On Financing Retirement with an Aging Population

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October 2013

A Looming Problem

- Financing retirement consumption with
  - Populations aging
  - Limited government borrowing
  - No lump-sum taxation
- U.S. system relies heavily on taxing workers' incomes
- Is there a better system?

Is There a Better System?

- One system being advocated:
  - Savings-for-retirement system
  - Lower distortionary taxes
- Argument against: some existing cohorts lose
- Argument for: this paper

This Paper

- What's new?
  - Productive capital stock larger
  - Capital tax policy more detailed
- Otherwise, standard OLG framework

Productive Capital

- Typical estimates are $\approx$ 3 GNPs:
  - Private fixed assets (2.2 GNPs)
  - Public fixed assets (0.6 GNPs)
  - Consumer durables (0.3 GNPs)
- But, other stocks help finance retirement:
  - Inventories (0.13 GNPs)
  - Land (0.89 GNPs)
  - Intangible capital (1.7 GNPs)

$\Rightarrow$ about 5.8 GNPs <u>currently</u> available

Business Tangible vs. Intangible Investment

- Our estimates found indirectly via national accounts, taxes
- Corrado, Hulten, Sichel use estimates on investments:
  - Computerized information (e.g., software)
  - Innovative property (e.g., R&D)
  - Economic competencies (e.g., brands, org. capital)
- Main findings for 2000–2003:
  - Tangibles included in GDP ≈ 0.085 GDPs
  - Intangibles included in GDP ≈ 0.024 GDPs
  - Intangibles not included in GDP ≈ 0.093 GDPs

Capital Tax Policy

- Typical analyses have only 1 tax on profits
- But, important to distinguish
  - Profits vs. distributions
  - Schedule C corporations vs. other business

$\Rightarrow$ tax reform affects capital stocks and prices

Preview of Main Findings

- Balanced growth comparison of
  - Continuation of current US policy
  - Elimination of FICA, Medicare, SS, Capital Taxes

    $\Rightarrow$ 18% welfare gain, 86% increase in net worth

  - Additional reforms to flatten and broaden taxes

    $\Rightarrow$ 25% welfare gain, 114% increase in net worth

- Taking into account transitions, all cohorts gain

Previous literature

- Underestimates welfare gains of future cohorts

- Exaggerates difficulty in finding Pareto improvements

Others Who Find Pareto-Improvement

- Needed policies with:
  - Large debt to GDP
    e.g., Birkeland-Prescott find 5 GNPs
  - Nonsmooth capital tax rate paths
    e.g. Conesa-Garriga find oscillatory rates in $[-60\%, 60\%]$
- We restrict debt/GDP, smoothly phase in new policies

Outline

- Theory
- US national accounts and fixed assets
- Model national accounts and fixed assets
- Balanced growth comparisons
- Devising a Pareto-improving transition

Theory

Model Economy

- Discrete time, $t = 0, 1, \ldots$
- Households in OLG structure, ages $j = 1, \ldots, J$
- Businesses of two types:
  - Schedule C corporations (Sector 1)
  - All other business (Sector 2)
- Government summarized by fiscal policies

Age-j Household Problem

- Choose assets a', consumption c, labor ℓ:

$$v_j(a,s) = \max_{a',c,\ell} \{u(c,\ell) + \beta\,\sigma_t^j v_{j+1}(a',s')\}$$

$$\text{s.t.} \quad (1+\tau_t^c)c + \sigma_t^j a' = (1+i_t)a + (1-\tau_t^\ell)w_t\ell + \psi_t^j$$

$$s' = F(s)$$

taking as given the

- prices $\{i_t, w_t\}$
- tax rates and transfers $\{\tau_t^c, \tau_t^\ell, \psi_t^j\}$
- survival probabilities $\{\sigma_t^j\}$
- evolution of the aggregate state s, $F(s)$
- age of retirement J_r, i.e., $\ell_t = 0$ if $j > J_r$

Technology

- Production technologies:
  - $Y_t = Y_{1t}^{\theta_1} Y_{2t}^{\theta_2}$ = composite final good
  - $Y_{it} = K_{iTt}^{\theta_{iT}} K_{iIt}^{\theta_{iI}} (\Omega_t L_{it})^{1-\theta_{iT}-\theta_{iI}}$, $i = 1, 2$
- Evolution of stocks and labor-augmenting technology
  - $K_{iT,t+1} = (1 - \delta_{iT}) K_{iTt} + X_{iTt}$ (Tangible)
  - $K_{iI,t+1} = (1 - \delta_{iI}) K_{iIt} + X_{iIt}$ (Intangible)
  - $\Omega_{t+1} = (1 + \gamma) \Omega_t$

Government Policy

- Public consumption $G_t = \phi_{Gt}$ GNP
- Public debt $B_t \leq \phi_{Bt}$ GNP
- Age-dependent lump-sum transfers $\{\psi_t^j\}$
- Tax rates $\tau = \{\tau_t^c, \tau_t^\ell, \tau_{1t}^d, \tau_{2t}^d, \tau_{1t}^\pi\}$, where
  - c = consumption
  - ℓ = labor (or payroll)
  - d = distribution
  - π = profit

Government Budget Constraints

- Evolution of debt:

$$B_{t+1} = (1 + i_t)B_t + \sum_j n_t^j \psi_t^j + G_t - \tau_t^c C_t$$
$$- \tau_t^\ell w_t L_t - \tau_{1t}^\pi \Pi_{1t} - \sum_i \tau_{it}^d D_{it}$$

  where profits and distributions are

  - $\Pi_{1t} = p_{1t} Y_{1t} - w_t L_{1t} - \delta_{1T} K_{1Tt} - X_{1It}$
  - $D_{1t} = (1 - \tau_{1t}^\pi)\Pi_{1t} - K_{1T,t+1} + K_{1Tt}$
  - $D_{2t} = \Pi_{2t} = p_{2t} Y_{2t} - w_t L_{2t} - \delta_{2T} K_{2Tt} - X_{2It}$

Equilibrium Conditions

- Labor, capital, and goods markets clear at each date
- Household policy functions $\{a' = f_j(s)\}_j$ imply $s' = F(s)$.
- Which implies:
  - Aggregate output: $Y = C + \sum_i (X_{iT} + X_{iI}) + G$
  - Aggregate assets: $A' = \sum_i V_i + B'$, or:

$$A' = \underbrace{(1-\tau_1^d)(K'_{1T} + (1-\tau_1^\pi)K'_{1I})}_{V_1} + \underbrace{K'_{2T} + (1-\tau_2^d)K'_{2I}}_{V_2} + B'$$

Strategy for Quantitative Assessment

Steps Taken

1.

2.

3.

   a.

   b.

   c.

4.

5.

Steps Taken

1. Revise NIPA accounts to be consistent with theory
2.
3.
    a.
    b.
    c.
4.
5.

Steps Taken

1. Revise NIPA accounts to be consistent with theory
2. Choose parameters so accounts of model economy match
3.
    a.
    b.
    c.
4.
5.

Steps Taken

1. Revise NIPA accounts to be consistent with theory

2. Choose parameters so accounts of model economy match

3. Compute balanced growth paths for:

    a.

    b.

    c.

4.

5.

Steps Taken

1. Revise NIPA accounts to be consistent with theory

2. Choose parameters so accounts of model economy match

3. Compute balanced growth paths for:

    a. Current US policy/demographics
    b. Continuing US policy with new demographics
    c. Alternative plans with new demographics

4.

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3. Compute balanced growth paths for:

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    c. Alternative plans with new demographics

4. Compute transition from (a) to (b) and (a) to (c)

5.

Steps Taken

1. Revise NIPA accounts to be consistent with theory

2. Choose parameters so accounts of model economy match

3. Compute balanced growth paths for:

    a. Current US policy/demographics
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4. Compute transition from (a) to (b) and (a) to (c)

5. Compare results to standard 1-sector, 1-capital economy

US NIPA and Factor Inputs

Total Adjusted Income, Avg 2000–2010

Labor Income (wL)	.585
Compensation of employees	.531
70% of proprietors' income	.053
Capital Income ($Y - wL - X_I$)	.415
Corporate profits	.073
30% of proprietors' income	.023
Rental income	.017
Surplus on govt enterprises	.000
Net income, rest of world	.007
Indirect business taxes	.072
Less: Sales tax	.042
Consumption of fixed capital	.117
Consumer durable depreciation	.060
Statistical discrepancy	−.004
Imputed capital services	.037

Total Adjusted Income, Avg 2000–2010

	Labor Income (wL)	.585
	Compensation of employees	.531
	70% of proprietors' income	.053
	Capital Income ($Y - wL - X_I$)	.415
	Corporate profits	.073
	30% of proprietors' income	.023
	Rental income	.017
	Surplus on govt enterprises	.000
	Net income, rest of world	.007
	Indirect business taxes	.072
⇒	*Less:* Sales tax	.042
	Consumption of fixed capital	.117
⇒	Consumer durable depreciation	.060
	Statistical discrepancy	−.004
⇒	Imputed capital services	.037

Total Adjusted Product, Avg 2000–2010

Consumption (C)	.743
Personal consumption exp less durables	.574
Less: Imputed sales tax, nondur & services	.035
Govt consumption expenditures, nondefense	.111
Plus: Imputed capital services	.037
Consumer durable depreciation	.060
Tangible Investment (X_T)	.214
Gross private domestic investment	.145
Schedule C corporations (X_{1T})	.069
Other private business	.076
Consumer durable goods	.081
Less: Imputed sales tax, durables	.005
Govt gross investment, nondefense	.025
Net exports of goods and services	−.042
Net income, rest of world	.007
Defense spending (G)	.044

Factor Inputs, Avg 2000–2010

Labor Input (L)	.277
Capital Stock (K')	5.835
Tangible capital (K'_T)	4.117
Private fixed assets	2.193
Public fixed assets	.602
Consumer durables	.304
Inventories	.134
Land	.885
Intangible capital (K'_I)	1.718

Note: IRS returns used to estimate $K'_{1T} = .885$, $K'_{2T} = 3.232$

Model Parameterization Consistent with US Data

Growth and Demographic Parameters

- Technology growth: 2%
- Population growth: 1%
- Survival probabilities: 2010 Life tables
- Number of workers per retiree: 3.4

  $\Rightarrow$ work life of 43 years

Preference and Technology Parameters

- Preference parameters $u(c, \ell) = \log c + \alpha \log(1 - \ell)$
  - Disutility of leisure $\alpha = 1.1$
  - Discount factor $\beta = .987$
- Technology Parameters
  - Tangible capital shares: $\theta_{1T} = .19$, $\theta_{2T} = .5$
  - Tangible depreciation rates: $\delta_{1T} = .05$, $\delta_{2T} = .015$

$\Rightarrow$ chosen to match L, wL, K_{iT}, X_{iT}, $i = 1, 2$

Preference and Technology Parameters

- Somewhat arbitrarily chosen are:
  - Schedule C income share $\theta_1 = .5$
  - Intangible shares and depreciation rates $\rightarrow K_I' = 1.72$
- But sensitivity analysis shows results are robust

Policy Parameters

- Spending and debt shares based on NIPA/FOF
  - Defense spending $\phi_G = 0.044$
  - Government debt $\phi_B = 0.533$
- % Tax rates based on IRS/NIPA
  - Profits, sector 1, $\tau_1^\pi = 33$
  - Distributions, sector 1, $\tau_1^d = 14.4$
  - Distributions, sector 2, $\tau_2^d = 38.2$
  - Labor $\tau^\ell = 38.2$
  - Consumption $\tau^c = 10$
- Transfer-GNP ratio = 36.9% (more on this later)

Equilibrium Outcomes

Government Revenues and Deficit, 2000–2010

		%GNP
$\tau^{\ell} wL$	= Labor taxes	22.3
$\tau_1^{\pi} \Pi_1$	= Schedule C profits taxes	2.6
$\tau_1^{d} D_1$	= Schedule C distribution taxes	0.4
$\tau_2^{d} D_2$	= Other distribution taxes	9.4
$\tau^{c} C$	= Consumption taxes (residual)	7.5
$B' - B$	= Deficit	1.6
		43.8

Government Expenditures, 2000–2010

		%GNP
G	= Defense spending	4.4
iB	= Interest on debt	2.5
Ψ	= Transfers	36.9
	= Medicare+Social Security	6.6
	+ Other transfers & nondefense	19.6
	+ *Implicit transfers* not in NIPA	10.7
		43.8

Government Expenditures, 2000–2010

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	$\nearrow$	43.8

Equal to revenues if all income taxed at marginal rates

Sources of Implicit Transfers

- Untaxed income (e.g., fringe benefits)
- Marginal rates exceed average rates

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- Marginal rates exceed average rates
- Example 1: fringe f is deducted from wages

$$\text{Model income} = \underbrace{(1-\tau^{\ell})wL}_{\text{Wages after tax}} + \underbrace{\tau^{\ell} f}_{\text{Implicit transfers}}$$

Sources of Implicit Transfers

- Untaxed income (e.g., fringe benefits)
- Marginal rates exceed average rates
- Example 2: $\tau^{\text{marg}} > \tau^{\text{avg}}$

$$\text{Model income} = \underbrace{(1-\tau^{\text{marg}})wL}_{\text{Wages after tax}} + \underbrace{(\tau^{\text{marg}}-\tau^{\text{avg}})wL}_{\text{Implicit transfers}}$$

Accounts and Factor Inputs Aligned

Accounts and Factor Inputs, Avg 2000–2010

	Model	Data
Total Income ($Y - X_I$)	1.000	1.000
Labor Income (wL)	.585	.585
Capital Income ($Y - wL - X_I$)	.415	.415
Total Product ($C + G + X_T$)	1.000	1.000
Consumption (C)	.745	.745
Tangible investment (X_T)	.211	.211
C-corporations (X_{1T})	.069	.069
Other business (X_{2T})	.142	.142
Defense spending (G)	.044	.044
Labor Input (L)	.277	.277
Capital Stock (K')	5.835	5.835
Tangible capital (K'_T)	4.117	4.117
C-corporations (K'_{1T})	.885	.885
Other business (K'_{2T})	3.232	3.232
Intangible capital (K'_I)	1.718	1.718

Comparison of Balanced Growth Paths

Changing Demographics

- Current demographics
  - 1% population growth
  - 3.4 workers per retiree
- New demographics
  - 1% to 0% population growth in 50 years
  - 2 workers per retiree on new balanced growth path

Changing Policy

- Start with current US policy and demographics
- Then, continuation of policy with new demographics
- Then, alternative saving-for-retirement policies:
  - FICA taxes and old-age transfers eliminated
  - Capital taxes eliminated
  - Implicit transfers eliminated

Tax Rates and Transfers

		Future Policy & New Demographics			
			Eliminate FICA Taxes and		
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Tax rates					
C Profits	33				
C Dist	14				
Other Dist	38				
Labor	38				
Consumption	10				
Transfers/GNP	37				

Tax Rates and Transfers

		Future Policy & New Demographics			
			Eliminate FICA Taxes and		
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Tax rates					
C Profits	33	33			
C Dist	14	14			
Other Dist	38	38			
Labor	38	38			
Consumption	10	14			
Transfers/GNP	37	40			

Tax Rates and Transfers

		Future Policy & New Demographics		
			Eliminate FICA Taxes and	
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Tax rates				
C Profits	33	33	33	
C Dist	14	14	14	
Other Dist	38	38	38	
Labor	38	38	28	
Consumption	10	14	10	
Transfers/GNP	37	40	30	

Tax Rates and Transfers

		Future Policy & New Demographics			
			Eliminate FICA Taxes and		
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Tax rates					
C Profits	33	33	33	0	
C Dist	14	14	14	0	
Other Dist	38	38	38	0	
Labor	38	38	28	28	
Consumption	10	14	10	28	
Transfers/GNP	37	40	30	30	

Tax Rates and Transfers

		Future Policy & New Demographics			
			Eliminate FICA Taxes and		
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Tax rates					
C Profits	33	33	33	0	0
C Dist	14	14	14	0	0
Other Dist	38	38	38	0	0
Labor	38	38	28	28	16
Consumption	10	14	10	28	23
Transfers/GNP	37	40	30	30	20

Balanced Growth Aggregate Statistics

		Future Policy & New Demographics			
			Eliminate FICA Taxes and		
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Capital/GNP					
Tangible	4.1				
Intangible	1.7				
GNP	1.0				
Labor input	1.0				
Net worth	1.0				
Welfare (%)	5				

Balanced Growth Aggregate Statistics

		Future Policy & New Demographics			
			Eliminate FICA Taxes and		
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Capital/GNP					
Tangible	4.1	4.3			
Intangible	1.7	1.8			
GNP	1.0	.96			
Labor input	1.0	.91			
Net worth	1.0	1.0			
Welfare (%)	5	0			

Balanced Growth Aggregate Statistics

		Future Policy & New Demographics			
			Eliminate FICA Taxes and		
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Capital/GNP					
Tangible	4.1	4.3	4.6		
Intangible	1.7	1.8	1.8		
GNP	1.0	.96	1.1		
Labor input	1.0	.91	1.0		
Net worth	1.0	1.0	1.2		
Welfare (%)	5	0	15		

Balanced Growth Aggregate Statistics

		Future Policy & New Demographics		
			Eliminate FICA Taxes and	
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Capital/GNP				
Tangible	4.1	4.3	4.6	5.9
Intangible	1.7	1.8	1.8	1.7
GNP	1.0	.96	1.1	1.3
Labor input	1.0	.91	1.0	.98
Net worth	1.0	1.0	1.2	1.9
Welfare (%)	5	0	15	18

Balanced Growth Aggregate Statistics

		Future Policy & New Demographics			
			Eliminate FICA Taxes and		
	Current US	Continue US Policy	Medicare & Social Security	+ Cut Capital Taxes	+ Cut Implicit Transfers
Capital/GNP					
Tangible	4.1	4.3	4.6	5.9	6.0
Intangible	1.7	1.8	1.8	1.7	1.7
GNP	1.0	.96	1.1	1.3	1.4
Labor input	1.0	.91	1.0	.98	1.1
Net worth	1.0	1.0	1.2	1.9	2.1
Welfare (%)	5	0	15	18	25

Devising a Pareto-Improving Transition Path

Transitions

- Initial assets from baseline economy
- Hold as constant fraction of GNP:
  - Defense spending (G)
  - Nondefense spending
    - + Transfers other than Medicare, SS (Ψ^{other})
- In steps, consider:

A. Continuing current policy with new demographics
B. Eliminating FICA taxes, Medicare, and SS
C. Policy B plus eliminating capital taxes
D. Policy C plus eliminating implicit transfers

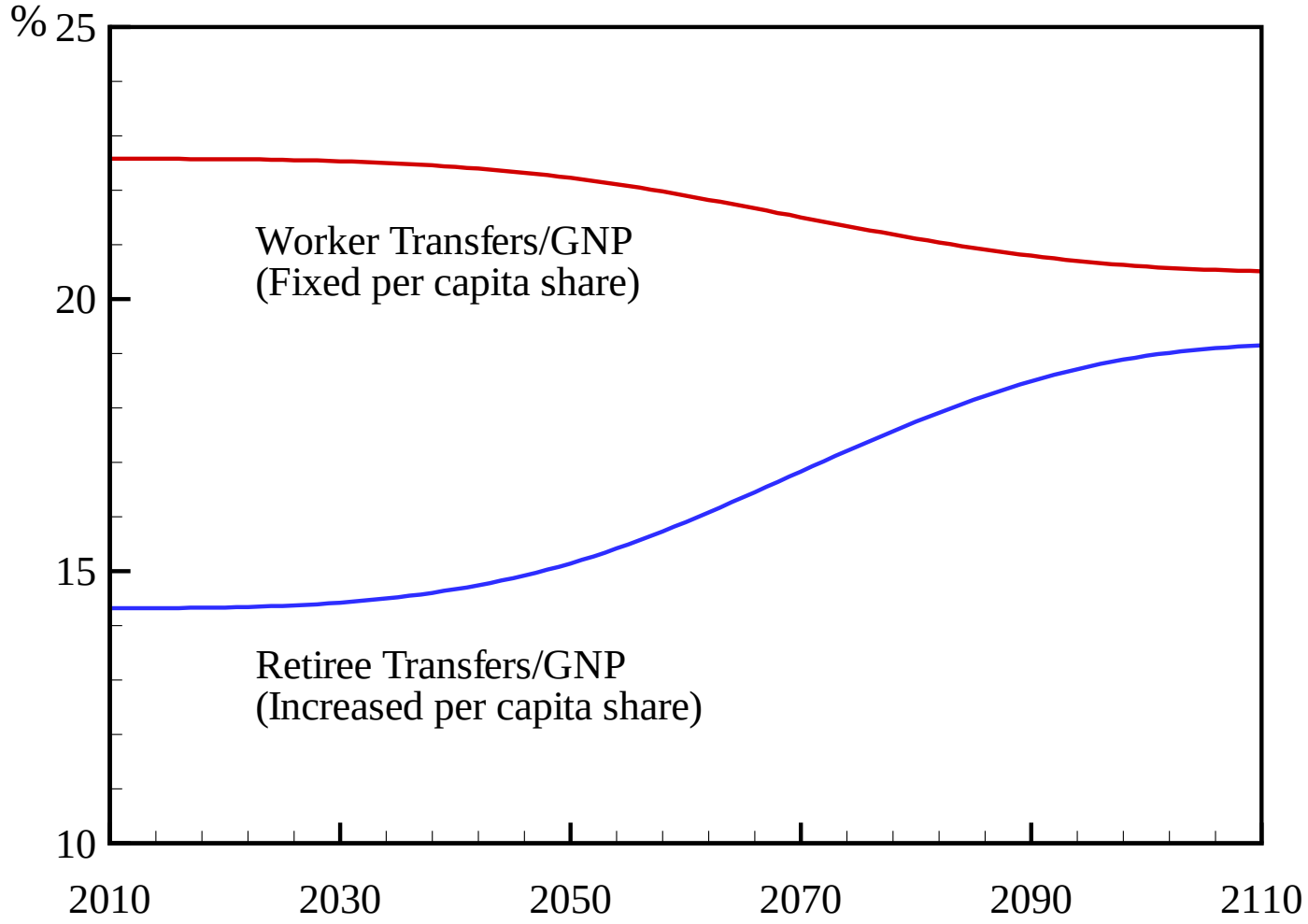
Transitions

Continuing Current US Policy

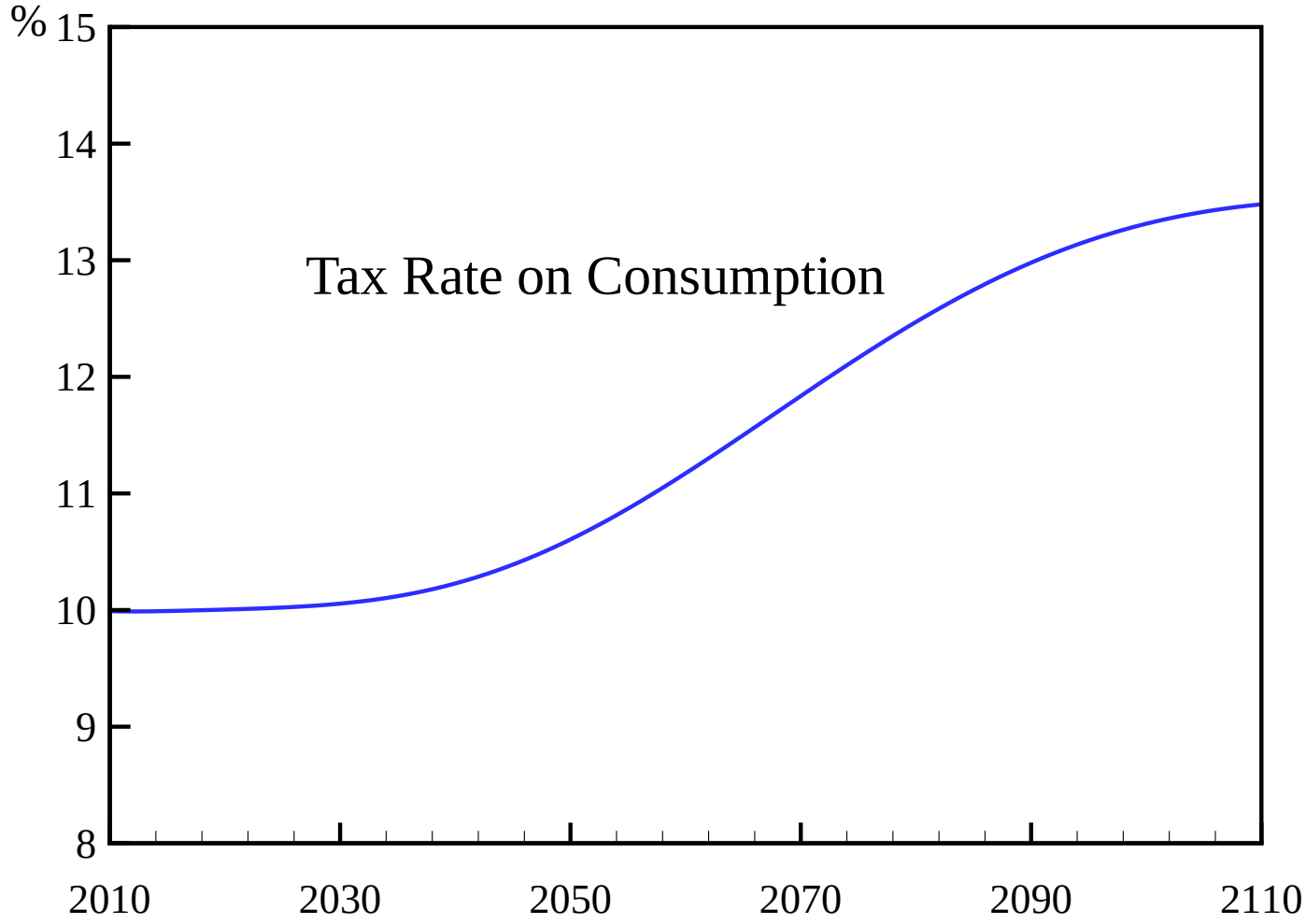
- Increase taxes to finance more retirees
  - Tried τ^{ℓ} first but too distortionary
  - Used τ^{c} instead
- Increase retiree transfers at rate of population growth

Note: We refer to this as the *Baseline*

Paths for Transfers to GNP



Implied Path for Consumption Tax



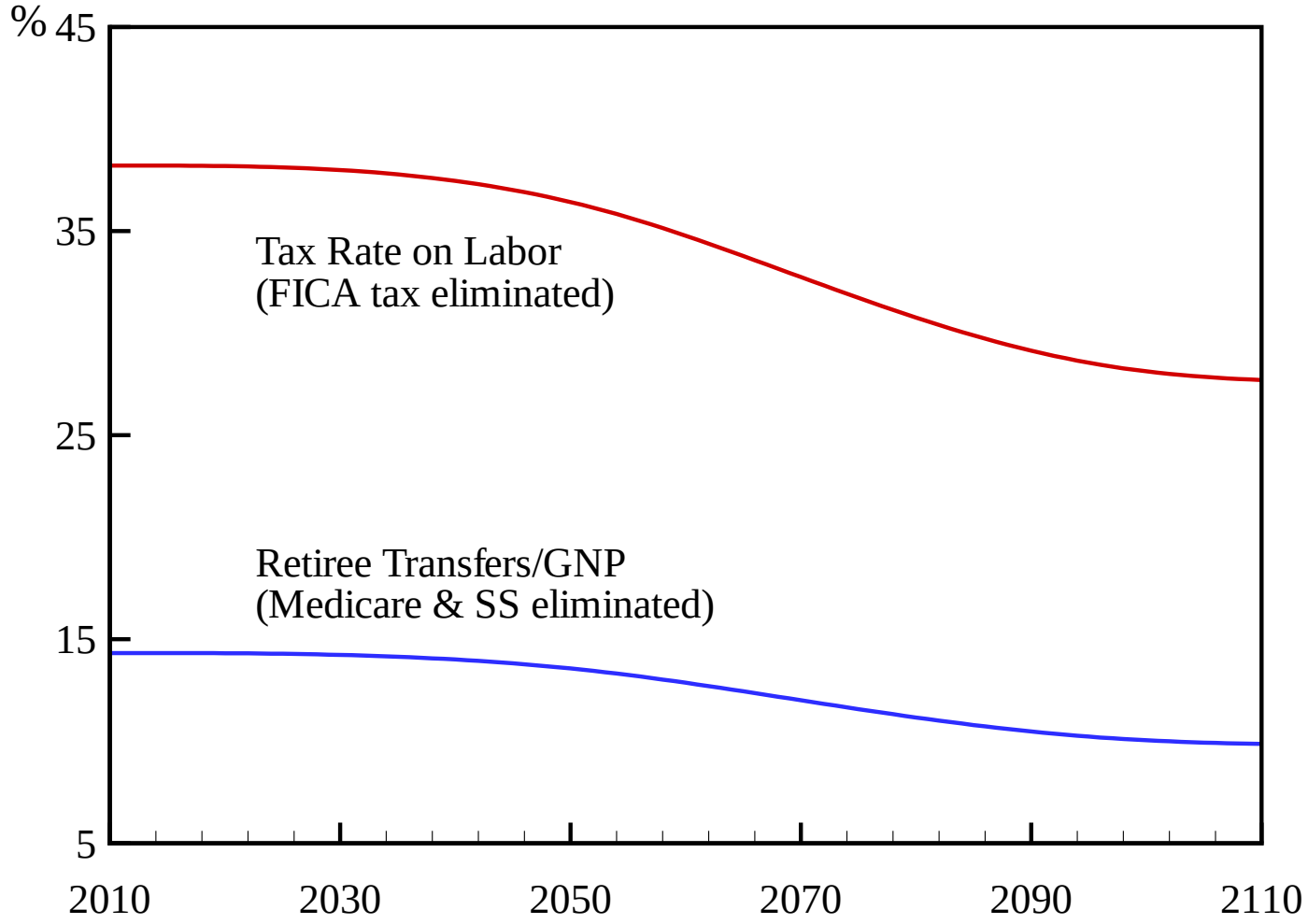
Compare Baseline to Saving-for-Retirement Plans

Eliminate FICA taxes, Medicare, SS

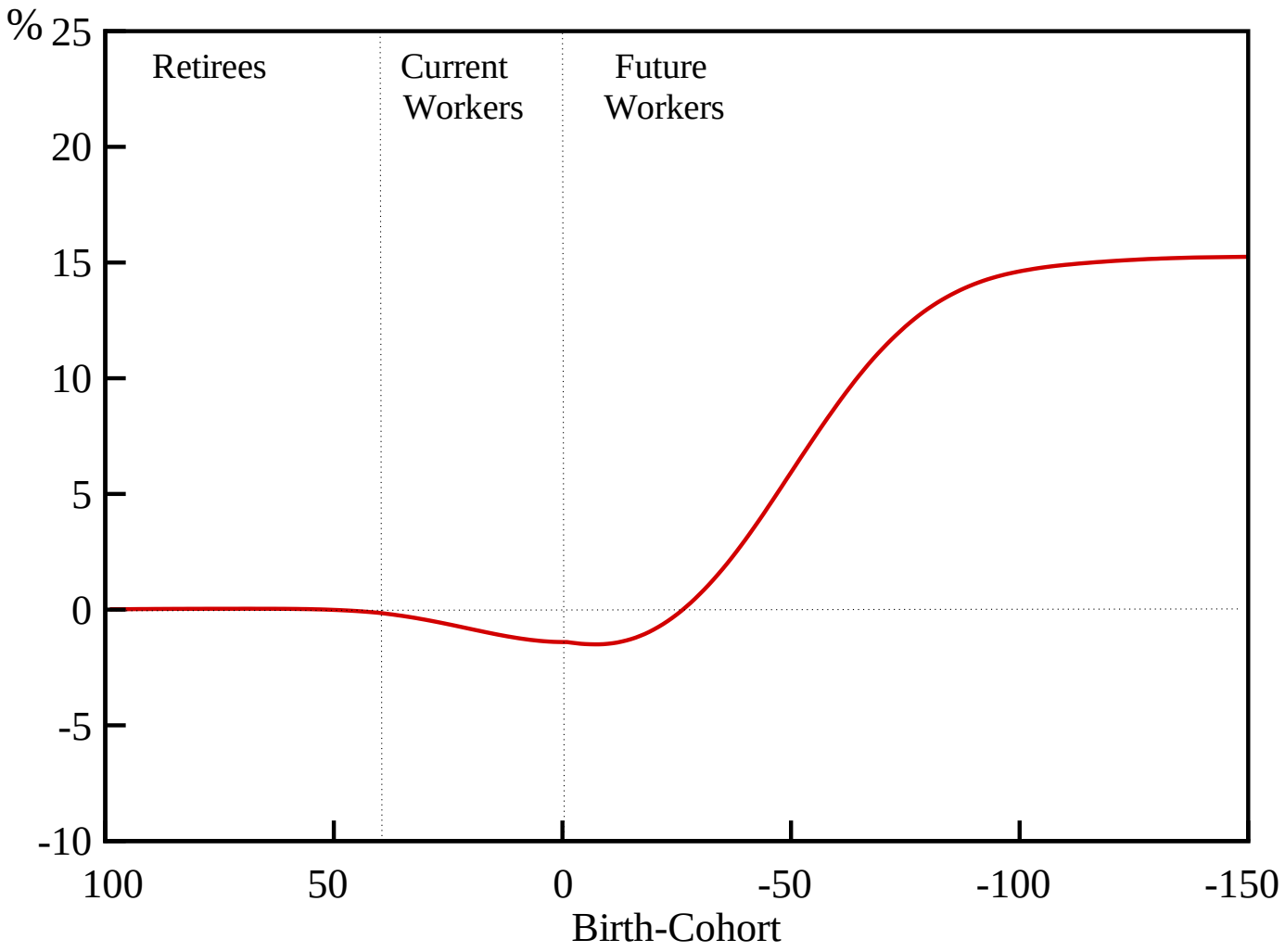
- Do this in steps:

  1. Gradually lower FICA taxes and old-age transfers
     - Result: Workers worse off
     - Intuition: Have high τ^{ℓ}, low old-age transfers

Paths for Tax Rate and Transfers



Welfare Gains/Losses by Birth Cohort



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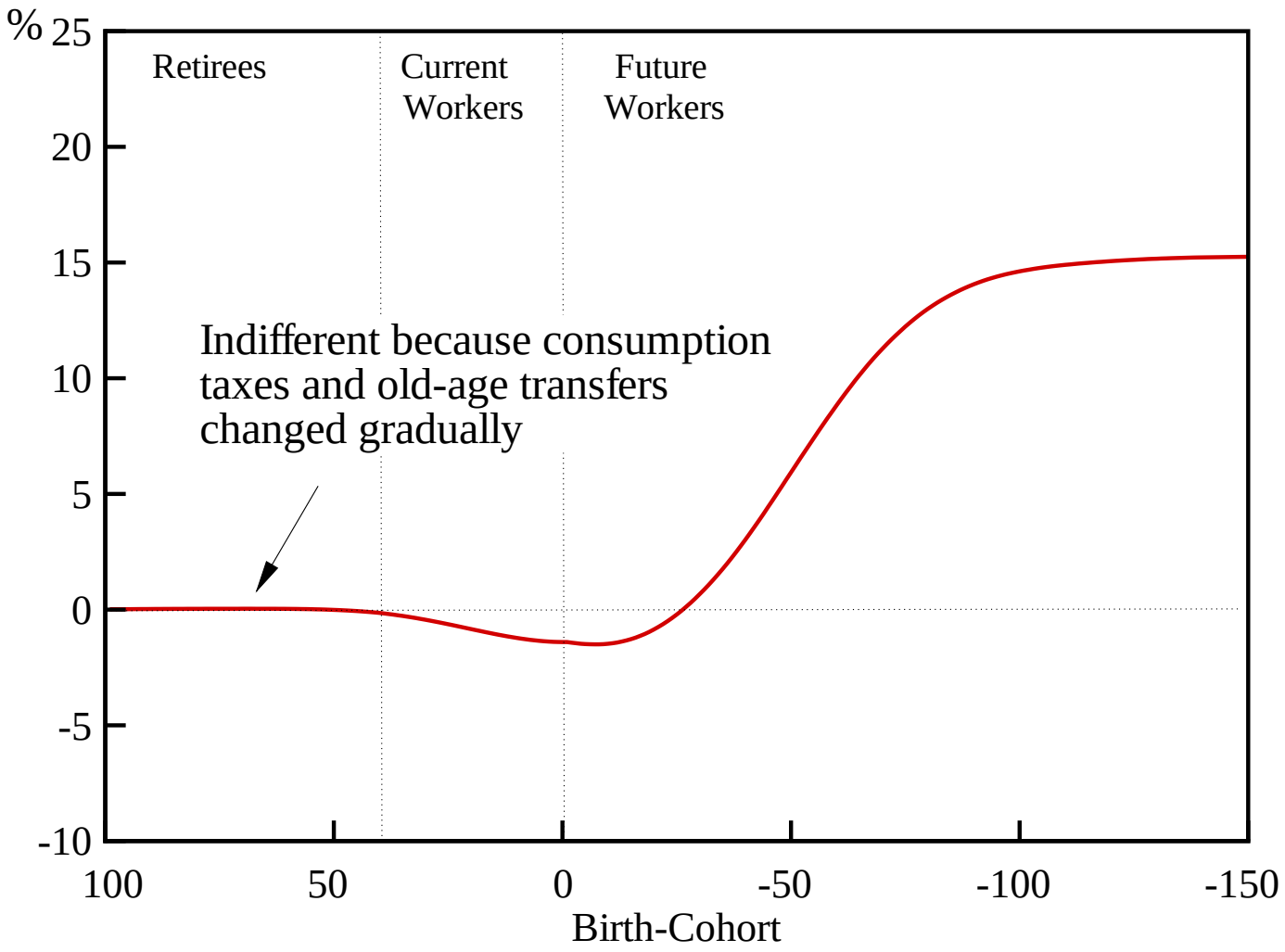

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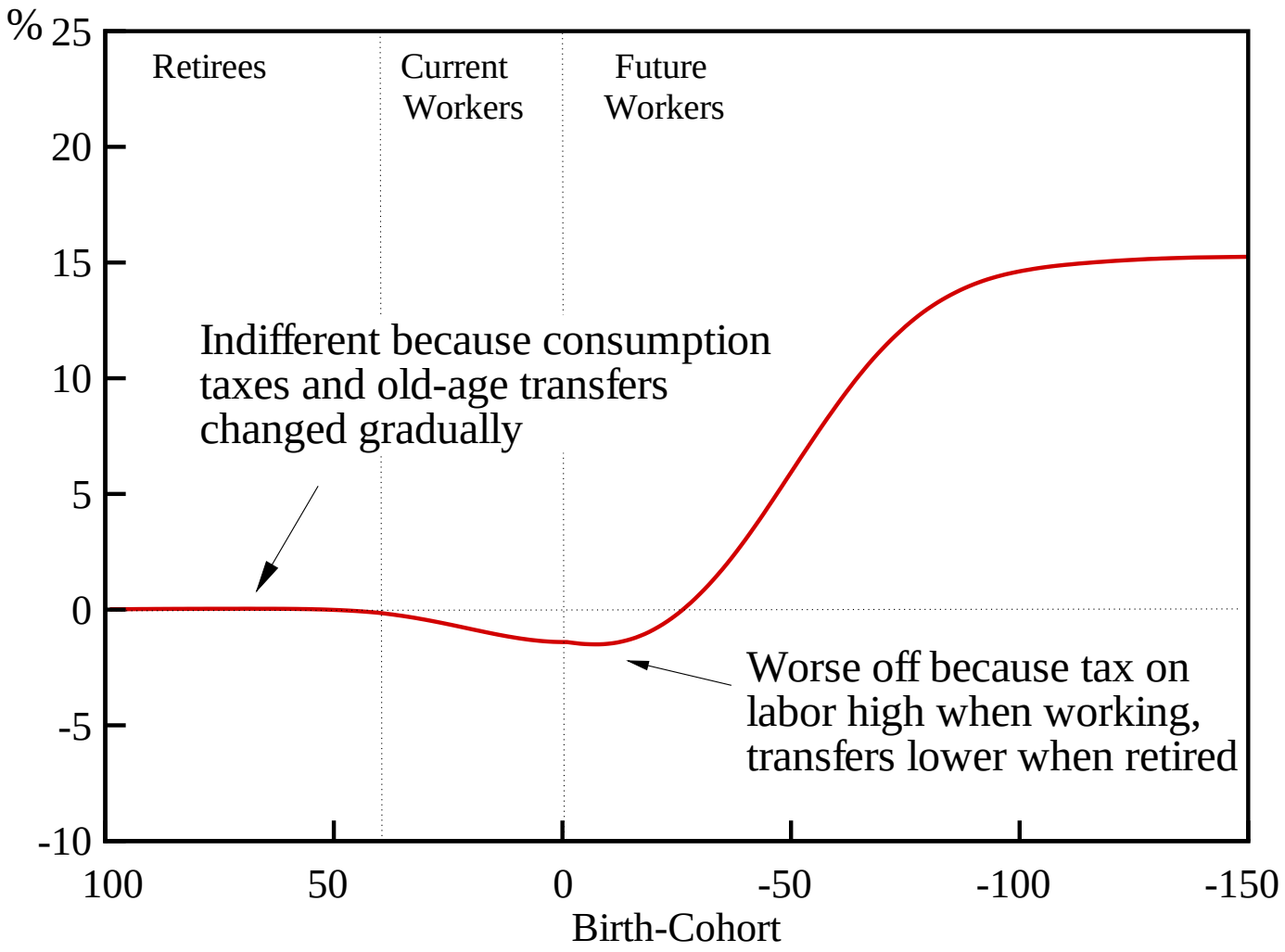
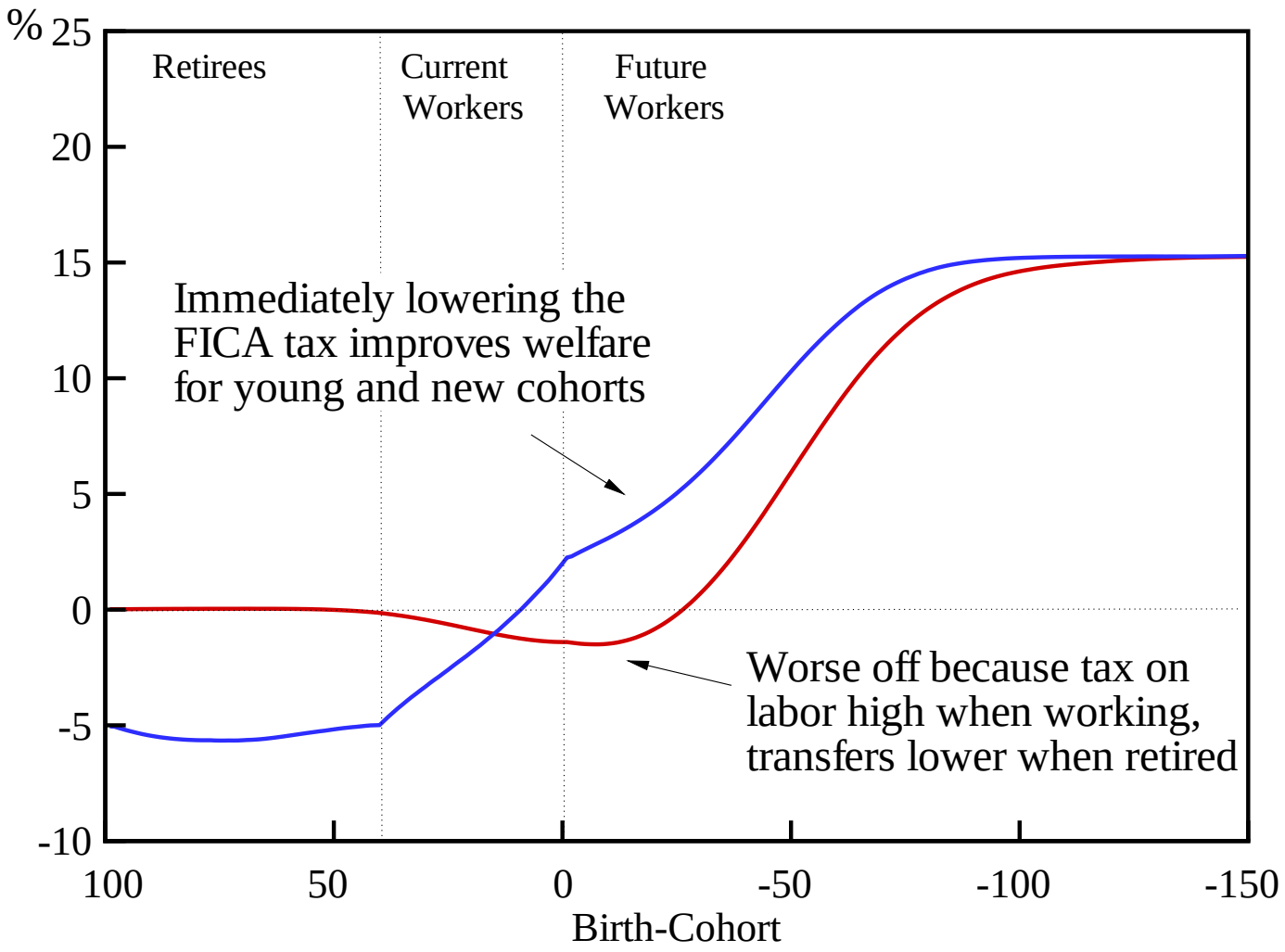


Eliminate FICA taxes, Medicare, SS

- Do this in steps:

  1. Gradually lower FICA taxes and old-age transfers
  2. Immediately lower FICA taxes with same transfers
     - Result: Retirees worse off
     - Intuition: τ^c makes up revenue shortfall

Welfare Gains/Losses by Birth Cohort



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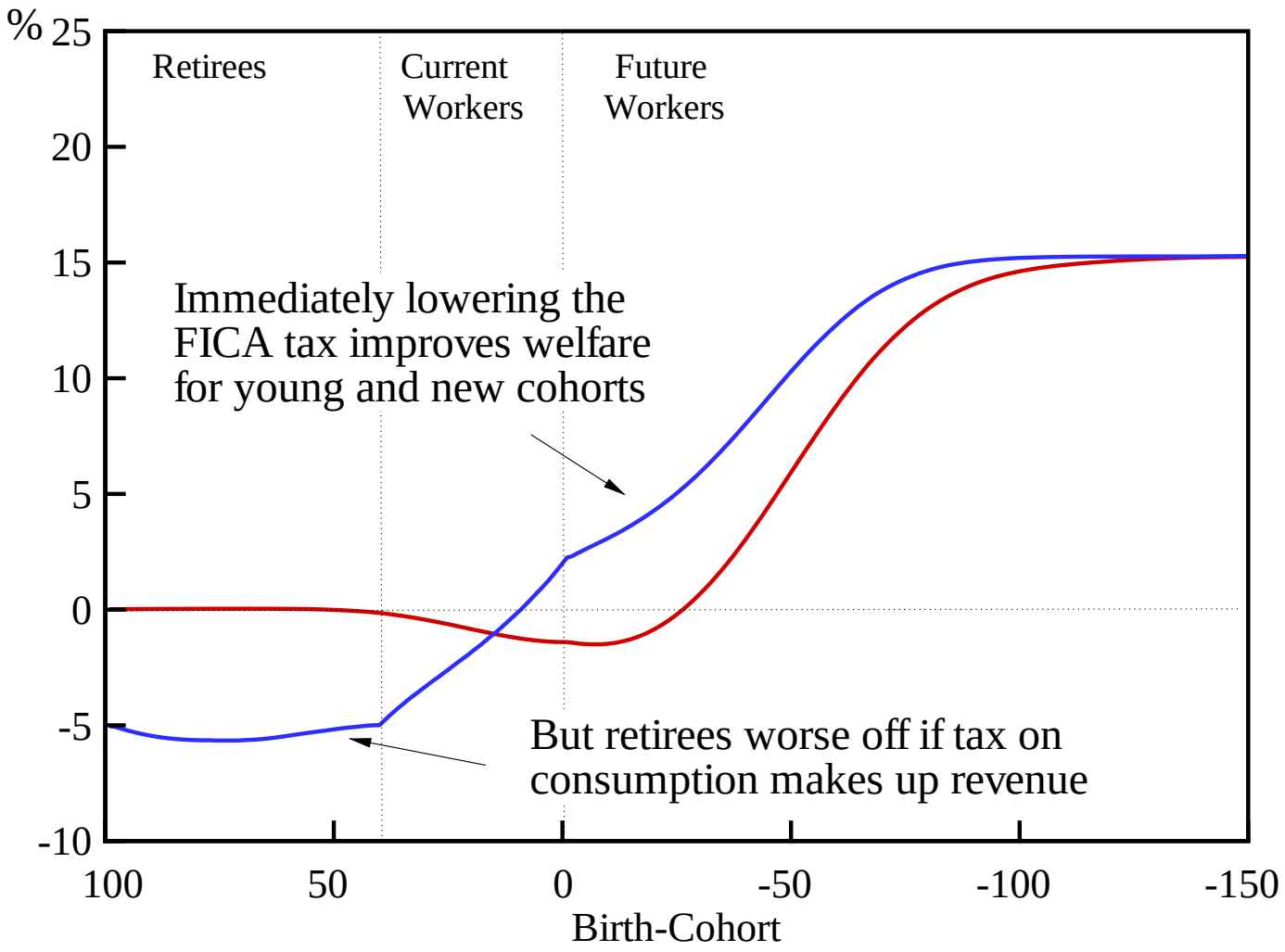
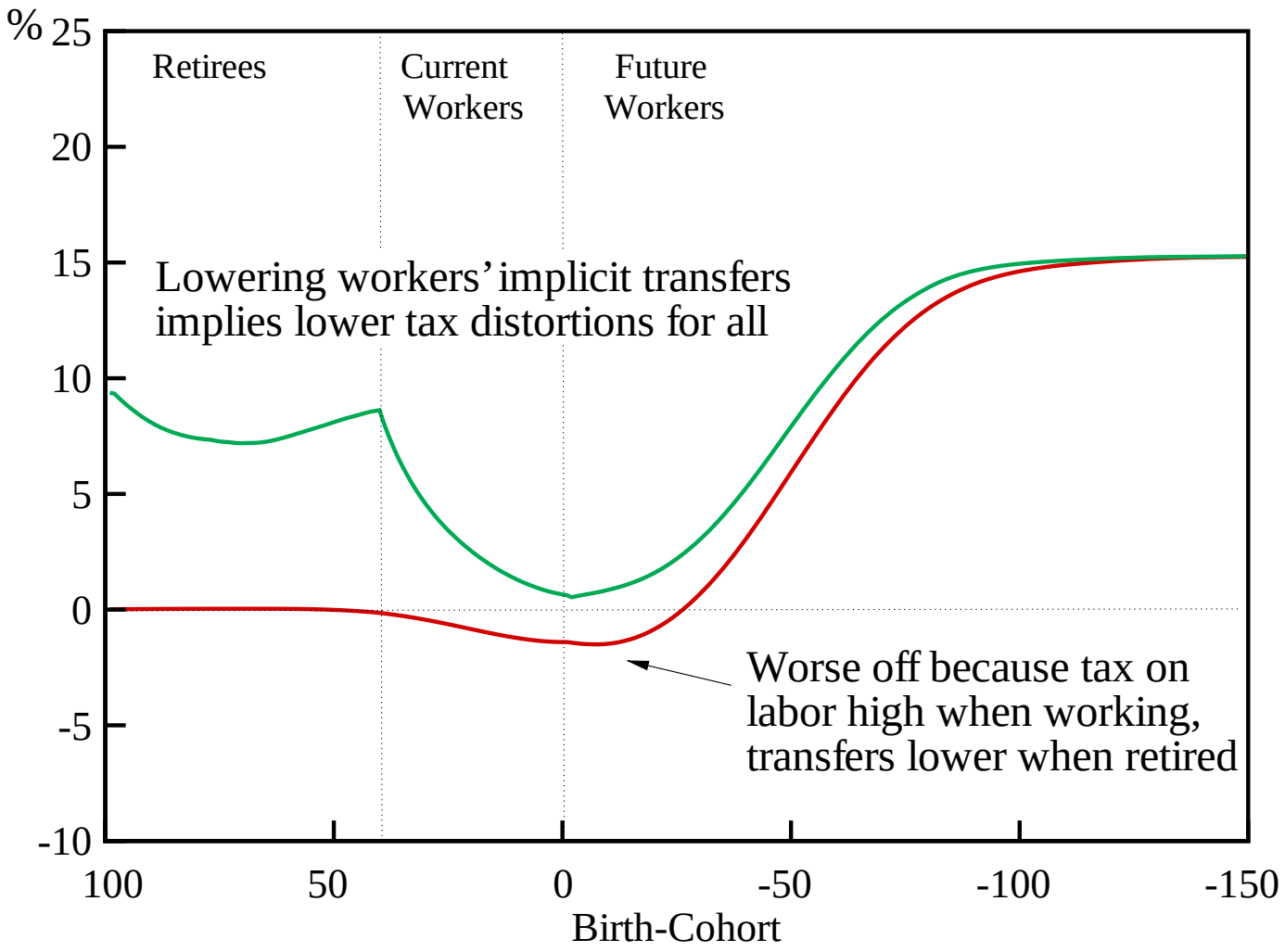


Eliminate FICA taxes, Medicare, SS

- Do this in steps:

  1. Gradually lower FICA taxes and old-age transfers
  2. Immediately lower FICA taxes with same transfers
  3. Temporarily reduce workers' *implicit* transfers
     - Result: Everyone better off
     - Intuition: τ^c, τ^ℓ both low enough

Welfare Gains/Losses by Birth Cohort



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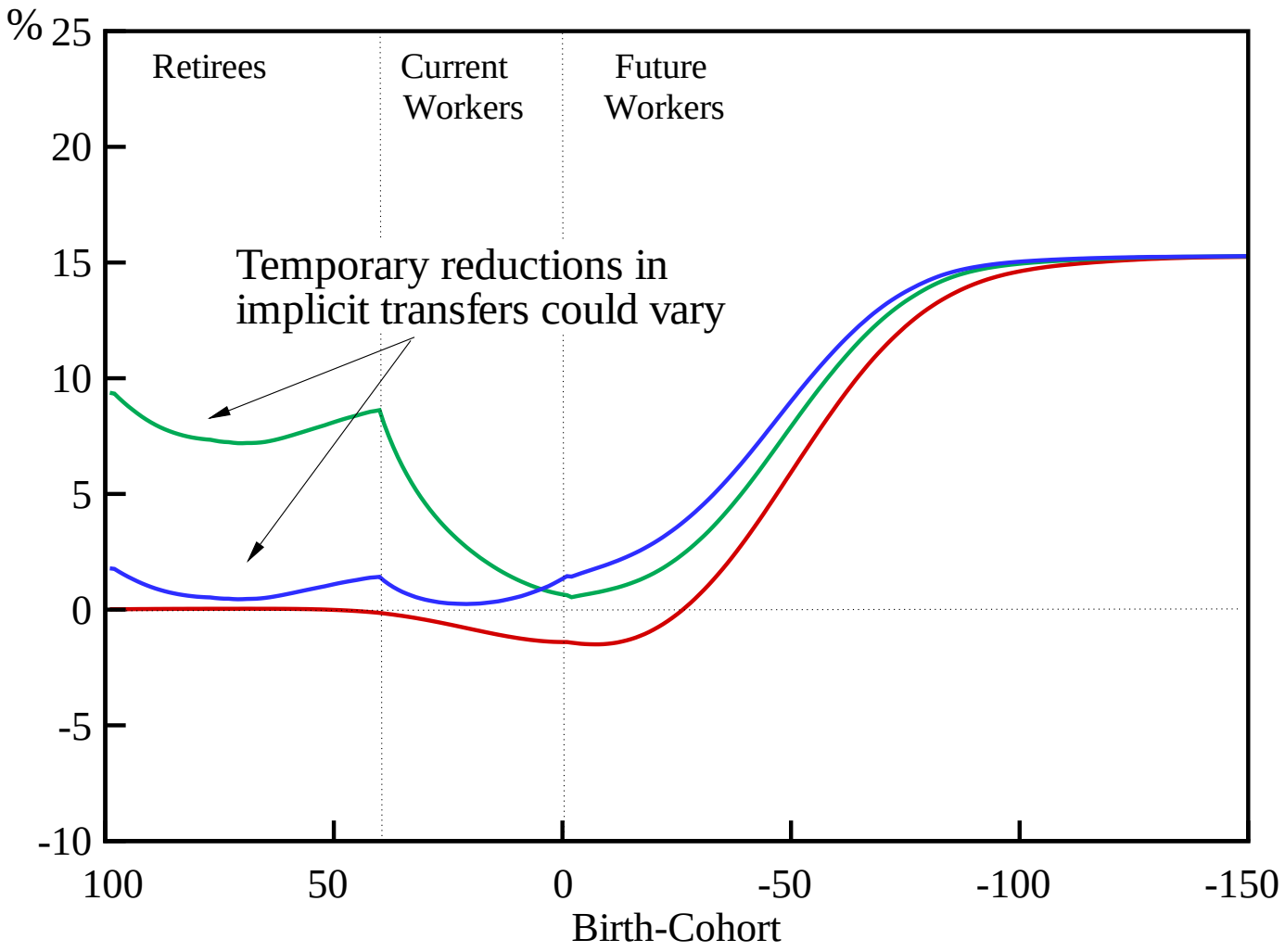

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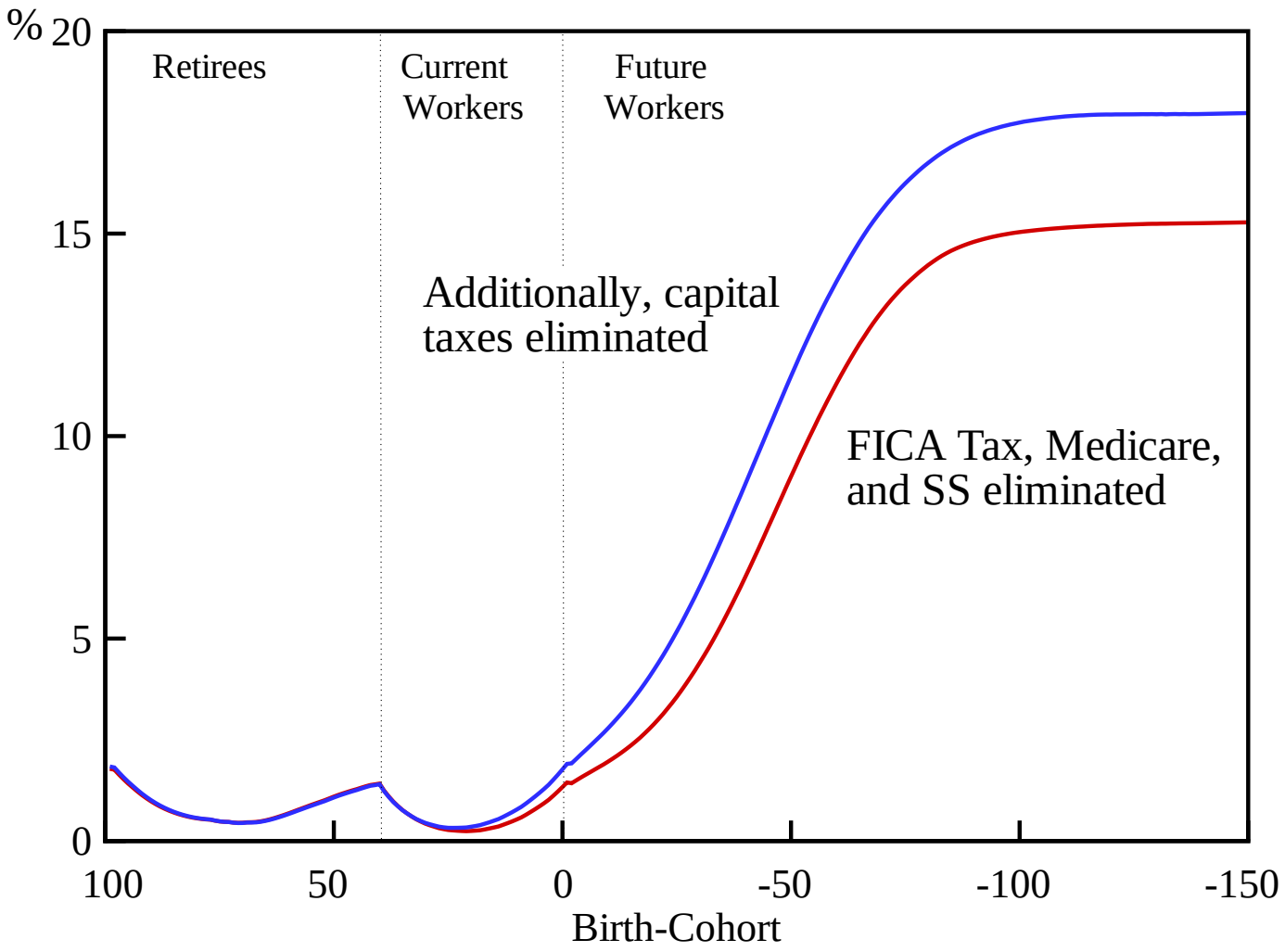
- **Same algorithm works with further reforms**

Capital Tax Reforms

- Eliminating capital taxes:
  - Increases productive capital stocks (K_T, K_I)
  - Increases household net worth $(V_1 + V_2)$
- What happens with gradual elimination?

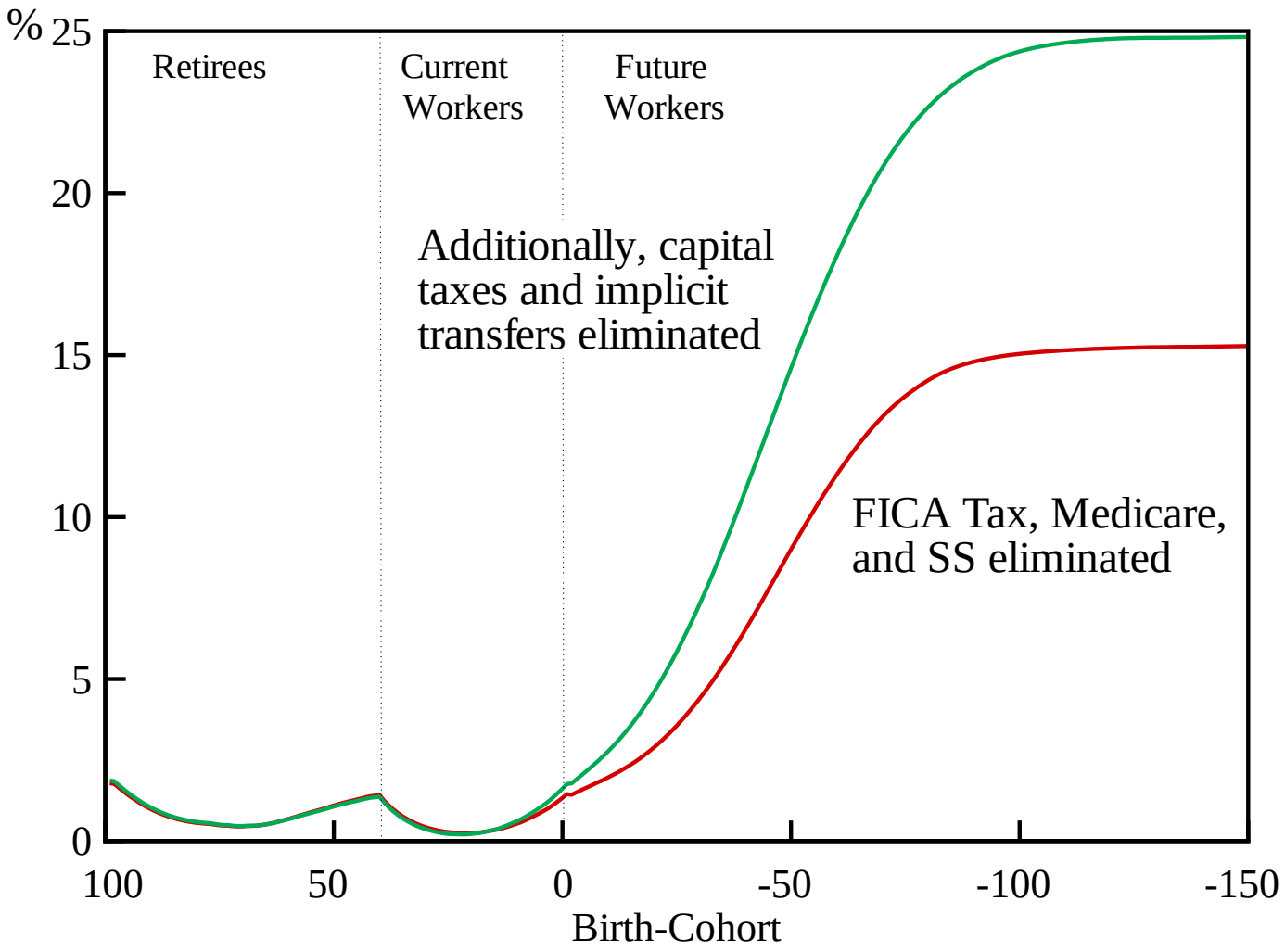
Welfare Gains/Losses by Birth Cohort



Flattening and Broadening

- Flattening: lower marginal rates to average
- Broadening: tax fringe benefits and other untaxed income
- What happens with gradual change in taxes and transfers?

Welfare Gains/Losses by Birth Cohort



Are the results sensitive to...

- Varying age-dependent productivities?
- Including annuity markets?
- Lowering the labor elasticity?
- Assuming final profits taxes are positive?
- Having two sectors, two types of capital?

Are the results sensitive to...

- Varying age-dependent productivities? No
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The "Standard" Analysis

- One production sector ($\theta_1 = 1$)
- One capital stock ($\theta_{1I} = 0$)
- Capital-output ratio of 3 ($\theta_{1T} = 1/3, \beta = .99, \delta = .06$)
- No taxes on distributions ($\tau_1^d = 0$)
- Transfers to retirees as in baseline

Welfare Relative to Current Policy

	Our Model	"Standard" Model
Eliminate FICA, Medicare, SS	15	8
Eliminate capital taxes	18	9
Eliminate implicit transfers	25	13

In *both* models, can find pareto-improving transitions

Welfare Relative to Current Policy

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In *both* models, can find pareto-improving transitions

- Previous analyses have
  - Exaggerated difficulty of finding pareto improvements
  - Underestimated gains of saving-for-retirement systems

Conclusions

- Current policy in face of an aging population:
  - Higher taxes necessary to finance
  - Larger entitlement programs for retirees
- We find welfare improved for all cohorts with
  - FICA and capital taxes eliminated and
  - No entitlement programs for retirees