Declining Fertility and Housing Costs

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Motivation

- The decline in fertility is a major issue in the public debate
- Housing costs are often at the center of the conversation. Why?
  - Children need space: new parents want extra rooms
  - Young households have little savings: housing affordability matters for them

How does the cost of family space shape fertility, and what can policy do?

This Paper

Model: a life-cycle model with housing, in which children need space

- Households choose whether to have children, rent or own, and how much space
- Buying requires a down payment, and earnings are risky

Quantification: estimate the model parameters to match key moments

- Calibrate 2007 as a steady state, fit the decline
- Project forward: transition to a new steady state with lower population

Counterfactuals: use the model to disentangle earnings risk, housing supply, down payments

Findings: What Matters for Fertility

- **What does not work: credit mostly affects timing**
  - Lower down payments: births rise $+2\%$ on impact, but it's mostly timing
- **What works: changes to long-term incentives**
  - Lower earnings risk: a child is a long commitment, and it becomes safer
  - More housing supply: family space is cheaper every period
  - Credit for parents: births $+6\%$ on impact, $+26\%$ in the long run
- **Thinking about the long run is crucial**
  - Housing supply and credit have the same impact, but very different long-run effects

Related Literature

Housing costs and fertility

Dettling & Kearney (2014, 2025), Khorunzhina & Miller (2022), Couillard (2025), van Doornik et al. (2025), Simon & Tamura (2009), Ström (2010), Lovenheim & Mumford (2013), Hacamo (2021), Cumming & Dettling (2024)

This paper: a structural model to evaluate housing policy, with a focus on long-run effects

Earnings risk and fertility

Sommer (2016), de la Croix & Pommeret (2021), Nakakuni (2026), Fraser (2001), Del Bono, Weber & Winter-Ebmer (2012), Ejrnæs & Jørgensen (2020), Clark & Lepinteur (2022)

This paper: interaction between earnings risk and the need for family housing

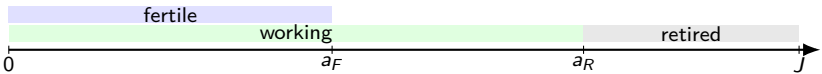
Housing over the life cycle

Fisher & Gervais (2011), Greaney et al. (2025), Halket & Vasudev (2014), Paz-Pardo (2024), Chetty & Szeidl (2007), Kaplan, Mitman & Violante (2020), Boar, Gorea & Midrigan (2022), Greenwald & Guren (2025)

This paper: study how life-cycle housing decisions interact with fertility

Environment

- Discrete time; overlapping generations of households, adult ages $a = 0, \ldots, J$:



- Households differ in wealth, housing, children, and labor efficiency
- They work until a_R, then retire on a pension
- They survive from age a to $a + 1$ with probability s_a
- Each period, a household chooses:
  - whether to try for a child, during the fertile window
  - whether to rent or own, and how much space; rentals are capped in size
  - how much to save; buying requires a down payment
- Children live at home, need space and do not work; when they mature, they enter at age 0

Preferences

Utility over a consumption aggregator $\mathcal{C}$ and the number of children at home n_t:

$$u(c_t, \hat{h}_t, n_t) = \frac{\mathcal{C}(c_t, \hat{h}_t, n_t)^{1-\sigma}}{1-\sigma} + \psi_t v(n_t), \qquad \mathcal{C}_c,\ \mathcal{C}_{\hat{h}} > 0,\ \text{concave}$$

- Children raise needs ($\mathcal{C}_n < 0$) and the marginal value of space ($\mathcal{C}_{\hat{h}n} > 0$)
- $\psi_t v(n_t)$: benefit of children at home
- The first child costs ξ in utility, once

Housing services. A household either owns h_t^O or rents h_t^R:

$$\hat{h}_t = \begin{cases} \chi\, h_t^O, & \text{owner}, \\ h_t^R, & \text{renter}, \end{cases} \qquad \chi > 1.$$

Labor Earnings

- Before retirement, households supply one unit of labor inelastically, with efficiency $e_a z_t$
  - e_a: age profile of earnings
  - z_t: idiosyncratic labor efficiency; $\log z_t$ follows an AR(1)
- Earnings are taxed at rate τ^w; retirees receive a pension m_t:

$$y_t(a, z_t) = \begin{cases} (1 - \tau^w)\, w\, e_a z_t, & a < a_R, \\ m_t, & a \geq a_R. \end{cases}$$

- Every household also receives T_t, the rebate of property-tax revenue

Housing

- A household enters period t with last period's house, h^O_{t-1} ($= 0$ for renters)
- **Owning.** A finite set of sizes, $h^O_t \in \mathcal{H}$, at price P_t
  - owners pay maintenance δ_H and property tax τ^p on the value $P_t h^O_t$
  - selling costs a fraction μ of the value
- **Renting.** Any size up to a cap, $h^R_t \leq \bar{h}^R$, at rent r_t
  - $\bar{h}^R < \max \mathcal{H}$: the largest homes are only for sale

Borrowing and the Down Payment

- Households save or borrow in a bond with gross return R_b
- **Down payment.** Buyers borrow at most a share ϕ of the house value
- **Collateral.** Owners who stay can borrow up to $\phi P_t h_t^O$
- Renters cannot borrow

Buy: $c_t + b_{t+1} + \underbrace{(\delta_H + \tau^p) P_t h_t^O}_{\text{maintenance and property tax}} = R_b b_t + y_t + T_t - \underbrace{P_t h_t^O}_{\text{new home}} + \underbrace{(1-\mu) P_t h_{t-1}^O}_{\text{old home sold}}, \quad b_{t+1} \geq -\phi P_t h_t^O$

Stay: $c_t + b_{t+1} + (\delta_H + \tau^p) P_t h_t^O = R_b b_t + y_t + T_t, \qquad b_{t+1} \geq -\phi P_t h_t^O$

Rent: $c_t + b_{t+1} + r_t h_t^R = R_b b_t + y_t + T_t + (1-\mu) P_t h_{t-1}^O, \qquad b_{t+1} \geq 0$

Fertility and Children

- n_t: children currently at home
- Until age a_F, households choose each period whether to **try** for a child
- A try succeeds with probability π_a, which falls with age, and adds one child
- Each child at home leaves with probability λ per period, independently

Bequests. A household of age a survives to $a+1$ with probability s_a. If it dies at the end of period t, it leaves the estate $x_{t+1} = b_{t+1} + (1-\mu)P_t h_t^O$, valued as in De Nardi (2004):

$$B(x_{t+1}) = \theta_0 \frac{(\theta_1 + x_{t+1})^{1-\sigma}}{1-\sigma}.$$

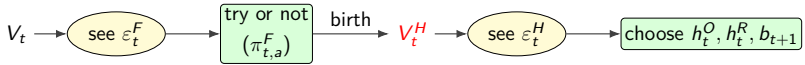
Housing Market, Firms and Bonds

- **Housing market**
  - **Developers.** Absentee developers build housing and sell it at P_t: $H_t = H_0 P_t^{\eta}$
  - **Landlords.** Absentee and competitive: they own all rental housing, no selling cost
  - **User cost.** Zero profit: a unit's earnings equal the income forgone on its price

$$\underbrace{r_t + P_{t+1} - (\delta_H + \tau^p) P_t}_{\text{rent and resale, net of maintenance and tax}} = \underbrace{R_b P_t}_{\text{forgone income}}$$

  - **Households.** Owners buy and sell at P_t, paying μ on a sale
- **Firms**
  - $Y_t = AL_t$, $w = A$, effective labor $L_t = \int_{a<a_R} e_a z_t \, dG_t$
- **Bond market**
  - The gross return R_b is fixed
  - Households and landlords can save or borrow at this rate, within the collateral limits

The Household's Problem: Housing and Savings



After the birth outcome, before observing the housing shock, the value is

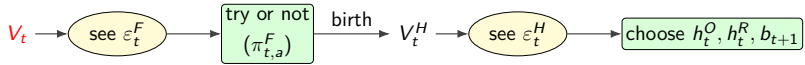
$$V_t^H(b_t, h_{t-1}^O, z_t, a_t, n_{t+1}) = \mathbb{E}_{\varepsilon_{t,j}^H} \max_{h_t^O, h_t^R, b_{t+1}} \Big\{ u(c_t, \hat{h}_t, n_{t+1}) + \varepsilon_{t,j}^H + \beta\, \mathbb{E}_t \Big[s_a V_{t+1}(b_{t+1}, h_t^O, z_{t+1}, a_t + 1, n_{t+1}) + (1 - s_a) B(x_{t+1}) \Big] \Big\}$$

subject to the budget and collateral constraint of the chosen tenure:

$$\begin{aligned}
&\text{Buy:} && c_t + b_{t+1} + (\delta_H + \tau^p) P_t h_t^O = R_b b_t + y_t + T_t - P_t \Big[h_t^O - (1-\mu) h_{t-1}^O \Big], && b_{t+1} \geq -\phi P_t h_t^O \\
&\text{Stay:} && c_t + b_{t+1} + (\delta_H + \tau^p) P_t h_t^O = R_b b_t + y_t + T_t, && b_{t+1} \geq -\phi P_t h_t^O \\
&\text{Rent:} && c_t + b_{t+1} + r_t h_t^R = R_b b_t + y_t + T_t + (1-\mu) P_t h_{t-1}^O, && b_{t+1} \geq 0
\end{aligned}$$

$\varepsilon_{t,j}^H \overset{iid}{\sim}$ Gumbel$(0, \kappa_T)$, one per option j: rent, or own each $h^O \in \mathcal{H}$.

The Household's Problem: Fertility



At the beginning of the period, before observing the fertility shock, not trying and trying are worth

$$V_{t,0}^F = V_t^H(b_t, h_{t-1}^O, z_t, a_t, n_t),$$
$$V_{t,A}^F = \pi_a\left[V_t^H(b_t, h_{t-1}^O, z_t, a_t, n_t + 1) - \xi\mathbf{1}\{\text{first child}\}\right] + (1 - \pi_a)\, V_{t,0}^F.$$

The household value and the probability of trying are

$$V_t = \mathbb{E}_{\varepsilon_{t,j}^F} \max_{j\in\{0,A\}} \left\{ V_{t,j}^F + \varepsilon_{t,j}^F \right\}, \qquad \pi_{t,a}^F = \frac{\exp\{V_{t,A}^F/\kappa\}}{\exp\{V_{t,A}^F/\kappa\} + \exp\{V_{t,0}^F/\kappa\}}.$$

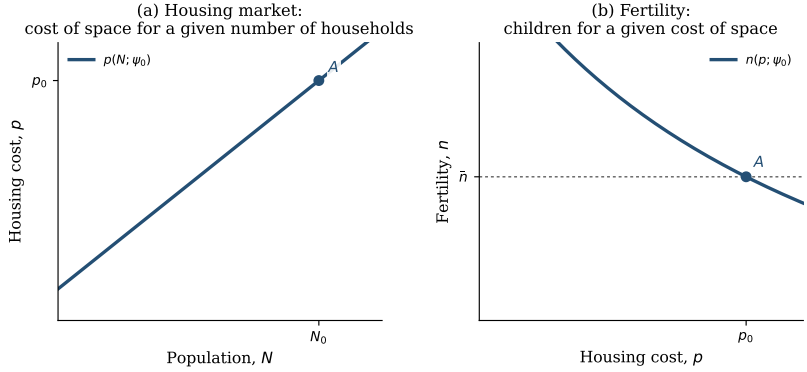
$\varepsilon_{t,j}^F \overset{iid}{\sim}$ Gumbel$(0, \kappa)$, $j \in \{0, A\}$; $\kappa = \kappa_1$ before the first child and κ_C after.

Equilibrium

Given an initial measure of households over states G_0, an equilibrium is a path of prices, pensions, rebates, value functions and policy functions such that, every period:

1. **Households** solve their problem, given prices, transfers and shocks
2. **Housing market** clears: owned and rented housing equal the stock, $\int (h_t^O + h_t^R)\, dG_t = H_t$
3. **Pensions**: payroll taxes pay N_t^R retirees, $\tau^w w L_t = m_t N_t^R$
4. **Rebate**: property-tax revenue is paid to all N_t households, $T_t N_t = \tau^p P_t \int (h_t^O + h_t^R)\, dG_t$
5. **Population**: births $B_t = \int \pi_a \pi_{t,a}^F\, dG_t$, new households $E_t = \lambda K_t$, K_t children

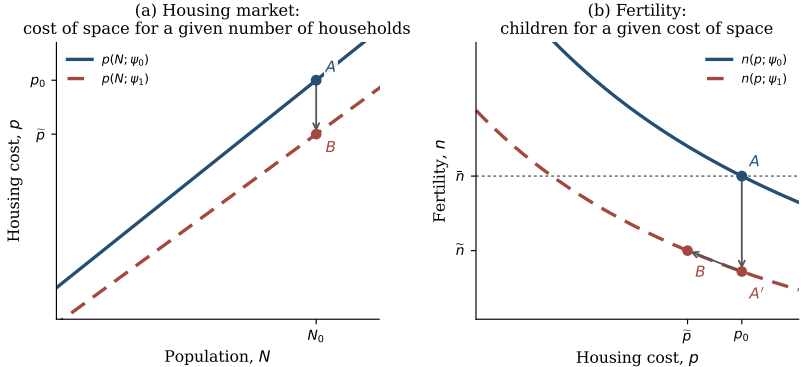
Initial Steady State



- Left: $p(N;\psi)$, the housing cost at which the housing market clears with N households
- Right: $n(p;\psi)$, the number of children households choose at housing cost p

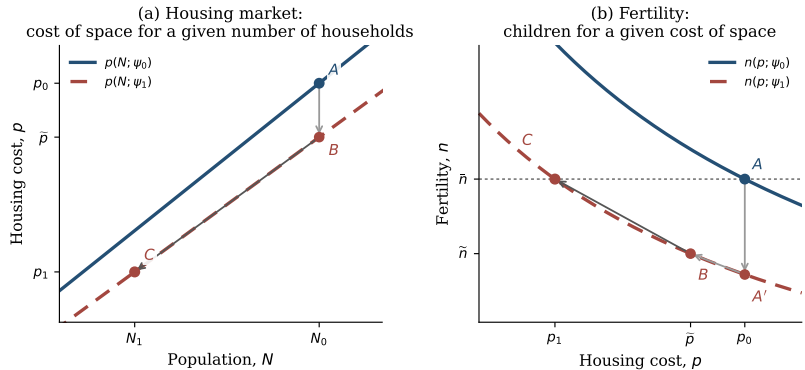
At A, housing clears at (N_0, p_0) and fertility is at the replacement rate $\bar{n}$.

Impact



A fall from ψ_0 to ψ_1 lowers fertility at unchanged housing cost: $A \to A'$. Housing costs then adjust at inherited population N_0: $A' \to B$.

Demographic Adjustment

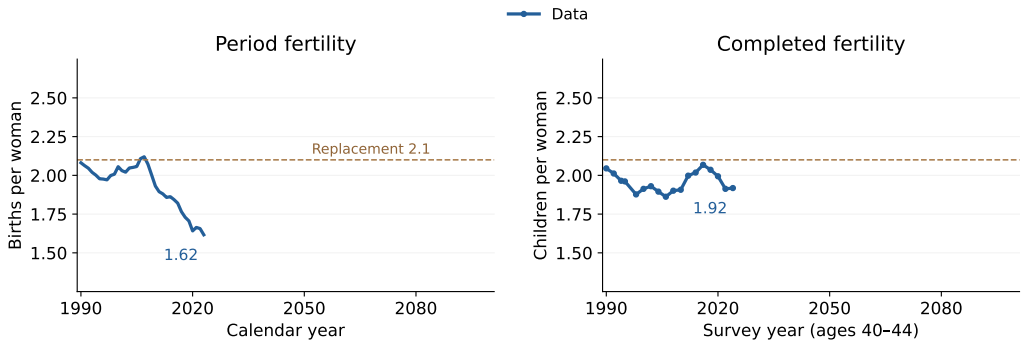


Smaller entering cohorts reduce housing demand. Lower housing costs offset the preference decline; C marks the new stationary outcome.

Quantifying the Dynamic Model

▸ Empirical evidence

Period fertility (TFR): children per woman if she lived all her fertile years at this year's birth rates
Completed fertility: children ever born per woman by the end of the fertile years (data: ages 40–44)



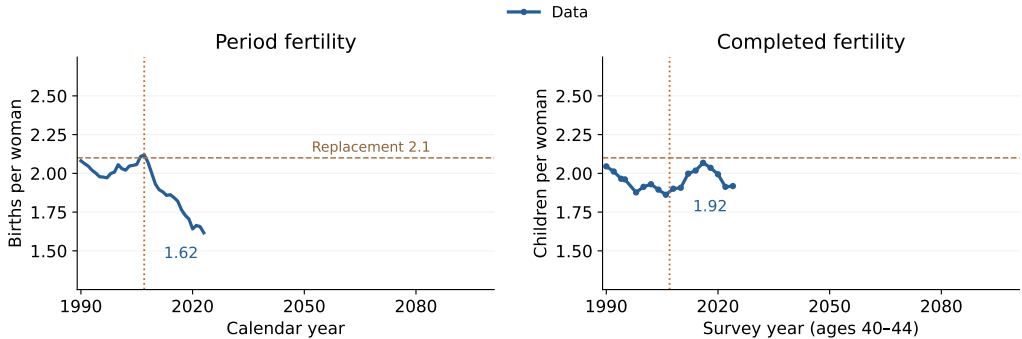
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With no response fertility stays low: the model shows how it reacts to house price drops

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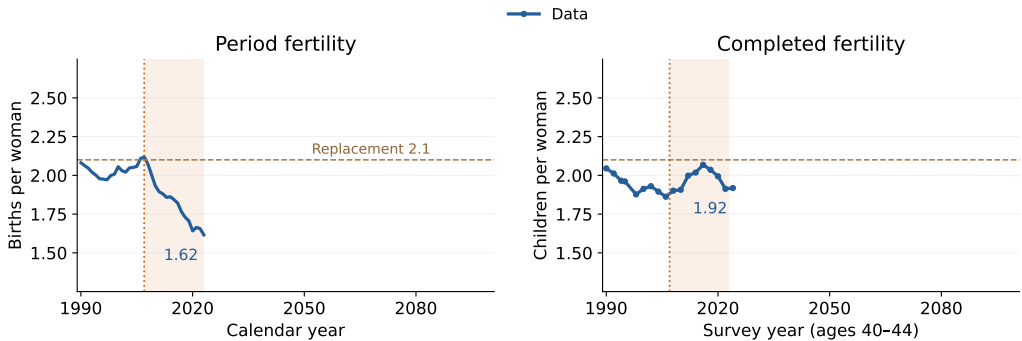
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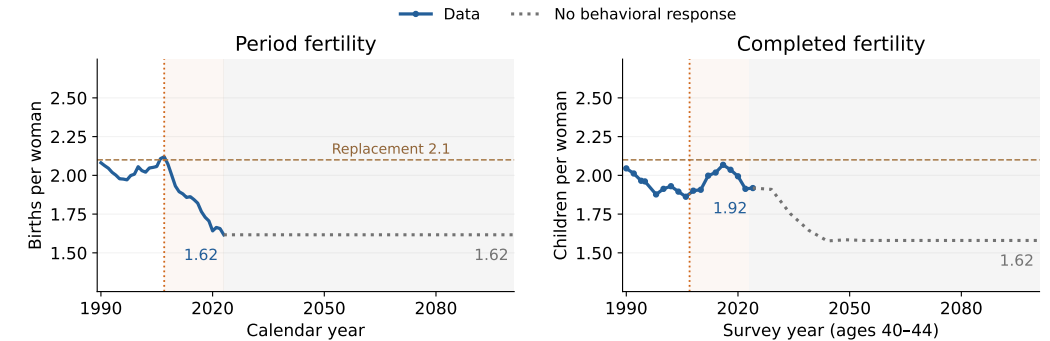
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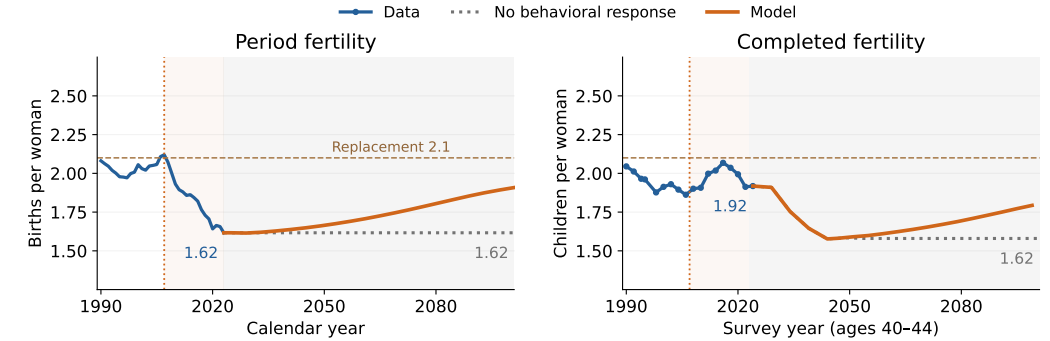
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Utility Specification

$$u_t(c_t, \hat{h}_t, n_t) = \frac{\left[\dfrac{c_t^{\alpha_0}\left(\hat{h}_t - \bar{h}(n_t)\right)^{1-\alpha_0}}{e(n_t)}\right]^{1-\sigma}}{1-\sigma} + \psi_t v(n_t), \qquad \hat{h}_t = \begin{cases} \chi\, h_t^O & \text{owner} \\ h_t^R & \text{renter} \end{cases}$$

$$e(n_t) = \left(\frac{2 + \omega\, n_t}{2}\right)^{\nu}, \qquad \bar{h}(n_t) = h_P \mathbf{1}\{n_t > 0\}, \qquad v(n_t) = n_t^{1-\gamma}.$$

Equivalence scale $e(n_t)$ as in Scholz, Seshadri & Khitatrakun (2006).

Identification

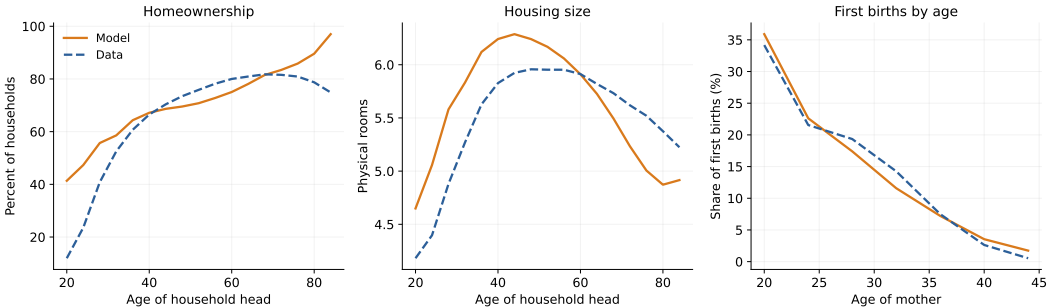
Block	Parameters	Moments
Fertility	ψ_0, ξ, κ_1, κ_C, γ	completed fertility, childlessness, one-child families, mean age at first birth, mothers by 25
Housing	h_P, χ, κ_T, H_0	rooms added at first birth, ownership rate, ownership gap of recent parents, mean rooms
Saving and bequests	β, θ_0	wealth over earnings, bequest flow

Calibration: Targets and Model

▸ Internal parameters ▸ External parameters

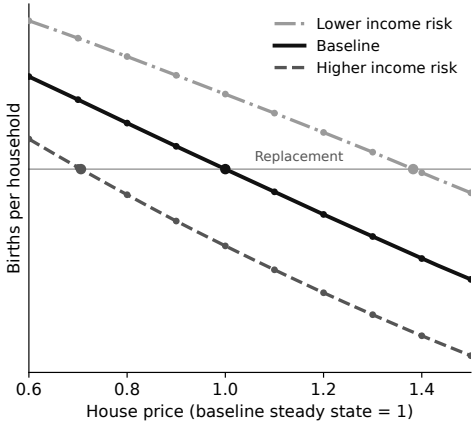
Moment	Target	Model	Source
Completed fertility	2.10	2.10	Replacement
Childless, women 40–44 (%)	19.8	20.0	CPS 2004/2006
Exactly one child among mothers, 40–44 (%)	21.4	21.6	CPS 2004/2006
Mean age at first birth (years)	25.98	25.97	NCHS natality 2003–2006
Mothers by age 25 (%)	45.7	45.3	CPS 2004/2006
Mean occupied rooms	5.73	5.77	AHS 2007
Ownership, heads 30–55 (%)	67.6	67.0	ACS 2005/2006
First-birth room response	1.440	1.491	PSID event study
Recent-parent ownership gap	0.128	0.124	ACS 2005/2006
Wealth / annual gross earnings	4.46	4.38	PSID 2005/2007
Annual bequests / wealth (%)	0.73	0.73	SCF 2007

Lifecycle Fit in 2007



Housing Costs and Income Risk

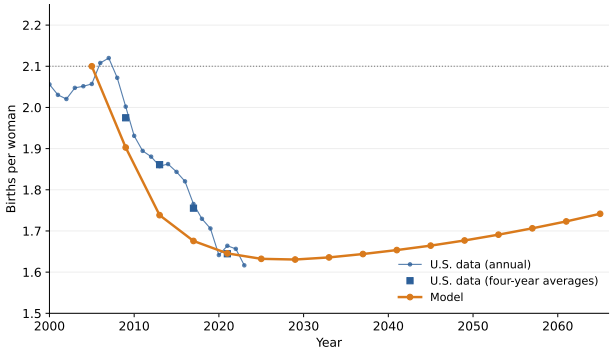
Heatmap Earnings risk



- Fertility falls with the house price, and lower income risk shifts it up

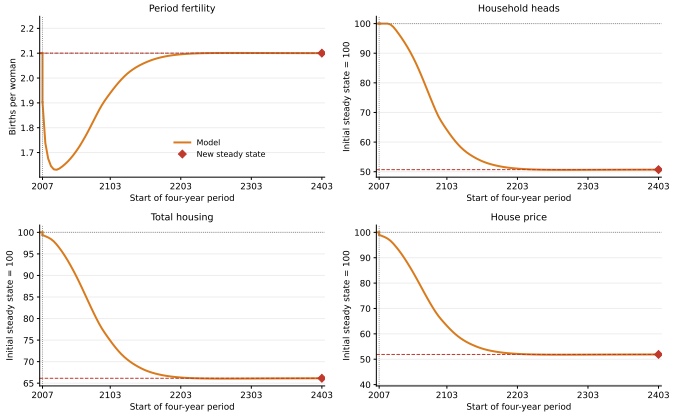
Fertility Transition: 2007–2063

▸ 2023 data and model ▸ 2023 lifecycle



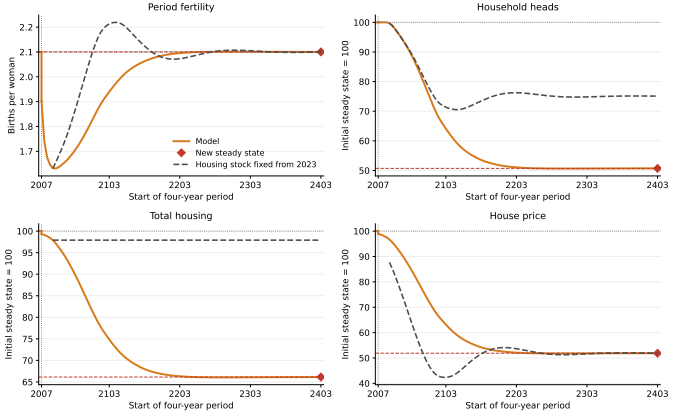
- Before 2007: the taste for children ψ is constant
- 2007–2023: it declines gradually, $\psi_t = \psi' + (\psi - \psi')\,\rho^t$
- ρ and ψ' are chosen to match the fall in births after 2007

Full Transition: 2007–2403



- Fertility recovers to replacement as housing gets cheaper
- In the long run, households and the house price settle near half their 2007 level

Full Transition: 2007–2403

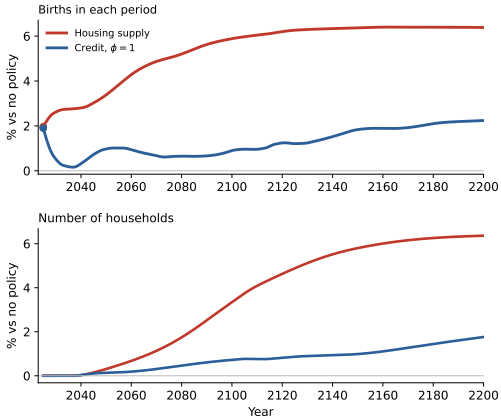


- **Baseline model:** the stock shrinks with households,
  - so space never gets unusually cheap and fertility rises smoothly to replacement
- **Fixed stock:** the price falls below its long-run level,
  - so fertility overshoots and the extra children refill the homes a generation later

Quantum and Tempo: Housing Supply vs Credit

Build-up

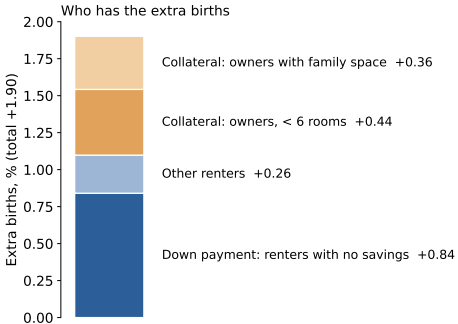
Demographers call **quantum** how many children, **tempo** when (Ryder 1964; Bongaarts & Feeney 1998)
In 2023 we raise the LTV limit to 100% ($\phi = 1$) or expand housing supply: same impact on births

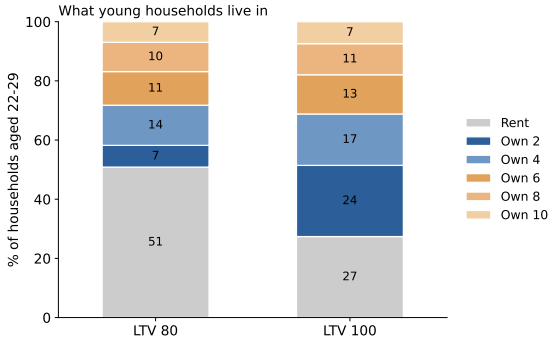


Lines: % differences from the no-policy path.

- **Same start**: both policies raise births about 2% on impact
- **Credit is mostly tempo**: the gain is nearly gone by 2035,
  - but a smaller lasting effect builds to +2.5% in the long run
- **Supply is quantum**: births rise every period, to +6%

Credit, Timing, and Tenure Choice

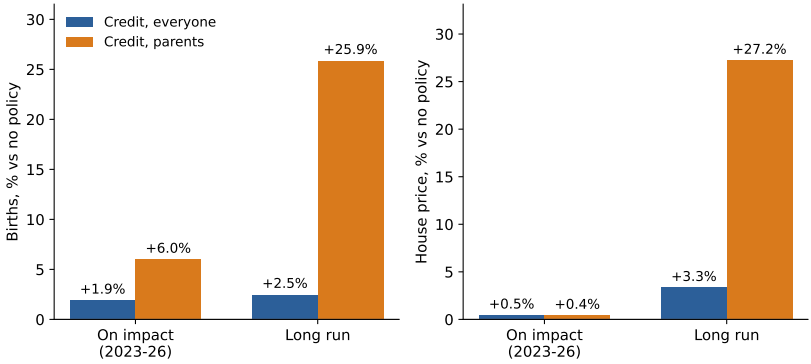




- Young renters buy the space they already rented: ownership at 22–29 rises by 50%
- Few move to family-size homes, and over half of those who do are childless
- Credit does not change the relative value of a child, so it mostly moves timing, not quantity

Credit Tied to Children

▸ Long view ▸ Property tax



- Credit only once there is a child lowers the cost of the child, not of waiting
- Same price on impact; parents' credit triples the birth gain (+6% vs +2%)
- Long run: households +26% with parents' credit, +2.5% with general credit

Conclusion

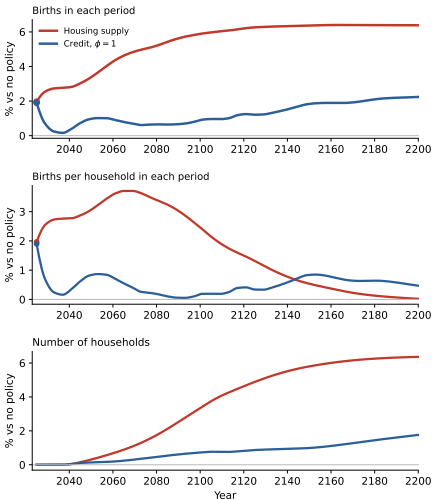
- A life-cycle model of fertility with housing: tenure, down payments, family space
- What changes incentives raises fertility: lower earnings risk, cheaper family space
- Lower down payments for everyone change mostly timing, but can be effective if targeted
- Housing policy for births must be judged in the long run, not only on impact

Thank You!

Appendix

Quantum and Tempo: Build-up

Back



Same impact: births rise about 2% under both.

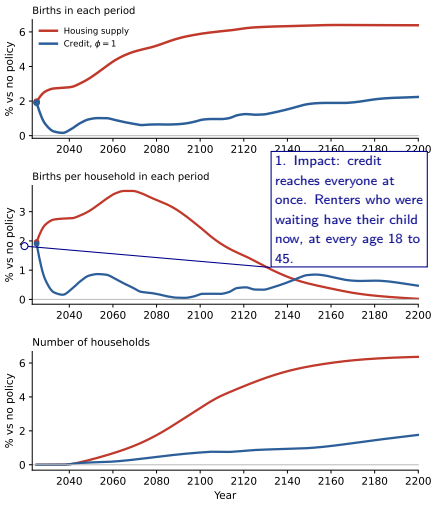
- **Credit is timing**: births come earlier
- **Supply is quantity**: births stay higher

Echoes: extra children become parents a generation later.

- Credit adds one pulse: echoes fade
- Supply adds a steady flow: echoes build up

Quantum and Tempo: Build-up

Back



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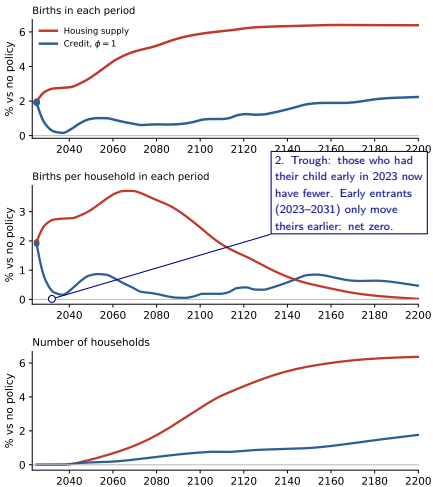
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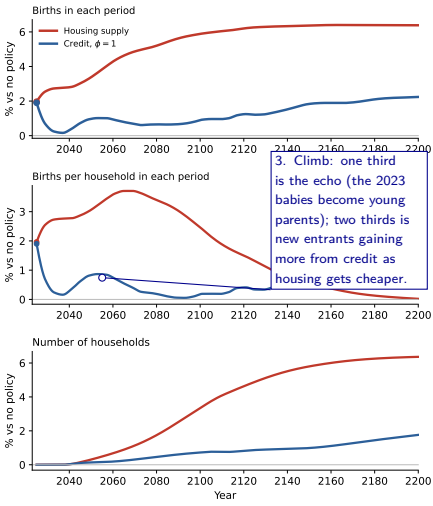
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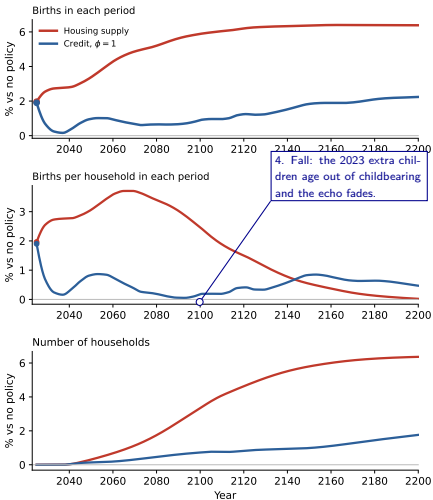
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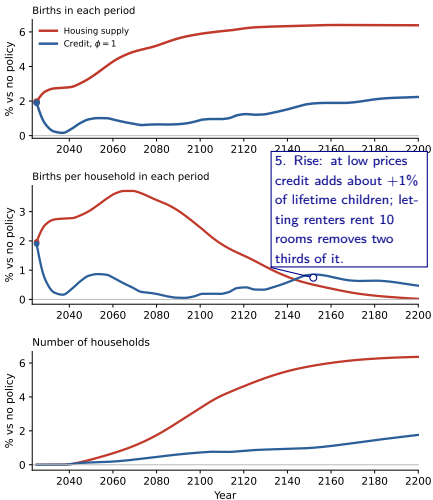
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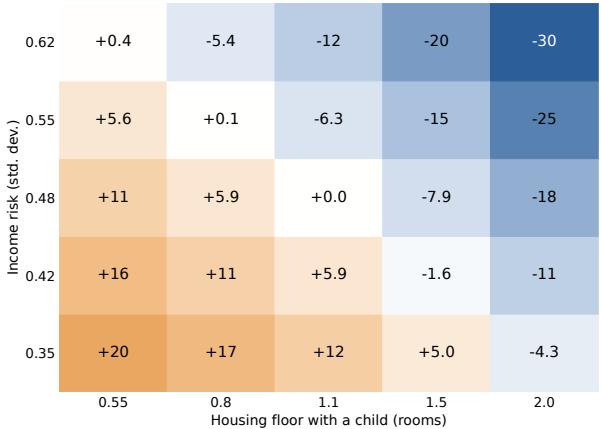
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Income Risk, Housing Needs and Fertility

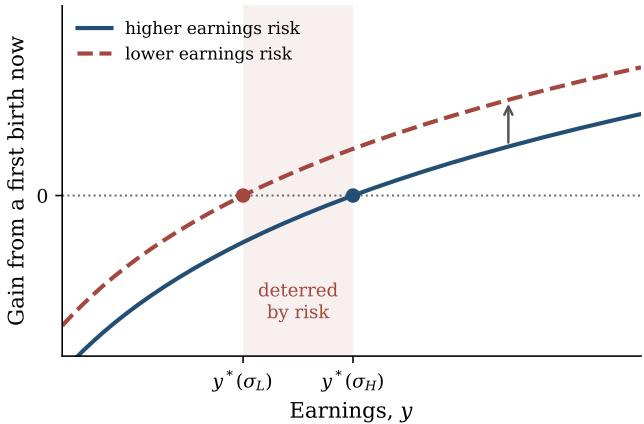
Back Mortgage credit



Fertility rises as income risk falls and as the housing floor falls.

Earnings Risk and the Cost of a Child

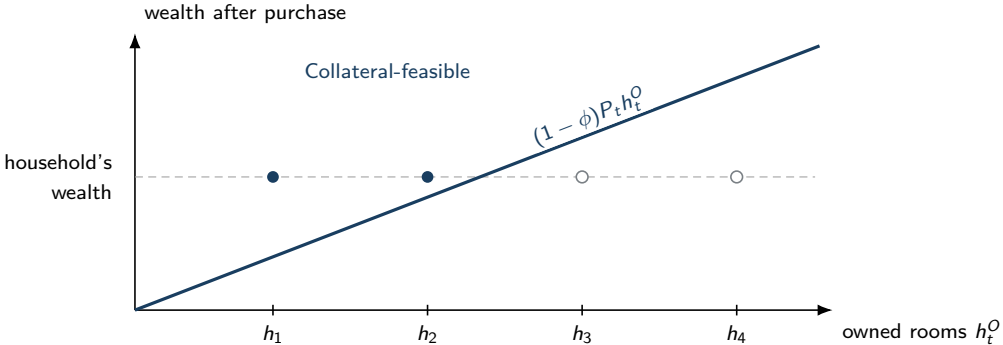
Back



Mortgage Credit and Family Space

Back

For a buyer, the borrowing limit restricts wealth after purchase, $b_{t+1} + P_t h_t^O$. A household can buy any size whose down payment is below its wealth.

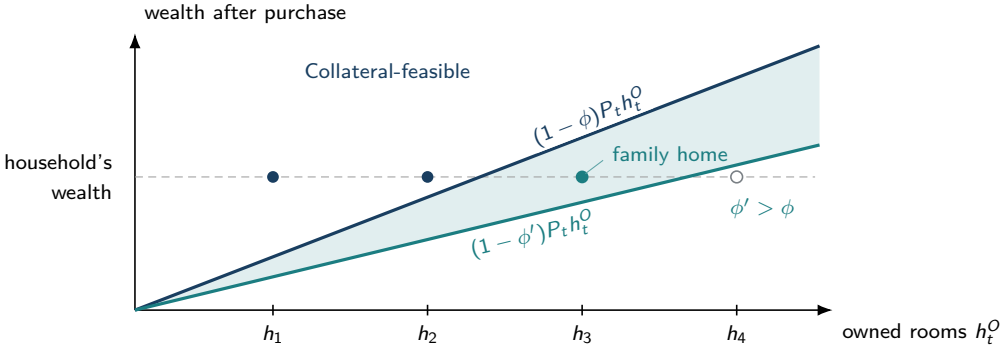


The collateral constraint selects which owned sizes are accessible at a given wealth.

Mortgage Credit and Family Space

Back

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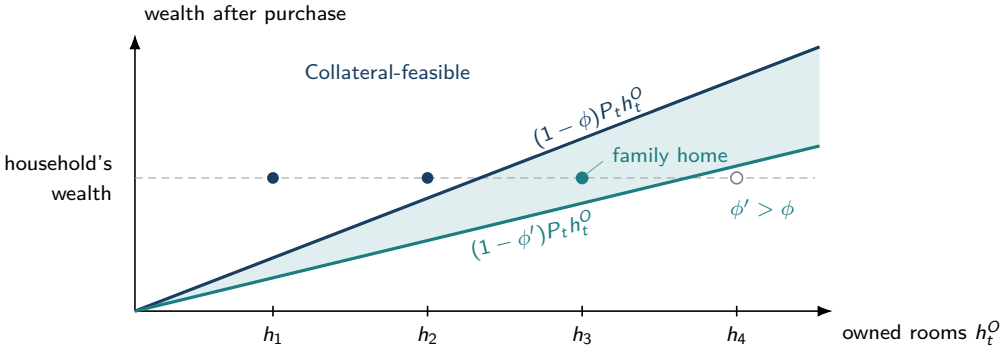


Higher leverage expands the collateral-feasible set.

Mortgage Credit and Family Space

Back

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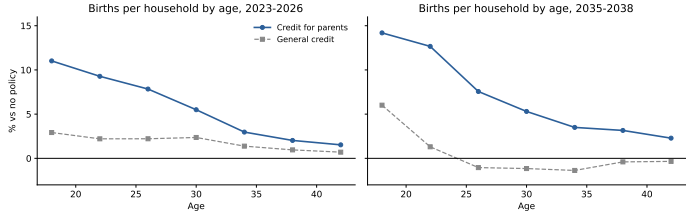
Credit can affect fertility by unlocking housing that is more valuable with a child.

If $h_3 \leq \bar{h}^R$, that space can also be rented; its bill $r_t h_3$ is unchanged at fixed prices.

Credit for Parents: Leverage That Buys Space

▸ Property tax ▸ Long view

LTV 100 only for households with children, base earnings risk, against the no-policy path.



On impact both raise births at every age; parent credit about three times as much in total.

Twelve years later general credit lowers births after 26 (earlier births); parent credit still raises them at every age (more children).

- Only for parents: births $+6.0\%$ on impact, 2023 cohort $+6.3\%$
- General credit: $+1.9\%$ on impact, -0.4% for the 2023 cohort
- A child subsidy paid in housing: its value is part of the return to having a child
- It raises demand for space: price $+3.1\%$ by 2059, $+27\%$ in the long run

Internally Calibrated Parameters

Back

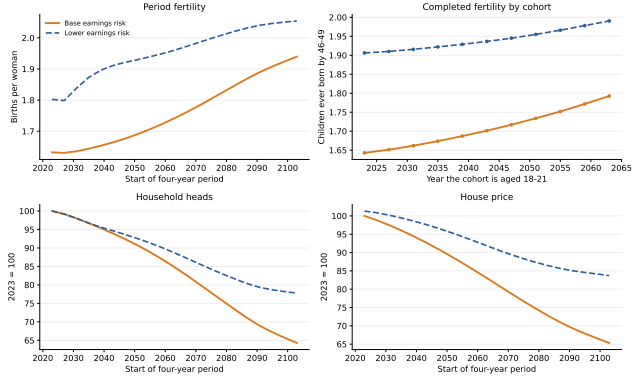
Parameter	Economic interpretation	Value
β_{annual}	Annual discount factor	0.939
κ_1	First-birth taste scale	0.054
κ_C	Later-birth taste scale	0.153
χ	Owner housing-service multiplier	1.086
H_0	Housing supply scale	7.352
θ_0	Bequest-motive scale	0.222
ξ	First-birth utility cost	0.267
h_P	Parenthood space requirement	1.098
ψ_0	Initial preference for children	0.162
γ	Curvature of the benefit of children	0.533
κ_T	Tenure taste scale	0.022

Externally Calibrated Parameters

Back

Parameter	Value	Source
Risk aversion σ	2	
Equivalence scale (ω, ν)	(0.7, 0.7)	Scholz et al. (2006)
Consumption share α_0	0.733	CEX 2019–23, childless renters
Housing-supply elasticity η	0.63	Baum-Snow & Han (2024)
Bond return R_b, annual real rate	2.0%	Greaney et al. (2025)
Payroll tax rate τ^w	8.0%	CPS ASEC pension ratio
Financed share ϕ	0.80	20% down payment
Maintenance δ_H, property tax τ^p	1.4%, 1.06% per year	BEA and Fed 2007; ACS 2007–11
Selling cost μ	6%	Greaney et al. (2025)
Rental size cap $\bar{h}^R$	6 rooms	Greaney et al. (2025)
Bequest-utility wealth shift θ_1	0.008	Greaney et al. (2025)
Earnings process (ρ_z, σ_z)	0.73, 0.48 per four years	PSID, four-year earnings
Ages	18, 66, 45	entry, retirement, last fertile age

Base and Lower Earnings Risk

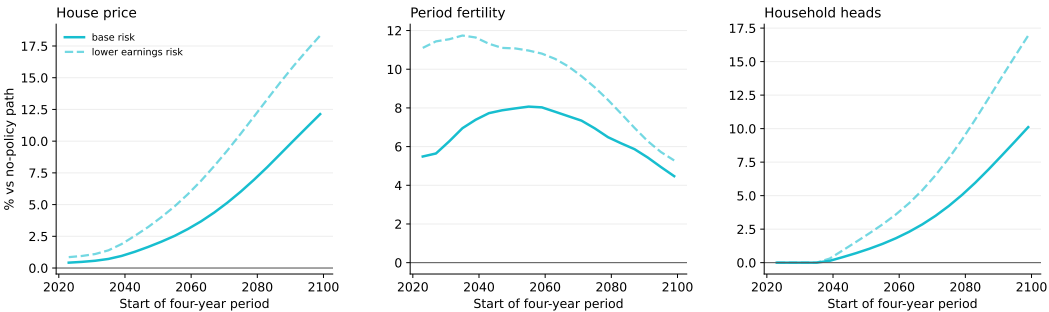


- Partial cut in earnings risk: completed fertility of the 2023 cohort rises 16%
- Sommer (2016): +16% from 1990s to 1970s risk, +26% from no risk

Credit for Parents: The Long View

Back

Price, period fertility and household heads, each policy against its own no-policy path, 2023–2100.



Property Tax, Rebated to All

Back

- Property tax from 1.06% to 2%, revenue rebated equally every period
- On impact: house price -6.2%, rent $+13.5\%$, births -0.2%
- By 2059: births $+1.1\%$, price -5.9%
- Long run: population $+0.5\%$, price -5.0%
- Lower price, higher rent: births follow the per-period cost of space

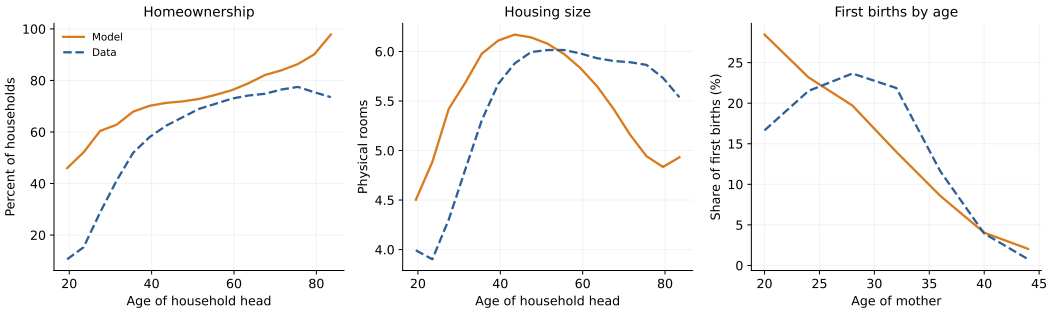
2023 Data and Model

Back

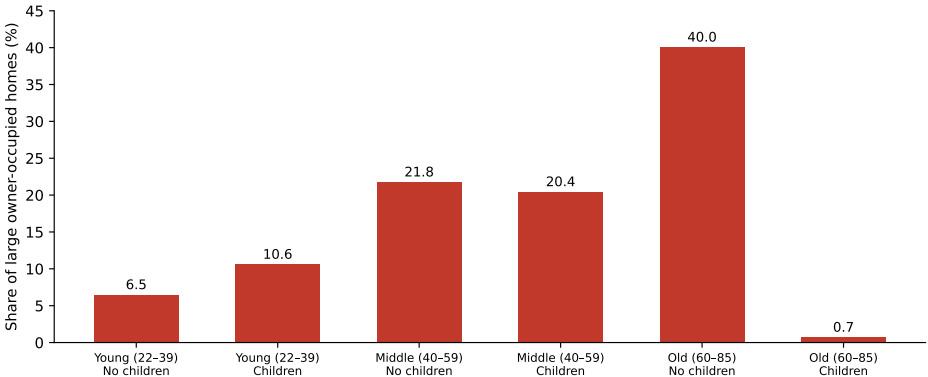
Moment	Data	Model	Source
Completed fertility, ages 40–44	1.92	1.69	CPS 2024
Childless, women 40–44 (%)	18.8	28.7	CPS 2024
Exactly one child among mothers, 40–44 (%)	22.2	22.5	CPS 2024
Mean age at first birth (years)	28.09	26.85	NCHS natality 2023
Mothers by age 25 (%)	27.4	32.4	CPS 2024
Mean occupied rooms	5.58	5.54	ACS 2023
Ownership, heads 30–55 (%)	58.7	69.9	ACS 2023
First-birth room response	1.465	0.605	PSID event study
Recent-parent ownership gap	0.183	0.139	ACS 2023
Wealth / annual gross earnings	5.36	4.42	PSID 2017/2019
Annual bequests / wealth (%)	0.88	0.82	external benchmark

Lifecycle Fit in 2023

Back



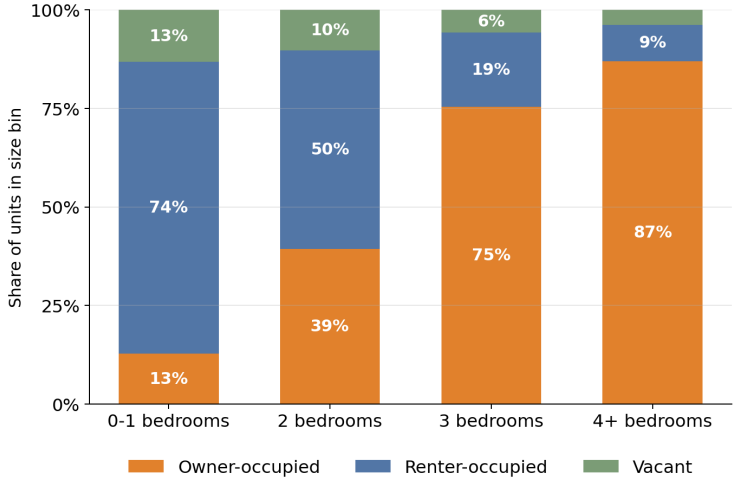
Who Owns the Large Homes



Owner-occupied homes with 6+ rooms; ACS 2023.

Big Units Are Owned

Back



Source: American Housing Survey, 2023.

Data

Back

- **AHS and ACS:** housing sizes, tenure, household composition, and age profiles.
- **PSID:** housing around childbirth, earnings, and wealth by age.
- **CPS and natality records:** completed fertility, childlessness, and birth timing.
- **Census population estimates:** age–sex population and demographic flows.

PSID Event Study: Design

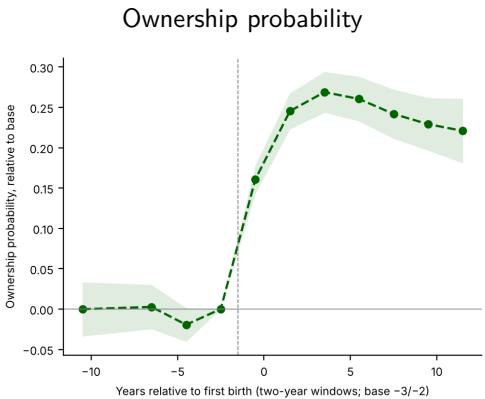
For woman i with first birth in two-year window E_i and any housing outcome Y_{it} (Sun and Abraham, 2021):

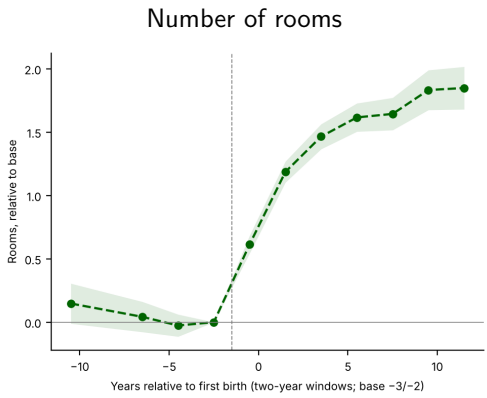
$$Y_{it} = \alpha_i + \lambda_t + x_{it}'\gamma + \sum_g \sum_{k \neq -3/-2} \delta_{g,k} \, \mathbf{1}\{E_i = g\} \, \mathbf{1}\{t - E_i \in k\} + \varepsilon_{it}$$

Plotted: $\hat{\beta}_k = \sum_g w_{g,k} \, \hat{\delta}_{g,k}$, the average over birth cohorts g weighted by their share of treated women in window k.

α_i, λ_t: person and survey-year fixed effects; x_{it}: age and education. Base window $-3/-2$ years; controls are women who never have a child. Sample: women who headed a household or were a spouse in the base window. PSID weights; standard errors clustered by person.

Ownership and Housing Size Around First Birth (new estimates)

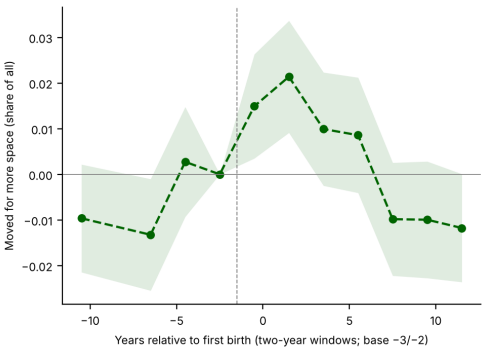




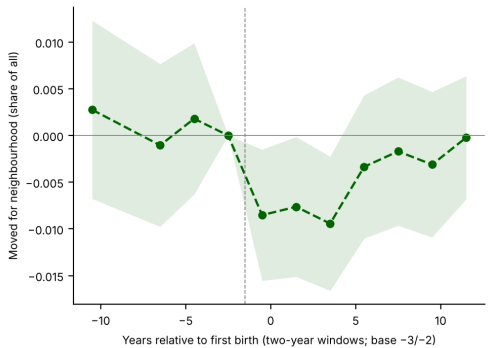
Source: PSID; Sun–Abraham event study, two-year windows, base −3/ − 2.

Moving Around First Birth (new estimates)

Moved for more space (share of all households)



Moved for neighborhood (share of all households)



Source: PSID; Sun–Abraham event study, two-year windows, base $-3/-2$.