Life in Shackles?

The Quantitative Implications of Reforming the Educational Financing System

B. Heijdra, L. Reijnders and F. Kindermann

Motivation

- Obtaining college education requires large investment of both time and money.
- To facilitate access to education, most governments have instituted education financing systems.
- System design varies substantially across countries
  - US: Mortgage Loans
  - Australia: Income Contingent Loans
  - Netherlands: Basic Grants financed from tax money

Motivation

- The problem of the US mortgage loan system:
  - It guarantees wide access to tertiary education.
  - BUT: College students may end up with lots of study debt.
  - Might be especially painful when a graduate is unlucky in the labor market.

Motivation

". . . student loan systems [. . .] are often badly designed for an extended period of high unemployment. In contrast to the housing crash the risk from student debt is not of a sudden explosion in losses but of a gradual financial suffocation. The pressure needs to be eased."

The Economist (October 29th, 2011)

Motivation


CREDIT CARD
3712 345468 9503
MR DUPED
LOAN


DEBT
COLLEGE DEGREE
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THE BUFFALO NEWS
ADAM ZYGLIS

Potential Solutions

- Theoretical literature promotes income dependent financing schemes to insure educational risks.
- Private arrangements:
  - Students sell a share of their future earnings to investors.
  - Equity investment idea dates back to Friedman.
  - Comes with some complications:
    default, costly income verification, ...
- Public arrangements:
  - Income dependent education financing system.
  - Government has the ability to tax college graduates.

In This Paper

- Focus on public arrangements.
- Quantitative analysis of different financing schemes.
- Start from mortgage loans system in the US.
- Reform system so that grants to students are financed from
  - comprehensive taxes or
  - graduate taxes or
  - degree-specific taxes.

Preview on Results

- Move to graduate or degree-specific tax scheme increases aggregate welfare.
- Risk-sharing benefits and positive education incentives outweigh labor-supply distortions.
- Reforms lead to considerable transitional dynamics.

Related Literature

- Theoretical contributions:
  - Garcia-Penalosa/Wälde (2000)
  - Jacobs/van Wijnbergen (2007)
  - Cigno/Luporini (2009)
  - Del Rey/Racionero (2010)
  - Lochner/Monge-Naranjo (2011)
  - Eckert/Zilcha (2012)
- Education Subsidies and Incomplete Markets:
  - Akyol/Athreya (2005)
  - Ionescu (2009)
  - Krueger/Ludwig (2013)
  - Abbott/Gallipoli/Meghir/Violante (2013)

A Quantitative Model with Education Decisions

The Overlapping Generations Framework

- Overlapping generations of heterogeneous individuals.
- Demographics:
  - lifespan is certain
  - population grows at constant rate
- Households:
  - choose how many years to stay in higher education
  - choose labor supply in the working phase
  - create human capital through learning-by-doing
  - decide about consumption and savings

Components of individual heterogeneity/risk

- Educational ability $\theta \in [0, 1]$.
- On-the-job learning ability
  - $\gamma \in \{\gamma_l, \gamma_h\}$
  - correlated with θ
- Individual labor productivity
  - $\eta \in \{0, \eta_l, 1, \eta_h\}$
  - evolves stochastically over life cycle with autocorrelation

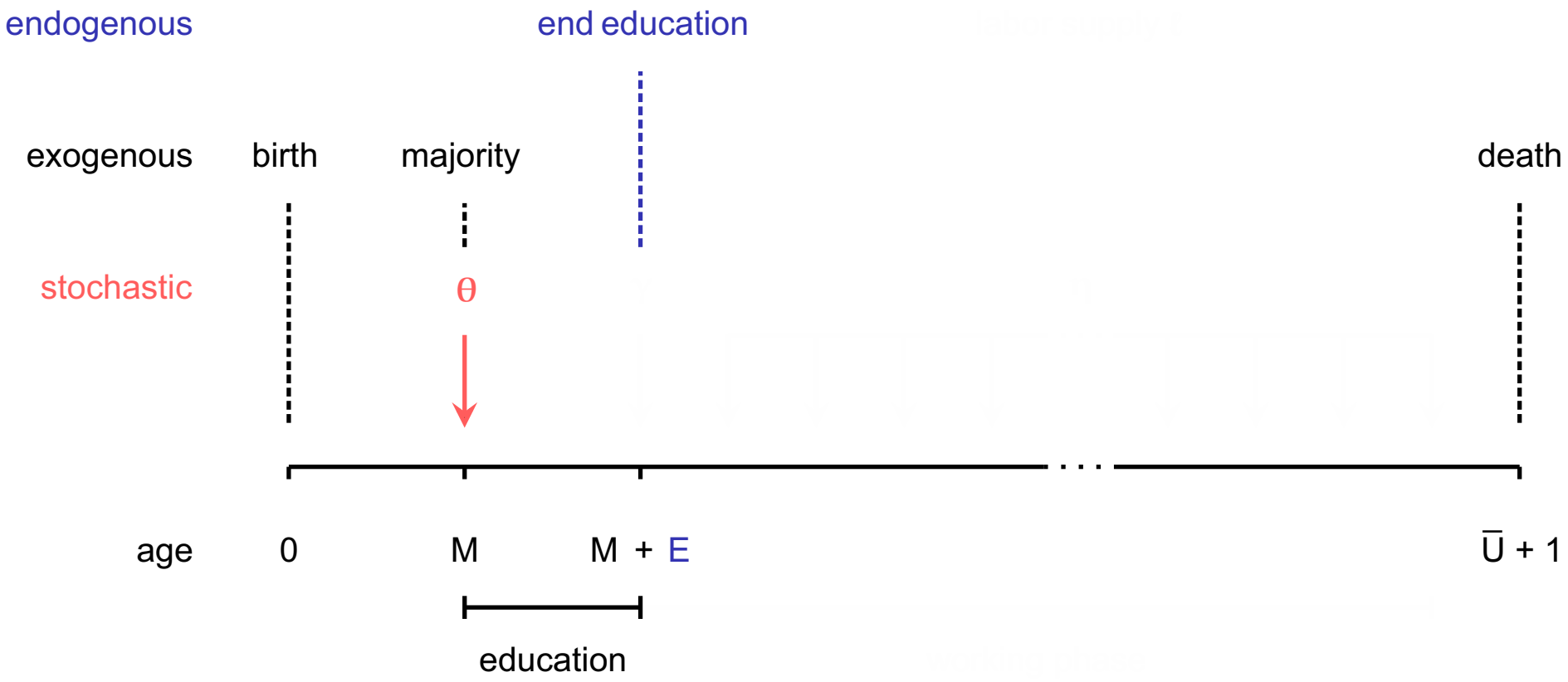
The Life Cycle

endogenous

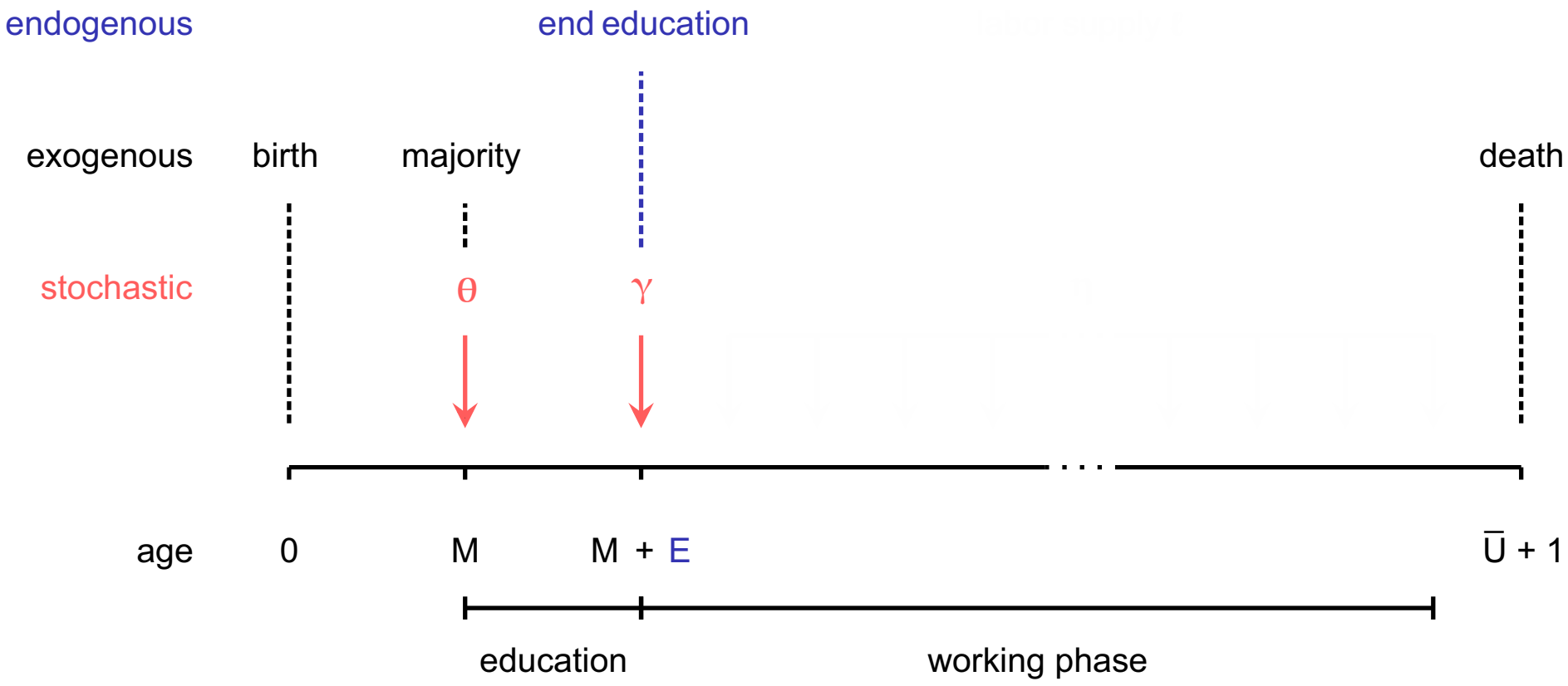
The Life Cycle

endogenous

The Life Cycle



The Life Cycle



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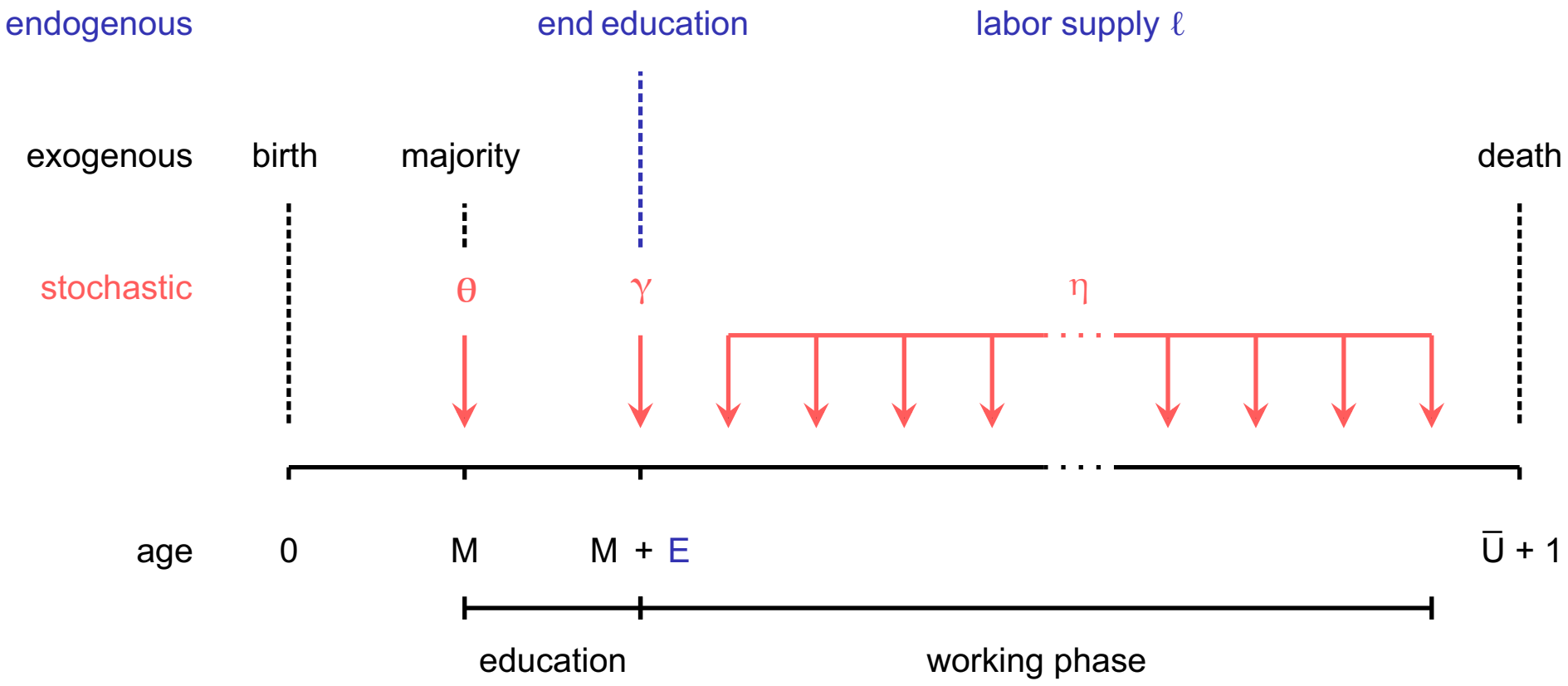

Individual Decision Making

Maximization Problem of a Worker

$$V_{u,t}(E,\gamma,a,h,\eta) = \max_{c,l,a^+\geq 0,h^+} \left\{ \left[c^{\varepsilon}(1-l)^{1-\varepsilon}\right]^{1-1/\sigma} \right.$$

$$\left. + \beta \left[\mathbb{E}_{\eta^+|\eta,E} \left[V_{u+1,t+1}(E,\gamma,a^+,h^+,\eta^+)^{1-\zeta} \right] \right]^{\frac{1-1/\sigma}{1-\zeta}} \right\}^{\frac{1}{1-1/\sigma}}$$

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- Budget constraint with $y = w_t \cdot \eta \cdot h \cdot l$

$$a^+ = [1 + (1-\tau_t^r)r_t]a + (1-\tau_t^w)y + \nu_{u,t}1_{\{\eta=0\}}$$

$$- \Upsilon_{u,t}(E,y) - (1+\tau_t^c)c.$$

- Human capital accumulation

$$h^+ = (1-\delta_u^h)[1+\gamma l^{\alpha}]h.$$

Individual Decision Making

Maximization Problem of a Student

$$S(\theta) = \max_{E \in \{0,2,4,6\}} \left[\sum_{s=t}^{t+E-1} \beta^{s-t} \left[(c_s)^{\varepsilon} (1-e)^{1-\varepsilon} \right]^{1-1/\sigma} + \beta^{E} \left[\mathbb{E}_{\gamma|\theta} \left[V_{M+E,t+E}\left(E, \gamma, 0, h, 1\right)^{1-\zeta} \right] \right]^{\frac{1-1/\sigma}{1-\zeta}} \right]^{\frac{1}{1-1/\sigma}}$$

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- Budget constraint

$$c_t = \frac{q_t - f_t}{1 + \tau_t^c}.$$

- Human capital accumulation

$$h = \Gamma(\theta, E) = 1 + \xi_1 \theta E - \xi_2 [1-\theta] E^2.$$

Education Financing System, Government and Firms

- Subsidized Mortgage Loan System:
  - Each student has to pay back her individual loan.
  - $\Upsilon_{u,t}(E, w_t\, \eta\, h\, l)$ is calculated such that the PV of repayments equals the PV of loan uptake.
  - Interest payments are deductible from income taxes.
- Government taxes consumption and income to finance
  - public consumption
  - unemployment benefits
- Firms produce in competitive markets using capital and labor with Cobb-Douglas technology.

Calibration

Calibration Strategy

- Two step calibration procedure:
  1. Take some parameters from literature or directly from data.
  2. Calibrate remaining parameters to match important target moments from the data.

Calibration Strategy

Excerpt of Step 1

- Risk aversion of $\zeta = 4$.
- Autocorrelation of productivity shocks $\rho_\eta = 0.821$.
- Unemployment probabilities by education from CPS.
- Annual student loan uptake to average income 0.238
- Grace period before loan repayment of 4 years.
- Total repayment time of 15 years.

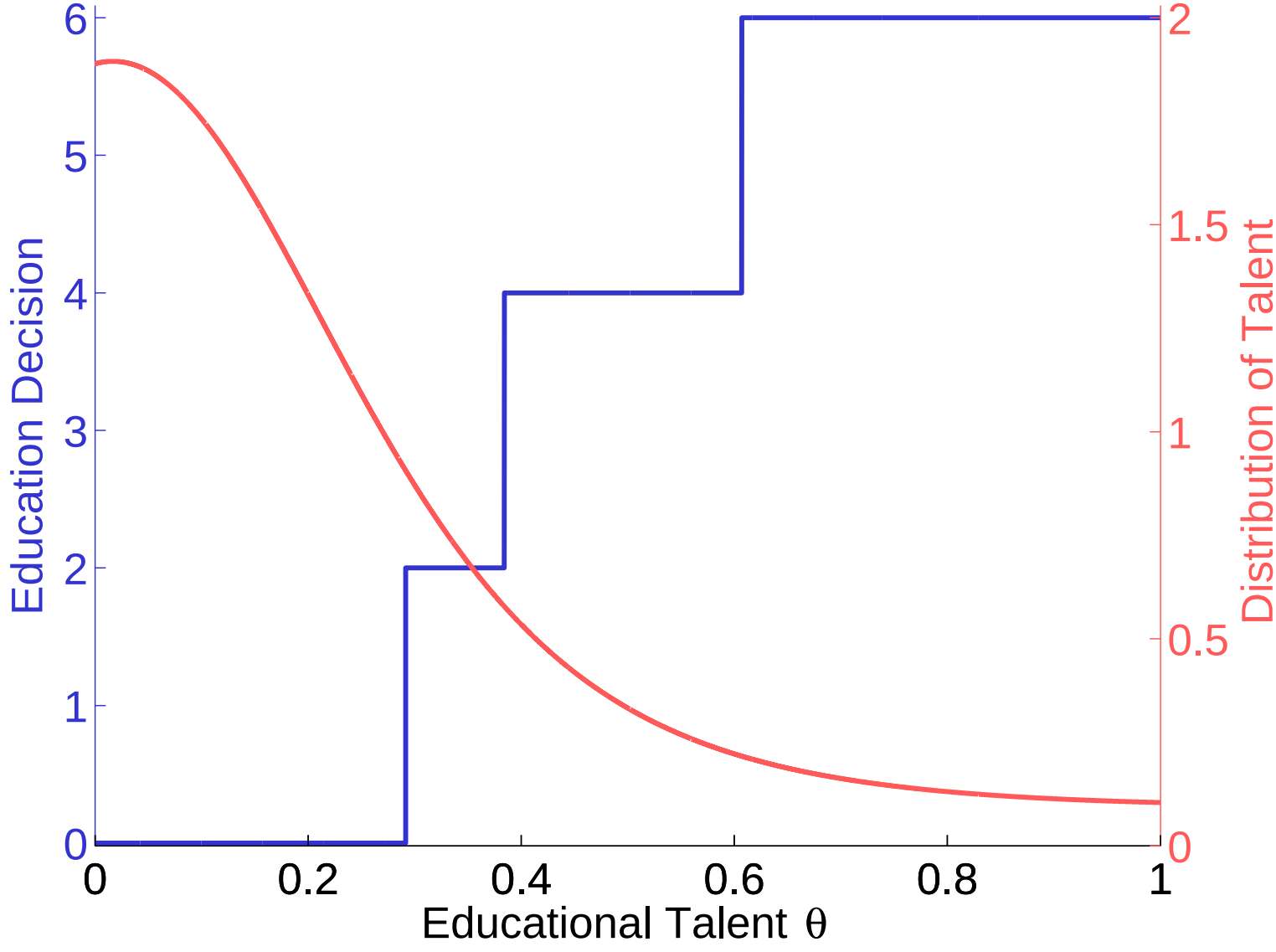
Calibration Strategy

Excerpt of Step 2

- Capital to output ratio.
- Consumption and income tax revenue.
- Education composition of the population from CPS.
- Average labor productivity profiles by education.
- Old-age labor force participation.
- Variance of income growth rates.
- Variance of log labor earnings by age.

Model Fit

Education Decisions and Skill Distribution

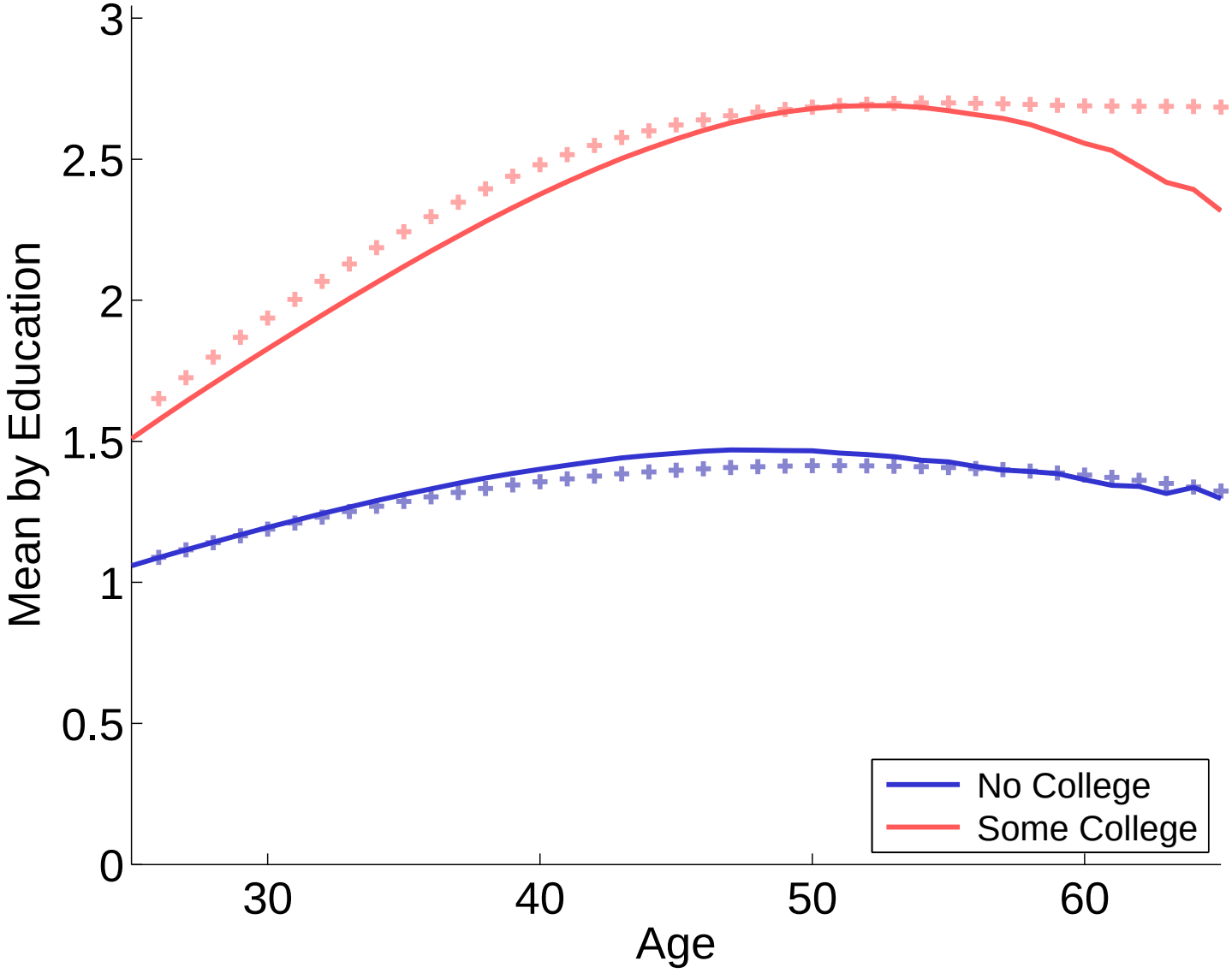


Education Composition of Workforce

Share with	Model	Data
0 years	52.02	53.20
2 years	13.12	11.12
4 years	21.81	22.89
6 years	13.05	12.79

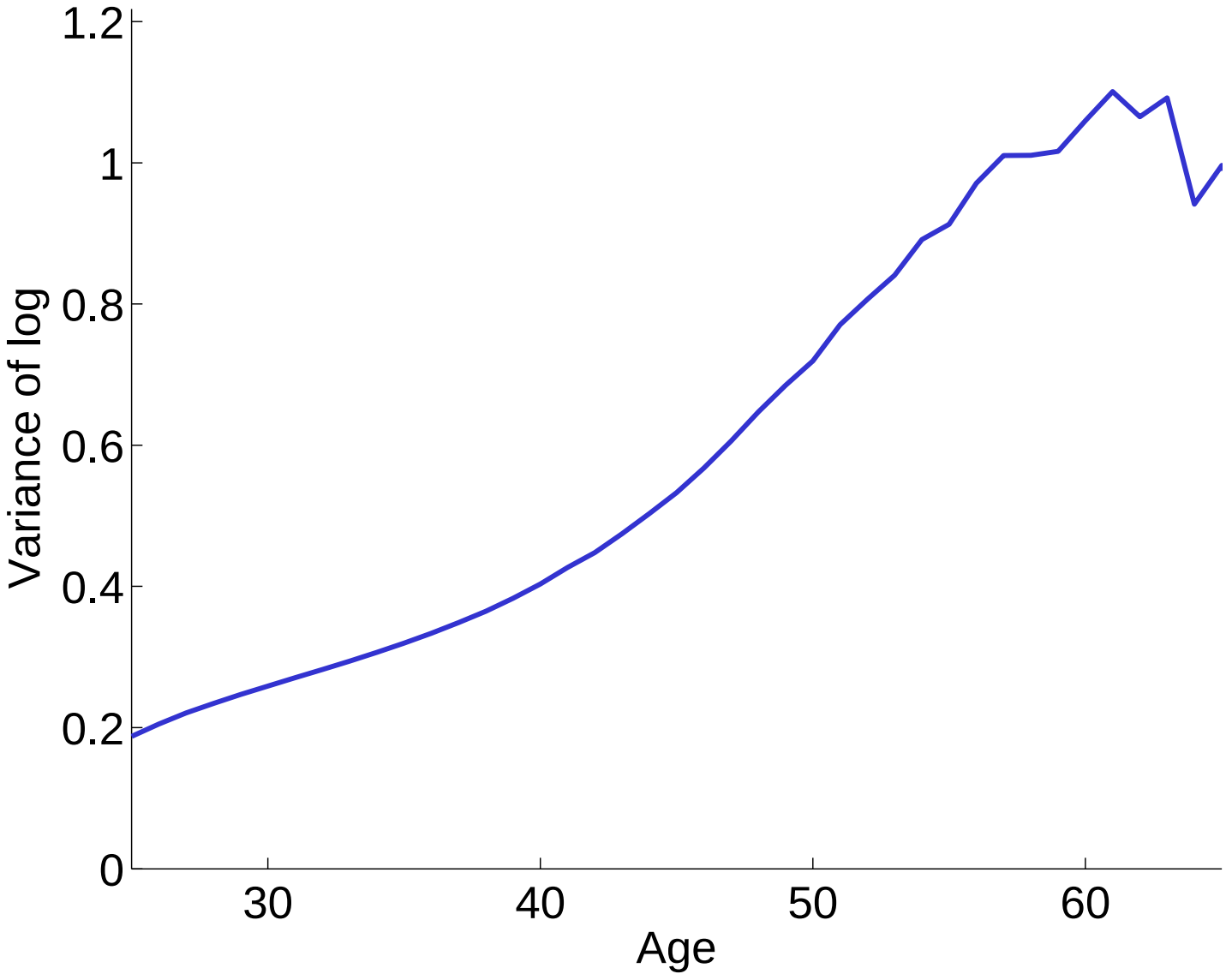
Model Fit

Average Labor Productivity by Education



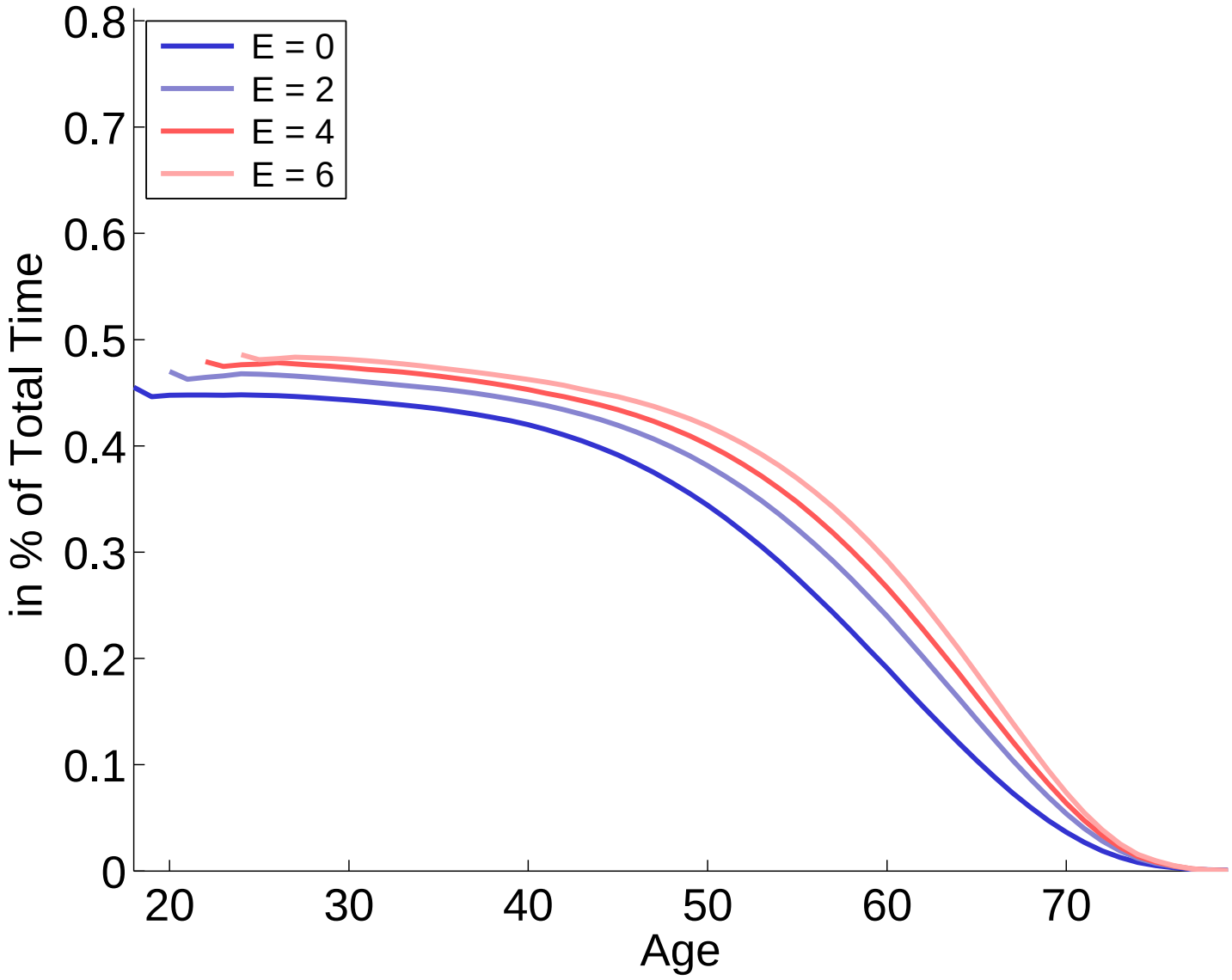
Model Fit

Variance of Log Labor Earnings



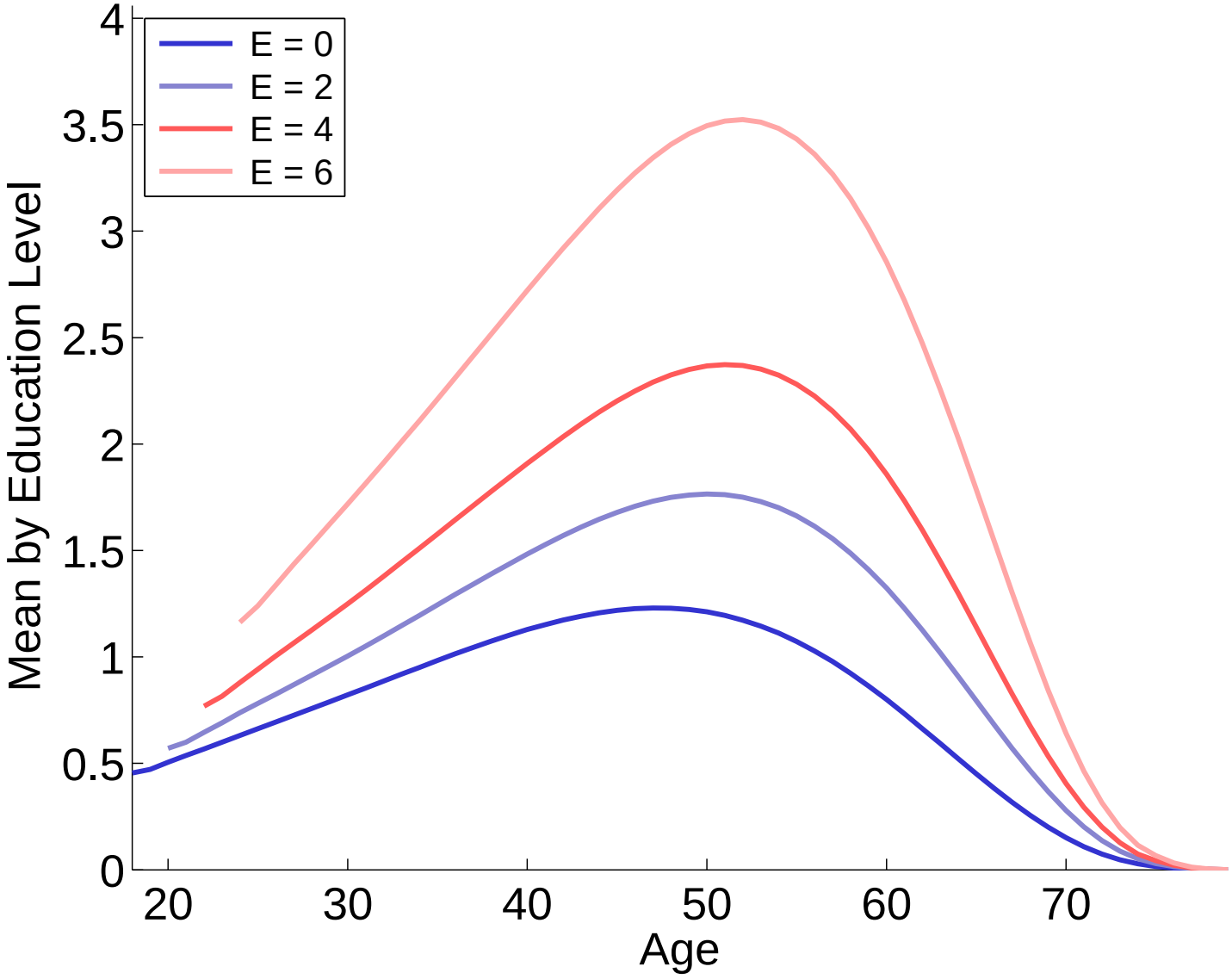
Initial Equilibrium

Labor Hours



Initial Equilibrium

Labor Income



Reforming the Education Financing System

The Though Experiment

- We start from the equilibrium described above.
- The government introduces one of three education financing systems, which finance the sum of grants to students on a pay-as-you-go basis by means of

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  - degree-specific taxes (DT):
    a tax on labor earnings that depends on the specific education degree a household has obtained.
- We calculate a full transition path.

Long-run Simulation Results

Long-Run Taxes and Education Decisions

	CT		GT		DT	
	τ^e	Distr.	τ^e	Distr.	τ^e	Distr.
$E = 0$	1.56	–11.12	0.00	0.53	0.00	–5.79
$E = 2$	1.56	–0.28	2.37	–12.45	1.01	0.65
$E = 4$	1.56	1.79	2.37	1.29	1.93	3.63
$E = 6$	1.56	9.61	2.37	10.63	2.67	1.51

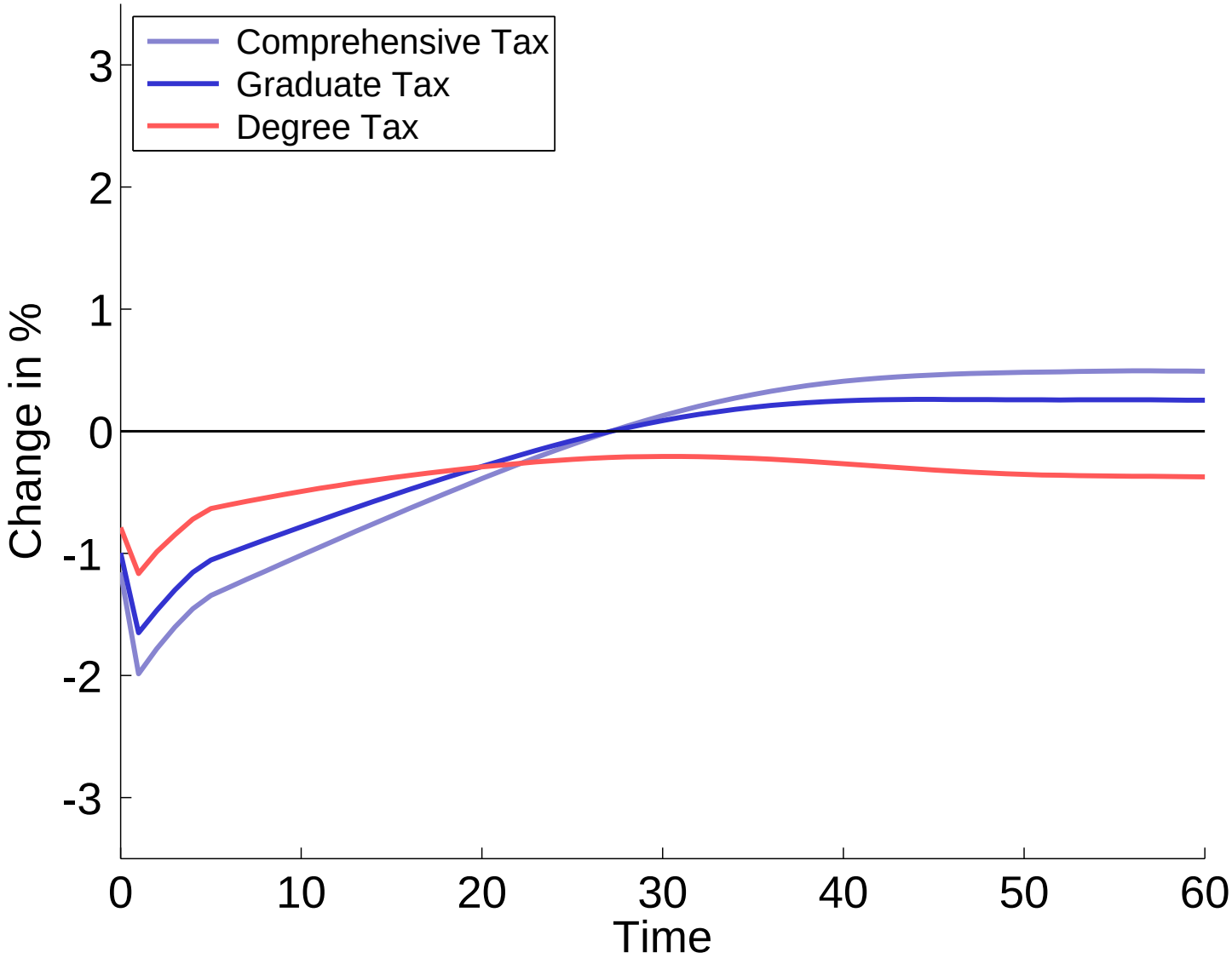
Long-Run Macroeconomics Effects

	CT	GT	DT
Macroeconomic quantities (in %)			
Effective labor	0.46	0.23	–0.40
Capital stock	3.00	2.72	1.89
Output	1.03	0.79	0.12
Consumption	0.53	0.30	–0.45
Factor prices and taxes (in %p)			
Wage	0.57	0.56	0.52
Interest rate	–0.15	–0.14	–0.13
Income tax rate	–0.21	–0.14	0.01

Transitional Dynamics

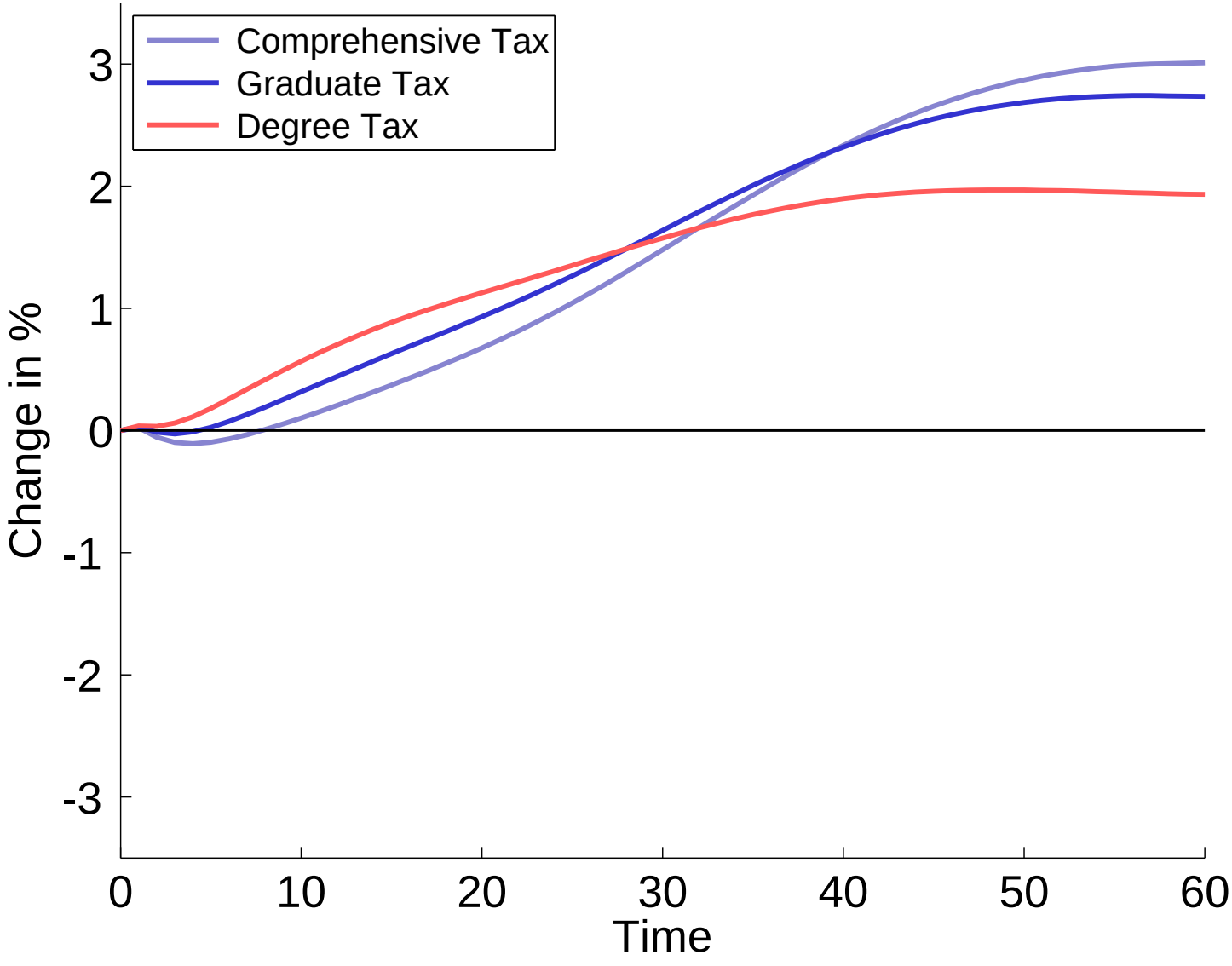
Transitional Dynamics

Effective Labor



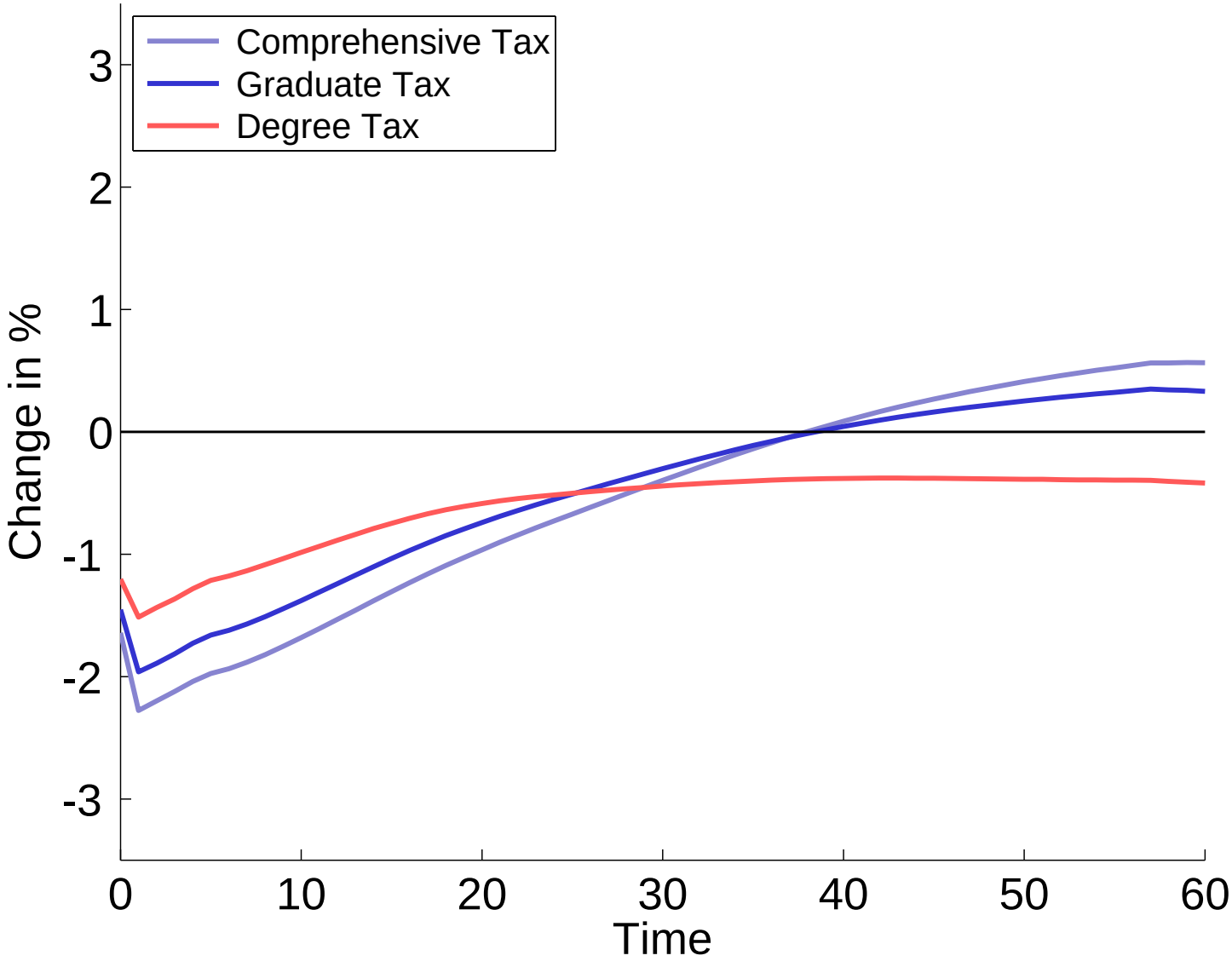
Transitional Dynamics

Capital



Transitional Dynamics

Consumption

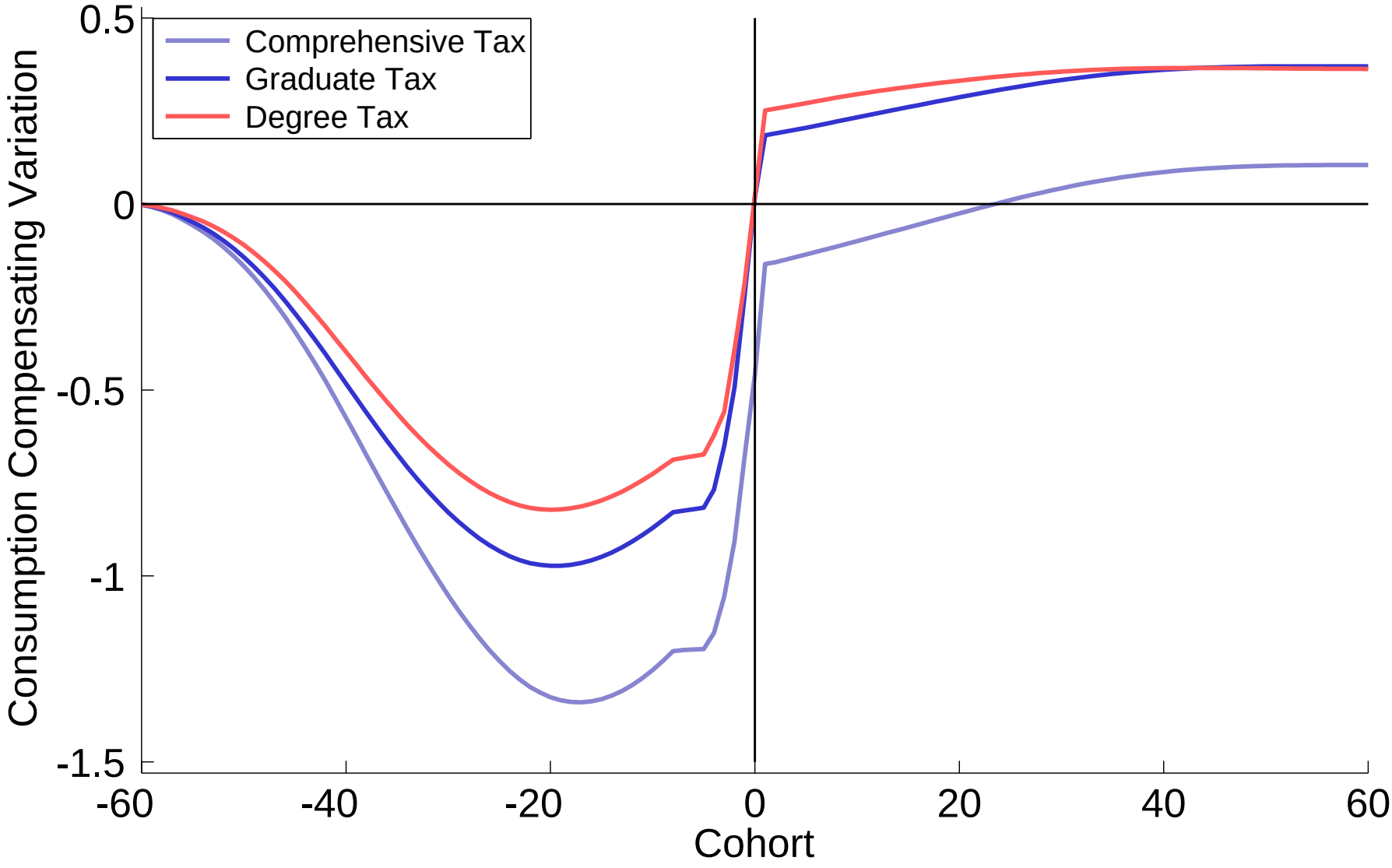


Welfare Analysis

The Concept of Welfare

- We measure welfare by means of compensating transfers.
- One transfer per cohort.
- Calculated such that cohort would be indifferent (in ex ante utility terms) between living in initial equilibrium and reform system.
- Negative of transfer indicates welfare effect.
- We relate transfer levels to initial equilibrium consumption.

Compensating Transfers



Aggregate Welfare

- Transfers can be easily aggregated across generations.
- Initial equilibrium interest rate to discount future.
- Converted into annuity stream.
- Again related to aggregate consumption.

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	CT	GT	DT
Total	–0.29	0.08	0.13

Decomposing the Welfare Effect

A Decomposition

- Reforming the education financing system leads to
  - $(+)$ Risk-sharing opportunity
  - $(-)$ Regressive redistribution
  - $(-)$ Work incentives
  - $(-/+)$ Education incentives
  - $(+)$ General equilibrium effects

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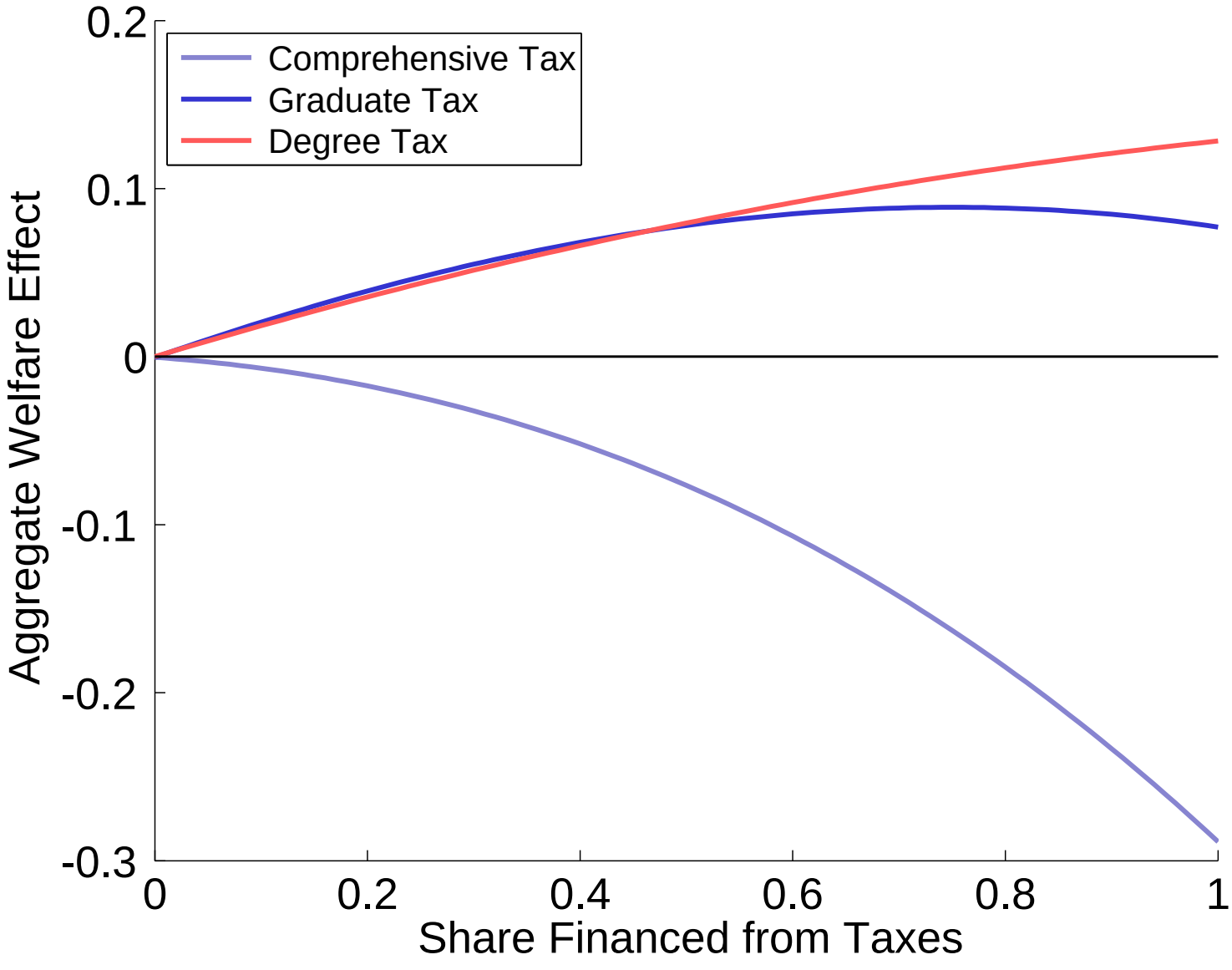
- Reforming the education financing system leads to
  - $(+)$ Risk-sharing opportunity
  - $(-)$ Regressive redistribution
  - $(-)$ Work incentives
  - $(-/+)$ Education incentives
  - $(+)$ General equilibrium effects
- Disentangle effects by using different specifications:
  - Small open economy
  - Fixed education choice
  - Repayments income contingent but perceived as lump-sum

Decomposition Results

	CT	GT	DT
Redistribution effect	–0.17	0.14	0.20
Work incentive effect	–0.19	–0.18	–0.17
Educational incentive effect	0.04	0.09	0.08
General equilibrium effect	0.03	0.03	0.02
Total	–0.29	0.08	0.13

Hybrid Systems



Conclusion

- Reforming education loan system can generate aggregate welfare gain.
- Risk-sharing benefits and education incentives can outweigh losses from labor supply distortions.
- System needs to be designed in a suitable way, otherwise regressive redistribution.
- Reforming the education financing system comes a transitional costs.
- Short-run generations can (in principle) be compensated.

Further Investigation

- Progressive taxes.
- Basic allowances in income contingent system.
- Quality of schools and price setting behavior.