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

<table>
<thead>
<tr>
<th>Value</th>
<th>’75-’85</th>
<th>’08-’18</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGDP Growth</td>
<td>3.2%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Investment Growth</td>
<td>5.0%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Net Worth/GDP</td>
<td>251%(^1)</td>
<td>372%</td>
</tr>
<tr>
<td>Interest Rates</td>
<td>2.91%</td>
<td>0.86%</td>
</tr>
</tbody>
</table>

\(^1\) 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:

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

(1)

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

(2)

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

(3)

and $a_{j,j+J+1} \geq 0$,

(4)
Firm Optimization

Firms solve:

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

Optimality conditions:

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

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

- Aggregate tax revenue:

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

- Government budget constraint:

\[ G_t = \Phi_t + B_t. \]
Equilibrium

Dynamic general equilibrium: prices \( \{w_t, r_t\} \) and quantities \( \{c_{j,t}^*, n_{j,t}^*, a_{j,t+1}^*\} \) 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:
   - \( K_t = \sum_{j=t}^{t-J+1} \sum_{e \in \{h,l\}} \mu_{j,t}^e a_{j,t+1} \)
   - \( L_t = \sum_{j=t}^{t-J+1} \sum_{e \in \{h,l\}} \mu_{j,t}^e \epsilon e z_{t-j+1} n_{j,t} \)
   - \( Y_t = C_t + K_{t+1} - (1 - \delta) K_t + G_t \)

4. Government budget constraint (9) is satisfied.

5. Accidental bequests received by the government are determined according to

\[
B_t = \sum_{j=t}^{t-J+1} \sum_{e \in \{h,l\}} (1 - s_{j,t}) \mu_{j,t}^e a_{j,t+1}^*.
\] (10)
Equilibrium Error

Normalized Resource Error

Periods
Population Dynamics

- Natives:
  \[ \mu_{j,t+1} = s_{j,t} \mu_{j,t} \quad (11) \]

- Immigrants:
  \[ \tilde{\mu}_{j,t+1} = s_{j,t} \tilde{\mu}_{j,t} + m_{j,t+1} \quad (12) \]

- Population:
  \[ M_t = \sum_{j=t}^{t-J+1} \sum_{e \in \{h,l\}} (\mu_{j,t} + \tilde{\mu}_{j,t}) \quad (13) \]
Population Dynamics

- Native newborns:

\[
\sum_{e \in \{h, l\}} \mu_{t+1, t+1}^{e} = \zeta_t M_t
\]  

(14)

- \(\zeta_t\) is the birth rate at time \(t\).

- Education shares determined by education rates by cohort.
Population Dynamics

- Immigrants:

\[
\sum_{e \in \{h, l\}} m_{j,t}^e = \psi_t \lambda_{j,t} M_t
\]  

(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:

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

(16)

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

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

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

![Birth Rates Graph]

- **Historical**
- **Projected**
- **Extrapolated**

The graph shows the birth rates from 1920 to 2080, with data and projections for the years 1940, 1960, 1980, 2000, 2020, 2040, 2060, and 2080.
Education Rates: Natives

- **Historical**
- **Extrapolated**

Year:
- 1920
- 1940
- 1960
- 1980
- 2000
- 2020
- 2040
- 2060
- 2080

College Share:
- Scale: 0 to 0.6
Education Rates: Immigrants

Year

College Share

Historical

Extrapolated
Dependency Ratio

![Dependency Ratio Graph](image-url)
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
Baseline Economy: Investment Growth

![Graph showing investment growth over years from 1970 to 2020. The graph compares model predictions (solid line) with data (dashed line). There is a peak around 1990 and a decline thereafter.](image-url)
Baseline Economy: Capital-to-Output
Baseline Economy: Real Interest Rates
Baseline Projection: Economic Growth

2LR: Population Growth = 0, Econ Growth Rate = g
Baseline Projection: Investment Growth
Baseline Projection: Capital-to-Output
Baseline Projection: Real Interest Rates

![Graph showing the trend of real interest rates from 1990 to 2050. The graph indicates a downward trend over the years.](image-url)
Counterfactual #1

- Increase the immigration rate by $4 \times \text{baseline}$

- Mathematically:

$$\sum_{e \in \{h,l\}} m_{j,t+1}^e = 4\psi_t \lambda_{j,t} M_t$$  \hspace{1cm} (18)
Counterfactual #1: Economic Growth

LR: Population Growth = 1.15%, Econ Growth Rate = 2.65%
Counterfactual #1: Investment Growth

The graph illustrates the investment growth over the years from 1990 to 2050. The baseline and counterfactual scenarios are compared. The investment growth for both scenarios is projected to decrease over time, with the counterfactual scenario showing a more significant drop after 2020 compared to the baseline.
Counterfactual #1: Capital-to-Output

![Graph showing the comparison between Baseline and Counterfactual Capital-to-Output ratios from 1990 to 2050. The Baseline trend is shown with a solid line, while the Counterfactual is indicated with a dashed line. The y-axis represents the Capital-to-Output ratio, ranging from 3 to 3.6, while the x-axis represents the years from 1990 to 2050. The trend shows a steady increase in both lines, with the Counterfactual line consistently below the Baseline line.]
Counterfactual #1: Real Interest Rates
Counterfactual #1: Dependency Ratio
Counterfactual #1: Taxes-to-Output

% Δ vs Baseline vs Baseline

Year

1990 2000 2010 2020 2030 2040 2050
Counterfactual #2

- Permanently increase college requirement to 100% of immigrants

- Gives an upper bound of skill requirement effect
Counterfactual #2: College Share

The graph shows the college share over time from 1900 to 2080. The baseline is represented by a solid line, while the counterfactual is shown with a dashed line. The y-axis represents the college share, ranging from 0 to 0.6, and the x-axis represents the years from 1900 to 2080.
Counterfactual #2: Economic Growth

![Graph showing economic growth over years with baseline and counterfactual lines. The graph includes years from 1990 to 2050 with economic growth values from 2 to 3.5.](image-url)
Counterfactual #2: Investment Growth

Graph showing investment growth from 1990 to 2050, comparing baseline and counterfactual scenarios.
Counterfactual #2: Real Interest Rates
Counterfactual #2: Capital-to-Output

![Graph showing the capital-to-output ratio from 1990 to 2050, with baseline and counterfactual curves.

- Baseline curve
- Counterfactual curve


Values: Baseline 3, 3.2, 3.4, 3.6

Values: Counterfactual 3.2, 3.4, 3.6]
Counterfactual #2: Taxes-to-Output

The diagram shows the percentage change in taxes-to-output vs baseline over years from 1990 to 2050. The percentage change increases gradually from 0 in 1990 to around 0.4 in 2050.
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?