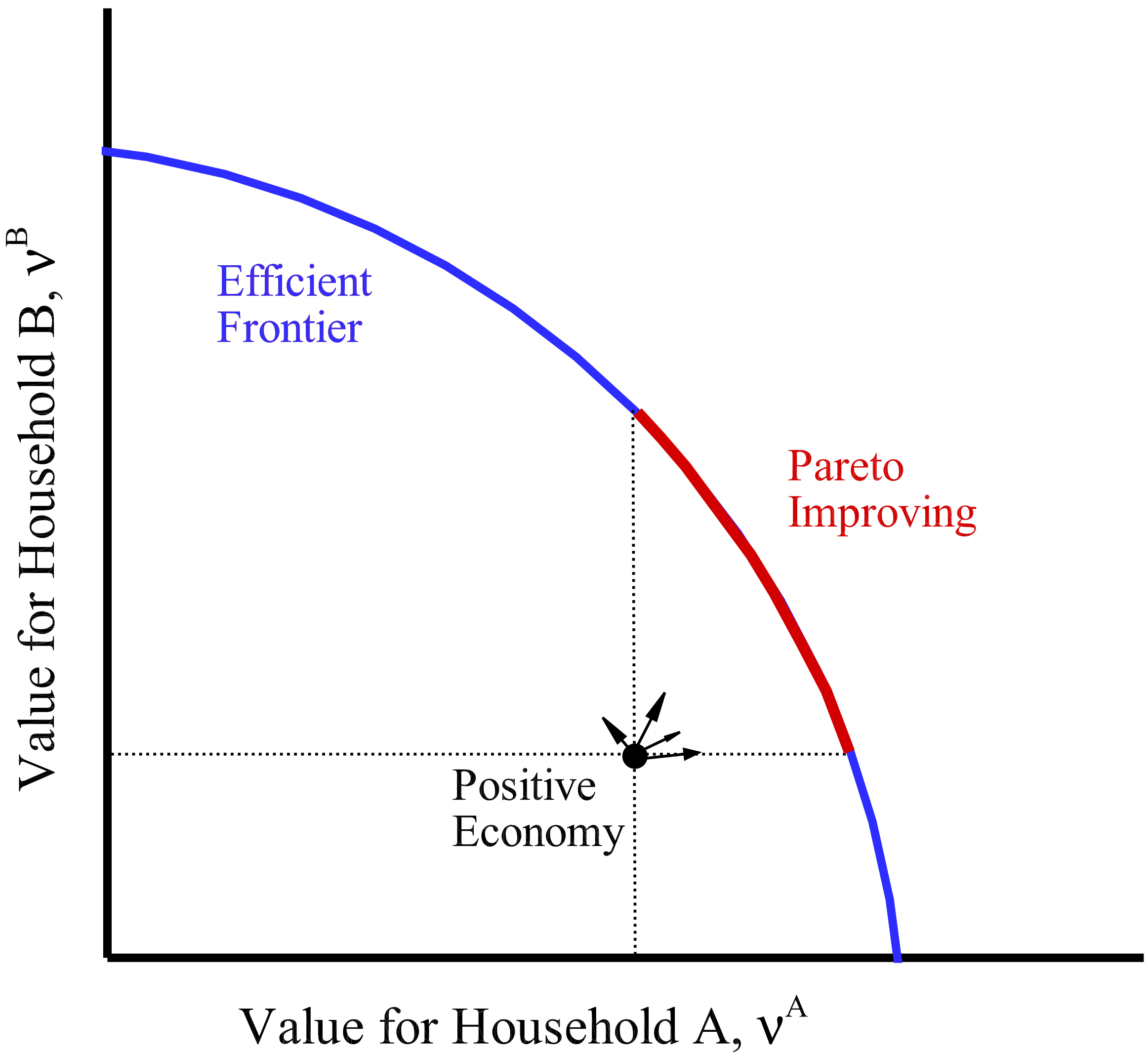
Idea in a Picture



Idea in a Picture

- This paper quantifies gains from:
  - Full Pareto-improving reform a la Mirrlees
  - Partial Pareto-improving reform a la Ramsey
  - Adding early-life transfer informed by Mirrlees
- Let's draw this in the picture

Idea in a Picture



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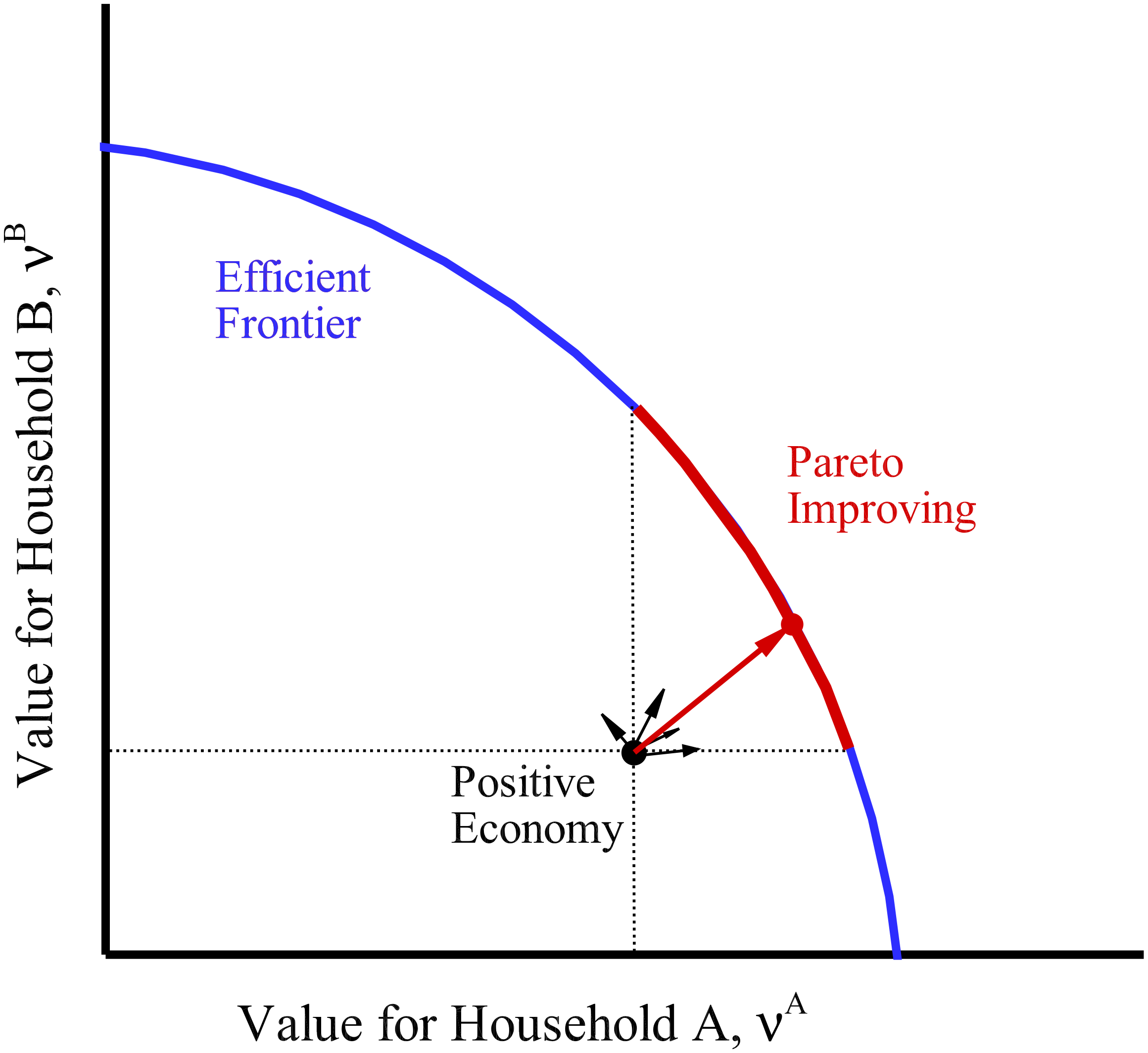

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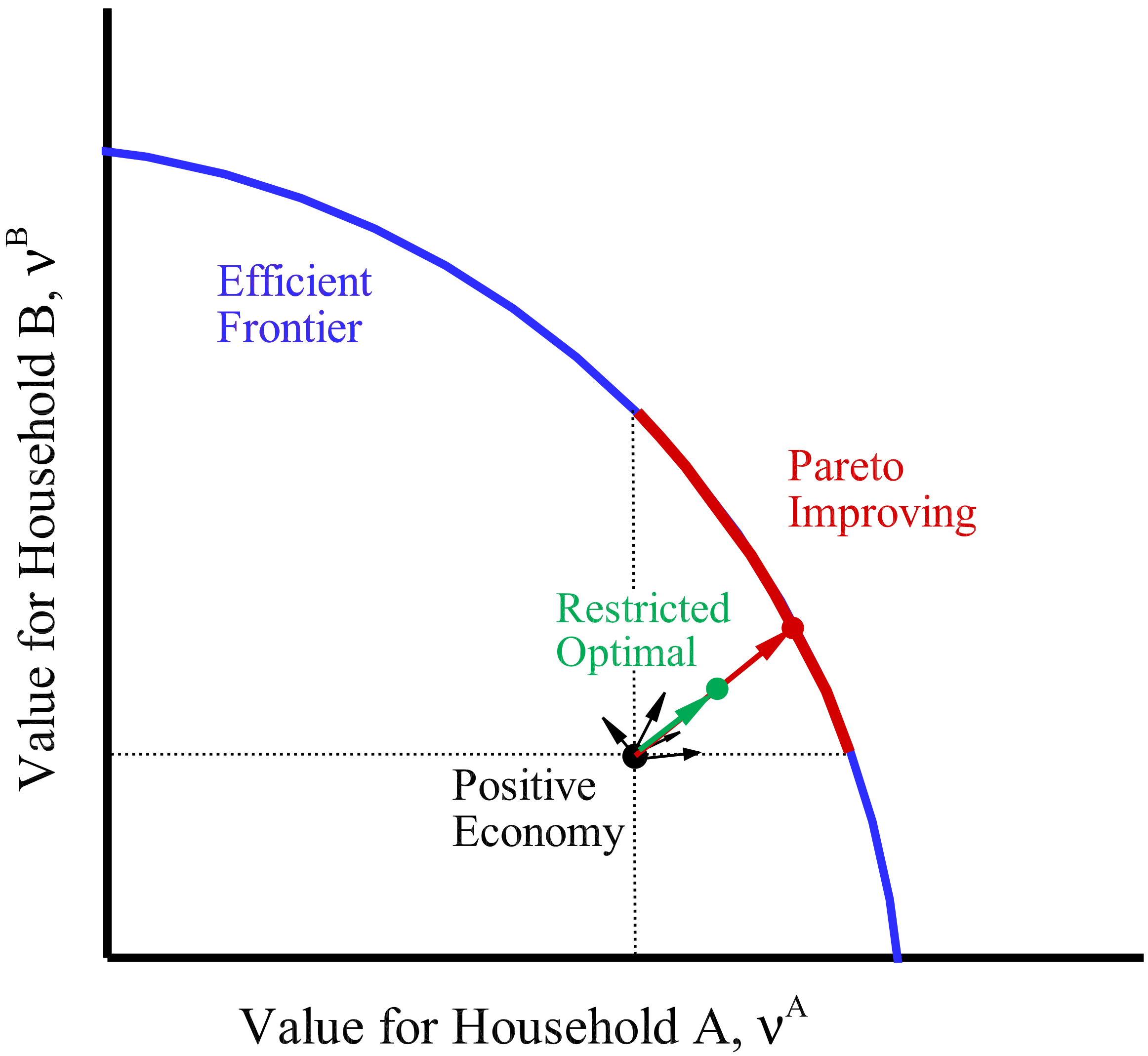


Our Approach

- Solve equilibrium for positive economy (●)
    - Inputs: fiscal policy and wage processes
    - Outputs: values under current policy
- Solve planner problem next (●)
    - Inputs: values under current policy
    - Outputs: labor and savings wedges and welfare gains
- Use results to inform current policy and reforms (●)

Main Findings (●→●)

- Maximum consumption equivalent gains (future cohorts):
  - 21% starting at age 25
  - Comparisons made to utilitarian planner
- Decompose by comparing allocations:
  - Consumption: level $\uparrow$ and variance $\downarrow$ for all groups
  - Leisure: level $\downarrow$ and variance $\uparrow$ for all groups

Note: Currently computing transitions

Main Findings (● → ●)

- Informed by comparison of baseline (●) and full reform (●)
  - Most gains in lifting consumption levels for young

$\Rightarrow$ Exploring early-life transfers: adds $\approx 2\%$ gains

Note: Computer is still hillclimbing

Contributions to Literature

- Theory and application of income tax design (●→)

  ⇒ Using administrative data from NL, go to (●)

- Pareto-improving reforms with fixed types

  Hosseini-Shourideh (2019)

  ⇒ Extend analysis to add dynamic risks

- Theory behind dynamic taxation and redistribution (●)

  Kapicka (2013), Farhi-Werning (2013), Golosov et al. (2016)

  ⇒ Link OLG (●) to planner (●) in full GE

Positive Economy (•)

- Open OLG economy a la Bewley
- Household heterogeneity in:
  - Age
  - Education (observed, permanent)
  - Productivity (private, stochastic)
  - Marital risk
  - Divorce risk (in progress)
  - Unemployment risk (in progress)
- Transfers and taxes on consumption, labor income, assets

Positive Economy ($\bullet$)

- Household problem

$$v_j(a,\epsilon;\Omega) = \max_{c,n,a'} \{U(c,\ell) + \beta E[v_{j+1}(a',\epsilon';\Omega)|\epsilon]\}$$

$$\text{s.t. } a' = (1+r)a - T_a(ra) + w\epsilon n - T_n(j, w\epsilon n) - (1+\tau_c)c$$

  where

  - j= age
  - a= financial assets
  - ϵ= productivity shock
  - Ω= factor prices and tax policies
  - c= consumption
  - n= labor supply ($n + \ell = 1$)

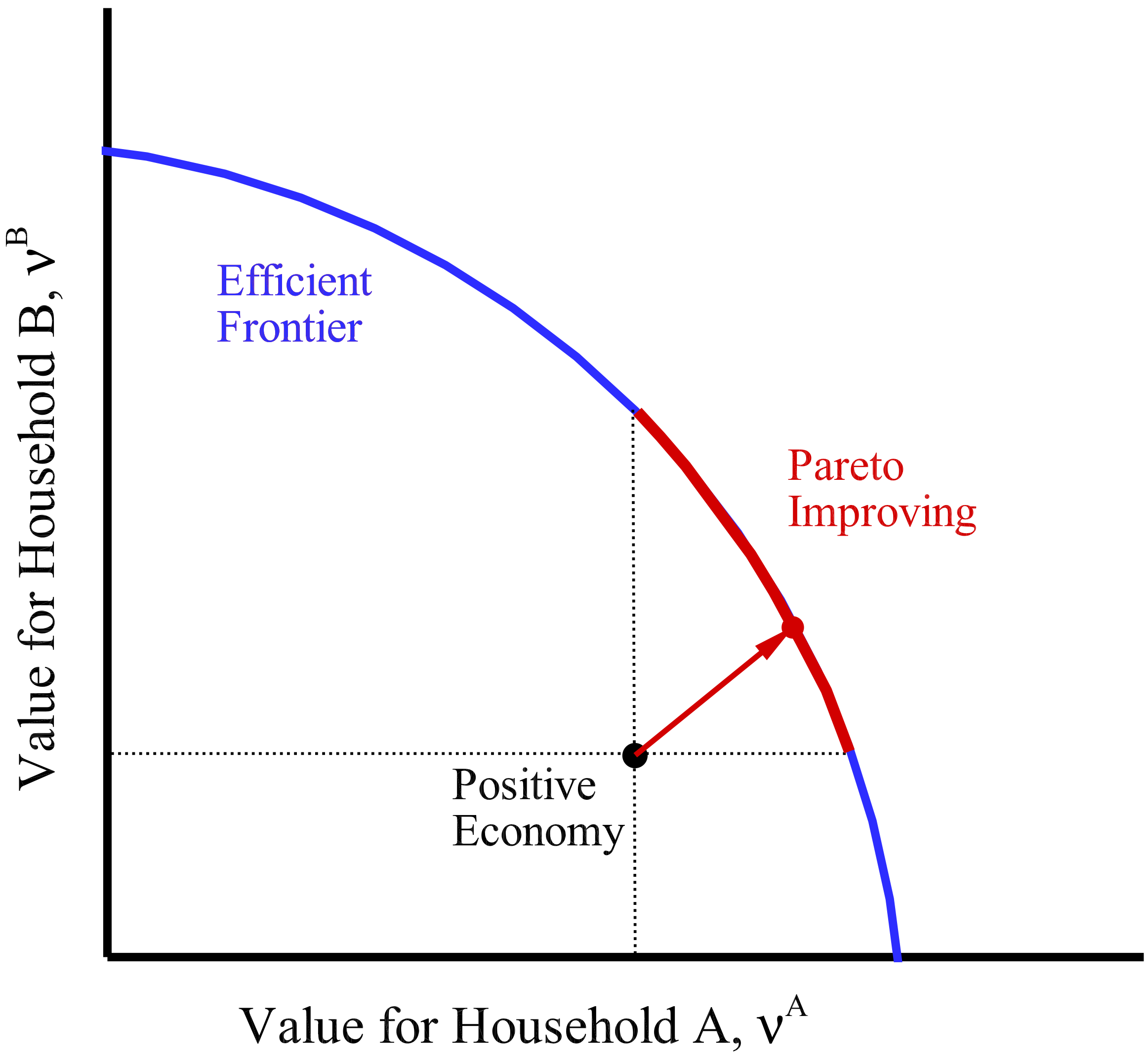
Reform Problem (•)

- Take inputs from positive economy:
  - Parameters for preferences and technologies
  - Wage profiles and shock processes
  - Values under current policy $(v_A, v_B, \ldots)$
- Compute maximum consumption equivalent gain

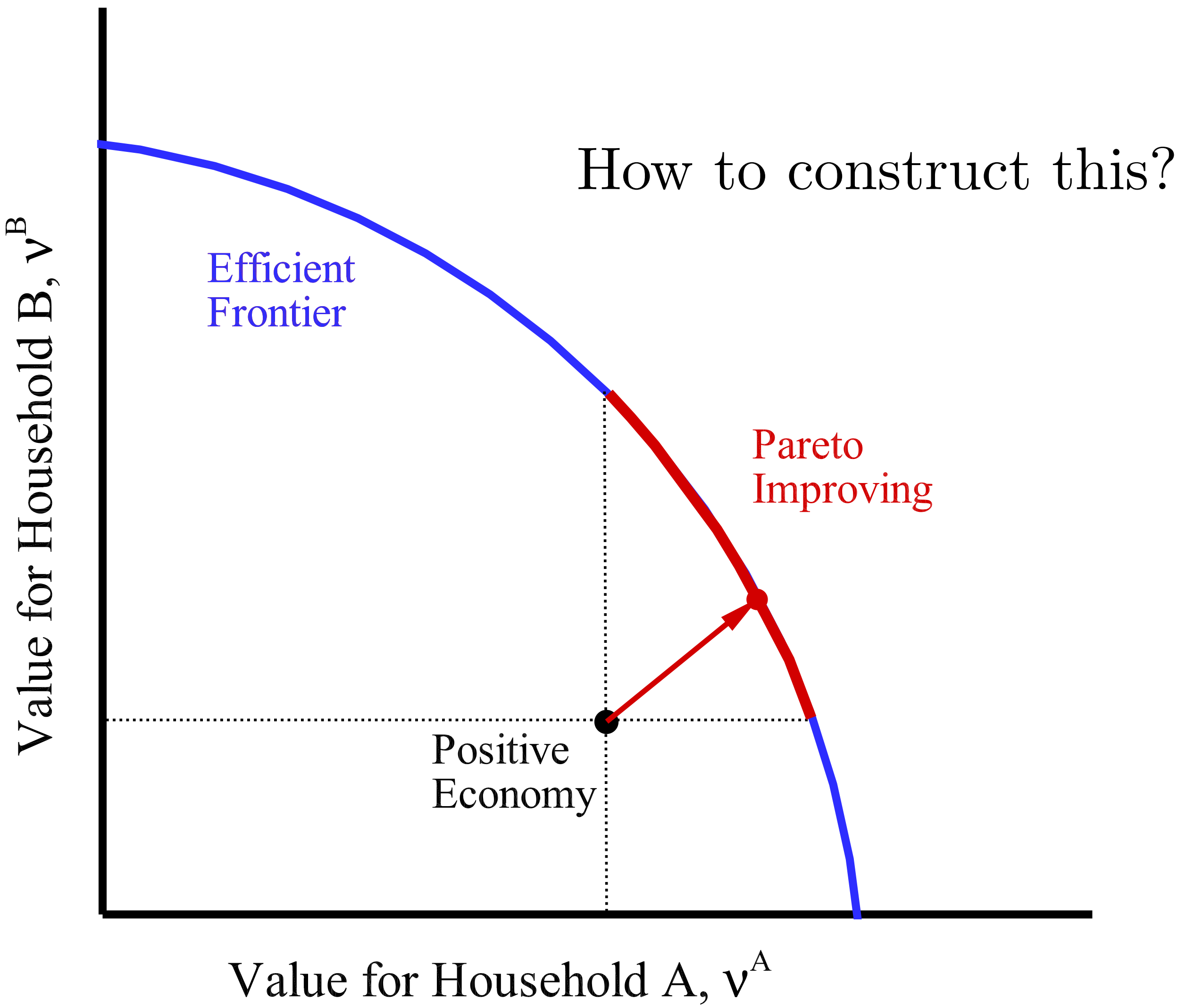
Notion of Efficiency

- Our focus is Pareto-improving reforms:
  - There is no alternative allocation that is
    - Resource feasible
    - Incentive feasible
  - Making all better off and some strictly better off
- Will report gain assuming same percentage for all

Pareto-improving Reforms



Pareto-improving Reforms



Planner Problem in Words

- Maximize present value of aggregate resources
- subject to
  - Incentive constraints for every household and history
  - Value delivered exceeds that of positive economy

Planner Problem in Practice

- Exploit separability to solve household by household
- Include only local downward incentive constraints
  - Verify numerically that constraints are satisfied
- Solve recursively by introducing additional states
  - Promised value for truth telling
  - Threat value for local lie

Planner Problem in Practice

- Exploit separability to solve household by household
- Include only local downward incentive constraints (IC)
  - Verify numerically that all ICs satisfied
- Solve recursively by introducing additional states
  - Promised value for truth telling (V)
  - Threat value for local lie ($\widetilde{V}$)

Planner Problem for a Household

Planner Problem for a Household

Max present value of resources

Planner Problem for a Household

$$\Pi_j(V, \widetilde{V}, \epsilon) \equiv \max \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon) \big[w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) \\ + \text{future value} \big]$$

As in positive economy,

- j= age
- ϵ= productivity shock
- c= consumption
- n= labor supply

Planner Problem for a Household

$$\Pi_j(V, \widetilde{V}, \epsilon) \equiv \max \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon) \Big[w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) \\ + \Pi_{j+1}(V_j(\epsilon_i), \widetilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R \Big]$$

Additionally, planner chooses

- V_j= promise value
- $\widetilde{V}_j$= threat value

Planner Problem for a Household

$$\Pi_j(V, \widetilde{V}, \epsilon) \equiv \max \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon)\Big[w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) + \Pi_{j+1}(V_j(\epsilon_i), \widetilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R\Big]$$

s.t. Local downward incentive constraints

Planner Problem for a Household

$$\Pi_j(V, \widetilde{V}, \epsilon) \equiv \max \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon) \Big[w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) + \Pi_{j+1}(V_j(\epsilon_i), \widetilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R \Big]$$

$$\text{s.t.} \quad U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \geq U(c_j(\epsilon_{i-1}), \ell_j^+(\epsilon_{i-1})) + \beta \widetilde{V}_j(\epsilon_i), \;\; i \geq 2$$

$$\text{where } \ell_j^+(\epsilon_{i-1}) = 1 - n_j(\epsilon_{i-1})\epsilon_{i-1}/\epsilon_i$$

Planner Problem for a Household

$$\Pi_j(V,\widetilde{V},\epsilon) \equiv \max \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon)\Big[w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i)$$
$$+\Pi_{j+1}(V_j(\epsilon_i),\widetilde{V}_j(\epsilon_{i+1}),\epsilon_i)/R\Big]$$

$$\text{s.t.} \quad U(c_j(\epsilon_i),\ell_j(\epsilon_i)) + \beta V_j(\epsilon_i)$$
$$\geq U(c_j(\epsilon_{i-1}),\ell_j^+(\epsilon_{i-1})) + \beta\widetilde{V}_j(\epsilon_i),\ i \geq 2$$

Deliver at least the promised value

Planner Problem for a Household

$$\Pi_j(V,\widetilde{V},\epsilon) \equiv \max \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon)\Big[w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i)$$

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$$V \leq \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon)\left[U(c_j(\epsilon_i),\ell_j(\epsilon_i)) + \beta V_j(\epsilon_i)\right]$$

Planner Problem for a Household

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$$V \leq \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon)\left[U(c_j(\epsilon_i),\ell_j(\epsilon_i)) + \beta V_j(\epsilon_i)\right]$$

Deliver no more than the threat value

Planner Problem for a Household

$$\Pi_j(V, \widetilde{V}, \epsilon) \equiv \max \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon)\Big[w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) + \Pi_{j+1}(V_j(\epsilon_i), \widetilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R\Big]$$

$$\text{s.t.} \quad U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \geq U(c_j(\epsilon_{i-1}), \ell_j^+(\epsilon_{i-1})) + \beta \widetilde{V}_j(\epsilon_i), \;\; i \geq 2$$

$$V \leq \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon) \left[U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i)\right]$$

$$\widetilde{V} \geq \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon^+) \left[U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i)\right]$$

Planner Problem for Future Generation ($j = 1$)

$$\Pi_j(V, -, \epsilon) \equiv \max \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon) \Big[w\epsilon_i n_j(\epsilon_i) - c_j(\epsilon_i) + \Pi_{j+1}(V_j(\epsilon_i), \widetilde{V}_j(\epsilon_{i+1}), \epsilon_i)/R \Big]$$

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$$V \leq \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon) \left[U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \right]$$

No threat value

Planner Problem for Future Generation ($j = 1$)

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$$V \leq \sum_{\epsilon_i} \pi_j(\epsilon_i|\epsilon) \left[U(c_j(\epsilon_i), \ell_j(\epsilon_i)) + \beta V_j(\epsilon_i) \right]$$

Replace arbitrary V with $\vartheta(\epsilon_0) + \vartheta_\Delta$

General Equilibrium

- Solve planner problem for positive economy values

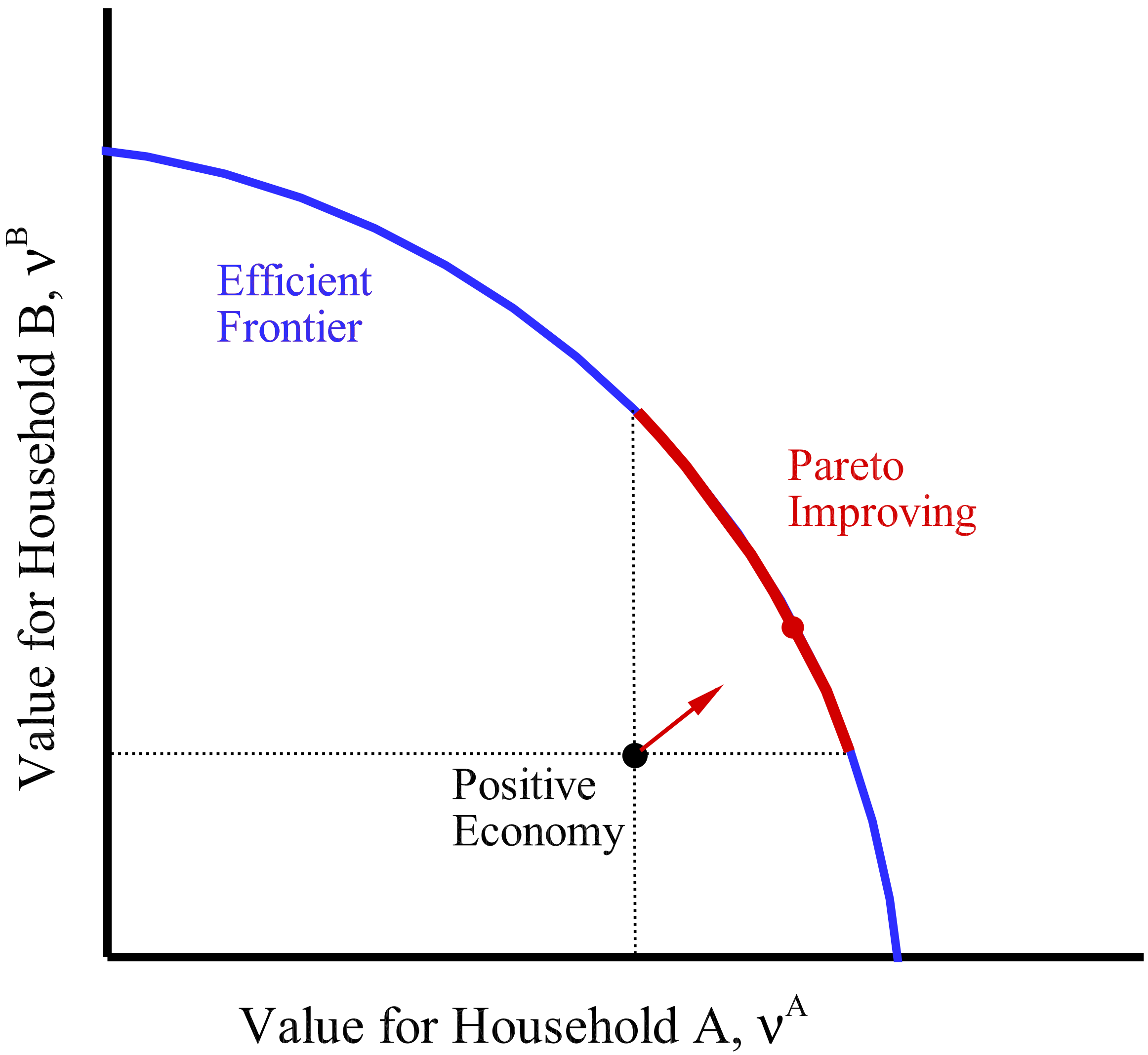
- Evaluate resource constraints

$$C_t + I_t + G_t + B_{t+1} = F(K_t, N_t) + RB_t$$

$$\lim_{T \to \infty} \frac{1}{R^{T-1}} (B_T + K_T) \geq 0$$

- Increase $\vartheta_{\triangle}$ until resources exhausted

Pareto-improving Reforms



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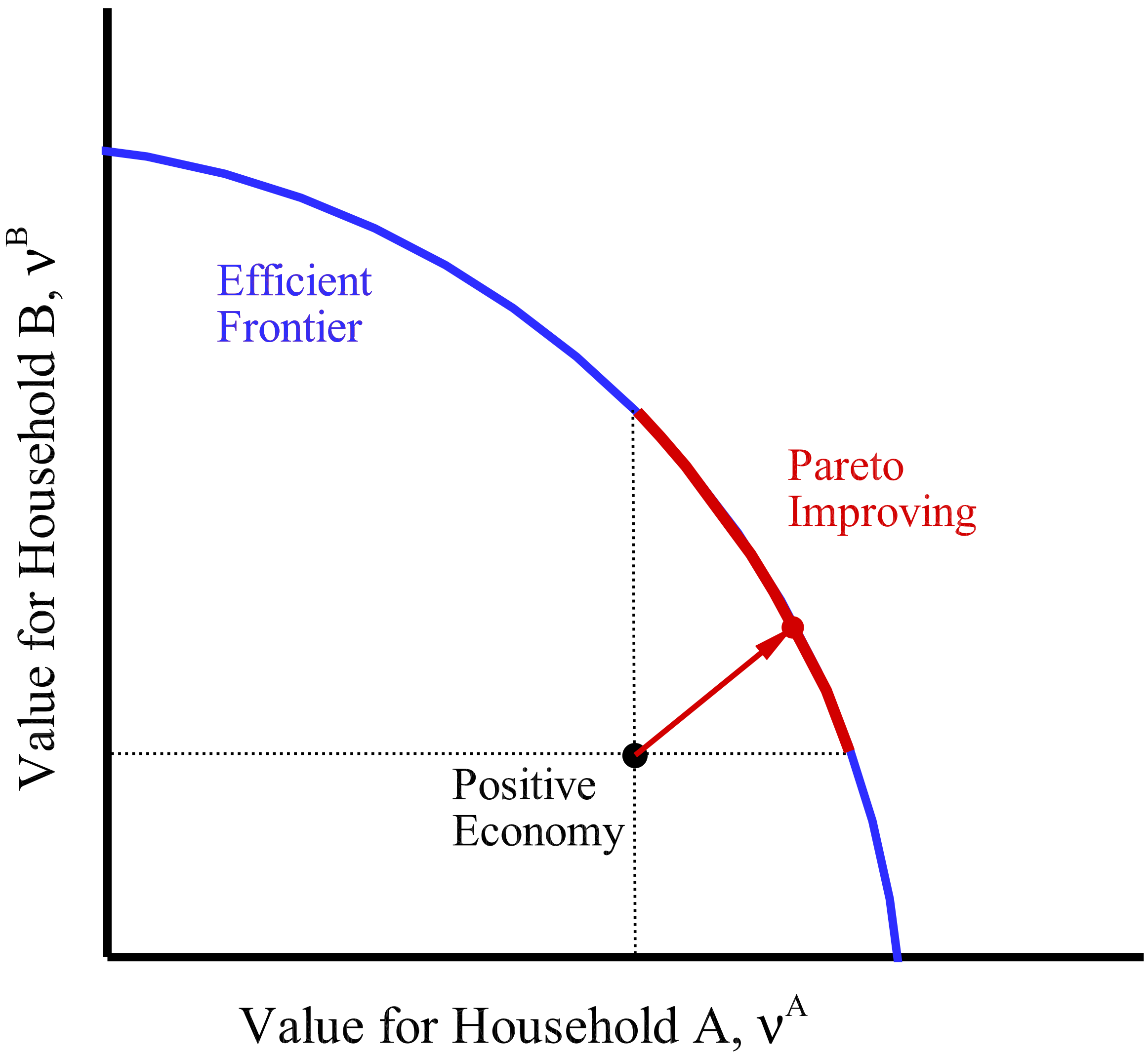


Quantitative Steps

1. Data

2. Quantify efficient reform (●→●)

3. Use answer to inform restricted reform (●→●)

Netherlands

- Merged administrative data, 2006-2014
  - Earnings from tax authority
  - Hours from employer provided data
  - Education from population survey
- National accounts
- Tax schedules

Note: Big data advantage for estimating elasticities & shocks

Estimation of Wage Processes

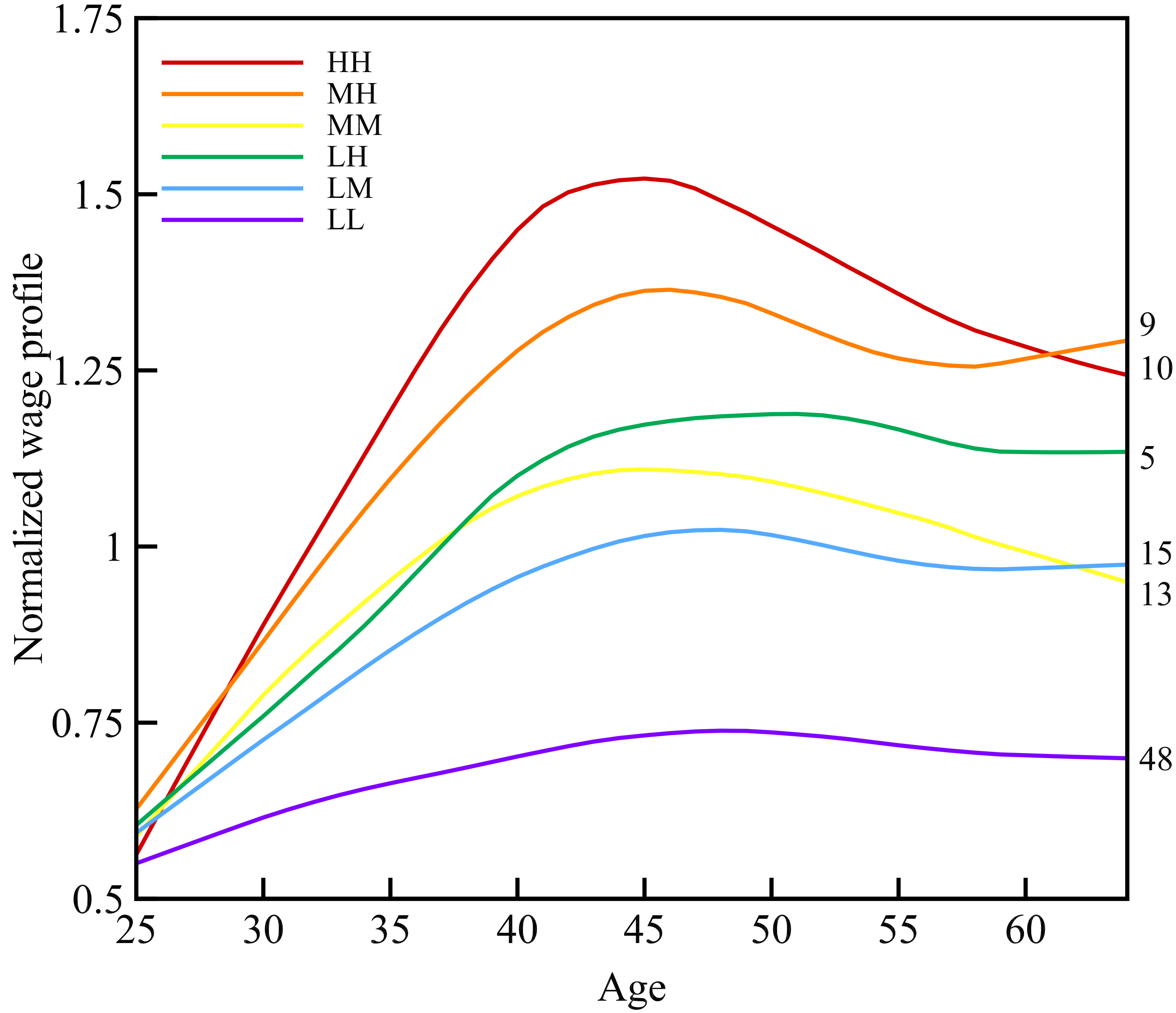
- Construct hourly wages W_{ijt} (j=age, t=time)
- Classify degrees:
  - High school or practical (Low)
  - University of applied sciences (Medium)
  - University (High)
- Construct residual wages ω_{ijt}:
  - $\log W_{ijt} = A_t + X_{ijt} + \omega_{ijt}$
  - Estimate AR(1) process for idiosyncratic risk

Marriage and Household Structure

- In period 0, individuals are single
  - Different by education (L,M,H)
- After that, individuals either
  - Form a couple (LL,LM,LH,MM,MH,HH) or
  - Remain single (included with LL,MM,HH)

Note: Working on adding divorce risk

Wage Profiles



Wage Process Estimates

Group	$\hat{\rho}$	$\hat{\sigma}_u^2$
Low, Low	.9542	.0096
Low, Medium	.9660	.0087
Low, High	.9673	.0162
Medium, Medium	.9570	.0099
Medium, High	.9616	.0109
High, High	.9564	.0172

An Aside

- Government:
  - Can *ex-post* infer type from choices
  - Can't *ex-ante* observe type
- But, can design policy to *induce* truthful reporting of type

Other Key Parameters

- Number of productivity types
- Preferences
- Status quo policy

Baseline: 20 types, log preferences, NL wages & policy

Quantitative Deliverables

- Welfare gains
  - Total consumption equivalent (ϑ_Δ)
  - Decomposition
- Wedges

Wedges

- Labor wedge:

$$\tau_n(\epsilon^j) = 1 - \frac{1}{w}\frac{U_\ell(c(\epsilon^j),\ell(\epsilon^j))}{U_c(c(\epsilon^j),\ell(\epsilon^j))}$$

- Savings wedge:

$$\tau_a(\epsilon^j) = 1 - \frac{U_c(c(\epsilon^j),\ell(\epsilon^j))}{\beta R E[U_c(c(\epsilon^{j+1}),\ell(\epsilon^{j+1}))|\epsilon^j]}$$

Wedges

- Labor wedge:

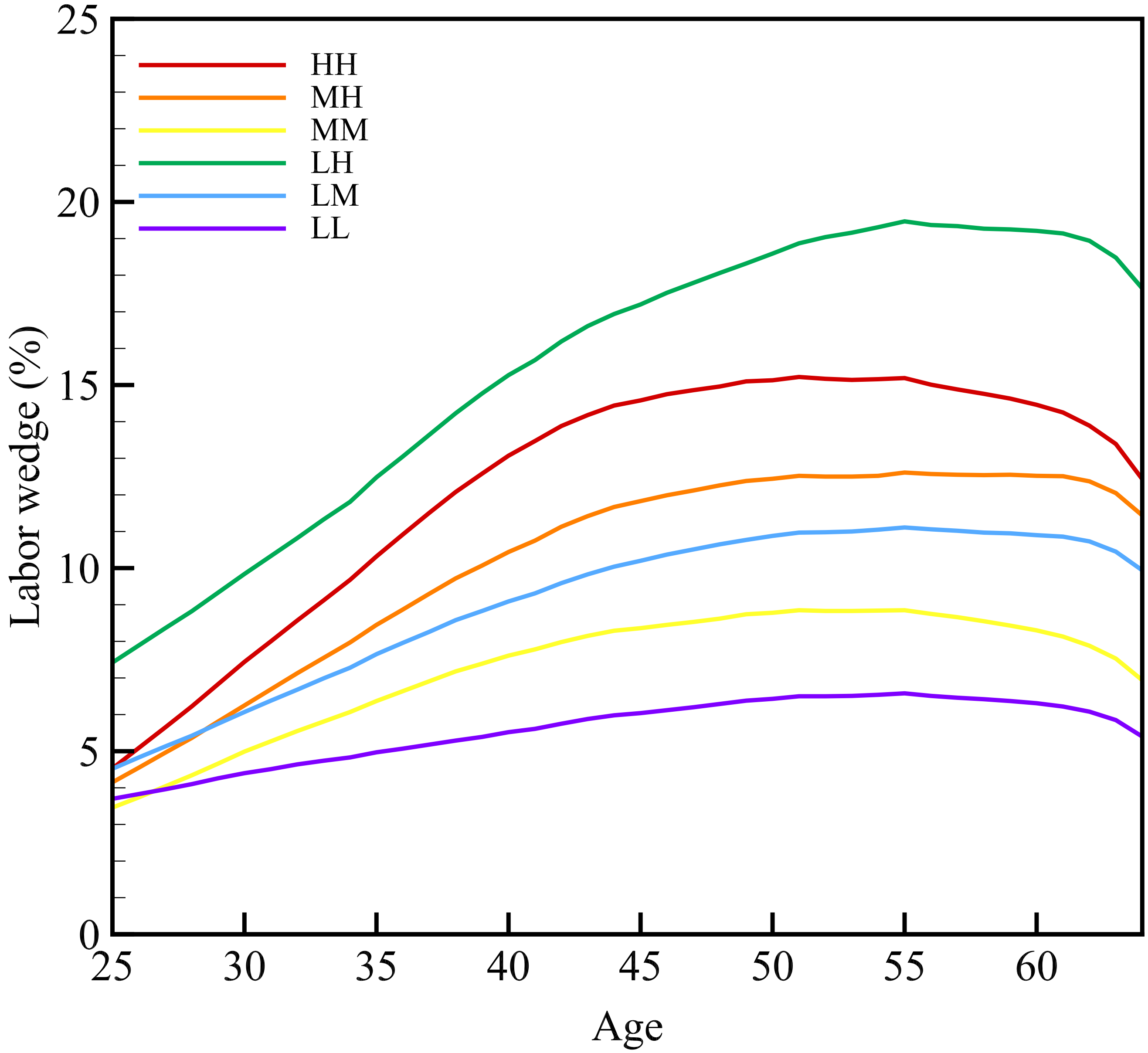
$$\tau_n(\epsilon^j) = 1 - \frac{1}{w}\frac{U_\ell(c(\epsilon^j),\ell(\epsilon^j))}{U_c(c(\epsilon^j),\ell(\epsilon^j))}$$

- Savings wedge:

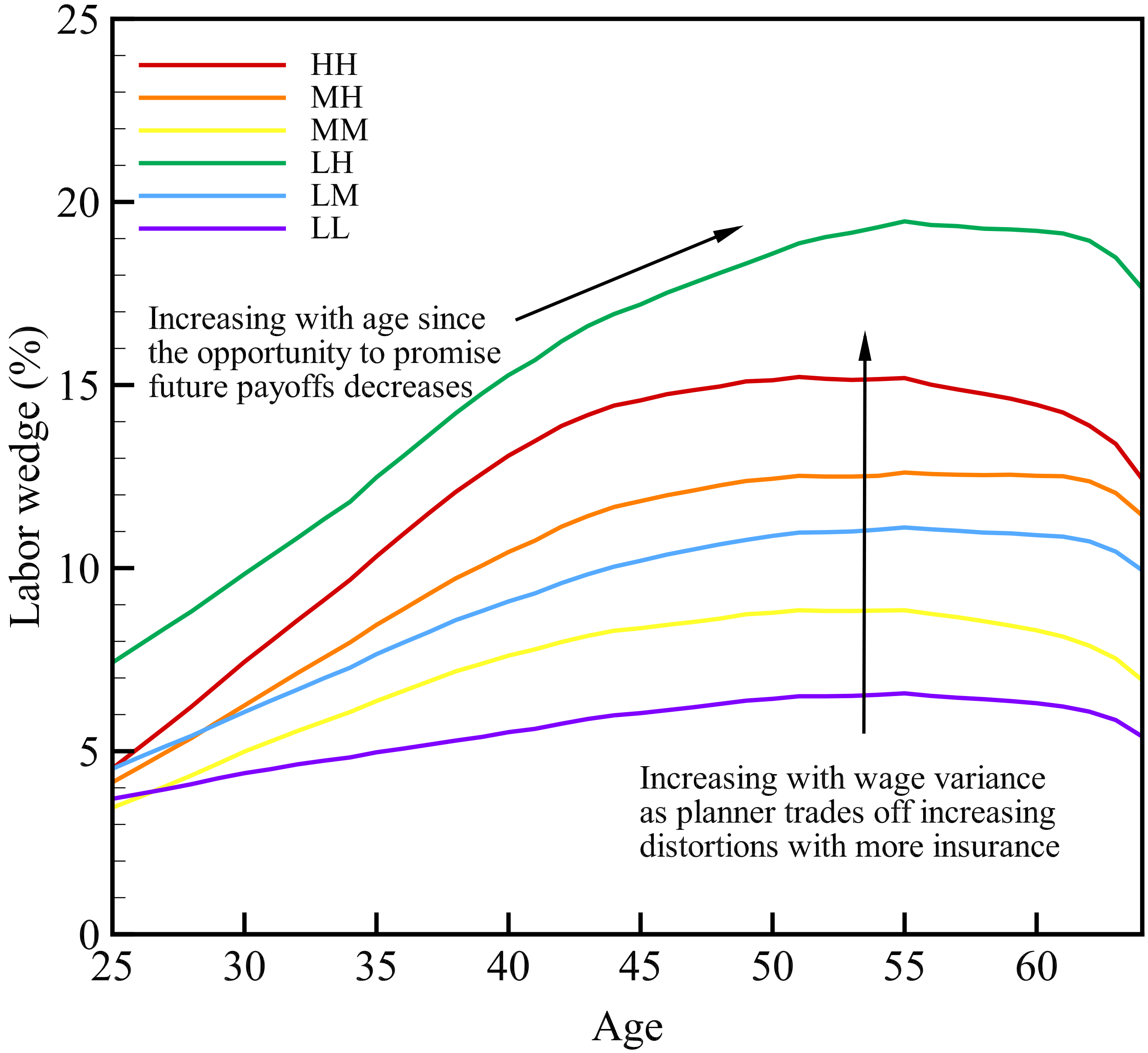
$$\tau_a(\epsilon^j) = 1 - \frac{U_c(c(\epsilon^j),\ell(\epsilon^j))}{\beta R E[U_c(c(\epsilon^{j+1}),\ell(\epsilon^{j+1}))|\epsilon_j]}$$

$\Rightarrow$ Hopefully informative for reforming current policy

Labor Wedges



Labor Wedges



Welfare, (•) vs (•)

- Consumption equivalent gain of 21% for future cohorts
- Large but maybe not surprising given:
  - Tax rates in NL over 40%
  - Tax wedges of planner in 4% to 20% range

Welfare, (•) vs (•)

- Consumption equivalent gain of 21% for future cohorts
- Large but maybe not surprising given:
  - Tax rates in NL over 40%
  - Tax wedges of planner in 4% to 20% range
- What are the implied Pareto weights?

Implied Pareto Weights

- Could also have solved:
  - $\max \sum_i \omega_i V^i$
  - subject to resource and incentive constraints
- What are the implied ω_i's for L,M,H?

Pareto Weights and Welfare Gains

	Equal Gains		Equal Weights	
Education	ω_i	Δ_i	ω_i	Δ_i
Low	0.8	21		
Medium	1.0	21		
High	1.2	21		

Pareto Weights and Welfare Gains

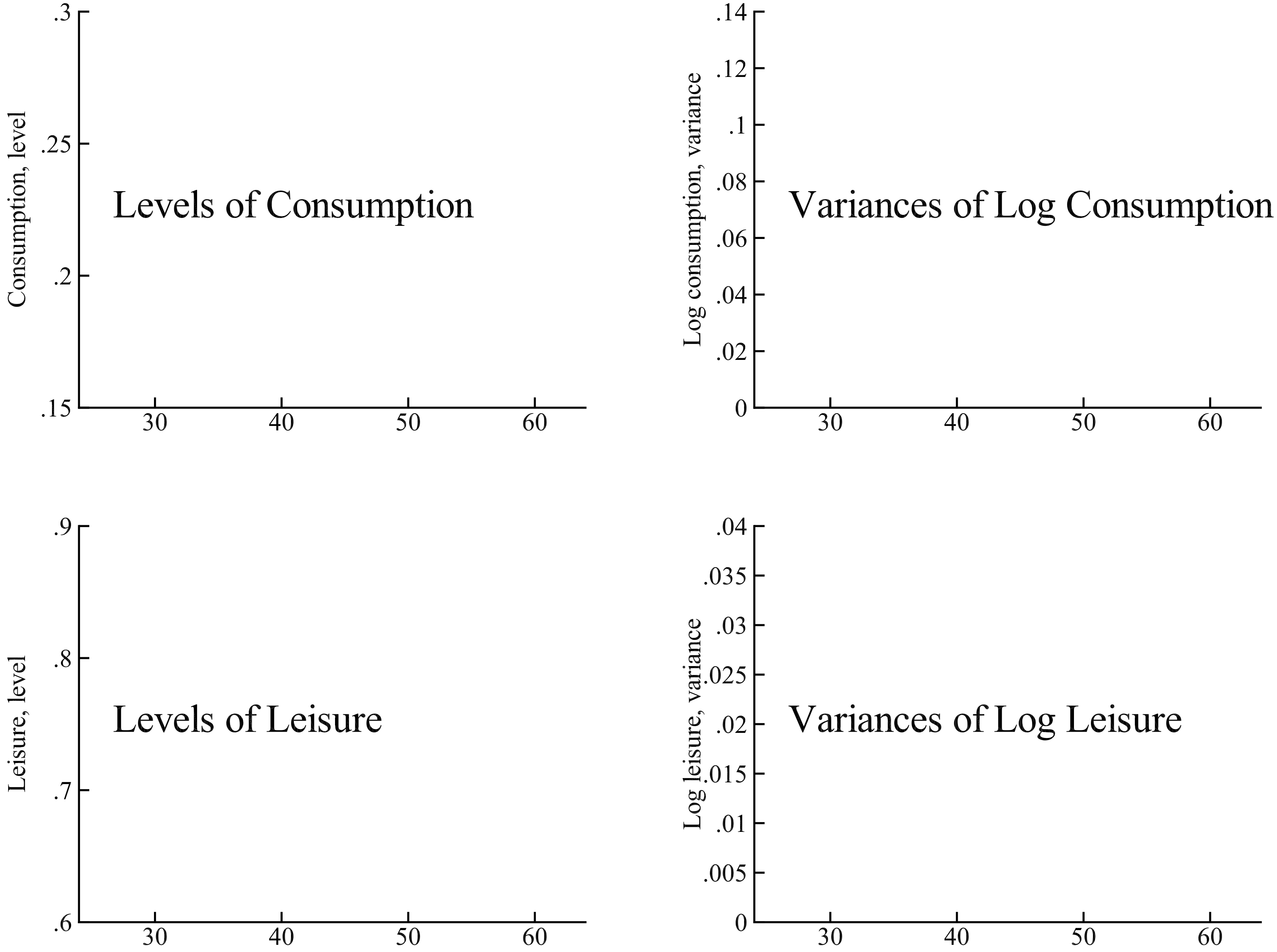
	Equal Gains		Equal Weights[†]	
Education	ω_i	Δ_i	ω_i	Δ_i
Low	0.8	21	1	32
Medium	1.0	21	1	18
High	1.2	21	1	2

[†] Utilitarian planner with $V^H \geq V^M \geq V^L$

Comparing Allocations, (•) vs (•)

- Consumption: level $\uparrow$ and variance $\downarrow$ for all groups
- Leisure: level $\downarrow$ and variance $\uparrow$ for all groups
- Intuition from simple static model:
  - No insurance: c varies, ℓ constant
  - Full insurance: c constant, ℓ varies
- What about magnitudes?

A Look Under the Hood: Group LL



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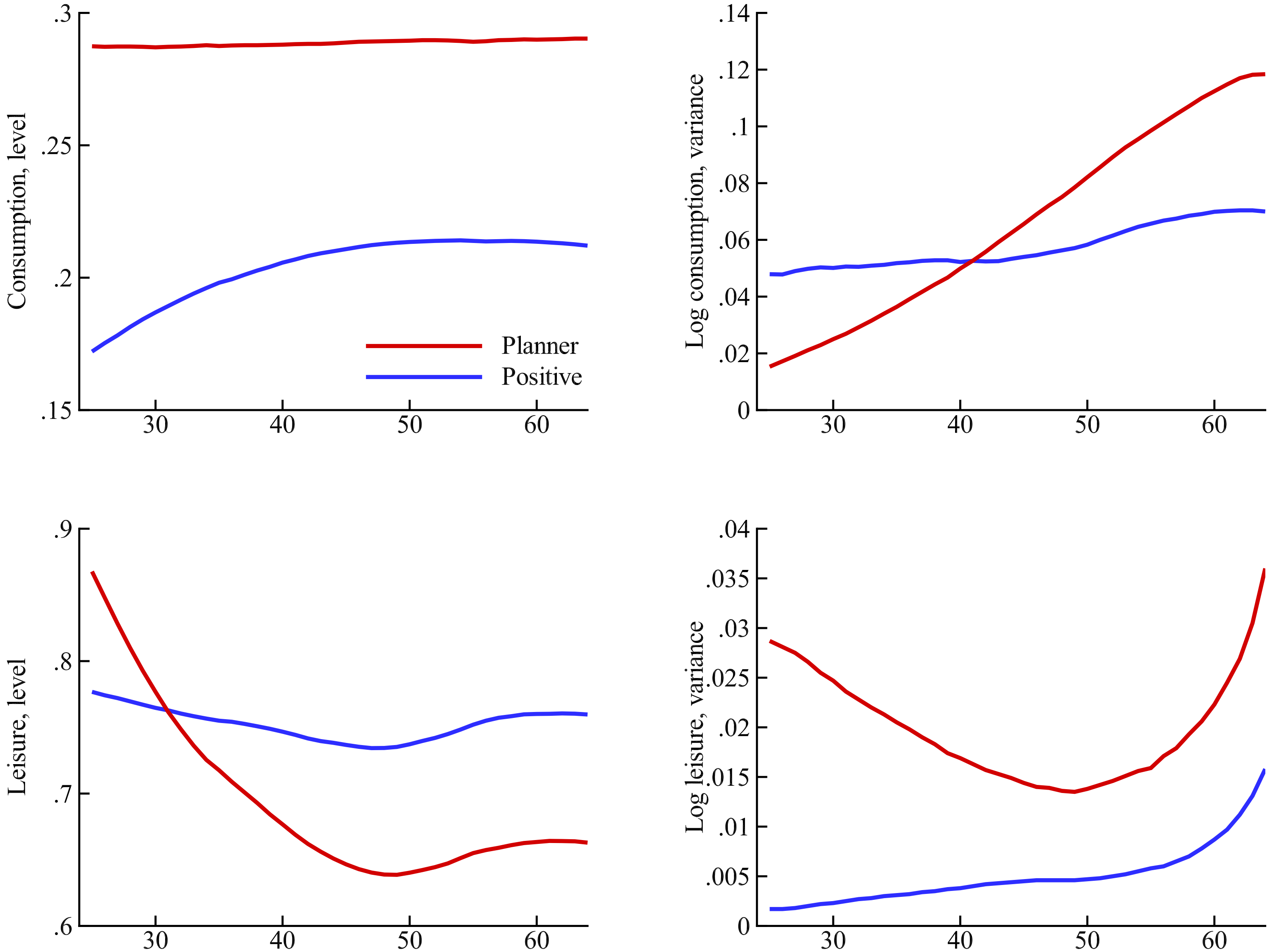
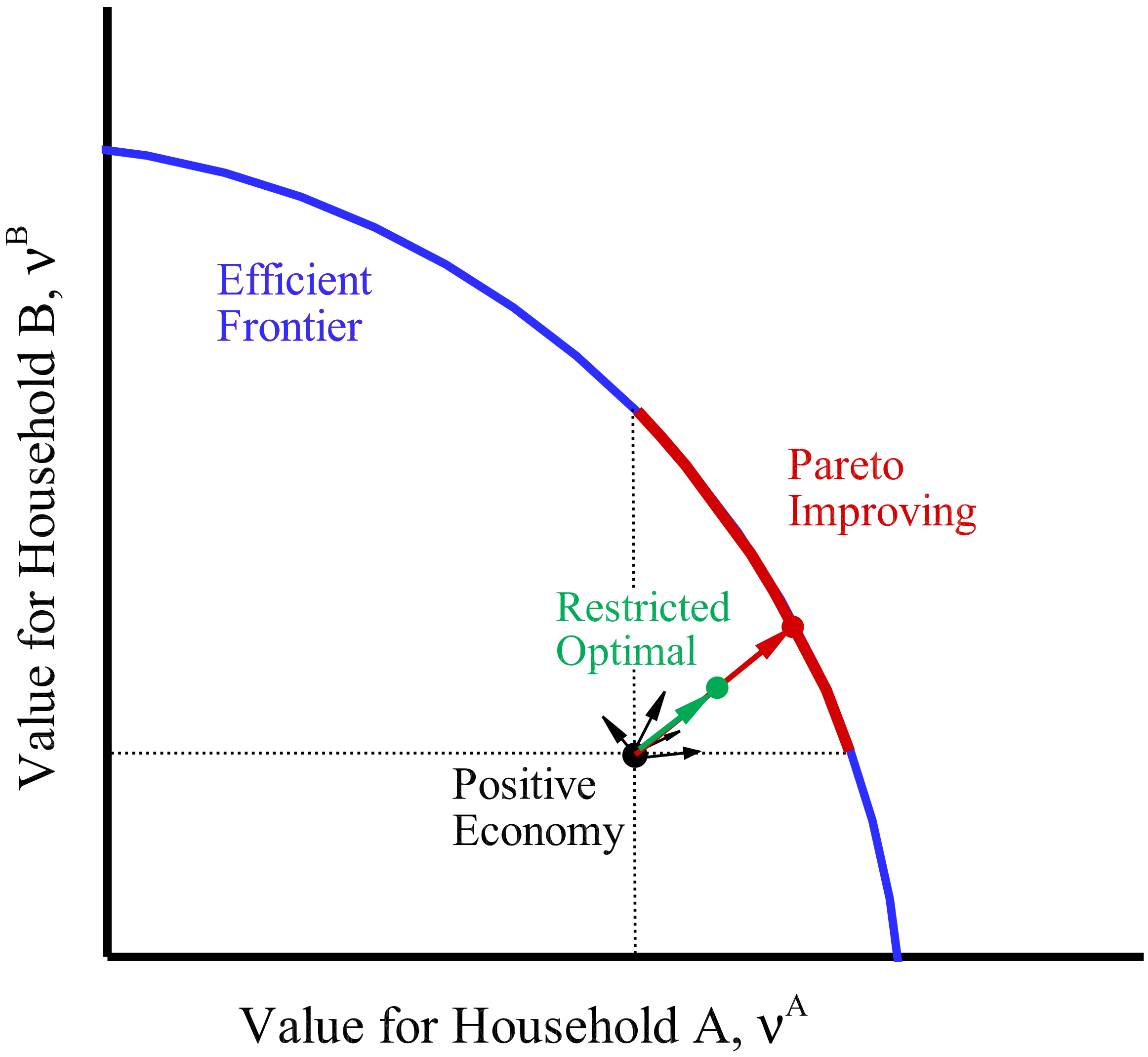


Informing Counterfactuals (●)



Informing Counterfactuals (•)

- Results of planner problem suggest large gains to
  - Lower average marginal tax rates
  - Early life transfers

Note: our results on restricted gains still tentative

Summary

- Ultimate deliverables of project:
  - Estimates of gains for efficient reform
  - Identification of sources of gains
  - Ideas for new policy instruments
  - Prototype for future analyses
- Stay tuned...