Can Guest Workers Solve Japan’s Fiscal Problems?

S. İmrohoroğlu, S. Kitao, and T. Yamada

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Research Question
Model
Calibration
Policy experiments
Welfare analysis
Extension
Conclusion
Basic Issue: Indebted and Disappearing Japan

Three significant challenges faced by Japan

1. High debt to output ratio (close to 150%)
2. Projected increase in government expenditures due to aging population
   - Spending to output projected to rise by 7% due to increases in public pension and health spending
3. Projected decline in "bodies"
   - Total: 127 million in 2010 to 50 million in 2100
   - Working age: 60 million in 2010 to 20 million in 2100

We explore the impact of various guest worker programs on (i) the fiscal sustainability and (ii) the welfare effects on the native born workers
High Debt to GNP Ratio

Figure: Net Debt to GNP Ratio (Ministry of Finance)
Disappearing Japan

Figure: Total and Working Age Population in Japan (Figure 8 in İmrohoroğlu, Kitao, and Yamada (2014))
What We Do

• Construct a general equilibrium model with overlapping generations of individuals
• Calibrate the model to Japanese micro data
• Incorporate the projected Japanese demographics and government accounts
• Compute a benchmark transition toward a final balanced growth path
• Compute alternative transitions indexed by a particular guest worker policy
• Measure impacts on the fiscal sustainability
• Compute welfare effects on current and future cohorts
What We Find

1. 200,000 workers for 10 years ↔ Current govt’s proposal
   ○ reduction of 0.5 to 1.1% points in terms of consumption tax rate in a few years
   ○ 2 to 4% points in a few decades
   ○ 3 to 5% points in the long run

2. U.S.-style (16.4% of employment)
   ○ 3 to 5% points in a 5 years
   ○ 6 to 10% points in a few decades
   ○ 3 to 6% points in the long run

• Very large welfare gains
  ○ 1 to 2% points of CEV for current cohorts
  ○ 2 to 4% points of CEV for future cohorts
Related Literature

- Evaluate the size of the fiscal problem in Japan
  - Doi, Hoshi, and Okimoto (2011)
  - İmrohoroğlu and Sudo (2011a, 2011b)
  - Hoshi and Ito (2014)
  - Hansen and İmrohoroğlu (2015)
  - İmrohoroğlu, Kitao, and Yamada (2014)
  - Braun and Joines (2014), Kitao (2015a, 2015b)

- Immigration issues
  - Fehr, Jokisch and Kotlikoff (2004)
  - Shimasawa and Oguro (2010)
Model Overview

- A large scale overlapping generations model
- Benchmark model: *no* foreign workers
  - Introduce them in policy experiments
- Individuals enter the economy at age $j = 1$, retire after $j^R$, can live up to $J$ years
- Demographics:
  - $s_{j,t}$: survival probability
  - $n_{j,t}$: cohort size
  - The cohort size $n_{j,t}$ evolve as
    \[ n_{j+1,t+1} = s_{j,t} n_{j,t} \]
Individuals’ Problem

Individuals’ maximize utility over the life cycle:

\[ U = \sum_{j=1}^{J} \beta^{j-1} S_{j,t+j-1} c_{j,t+j-1}^{1-\theta} (1-\theta). \]

- \( \beta \): discount factor
- \( S_{j,t+j-1} = \prod_{k=1}^{j-1} s_{k,t+k-1} \): unconditional survival probability
- \( c_{j,t} \): consumption of age \( j \) at time \( t \)
- \( \theta \): inverse of the intertemporal elasticity of substitution
Individuals’ Problem (cont.)

After-tax earnings:

\[ \tilde{y}_{j,t} = (1 - \tau_{l,t} - \tau_{p,t})y_{j,t}\Lambda_{j,t} \]

- \( y_{j,t} = w_t \eta_j \): before-tax earnings
  - \( w_t \): wage, \( \eta_j \): age-specific productivity
- \( \Lambda_{j,t} \in [0, 1] \): employment rate of age \( j \) at \( t \)
- \( \tau_{l,t} \): labor income tax \( \leftarrow \) exogenous
- \( \tau_{p,t} \): payroll tax for public pension \( \leftarrow \) exogenous
Individuals’ Problem (cont.)

Budget constraint:

\[ c_{j,t}(1 + \tau_{c,t}) + s_{j,t}a_{j+1,t+1} = \tilde{y}_{j,t} + p_{j,t} + tr_t + R_t a_{j,t} \]

- \( \tau_{c,t} \): consumption tax rate \( \leftarrow \) endogenous
- \( s_{j,t} \): actuarially fair price of annuity
  - assume perfect annuity markets
- \( a_{j,t} \): a composite of firms’ capital and government bonds
- \( R_t \): after-tax gross return
- \( p_{j,t} \): pension benefit \( (> 0 \text{ if } j \geq j^R) \)
- \( tr_t \): non-pension lump-sum transfer
Savings on capital and government bond:

- Two types of assets: capital and government bond
  - different interest rates: $r_{k,t}$ and $r_{b,t}$
- Share parameter $\phi_t$: exogenous
- After-tax gross return on individuals’ savings
  - $\phi_t$: bond holdings, $1 - \phi_t$: capital holdings
  
  $R_t = 1 + (1 - \tau_{k,t})r_{k,t}(1 - \phi_t) + (1 - \tau_{b,t})r_{b,t}\phi_t$
Technology

- **Production technology:**
  \[ Y_t = Z_t K_t^\alpha L_t^{1-\alpha} \]

- **Factor prices:**
  \[ r_{k,t} = \alpha Z_t \left( \frac{K_t}{L_t} \right)^{\alpha-1} - \delta, \quad w_t = (1 - \alpha) Z_t \left( \frac{K_t}{L_t} \right)^\alpha \]

- \( K_t = (1 - \phi_t) \sum_j a_{j,t} n_{j,t} \): aggregate capital
- \( L_t = \sum_j \eta_j \Lambda_{j,t} n_{j,t} \): aggregate labor
Government and Fiscal Policies

Government budget:

\[(1 + r_{b,t})B_t + G_t + P_t + TR_t = T_t + B_{t+1}\]

- \(B_{t+1}\): issuance of new debt
- \(G_t\): (exogenous) government expenditure
- \(P_t\): pension benefits to retirees
- \(TR_t\): transfers to individuals
- \(T_t\): total tax revenues
Government and Fiscal Policies (cont.)

Government budget:

\[
T_t = \tau_{c,t} \sum_j c_{j,t} n_{j,t} + \sum_j (\tau_{l,t} + \tau_{p,t}) y_{j,t} \Lambda_{j,t} n_{j,t} \\
+ [\tau_{k,t} r_{k,t} (1 - \phi_t) + \tau_{b,t} r_{b,t} \phi_t] \sum_j a_{j,t} n_{j,t}
\]

\[
G_t = \sum_{j,t} g_{j,t} n_{j,t}
\]

\[
P_t = \sum_j p_{j,t} n_{j,t}
\]

\[
TR_t = tr_t \sum_j n_{j,t}
\]
Calibration

- **Target:** Japanese economy in 2014 (initial SS)
  - final SS: a balanced growth path with stationary population
- **Demography:**
  - \( \{s_j,t\} \): estimates by the National Institute of Population and Social Security Research from 2014 to 2060
  - Converges to a stationary population in 2200
- **Preferences:**
  - \( \beta = 1.0162 \Rightarrow K/Y = 2.5 \)
  - \( \theta = 2 \Rightarrow IES = 0.5 \)
- **Technology:**
  - \( Z_{t+1}/Z_t = 1.5% \): per-capita output growth of about 1%
  - \( \delta = 0.0821, \alpha = 0.3794 \)
Tax Rates

- **Initial SS:**
  - $\tau_l = 18\%$: Gunji and Miyazaki (2011)
    - 33% in 2007 net of pension premium 15%
  - $\tau_p = 18\%$: approximation of the premium for the employment based pension (*kosei nenkin*)
  - $\tau_k = 35\%$: corporate tax rate
  - $\tau_b = 20\%$: tax on the interest paid on government debt
  - $\tau_{c,2014} = 8\%$: actual consumption tax rate

- **Transition:**
  - $\{\tau_{c,t}\}$ is *endogenously* determined after 2015 to achieve the government budget balance
Government Expenditures

- Per-capita government expenditure: $G/Y = 0.18$
- Replacement rate $\kappa_t$: $P_t/Y_t = 0.106$
  - Adjusted by the “macroeconomic slide”
- $B_t/Y_t = 130\%$: the debt to GDP ratio fixed
- $r_{b,t} = 1\%$: return from the government bond exogenous
Underlying Assumptions

- **Guest workers**
  - come to Japan at age 35 and stays for 10 years
  - pay $\tau_l$ and $\tau_c$, but they do not pay $\tau_p$ (premium)
  - consume 50% of earnings (net of consumption tax)
  - do not save domestically
    - send their earnings to their own economies
  - the government incurs medical expenditure $g_{j,t}^*$ for each guest worker
    - $g_{j,t}^* = 0.5m_{j,t}$
Guest Worker Programs

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Annual Flow of Foreign-Born Workers</th>
<th>Their Relative Skill Level</th>
</tr>
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<tbody>
<tr>
<td>Experiment 1</td>
<td>100,000</td>
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<td>50%</td>
</tr>
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<td>100%</td>
</tr>
<tr>
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<td>Experiment 6</td>
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- **Exp 1** and **Exp 2**: unskilled workers
- **Exp 3** and **Exp 4**: average native-born workers
Guest Workers: Number and Share

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## Experiment 1 and 2

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Capital: Baseline and Changes

- Left: the time path of detrended capital
- Right: the ratio to the baseline model
Labor: Baseline and Changes

- Left: the time path of detrended labor
- Right: the ratio to the baseline model
Output: Baseline and Changes

- Left: the time path of detrended output
- Right: the ratio to the baseline model
Interest Rate: Baseline and Changes

- Left: the time path of interest rate (%)
- Right: %-difference
Wage: Baseline and Changes

- Left: the time path of detrended wage
- Right: the ratio to the baseline model
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## Experiment 3 and 4

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Interest Rate and Wage

- Left: interest rate (%-difference), Right: wage
Consumption Tax Rate

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## Experiment 5 and 6

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Consumption Tax Rate

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Welfare analysis: CEV

- We compute the consumption equivalent variation (CEV) for individuals at each age.
- What percent of consumption over the remaining life time each individual needs in the benchmark transition in order to achieve the same remaining life time utility under an alternative transition?
- For individuals born in 2015 and later, we compute a similar CEV that equalizes life time utilities across the benchmark and an alternative transition.
- A CEV of 1%, for example, implies that an individual is better off if a guest worker program is introduced; his remaining life-time utility would be the same in the baseline economy if his consumption in each period were raised by 1%.
Welfare Effects of Experiments 1-4

- Left: the welfare effects in CEV from guest worker programs on the generations alive in 2014
- Right: the CEV for future generations
Welfare Effects of Experiments 5-6

- Left: the welfare effects in CEV from guest worker programs on the generations alive in 2014
- Right: the CEV for future generations
## Partial Equilibrium Analysis

<table>
<thead>
<tr>
<th>Year</th>
<th>GE</th>
<th>PE</th>
<th>Exp 1</th>
<th>Exp 2</th>
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<th>Exp 4</th>
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<td>11.35</td>
<td>11.10</td>
<td>10.86</td>
<td>10.86</td>
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<td>2020</td>
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<td>12.56</td>
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<td>2040</td>
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### “Immigration” Policy

<table>
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<th>Year</th>
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<td>4.43</td>
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Conclusion

- Japan is facing a severe aging-induced fiscal problem.
- If current spending policy is maintained with debt stabilized around 200%, a huge consumption tax rate (50%) is needed to achieve fiscal sustainability (Hansen and İmrohoroğlu, Braun and Joines)
- Even a relatively small policy has measurable fiscal effects and large welfare gains
- A U.S.-style program essentially solves Japan’s fiscal problems
  - Needed consumption tax much lower
  - Welfare gains under this program are even larger
- Political feasibility?