# Immigration Policy in a Time of Secular Stagnation

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# Overview

- Significant demographic transition in the US over last century
- Macroeconomic implications - *Secular Stagnation*
- Fiscal consequences - Social Security, Government Debt, Monetary Policy
- Focus on immigration as an economic policy instrument

# Empirical Overview

| Value | '75-'85 | '08-'18 |
|---|---|---|
| RGDP Growth | 3.2% | 1.5% |
| Investment Growth | 5.0% | 2.7% |
| Net Worth/GDP | 251%[1] | 372% |
| Interest Rates | 2.91% | 0.86% |

[1] 1987 value

# Mechanism

- Rise in life expectancy, decline in birth rate
- Relative rise in share of households nearer to peak of life-cycle wealth
- Rise in wealth relative to output
- Declining interest rates

# Related Literature

- Eggertsson, Lancastre, Summers (2018)
- Ariby, Geppert, Ludwig (2017)
- Storesletten (2000)

# Questions

- To what extent can immigration policy resolve demographic imbalances?
- How much can skilled immigration improve economic growth?
- How much immigration would it take to reach 4% growth?
- How can immigration impact the fiscal outlook?

# Goals

- Present a model accounting for demographics (age, education)
- Explain macroeconomic trends since 1980's
- Evaluate counterfactual immigration policies

# Model Overview

- Standard OLG, production economy
- Two types - high/low productivity
- Linear income tax per type
- Cohort-dependent birth rates and survival rates
- Historical immigration rates by education

# Agent Optimization

- Agent of cohort $j$ with education $e$ at time $t$ solves:

$$V_{j,t}(a_{j,t}) = \max_{c_{j,t}, n_{j,t}, a_{j,t+1}} \frac{\left(c_{j,t}^{\gamma}(1-n_{j,t})^{1-\gamma}\right)^{1-\sigma}}{1-\sigma} + s_{j,t}\beta V_{j,t+1}(a_{j,t+1}) \tag{1}$$

$$\text{s.t.} \quad c_{j,t} = w_t \epsilon_e z_{t-j+1} n_{j,t} + (1+r_t)a_{j,t} - a_{j,t+1} - \phi_e(\cdot) \tag{2}$$

$$\phi_e(\cdot) = \tau_e \left(w_t \epsilon_e z_{t-j+1} n_{j,t} + r_t a_{j,t}\right) \tag{3}$$

$$\text{and} \quad a_{j,j+J+1} \geq 0, \tag{4}$$

# Firm Optimization

- Firms solve:

$$\max_{K_t, L_t} K_t^{\alpha} \left(A_t L_t\right)^{1-\alpha} - (r_t + \delta) K_t - w_t L_t \tag{5}$$

- Optimality conditions:

$$r_t = \alpha \left(\frac{K_t}{A_t L_t}\right)^{\alpha - 1} - \delta \tag{6}$$

$$w_t = (1 - \alpha) \left(\frac{K_t}{A_t L_t}\right)^{\alpha}. \tag{7}$$

# Government

- Aggregate tax revenue:

$$\Phi_t = \sum_{j=t}^{t-J+1} \sum_{e \in \{h,l\}} \mu_{j,t}^{e} \phi_e(\cdot). \tag{8}$$

- Government budget constraint:

$$G_t = \Phi_t + B_t, \tag{9}$$

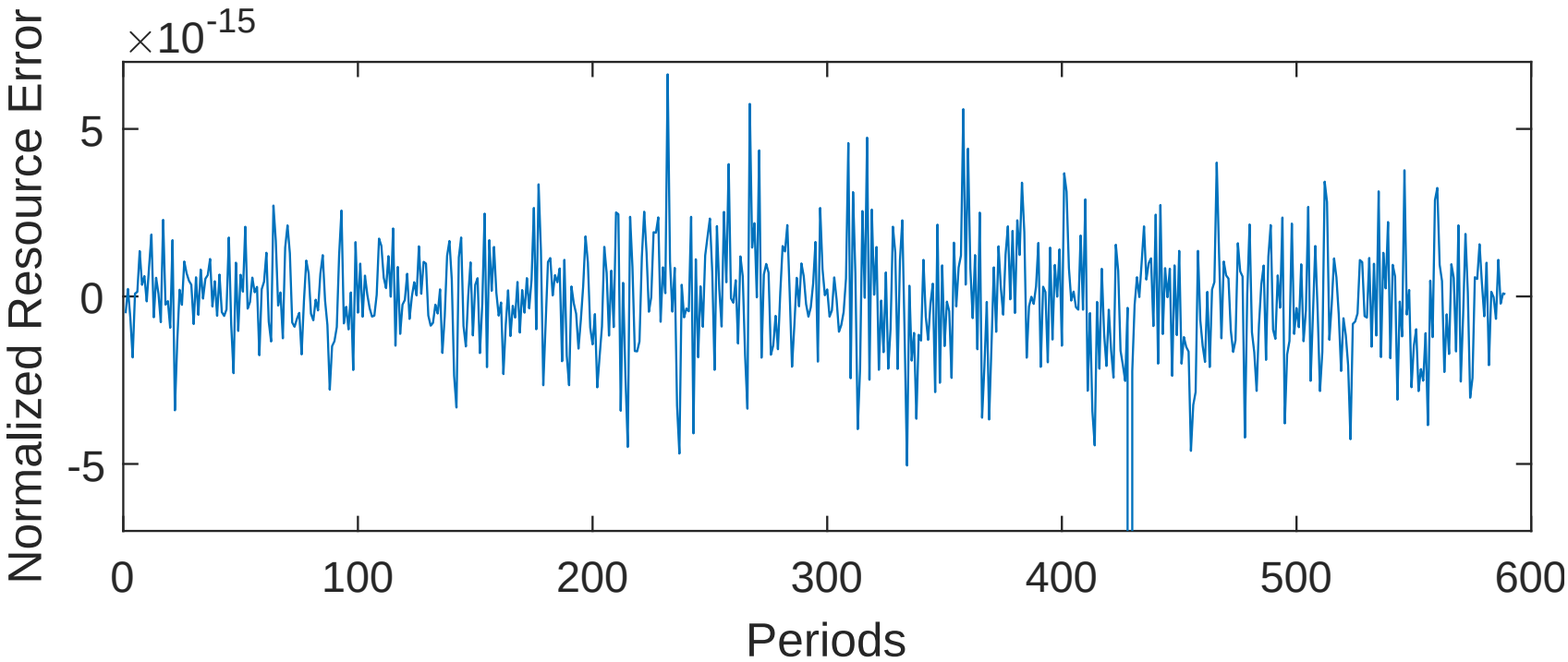
# Equilibrium

Dynamic general equilibrium: prices $\{w_t, r_t\}$ and quantities $\left\{c^*_{j,t}, n^*_{j,t}, a^*_{j,t+1}\right\}$ such that:

1. Given prices and government policy, agents choices satisfy Equation 1 - Equation 4,
2. Prices are determined in competitive markets according to Equation 6 and Equation 7,
3. Markets clear:
   - $K_t = \sum_{j=t}^{t-J+1} \sum_{e\in\{h,l\}} \mu^e_{j,t} a_{j,t+1}$
   - $L_t = \sum_{j=t}^{t-J+1} \sum_{e\in\{h,l\}} \mu^e_{j,t} \epsilon_e z_{t-j+1} n_{j,t}$
   - $Y_t = C_t + K_{t+1} - (1-\delta)K_t + G_t$
4. Government budget constraint (9) is satisfied.
5. Accidental bequests received by the government are determined according to

$$B_t = \sum_{j=t}^{t-J+1} \sum_{e\in\{h,l\}} (1 - s_{j,t}) \mu^e_{j,t} a_{j,t+1}. \tag{10}$$

# Equilibrium Error



# Population Dynamics

- Natives:

$$\mu^e_{j,t+1} = s_{j,t}\mu^e_{j,t} \tag{11}$$

- Immigrants:

$$\tilde{\mu}^e_{j,t+1} = s_{j,t}\tilde{\mu}^e_{j,t} + m^e_{j,t+1} \tag{12}$$

- Population:

$$M_t = \sum_{j=t}^{t-J+1} \sum_{e\in\{h,l\}} \left(\mu^e_{j,t} + \tilde{\mu}^e_{j,t}\right) \tag{13}$$

# Population Dynamics

- Native newborns:

$$\sum_{e \in \{h,l\}} \mu^{e}_{t+1,t+1} = \zeta_t M_t \tag{14}$$

  - $\zeta_t$ is the birth rate at time $t$.

  - Education shares determined by education rates by cohort.

# Population Dynamics

- Immigrants:

$$\sum_{e \in \{h,l\}} m^e_{j,t} = \psi_t \lambda_{j,t} M_t \tag{15}$$

  - $\psi_t$ is the immigration rate at time $t$.

  - Education shares determined by immigrant education rates by year.

# Population Dynamics

- Define *relative population* at time $t$ as:

$$\left\{ \frac{\sum_{e \in \{h,l\}} \left( \mu^e_{j,t} + \tilde{\mu}^e_{j,t} \right)}{M_t} \right\}_{j=t}^{t-J+1} \tag{16}$$

- Population is *relatively stable* if $\forall\ \varepsilon > 0\ \exists\ t(\varepsilon) > 0$ such that $t > t(\varepsilon) \Rightarrow$

$$\max \left\{ \left| \left\{ \frac{\sum_{e \in \{h,l\}} \left( \mu^e_{j,t} + \tilde{\mu}^e_{j,t} \right)}{M_t} \right\}_{j=t}^{t-J+1} - \left\{ \frac{\sum_{e \in \{h,l\}} \left( \mu^e_{j,t} + \tilde{\mu}^e_{j,t} \right)}{M_t} \right\}_{j=t+1}^{(t+1)-J+1} \right| \right\} < \varepsilon \tag{17}$$

# Computing Population Dynamics

1. Using earliest available data, find relatively stable population.

2. Allow demographics to change over the transition.

3. Iterate until new relatively stable population (and stable prices) reached.

# Parameters

| Parameter | Symbol | Value |
|---|---|---|
| Coefficient of Relative Risk Aversion | $\sigma$ | 3 |
| Consumption Share of Utility | $\gamma$ | 0.65 |
| Discount Factor | $\beta$ | 1.025 |
| Maximum Age | $J$ | 120 |
| Capital Share | $\alpha$ | 0.36 |
| Depreciation Rate | $\delta$ | 0.085 |
| Labor Productivity Growth Rate | $g$ | 0.015 |
| Education Premium | $\epsilon_e$ | 170% |
| Tax Rate - college not attained | $\tau_l$ | 6.2% |
| Tax Rate - college attained | $\tau_h$ | 12.1% |

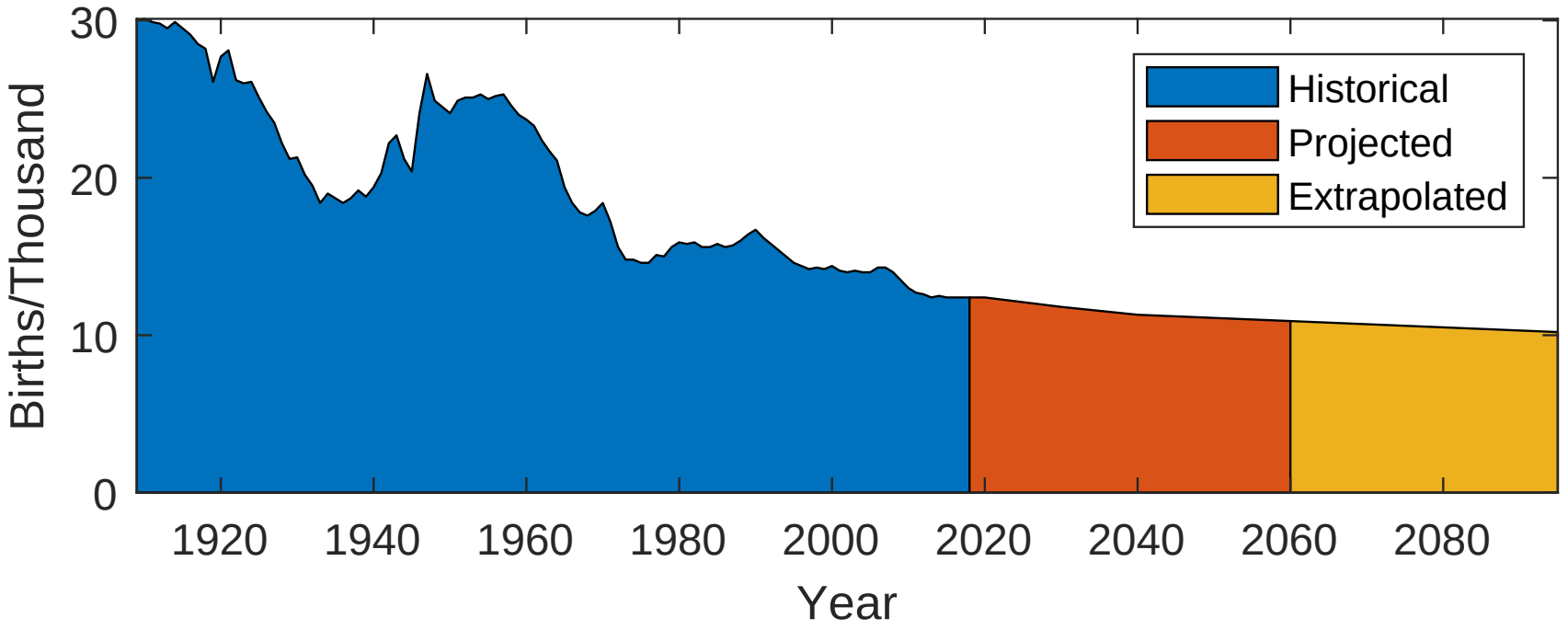
# Implementing Demographics

- Total Change horizon: 1900-2095
- Assume initial value is true dating back to 1900
- Allow historical values to change over transition
- Integrate available projections (e.g., birth rates from Census Bureau)
- Extrapolate until 2095

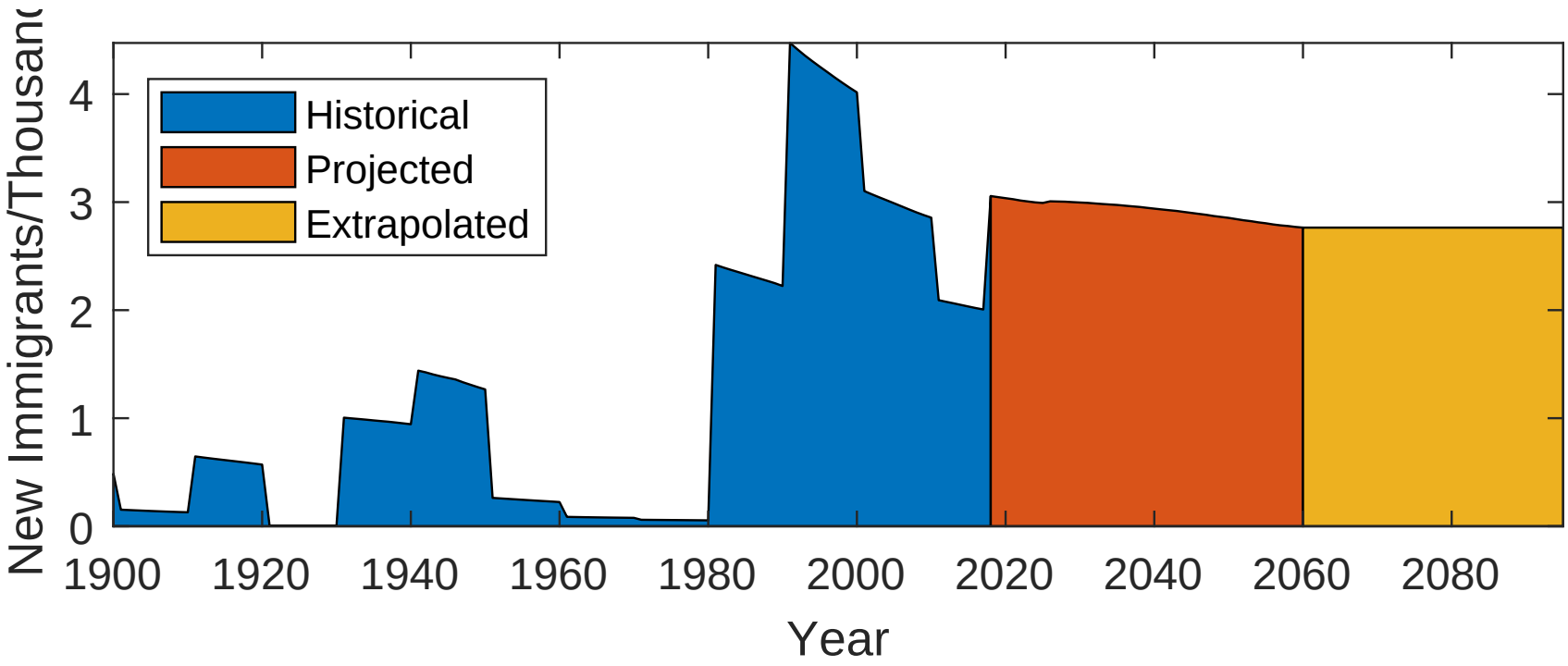
# Assumptions

- Age distribution of entrants equals cross sectional age distribution in 2017.
- Birth rate per year is common to all types.
- Children of immigrants draw from native college attainment distribution.
- Capital of immigrants is the same as natives, per type.

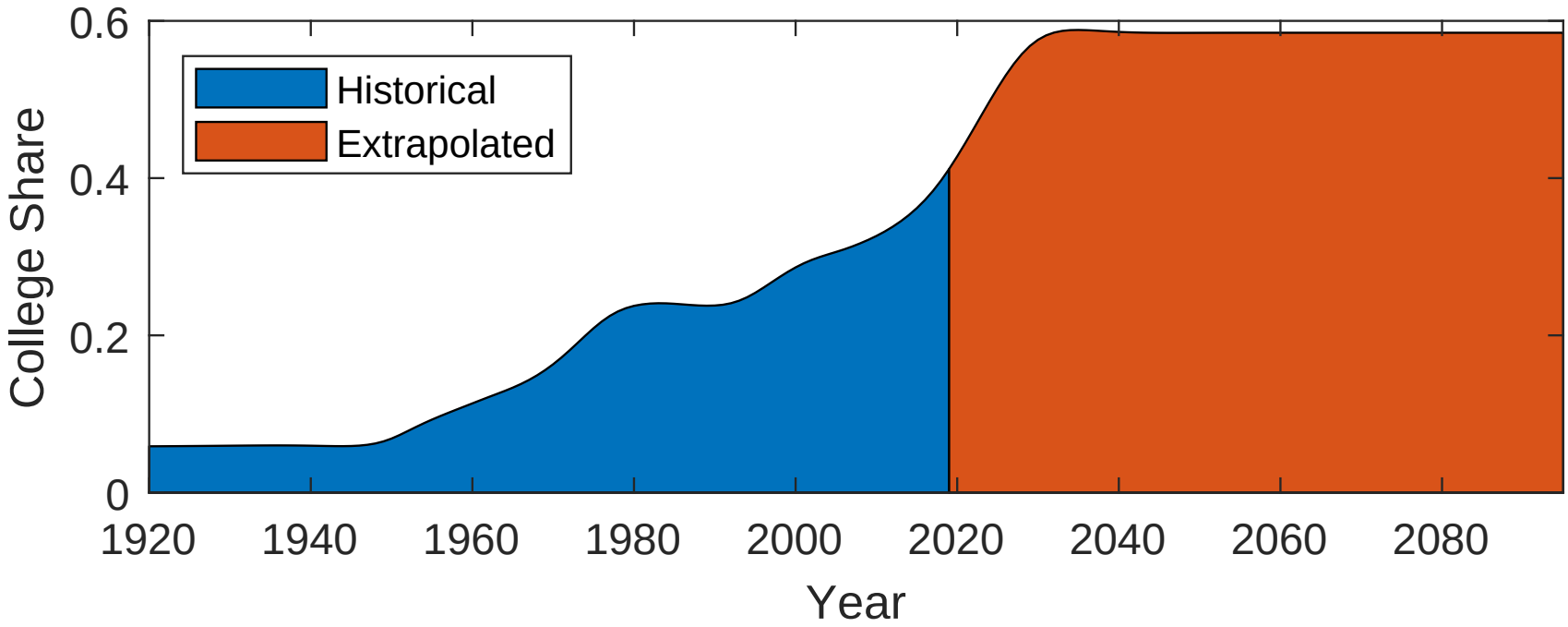
# Birth Rates


30
20
10
0
Births/Thousand
1920
1940
1960
1980
2000
2020
2040
2060
2080
Year
Historical
Projected
Extrapolated

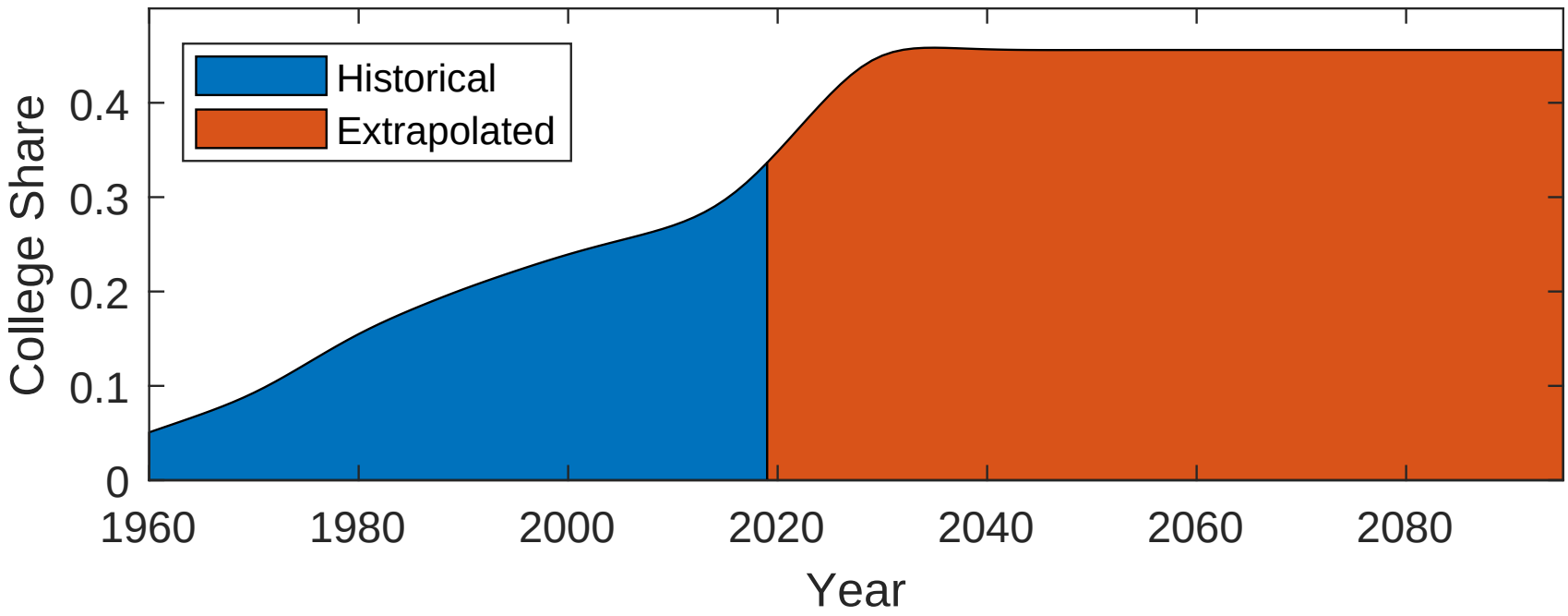
# Immigration Rates



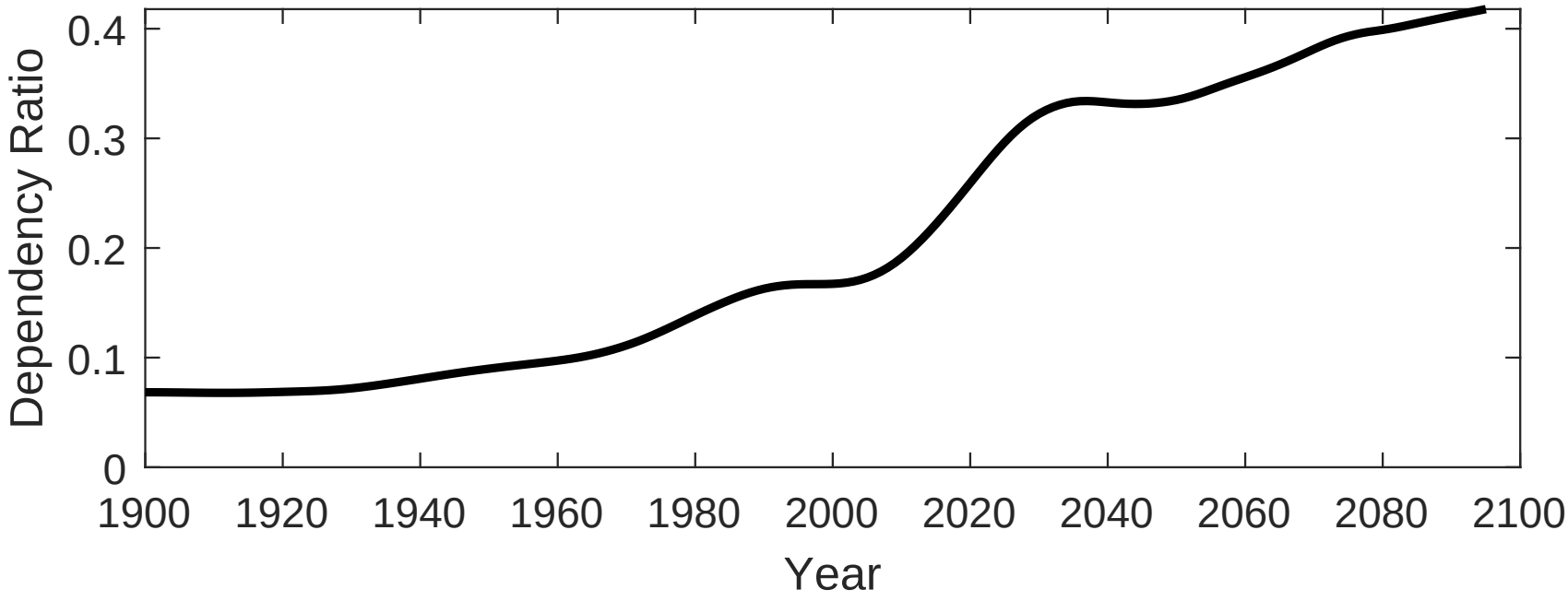
# Education Rates: Natives



# Education Rates: Immigrants



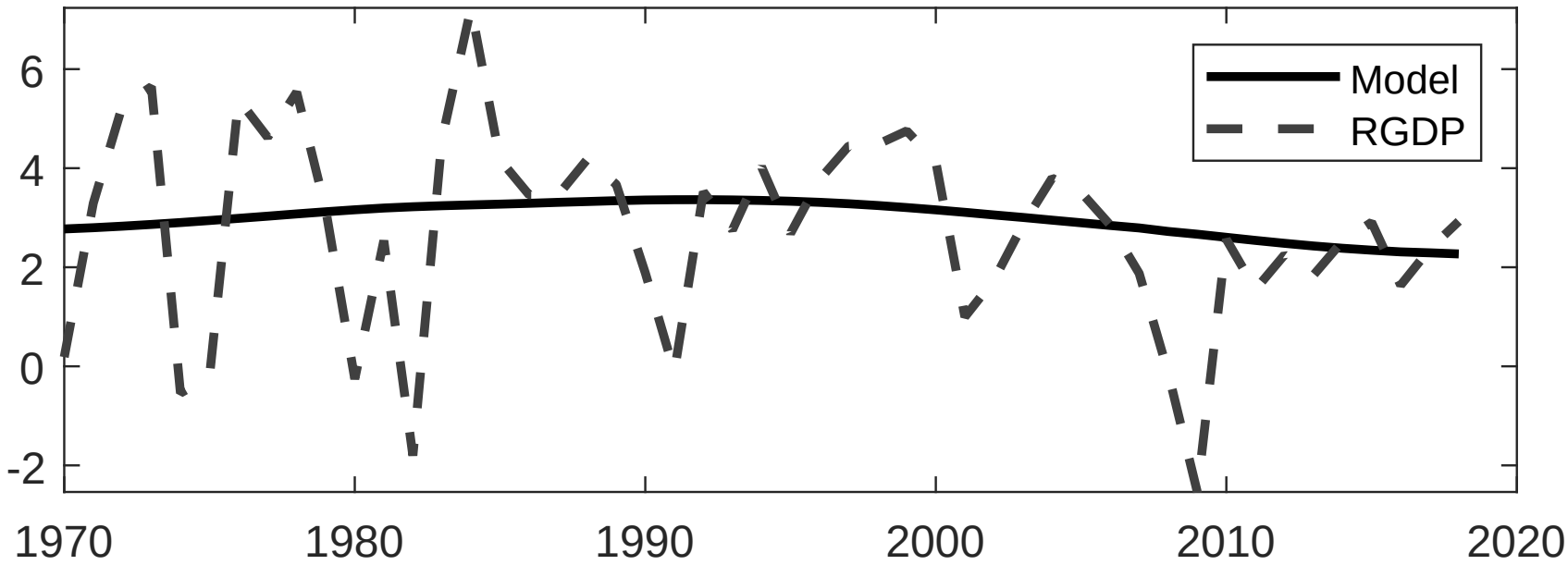
# Dependency Ratio



# Computing Equilibrium Path

- Value function iteration + iterating over K/L ratio
- Problem: Don't want to shock the economy with changing demographics.
- Solution: Add more initial periods until economy is "stationary" over the first N periods.

# Baseline Economy: Economic Growth



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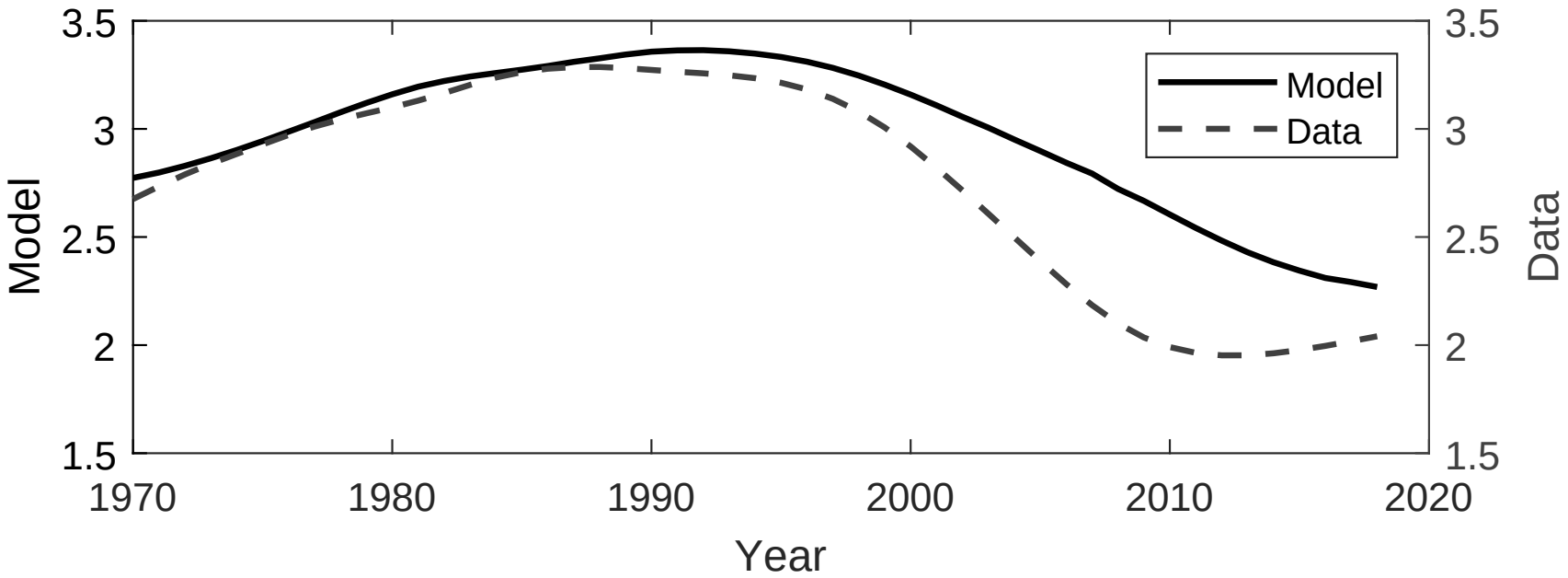
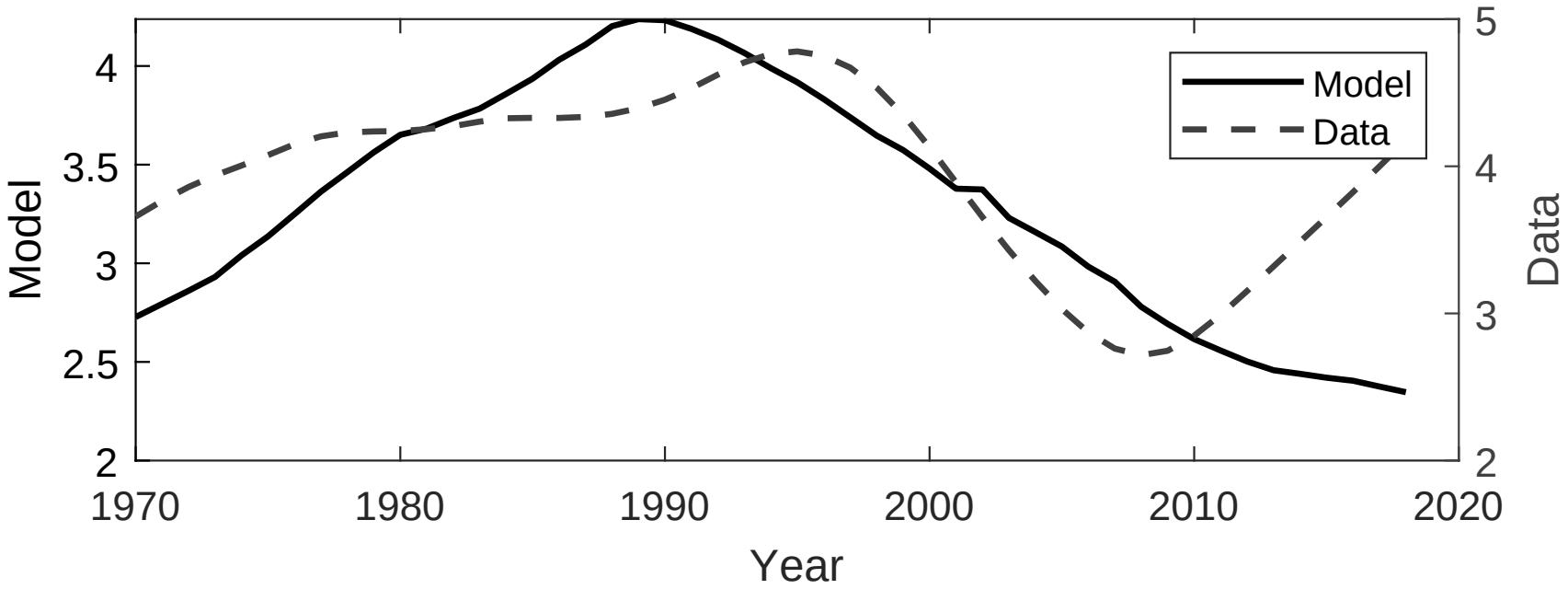
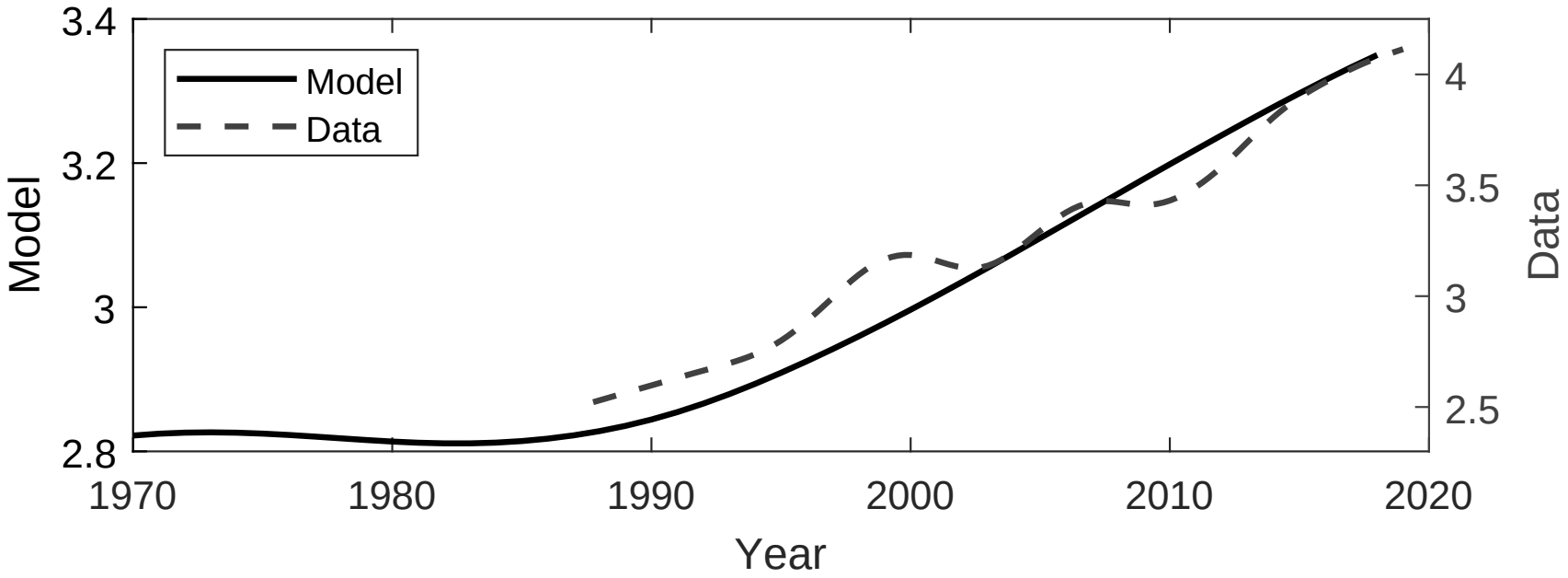


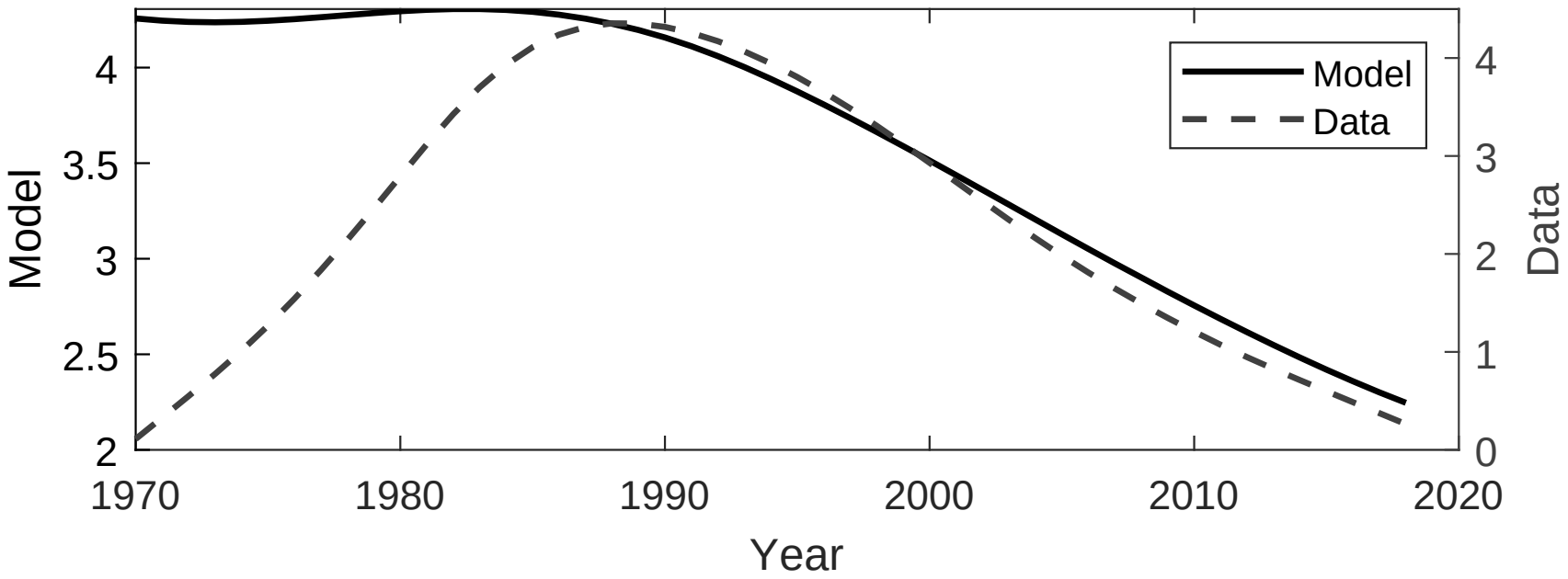
# Baseline Economy: Investment Growth



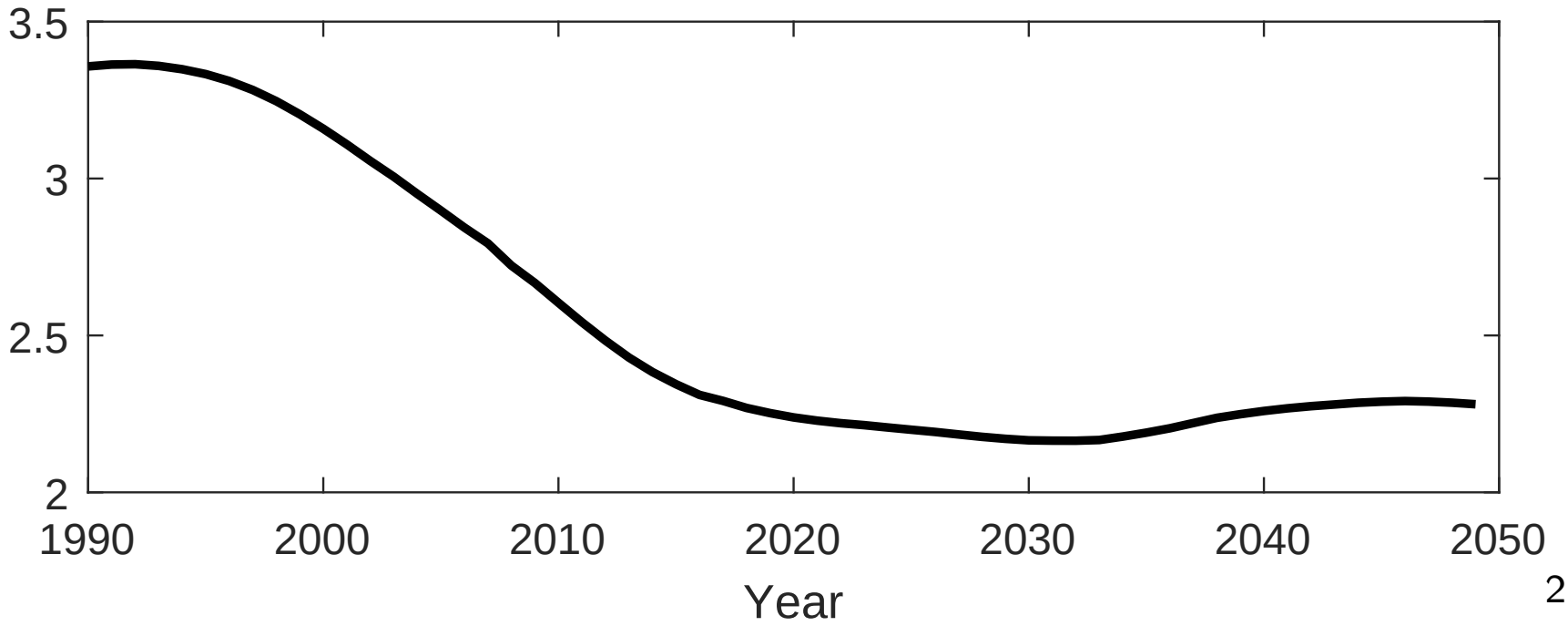
# Baseline Economy: Capital-to-Output



# Baseline Economy: Real Interest Rates

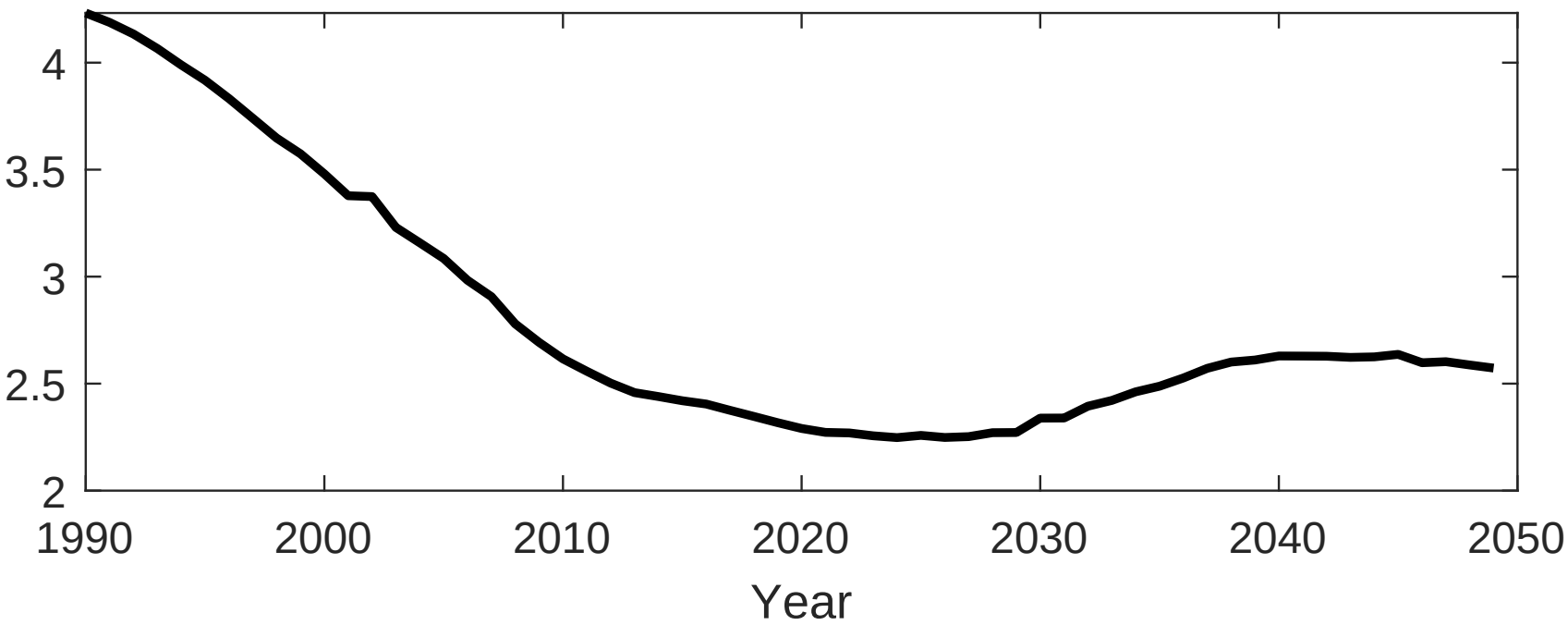


# Baseline Projection: Economic Growth




[2]LR: Population Growth $= 0$, Econ Growth Rate $= g$

# Baseline Projection: Investment Growth



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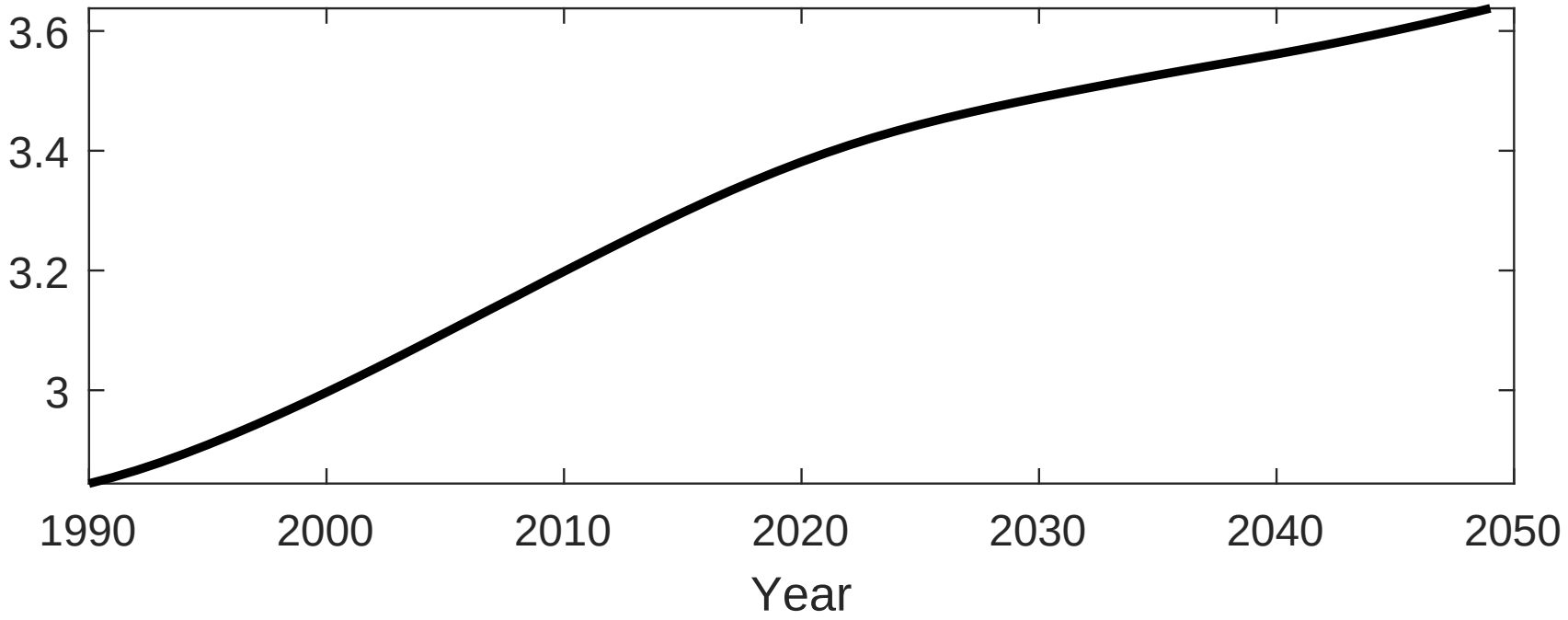

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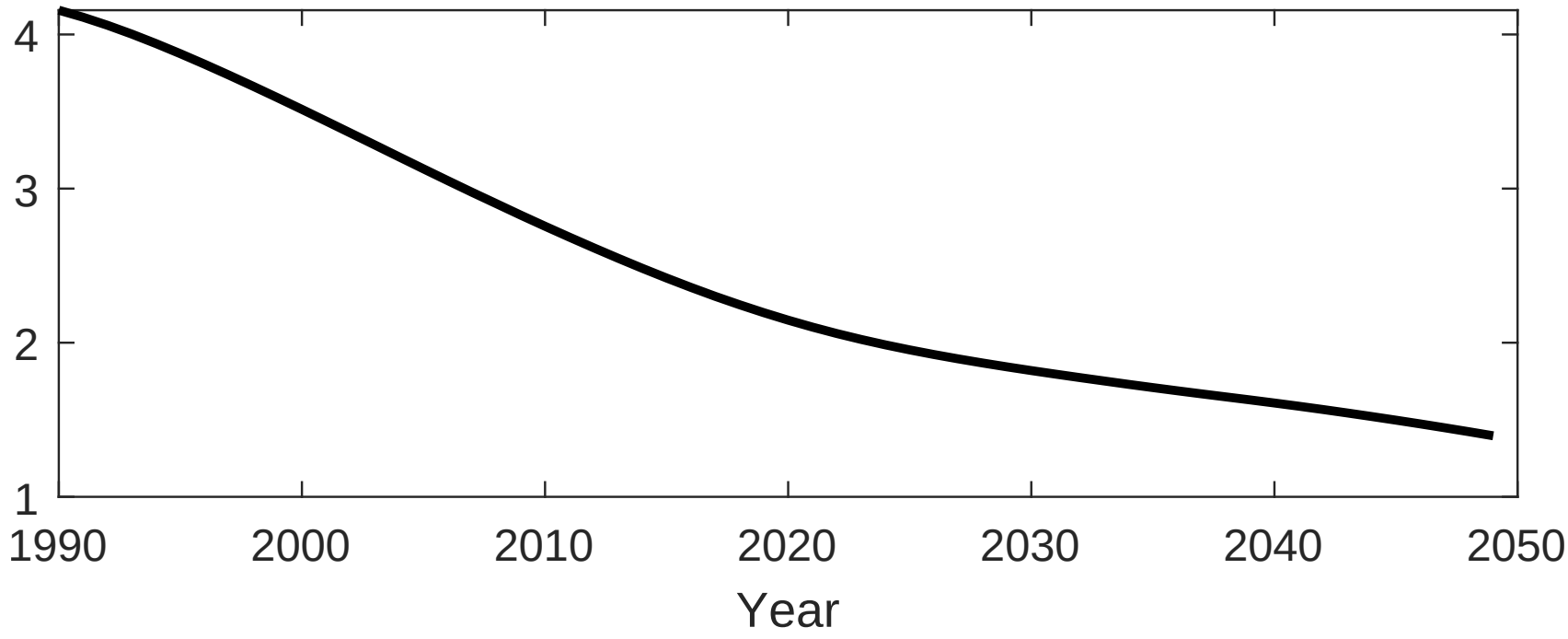


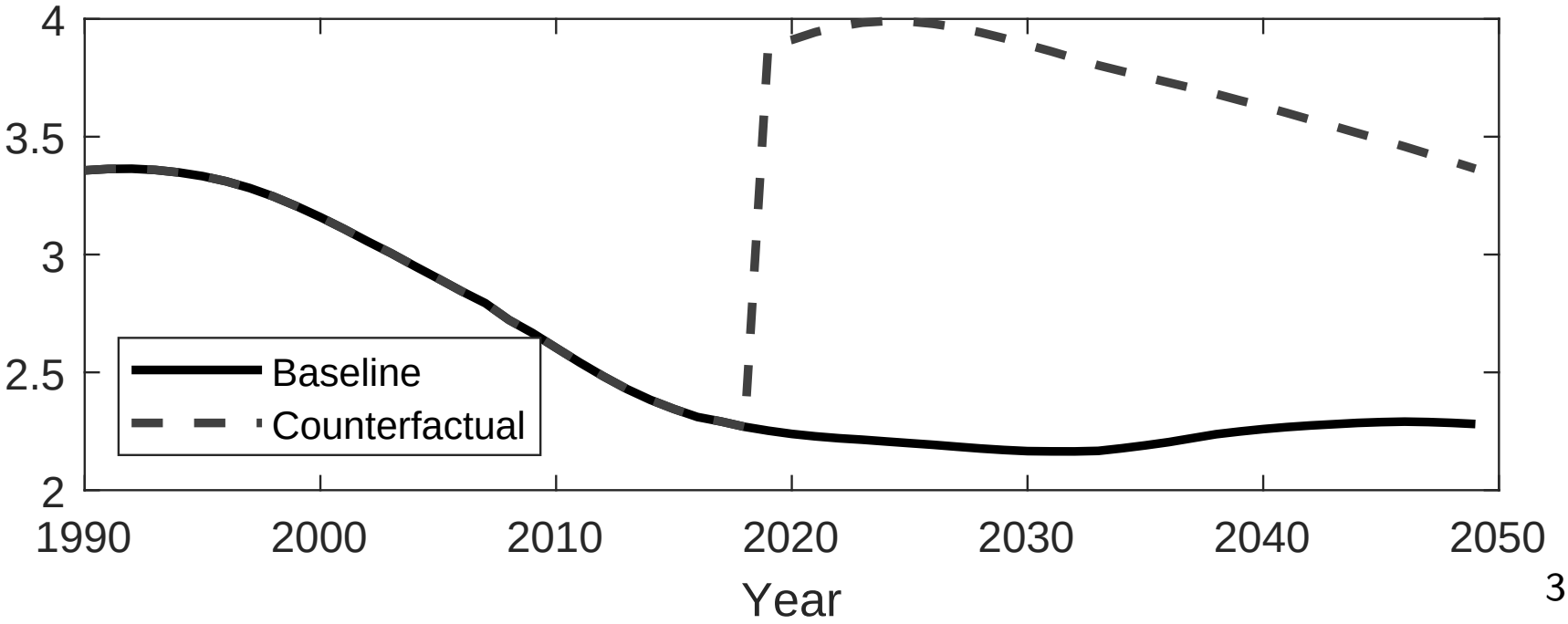
# Counterfactual #1

- Increase the immigration rate by 4 $\times$ baseline

- Mathematically:

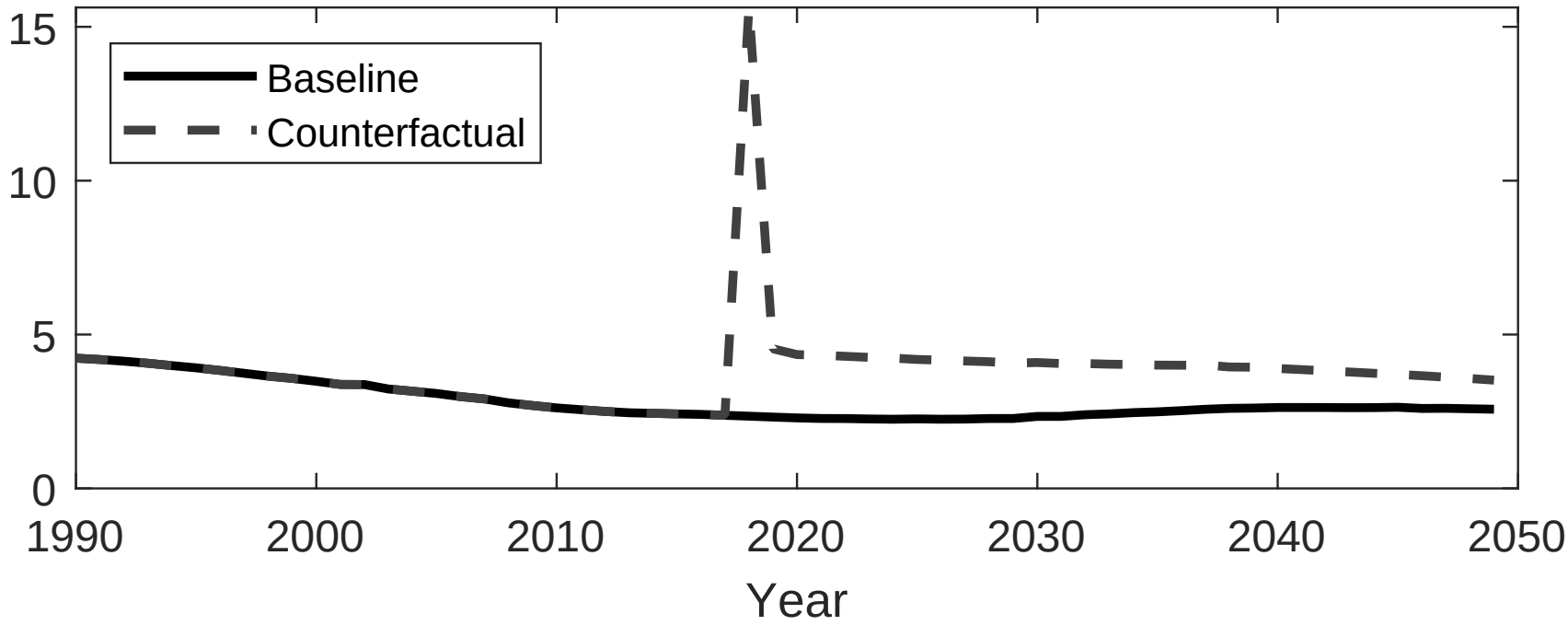
$$\sum_{e \in \{h,l\}} m^{e}_{j,t+1} = 4\psi_t \lambda_{j,t} M_t \tag{18}$$

# Counterfactual #1: Economic Growth

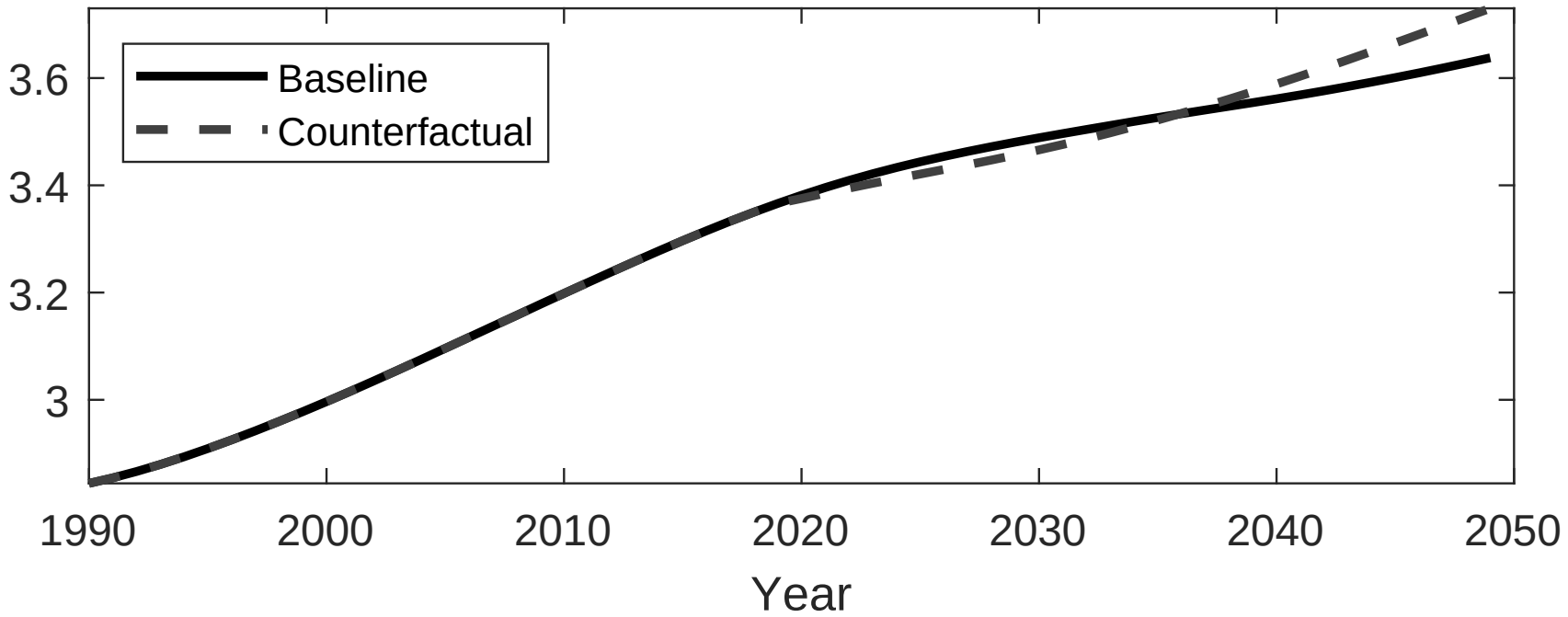



[3] LR: Population Growth = 1.15%, Econ Growth Rate = 2.65%

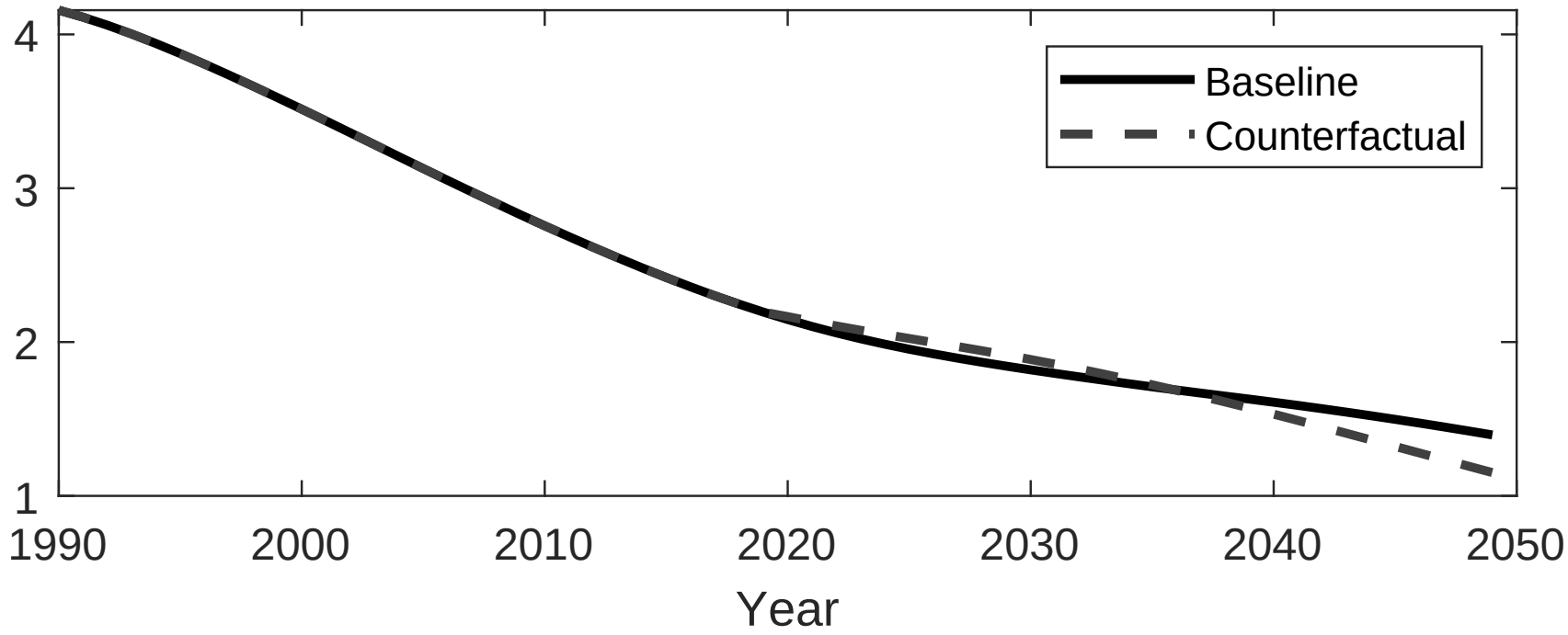
# Counterfactual #1: Investment Growth



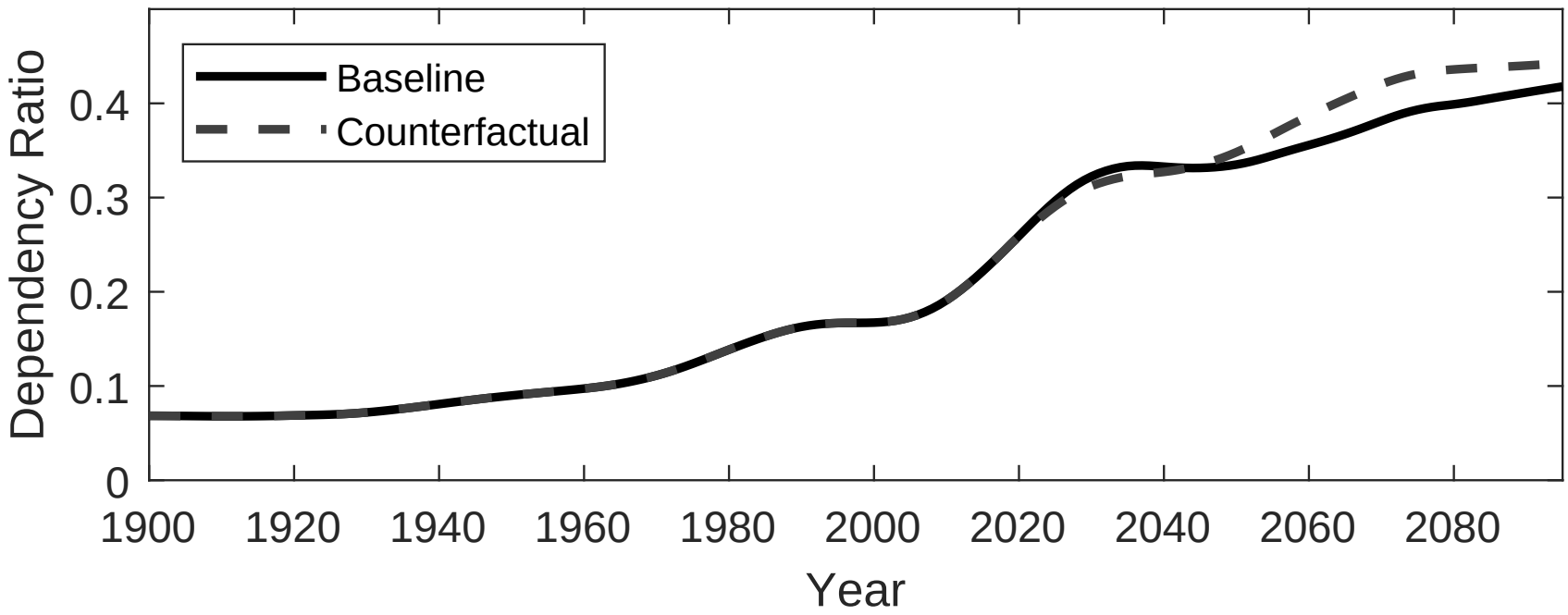
# Counterfactual #1: Capital-to-Output



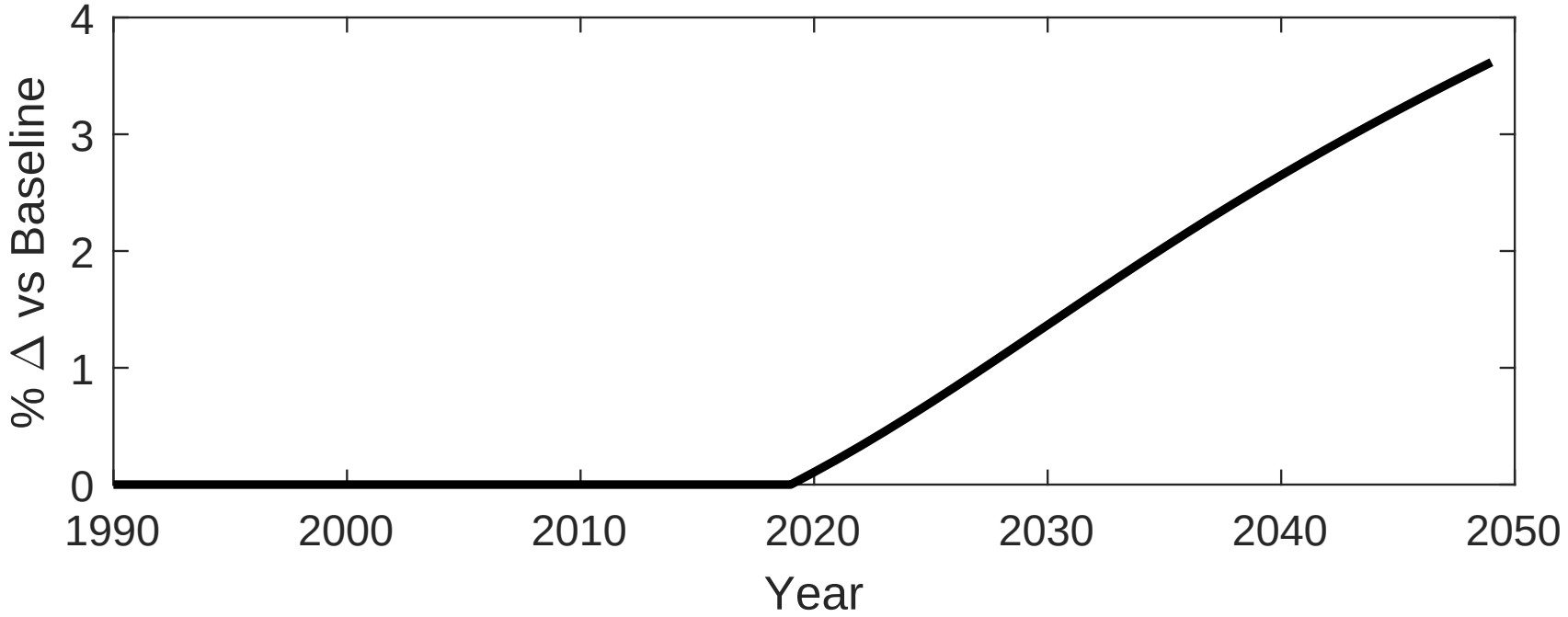
# Counterfactual #1: Real Interest Rates



# Counterfactual #1: Dependency Ratio



# Counterfactual #1: Taxes-to-Output

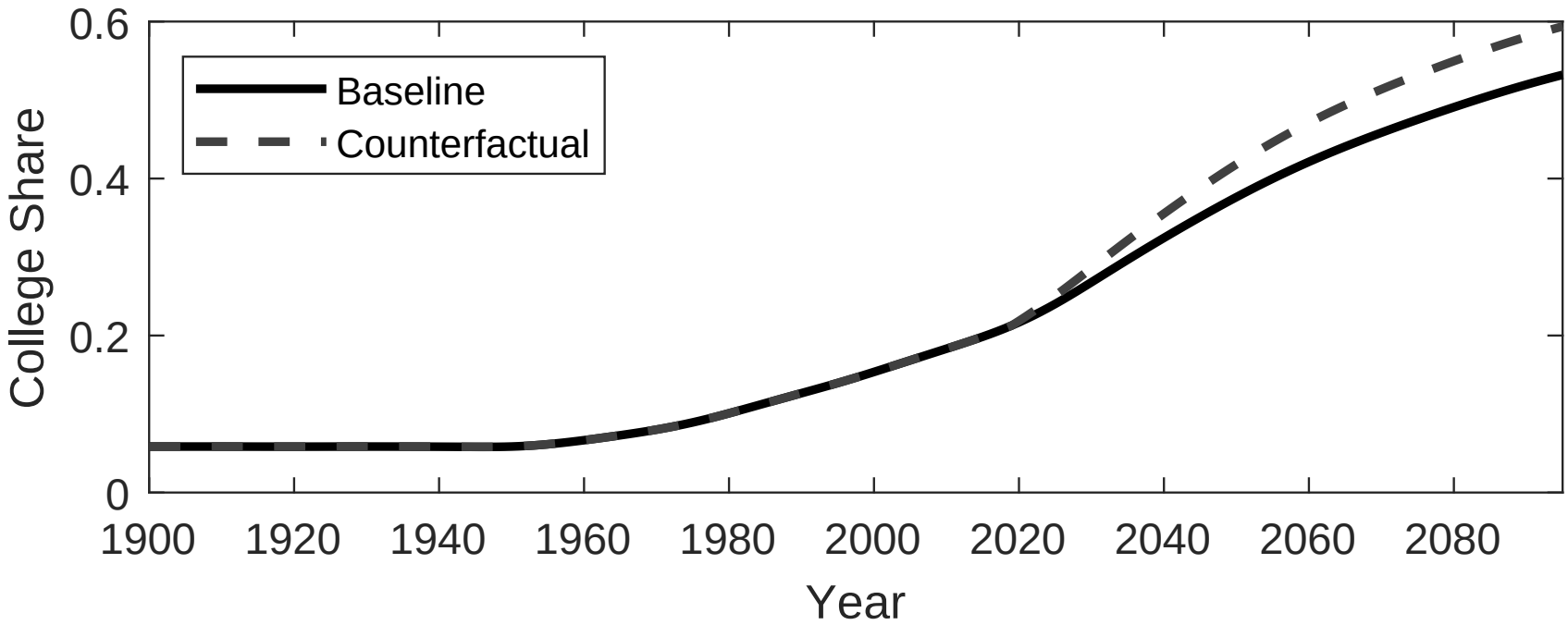


# Counterfactual #2

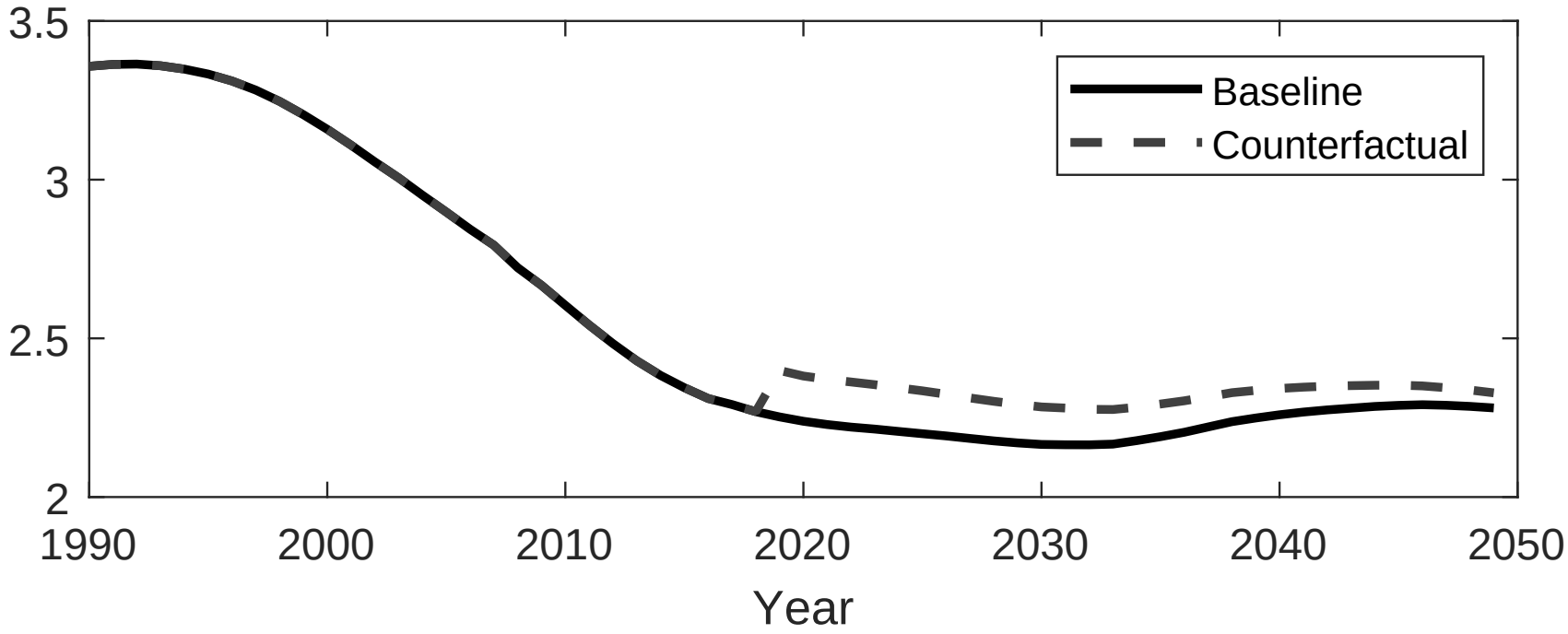
- Permanently increase college requirement to 100% of immigrants

- Gives an upper bound of skill requirement effect

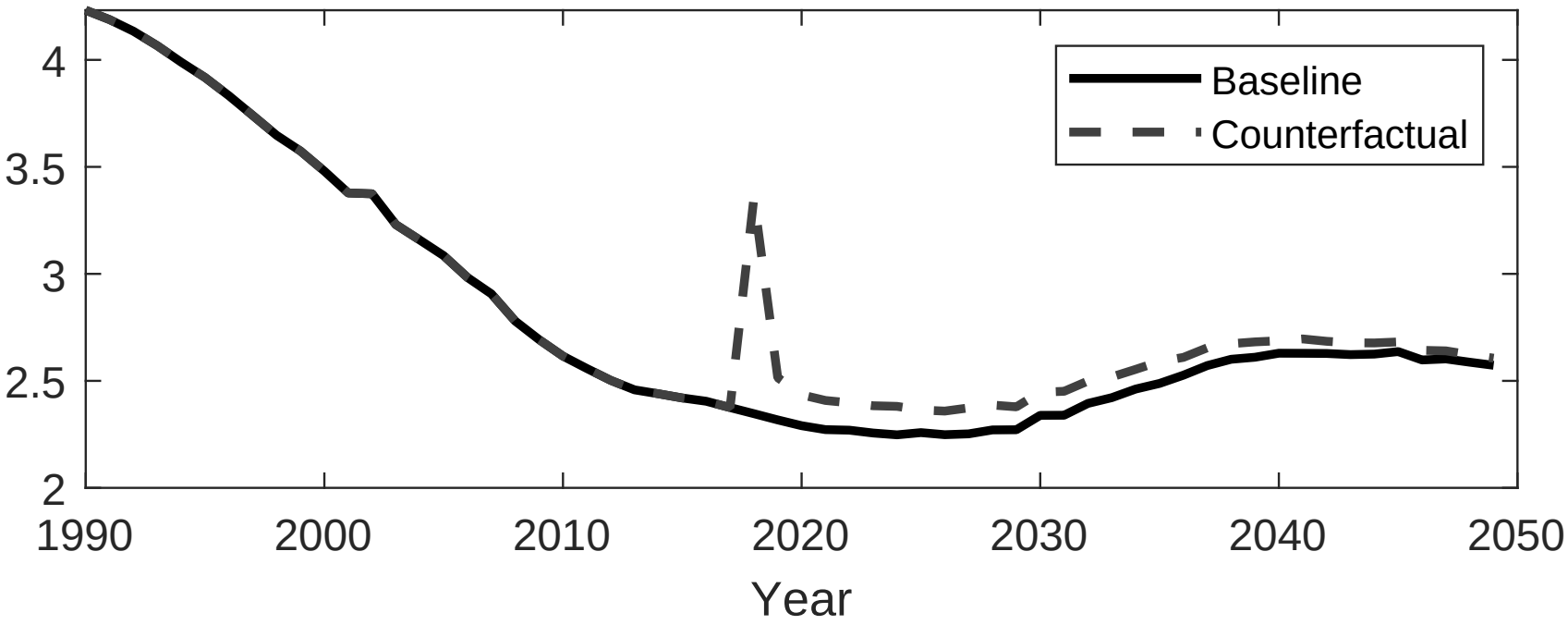
# Counterfactual #2: College Share



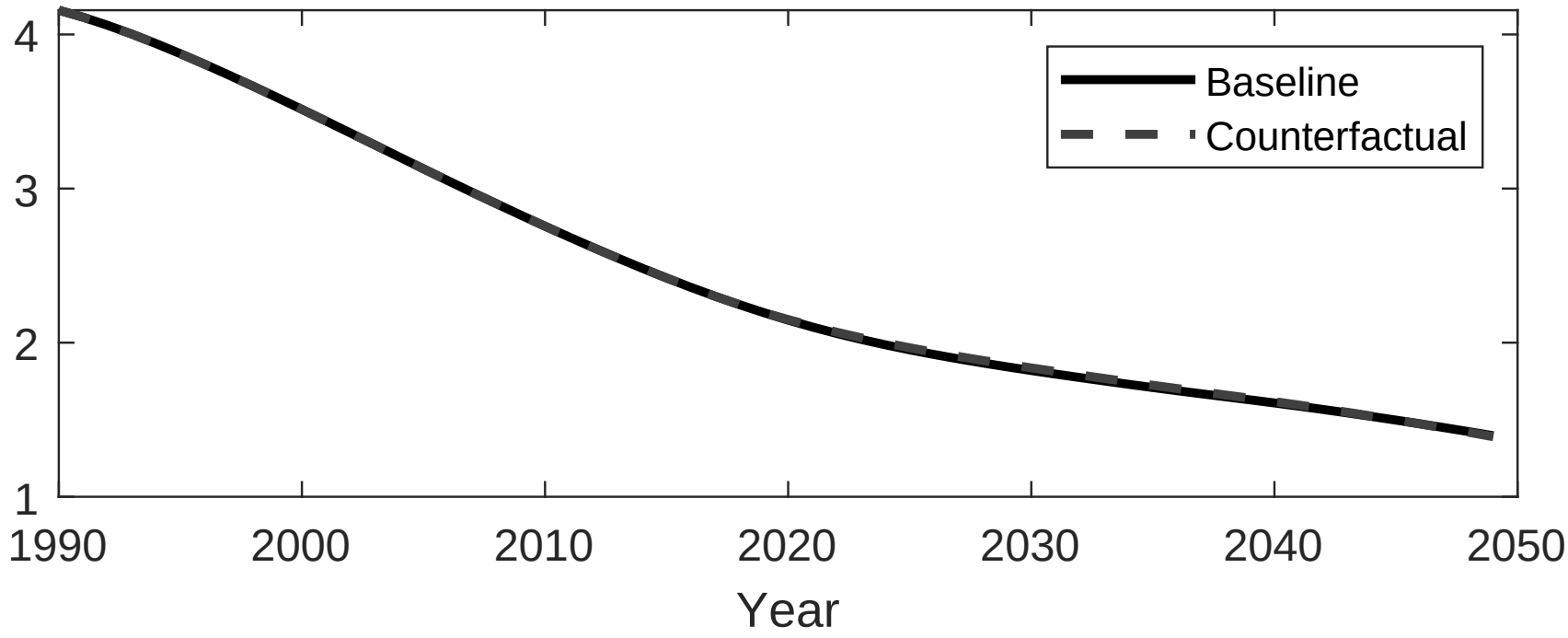
# Counterfactual #2: Economic Growth



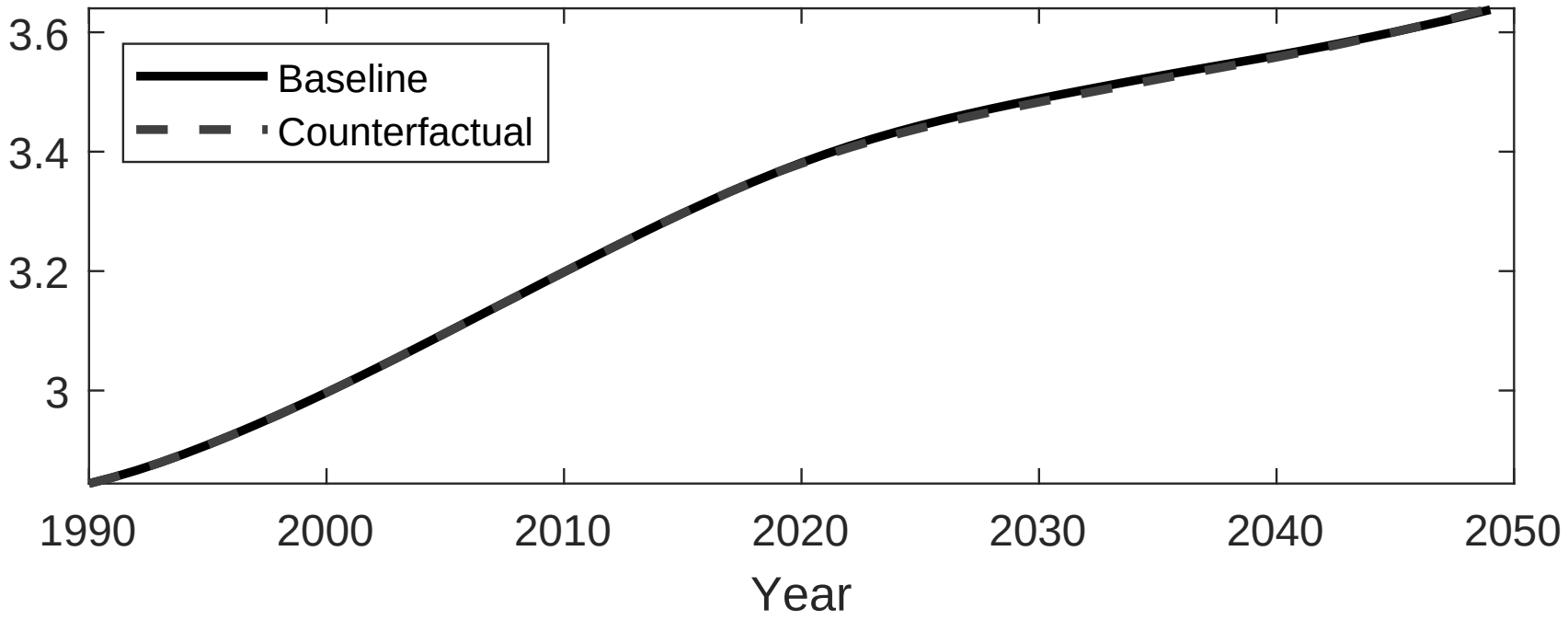
# Counterfactual #2: Investment Growth



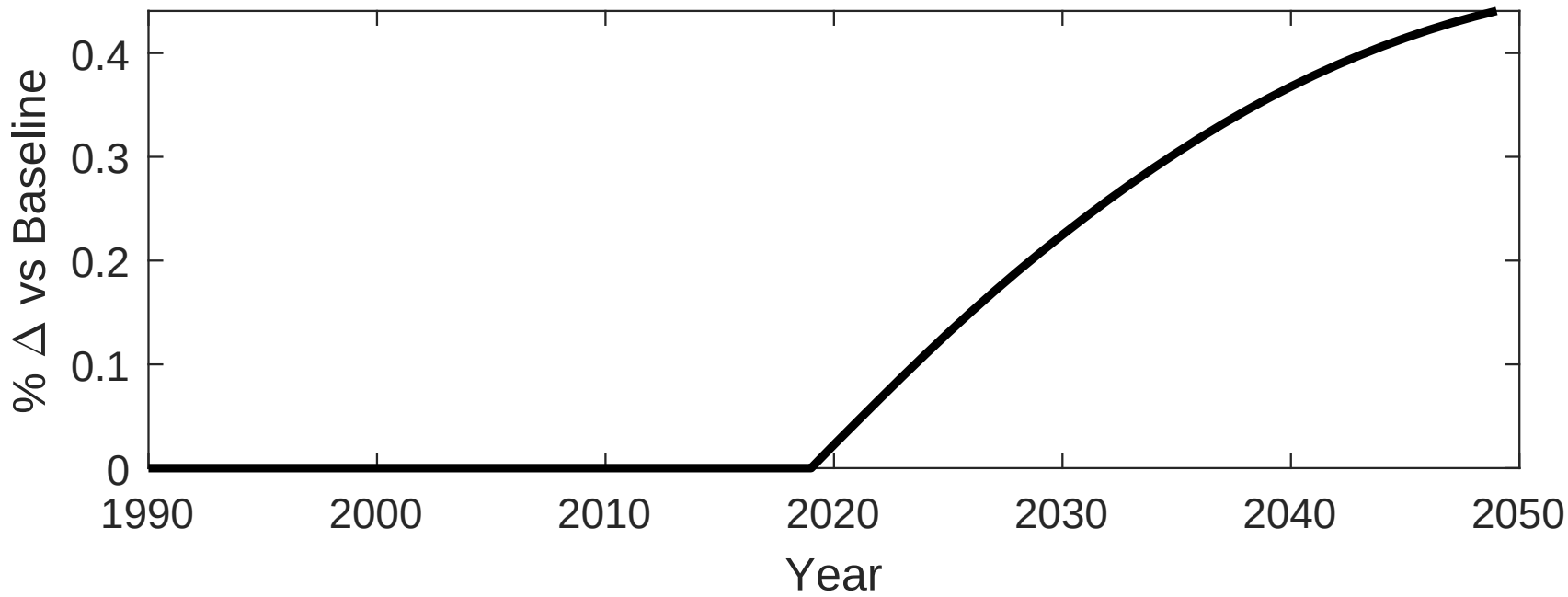
# Counterfactual #2: Real Interest Rates



# Counterfactual #2: Capital-to-Output



# Counterfactual #2: Taxes-to-Output



# Conclusion

- Increased immigration rates might not resolve demographic imbalances.
- Immigration could possibly alleviate budget issues - requires significant immigration and little corresponding government expenditures.
- 4% growth is possible through 4$\times$ immigration rate.

# Future Work

- Improve demographics - e.g., birth rates by type, and data inputs
- Get more out of the model and understand the mechanism
- Richer fiscal policy - e.g., Social Security and government debt
- Evaluate alternative assumptions

# Remaining Questions

- Are prices really determined in a "closed" economy?

- What are the consequences of rising debt?