

# Fertility, Housing Costs and City Growth

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# Children Across the Urban Space

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# Children Across the Urban Space

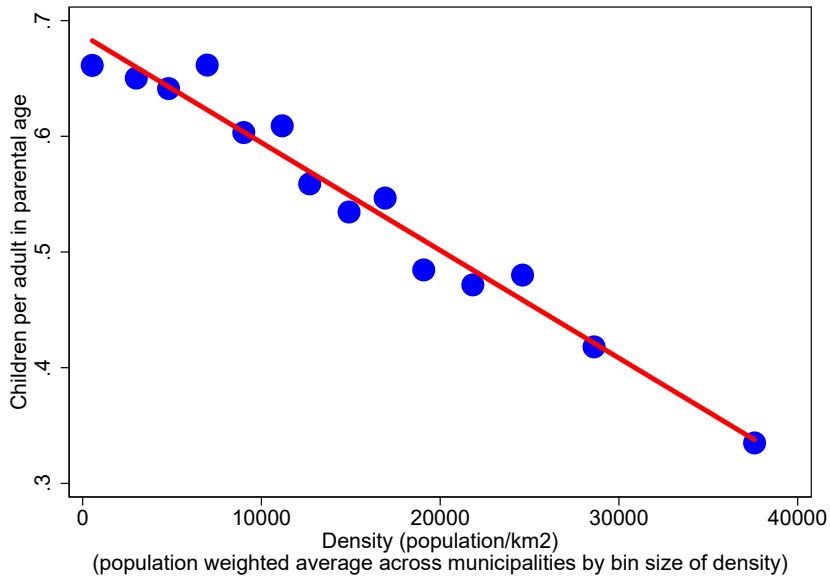
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## Density-Dependent Fertility

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



# The Story

- ▶ Housing space is 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.

# The Story

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  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 time and space. The housing market acts as an **automatic stabiliser** of fertility over time.
  3. The **joint** determination of population dynamics and housing prices.
- ▶ 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).

# Empirical Facts from France

# Data

- ▶ **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).

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- ▶ **Housing consumption.** Household level data from Enquête Nationale Logement (ENL, 1984-2013) on housing consumption and other household characteristics (composition, income, ...).

## Fact 1: Housing Consumption and Demographics

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

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- ▶ Holds controlling location. Not driven by sorting of families in cheaper locations.



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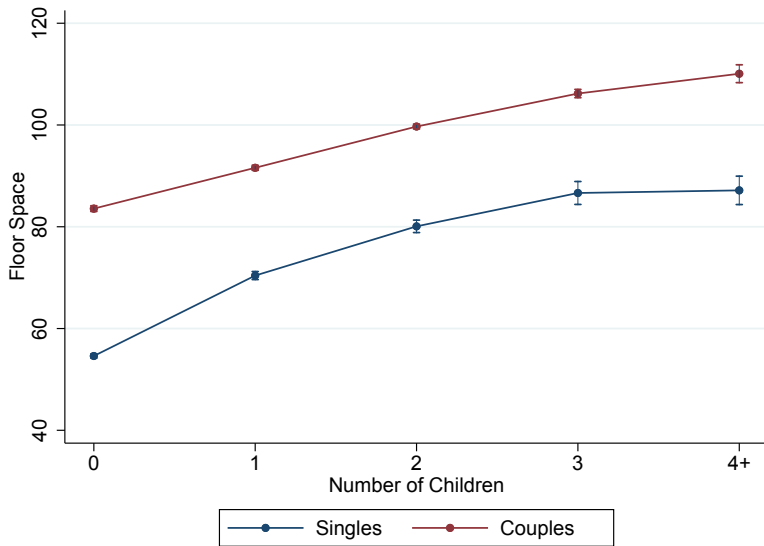
- ▶ Holds for floorspace and housing budget share.
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$$h_{i,\ell_k,t} = c_{k,t} + f_k(d_{\ell_k}) + \sum_{m=1}^N \beta_m \cdot 1_{\{i \in \mathbb{S}_m\}} + X_{i,\ell_k,t} \cdot \alpha + \nu_{i,t}$$

$(i, k, \ell_k, t) = (\text{Household, Urban Area, Commune in Urban Area, Year})$

$X_{i,\ell_k,t} = (\text{Age, Education, Income, Owner})$

## Fact 1: Housing Consumption and Demographics



# Spatial Sorting across Demographics

## Fact 2: 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)

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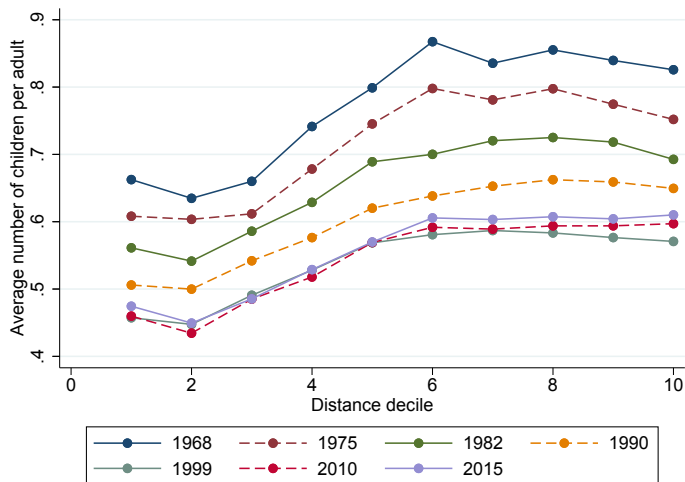
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**At Commune ( $\ell_k$ ) Level!**

$$y_{\ell_k,t} = c_{k,t} + f_k(d_{\ell_k}) + X_{\ell_k,t} \cdot \alpha + \nu_{\ell_k,t}$$

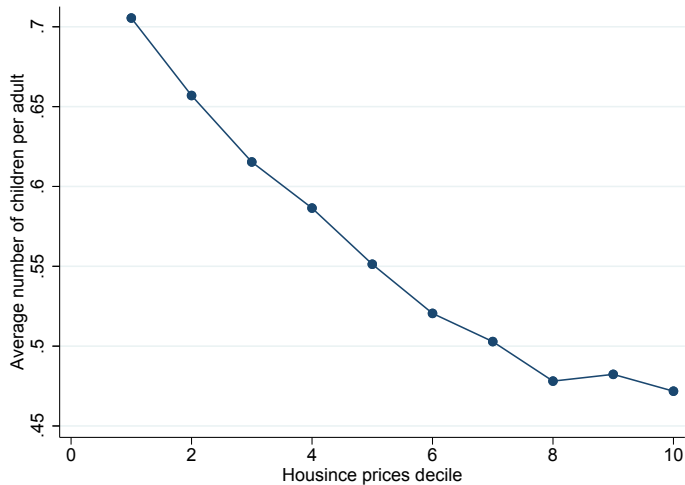
## Fact 2: Fertility is Higher in Suburbs

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## Fact 2: Fertility is Higher in Suburbs

Fertility is lower in more expensive locations



# Spatial sorting across demographics

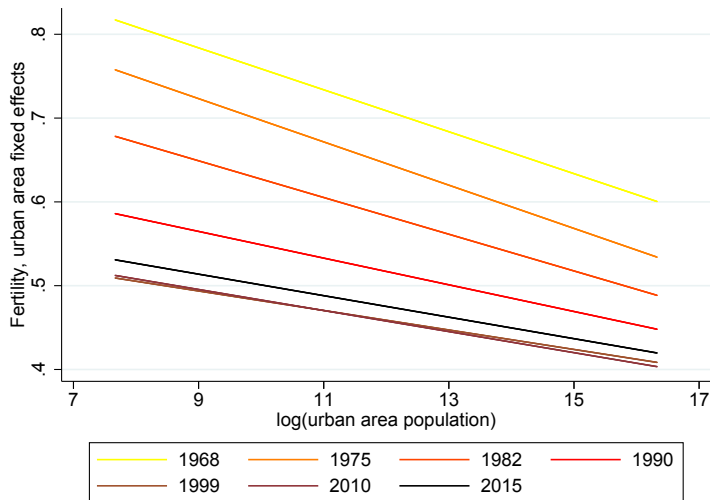
## Fact 3: Central Fertility across Cities

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

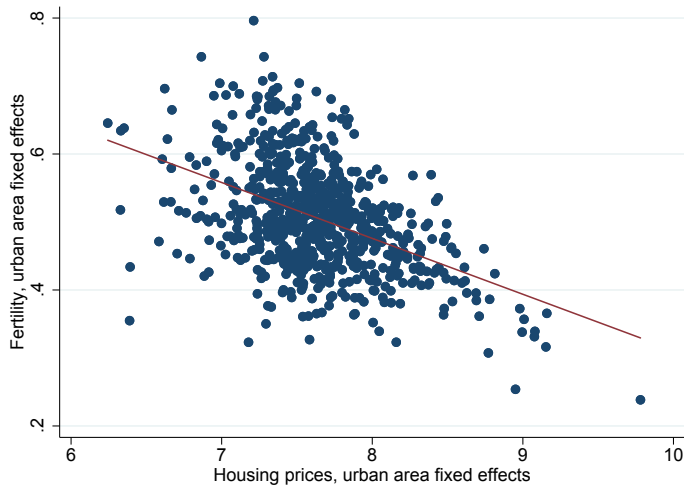
$$y_{\ell_k,t} = c_{k,t} + f_k(d_{\ell_k}) + X_{\ell_k,t} \cdot \alpha + \nu_{\ell_k,t}$$





## Fact 3: Central Fertility Higher in Smaller Cities

Fertility lower in more expensive cities



# Fact 4: Average Age is Higher in Suburbs and Smaller Cities

Within and Across Cities

Figure: Within Cities

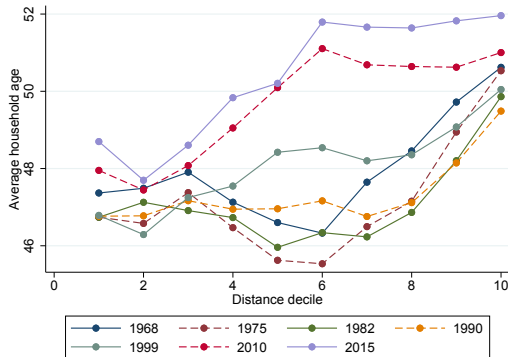
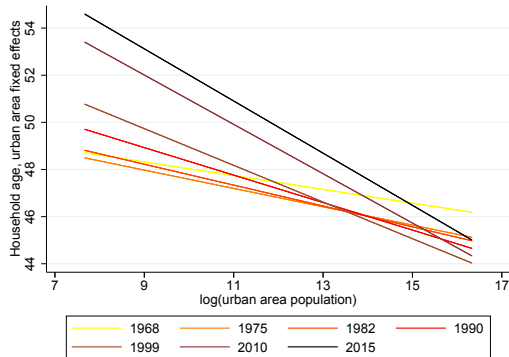


Figure: Across City Centers



# Theory

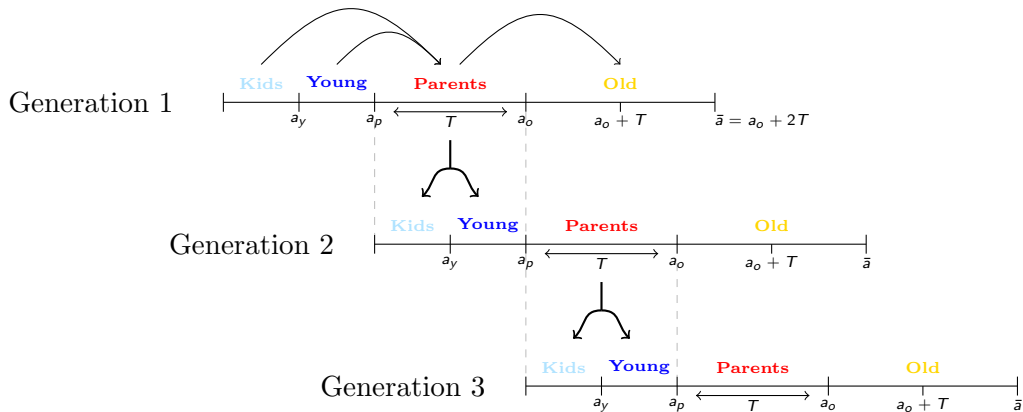
## Set-up

- ▶ **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,  $\ell_k \in \{1, \dots, \mathcal{L}_k\}$ .  
Household income net of commuting costs in  $\ell_k$  at age  $a \geq a_y$ ,

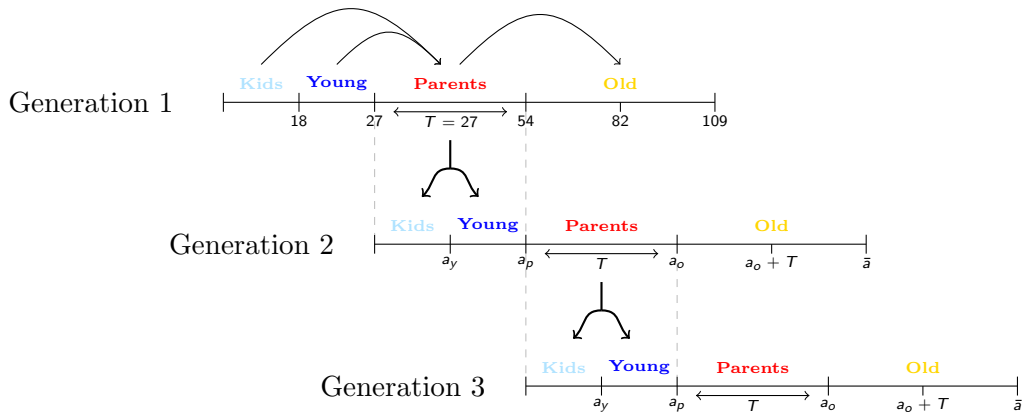
$$y(a, \ell_k) = \theta_k \cdot w(a, \ell_k) + b(a),$$

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

# Timing



# Timing



# Preferences and budget constraints

- **Budget constraints.** At age  $a$  in location  $\ell_k$ ,

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

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  $q_{\ell_k}$  the housing price in  $\ell_k$ .

- **Preferences.** Instantaneous utility,

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

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  $a_p$ ),  $\varepsilon_{n, \ell_k}$ , drawn from a type 1 Extreme Value distribution with scale parameter  $\sigma$ .

# 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  $\ell_k$ .



# Quantitative Evaluation using French data since WWII

# Numerical illustrations

- ▶ Quantitative evaluation using French data since WWII in progress.
- ▶ For now, provide numerical illustrations of a calibrated simulated multicity economy aiming at reproducing qualitatively French data since WWII.
- ▶ Investigates the response across space and time of cities to
  1. Aggregate demographic changes (e.g. baby-boom and rising longevity)
  2. Aggregate changes in the urban structure (e.g. shifts in commuting costs and housing supply regulations)

# Numerical illustrations

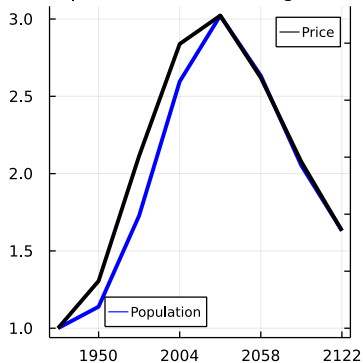
## Aggregate demographic changes

- ▶ **Baby-boom.** Fertility preference shifter  $\Delta_t \nu$  in period  $t \in \{0, 1, 2\}$ , with  $\Delta_0 \nu > \Delta_1 \nu > \Delta_2 \nu > 0$ .  
Magnitude to roughly match the increase in fertility during the baby-boom in France. Progressive phasing-out.
- ▶ **Rising longevity.** Increase in survival probabilities at older ages in line with data. Probability to survive into old age, above 54 (resp. very old age, above 81) increases from 0.5 to 0.7 (resp. 0.04 to 0.3) between  $t = 0$  and today.

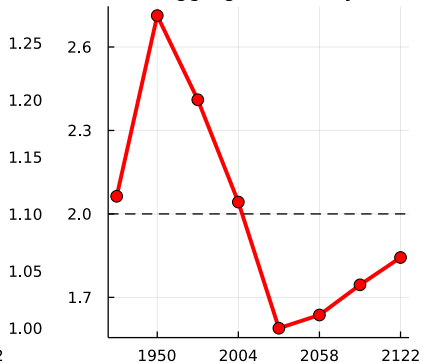
# Aggregate demographic changes

## Population dynamics

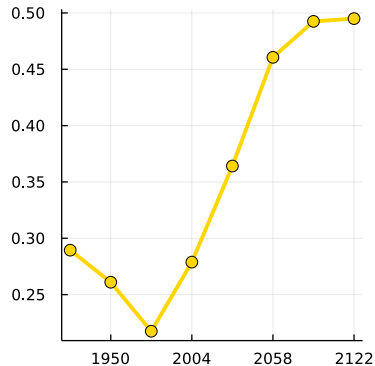
Population and Housing Price



Aggregate Fertility



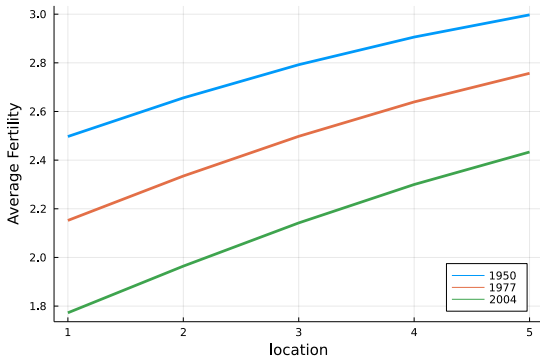
Share of Old



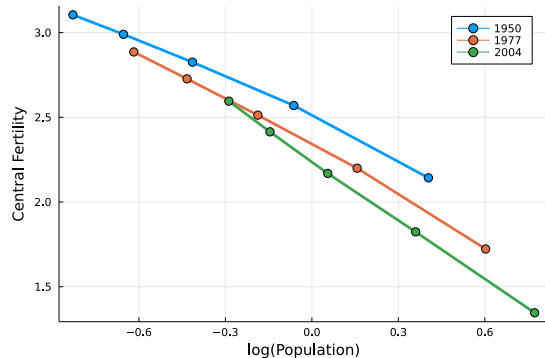
# Fertility across urban locations

Facts 2 and 3. Fertility within and across urban areas.

(a) Fact 2: Within city



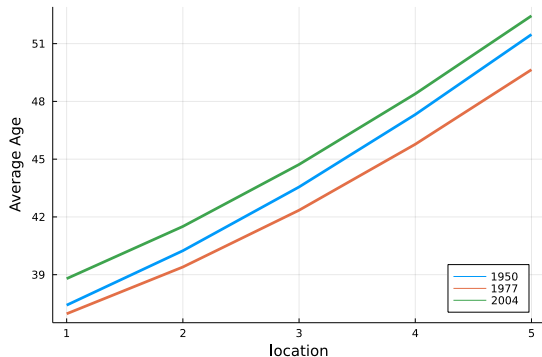
(b) Fact 3: Across cities



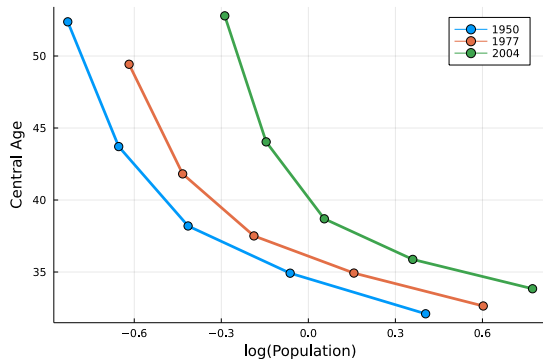
# Spatial sorting by age

Fact 4. Average age across urban locations

(a) Fact 4: Within city



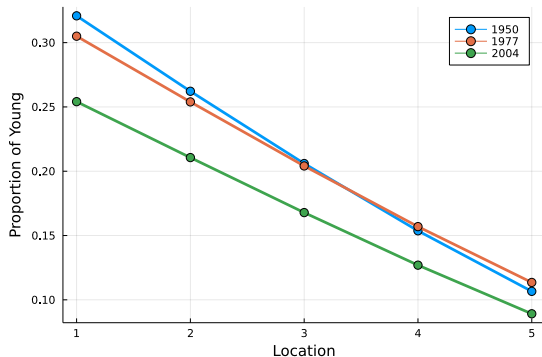
(b) Fact 4: Across cities



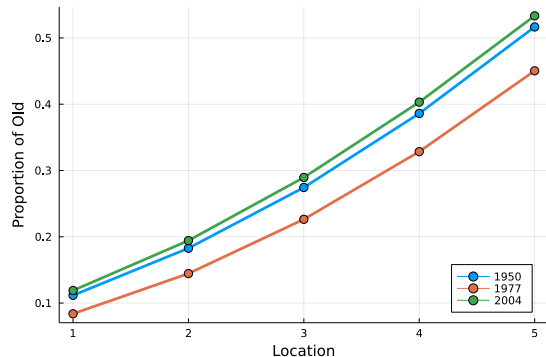
# Spatial sorting by age

Fact 5. Young vs. Old across urban locations

(a) Fact 5: Young within city



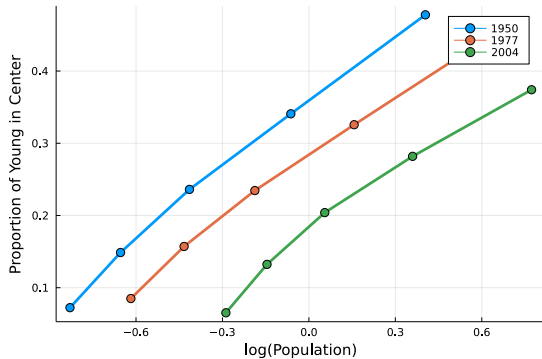
(b) Fact 5: Old within city



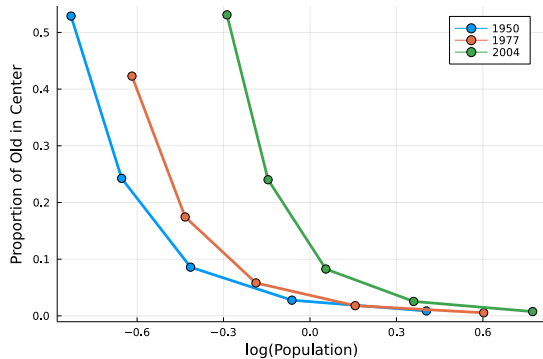
# Spatial sorting by age

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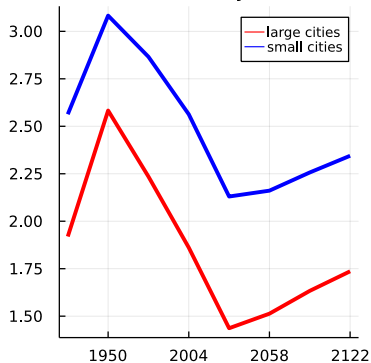




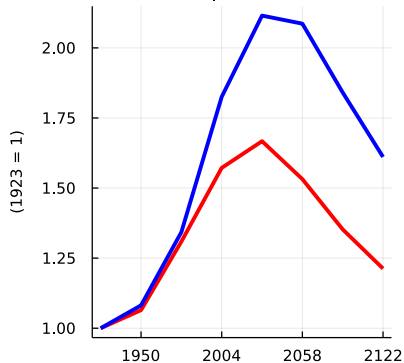
# Spatial Distribution of Population

Large vs. Small cities

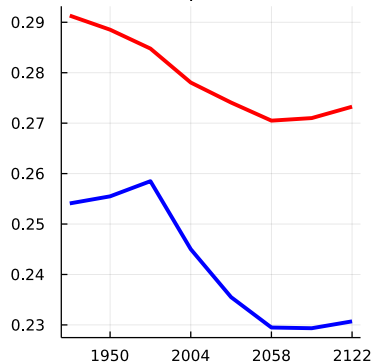
Fertility



Population



Central Population Share



# Numerical illustrations

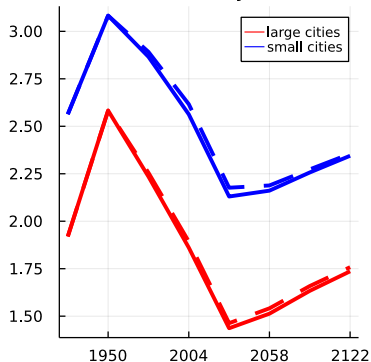
## Aggregate changes in the urban structure

- ▶ **Drop in commuting costs.** Drop in commuting costs at date  $t = 1$ ,  $\tau_t = \tau - \Delta_t \tau$ , with  $\Delta_t \tau > 0$  for  $t \geq 1$  and 0 otherwise.  
Corresponds to better commuting technologies (e.g. automobiles, ...) in the 1960s-1970s.
- ▶ **Stricter housing supply regulations.** Tightening of housing supply in the recent period, at date  $t \geq 2$ ,  $\delta_t = \delta - \Delta_t \delta$ , with  $\Delta_t \delta = \Delta \delta > 0$ , for  $t \geq 2$  and 0 otherwise.  
Corresponds to stricter urban planning in France starting the 1990s. Partly mimic the recent rise in housing prices.

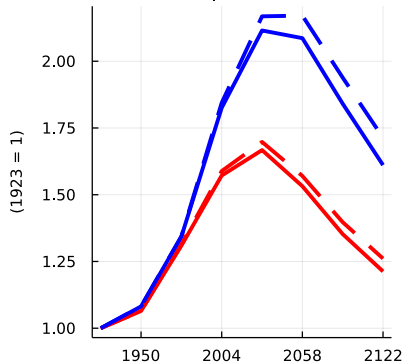
# Commuting costs, fertility and suburbanisation

## Drop in commuting costs

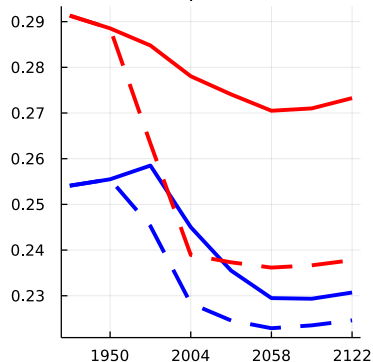
Fertility



Population

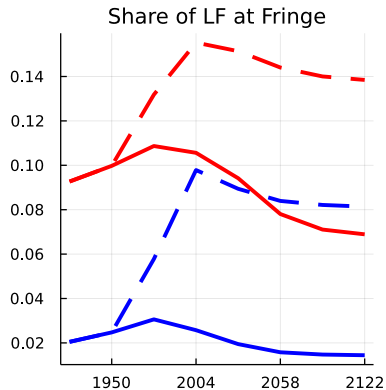
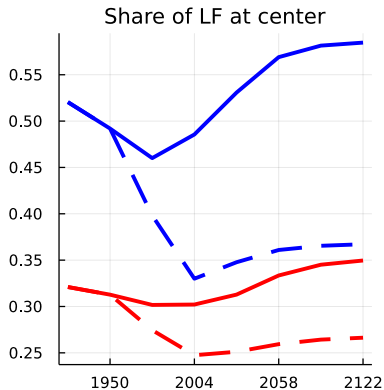
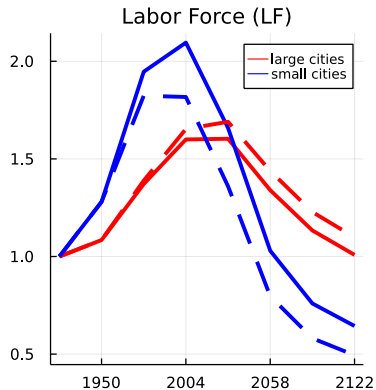


Central Population Share



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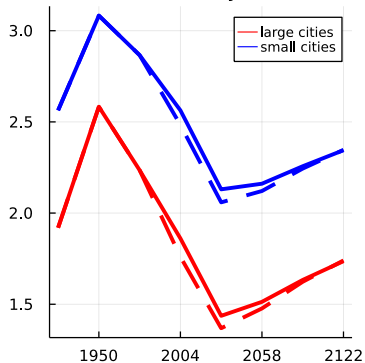
## Drop in commuting costs



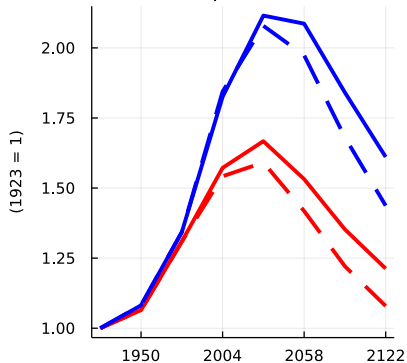
# Housing supply regulations, fertility and city growth

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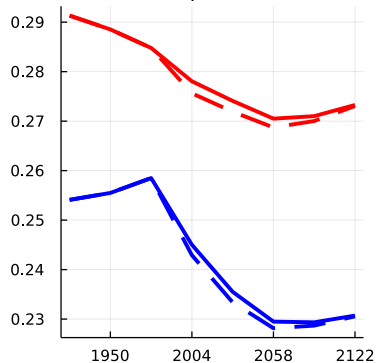
Fertility



Population



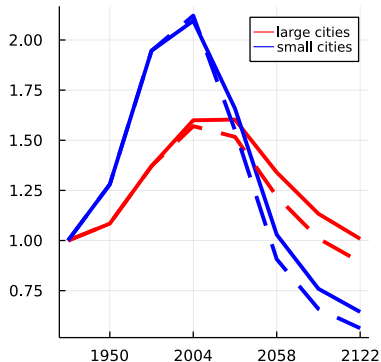
Central Population Share



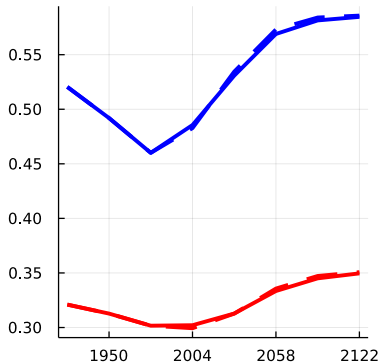
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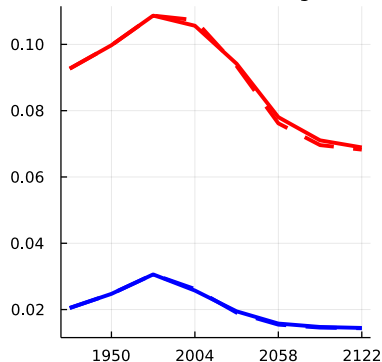
Labor Force (LF)



Share of LF at center



Share of LF at Fringe



# Conclusion

- ▶ Novel facts about fertility and demographic sorting across urban locations in France.
- ▶ Spatial overlapping generations equilibrium model with endogenous population dynamics reproduces these stylized facts (qualitatively).
- ▶ Quantitative estimation (in progress) to identify through a variety of counterfactuals
  - ▶ the role of demographic shifts in explaining the spatial distribution of population.
  - ▶ the role of changes in commuting technologies and/or housing supply regulations for the population dynamics of cities.
  - ▶ the side-effects of family policies for the distribution of population and economic activity across space.
- ▶ With agglomeration forces, fertility and population dynamics matter for aggregate productivity.