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

- 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. \hspace{1cm} c_{j,t} = w_t e z_{t-j+1} n_{j,t} + (1 + r_t) a_{j,t} - a_{j,t+1} - \phi_e(\cdot) \hspace{1cm} (2)

$$\phi_e(\cdot) = \tau_e (w_t e z_{t-j+1} n_{j,t} + r_t a_{j,t}) \hspace{1cm} (3)$$

and \hspace{1cm} a_{j,j+J+1} \geq 0, \hspace{1cm} (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

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

Normalized Resource Error

$\times 10^{-15}$

0 100 200 300 400 500 600
Periods
-5
0
5

0 100 200 300 400 500 600
Periods

Normalized Resource Error

$10^{-15}$

0 100 200 300 400 500 600
Periods

$10^{-15}$
Population Dynamics

▶ Natives:

\[ \mu_{j,t+1}^{e} = s_{j,t} \mu_{j,t}^{e} \] (11)

▶ Immigrants:

\[ \tilde{\mu}_{j,t+1}^{e} = s_{j,t} \tilde{\mu}_{j,t}^{e} + m_{j,t+1}^{e} \] (12)

▶ Population:

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

- Native newborns:

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

(14)

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

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

- Immigrants:

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

(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:

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

(16)

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

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

(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.
## Parameters

<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.
Immigration Rates

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

The graph shows the historical, projected, and extrapolated immigration rates from 1900 to 2080. The trends indicate a significant increase in immigration rates from 1920 to 2000, with a peak in the early 2000s. The projected rates suggest a continued increase, while the extrapolated rates show a sustained high rate of immigration.
Education Rates: Immigrants

![Chart showing education rates for immigrants from 1960 to 2080, comparing historical and extrapolated data. The chart indicates a steady increase in college share with predictions reaching up to 0.4 by 2080.]
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: Economic Growth
Baseline Economy: Investment Growth
Baseline Economy: Capital-to-Output

![Graph showing the model and data for capital-to-output ratio from 1970 to 2020. The graph illustrates the gradual increase in capital-to-output ratio over time, with the model line showing a consistent upward trend compared to the data line.](chart.png)
Baseline Economy: Real Interest Rates
Baseline Projection: Economic Growth

\[ 2 \text{LR: Population Growth} = 0, \text{Econ Growth Rate} = g \]
Baseline Projection: Investment Growth
Baseline Projection: Capital-to-Output
Baseline Projection: Real Interest Rates
Counterfactual #1

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

- Mathematically:

\[
\sum_{e \in \{h, l\}} m_{j,t+1}^e = 4 \psi_t \lambda_{j,t} M_t \tag{18}
\]
Counterfactual #1: Economic Growth

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

- **Baseline**
- **Counterfactual**

The graph illustrates the comparison between baseline and counterfactual investment growth over the years from 1990 to 2050. The baseline shows a gradual decrease in investment growth, while the counterfactual displays a significant decline at around 2020.
Counterfactual #1: Capital-to-Output
Counterfactual #1: Real Interest Rates

![Graph showing Real Interest Rates over time](image-url)
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

![Graph showing the college share over time from 1900 to 2080. The graph compares the baseline and counterfactual scenarios. The baseline trend is indicated by a solid line, while the counterfactual is shown by a dashed line. The college share increases over time.]
Counterfactual #2: Economic Growth

![Graph showing economic growth over time with baseline and counterfactual curves.](image-url)
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?