Highly Disaggregated Land Unavailability

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Supply Constraints: Existing Proxies Contradict Standard Theory

Economic Theory:

- Building constraints → Steeper Supply Curve → Higher Price Growth With Demand Growth
  → Policymakers: Lower Supply Constraints to Improve Affordability! (White House, 2025)

But… according to existing supply constraint proxies:

1) Supply constraints don't explain house price growth across cities (Davidoff 2013, Guren et al 2021)
2) Looser supply constraints don't mitigate the price impacts of demand growth (Louie et al, 2026)

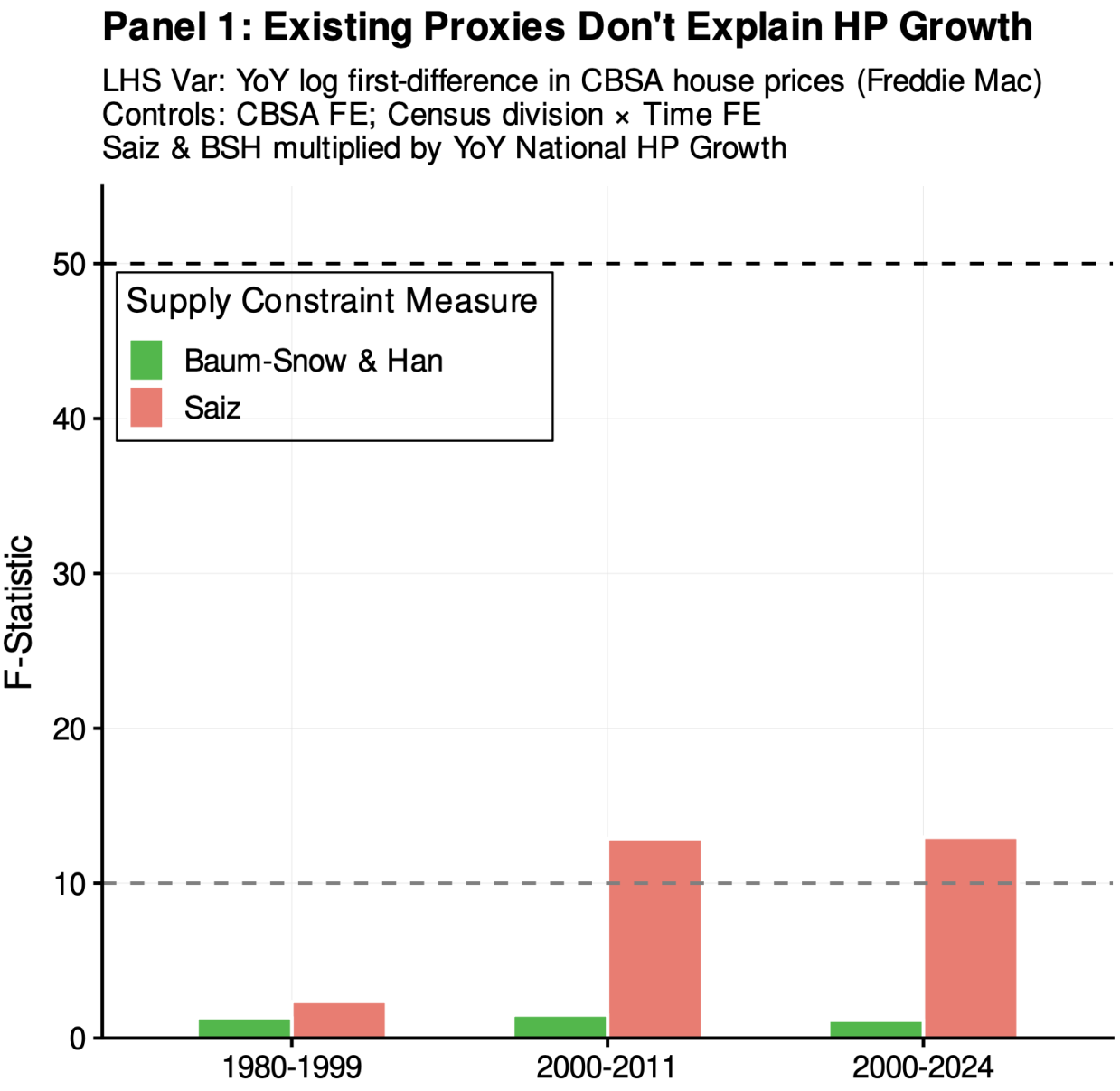
→ **These results contradict standard theory** and imply that:

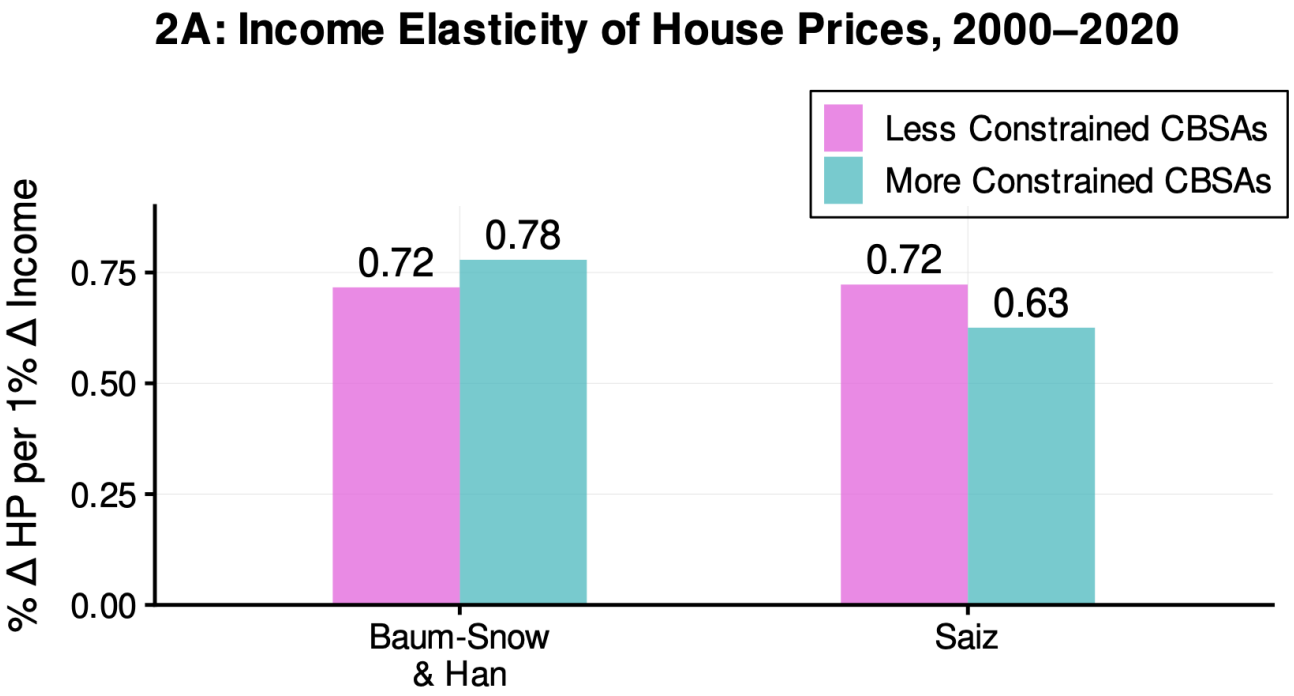
a) Supply constraints explain little of the heterogeneous price growth across cities
b) Demand shocks have similar price impacts regardless of supply elasticities
c) Extensive literature using these proxies for identification is unfounded (Davidoff, 2016)

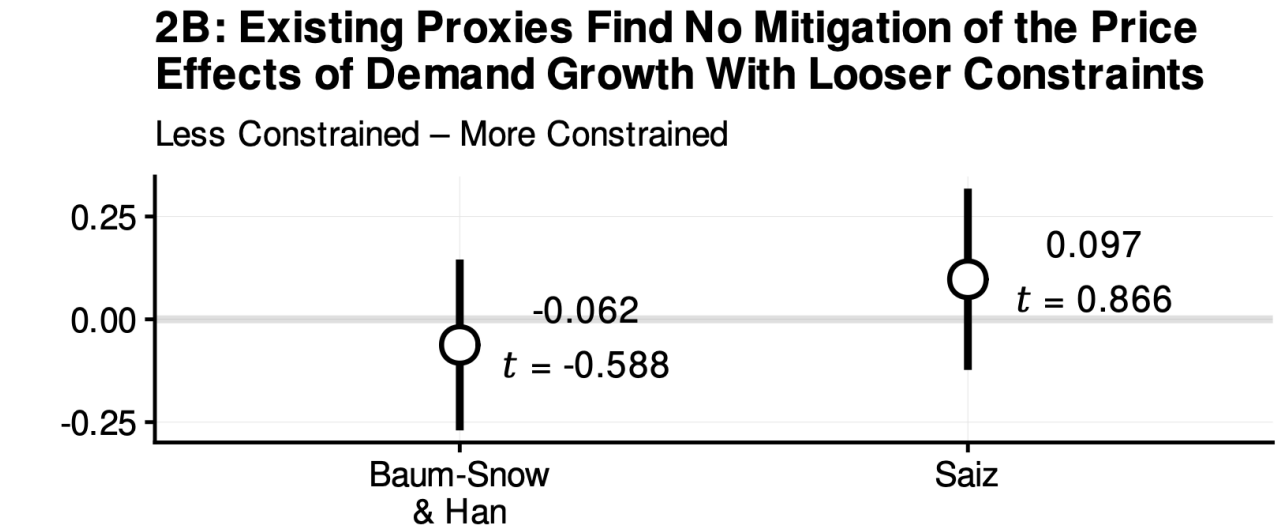
This Paper: Combine highly disaggregated LU with ML → LU-ML Indices

- New, robust validation for core housing and urban theory
- Deeper understanding of how supply constraints impact housing markets

The Limitations of Existing Supply Constraint Proxies

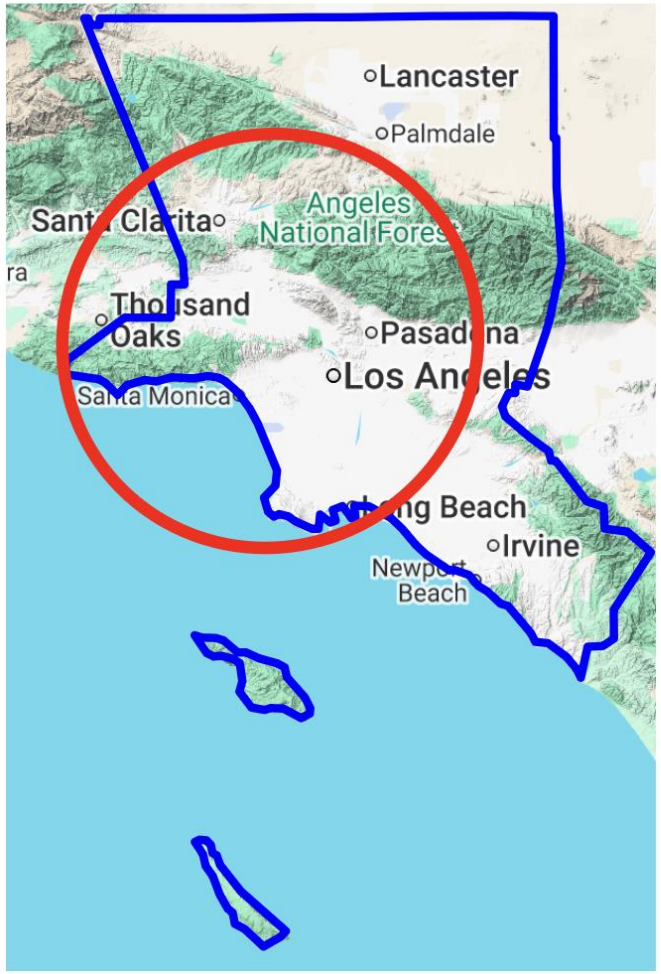






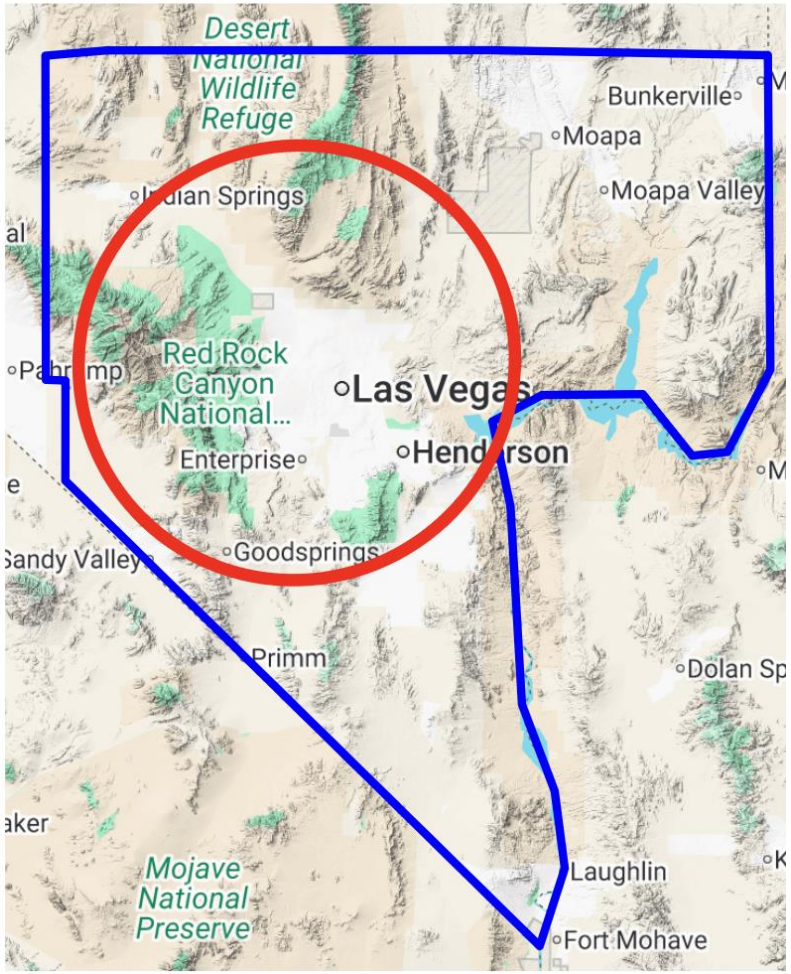
The Saiz/BSH Circle Mismeasures Land Unavailability

A: Los Angeles



B: Chicago

C: Las Vegas

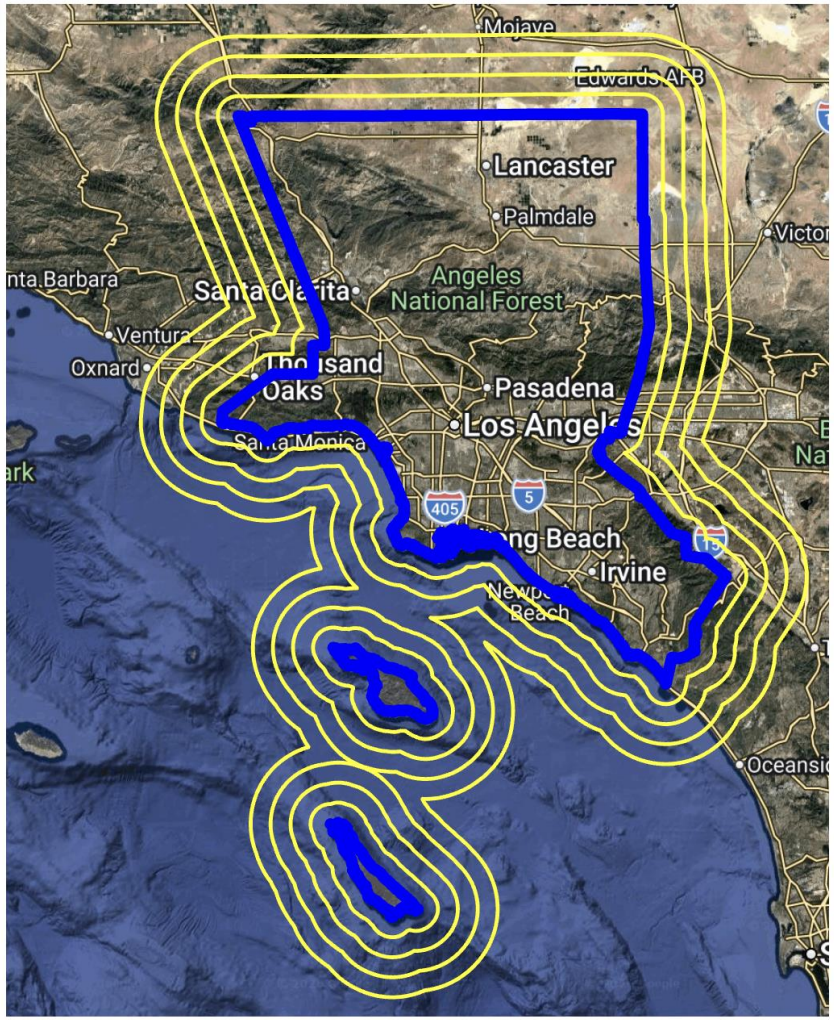


- Misses Major Housing Growth on the Periphery (In LA: Lancaster/Palmdale, Anaheim, Irvine)
- Ignores the spatial layout of constraints and potential for expansion:
  - Equates Chicago (39%) and Las Vegas (38%)
  - Las Vegas is surrounded by mountains. Chicago is unconstrained west and south

The LU-ML Features – A Topographical Map of Each City

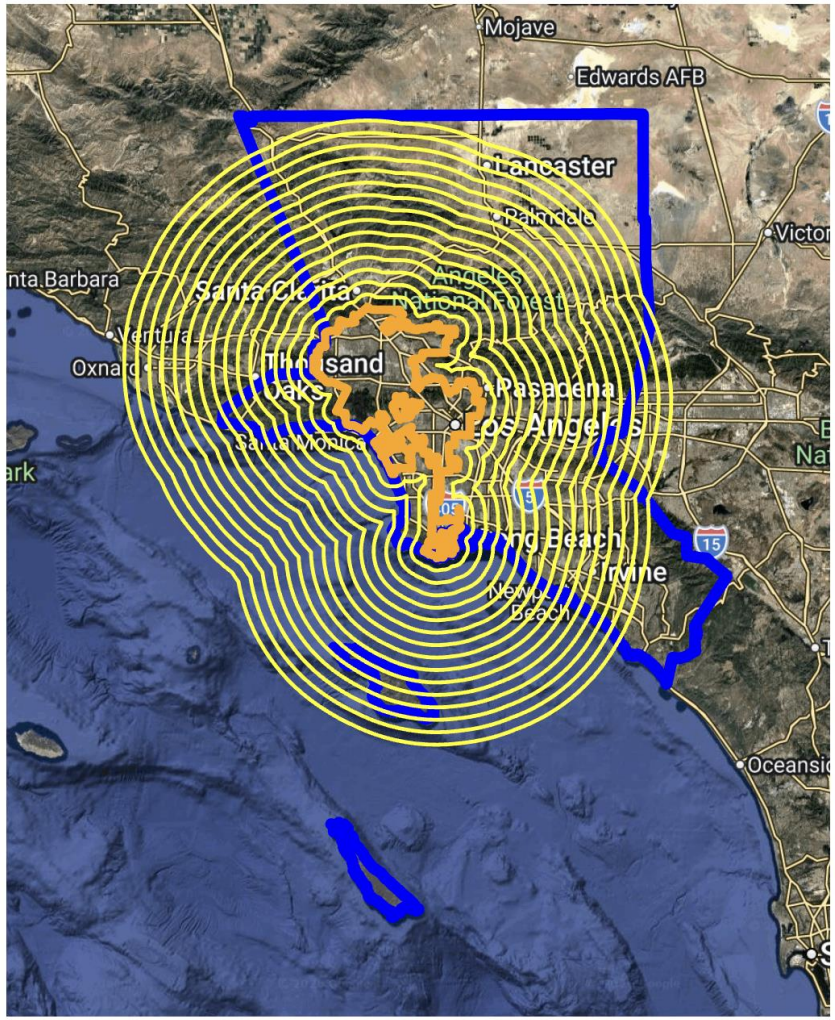
A: CBSA Polygon Buffers

5 polygons in 5pp increments from 0% to 20% of the CBSA area



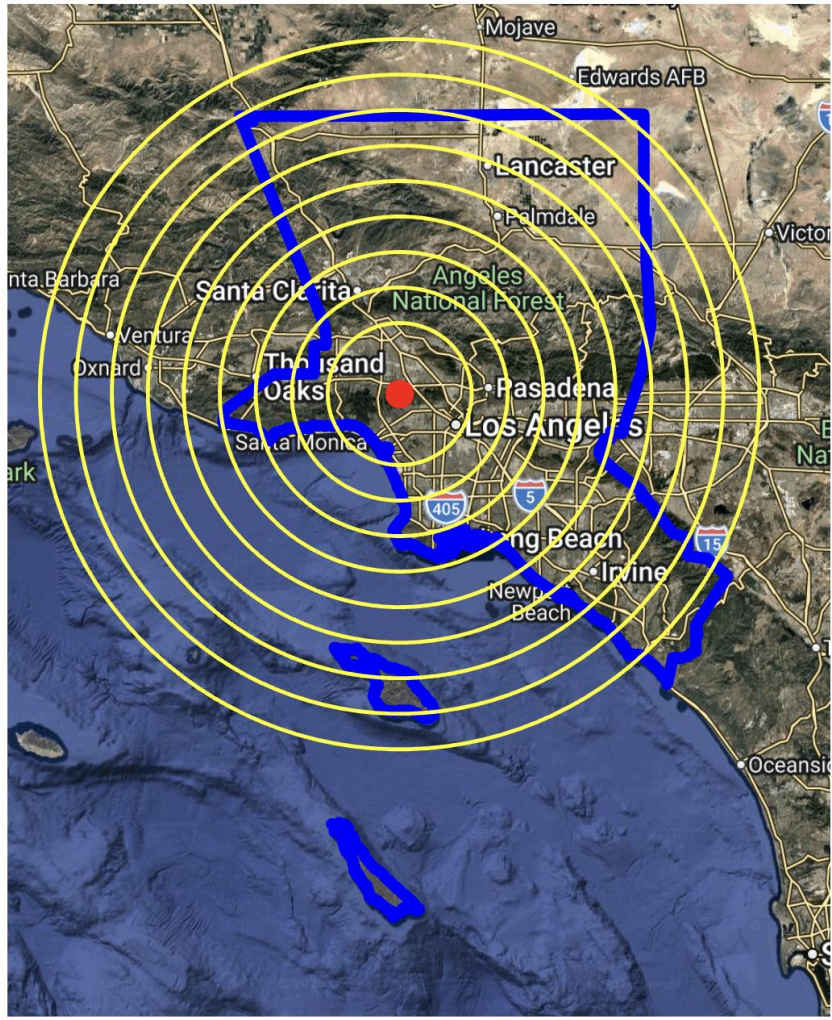
B: First Principal City Buffers

16 polygons in 10pp increments from 0% to 150% of the principal city's area



C: First Principal City Centroid Circles

9 circles in 10km increments from 20km to 100km from the principal city centroid



- Measure land unavailability due to steep slopes, water, and wetlands across 30 spatial definitions
- 90 total features

Building the LU-ML Indices

LU-ML Price Pressure Index:

- Target Variable: YoY city-level house price growth
- Measures: $\mathbb{E}(\text{HP growth} \mid \text{LU})$
  - How tightly constraints bind for prices over time

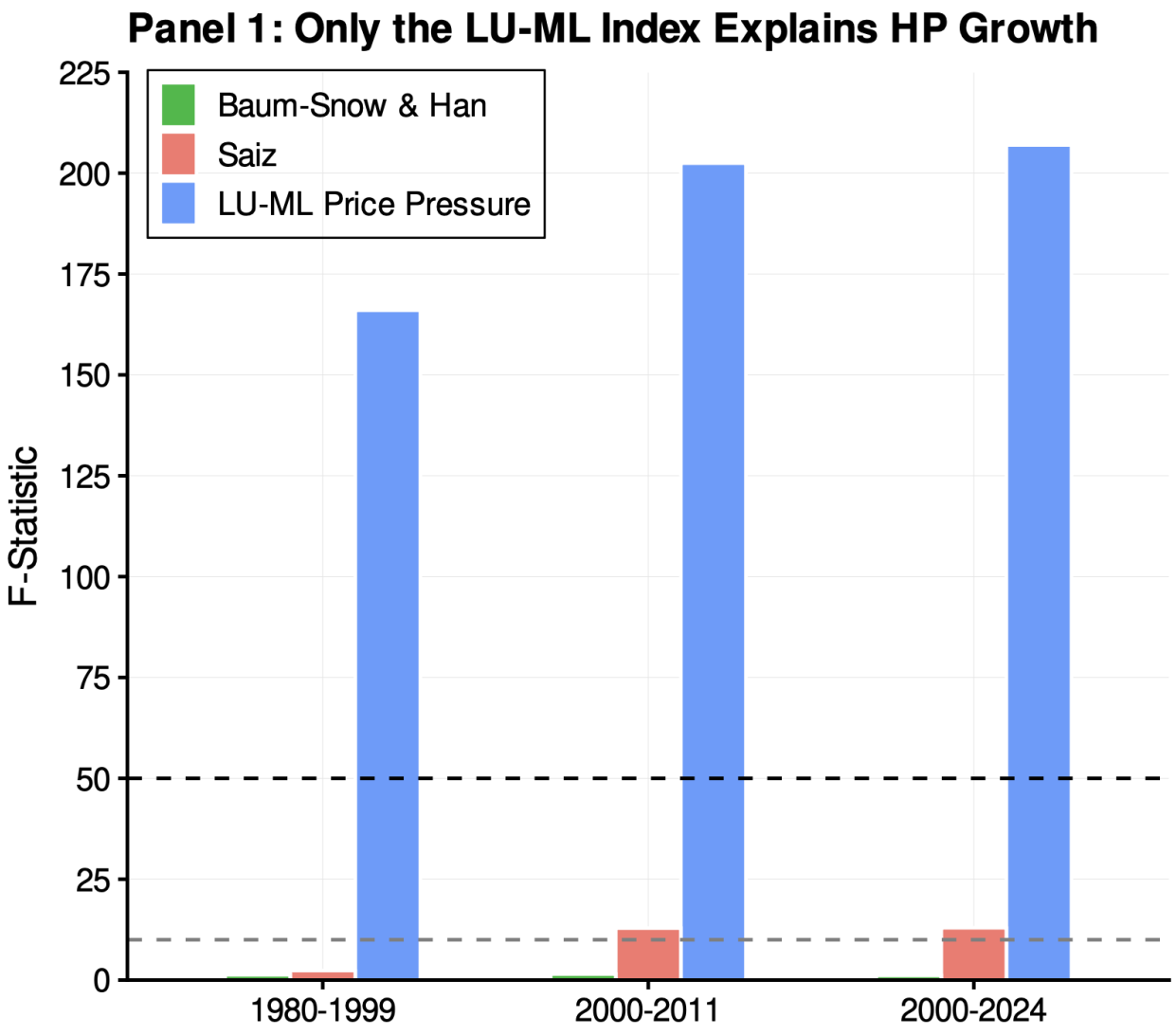
LU-ML Supply Index:

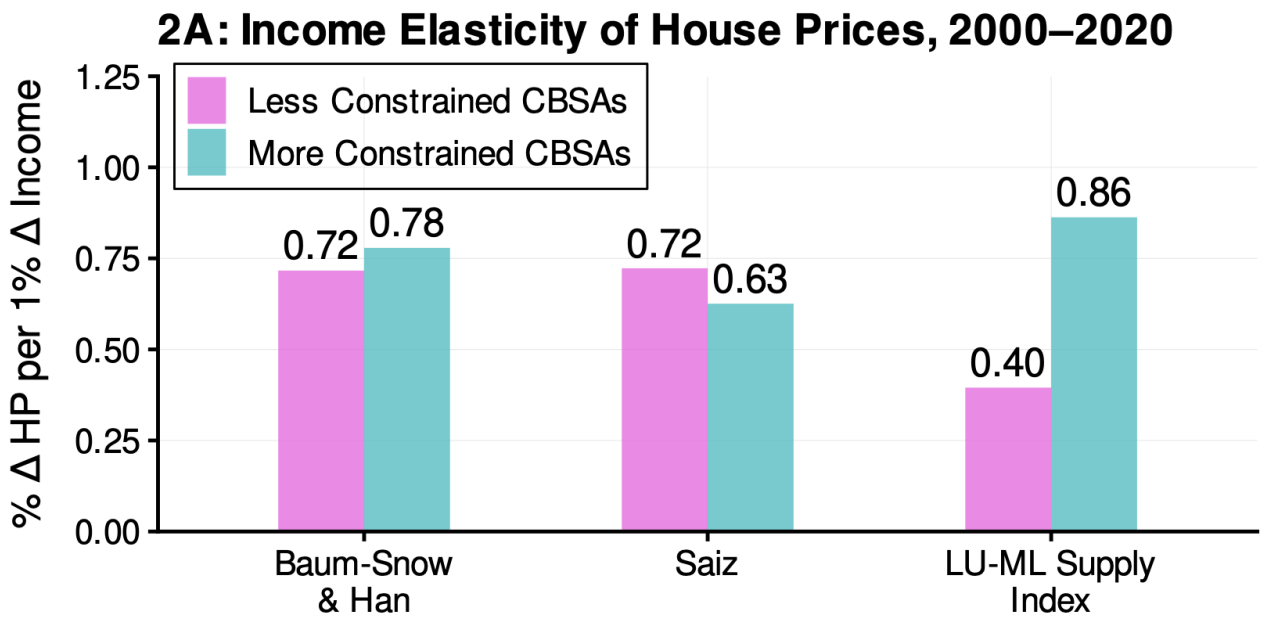
- Target Variable: Decadal city-level housing unit growth
- Measures: $\mathbb{E}(\text{HU growth} \mid \text{LU})$
  - How tightly geographic constraints restrict housing expansion over time

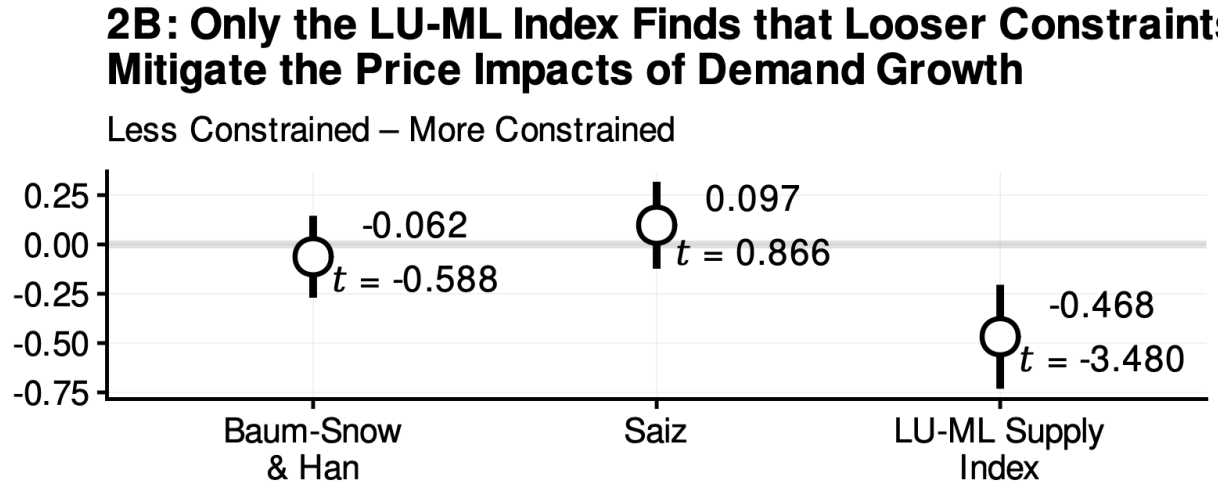
Methodology:

- Combine LU features using XGBoost targeting HP or HU Growth
  - Captures the nonlinear and heterogeneous impacts of geography
- Out-of-sample cross-fitting prevents contamination from idiosyncratic local factors
- Empirical Specifications and novel controls further isolate LU-ML from housing demand
  - LU-ML is largely uncorrelated with demand, unlike existing proxies
- Highly Flexible: Adapts to panels or long-differences across all spatial definitions

The LU-ML Indices Capture Supply Constraints in Housing Markets







- Results robust to other HP datasets, spatial definitions, and empirical specifications

Key LU-ML Price Pressure Results

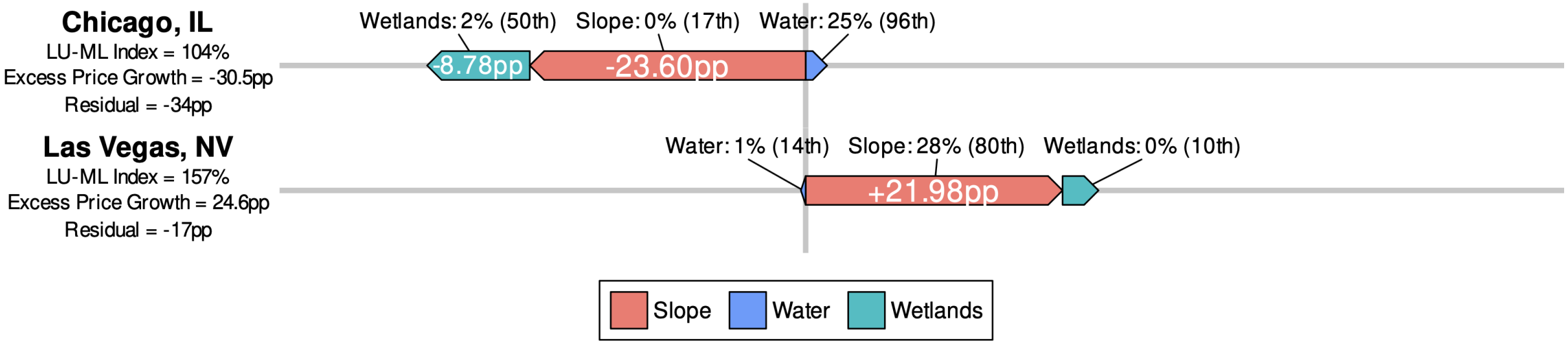
LU-ML Price Pressure Index: $\mathbb{E}(\text{HP growth} \mid \text{LU})$

1. The impact of LU constraints is heterogeneous across cities
   - Steep slopes are the most important factor
   - Interactions between constraints matter

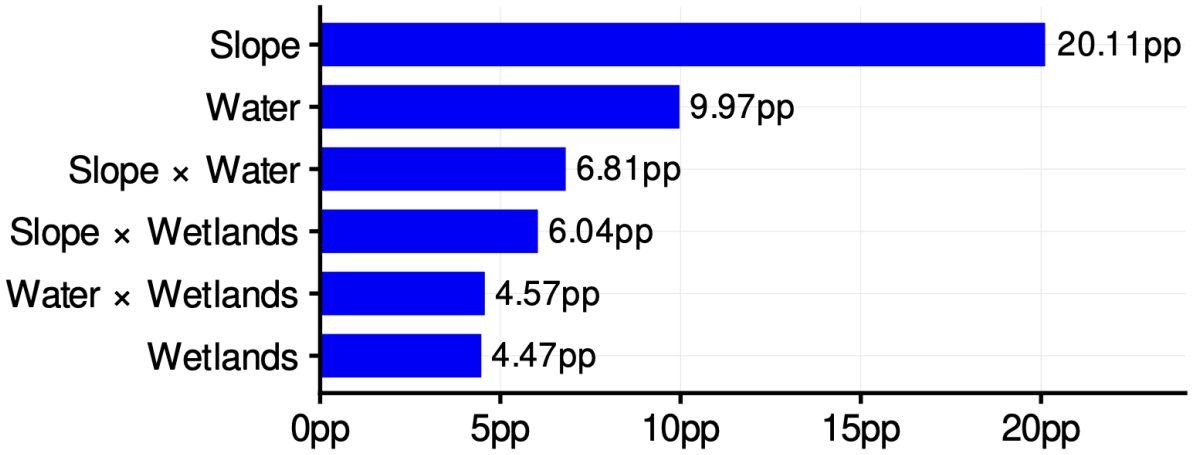
2. The LU-ML Index captures supply, not amenities or housing demand
   - Persists even under extreme simulated cases of unobserved demand confounding

Opening the Black Box: The Geographic Drivers of LU-ML Price Pressure

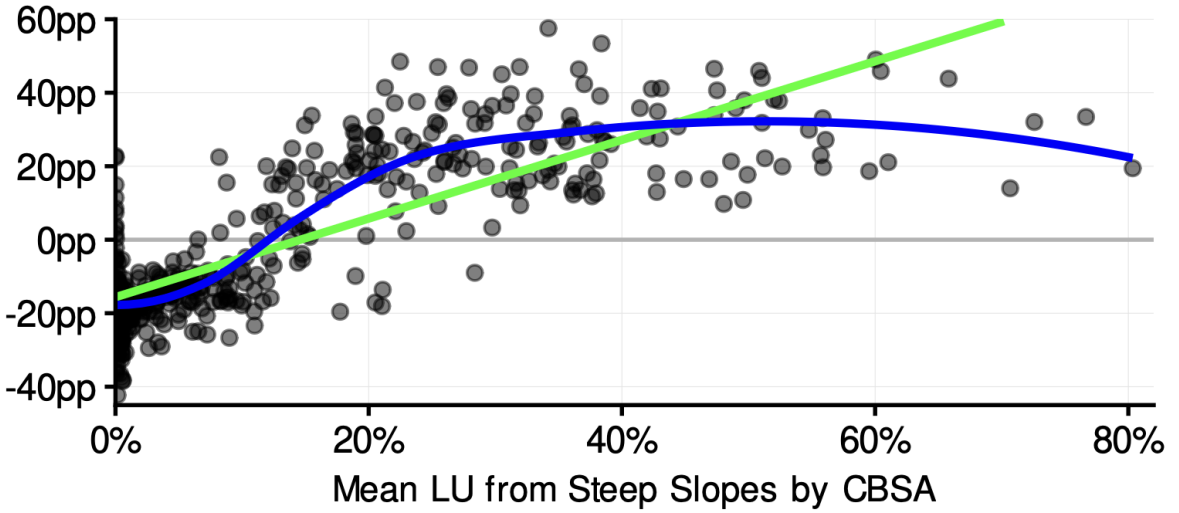
1: Land Unavailability Contributions to the LU-ML Price Pressure Index (Chicago vs. Las Vegas, 2002–2024)



2A: Average Marginal Impact on LU-ML Index



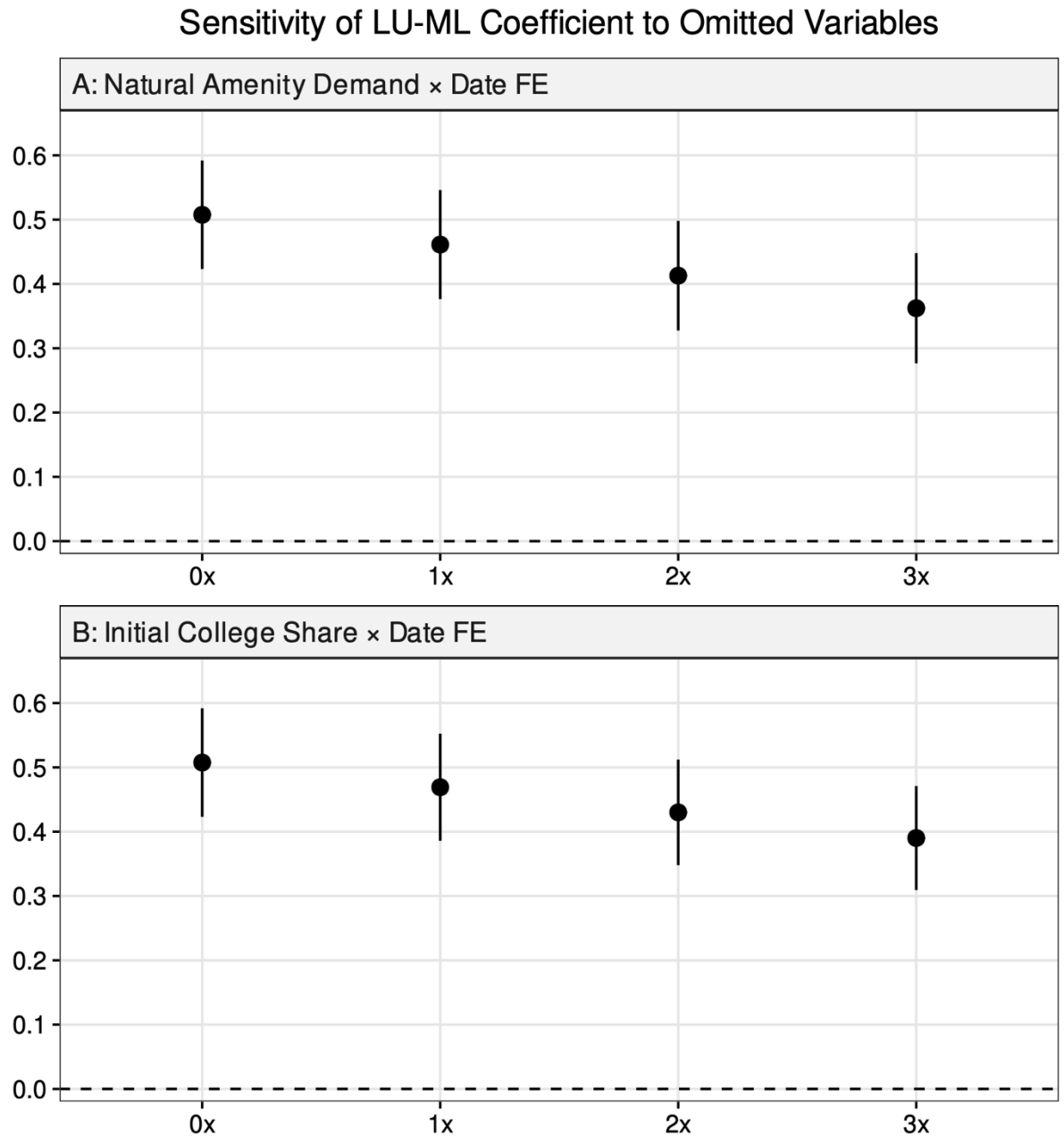
2B: Marginal Contribution of Steep Slopes by CBSA



The LU-ML Index Captures Supply, Not Amenities or Housing Demand

LU-ML Price Pressure and House Prices (2000–2023)

	YoY Log Change in House Prices			
	(1)	(2)	(3)	(4)
LU-ML Price Pressure Index	0.695***	0.661***	0.642***	0.508***
	(0.048)	(0.045)	(0.045)	(0.043)
Total Income Growth		0.328***	0.315***	0.310***
		(0.056)	(0.054)	(0.050)
Natural Amenity Quintile 2 × YoY National HP Growth			0.004	
			(0.065)	
Natural Amenity Quintile 3 × YoY National HP Growth			0.058	
			(0.065)	
Natural Amenity Quintile 4 × YoY National HP Growth			0.089	
			(0.065)	
Natural Amenity Quintile 5 × YoY National HP Growth			0.177***	
			(0.068)	
CBSA Fixed Effects	✓	✓	✓	✓
Census Division × Date FE	✓	✓	✓	✓
Amenity Quintile × Date FE				✓
College Share × Date FE				✓
Median Income × Date FE				✓
Housing Density × Date FE				✓
Emp Shares × Date FE				✓



Key LU-ML Supply Index Results

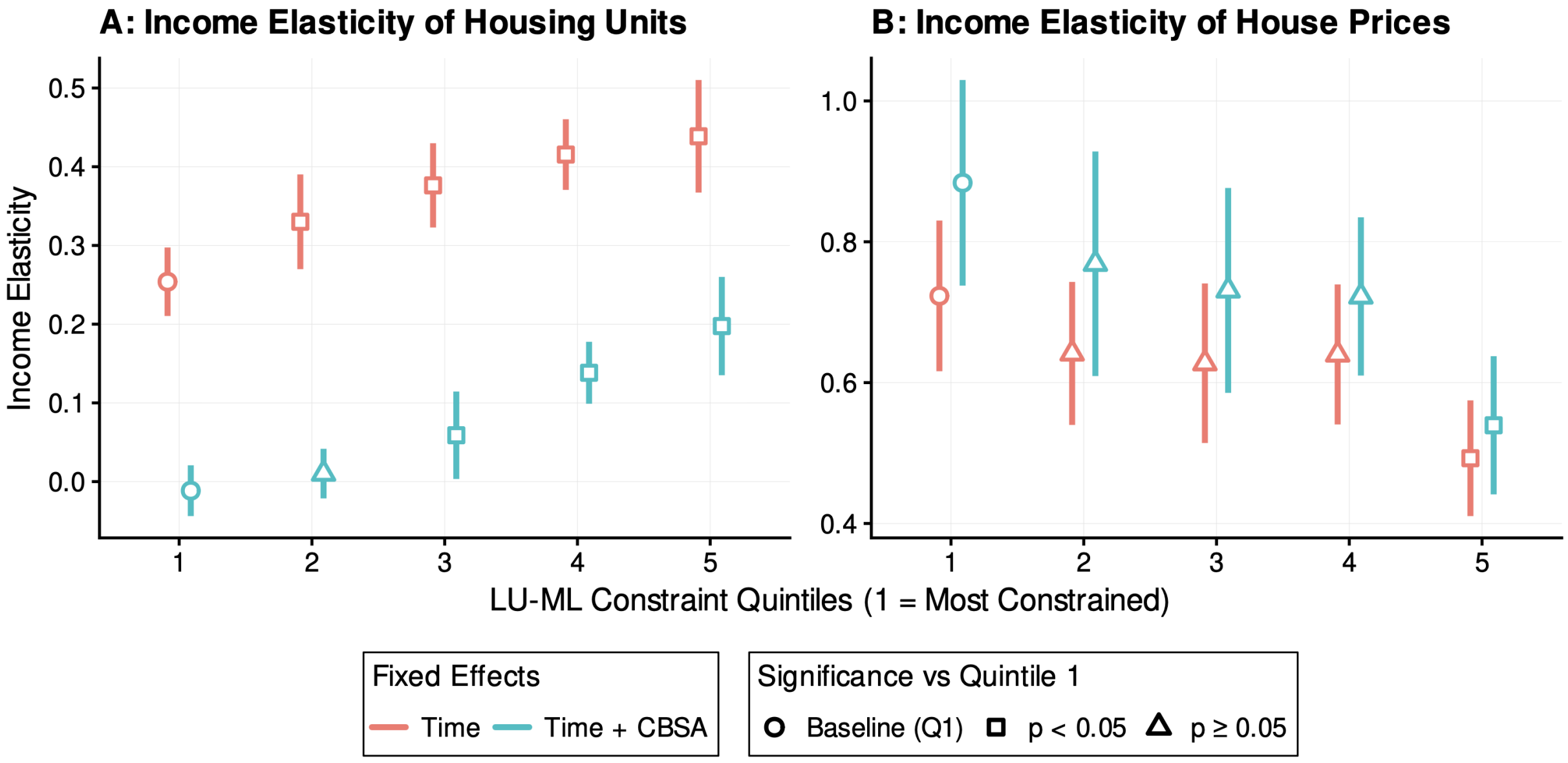
LU-ML Supply Index: $\mathbb{E}(\text{HU growth} \mid \text{LU})$

1. In response to demand growth: looser constraints facilitate supply, but the price impacts are non-linear
   - Only in the least constrained cities do looser constraints mitigate the price effects of demand growth

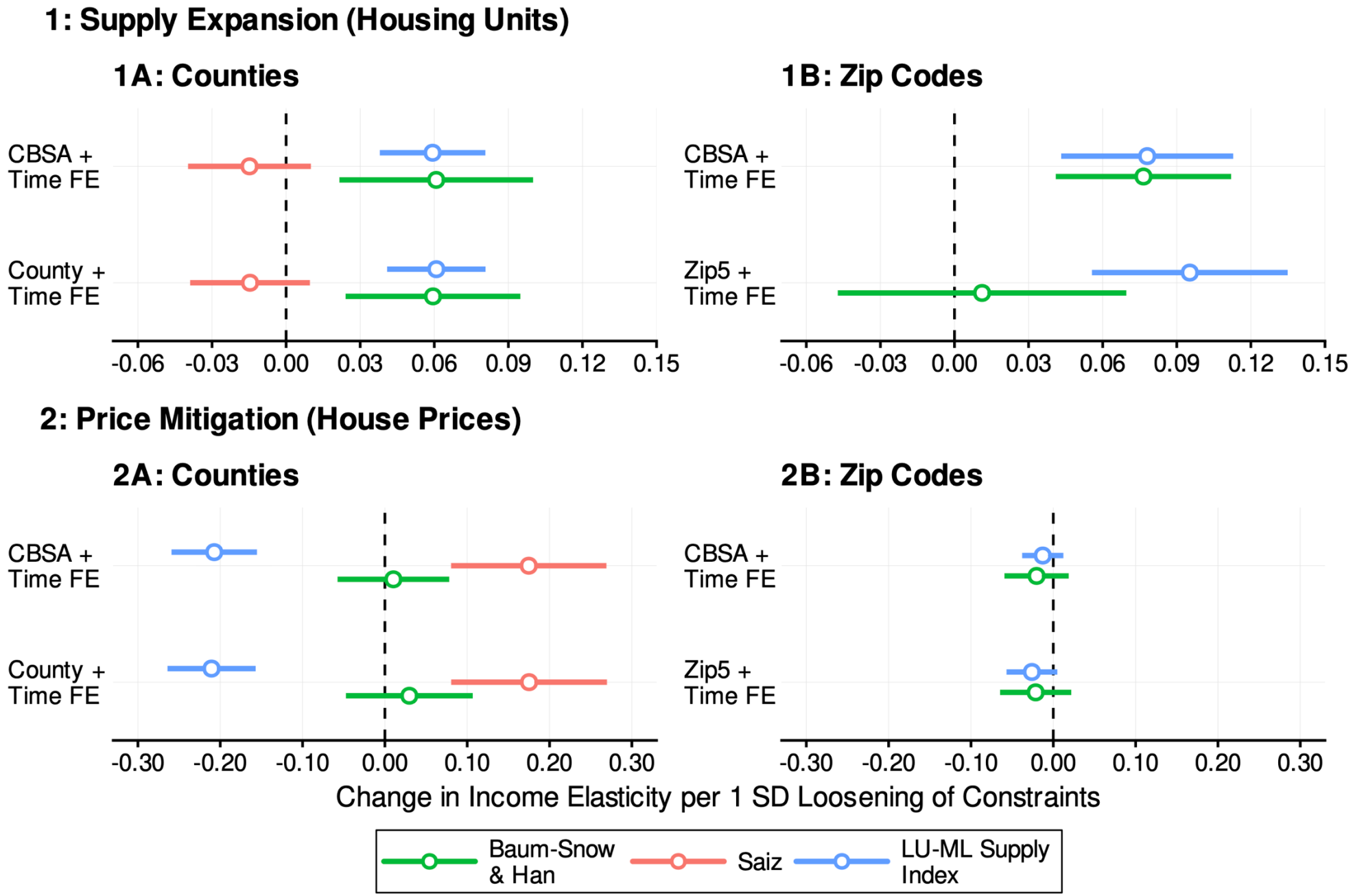
2. Within cities, looser constraints:
   - Facilitate supply for both counties and zip codes
   - Only mitigate price growth for counties
     - Counties are integrated labor markets; spatial arbitrage across zip codes

3. Effective supply constraints have evolved dramatically over time
   - Mitigation effects of looser constraints were largely confined to the 2000s

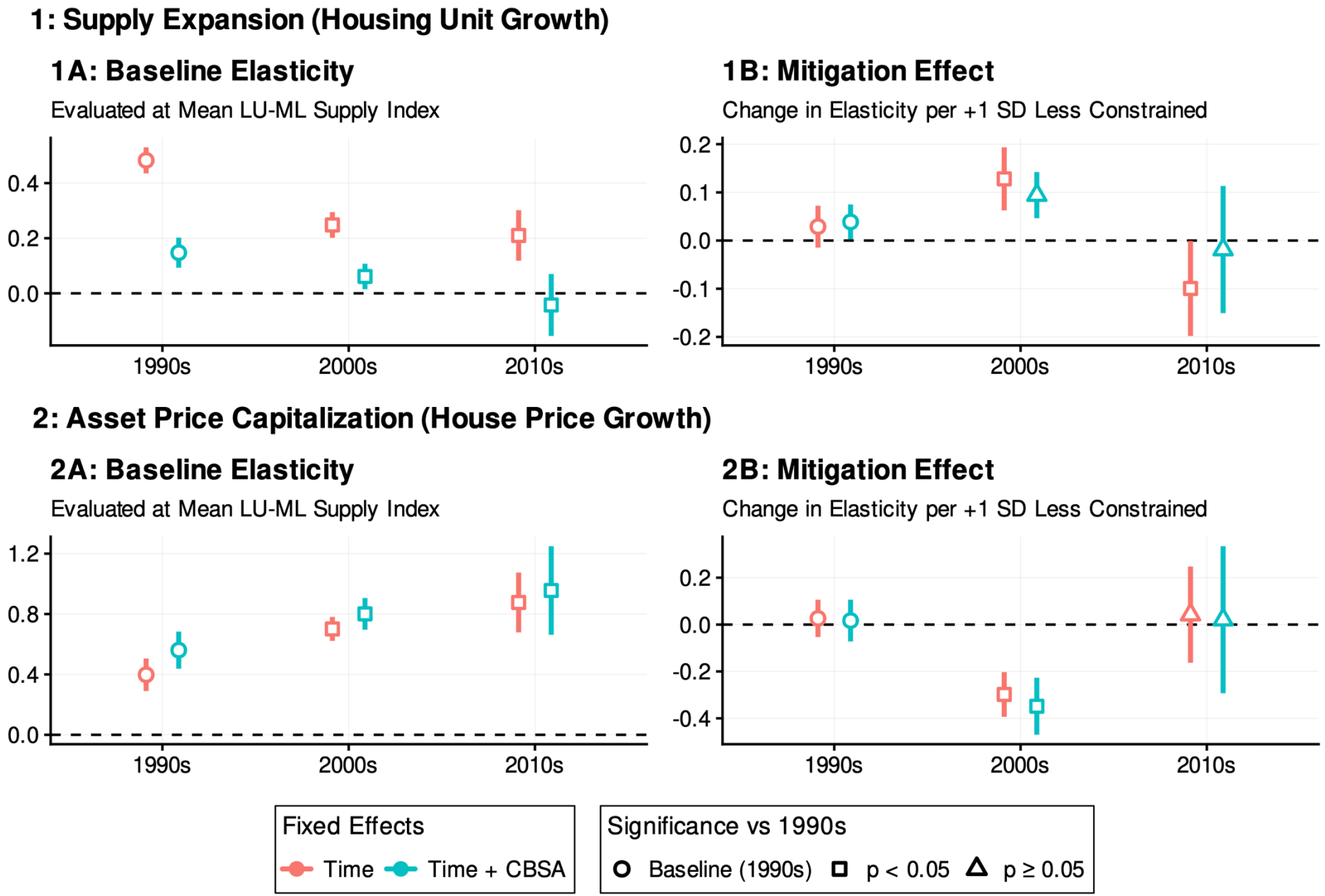
Looser Constraints Facilitate Supply, But Price Impacts are Non-Linear



Within Cities: Counties Mitigate Prices, Zip Codes Do Not



The Time-Varying Impacts of Supply Constraints



Conclusion

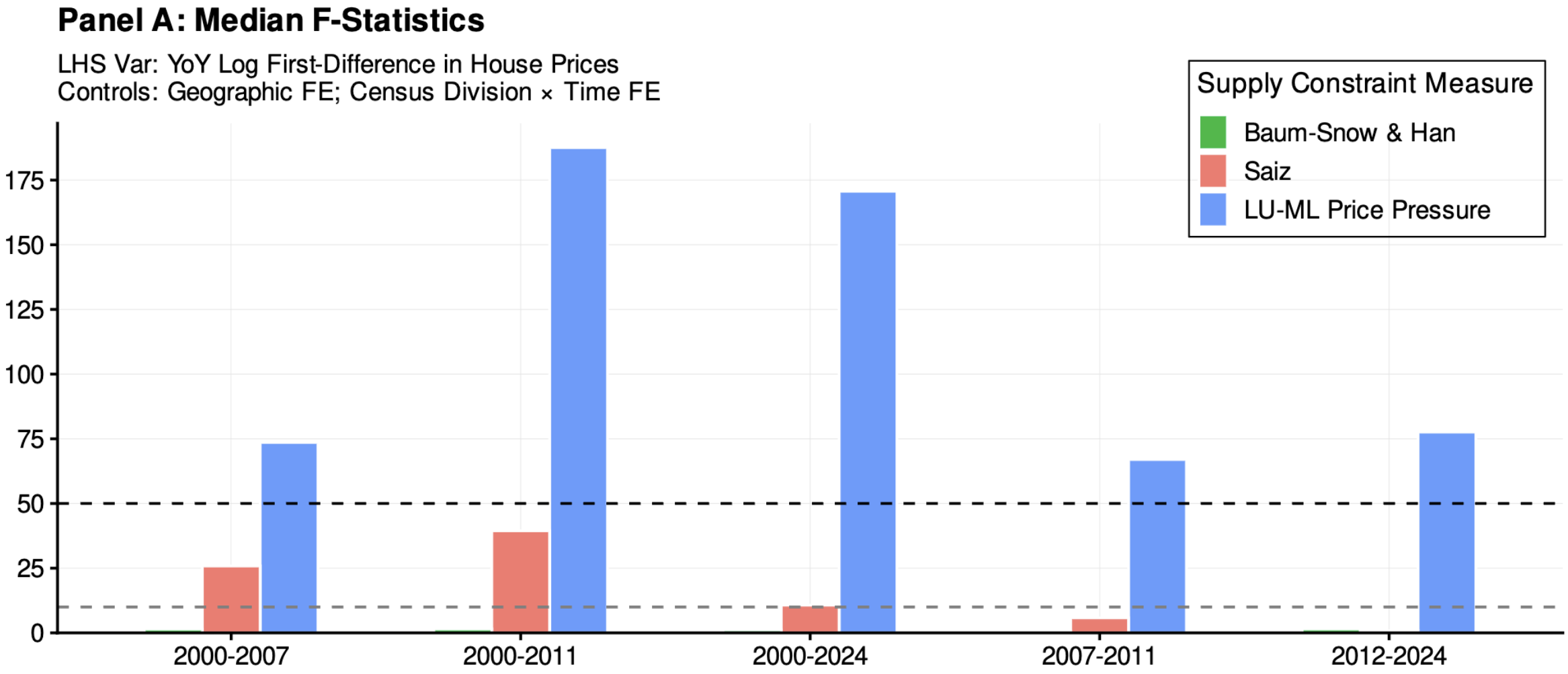
- A New Methodological Framework:
  - LU-ML Supply Index: $\mathbb{E}(\text{HU growth} \mid \text{LU})$
  - LU-ML Price Pressure Index: $\mathbb{E}(\text{HP growth} \mid \text{LU})$

- The LU-ML Indices isolate physical constraints from amenities and local demand

- Unlike existing proxies, the LU-ML Indices:
  - Explain house price growth across cities
  - Show that looser constraints mitigate the impacts of demand growth
    - But these effects are non-linear, spatial, and time-varying
- Ultimately, we must shift away from just static, linear constraints when studying housing markets and affordability

Appendix

Appendix: Only the LU-ML Index Explains House Price Growth



Appendix: The LU-ML Index Has Much Better Coverage

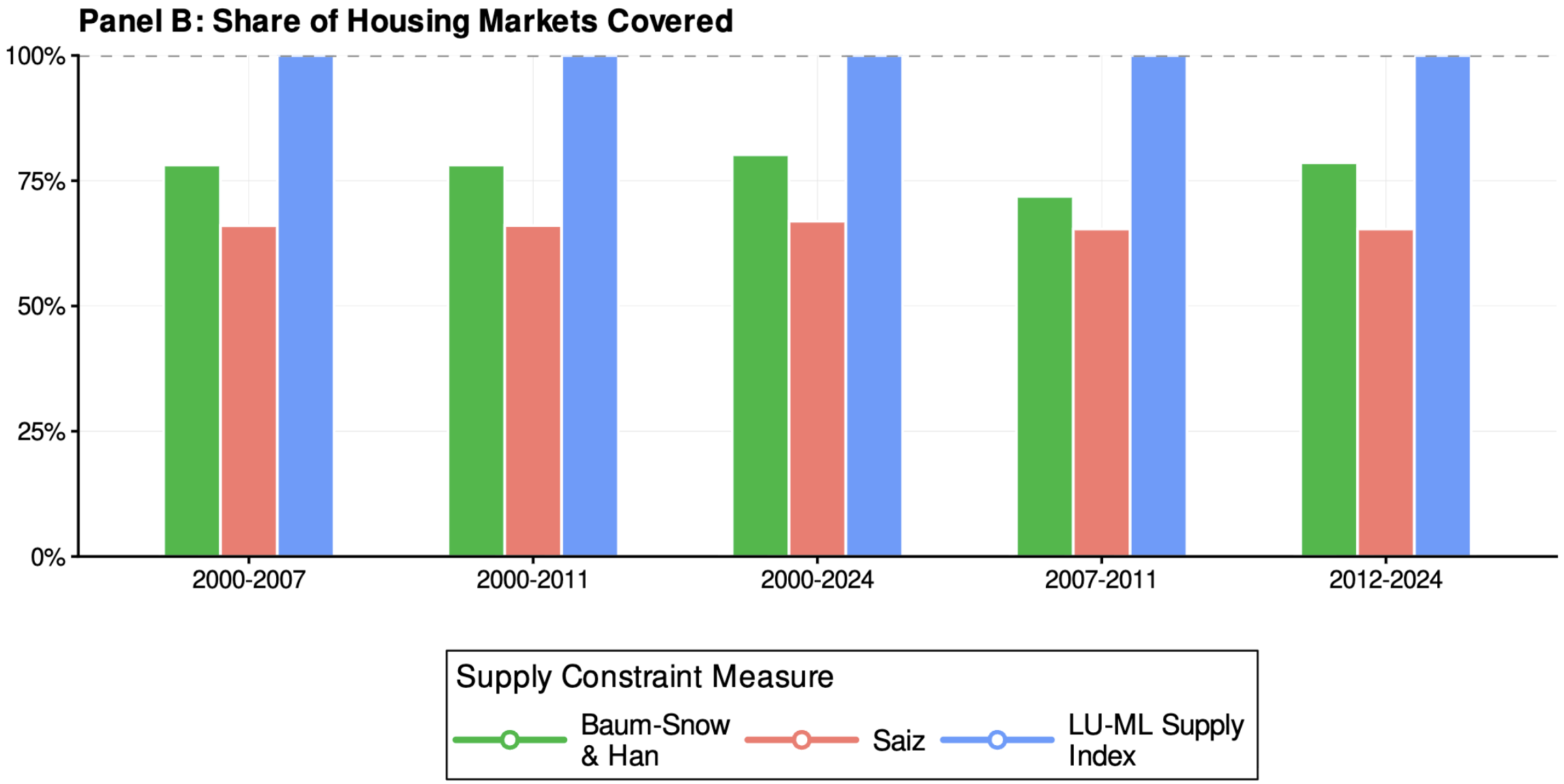
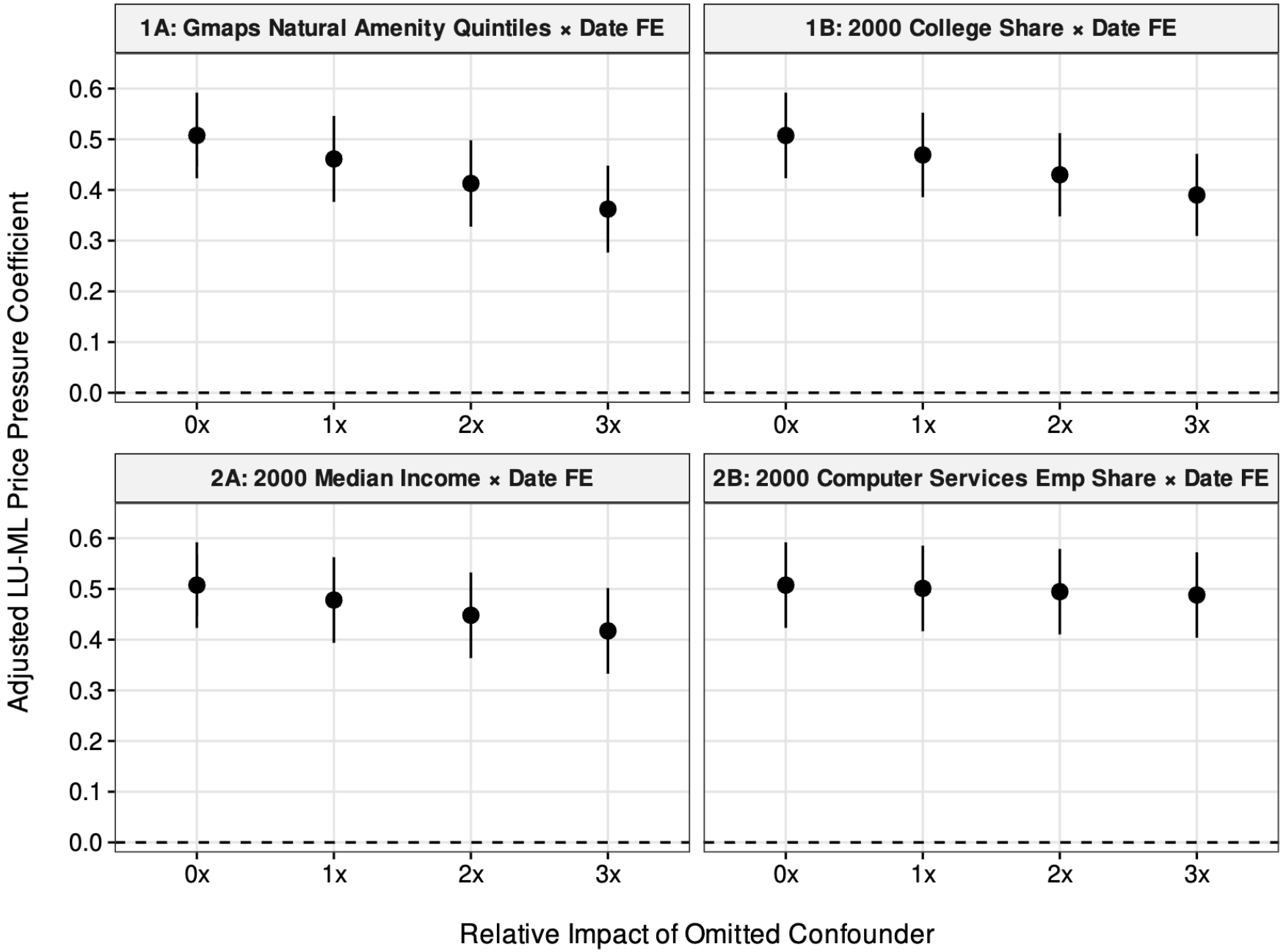


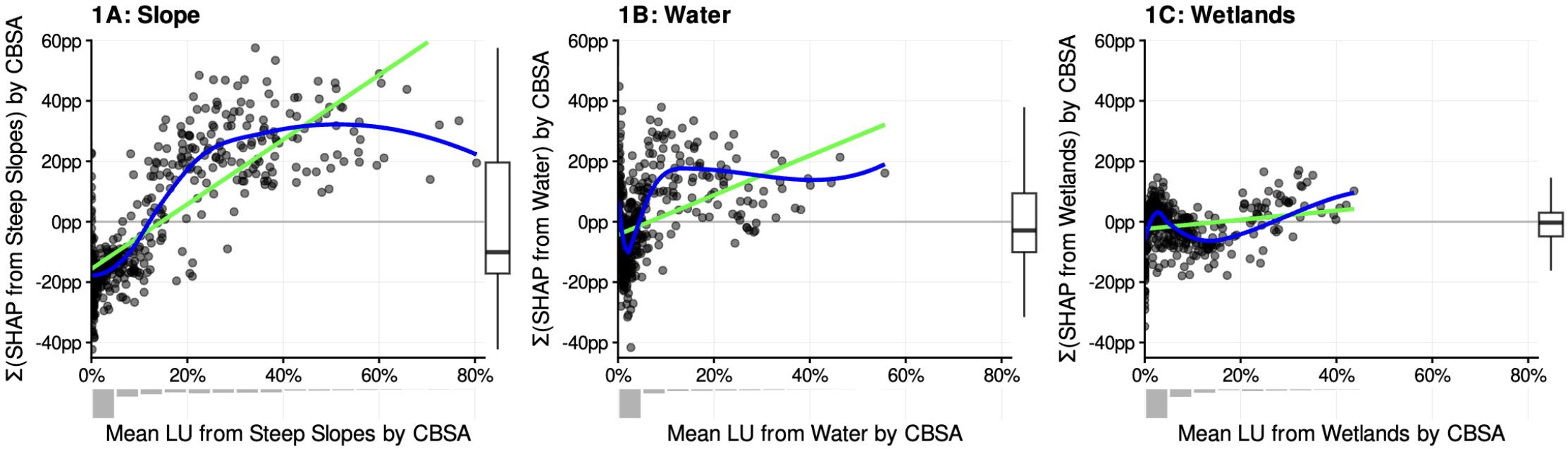
Table A1: Explanatory Power of Supply Constraint Measures in Panel Regressions

Geographic Level	House Price Dataset	Baum-Snow & Han	Saiz	LU-ML Price Pressure Index
Panel A: 2000–2007				
CBSA	FHFA	$R^2 = 0.00$, N = 332	$R^2 = 0.03$, N = 256	$R^2 = 0.14$, N = 910
CBSA	Freddie Mac	$R^2 = 0.01$, N = 314	$R^2 = 0.03$, N = 251	$R^2 = 0.21$, N = 380
Census Tract	FHFA	$R^2 = 0.00$, N = 41806	$R^2 = 0.02$, N = 40659	$R^2 = 0.10$, N = 50172
County	FHFA	$R^2 = 0.00$, N = 711	$R^2 = 0.02$, N = 1582	$R^2 = 0.11$, N = 2396
Zip5	FHFA	$R^2 = 0.00$, N = 11678	$R^2 = 0.03$, N = 11406	$R^2 = 0.08$, N = 14870
Panel B: 2007–2011				
CBSA	FHFA	$R^2 = 0.00$, N = 332	$R^2 = 0.01$, N = 256	$R^2 = 0.09$, N = 915
CBSA	Freddie Mac	$R^2 = 0.00$, N = 314	$R^2 = 0.02$, N = 251	$R^2 = 0.15$, N = 380
Census Tract	FHFA	$R^2 = 0.00$, N = 45624	$R^2 = 0.01$, N = 44911	$R^2 = 0.07$, N = 57720
County	FHFA	$R^2 = 0.00$, N = 714	$R^2 = 0.01$, N = 1681	$R^2 = 0.04$, N = 2707
Zip5	FHFA	$R^2 = 0.00$, N = 13000	$R^2 = 0.01$, N = 12810	$R^2 = 0.06$, N = 18008
Panel C: 2000–2011				
CBSA	FHFA	$R^2 = 0.00$, N = 332	$R^2 = 0.05$, N = 256	$R^2 = 0.19$, N = 910
CBSA	Freddie Mac	$R^2 = 0.00$, N = 314	$R^2 = 0.05$, N = 251	$R^2 = 0.24$, N = 380
Census Tract	FHFA	$R^2 = 0.00$, N = 40373	$R^2 = 0.05$, N = 39215	$R^2 = 0.12$, N = 48636
County	FHFA	$R^2 = 0.00$, N = 711	$R^2 = 0.05$, N = 1582	$R^2 = 0.17$, N = 2395
Zip5	FHFA	$R^2 = 0.01$, N = 11633	$R^2 = 0.06$, N = 11356	$R^2 = 0.12$, N = 14813

Stability of the LU-ML Price Pressure Index to Unobserved Spatial Demand



1: Marginal Predictive Impact of Land Unavailability Types on the LU-ML Price Pressure Index by CBSA



2: Aggregate Marginal Predictive Impact on the LU-ML Price Pressure Index

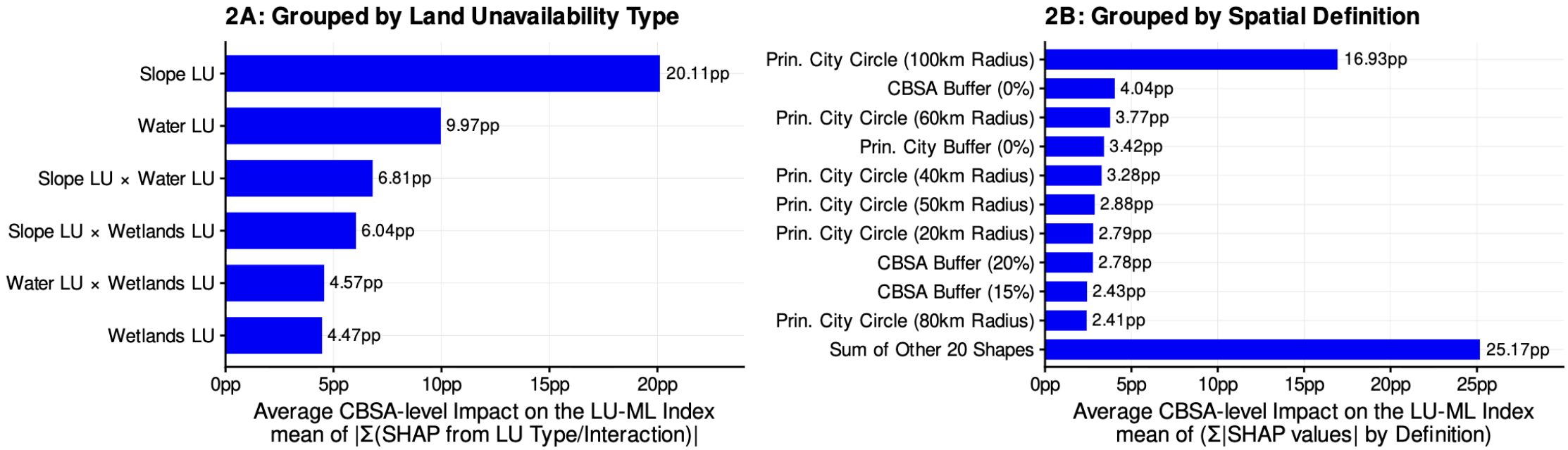


Figure 11: Mitigation Effects (β_3) by Supply Proxy, CBSA Decadal Panel (1990–2020)

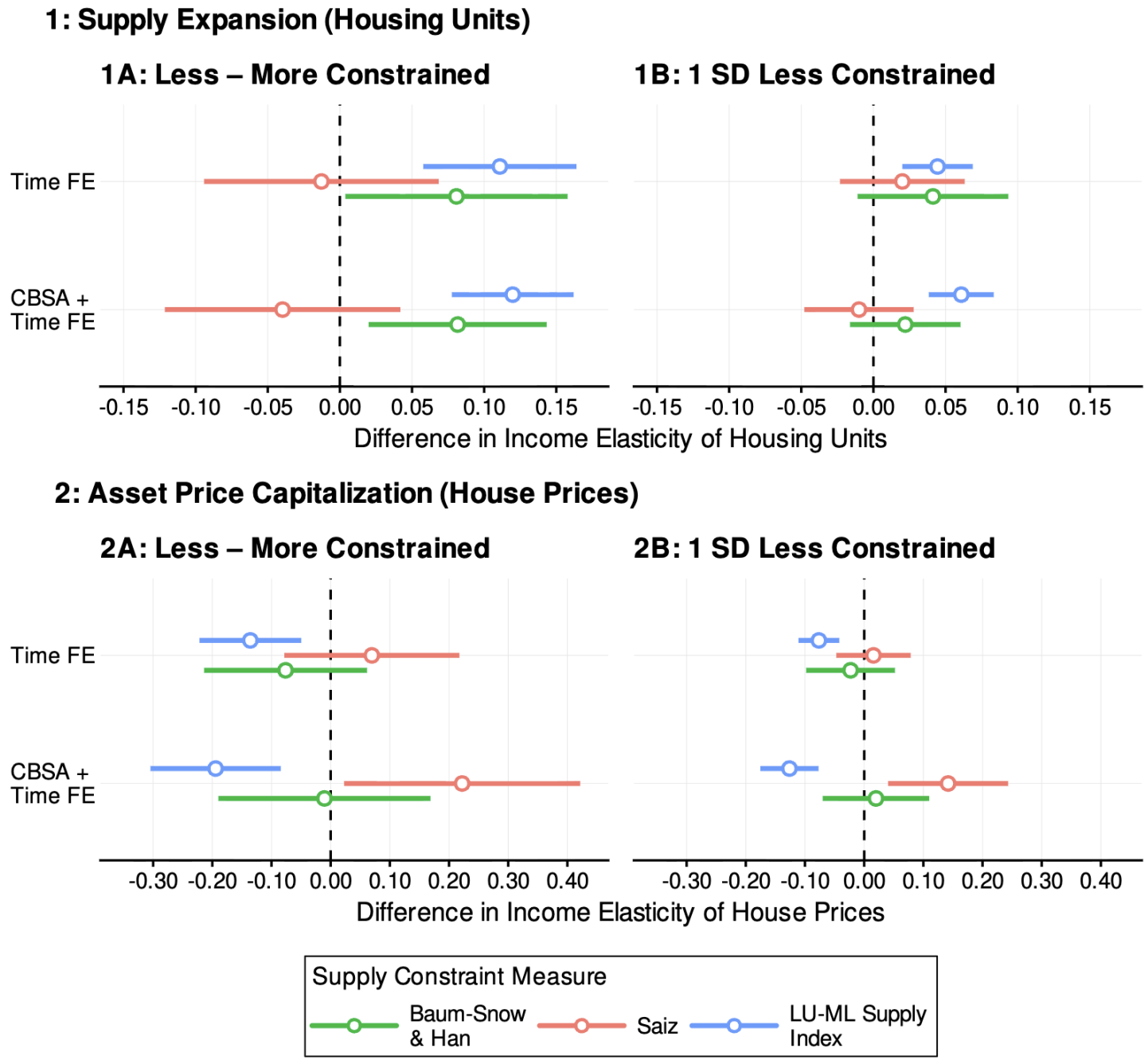
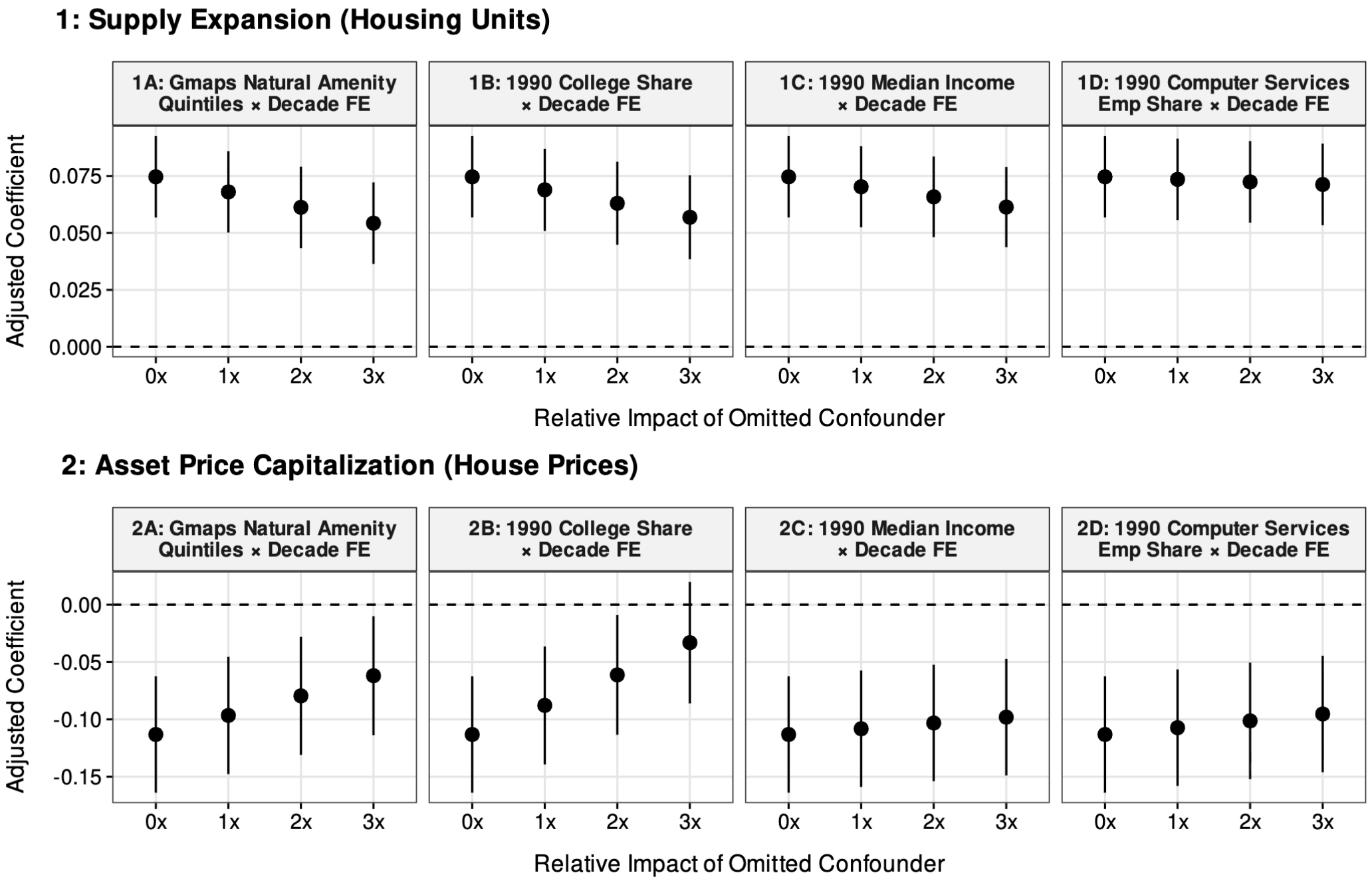


Figure 13: Stability of the LU-ML Mitigation Effect (β_3) to Unobserved Spatial Demand



The National Housing Supply Curve Shifted Inward and Steepened

- Inward Shift (Supply Contraction)
  - Leftward shift of 1.6 SDs
  - Not driven by falling demand (Prices rose)

- Steepening (Loss of Elasticity)
  - Variance compression
  - Loss of elastic right tail

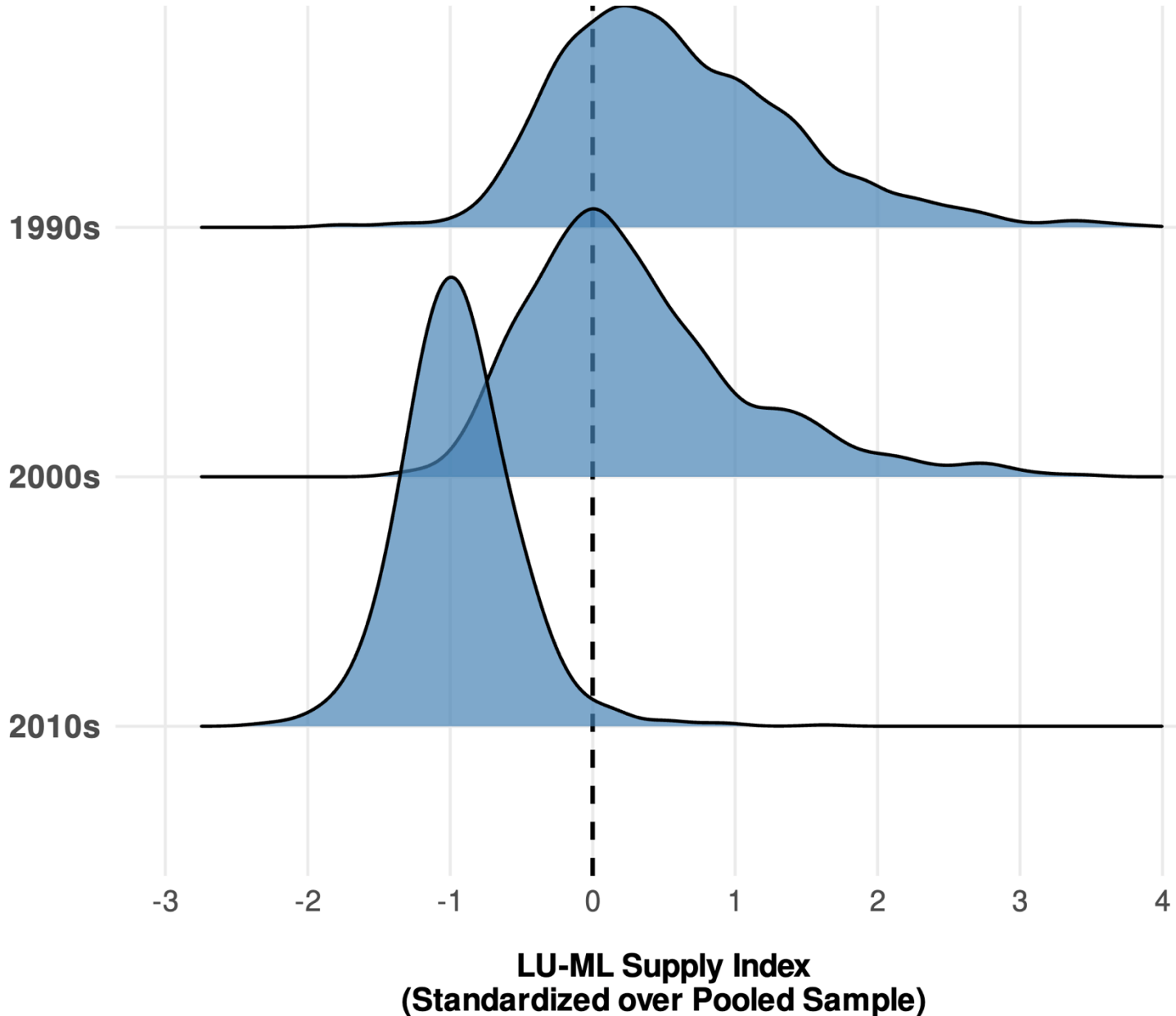


Figure 15: Time-Varying Income Elasticities, Secular Growth Premiums, and Mitigation Effects, 1990–2020

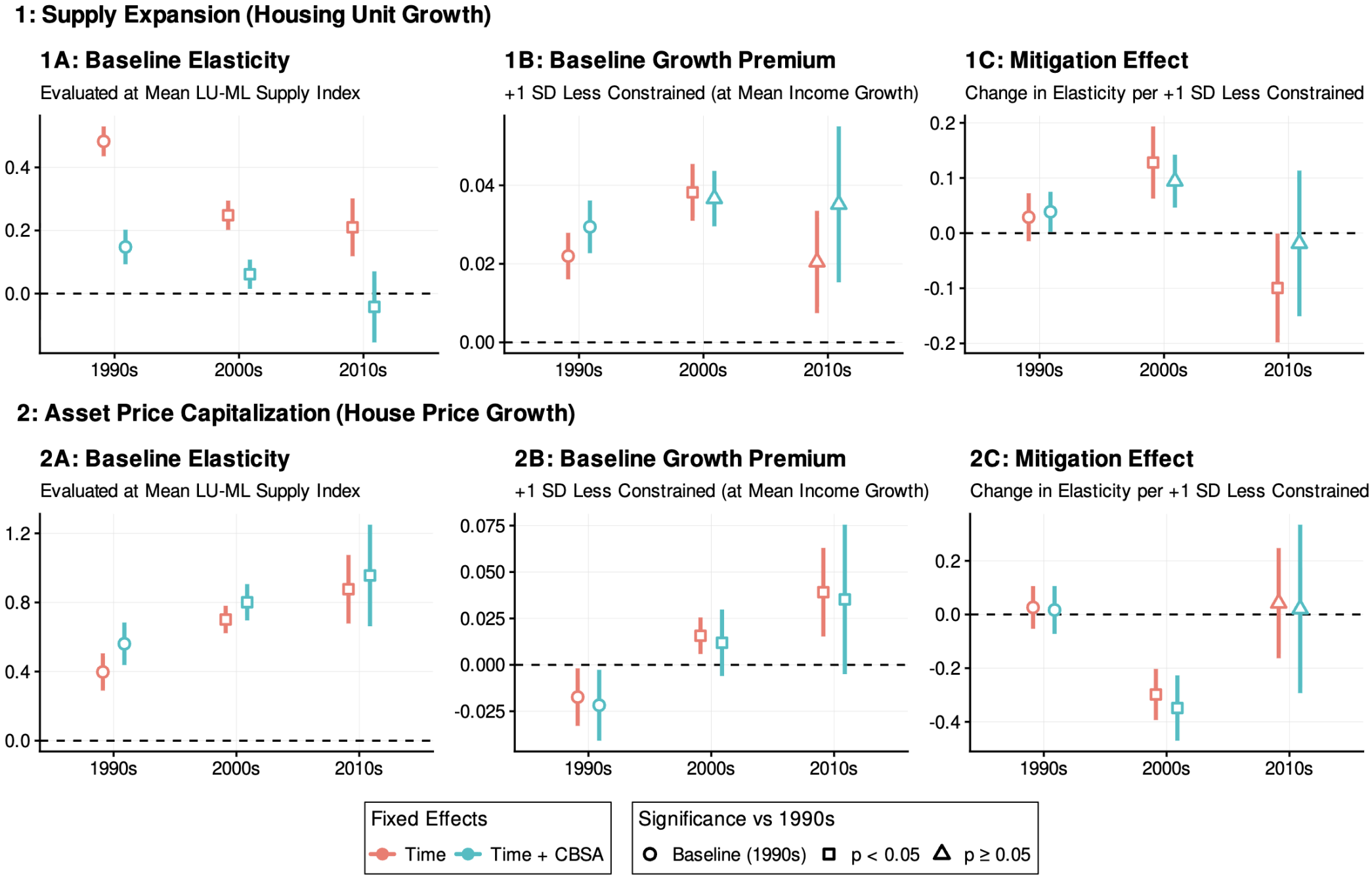


Figure A3: Natural Amenity Gradient Across House Price Datasets

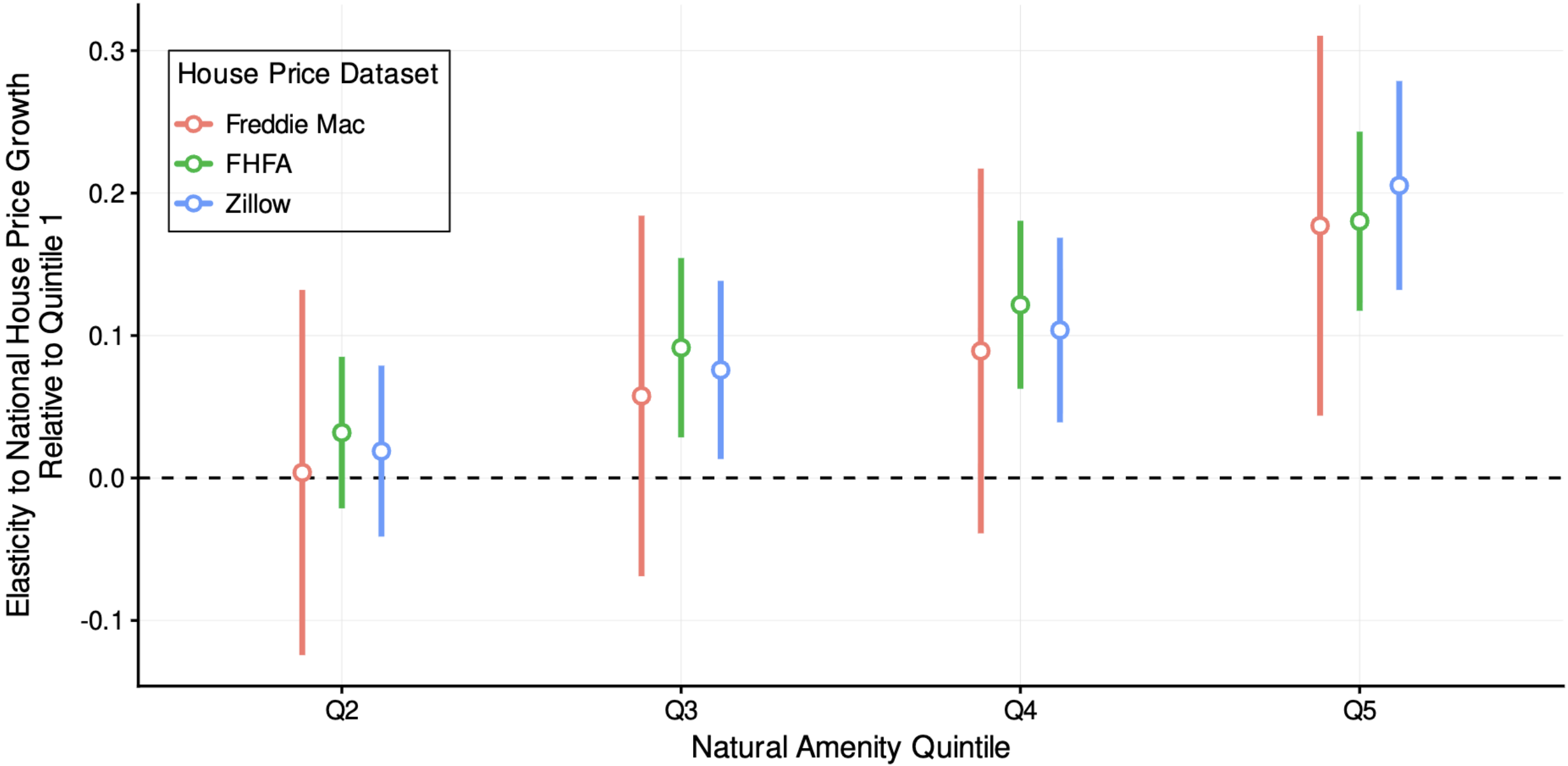


Figure A4: Stability of the LU-ML Price Pressure Index In the First Stage and Reduced Form of Guren et al. (2021)

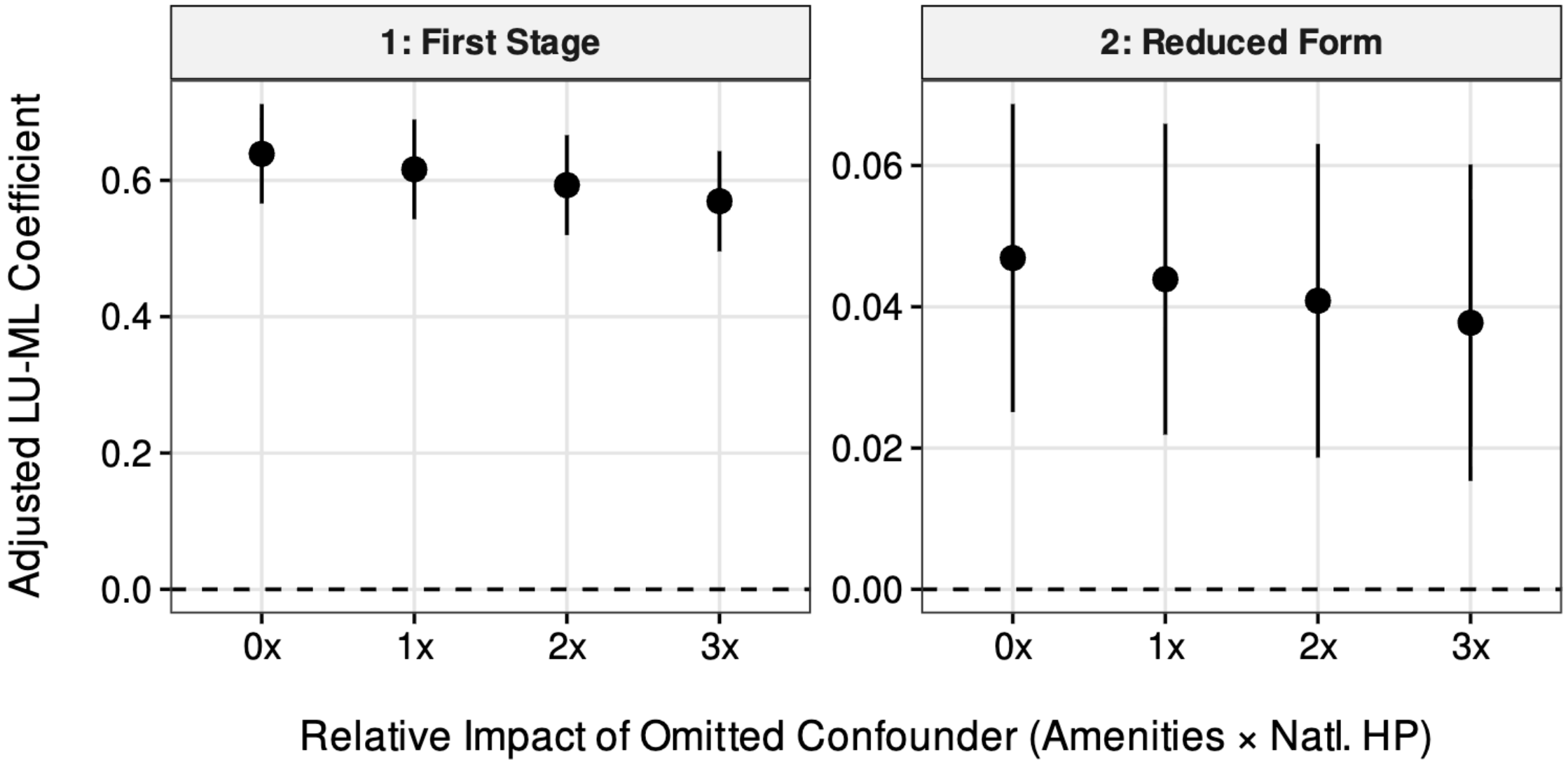


Figure B2: Spatial Permutation Test of the LU-ML Supply Index Mitigation Effect (β_3)

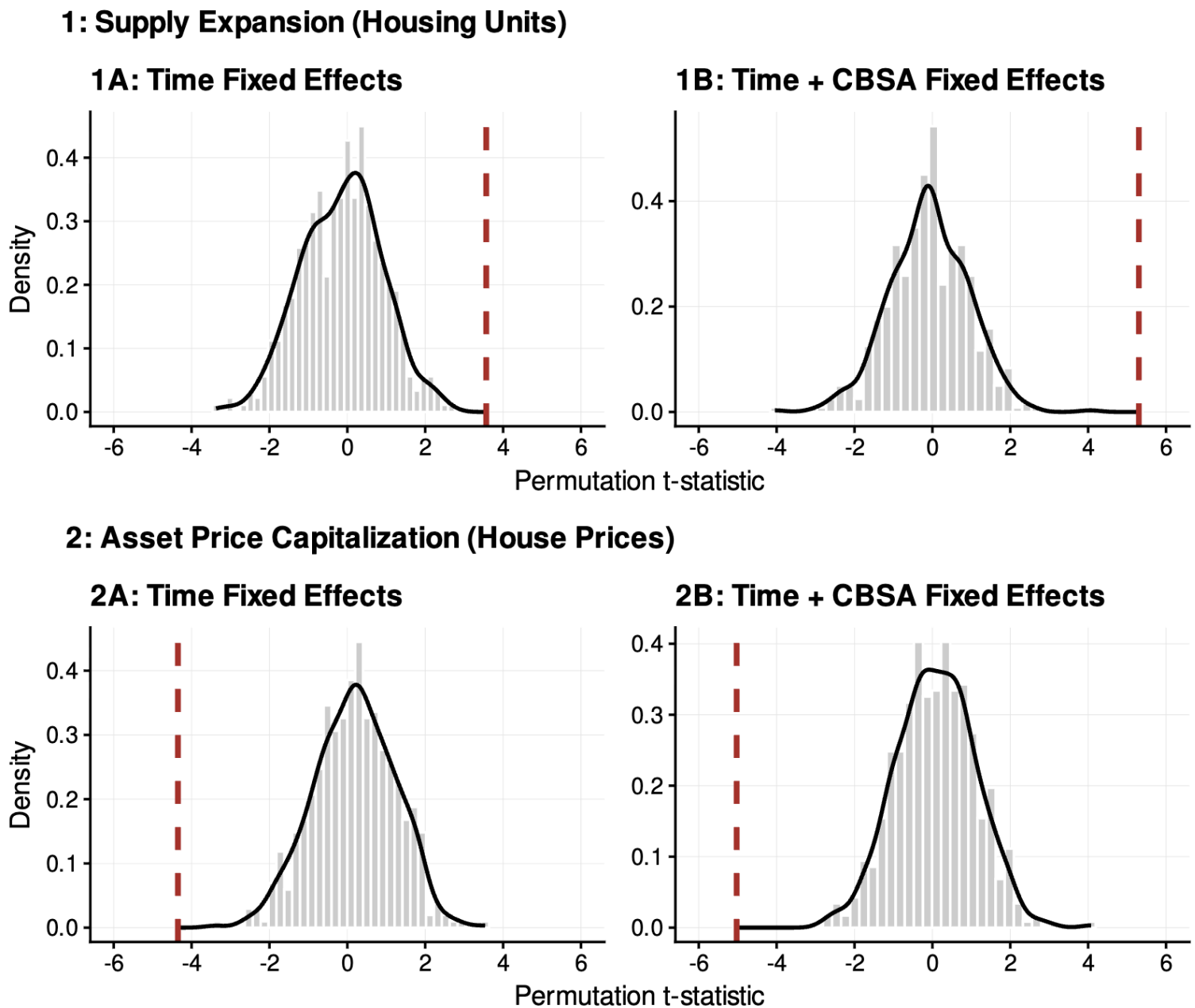


Figure 17: The Housing Collateral Channel For Entrepreneurship (2SLS Estimates, 1994–2022)