Home ownership, family size, and college enrollment: Evidence from the housing cycle in the United States

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The QQ Trade-off

- A negative relationship between family size and child quality, termed the quantity-quality (QQ) tradeoff (Becker, 1960; Becker and Lewis, 1973; Becker and Tomes, 1976).
- The QQ trade-off occurs due to resource dilution (Blake, 1981).
  - The QQ trade-off is less likely to occur in developed countries (e.g., Rosenzweig and Wolpin, 1980; Li et al., 2008; Rosenzweig and Zhang, 2009) than in developing countries (e.g., Black et al., 2005; Caceres-Delpiano, 2006; Angrist et al., 2010).
  - Within a given country, the QQ trade-off is more likely to occur in less developed areas and to eventually disappear along with local development (e.g., Chen et al., 2021; Maralani, 2008; Li et al., 2008).

Research Question

- In a developed country without a QQ trade-off at the aggregate level, whether firstborns' college enrollment is affected by family size when there is an unexpected shock that changes their budget constraints?
  - We utilize the change in housing prices during the real estate cycle from 2005 to 2012 in the U.S..

Homeowners Versus Renters

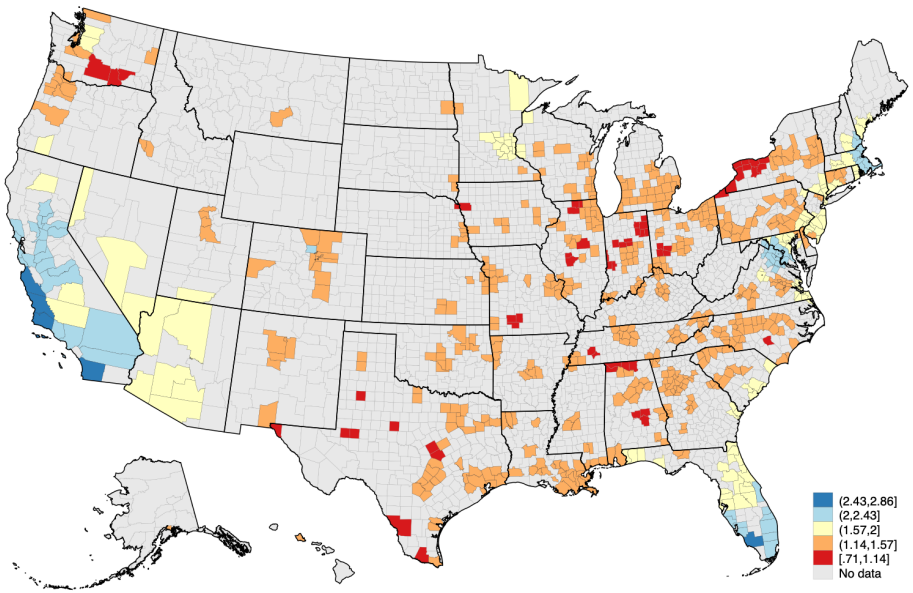
- Changes in housing prices affect household consumption in two ways (Buiter, 2010):
  1. Wealth effect: a decrease in house prices transfers wealth from homeowners to renters, and vice versa.
  2. Collateral effect: home depreciation reduces borrowing capacity and undermines consumption, whereas home appreciation loosens borrowing constraints and boosts consumption.
- The effects of housing price change on household consumption are different for homeowners and renters:
  - The wealth effects for homeowners and renters are the opposite.
  - The collateral effects are only applicable to homeowners.

The US Context

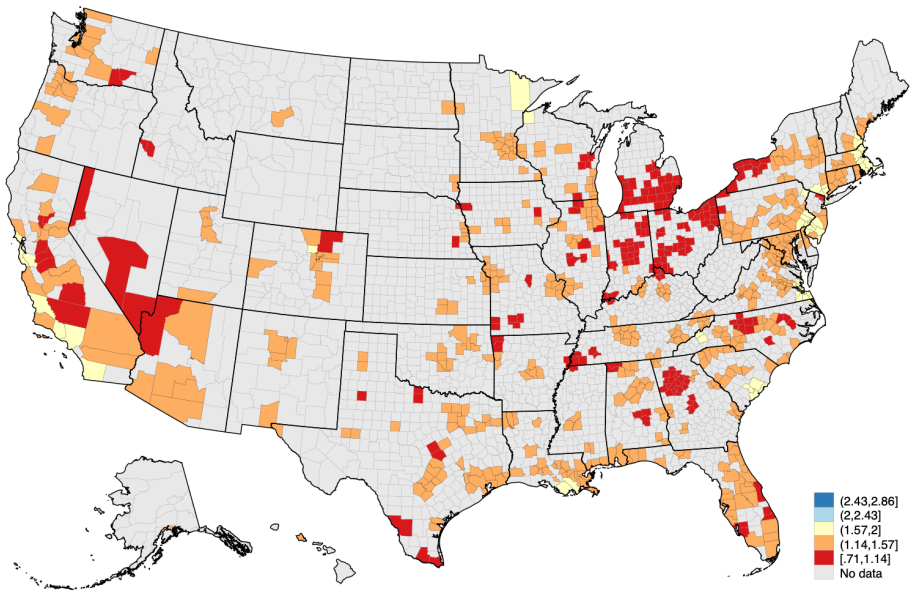
- The U.S. had the highest expenditure per full-time enrolled (FTE) student at the postsecondary level among all member countries of the OECD between 2005 and 2016.
- The U.S. experienced a housing boom from 1997 to 2006 and then a housing bust from 2007 to 2012.
- Housing wealth makes up over 70 percent of net worth for the median U.S. household (Cooper, 2015).

Real Rent and Real Housing Price during 2005–2012

Housing Price Index by MSA, 2005 and 2010



2005



2010

The QQ Trade-Off

- In the US:
  - Supporting Evidence: Blake (1981); Stafford (1987) ;Conley and Glauber (2006)
  - Disproving Evidence: Caceres-Delpiano (2006)
- In other countries:
  - Supporting Evidence: China (e.g., Rosenzweig and Zhang, 2009; Li et al., 2008), India (e.g., Rosenzweig and Wolpin, 1980; Azam and Saing, 2018), and France (e.g., Goux and Maurin, 2005)
  - Disproving Evidence:
    - No effect: Israel (Angrist et al., 2010), Indonesia (Maralani, 2008)
    - Positive impact: China (Qian, 2009) and Norway (Black et al., 2005).

Housing Wealth and Education Attainment

- Boehm and Schlottmann (1999): children of homeowners can secure higher educational attainment than children of renters.
- Lovenheim (2011): every $10,000 increase in housing wealth during the 2000s increased college enrollment of 18- and 19-year-olds by 1.37 percentage points.
- Cooper (2015): two-year home appreciation leads to a greater likelihood of attending a postsecondary institution for homeowners' children and a higher annual income in the future, while such appreciation generates an opposite effect on the children of renters.

Data Sources

- Household data
  - 2005–12 American Community Survey (ACS)
  - The data include personal information on education, employment, and demographics, and also household-level information on housing ownership and mortgage status.
- Housing price data
  - Housing price index (HPI) at the MSA-level from the Federal Housing Finance Agency (FHFA)
  - The housing price growth is equal to the log change in real HPI over two to five years.

Sample Selection

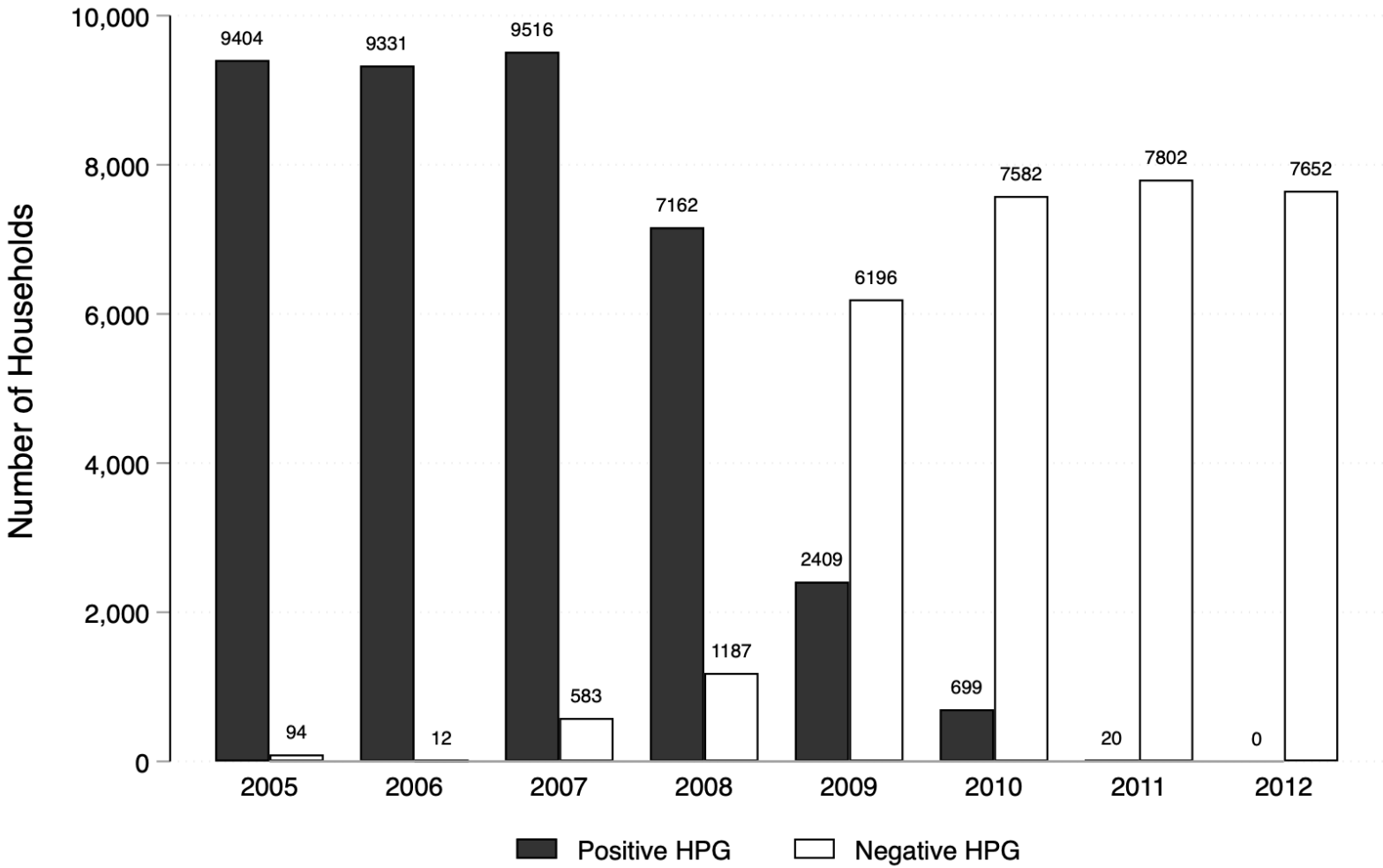
1. The first-born children aged 18–20
2. Nuclear families
3. Children with at least one sibling
4. Mother aged 19–39 at first birth and father aged 19 or older than 19 at first birth
5. Exclude families with extremely large numbers of children (>4) and those with twins at the first two parities
6. Exclude individuals with different birth states and residential states

Summary Statistics

	Owners (N=62,512)		Renters (N=7,137)	
	Mean	SD	Mean	SD
Panel A: Firstborn's information				
Number of siblings	1.470	0.713	1.652	0.827
Attending college (1/0)	0.442	0.497	0.334	0.472
Male	0.540	0.498	0.558	0.497
Employed (1/0)	0.528	0.499	0.418	0.493
Race:				
White	0.824	0.381	0.606	0.489
Black	0.058	0.234	0.152	0.359
Other races	0.118	0.323	0.242	0.428
Panel B: Household backgroung				
Same-sex first two children (1/0)	0.501	0.500	0.495	0.500
Real household income	6.091	0.672	5.402	0.745
Mother's age	45.92	4.331	44.05	4.649
Father's age	48.21	5.191	46.74	5.861
Mother having a Bachelor's degree (1/0)	0.326	0.469	0.113	0.316
Father having a Bachelor's degree (1/0)	0.349	0.477	0.113	0.316
Mother unemployed (1/0)	0.028	0.166	0.066	0.249
Father unemployed (1/0)	0.030	0.172	0.076	0.266
Panel C: Housing price growth				
Two-year housing price growth	0.003	0.177	-0.021	0.206
Three-year housing price growth	0.023	0.244	-0.013	0.291
Four-year housing price growth	0.060	0.287	0.018	0.352
Five-year housing price growth	0.111	0.302	0.080	0.371

Notes: Statistics are weighted using IPUMS household weights. The housing price growth means the log difference of housing price index between two years.

Number of Households Experiencing Positive and Negative Housing Price Growth, 2005–2012



Empirical Model 1: The Simple QQ Trade-Off

$$Educ_{ist} = \alpha + \beta Sibsize_{ist} + \gamma X_{ist} + \delta_s + \theta_t + \varepsilon_{ist}, \quad (1)$$

- $Educ_{ist}$: equals to one if the first-born child i living in the MSA s attended college when they are aged 18–20 in survey year t
- $Sibsize_{ist}$ is the sibship size for child i in the MSA s in the survey year t.
- X_{ist} (Baseline controls): child i's sex, race, real household income, mother's age and its square, father's age and its square, mother having a bachelor's degree, and father having a bachelor's degree. *Employment controls: the first-born child's employment status and whether their parents are unemployed.
- δ_s and θ_t are MSA and year fixed effects.
- ε_{ist} represents an idiosyncratic error term. The standard errors are clusteblue by the state level (48 states).

Instrumental Variable Approach

- Endogeneity problem: $Sibsize_{ist}$ may be correlated with unobservable variables that also affect children's education, such as parental preferences, quality of eudcation, etc.
- Use sex composition of the first two children as IV.

$$Sibsize_{ist} = \alpha + \beta SameSex_{ist} + \gamma X_{ist} + \delta_s + \theta_t + \varepsilon_{ist} \qquad (2)$$

- $SameSex_{ist}$ is unity if the first-born child i in the household with same-gender first two children in the MSA s in survey year t.
- We expect a positive value of β in the equation (2).

First-stage Results

	Owners (1)	Renters (2)	All (3)
Same-sex first two children	0.093***	0.111***	0.094***
	(0.007)	(0.014)	(0.007)
F-ratio	166	61	186
Baseline control	Y	Y	Y
MSA FE	Y	Y	Y
Year FE	Y	Y	Y
Observations	62,512	7,137	69,649

Notes: Standard errors are shown in parentheses and are cluste-blue by state.
*: Significant at 10%. **: Significant at 5%. ***: Significant at 1%.

Empirical Model 2: The Effect of Change in Housing Wealth on QQ Trade-Off.

$$Educ_{ist} = \alpha + \psi Sibsize_{ist} \times HousingGrowth_{ist} + \beta Sibsize_{ist} + \ell HousingGrowth_{ist} + \gamma X_{ist} + \delta_s + \theta_t + \varepsilon_{ist} \quad (3)$$

- $HousingGrowth_{is(t-1)}$ is the pre-period housing price growth in the MSA s (2- to 5-year changes).
- We use $SameSex \times HousingGrowth$ as the IV for $Sibsize \times HousingGrowth$
- Run regressions for homeowners and renters, separately.

Empirical Model 3: A Nonlinearity of QQ Trade-Off along with the Levels of Housing Price Growth.

$$Educ_{ist} = \alpha + \psi \sum_{N=1}^{3} Sibsize_{ist} \times Tertile\_N_{ist} + \beta Sibsize_{ist} + \ell \sum_{N=1}^{3} Tertile\_N_{ist} + \gamma X_{ist} + \delta_s + \theta_t + \varepsilon_{ist}. \quad (4)$$

- *Tertile*_1, *Tertile*_2, and *Tertile*_3: MSAs belong to areas with low, intermediate, or high housing price growth, respectively.
- We use *SameSex* $\times$ *Tertile*_*N* as the IV for *Sibsize* $\times$ *Tertile*_*N* ($N =$ 1, 2, or 3).
- Run regressions for homeowners and renters, separately.

Estimates of the effects of sibship size on college enrollment of the first born

	OLS (1)	2SLS (2)	2SLS (3)
Panel A: Owners (N=62,512)			
Number of siblings	0.014***	-0.012	-0.013
	(0.004)	(0.048)	(0.048)
Panel B: Renters (N=7,137)			
Number of siblings	0.003	-0.068	-0.076
	(0.007)	(0.144)	(0.135)
Panel C: Pooled (N=69,649)			
Number of siblings	0.010**	-0.011	-0.013
	(0.004)	(0.039)	(0.038)
Baseline controls	Y	Y	Y
Employment controls	N	N	Y
MSA FE	Y	Y	Y
Year FE	Y	Y	Y

Notes: Standard errors are shown in parentheses and are clusteblue by state.
*: Significant at 10%. **: Significant at 5%. ***: Significant at

2SLS estimates of the effect of three-year housing price growth on the QQ trade-off

	Owners			Renters		
	(1)	(2)	(3)	(4)	(5)	(6)
Number of siblings	-0.024	-0.022	-0.025	-0.043	-0.055	-0.053
	(0.048)	(0.047)	(0.047)	(0.154)	(0.157)	(0.143)
Sibship × Housing price growth	0.418***	0.400***	0.416***	0.207	0.138	0.191
	(0.141)	(0.135)	(0.143)	(0.194)	(0.209)	(0.194)
Housing price growth	-0.680***	-0.627***	-0.685***	-0.373	-0.208	-0.349
	(0.216)	(0.211)	(0.221)	(0.347)	(0.389)	(0.346)
Baseline Controls	Y	Y	Y	Y	Y	Y
Employment Controls	N	N	Y	N	N	Y
MSA FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
MSA time trend	N	Y	N	N	Y	N
Observations	62,512	62,512	62,512	7,137	7,137	7,137

Note: Standard errors are shown in parentheses and are clusteblue by state.
*: Significant at 10%. **: Significant at 5%. ***: Significant at 1%.

2SLS estimates of the QQ trade-off over three levels of housing price growth

	Owners			Renters		
	(1)	(2)	(3)	(4)	(5)	(6)
Number of siblings	-0.202***	-0.200***	-0.198***	-0.170	-0.171	-0.169
	(0.073)	(0.070)	(0.075)	(0.211)	(0.223)	(0.199)
Sibship × Tertile 2	0.296**	0.306***	0.278**	0.099	0.259	0.088
	(0.115)	(0.115)	(0.120)	(0.254)	(0.254)	(0.260)
Sibship × Tertile 3	0.307***	0.305***	0.305***	0.292	0.197	0.272
	(0.104)	(0.102)	(0.105)	(0.239)	(0.253)	(0.236)
Tertile 2	-0.443***	-0.442**	-0.418**	-0.156	-0.429	-0.136
	(0.167)	(0.173)	(0.174)	(0.406)	(0.413)	(0.417)
Tertile 3	-0.464***	-0.445***	-0.462***	-0.494	-0.380	-0.461
	(0.157)	(0.150)	(0.159)	(0.387)	(0.406)	(0.381)
Baseline controls	Y	Y	Y	Y	Y	Y
Employment controls	N	N	Y	N	N	Y
MSA FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
State time trend	N	Y	N	N	Y	N
Observations	62,512	62,512	62,512	7,137	7,137	7,137

Note: Standard errors are shown in parentheses and are clusteblue by state.
*: Significant at 10%. **: Significant at 5%. ***: Significant at 1%.

Mechanisms

- Main results: local housing shocks only impact homeowner households but not renter households.
- Potential mechanisms through which housing shocks affect homeowner households.
  - Wealth effect or collateral effect?
- Mortgage status: homeowner households with mortgages usually have a stronger collateral effect than those without (Cooper, 2013)

2SLS estimates of the QQ trade-off over three-level housing price growth by homeowners' mortgage status

	With Mortgage			Without Mortgage		
	(1)	(2)	(3)	(4)	(5)	(6)
Number of siblings	-0.224***	-0.219***	-0.222***	0.096	0.087	0.109
	(0.081)	(0.077)	(0.082)	(0.308)	(0.264)	(0.314)
Sibship × Tertile 2	0.257**	0.254**	0.237*	0.313	0.510	0.286
	(0.129)	(0.127)	(0.137)	(0.539)	(0.667)	(0.530)
Sibship × Tertile 3	0.302***	0.298***	0.303**	0.139	0.139	0.125
	(0.116)	(0.113)	(0.119)	(0.308)	(0.264)	(0.314)
Tertile 2	-0.387**	-0.367*	-0.359*	-0.453	-0.709	-0.415
	(0.190)	(0.190)	(0.202)	(0.763)	(0.970)	(0.751)
Tertile 3	-0.459***	-0.429**	-0.461**	-0.199	-0.215	-0.181
	(0.176)	(0.170)	(0.181)	(0.437)	(0.388)	(0.448)
Baseline Controls	Y	Y	Y	Y	Y	Y
Employment Controls	N	N	Y	N	N	Y
MSA FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
MSA time trend	N	Y	N	N	Y	N
Observations	54,084	54,084	54,084	8,428	8,428	8,428

Note: Standard errors are shown in parentheses and are clusteblue by state.
*: Significant at 10%. **: Significant at 5%. ***: Significant at 1%.

Future Work

Figure out the underlying mechanism by providing evidence on homeowner households' borrowing behaviors, investment behaviors, and expenditure behaviors

- Panel Study of Income Dynamics (PSID) data
- Household structure, income, expense, housing values, loan, mortgage, renting status, members' age, sex education, and employment status, etc.
- Apply for zip code information

Conclusion

- Without considering shocks from the housing market: no QQ trade-off in the U.S.. (consistent with previous studies)
- Considering shocks from the housing market:
  - Homeowner households
    - In the area with a relatively high housing price growth: having one younger sibling increases firstborn college enrollment.
    - In the area with a relatively low housing price growth: having one younger sibling decreases enrollment.
    - This impact is mainly driven by homeowner households with mortgages.
  - Renter households
    - face no QQ trade-off across various model specifications

Thank you for listening!

The full paper is available at SSRN:
https://ssrn.com/abstract=3979699