Estimating the impact of immigrants on the host country social security system when return migration is an endogenous choice

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(International Economic Review, 2012)

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March 8, 2016
Motivation

- Many European countries facing a Social security crisis due to an aging native population.

- Old-age dependency ratio in Germany: From 21.7% in 1990 to 49.2% in 2030.

- Immigration: Potential alternative to tax hikes or lower benefits.

- Standard approach: Treat return migration as an exogenous factor.

- Research question: What is the fiscal impact of immigrants? Focus on Germany.
Main Contribution and Results

- **This paper:** Calculate the **net gain** of the German **pension** (PI) and **unemployment** insurance (UI) systems from immigrants by country of origin and age at arrival.
- Main contribution → Endogenous return migration.
- Dynamic model → Joint return migration & saving decisions.
- Uncertainty → Future employment & income.
- Estimation → Immigrant sample of the GSOEP.
- Main results:
  1. PI system: Net gain from immigrants regardless age-at-arrival and nationality.
  2. UI system: Net gain from immigrants regardless age-at-arrival for all nationalities but Turks.
  3. Net gains fall when return migration is exogenous.
Basic Structure

- Uncertainty about earning, preferences & labor market status.
- Decisions → Each period (2 years), after shocks are realized:
  1. Decide whether to stay Germany or return.
  2. If stay, decide how much to save.
- Heterogeneity:
  1. Permanent unobserved characteristics (preferences, ability... $K = 4$ types)
  2. Permanent observed characteristics (Country of origin, age at arrival.)
  3. Time-varying observed characteristics (accumulated savings, labor status, age, duration of residence in Germany).
- Decision spell:
  1. Start: Arrival to Germany.
  2. End: Dies or return.
Preferences in Germany

- **Utility function:**

\[ u_t(.) = \mu(age, type) \frac{c_t^\lambda}{\lambda} + \rho(t, age_0, type) \exp(\eta_t^s) \]

- \( \mu(.) \rightarrow \) shifts the MU of consumption:

\[
\mu_t = \sum_{k=1}^{4} \mu_k \mathbb{I}(type = k) \exp[\mu_5 \mathbb{I}(age_t \leq 24) + \mu_6 \mathbb{I}(age_t \leq 30) \\
+ \mu_7 \mathbb{I}(age_t \geq 50) + \mu_8 \mathbb{I}(age_t \geq 60) + \mu_9 \mathbb{I}(age_t \geq 70)]
\]

- \( \rho(.) \rightarrow \) deterministic part of psychic costs function:

\[
\rho_t = \sum_{k=1}^{4} [(1 + \rho_0 age_0) \rho_k \mathbb{I}(type = k) - \exp(\rho_{4+k}) \mathbb{I}(type = k) t]
\]
Immigrants are subject to three constraints:

(i) \( c_t + (A_{t+1} - A_t) \leq y_t^{\text{net}} + y_t^T + rA_t \), \quad \text{(Budget constraint)}
(ii) \( c_t \geq c_{\text{min}}(age_t, z) \), \quad \text{(Minimum consumption guaranteed)}
(iii) \( A_t \geq 0 \). \quad \text{(No borrowing)}
Labor market status in Germany

- Assumption: Not retired immigrants are either employed or unemployed.

- Labor market status $l_t$ is modeled using a multinomial logit:

\[ P(l_t = j) = \frac{\exp(x_t \gamma_j)}{1 + \sum_{k=1}^{2} \exp(x_t \gamma_k)} \quad j = 1, 2, \]

where $x_t = (l_{t-1}, age_t, age_0, z, type)$, $z$: nationality

Empirical specification
Gross labor income: $\tilde{y}_t = pH_t \exp(\eta_t^y)$

$p$: rental price of human capital ($H_t$), $\eta_t^y$: random productivity shock.

Human capital formation:

$$\ln(H_t) = \nu_1 t + \nu_2 t^2 + \nu_3 \text{age}_0 + \sum_{z=2}^{5} \nu_{2+z} \mathbb{I}(\text{country} = z) + \sum_{k=2}^{4} \nu_{6+k} \mathbb{I}(\text{type} = k)$$

3 types of social security contributions paid out of gross labor income:

(1) Pension (9.35%)
(2) Unemployment (2.15%)
(3) Health (7%)

Net earnings are given by:

$$y_t^{net} = (1 - \tau(\tilde{y}_t - \Gamma(\tilde{y}))) [\tilde{y}_t - \Gamma(\tilde{y}_t)]$$

where $\Gamma(\tilde{y})$: total SS contributions, $\tau(.)$: average income tax rate.
Simplifications to unemployment benefits:
- Unemployment benefits and assistance at any period are 67% and 57% of expected net earnings of that period rather than realized last net earnings.
- Duration of entitlement to benefits: 2 years (one model period).
- After four years (two periods) of residence all immigrants are eligible.

Simplifications to pension benefits:
- At period $t$, Replacement rate applied to the average of expected net earnings at all periods until period $t$ rather than to the realized earnings.

Simplifications to subsistence income:
- It depends on marital status and number of children.
- Model: 520 DM times a family multiplier depending on age and nationality.
Preferences in the home country

Utility from spending remaining lifetime in home country:

\[ V^L(\tilde{S}_t) = V^L(pppA_t, age_t, t, z, type) \]

- \( V^L(.) \) stands for:
  1. General attractiveness of the source country.
  2. Value of accumulated savings after return.
  3. Value of potential earnings after return.
  4. Value of German pension benefits in home country.

- Parameters of \( V^L(.) \) are estimated along with the structural parameters of the model.
The Problem in Recursive Formulation

- Immigrants maximize the present discounted value of their remaining lifetime utility from the age of arrival until they return to their country or die.

- If they stay:

$$V^S_t(S_t) = \max_{\Delta A^k_t} E \left[ \sum_{t=1}^{T} \sum_{k=1}^{K} \delta(t) \tau - 1 u^k \tau d^k | S_t \right]$$

where $S_t = \{\text{accumulated savings, } l_t, t, z, \text{age}_0, k, \eta^y, \eta^s\}$

- Immigrants compare $V^S_t(S_t)$ with $V^L_t(\tilde{S}_t)$ and makes his return decision. Dynamic programming form of the optimization problem:

$$V_t(S_t) = \max \left\{ V^S_t(S_t), V^L_t(\tilde{S}_t) \right\}$$

$$V^S_t(S_t) = \max_{A_{t+1}} \left\{ u(c_t, \eta_t) + \delta E_t V_{t+1}(S_{t+1}) \right\}$$
Data Set

- **German Socio-Economic Panel (GSOEP).**
  - Longitudinal data set of households in Germany.
  - Immigrants from five countries (Greece, Italy, Spain, Turkey and Ex-Yugoslavia).
  - Use the 2000 version (from 1984 to 2000).
  - Not random sample of the flow.
  - Sample of the stock of them living in Germany in 1984.
  - Final sample: 1,062 male first-generation household heads.
  - Information on return migration, saving, labor market status and income.

- **Macro data:**
  - PPP between source country and Germany.
  - Expected wages in the source country.
Labor market outcomes

Figure 1
Fraction unemployed and retired by EU status

- Fraction unemployed immigrants ↑ with duration of residence.
- Big fraction of immigrants retired before age 60.
Income and saving choices

**Figure 2**
Mean income and saving profiles by EU status (in 1,000 DM, 1998 prices)

- Rather flat income profiles.
- Saving flow of non-EU ↓ with the duration of residence.
- Relatively flat saving profile of EU immigrants.
Return migration choices

FIGURE 3
SMOOTHED KAPLAN–MEIER HAZARD CONTRIBUTIONS FOR RETURN MIGRATION BY EU STATUS

- Handle left-truncation → No direct year-of-arrival effects.
- EU immigrants are more likely to return.
- Non-EU → Hump-shaped hazard function.
Interpretation of Types

- Types 3s are stayers, the rest are returners.
- Increasing hazard rates (1 and 2) \(\rightarrow\) Role of savings accumulation.
- Different type percentage by country explains differences in return migration by EU status. (EU: high % of type 4 at arrival.)
- Share of stayer type increases over time.
Model Fit

**Figure 5**

Fit of hazard functions for return migration by EU status

- Good model fit.
- Chi-squared tests for equality of actual and predicted values are not rejected.
Pension Insurance

\[ \text{Net Contribution} = \text{Contribution} - (\text{Pension benefits + survivor's benefits}). \]

Recall that the net gain of the PI is independent of age of entry and country. (\(\uparrow\) average retirement age).

- Lower net gain for EU (more likely to return \(\rightarrow\) Shorter contribution period).

**Figure 8**
Net lifetime contributions to pension insurance system by age at entry and country of origin (in 1,000 DM, 1998 prices)
Unemployment Insurance

Net gain from all nationalities but Turks.

Key factors: unemployment rates and return migration behavior.
Counterfactual: Exogenous Return Migration

- Net contributions to both PI and UI fall.
- Negative contribution to UI for many nationalities and ages.
- Reason → Ignore self-selection in return migration.
- Fall vary across nationalities.
Conclusions

- **Positive net contribution** of immigrants to PI system regardless origin and age at entry.

- **Positive contribution** to UI system for all nationalities but Turks.

- **Substantial magnitude** for certain demographic groups.

- **Endogenous return migration** decision plays a key role.

(A.1) \[
P(l = j) = \begin{bmatrix}
\exp((\gamma_{17(j-1)+1} + \gamma_{17(j-1)+2}age_0 + \gamma_{17(j-1)+3}I(l_{t-1} = 0))
+ \gamma_{17(j-1)+4}age_t + \gamma_{17(j-1)+5}age_t^2
+ \sum_{z=2}^{5} \gamma_{17(j-1)+4+z}I(country = z)
+ \sum_{k=2}^{4} \gamma_{17(j-1)+8+k}I(type = k)
+ \sum_{t=0}^{3} \gamma_{17(j-1)+13+t}I(age = 60 + 2t)
+ \gamma_{17(j-1)+17}I(age = 62)I(z \geq 3)
\end{bmatrix} / \\
\begin{bmatrix}
1 + \sum_{h=1}^{2} \gamma_{17(h-1)+1} + \gamma_{17(h-1)+2}age_0 + \gamma_{17(h-1)+3}I(l_{t-1} = 0)
+ \gamma_{17(h-1)+4}age_t + \gamma_{17(h-1)+5}age_t^2
+ \sum_{z=2}^{5} \gamma_{17(h-1)+4+z}I(country = z)
+ \sum_{k=2}^{4} \gamma_{17(h-1)+8+k}I(type = k)
+ \sum_{t=0}^{3} \gamma_{17(h-1)+13+t}I(age = 60 + 2t)
+ \gamma_{17(h-1)+17}I(age = 62)I(z \geq 3)
\end{bmatrix}
\end{bmatrix}
\]

j = 1, 2
A.4. Preferences for Living in the Home Country. The value of spending the remaining lifetime in the home country is specified as in Equation (A.5).

\begin{align*}
V^L(\tilde{S}_t) &= \sum_{country=z} I(z) \left( \frac{1-\delta(type)^{p\text{age}_t}}{1-\delta(type)} \right) \pi_{0,z} \\
&+ \sum_{country=z} I(z) \left[ I(type = 1) + \sum_{k=2}^{4} \exp(\pi_{1,k-1})I(type = k) \right] \left[ \exp(\pi_{1,7}) + \exp(\pi_{1,8}p\text{age}_t) \right] \\
&\left( 1 - \exp \left( \left[ I(type = 1) + \sum_{k=2}^{4} \exp(\pi_{1,k+2})I(type = k) \right] (\pi_{1,9} + \pi_{1,10}p\text{age}_t)ppp^zA_t \right) \right) \\
&+ \sum_{z(country)=1}^{5} I(z) \max \left\{ \left( \frac{\hat{w}^z}{\hat{w}_{Turk}} \right)^{\exp(\pi_{2,1})} \pi_{2,2} + \left( \frac{\hat{w}^z}{\hat{w}_{Turk}} \right)^{\exp(\pi_{2,3})} \pi_{2,4}p\text{age}_t, 0 \right\} \\
&+ \sum_{z(country)=1}^{5} I(z) \left( \frac{ppp^z}{ppp_{Turk}} \right)^{\exp(\pi_{3,1})} \Delta_{age} \exp(\pi_{3,2}) \left[ 1 - \exp(\pi_{3,3}t) \right].
\end{align*}
**Figure 6**

Fit of saving profiles by EU status (in 1,000 DM, 1998 prices)
Figure 9

Effect of exogenous return migration on net pension insurance contributions (in 1,000 DM, 1998 prices)