Replication Package for: Fertility and Career Choices in an Overlapping Generations Model with Sandwich Caregivers

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1 Overview

This package replicates all the key stylized facts, simulations, and quantitative results presented in the paper. Specifically, it reproduces:

- Figure 1(a), 1(b), 2(a), 2(b): Stylized facts based on Japanese data.
- Figures 3, 4, 5, 6, 7, 8, 9, 10: The main analytical results.
- Figures 11, 12: The calibration exercise and numerical simulations.

All computation codes are written in Python 3.12.2. Note that the parameters used in the analytical results may differ from the calibrated parameters to improve clarity.

For a quick check, run the code `check_all.py` (instructions below) to run all the replication files at once.

2 Data sources

- **Data to plot figure 1(a)**: Annual job leavers due to caring for family members (that are not children) in Japan: Labor Force Survey, Employment Trend Survey. URL: `https://www.e-stat.go.jp/`

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stat-search/files?page=1&layout=datalist&toukei=00450073&tstat=000001012468&cycle=0&tclass1=000001012478&stat_infid=000040078074&cycle_facet=tclass1&tclass2val=0. Accessed: August 12, 2025.

- **Data to plot figure 1(b)**: Time use for nursing and caring for non-child family members by forms of employment. Compiled from URL: https://www.stat.go.jp/english/data/shakai/index.html. Accessed: August 12, 2025.

- **Data to plot figure 2(a)**: The number of siblings per person. National Survey on Household Changes (8th survey). Compiled from URL: https://www.e-stat.go.jp/stat-search/files?page=1&layout=datalist&toukei=00450435&bunya_l=02&tstat=000001034766&cycle=0&tclass1=000001160326&tclass2=000001166126&tclass3val=0.

- **Data to plot figure 2(b)**: Elderly care time's principal caregivers. Data obtained from the Comprehensive Survey of Living Conditions, URL: https://www.mhlw.go.jp/english/database/db-hss/cslc-index.html

- **Dataset for numerical simulations**:

  1. Regular worker ratio:
     - For the period 1970 – 1984. URL: https://web.archive.org/web/20250427200751/https://www.ritsumei.ac.jp/~satokei/sociallaw/temporaryworkers.html. Accessed: April 23, 2025.
     - For the period 1985 – 2020: Esteban-Pretel, J., & Fujimoto, J. (2020). Non-regular employment over the life-cycle: Worker flow analysis for Japan. Journal of the Japanese and International Economies, 57, 101088.
  2. Fertility rate for Japan: United Nations - World Population Prospects.

In the replication package, the data to plot the stylized facts (1a, 1b, 2a, 2b) are stored in the file japan_stylized_data.xlsx. The data used for calibration is stored in the file calibration_target.xlsx.

3 Replication instructions

3.1 Setup

Before running any scripts, ensure that the following Python packages are installed and up to date: `pandas, numpy, matplotlib, scipy`.

Navigate to the root directory of the replication package (named `replication`), which contains all necessary data and scripts. Then, copy the full path to this folder as `<path>`. Depending on your operating system, follow the corresponding instructions below:

- **On Mac OS:** Open the `Terminal` application and type:
  `cd '<path>'`
  (replace `<path>` with the actual path, without angle brackets), then press `Enter`.
- **On Windows:** Open the `Command Prompt` (or `PowerShell`) and type:
  `cd '<path>'`
  (use double quotes around the path if it contains spaces), then press `Enter`.

3.2 Code description

1. Name: `check_all.py` Run in Terminal/Command Prompt:
   `python check_all.py`
   Function: Run all the `.py` scripts in the folder. Use this to batch run all the replication codes.

2. Name: `make_stylize.py`
   Run in Terminal/Command Prompt:
   `python make_stylize.py`
   Function: Automatically generates Figure 1(a), 1(b), 2(a), 2(b) and save them into separated pdf files.

3. Name: `draw_fig3.py`
   Run in Terminal/Command Prompt:
   `python draw_fig3.py`
   Function: Produces Figure 3 to illustrate the changes in ϕ when (k, x) changes.

4. Name: `draw_fig4.py`
   Run in Terminal/Command Prompt:
   `python draw_fig4.py`
   Function: Produces Figure 4 that collects all the steady states of ϕ given different values of σ.

5. Name: `draw_phase1.py`
   Run in Terminal/Command Prompt:
   `python draw_phase1.py`
   Function: Produces Figure 6 that draws the phase diagram for the case $\phi^* < 1$ at the steady state.

6. Name: `draw_phase2.py`
   Run in Terminal/Command Prompt:
   `python draw_phase2.py`
   Function: Produces Figure 8 that draws the phase diagram for the case $\phi^* = 1$ at the steady state.

7. Name: `draw_phase1_shift.py`
   Run in Terminal/Command Prompt:
   `python draw_phase1_shift.py`
   Function: Produces Figures 5 and 9. Figure 5 shows the construction of the phase planes in the case $\phi^* < 1$. Figure 9 shows the shifts in the nullclines that result in a new steady state, keeping the regime $\phi^* < 1$ unchanged.

8. Name: `draw_phase2_shift.py`
   Run in Terminal/Command Prompt:
   `python draw_phase2_shift.py`
   Function: Produces Figures 7 and 10. Figure 7 shows the construction of the phase planes in the case $\phi^* = 1$. Figure 10 shows the shifts in the nullclines that result in a new steady state, keeping the regime $\phi^* = 1$ unchanged.

9. Name: `draw_fig11.py`
   Run in Terminal/Command Prompt:
   `python draw_fig11.py`
   Function: Produces Figure 11 that plots the model dynamics and compares them with the Japanese data.

10. Name: `draw_fig12.py`
    Run in Terminal/Command Prompt:
    `python draw_fig12.py`
    Function: Produces Figure 12 that plots the numerical examples of artificial economies.