On Financing Retirement with an Aging Population*

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* Materials available at www.minneapolisfed.org/research

A Looming Question

- How to finance retirement consumption with
  - Populations aging
  - Constraints on government borrowing
  - Restrictions on non-distortionary taxation?
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- Is there a better system?

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- Policy analysts increasingly advocate
  - Savings-for-retirement systems
  - Lower distortionary taxes
- Arguments for/against:
  - For: large welfare gains for future cohorts
  - Against: welfare losses for some existing cohorts

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- Previous analyses abstract from 2 important factors...

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  - Capital tax policy more detailed

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  $\Rightarrow$ more private savings opportunities

Productive Capital Stock Larger

- Typical estimates are ≈ 3 GNPs:
  - Private fixed assets (2.19 GNPs)
  - Public fixed assets (0.60 GNPs)
  - Consumer durables (0.31 GNPs)
- But, other stocks help finance retirement:
  - Inventories (0.13 GNPs)
  - Land (0.93 GNPs)
  - Intangible capital (1.72 GNPs)

⇒ about 5.9 GNPs currently 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 More Detailed

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  - Quantities
  - Prices
- Thus, policy reform yields
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Preview of Main Findings

- Balanced growth comparison of
  - Current policy/New demographics
  - New policy/New demographics

  $\Rightarrow$ 20% welfare gain, 130% increase in HH net worth

- Taking into account transition, *all* cohorts gain

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 out capital taxes

Outline

- Theory
- National Accounts—theory and data—aligned
- Balanced growth comparisons
- Transition to proposed new policy

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.

   d.

4.

5.

Steps Taken

1. Revise NIPA accounts to be consistent with theory
2.
3.
    a.
    b.
    c.
    d.
4.
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2. Choose parameters so accounts of baseline economy match
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2. Choose parameters so accounts of baseline economy match
3. Compute balanced growth paths for 4 economies:
    a.
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    b. New policy/Current demographics
    c. Current policy/New demographics
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4. Compute transition from (a) to (c) and (a) to (d)

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

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

Jump to Results of Steps 1 and 2...
(See Appendix A for Details)

Accounts and Factor Inputs, Avg 2000-2009

	Model	Data
Total Income ($Y - X_I$)	1.000	1.000
Labor Income (wL)	.587	.587
Capital Income ($Y - wL - X_I$)	.413	.413
Total Product ($C + G + X_T$)	1.000	1.000
Consumption (C)	.743	.743
Tangible investment (X_T)	.214	.214
C-corporations (X_{1T})	.070	.070
Other business (X_{2T})	.144	.144
Defense spending (G)	.043	.043
Labor Input (L)	.279	.279
Capital Stock (K')	5.871	5.871
Tangible capital (K'_T)	4.153	4.153
C-corporations (K'_{1T})	.892	.892
Other business (K'_{2T})	3.261	3.261
Intangible capital (K'_I)	1.718	1.718

Policy Parameters for Baseline

- Spending and debt shares based on NIPA/FOF
  - Defense spending $\phi_G = 0.043$
  - Government debt $\phi_B = 0.511$
- Tax rates based on IRS/NIPA
  - Profits, sector 1, $\tau_1^{\pi} = 0.4$
  - Distributions, sector 1, $\tau_1^{d} = 0.2$
  - Distributions, sector 2, $\tau_2^{d} = 0.4$
  - Payroll $\tau^{\ell} = 0.15$
  - Consumption $\tau^{c} = 0.27$
- Transfer ratio based on NIPA, $\psi^r/\psi^w = 1.97$

Comparison of Balanced Growth Paths

Changing Demographics

- Current demographics
  - 1% population growth
  - 3.4 workers per retiree
- New demographics
  - 0% population growth
  - 2 workers per retiree

Changing Policy

- Current policy: taxes and transfers of baseline model
- New policy:
  - Capital and payroll taxes eliminated
  - Transfers for SS and medicare eliminated

Taxes & Transfers in 4 Economies

	Current Demographics		New Demographics	
	Current Policy	New Policy	Current Policy	New Policy
Tax Rates				
Profits (τ_1^π)	.40	0	.40	0
Distributions (τ_1^d)	.20	0	.20	0
Distributions (τ_2^d)	.40	0	.40	0
Payroll (τ^ℓ)	.15	0	.18	0
Consumption (τ^c)	.27	.28	.27	.27
Transfer Ratio (ψ^r/ψ^w)	1.97	1	1.95	1

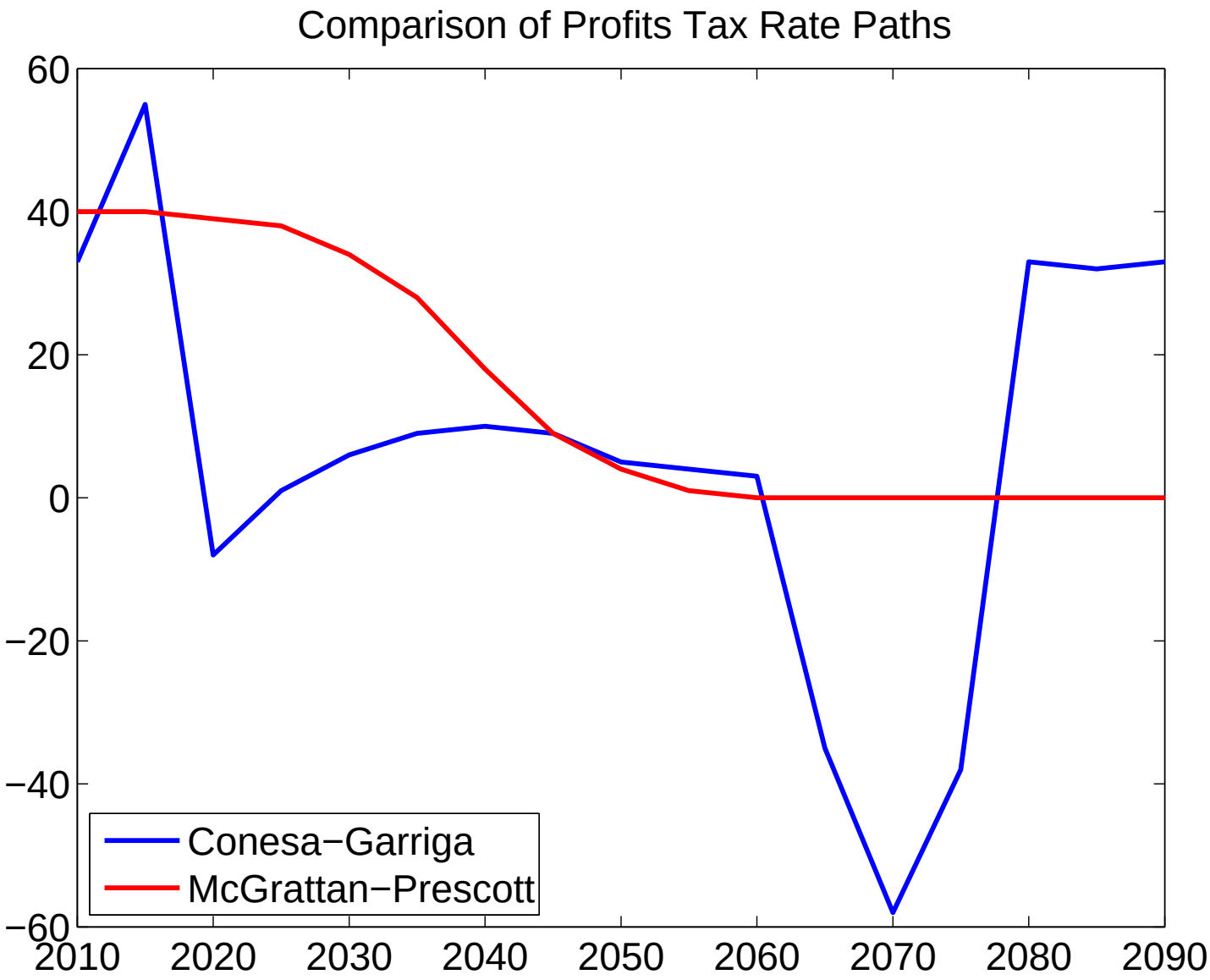
Key Balanced Growth Results

	Current Demographics		New Demographics	
	Current Policy	New Policy	Current Policy	New Policy
Per Capita GNP	.72	1.06	.67	1.01
Govt Transfers/GNP	.37	.13	.40	.14
To retirees	.14	.03	.19	.05
To workers	.23	.10	.21	.09
Labor Input	.28	.33	.25	.30
Capital Stock/GNP	5.9	7.5	5.9	7.7
HH Net Worth/GNP	5.4	8.0	5.4	8.2
Welfare Gain	4%	19%	0%	20%

Transitions

- Initial assets from baseline economy
- Spending and debt shares held constant
- Transfers set with new policies and current allocations
- Payroll and consumption tax rates immediately reset
- Capital tax rates phased out gradually

Comparison of Tax Rate Choices



Transitions

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What are the consequences for the transition and welfare?

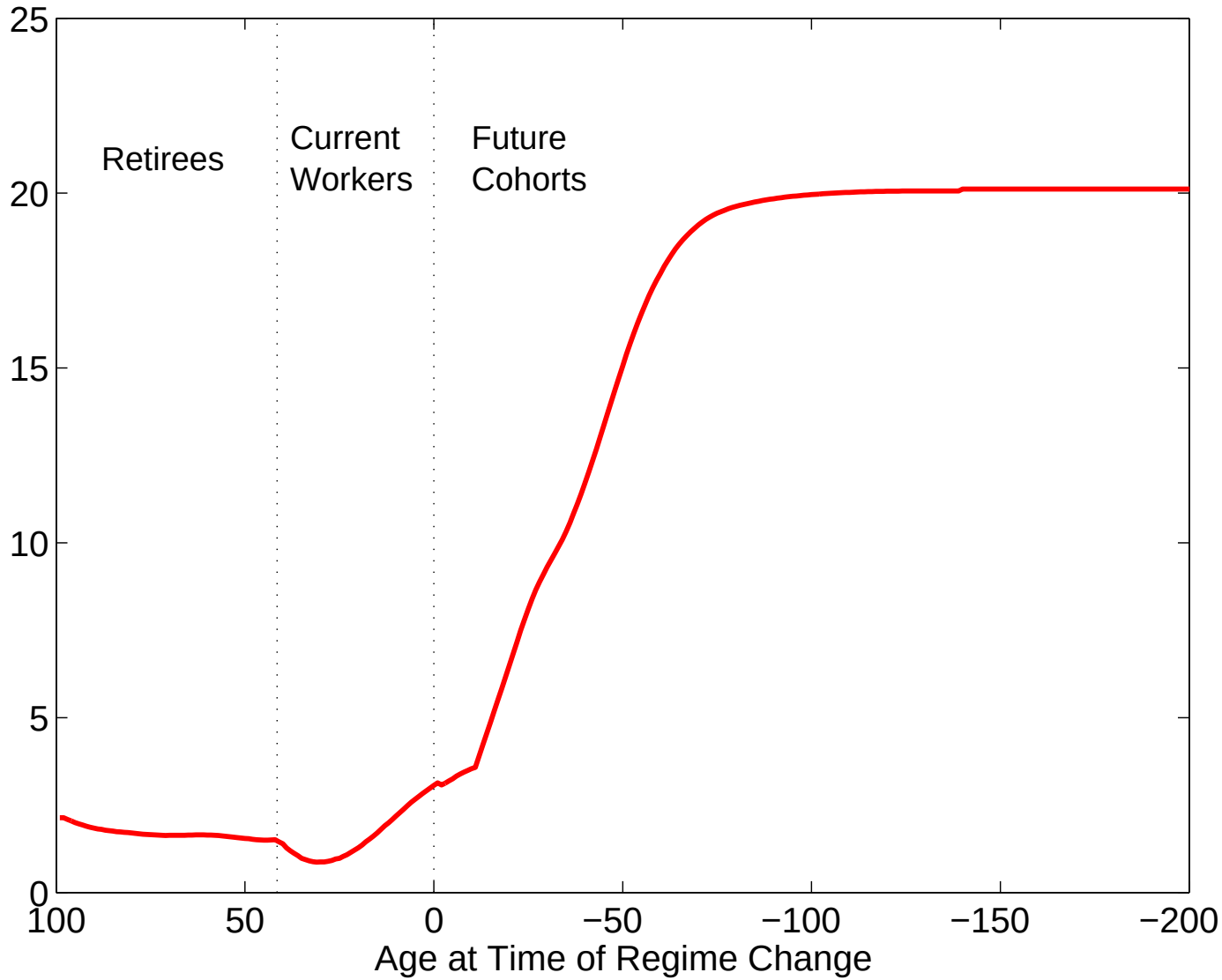
Variables in Transition

- No wild oscillations in interest rates
- Large and steady rise in
  - Workers' wages ($\approx 30\%$)
  - Consumption ($\approx 30\%$)
  - GDP ($\approx 40\%$)
- Immediate rise and doubling of investments (before taxes fall)
- Immediate and modest rise in labor input ($\approx 15\%$)

(See Appendix B for Figures)

Welfare

Figure 1
Percentage Welfare Gain of New Policy by Cohort Age

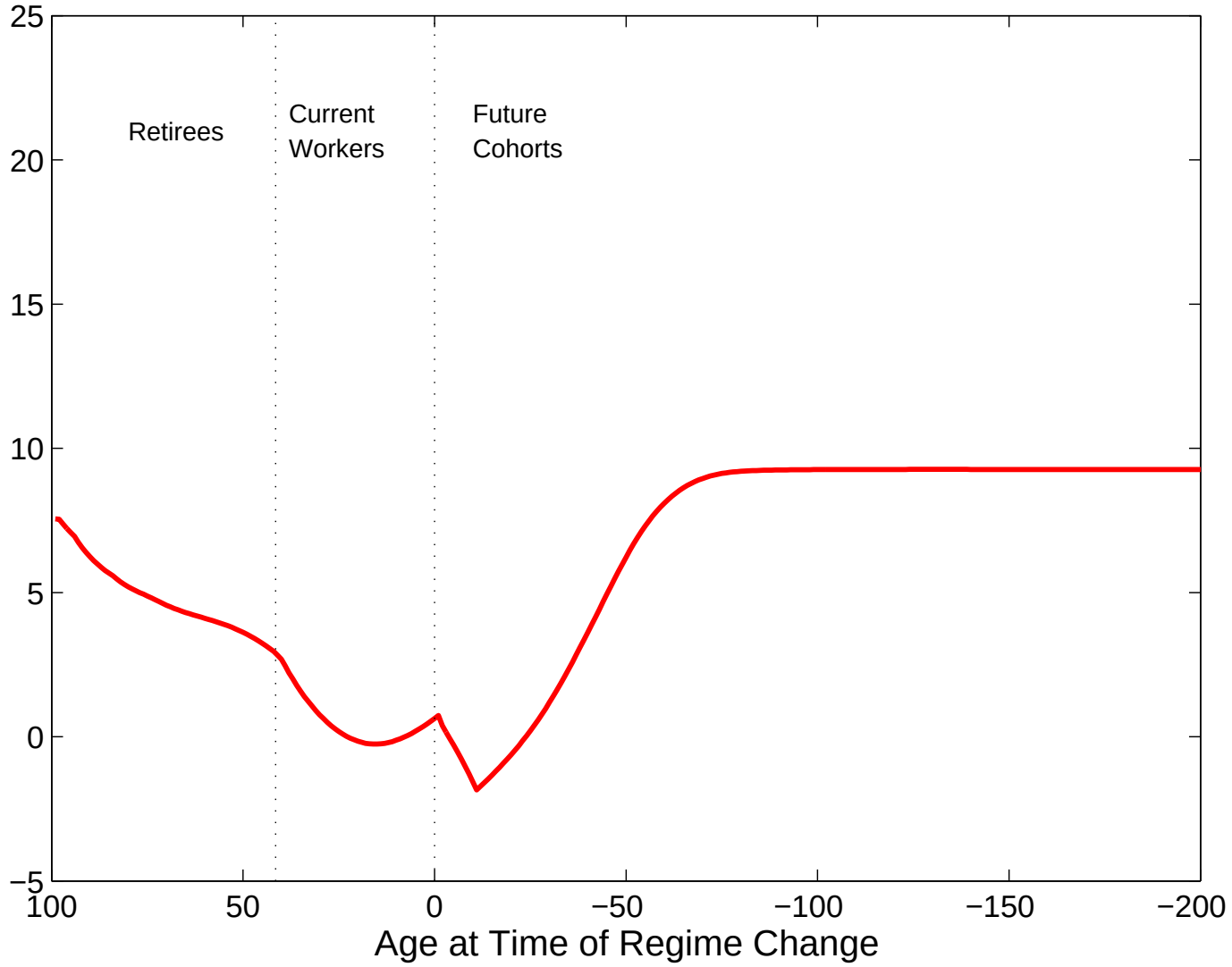


The "Standard" Analysis

- 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 ($\psi^r/\psi^w = 2.11$)

The "Standard" Analysis

Figure 2
Percentage Welfare Gain of New Policy by Cohort Age
(Economy with Small Capital−Output Ratio)



Conclusions

- Current policy in face of an aging population:
  - Higher capital and payroll taxes to fund
  - Large entitlement programs for retirees
- We find welfare improved for all cohorts with
  - Capital and payroll taxes eliminated and
  - No entitlement programs for retirees

Appendix A: National Accounts and Parameters

US NIPA and Factor Inputs

Total Adjusted Income, Avg 2000-2009

Labor Income (wL)	.587
Compensation of employees	.534
70% of proprietors' income	.053
Capital Income ($Y - wL - X_I$)	.413
Corporate profits	.072
30% of proprietors' income	.023
Rental income	.016
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

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⇒	Consumer durable depreciation	.060
	Statistical discrepancy	−.004
⇒	Imputed capital services	.037

Total Adjusted Product, Avg 2000-2009

Consumption (C)	.743
Personal consumption exp less durables	.573
Less: Imputed sales tax, nondur & services	.035
Govt consumption expenditures, nondefense	.110
Plus: Imputed capital services	.037
Consumer durable depreciation	.060
Tangible Investment (X_T)	.214
Gross private domestic investment	.149
Schedule C corporations (X_{1T})	.070
Other private business	.079
Consumer durable goods	.082
Less: Imputed sales tax, durables	.005
Govt gross investment, nondefense	.025
Net exports of goods and services	−.043
Net income, rest of world	.007
Defense spending (G)	.043

Factor Inputs, Avg 2000-2009

Labor Input (L)	.279
Capital Stock (K')	5.871
Tangible capital (K'_T)	4.153
Private fixed assets	2.192
Public fixed assets	.595
Consumer durables	.305
Inventories	.134
Land	.928
Intangible capital (K'_I)	1.718

Note: IRS returns used to estimate $K'_{1T} = .892$, $K'_{2T} = 3.261$

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 $\alpha = 1.3$
  - Discount factor $\beta = .984$
- Technology Parameters
  - Tangible capital shares: $\theta_{1T} = .19$, $\theta_{2T} = .51$
  - 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:
  - Sectoral income share $\theta_1 = .5$
  - Intangible shares and depreciation rates $\rightarrow K_I' = 1.72$
- But sensitivity analysis shows results are robust

Policy Parameters

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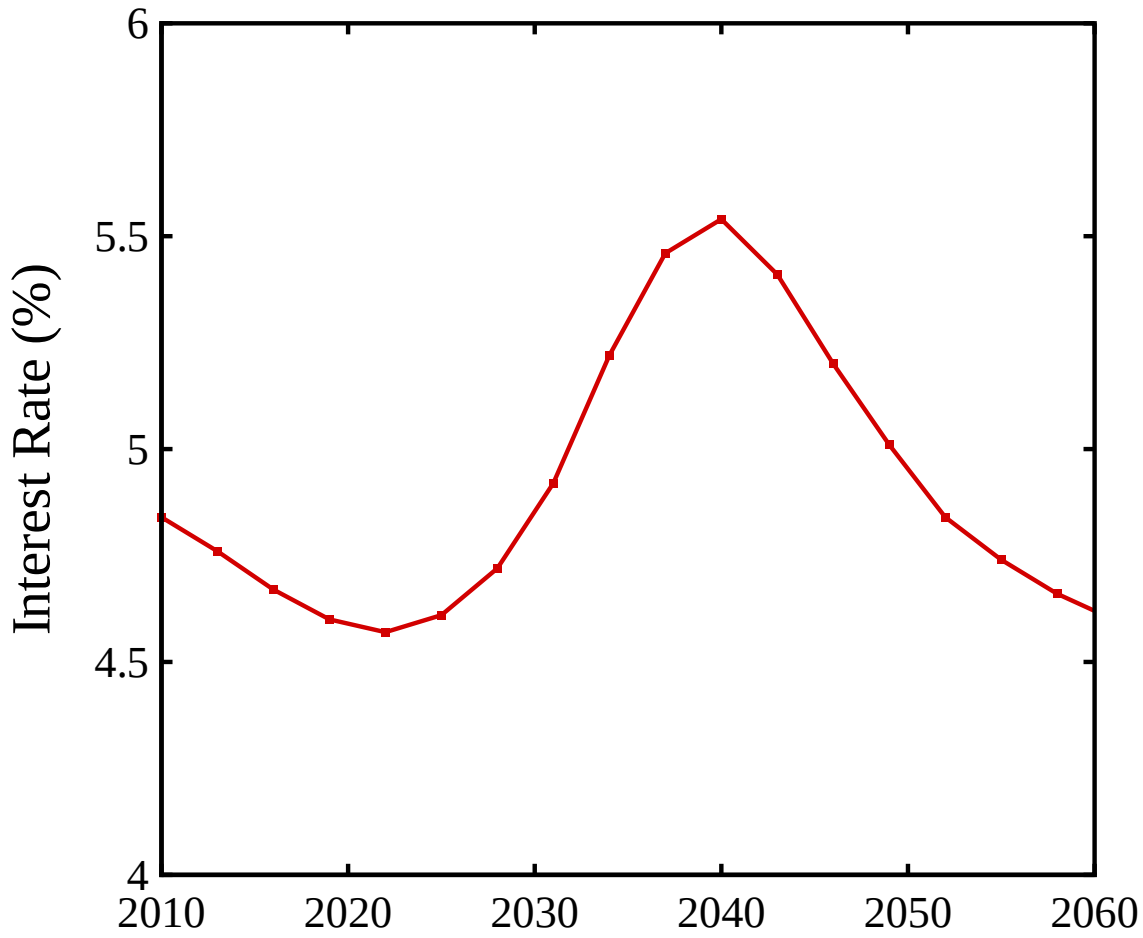
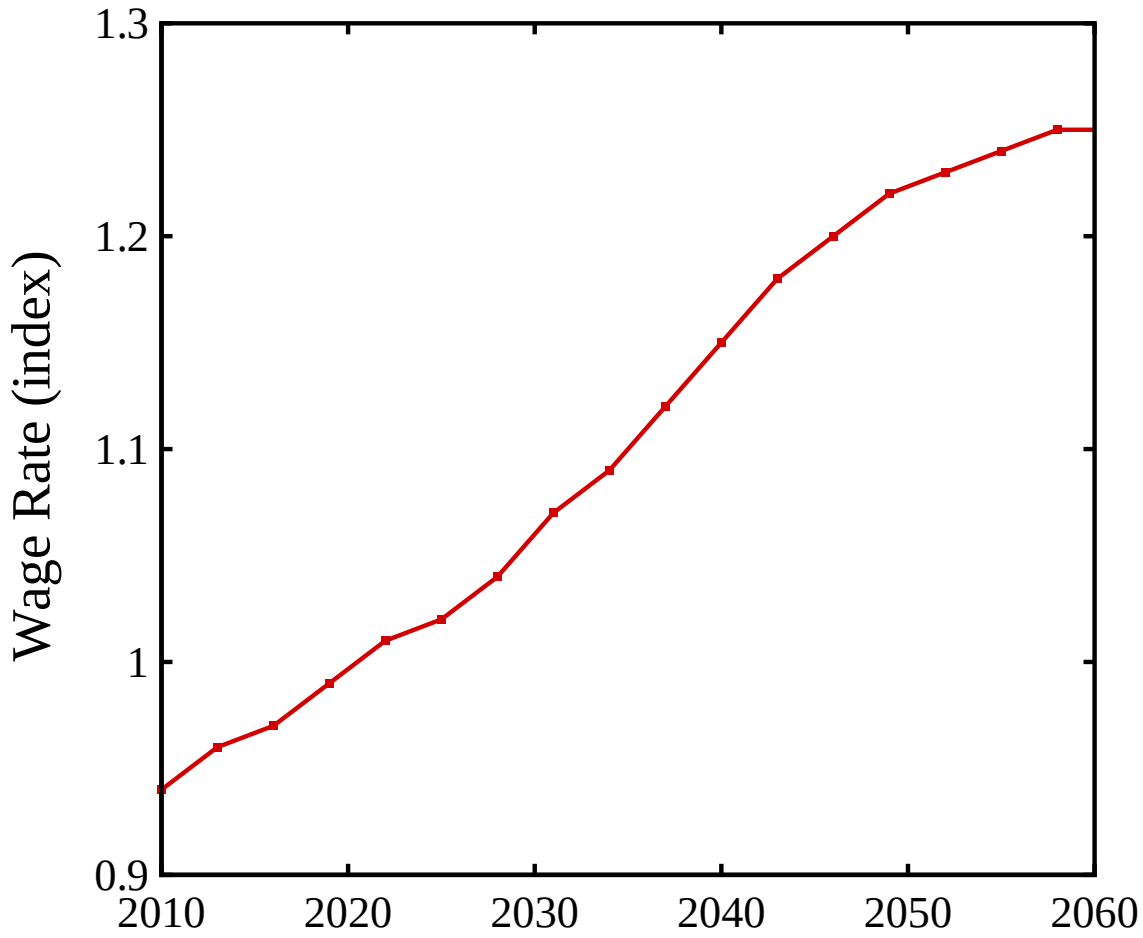
Appendix B: Transition Figures

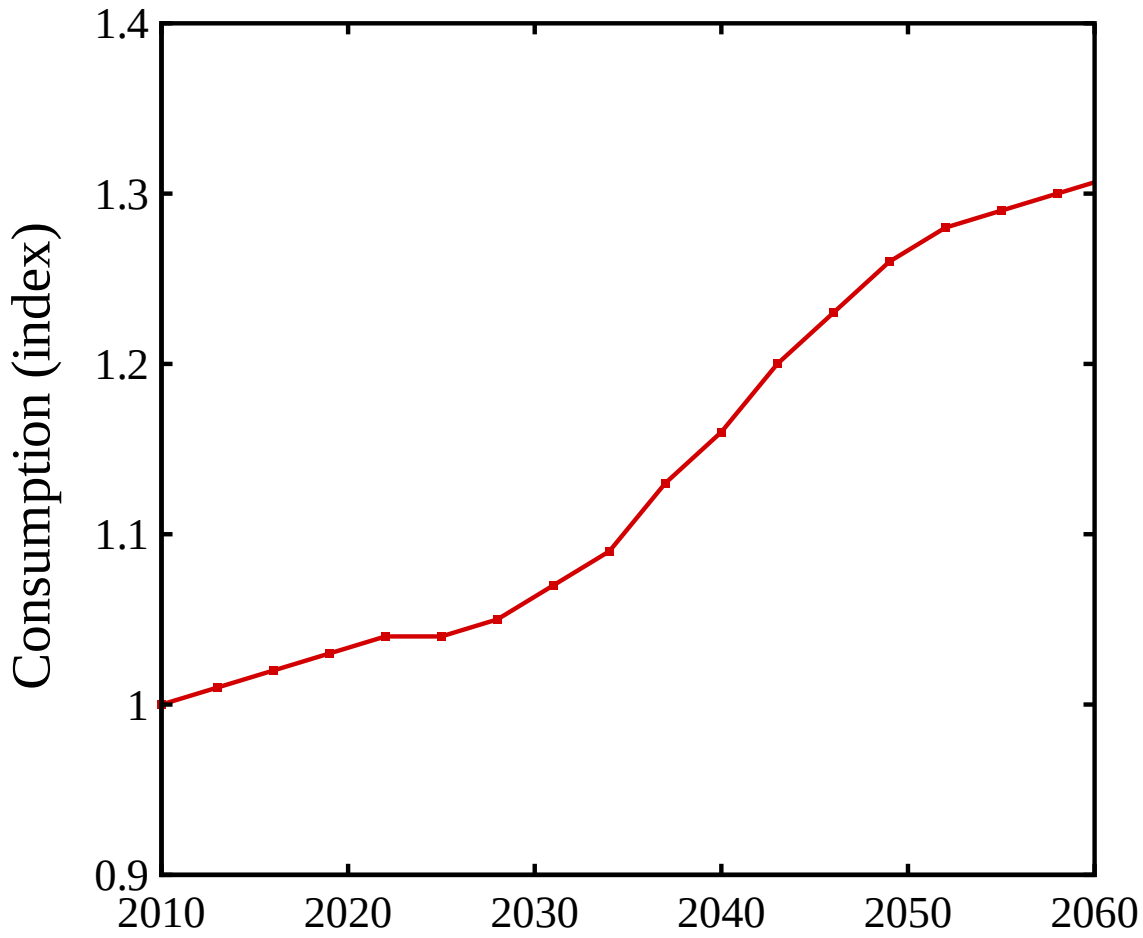
Transition: No wild oscillations in interest rates



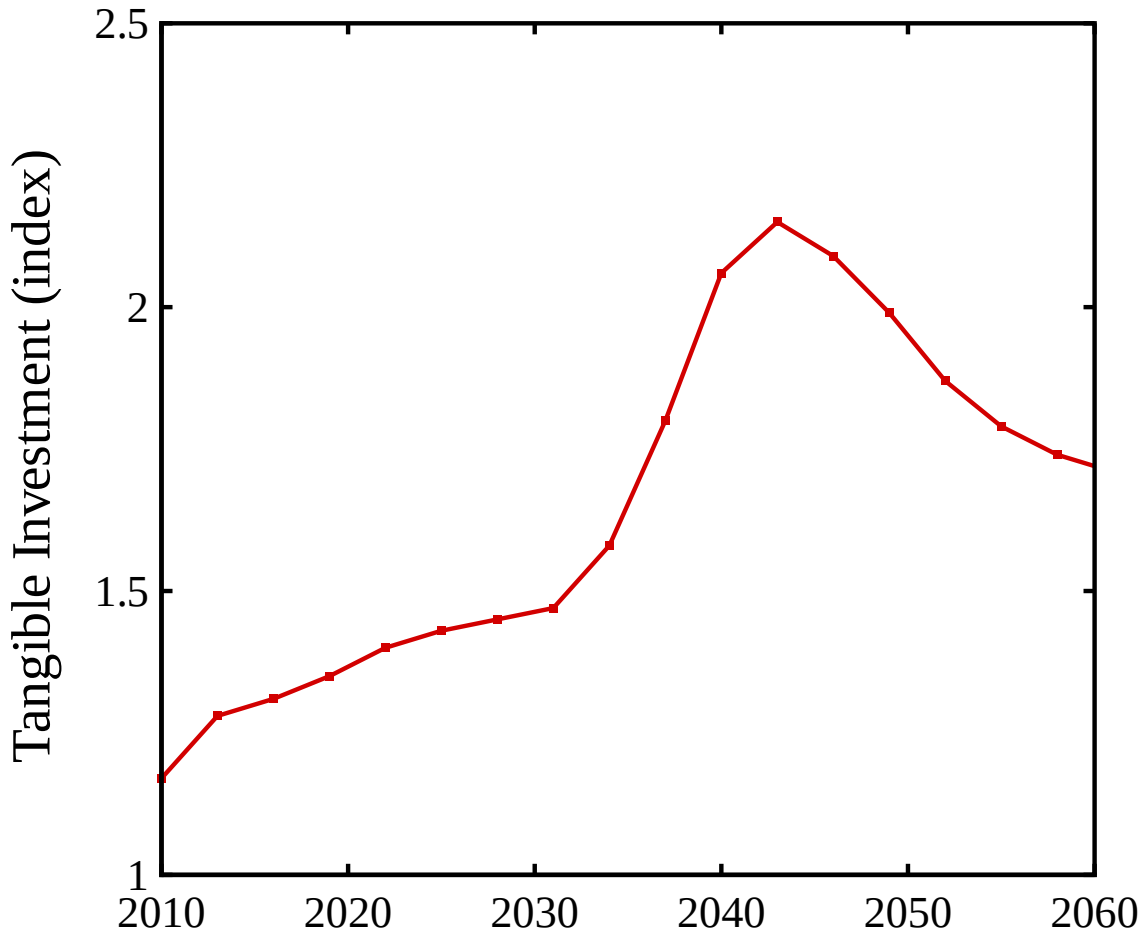
Transition: Large rise in wages for workers



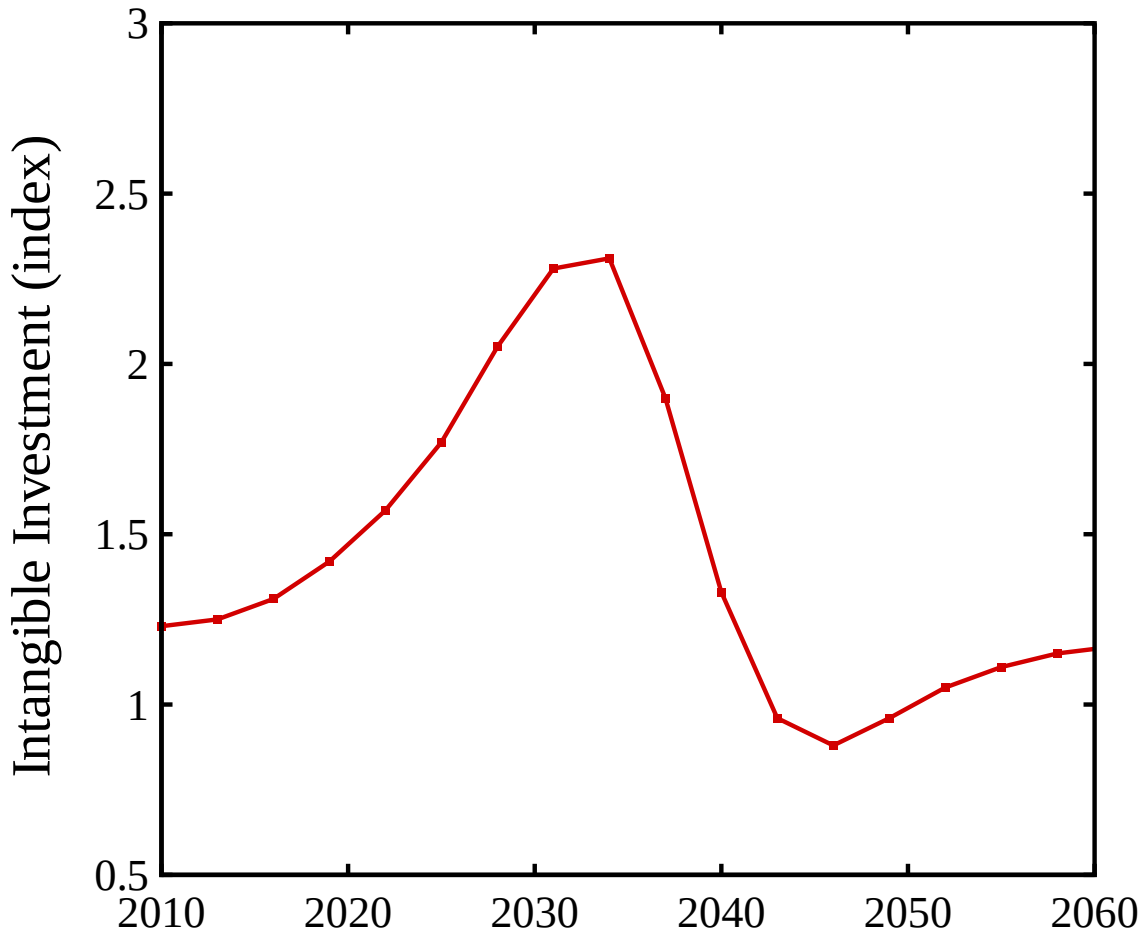
Transition: Large rise in consumption



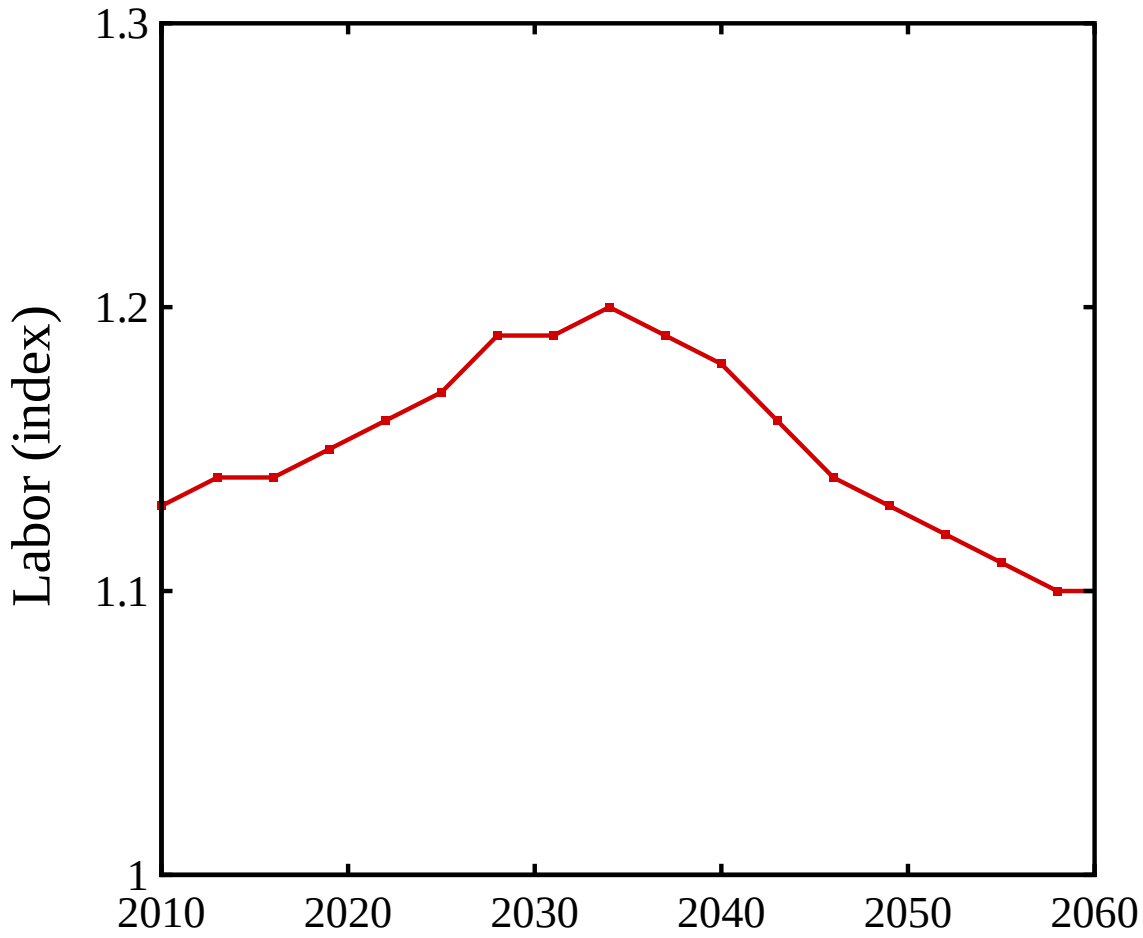
Transition: Immediate rise in tangible investment



Transition: Immediate rise in intangible investment



Transition: Modest rise in labor input



Transition: Large rise in GDP