Fertility, Housing Costs and City Growth

Nicolas Coeurdacier (SciencesPo & CEPR)

Pierre-Philippe Combes (SciencesPo)

Laurent Gobillon (Paris School of Economics)

Florian Oswald (SciencesPo)

September 29, 2022

Children Across the Urban Space

- The center of large cities is virtually *childless*:
  1. Within a given city, families with more children live in more suburban locations.
  2. Comparing across urban centers, larger families tend to live in the less dense ones of smaller cities.

- Lower Fertility (children per adult in parental age) in denser urban locations.

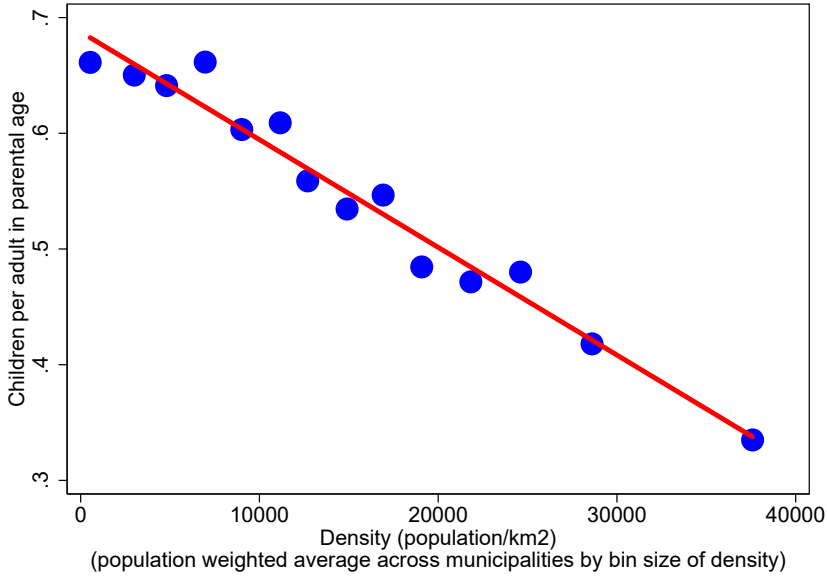
Children Across the Urban Space

- The center of large cities is virtually *childless*:
  1. Within a given city, families with more children live in more suburban locations.
  2. Comparing across urban centers, larger families tend to live in the less dense ones of smaller cities.

- Lower Fertility (children per adult in parental age) in denser urban locations.

Density-Dependent Fertility

We document *negative density-dependence* of fertility across space in French urban areas.


Children per adult in parental age
.3
.4
.5
.6
.7
0
10000
20000
30000
40000
Density (population/km2)
(population weighted average across municipalities by bin size of density)

The Story

- Housing space scarce in denser locations (e.g. center of large cities).
- Children are costly in terms of housing space.
  1. **Sorting.** Households with a preference for larger families locate in cheaper (less dense) locations.
  2. **Endogenous fertility choice.** For given fertility preference, households in more expensive (denser) locations have fewer children.
- Generates negative density-dependence of fertility.

This Paper

- Develops a quantitative life-cycle spatial model with endogenous fertility and demographics to account for
  1. Sorting patterns across demographics.
  2. The dynamics of fertility across space.
  3. The **joint** determination of population dynamics and housing prices. The housing market acts as an **automatic stabiliser** of fertility over time.

- Structural estimation using French data for counterfactuals since WWII. [not there yet]

Related Literature

Ecology and Demography

- *Density-dependent population dynamics.* Sibly and Hone (2002), Sinclair (1989, 2003), Mills (2012) for references. Relevance for humans discussed in Lee (1987) and Lutz et al. (2006).
- *Demographic Transition and Urbanization.* Thompson (1916, 1929), Davis (1937) and Notestein (1945). Caldwell(2006) for a survey.

Fertility in Economics

- Becker (1960). References in Hotz et al. (1997), Jones et al. (2008) and Doepke et al.(2022).

Demographics and housing prices

- *Demographics and housing prices (macro).* Starting with Mankiw and Weil (1989).
- *Housing costs and fertility choice (applied micro).* Simon and Tamura (2009), Lovenheim and Mumford (2013) and Dettling and Kearney (2014).

Sorting of individuals across urban space

- *Sorting across skills.* Glaeser & Mare (2001), Combes et al. (2008), Baum-Snow et al. (2011), Eeckhout et al. (2014), Diamond (2016), Roca and Puga (2017), Couture et al. (2019), ...
- *Suburbanisation vs. the revival of cities.* Baum-Snow (2007) and Redding (2021). Couture and Handbury (2020), Moreno-Maldonado and Santamaria (2022).

Outline

1. Empirical Facts from France
   - Motivating evidence on housing consumption and sorting across demographics.
2. Theory
   - A spatial life-cycle model with endogenous fertility and population dynamics.
3. Quantitative Evaluation using French data since WWII [not there yet]
   - Structural estimation and counterfactuals.

Empirical Facts from France

Data

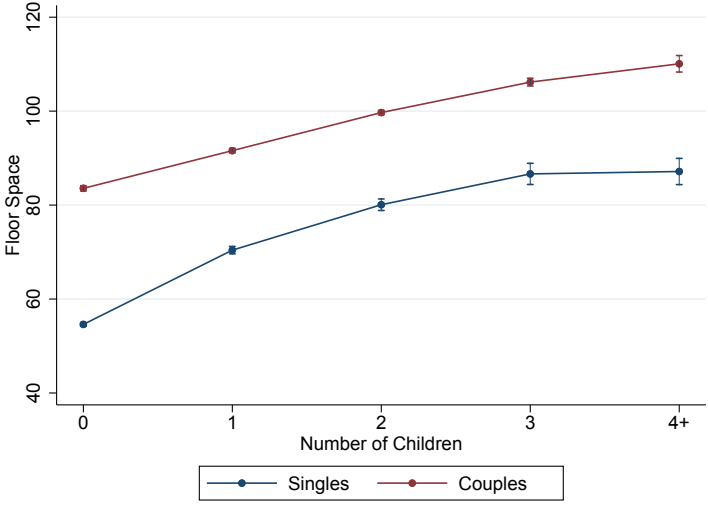
- **Spatial units.** Around 36,000 municipalities. 17,500 urban municipalities across 792 urban reas (UAs). Distance of a given municipality from center of UA.
- **Household census data.** SAPHIR dataset of harmonized individual census data (1968-2015). Demographic variables at the municipality level. Fertility measured as children (0-17) per adult in parental age (27-53).
- **Housing prices.** Notary data on transactions of second-hand dwellings. Price index at the municipality level (2000-2012).
- **Housing consumption.** Household level data from Enquête Nationale Logement (ENL, 1984-2013) on housing consumption and other household characteristics (composition, income, ...).

Housing consumption and demographics

Fact 1: Household housing consumption is increasing with the number of children in a given location.

- Holds for floorspace and housing budget share.
- Holds controlling location. Not driven by sorting of families in cheaper locations.

Fact 1: Housing consumption and demographics



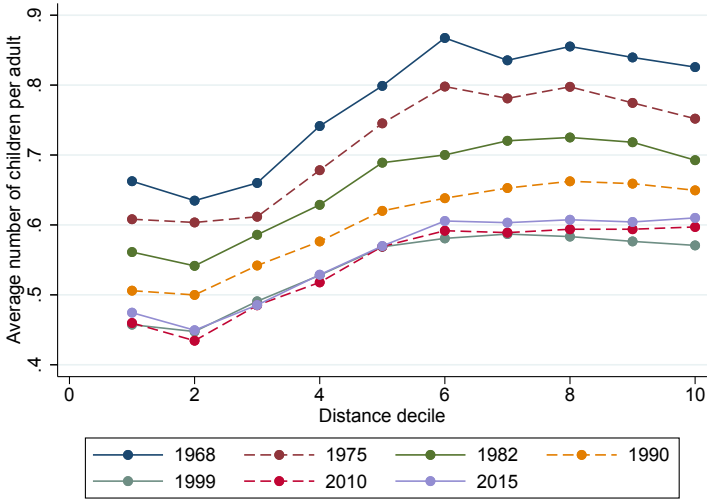
Urban spatial sorting across demographics

Fertility within Cities

Fact 2: In a given urban area, fertility is higher in more suburban locations.

- Fertility higher by about 30% in the most suburban locations.
- Holds across census waves. Drop in fertility over time in all locations.
- Within city, fertility lower in more expensive locations (e.g. central locations)

Fact 2: Fertility is Higher in Suburbs



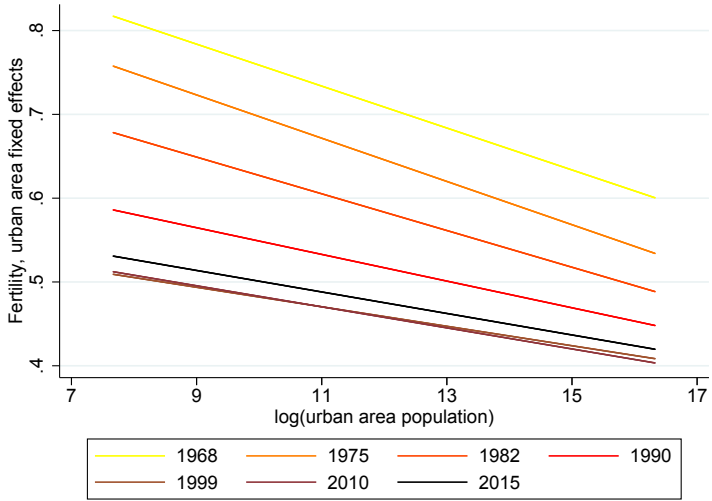
Urban spatial sorting across demographics

Central Fertility across Cities

Fact 3: Across urban areas, central fertility is higher in less populated cities.

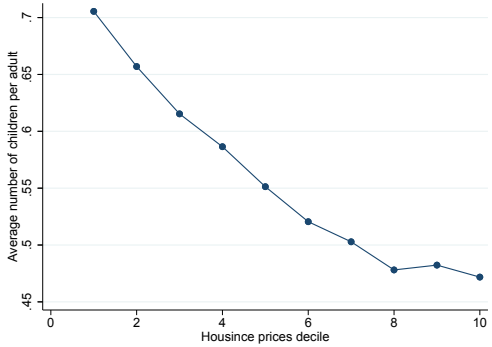
- Similar magnitude of variations across urban centers.
- Holds across census waves. Drop in fertility over time in all urban centers, more pronounced in smaller cities.
- Across urban centers, fertility lower in more expensive cities (e.g. larger cities).

Fact 3: Central Fertility Higher in Smaller Cities

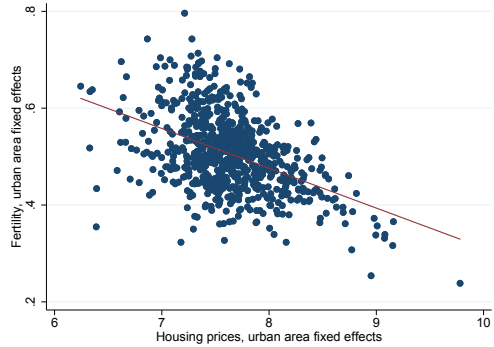


Mechanism behind Facts 2 and 3: House Prices

Fact 2: Within Urban Areas



Fact 3: Across Urban Areas



Urban spatial sorting across demographics

Average age of urban locations

Fact 4: Average age increases with distance to center.

In a given urban area, the average age of adults increases as we move towards more suburban locations. Across urban areas' centers, the average age of adults is higher in less populated cities.

- Driven by the **sorting** of younger households in the center of large cities and the sorting of older households in smaller cities.
- Aging over time across urban locations—particularly pronounced in smaller cities and in some suburban municipalities where the number of older households increased sharply.

Theory

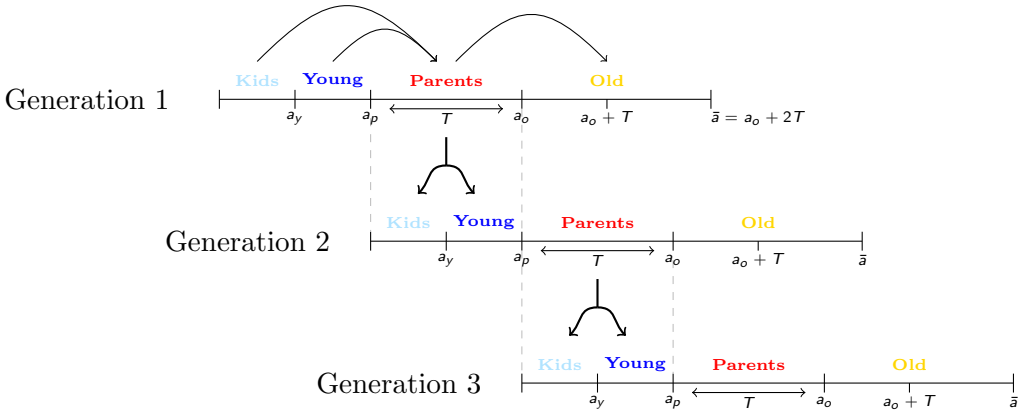
Set-up

- **Overlapping generations.** Focus first on spatial equilibrium at given date t.
- **Stages of life.** Four stages of life, **children** (c), **young** (y), **parents** (p) and **old** (o). Children sheltered by parents making fertility decisions, young and parents work and old retired. Enter each stage at age a_s, $s \in \{y, p, o\}$.
- **Spatial Structure and Household Income.** K cities. City made of a fixed number $\mathcal{L}_k$ of locations, $\ell_k \in \{1, ..., \mathcal{L}_k\}$.
  Household income net of commuting costs in ℓ_k at age $a \geq a_y$,

$$y(a, \ell_k) = \theta_k \cdot w(a, \ell_k) + b(a),$$

  with wage income net of commuting costs $w(a, \ell_k)$ decreasing with ℓ_k within a city k, retirement benefits $b(a)$ independent of location, θ_k a city-level income fixed effect.

Timing


Generation 1
Kids
Young
Parents
Old
a_y
a_p
T
a_o
$a_o + T$
$\bar{a} = a_o + 2T$
Generation 2
Kids
Young
Parents
Old
a_y
a_p
T
a_o
$a_o + T$
$\bar{a}$
Generation 3
Kids
Young
Parents
Old
a_y
a_p
T
a_o
$a_o + T$
$\bar{a}$

Preferences and budget constraints

- **Budget constraints.** At age a in location ℓ_k,

$$c(a, \ell_k, n) + q_{\ell_k} h(\mathcal{N} + n) = y(a, \ell_k),$$

with consumption $c(a, \ell_k, n)$, housing space h increasing in the number of sheltered children n ($n = 0$ for young and old) and q_{ℓ_k} the housing price in ℓ_k.

- **Preferences.** Instantaneous utility,

$$U(a, \ell_k, n) = A_k + u\left(c(a, \ell_k, n)\right) + v(n) + \sigma \varepsilon_{n,\ell_k}.$$

with city amenity A_k, household specific preferences for location at any age and for fertility at age a_p. Preference shock for location (and fertility at age a_p), ε_{n,ℓ_k}, drawn from a type 1 Extreme Value distribution with scale parameter σ.

Spatial Equilibrium

- Assuming no moving costs, and parental stage lasting for one period only: Decisions independent from each other at each age.
- Location decisions at all ages and fertility decisions at age a_p expressed as discrete choice probabilities.
- Given aggregate demographic composition of adult households, this determines the housing demand $H_d(\ell_k)$ in each location ℓ_k.

Spatial Equilibrium

Definition 1

For a given set of city/location characteristics and a given aggregate demographic composition of adult households, a static spatial equilibrium is a vector of housing costs, $\{q_{\ell_k}\}_{\ell_k \in \mathcal{L}}$, demographic composition, $\{L_{a,\ell_k}\}_{\ell_k \in \mathcal{L}, a_y \leq a \leq \bar{a}}$, and average fertility, $\{n_{\ell_k}\}_{\ell_k \in \mathcal{L}}$, in each location such that:

- Location decisions at each age a and fertility decision at age a_p maximise utility.
- The housing market clears in each and every location $\ell_k \in \mathcal{L}$,

$$H_d(\ell_k) = \delta_{\ell_k}(q_{\ell_k})^{\rho},$$

with ρ the supply elasticity and δ_{ℓ_k} a location-specific supply shifter.

Dynamics across time

Sequence of spatial equilibria with endogenous population dynamics

Definition 2

For time-varying city/location characteristics, potentially age-specific and a given initial aggregate demographic composition of adult households, $\{L_{a,0}\}_{a_y \leq a \leq \bar{a}}$, a sequence of equilibria for $t \geq 0$ is defined recursively such that:

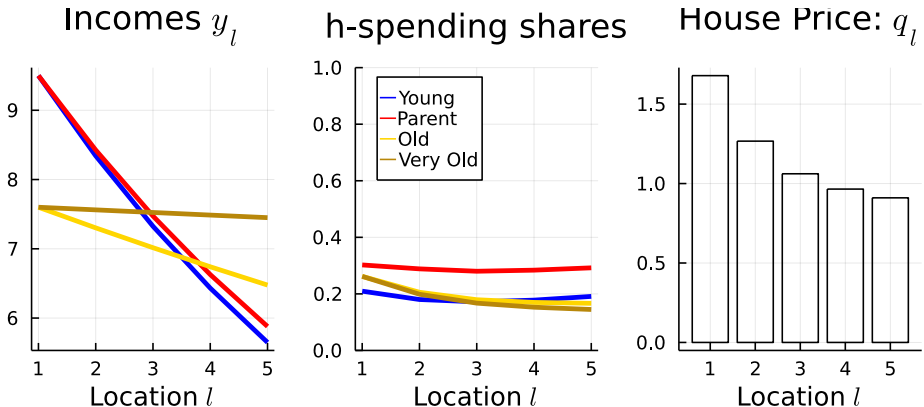
- The equilibrium at each date t is a static spatial equilibrium according to Definition 1 for a given distribution by age of the aggregate population, $\{L_{a,t}\}_{a_y \leq a \leq \bar{a}}$.
- Aggregate population dynamics by age at each date t, $\{L_{a,t}\}_{a_y \leq a \leq \bar{a}}$ depends on endogenous fertility decisions at each date t and exogenous survival porbabilities into older age.

Results

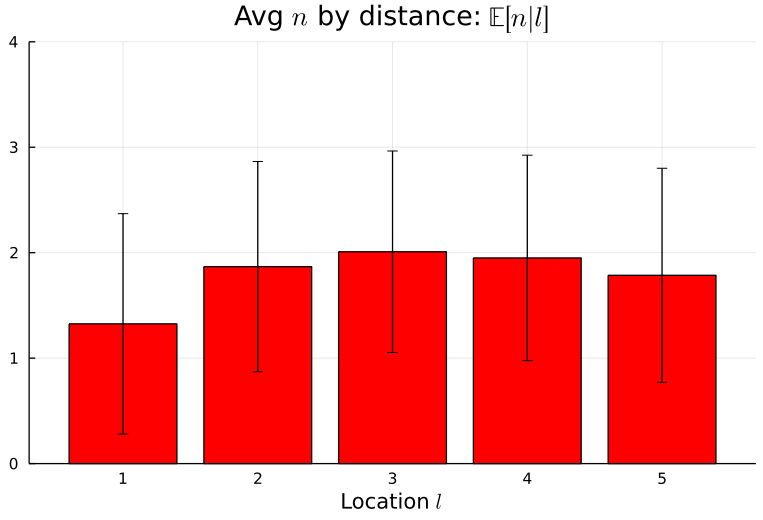
Results

- We are estimating preference parameters via MLE. This is ongoing.
- Today we present simulations, which qualitatively match stylized facts.
- Our eventual goal is serious quantification with estimated parameters.

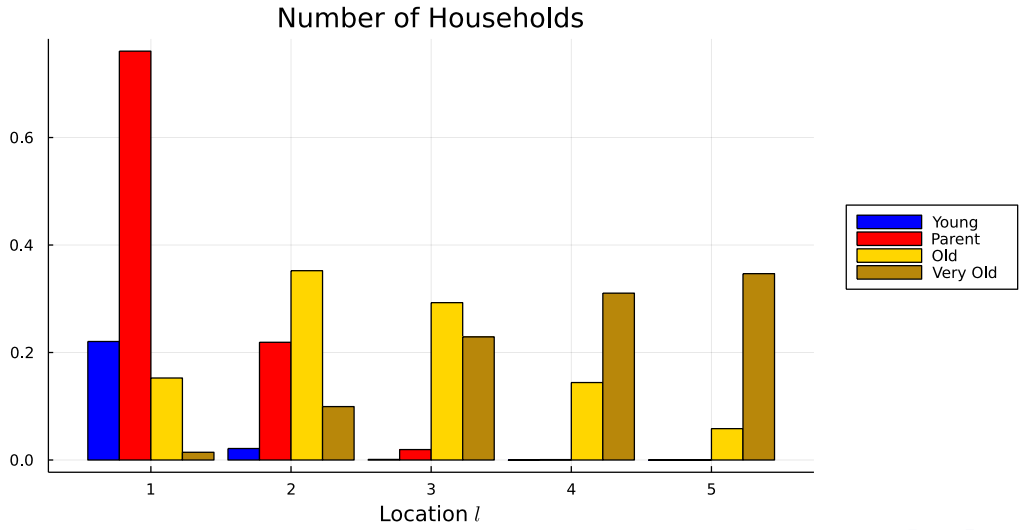
Simulating a Single City: Setup



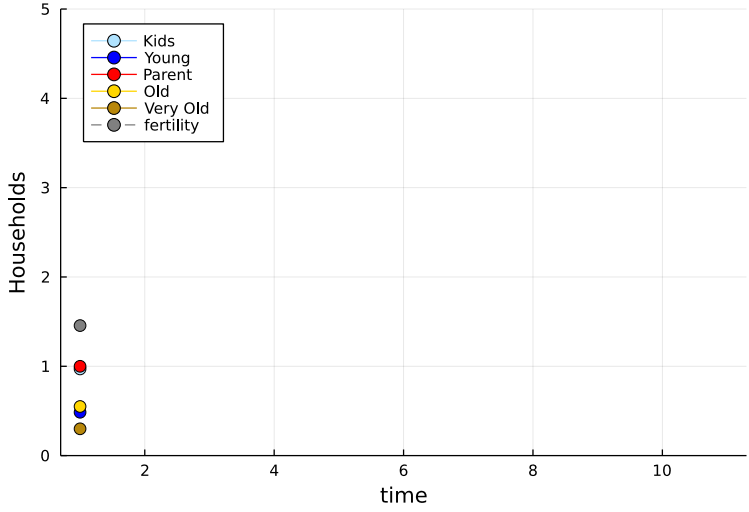
Simulating a Single City: Fertility



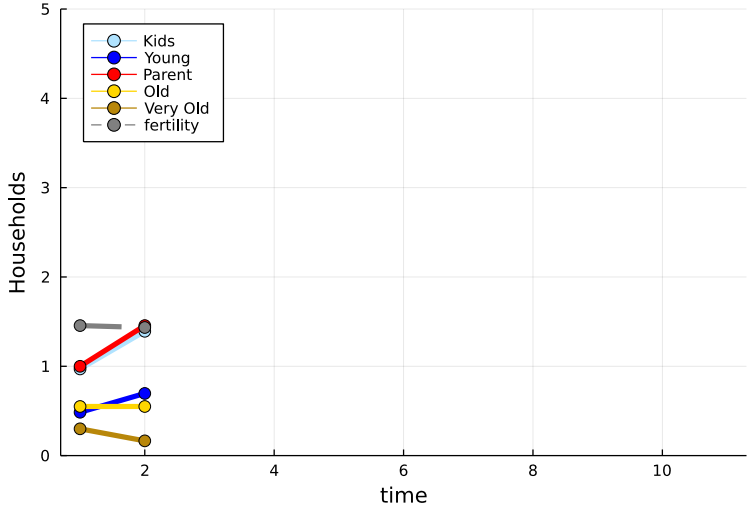
Simulating a Single City: Sorting



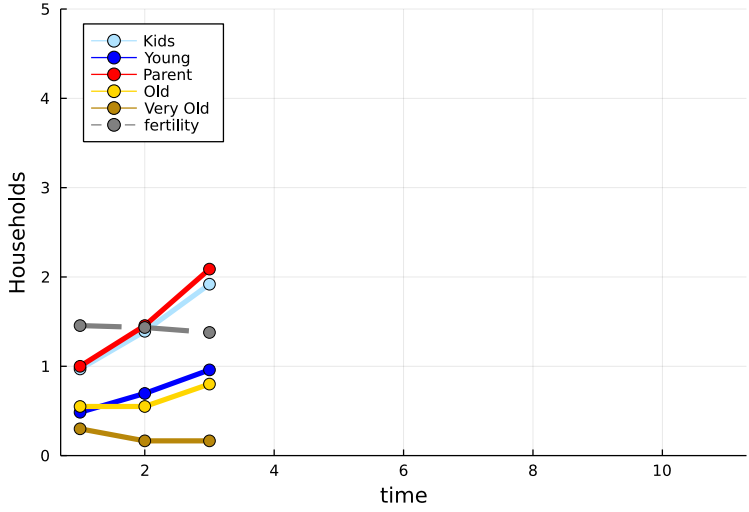
Simulating a Single City: Dynamics of the Baby Boom



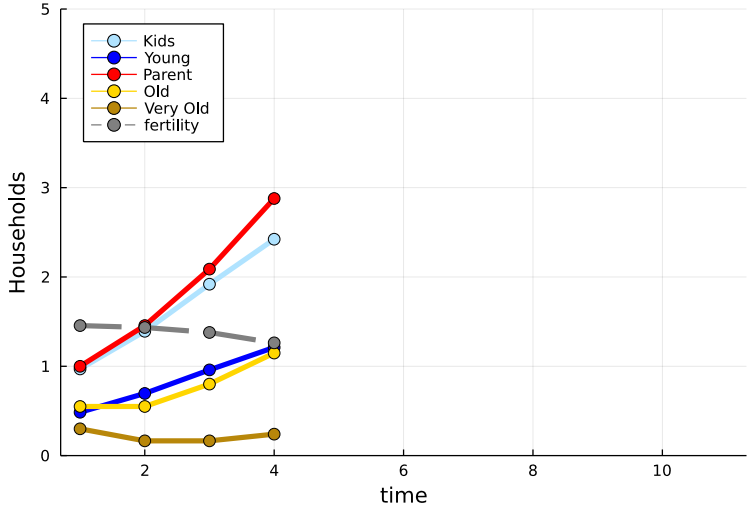
Simulating a Single City: Dynamics of the Baby Boom



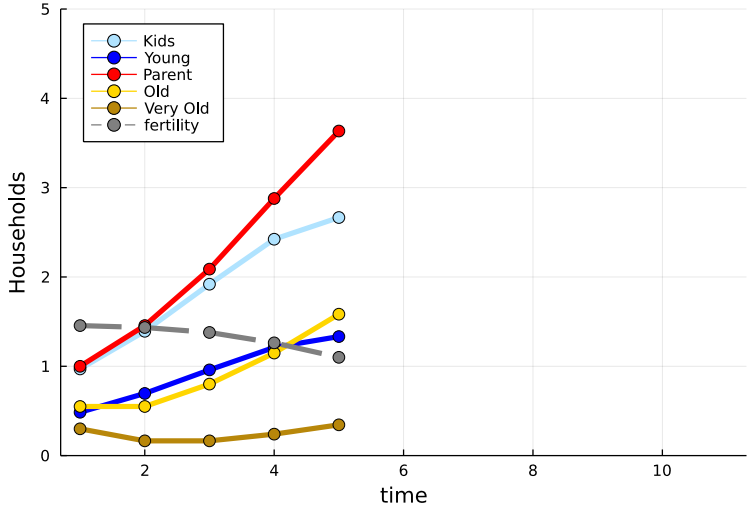
Simulating a Single City: Dynamics of the Baby Boom



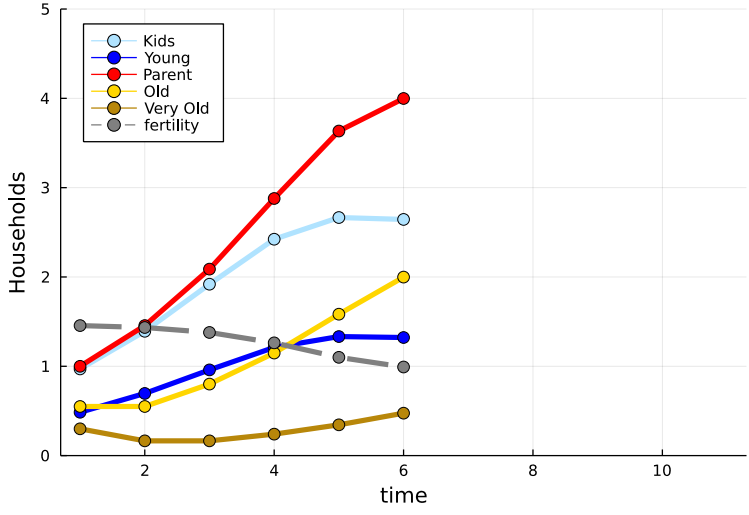
Simulating a Single City: Dynamics of the Baby Boom



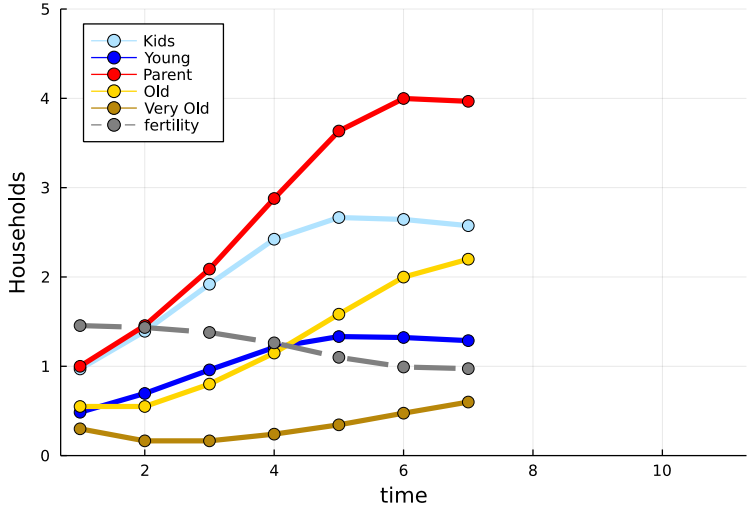
Simulating a Single City: Dynamics of the Baby Boom



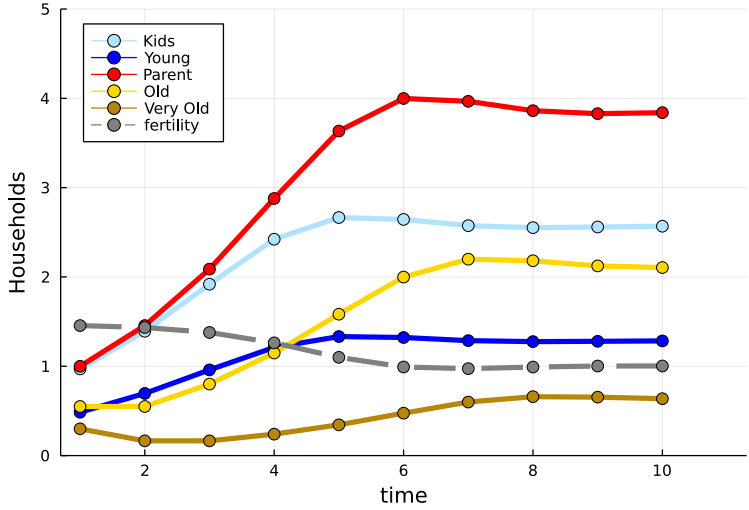
Simulating a Single City: Dynamics of the Baby Boom



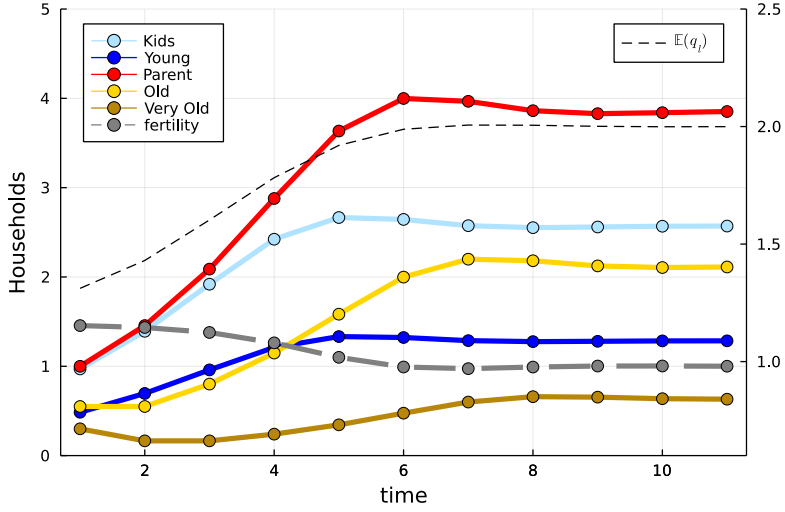
Simulating a Single City: Dynamics of the Baby Boom



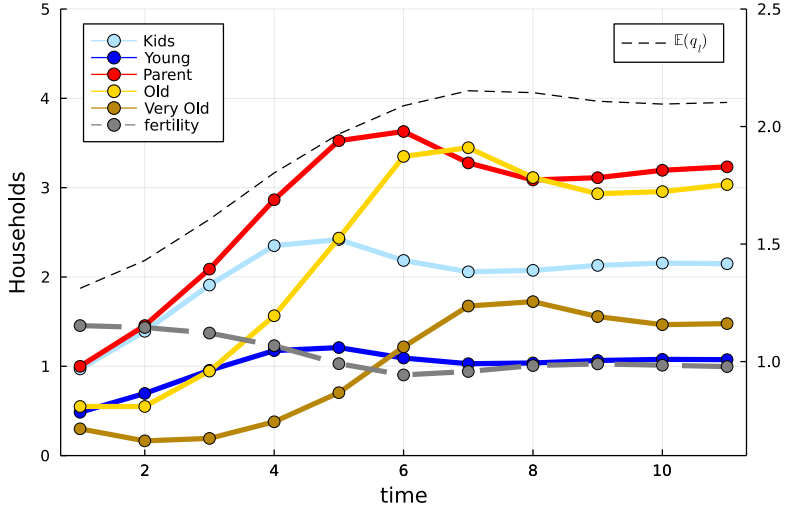
Simulating a Single City: Dynamics of the Baby Boom



Simulating a Single City: Dynamics of the Baby Boom



Counterfactuals: Baby Boom + Increaseing Longevity



Conclusion

- We document 4 robust facts about fertility and demographics in France.
- We build a spatial overlapping generations equilibrium model which reproduces the stylized facts.
- We are estimating preferences by maximum likelihood.
- We use the model to compute counterfactuals regarding housing and fertility policies.