Housing Wealth Effects: The Long View

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How Big Are Housing Wealth Effects?

- Substantial evidence of "housing wealth effects" in the 2000s boom and Great Recession (Mian and Sufi)
- Were the 2000s special?
  - Boom: Automated underwriting, subprime credit, HELOCs ("houses as ATMs")
  - Bust: Large house price fall, credit contraction trigger deleveraging

What We Do: Empirics

- Estimate housing wealth effect back to 1980s using consistent and new methodology
- Main findings:
  - Sizable housing wealth effect back to 1980s
  - Not particularly high post-2000, if anything lower
  - No boom-bust asymmetry
  - Robust to alternative specifications (OLS, Saiz)

What We Do: Theory

1. Data to Theory:
    - What is a housing wealth effect? PE vs. GE
2. Confront "new canonical model" of PE housing wealth effects with our empirical findings:
    - Model does not generate high housing wealth elasticity in 2000s either!
        - Key role of impatient low-LTV households
        - Rightward shift in LTV distribution also increases number of underwater (unresponsive) agents

Related Literature

- Empirics:
  - Mian and Sufi (2011, 2014, 2014) and Mian et al. (2013)
  - Case, Quigley, Shiller (2005, 2013)
  - See also: Campbell and Cocco (2007); Caroll et al. (2011), Attanasio et al. (2009, 2011); Aladangady (2017)
- Theory:
  - Sinai and Souleles (2005), Flavin and Nakagawa (2008)
  - Chen et al. (2013); Berger et al. (2017); Kaplan, Mitman, and Violante (2017); Gorea and Midrigan (2017), Guren et al. (2017), Beraja et al. (2017); Wong (2016)

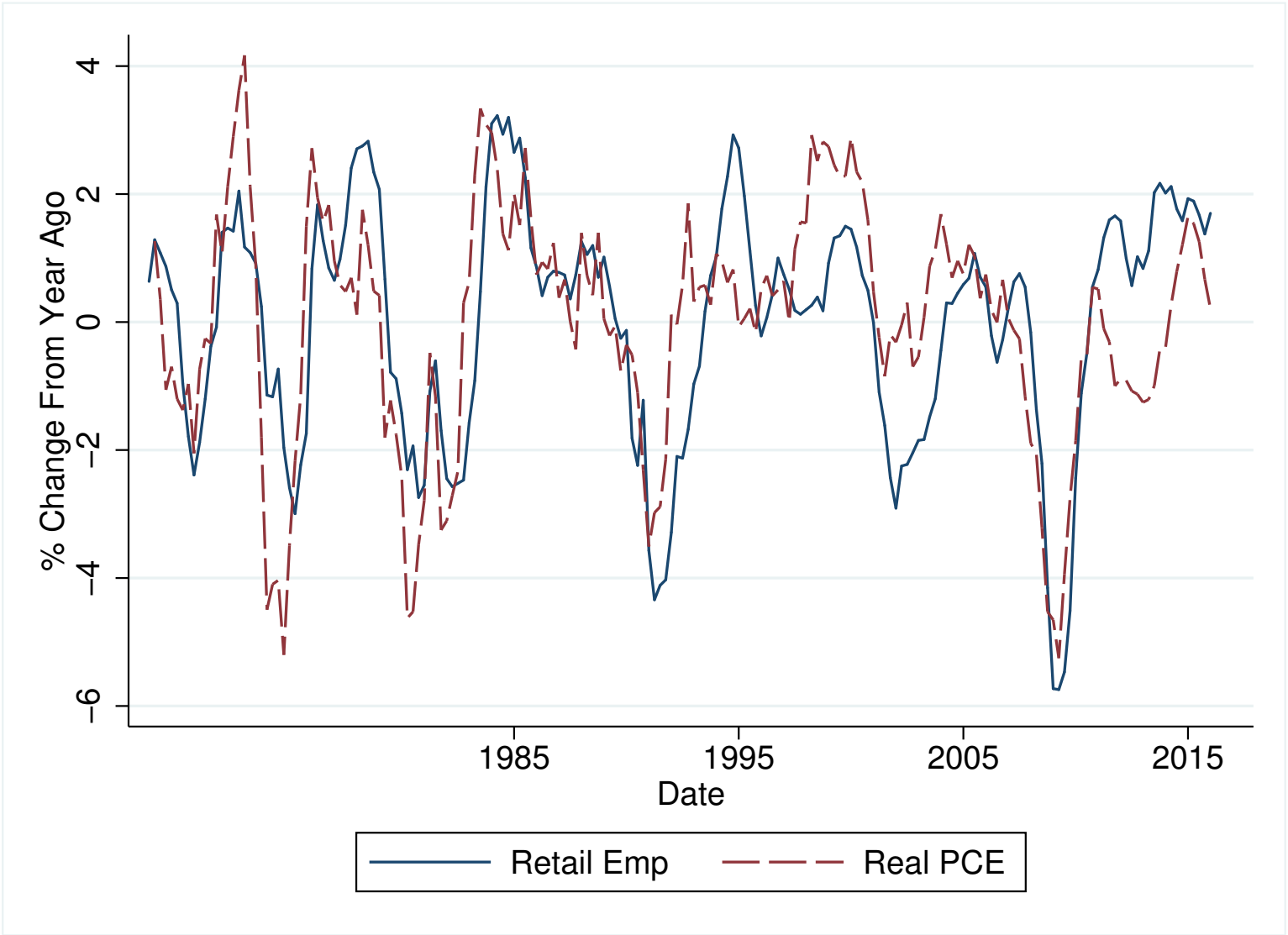
Empirical Approach

Data

- We use data on 380 CBSAs (cities) for 1975-2017
- Retail employment per capita from QCEW / Census
  - Use as proxy for consumer expenditures
  - Highly correlated at an aggregate level (next slide)
  - No annual, high-quality, regionally disaggregated, data on consumer expenditures.
    - Retail employment often used as proxy (e.g., BEA, Survey of Buying Power)
- House prices from Freddie Mac.
  (Deflated by GDP deflator)

▸ Data Details ▸ SIC vs. NAICS

Consumption vs. Retail Employment



▸ More on Consumption vs. Retail Employment

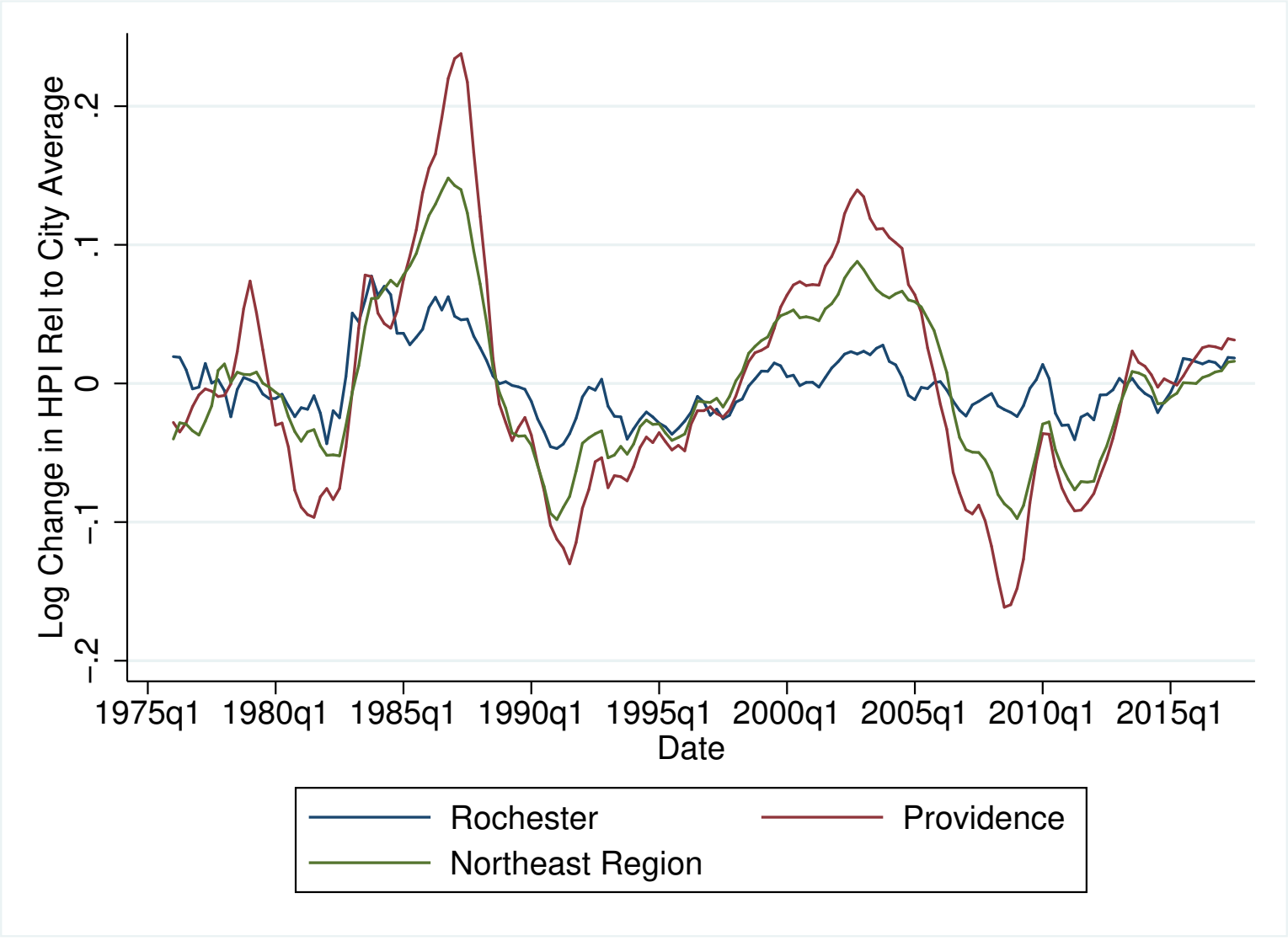
Empirical Framework

$$\Delta y_{i,r,t} = \psi_i + \xi_{r,t} + \beta \Delta p_{i,r,t} + \Gamma X_{i,r,t} + \varepsilon_{i,r,t}$$

- i is CBSA (i.e., city), r is region, t is quarter, and Δ is annual difference.
- Goal is to estimate β
  - Housing wealth effect measured as an elasticity
- Approach to identification: "sensitivity instrument"
  - Exploit differential sensitivity of local house prices to regional housing cycles (Sinai 2012; Palmer 2015)

▸ Simultaneous Equations Model

Sensitivity Example: Providence vs. Rochester



▸ Regional HPI's

Sensitivity Instrument: First Pass

- Estimate:

$$\Delta p_{i,r,t} = \varphi_i + \gamma_i \Delta P_{r,t} + \nu_{i,r,t}.$$

  and use $\hat{\gamma}_i \Delta P_{r,t}$ as our instrument?

- Intuition: Differences in housing supply curves across locations lead to different response of house prices to aggregate shocks
- Concern: Heterogeneous $\hat{\gamma}_i$ could arise from reverse causation
  - Heterogeneous industrial structure $\Rightarrow$ heterogenous business cycle volatility $\Rightarrow$ heterogeneous house price volatility

Sensitivity Instrument: Refined Version

- Control for local and agg change in y when estimating γ_i:

$$\Delta p_{i,r,t} = \varphi_i + \delta_i \Delta y_{i,r,t} + \mu_i \Delta Y_{r,t} + \gamma_i \Delta P_{r,t} + \nu_{i,r,t}$$

  and use $\hat{\gamma}_i \Delta P_{r,t}$ as our instrument.

  - R-squared without $\gamma_i \Delta P_{r,t}$ term: 0.18
  - Adding $\gamma_i \Delta P_{r,t}$ term raises R-squared to 0.62!
  - Powerful instrument!

- Correlated with Saiz and Wharton Land Use Regulation Index, but much more powerful.

▸ Algebra ▸ Bartik Estimate of δ

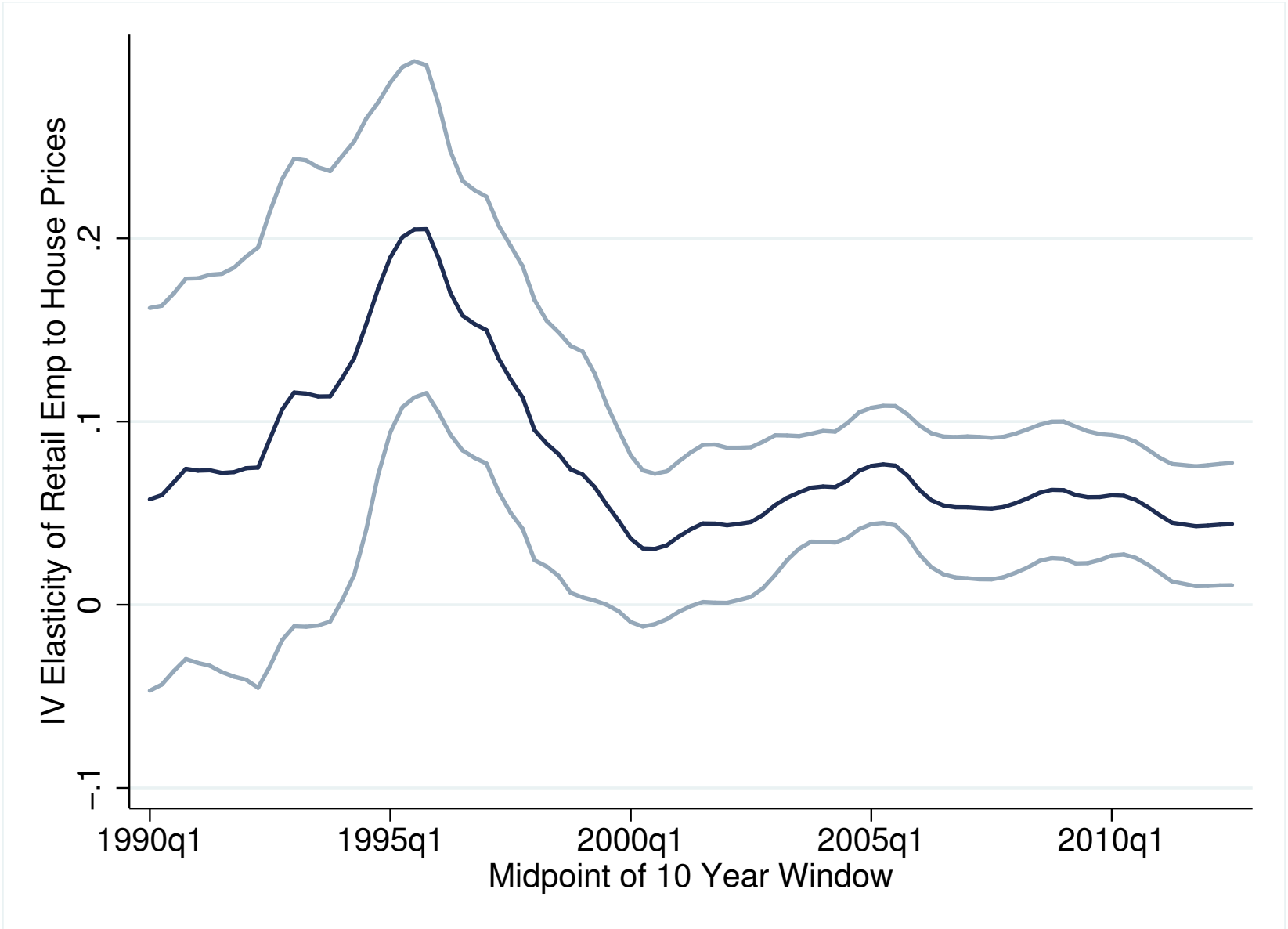
Identifying Assumption

- Not some other unobserved aggregate factor that:
  1. Moves with house prices in time series.
  2. Differentially affects the same set of cities
- Similar to assumptions behind a Bartik instrument
  - Consider differential exposure to oil shocks (Texas vs Florida)
  - Not some other factor that happens to differentially affect Texas at the same time as oil price go up
- Panel data allows us to add controls:
  - Cyclical sensitivity, industry shares with time-specific coefficients, mortgage rates, risk premia ▸ Details
- 10-year rolling windows, leave self out on time and city

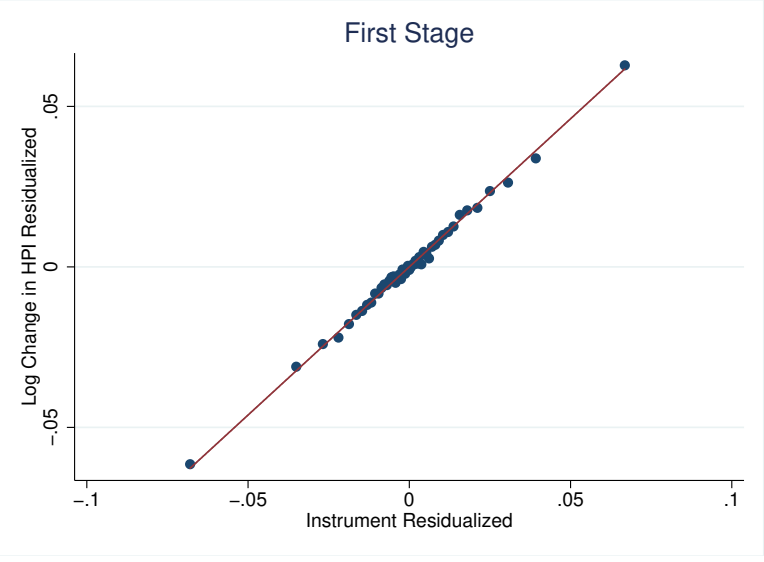
▸ Empirical Model ▸ Other Details

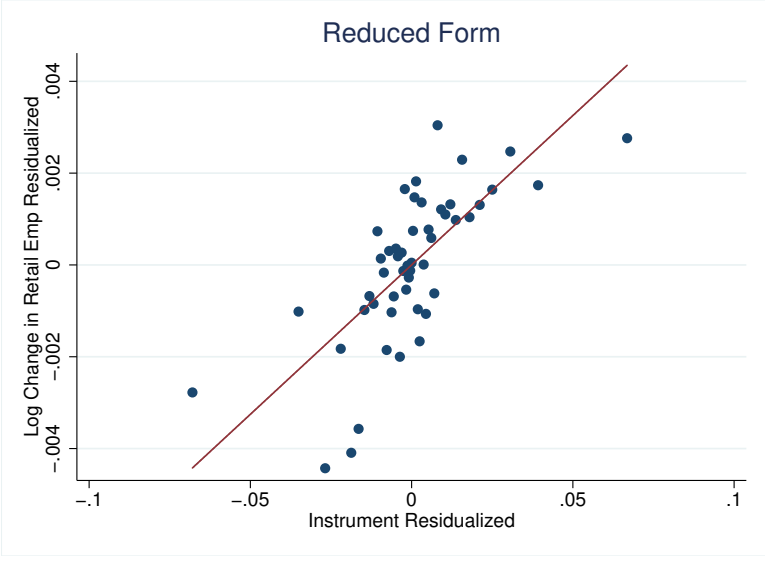
Empirical Results

Elasticity of Retail Emp to House Prices: 10-Year Windows



Pooled Estimates

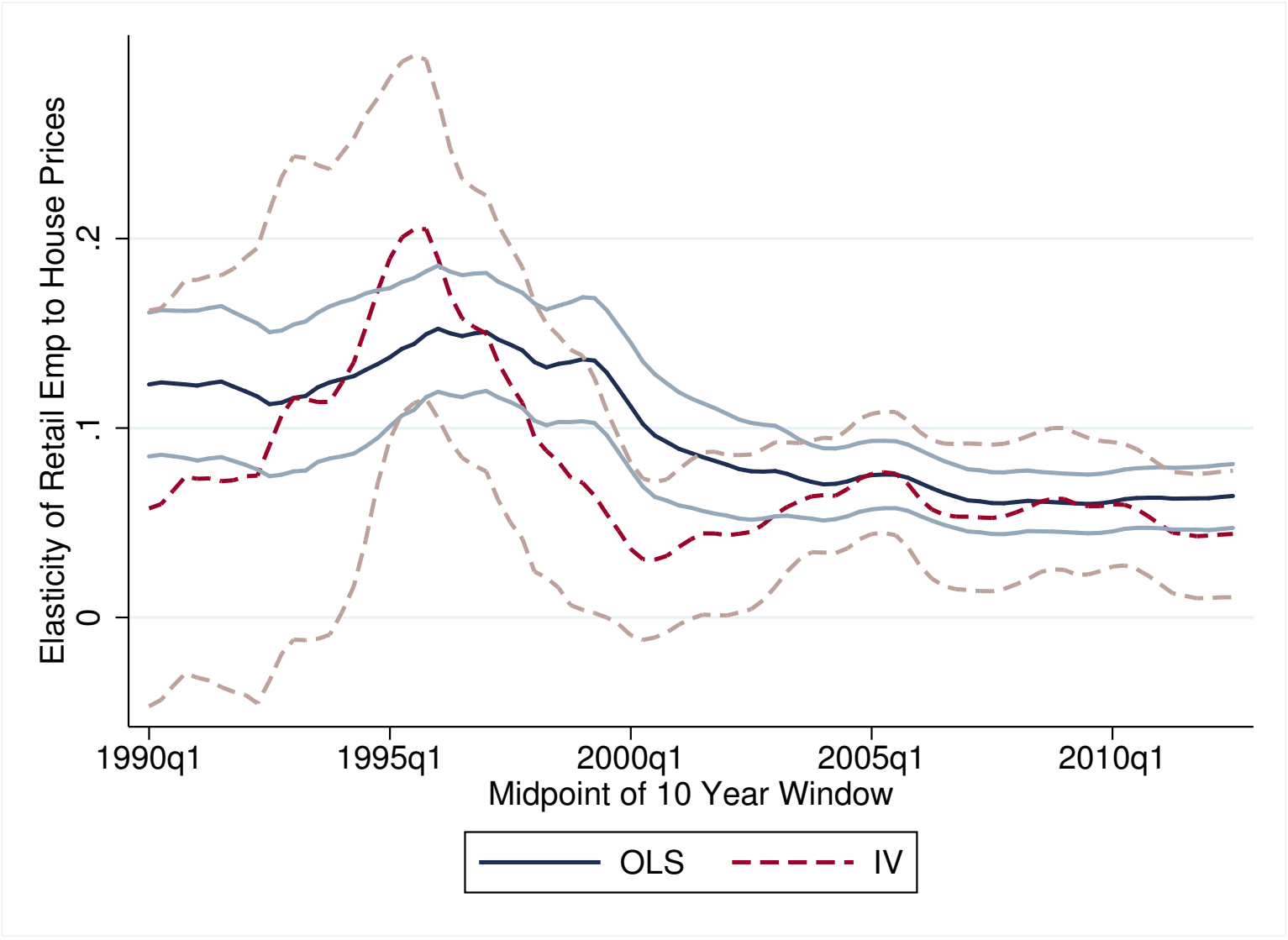




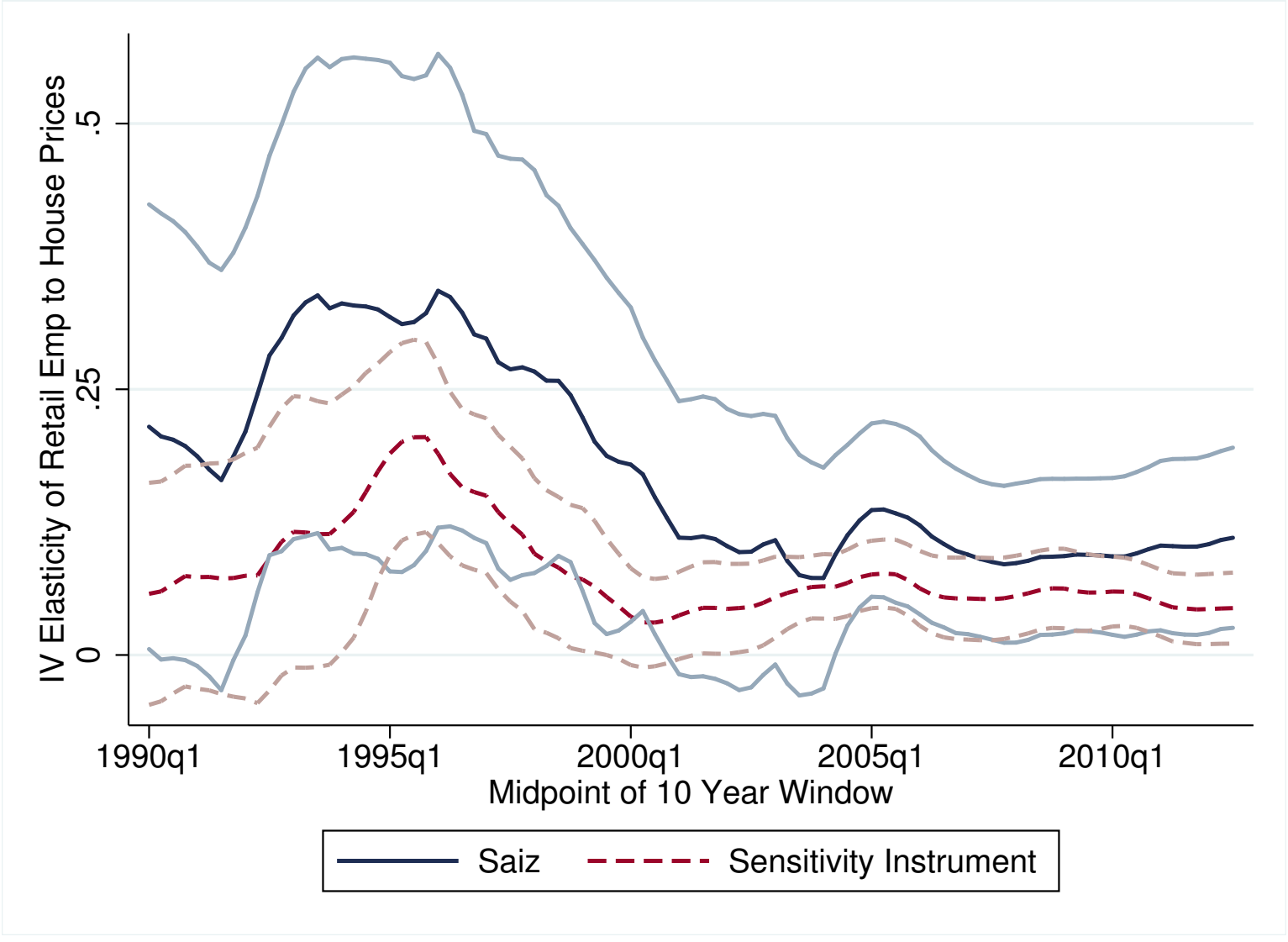
- Pooled estimate for 1990-2017: 0.071 (0.012).
- Implied marginal propensity to consume out of housing wealth: 3.27 cents per dollar of housing wealth (7.1/2.17=3.27)

▸ Comparison to Other Approaches

OLS vs. IV


Elasticity of Retail Emp to House Prices
0
.1
.2
1990q1
1995q1
2000q1
2005q1
2010q1
Midpoint of 10 Year Window
OLS
IV

Saiz vs. Sensitivity Instrument



No Evidence of Boom-Bust Asymmetry

	(1)	(2)
$\Delta \log(P) -$	0.076***	
	(0.018)	
$\Delta \log(P) +$	0.063***	
	(0.017)	
P Test for Equality	0.587	
$\Delta \log(P)$		0.072***
		(0.013)
$\Delta \log(P)^2$		0.010
		(0.040)

- Cannot reject equality of positive and negative coefficients
- Quadratic term quantitatively small

Robustness and Alternate Specifications

- No Controls Details
- Alternate Specifications:
  1. 3Y differences Details
  2. Population weighting Details
  3. Non per-capita Details
  4. Dropping sand states Details
  5. 5Y window Details
  6. Misc. Other Robustness Details
- Repeated Cross-Sections Details
- Alternate Data Sets
  1. CBP For Employment Details
  2. FHFA HPI Details
- Accounting For Sampling Error in the γ_is Details
- Manufacturing Details

Data to Theory

Data to Theory

- Can we interpret β as a partial equilibrium effect given that house prices are endogenous at the city level?
    - Simple GE model in which agg shock affects cities differently (e.g. due to differential housing supply elasticities)
- If all other markets national, β captures PE effect of house prices on consumption. All GE in FE.
- If other markets not national, β includes local GE effects.
    - We show (in appendix):

$$\beta \simeq \beta_{LFM}\beta_{PE}$$

    - β_{LFM} is the local government spending multiplier $\approx$1.5
    - β_{PE} is the PE effect of house prices on consumption

▸ Details

New Canonical Model of Housing Wealth Effect

Model Sketch

- Standard version of "new canonical model."
- PE Lifecycle model with uninsurable income risk. ▸ Details
- CRRA preferences over CES bundle of housing and non-durable consumption with warm-glow bequest motive. ▸ Details
- Can own or rent housing
  - Housing adjustment costs, constant price/rent ratio
- Can only borrow through long-term mortgages that amortize over remaining life, are subject to origination cost and LTV constraint:

$$M' \leq \theta P H', \ \theta = 0.8$$

- Liquid asset with return $<$ mortgage rate.
- Default with utility cost.

Calibration

- Calibrate some parameters to standard values ▸ Details
- Choose:
  - Preference for housing, discount rate, bequest motive, refinancing cost, rent-price ratio
- To match:
  - From 2001 SCF distribution (P25, P50, P75, P90) ▸ Fit
    - Home value-to-income
    - LTV
    - Liquid Assets
  - Home ownership rate
  - Refinancing rate of 9.3% (Deng et al., 2000). ▸ Details
  - Moving rate among owners of 3.2% from 2001 CPS.

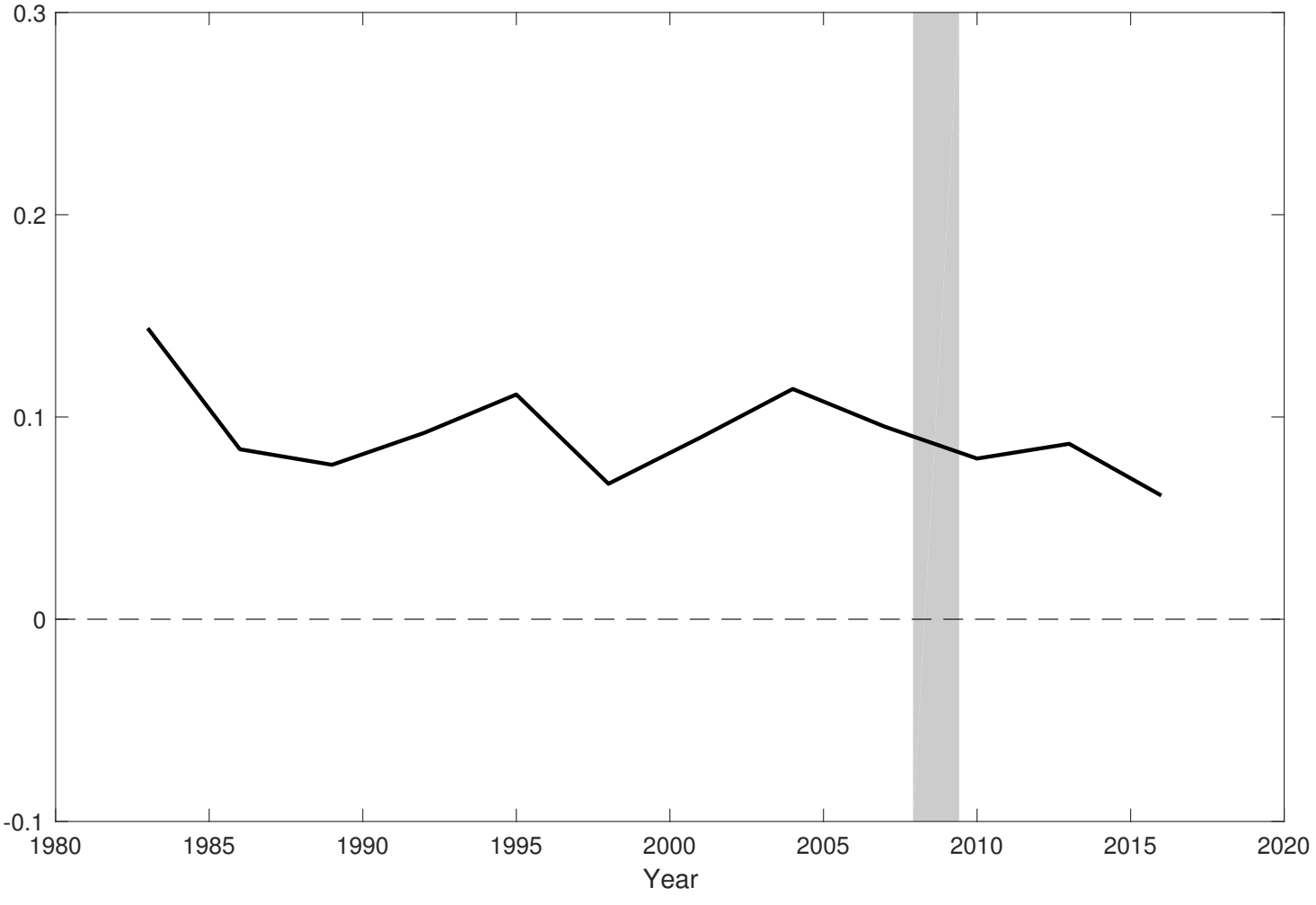
Experiment

- Solve model for consumption function as a function of state variables
  - Liquid assets, mortgage, home value, income, age, house price
  - Assume households expect house prices will remain constant in future (consider extensions later)
- Calculate derivative of city consumption to house price by integrating over states

$$\frac{\partial C}{\partial P} = \frac{\partial}{\partial P} \int c(a, m, Ph, y, t, P) d\Phi(a, m, h, y, t)$$

- Distribution of states, Φ_t, is empirical distribution from SCF
  - Calculate repeatedly for Φ_{1983}, Φ_{1986}, ..., Φ_{2016}
  - Adjust bust SCF LTV dist to match CoreLogic equity estimates post-2007

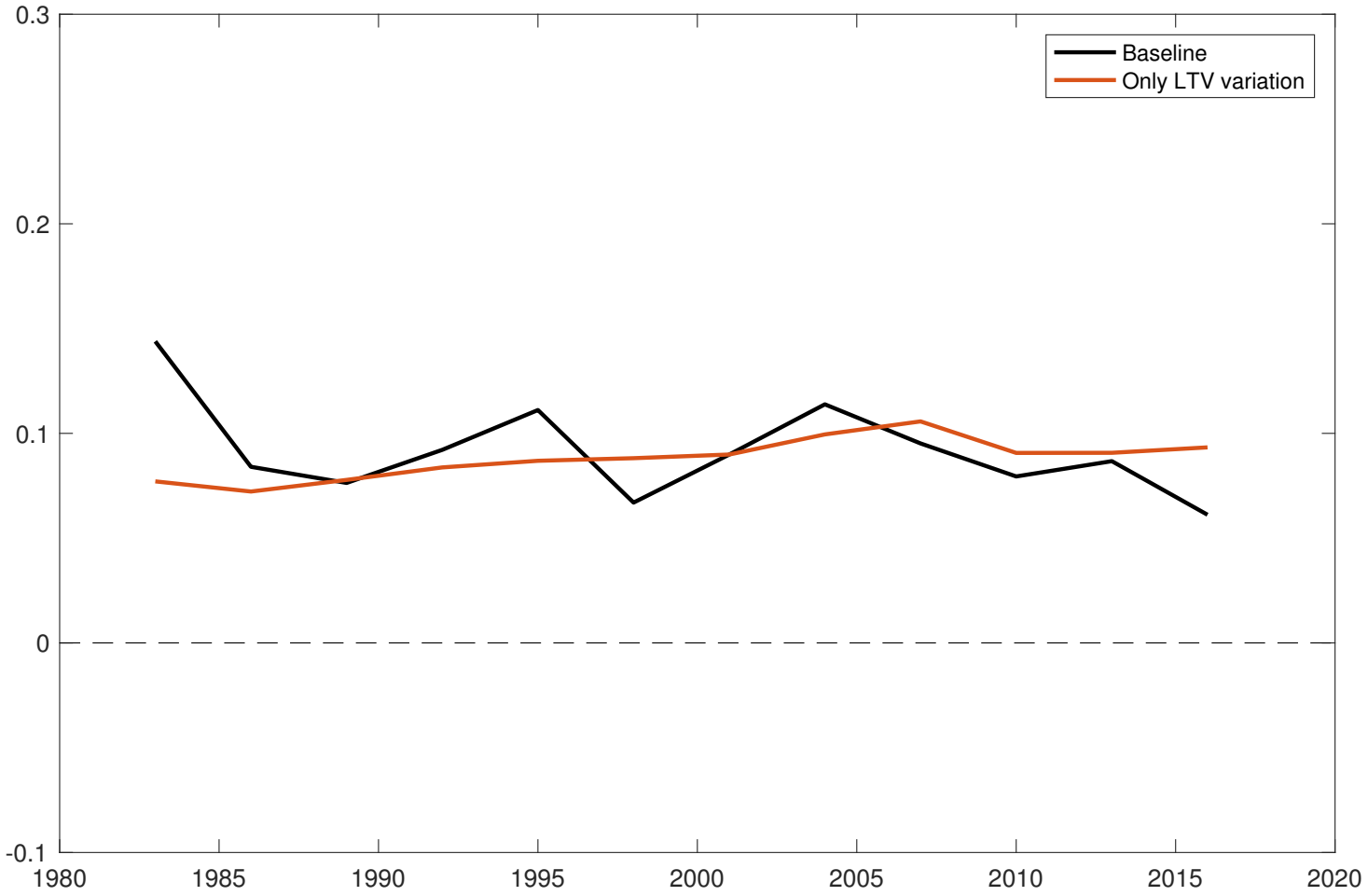
Theory: Local Consumption Response to House Prices



Evolution of Household Leverage

- Spike in leverage during the Great Recession ▸ Figure
- "Great Leveraging" of 80's and 90's: 75th percentile of LTV's rose from 0.4 to 0.8 ▸ Figure
- Why didn't either of these lead to bigger changes in housing wealth elasticity?

Housing Wealth Elasticity almost Flat varying LTV Distribution (Red Line)



- Counterfactual: Only the marginal distribution of LTV changing. ▸ Method

Why so Stable? Intuition

1. High MPC out of housing wealth for unconstrained due to impatience
   - Incomplete Markets:$\beta < R^{-1}$ due to precautionary motive (vs. PIH implies $\beta = R^{-1}$)
   - Even low LTV homeowners (62% in 2007) have substantial MPC's
2. "Hump" in MPC out of housing wealth
   - MPC rises as households approach borrowing constraint, then falls for underwater households (Ganong and Noel).
   - Effects of households being pushed into constraint offset by effect of households pushed far past constraint.

Decomposition of Elasticity

	2007		2010	
	Elas.	Group size	Elas.	Group size
Renters (not moving)	0.00	0.30	0.00	0.31
Upsizers	-0.89	0.04	-0.78	0.05
Downsizers	0.46	0.06	0.44	0.04
Stayers				
LTV ≤ 0.6 ("low")	0.15	0.38	0.17	0.31
LTV $\in (0.6, 0.8]$ ("med.")	0.18	0.10	0.22	0.08
LTV $\in (0.8, 1.0]$ ("high")	0.28	0.09	0.29	0.10
LTV ≥ 1.0 ("underwater")	0.01	0.04	0.03	0.11
Total	0.095	1.00	0.079	1.00

▸ Changing Beta

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1. High MPC out of housing wealth for unconstrained due to impatience
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   - Even low LTV homeowners (62% in 2007) have substantial MPC's
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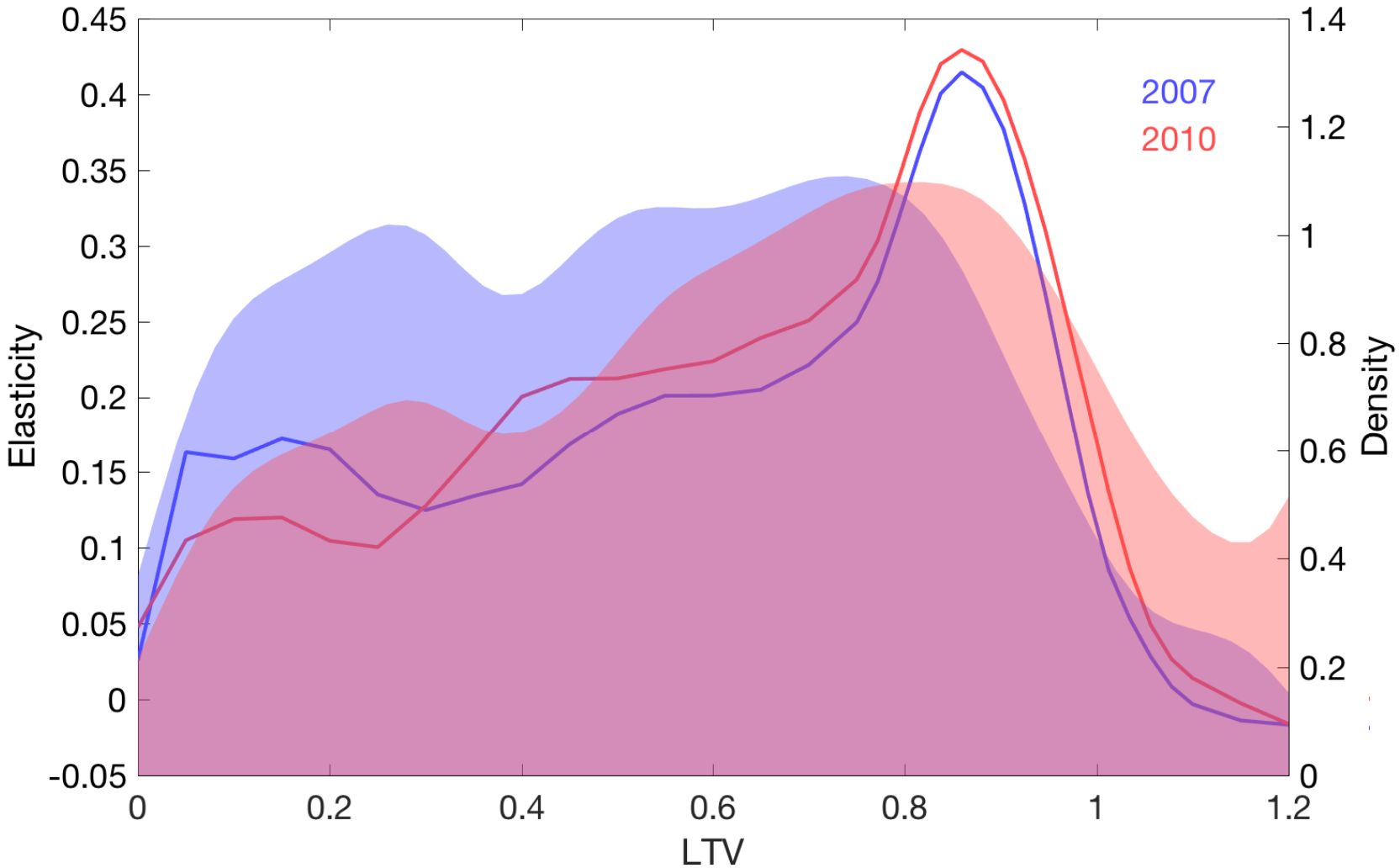
Hump in LTVs



▸ With Renters ▸ 2001 vs 2004

Shifting Weights in Great Recession

	2007		2010	
	Elas.	Group size	Elas.	Group size
Renters (not moving)	0.00	0.30	0.00	0.31
Upsizers	-0.89	0.04	-0.78	0.05
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Total	0.095	1.00	0.079	1.00

- 7% moved out of low. 1% to high, 7% to underwater.

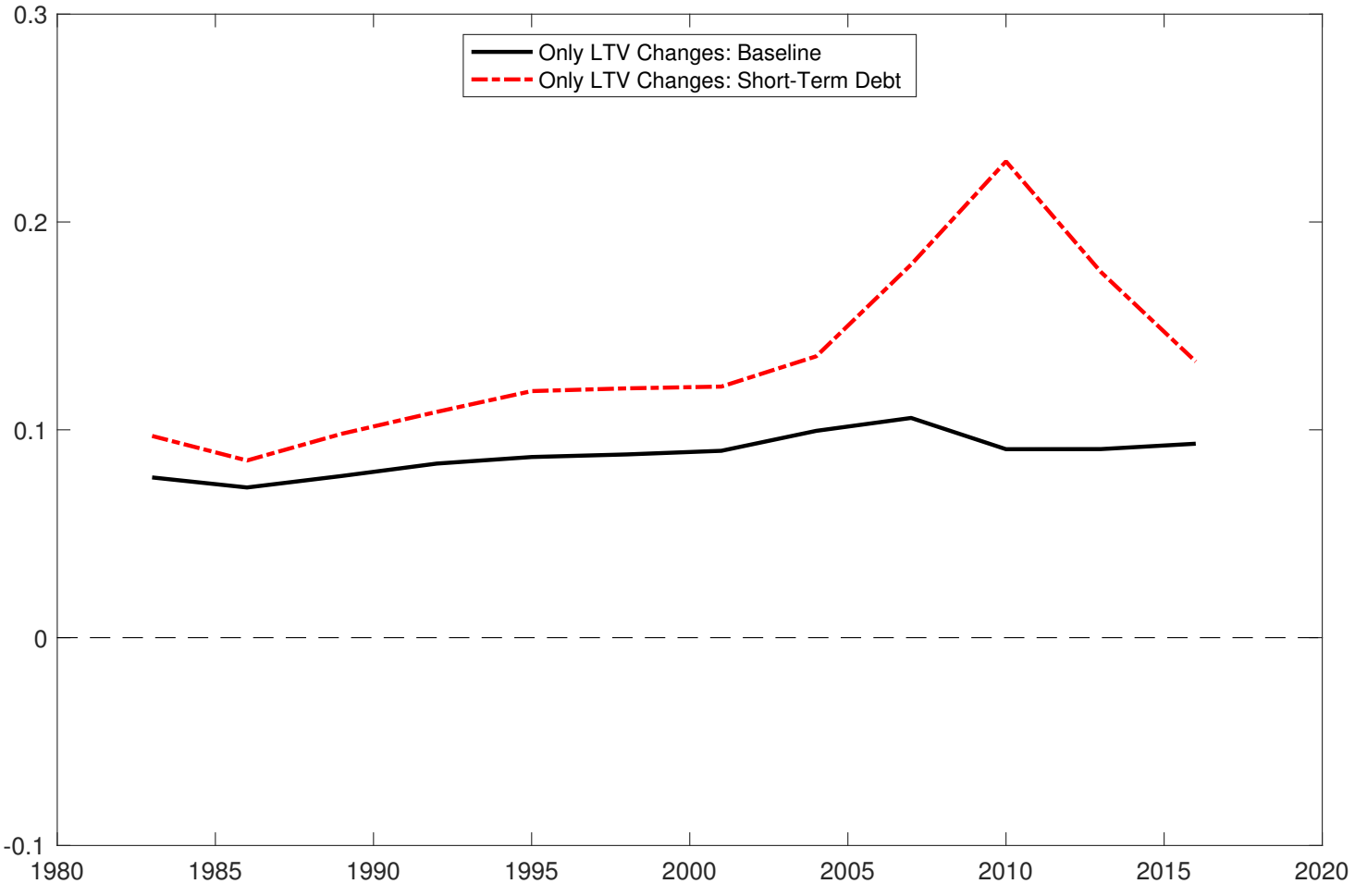
▸ TimeSeries

Shifting Weights in Great Leveraging

	1986		2007	
	Elas.	Group size	Elas.	Group size
Renters (not moving)	0.01	0.30	0.00	0.30
Upsizers	-0.64	0.06	-0.89	0.04
Downsizers	0.29	0.04	0.46	0.06
Stayers				
LTV ≤ 0.6 ("low")	0.17	0.54	0.15	0.38
LTV $\in (0.6, 0.8]$ ("med.")	0.26	0.05	0.18	0.10
LTV $\in (0.8, 1.0]$ ("high")	0.23	0.01	0.28	0.09
LTV ≥ 1.0 ("underwater")	0.01	0.00	0.01	0.04
Total	0.084	1.00	0.095	1.00

- 16% moved out of low and into med, high, underwater

Role of Long-Term Debt



- Without long-term debt, underwater households also have high elasticities

Model Summary

- New canonical model generates substantial housing wealth elasticity
- But little role for shifts in LTV distribution
  - Substantial housing wealth elasticity even for low LTV households
  - MPC rises as households approach borrowing constraint, then falls for underwater households (Ganong and Noel).
  - Similar intuitions for why changes in LTV constraint have little effect on elasticity. ▸ Credit Constraints
- Our theoretical analysis is for elasticity (not level) of consumption
- New canonical model **does** imply important role for LTV distribution in **level** of consumption

Other Experiments and Robustness

Other Experiments

1. Varying credit constraints ▸ Credit Constraints
2. Only home price variation ▸ Home Values

Robustness

1. Model Consistency ▸ Model Consistency
2. No Short-Run Housing Adjustment ▸ No Housing Adj
3. Changing Interest Rates ▸ Interest Rates
4. Non-Linearity ▸ Non-Linearity
5. Different Assumptions on Rent Cyclicality ▸ Constant Rent

▸ Model vs. Data

Conclusion

- We present new evidence on housing wealth elasticities going back to the 1980s.
  - Based on new "sensitivity" instrument
  - Housing wealth elasticities were if anything larger pre- than post-2000
- Show (perhaps surprisingly) that canonical model also does not predict high housing wealth elasticity in 2000s
  - Key roles of impatient low-LTV agents and underwater unresponsive agents.
- Suggests housing wealth elasticity reflects fundamental forces, not special features of 2000s boom-bust cycle

APPENDIX SLIDES

Data Details

- House prices: Freddie Mac HPI back to 1975 for 381 CBSAs.
  - Balanced panel back to 1975 *without imputation*.
  - Downside: Combines transactions and appraisals.
  - Results robust to transaction-only indices in recent periods
- Retail Employment: QCEW back to 1975 at the county level
  - Aggregate to CBSA level
- Supplement with County Business Patterns data for industry shares.=
  - Less missing data for some industries
  - Results robust to using this data for everything

▸ Return

SIC to NAICS Transition

- QCEW available for SIC 1975-2000 and NAICS 1990-2000
- Retail employment definition changed:
  - Higher under SIC because includes wholesale.
- Solution: Series line up in overlapping period in log changes.
  - So splice together series in log changes in 1993.
  - Results not sensitive to splicing date.

Return

Consumption vs. Retail Employment

	1	2	3	4
	OLS Total Cons	IV Total Cons	OLS Ex Rent	IV Ex Rent
Retail Emp	0.460**	0.940**	0.521*	0.969**
	(0.179)	(0.314)	(0.230)	(0.400)
CBSA FE	X	X	X	X
Time FE	X	X	X	X
N	423	408	423	408

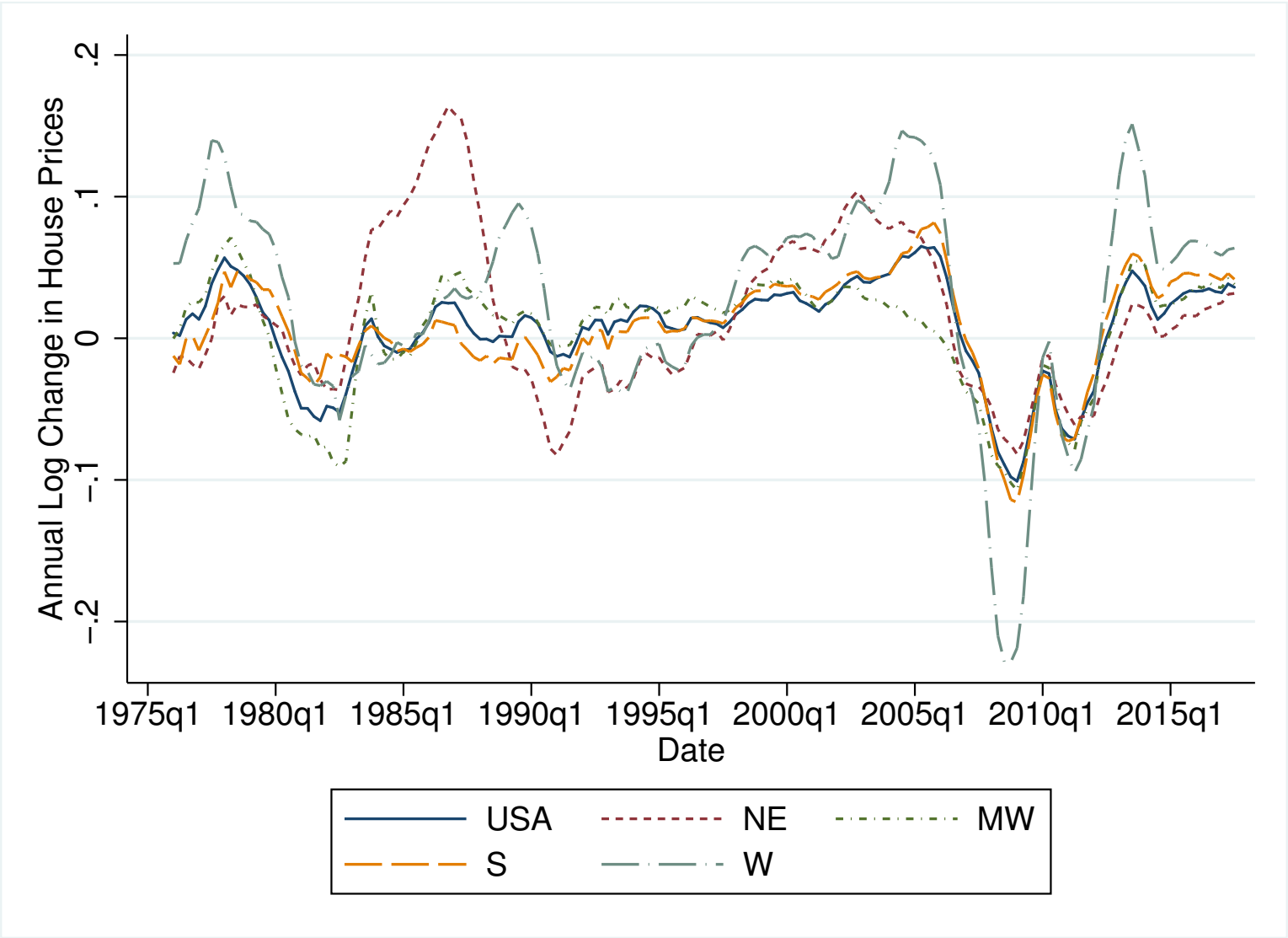
- Regressions of city-level consumption using CEX data for 17 cities on retail employment in these cities
- We instrument for retail employment with state-level house prices to eliminate attenuation bias due to measurement error in retail employment

Return

Cons vs. Retail Emp: Corr in Rolling 10-Year Windows

Return

Regional House Price Indices



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Simultaneous Equations Model

$$\Delta y_{i,r,t} = \psi_i + \xi_{r,t} + \beta \Delta p_{i,r,t} + \alpha_i \mathcal{E}_{r,t} + \varepsilon_{i,r,t},$$
$$\Delta p_{i,r,t} = \varphi_i + \zeta_{r,t} + \delta \Delta y_{i,r,t} + \gamma_i \mathcal{V}_{r,t} + \nu_{i,r,t}.$$

Assume:

- Reverse causation ($\delta \Delta y_{i,r,t}$)
- $\Delta p_{i,r,t}$ may be measured with error
- Arbitrary correlation of aggregate shocks ($\xi_{r,t}$ and $\zeta_{r,t}$)
- Identifying assumption: $\gamma_i \mathcal{V}_{r,t} \perp \alpha_i \mathcal{E}_{r,t}$ conditional on controls (time fixed effects imply γ_i and α_i mean zero)

We show how γ_i can be estimated and that
$z_{i,r,t} = \hat{\gamma}_i \Delta P_{r,t}$ is a valid instrument for $\Delta p_{i,r,t}$

▸ Return to Empirical Framework ▸ Return to Identifying Assumption

Identifying Assumption: Simple Case

- Two types of cities:
  - High Sensitivity cities: γ_{high}
  - Low Sensitivity cities: γ_{low}
- Identifying assumption in this case:
  $(\bar{\alpha}(high) - \bar{\alpha}(low))Cov(V, \mathcal{E}) = 0$
  - For any correlated $\mathcal{E}$ need same $\bar{\alpha}$ across groups
  - Similar to identifying assumption for Bartik instrument
  - Potential bias proportional to product of two terms
- How might identifying assumption be violated?:
  - e.g., Suppose $\mathcal{E}$ is the real interest rate, $Cov(V, \mathcal{E}) > 0$,
  - AND γ_{high} cities more directly exposed to interest rates (e.g., through credit card debt)
  - (In practice, interest rates not a source of bias
    - Interest rates only modestly correlated with house prices
    - And we can control directly for exposure to any observable)

Return

Constructing Gamma: Algebra

$$\Delta y_{i,r,t} = \psi_i + \xi_{r,t} + \beta \Delta p_{i,r,t} + \alpha_i \mathcal{E}_{r,t} + \varepsilon_{i,r,t},$$
$$\Delta p_{i,r,t} = \varphi_i + \zeta_{r,t} + \delta \Delta y_{i,r,t} + \gamma_i \mathcal{V}_{r,t} + \nu_{i,r,t}.$$

- Aggregate house price equation:

$$\Delta P_{r,t} = \zeta_{r,t} + \delta \Delta Y_{r,t} + \gamma_r \mathcal{V}_{r,t},$$

- Plug this back into house price equation:

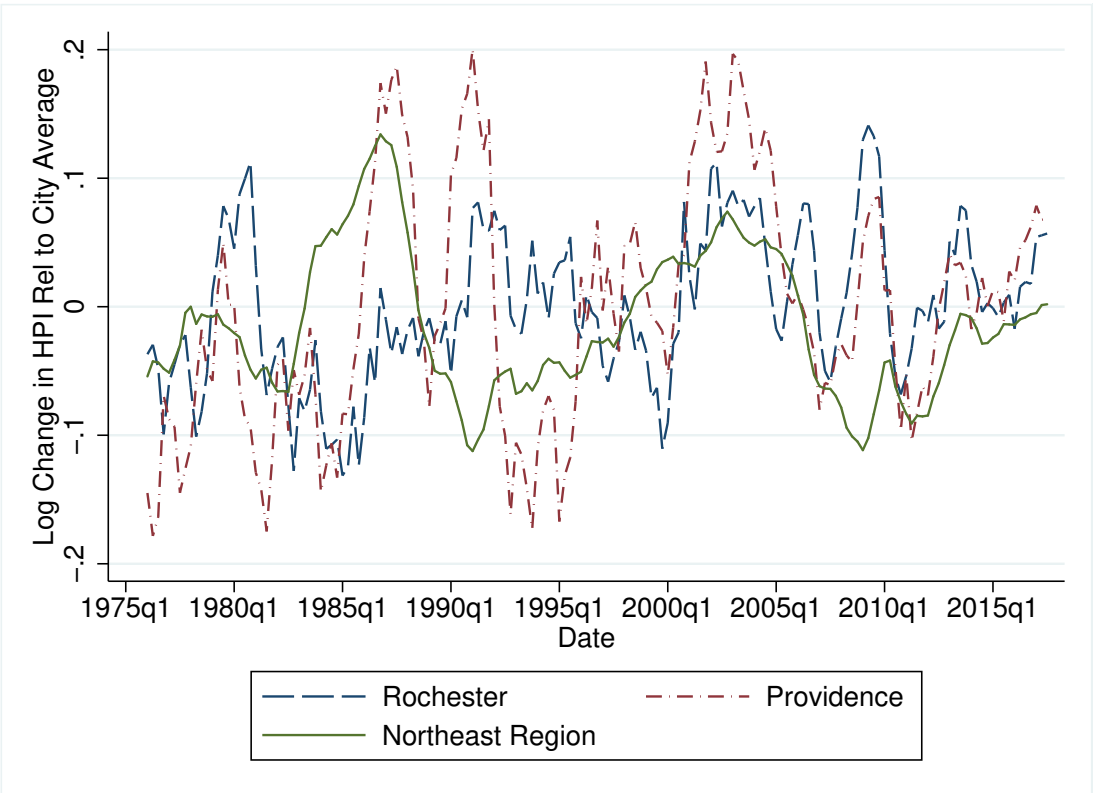
$$\Delta p_{i,r,t} = \varphi_i + \tilde{\zeta}_{r,t} + \delta \Delta y_{i,r,t} + \frac{\gamma_i}{\gamma_r} \Delta P_{r,t} - \frac{\gamma_i}{\gamma_r} \delta \Delta Y_{r,t} + \nu_{i,r,t}$$

- Algebra the same with δ_i

▸ Return

Bartik Estimate of Delta

- Alternative to estimate δ and subtract $\delta \Delta y_{i,r,t}$
- Regressing $\Delta p_{i,r,t}$ on $\Delta y_{i,r,t}$ instrumented with Bartik shocks yields $\hat{\delta} = 2.9$
- Plotting $\Delta p - 2.9\Delta y$ still yields substantial variation:



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Controls

- Control for 2-digit industry shares with time-specific coefficients.
- Control for systematic CBSA differences in responsiveness to:
  - Regional retail employment.
  - Real 30-year mortgage rate.
  - Gilchrist and Zakrajsek (2012) spread (including default risk)
  - Construct by estimating

$$\Delta y_{i,r,t} = \psi_i + \xi_{r,t} + \alpha_i \Delta X_{r,t} + \varepsilon_{i,r,t}$$

    and including $\hat{\alpha}_i \Delta X_{r,t}$ as control for these three Xs.
- Controls (mostly industry shares) reduce elasticities by about 20%, leave time series pattern unchanged.
  - CBSA FE also important for level.

▸ Return

Some Other Details

- 10 year rolling window estimation
- Leave-one-out on time and city to avoid mechanical correlations in small sample:
  - Regional house price index excludes "self"
  - γ_i's estimate using time periods outside 10-year window used in main estimation
- CBSA FE taken out once for whole 1976-2015 period so time variation in FE does not drive time variation in estimate.
- Standard errors: Two-way clustered by CBSA and region-time

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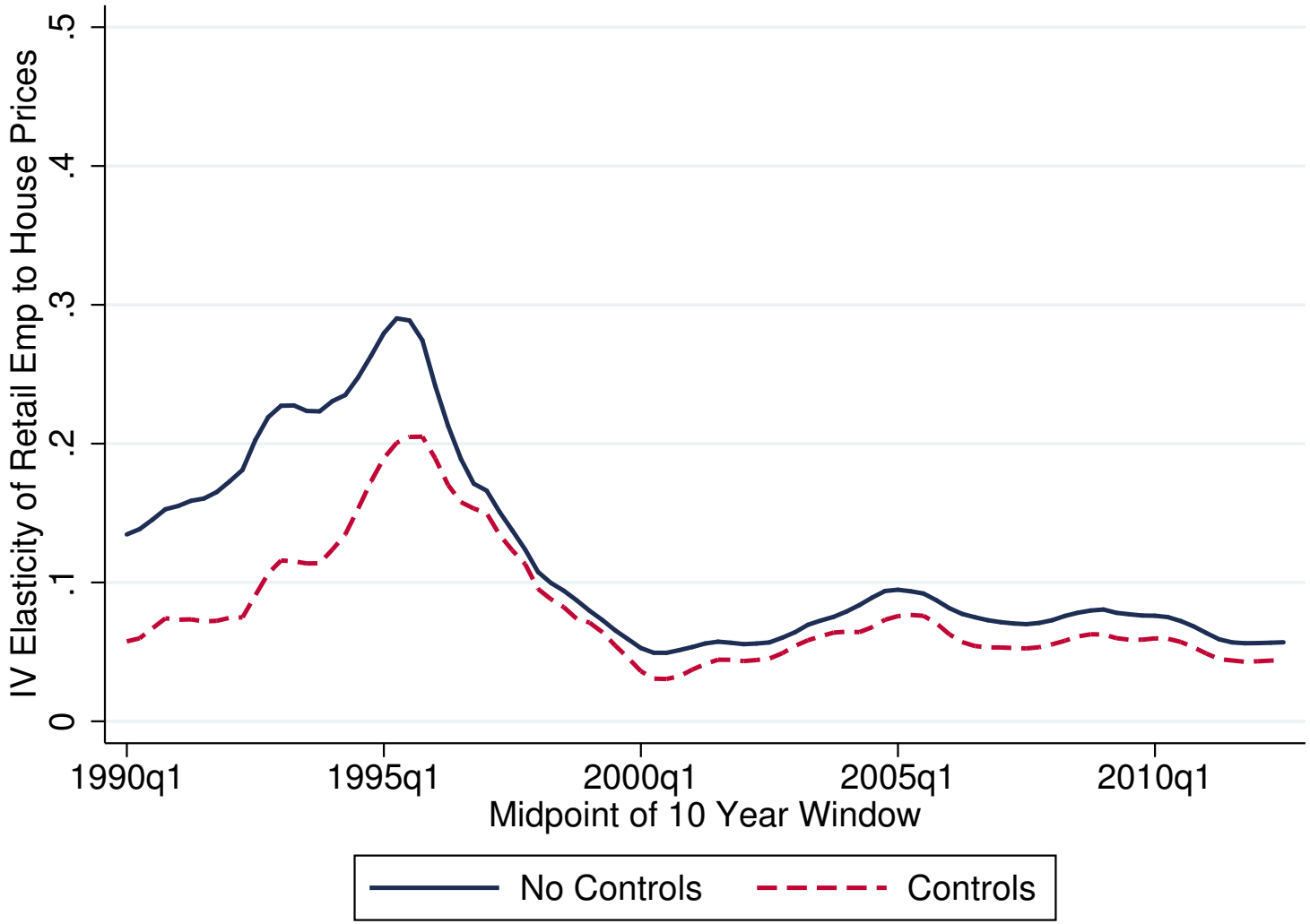
Comparison to Other Methodologies for 2006-2009

Specification	2006-2009 Elasticity	
Baseline Instrument (Per Capita), CBSA FE	0.061**	(0.020)
Baseline Instrument (Per Capita)	0.096***	(0.020)
Baseline Instrument	0.116***	(0.020)
Baseline Instrument, Saiz Sample	0.126***	(0.025)
Saiz Elasticity Instrument	0.165**	(0.062)
OLS	0.118***	(0.013)

- Mian and Sufi (2014): 0.09-0.16, previous lit 0.06-0.17

▸ Return

Role of Controls in Baseline Specification



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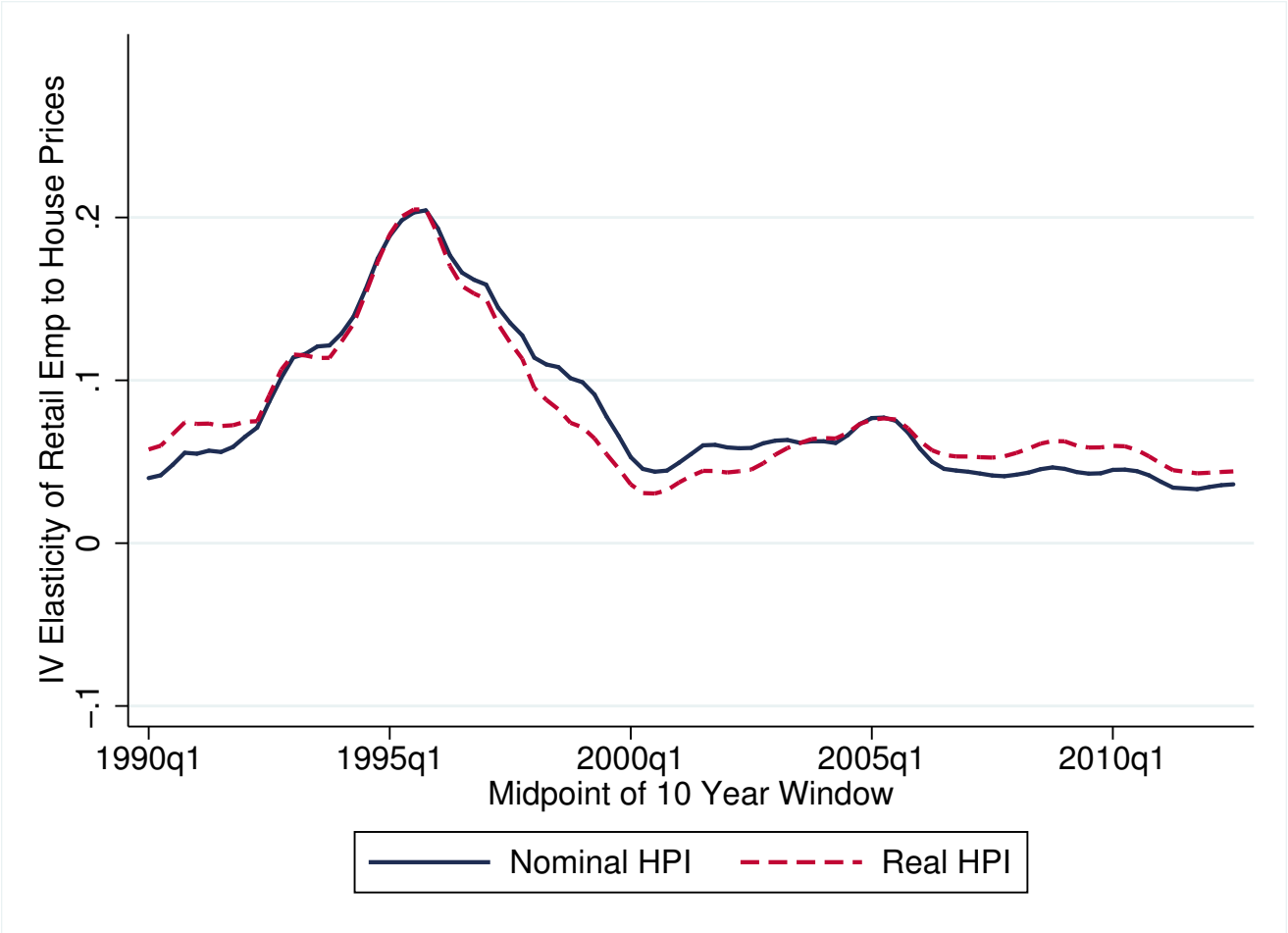
Nominal vs. Real



- Nominal post-1990 pooled elasticity is 0.062 rather than 0.071.

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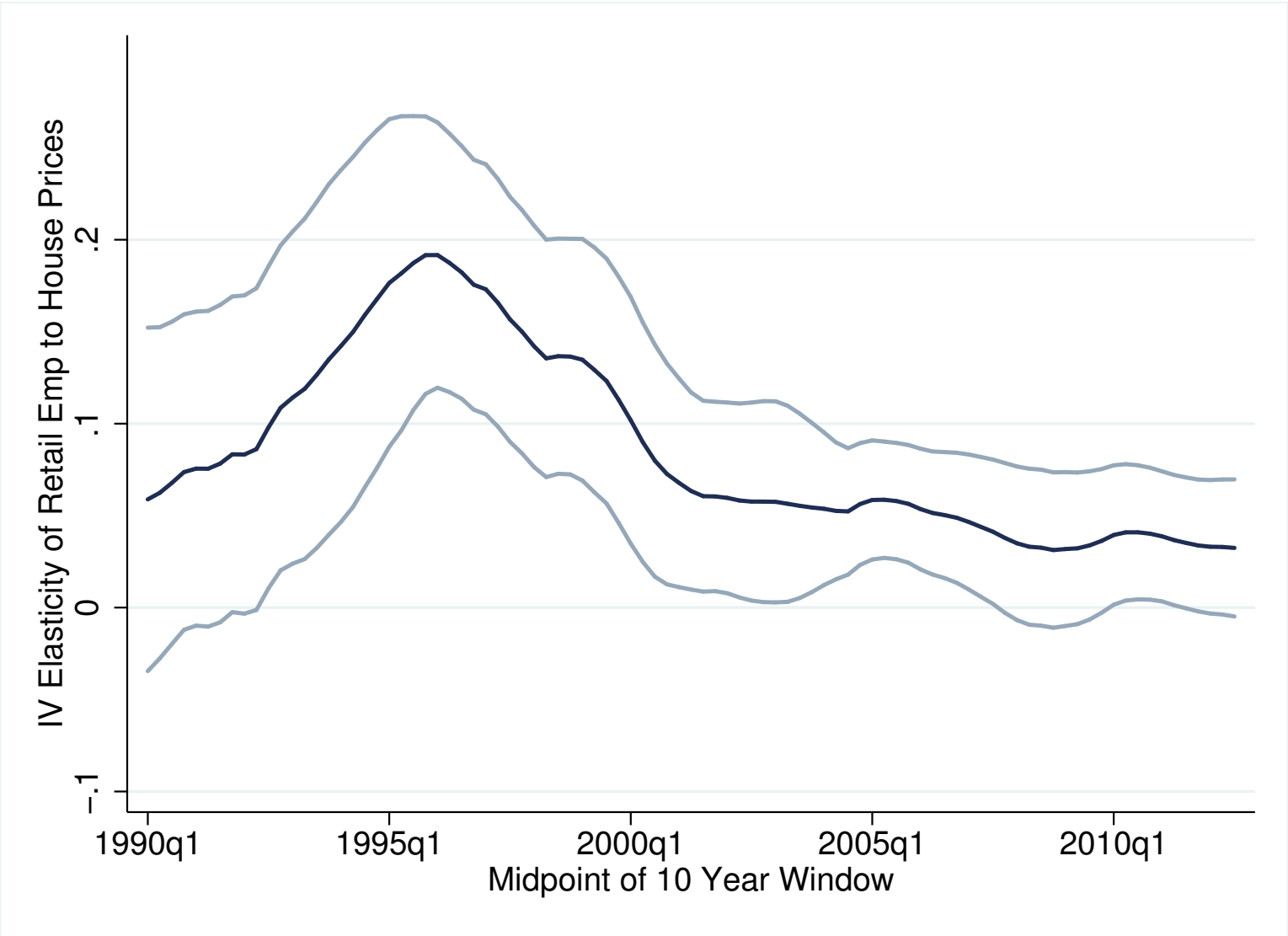
3 Year Differences



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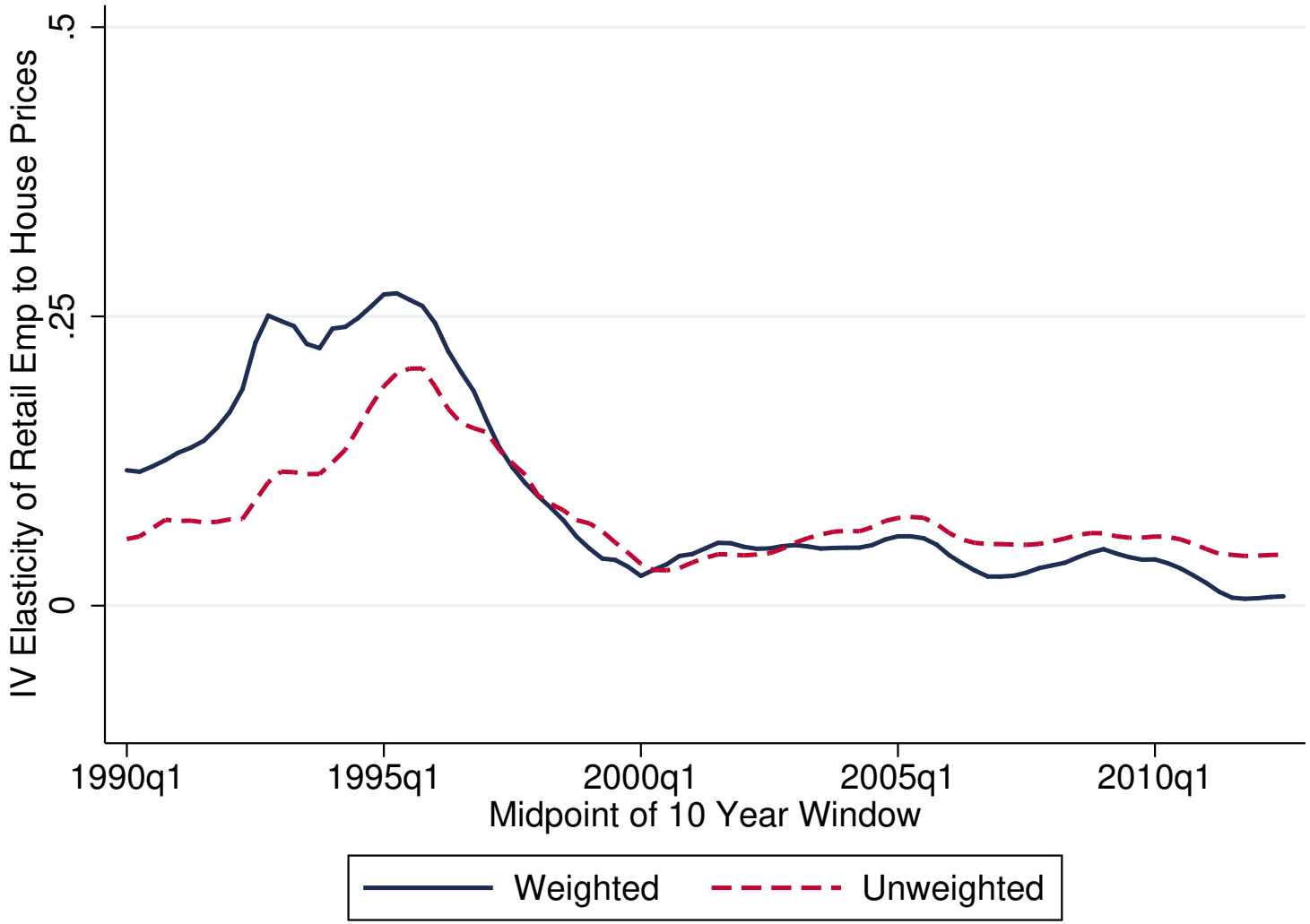
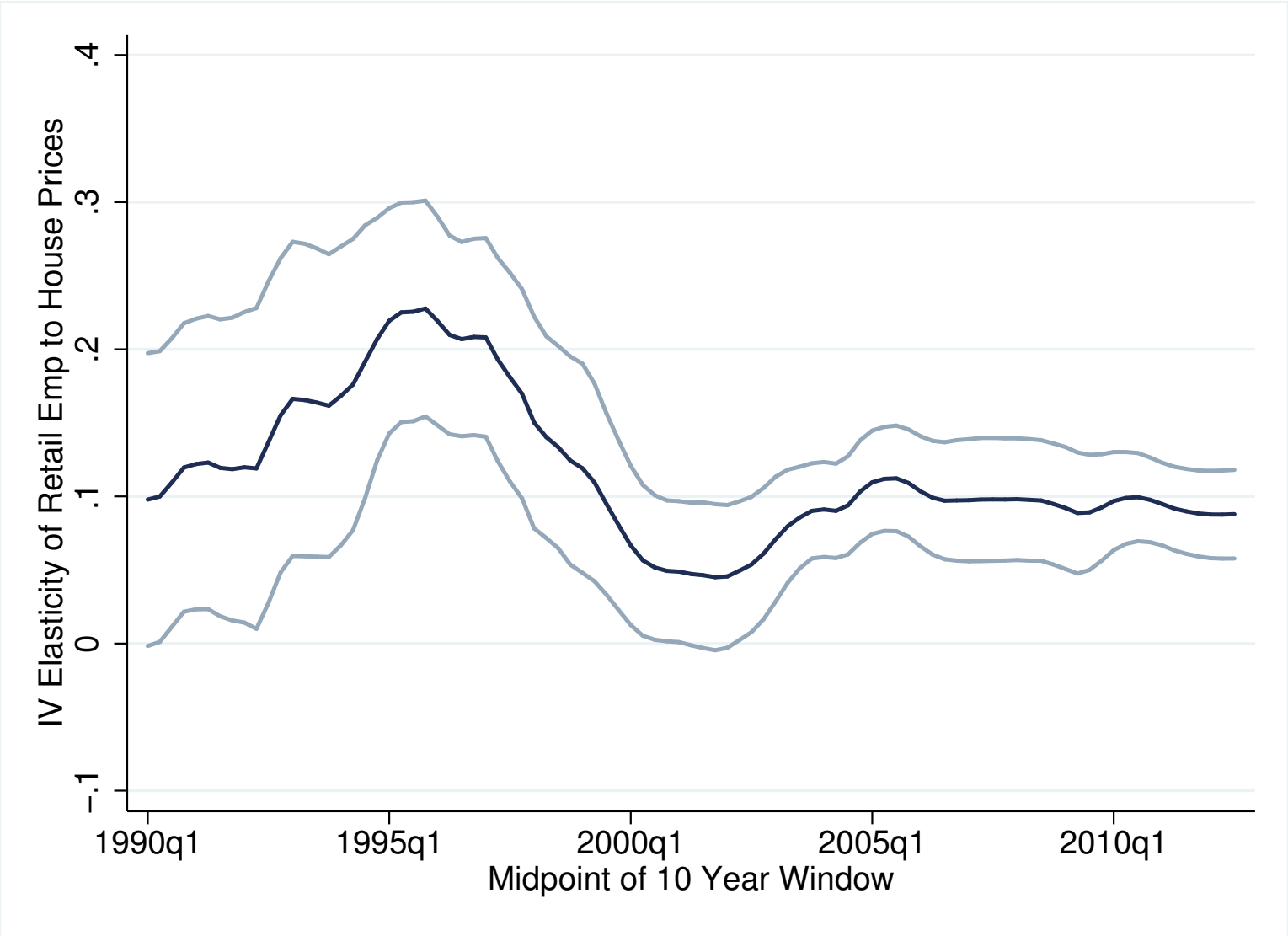
Population Weighted



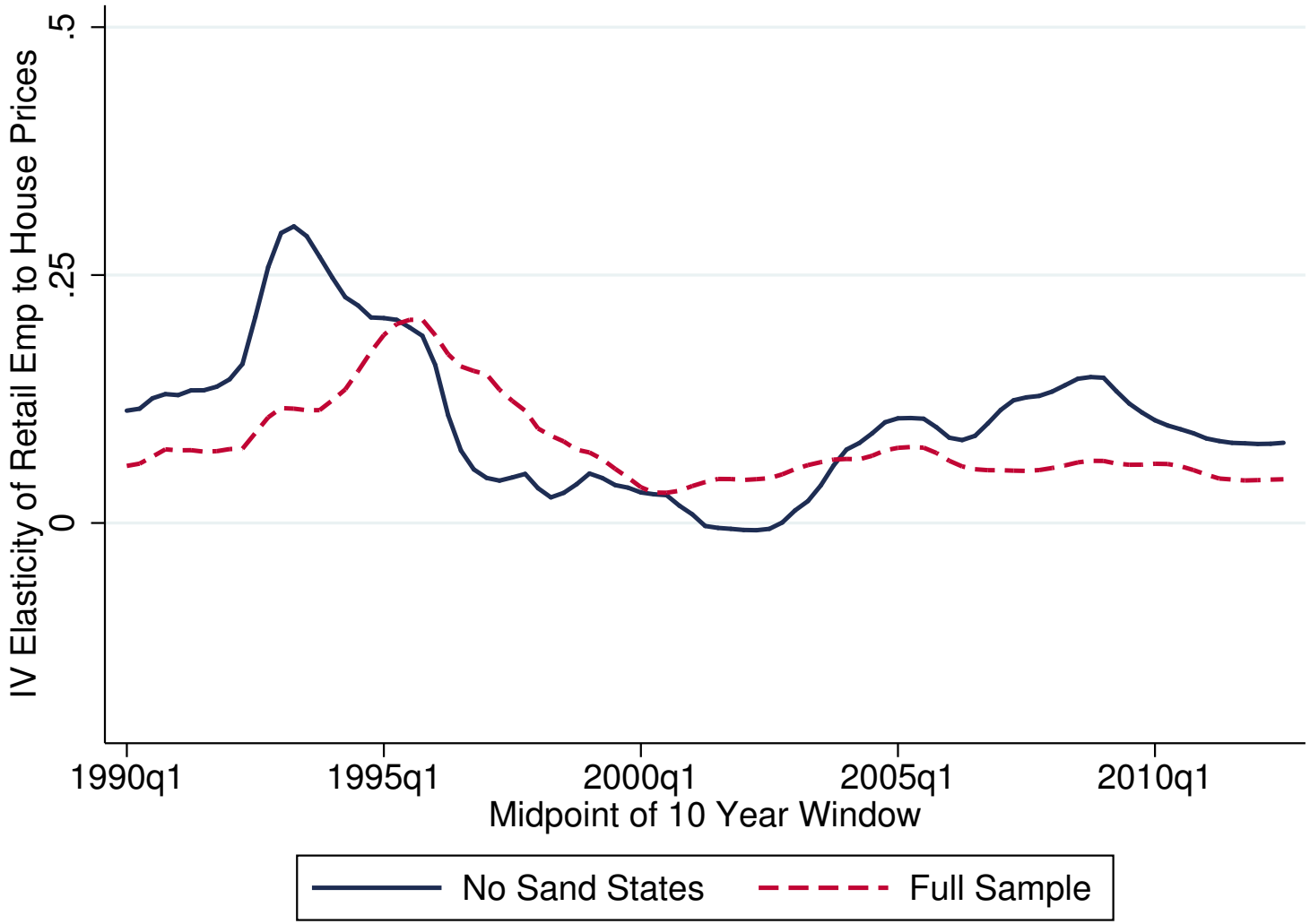
Return

Non Per Capita



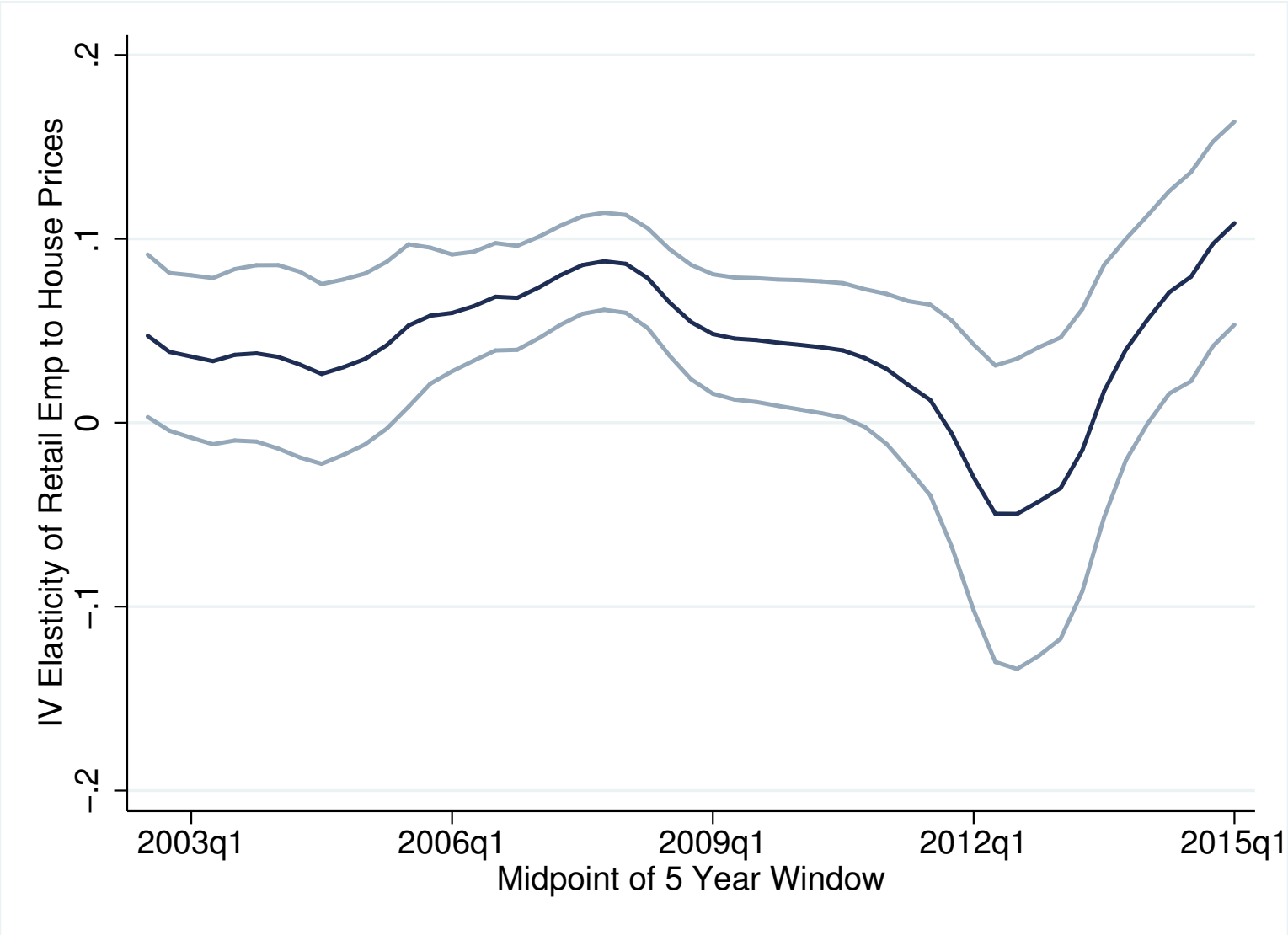
Return

Dropping Sand Sates



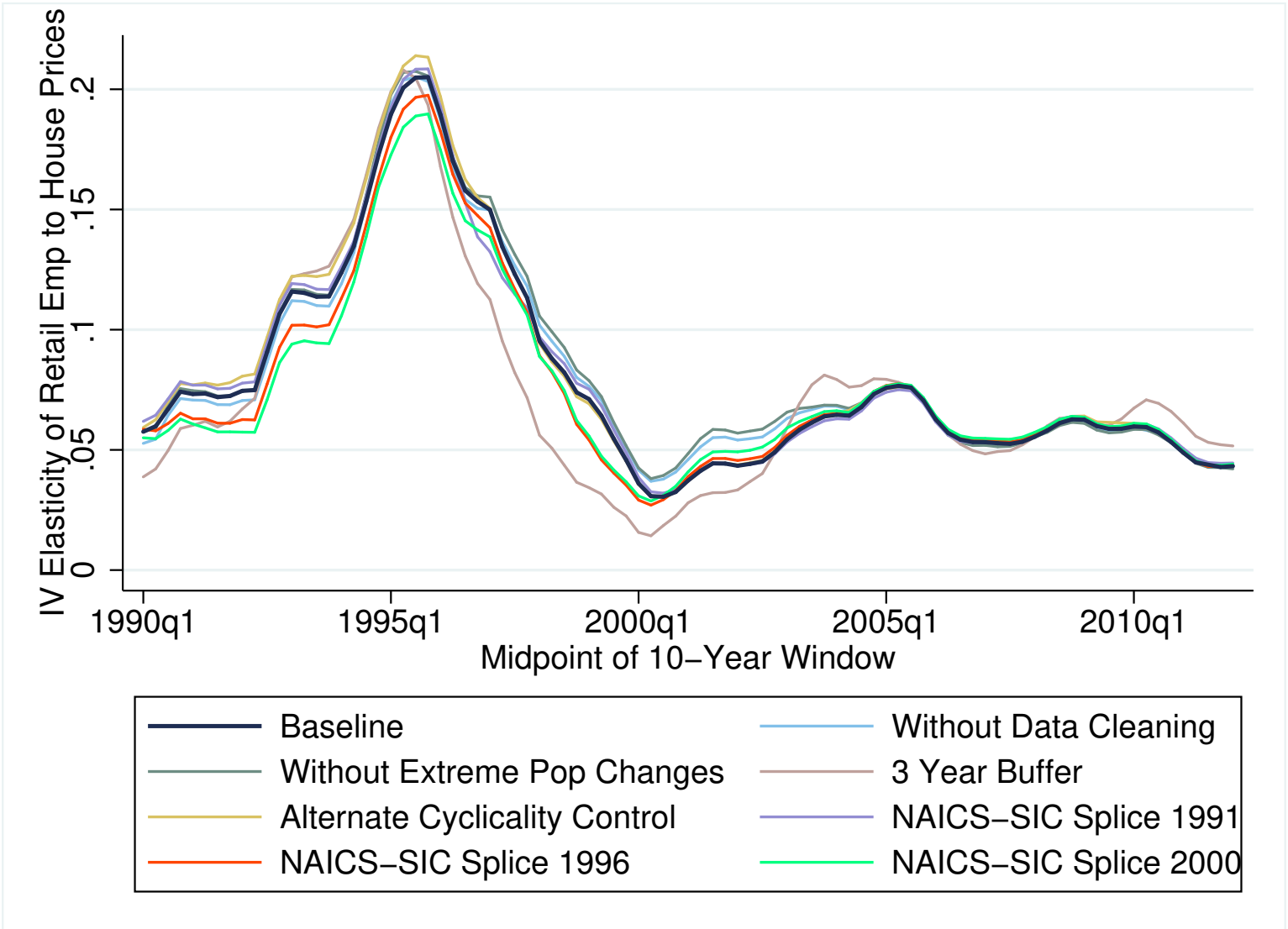
Return

5 Year Rolling Window



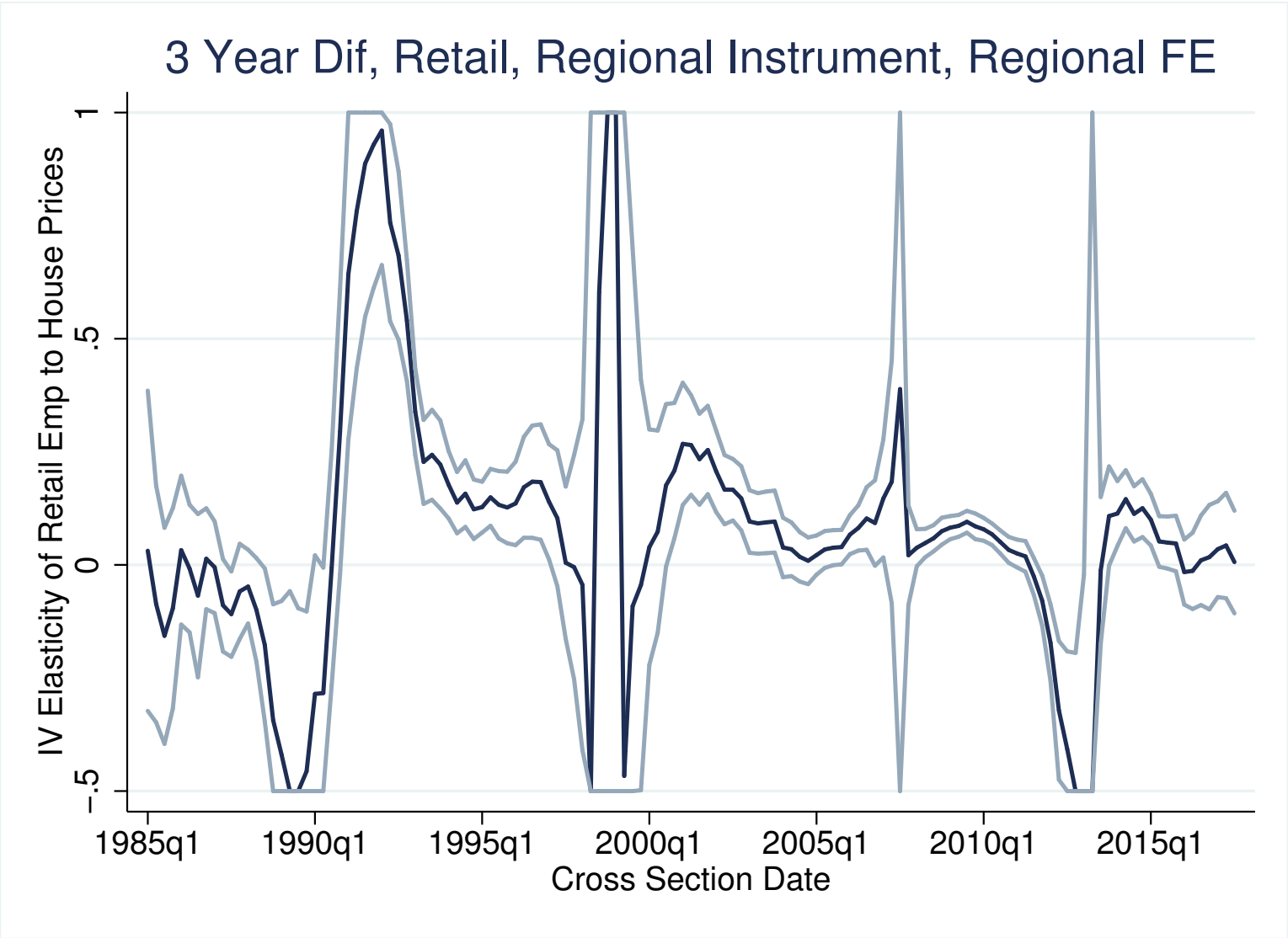
Return

Miscellaneous Other Robustness Tests



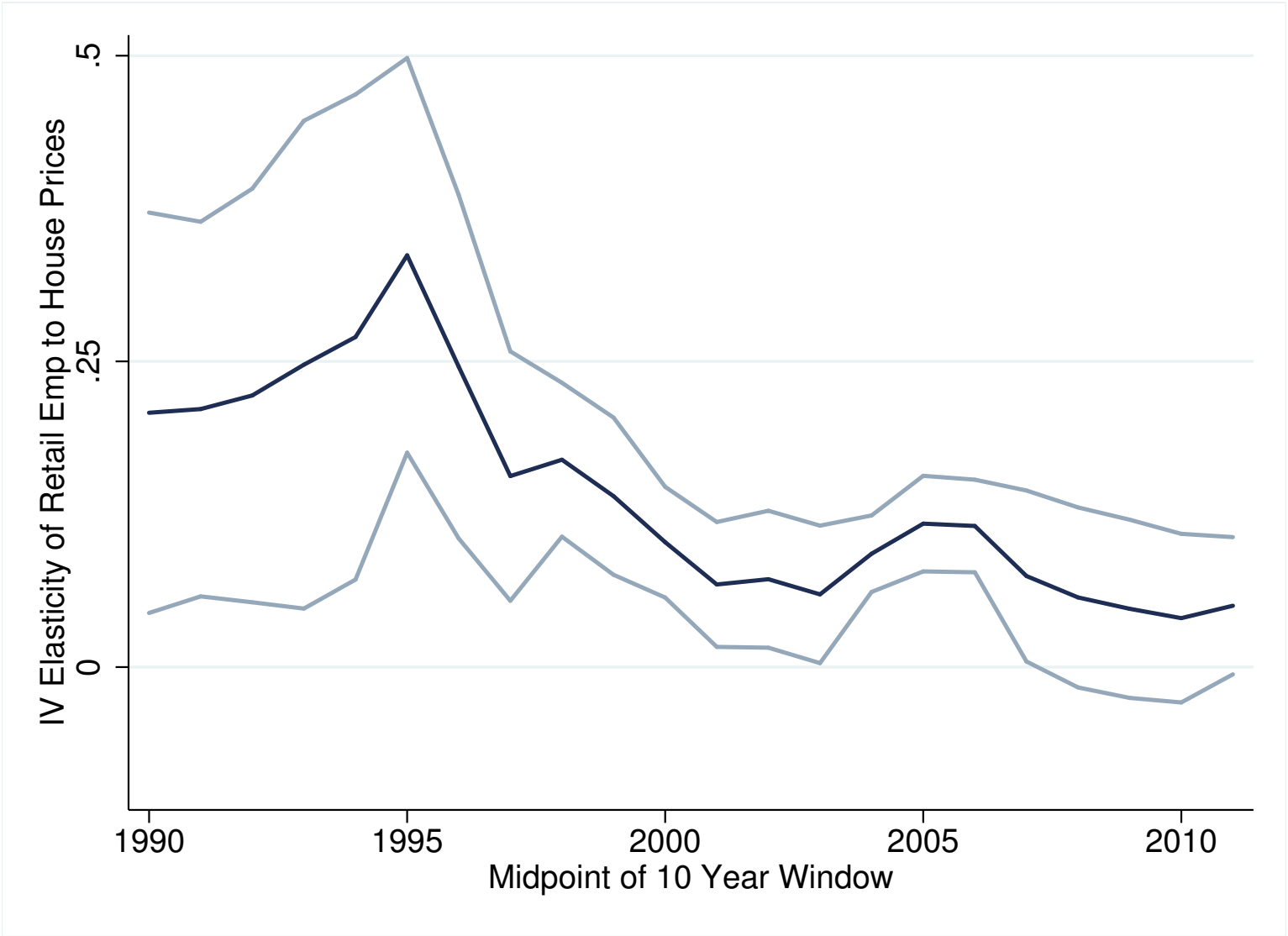
Return

Repeated Cross-Sections: 3 Year Differences



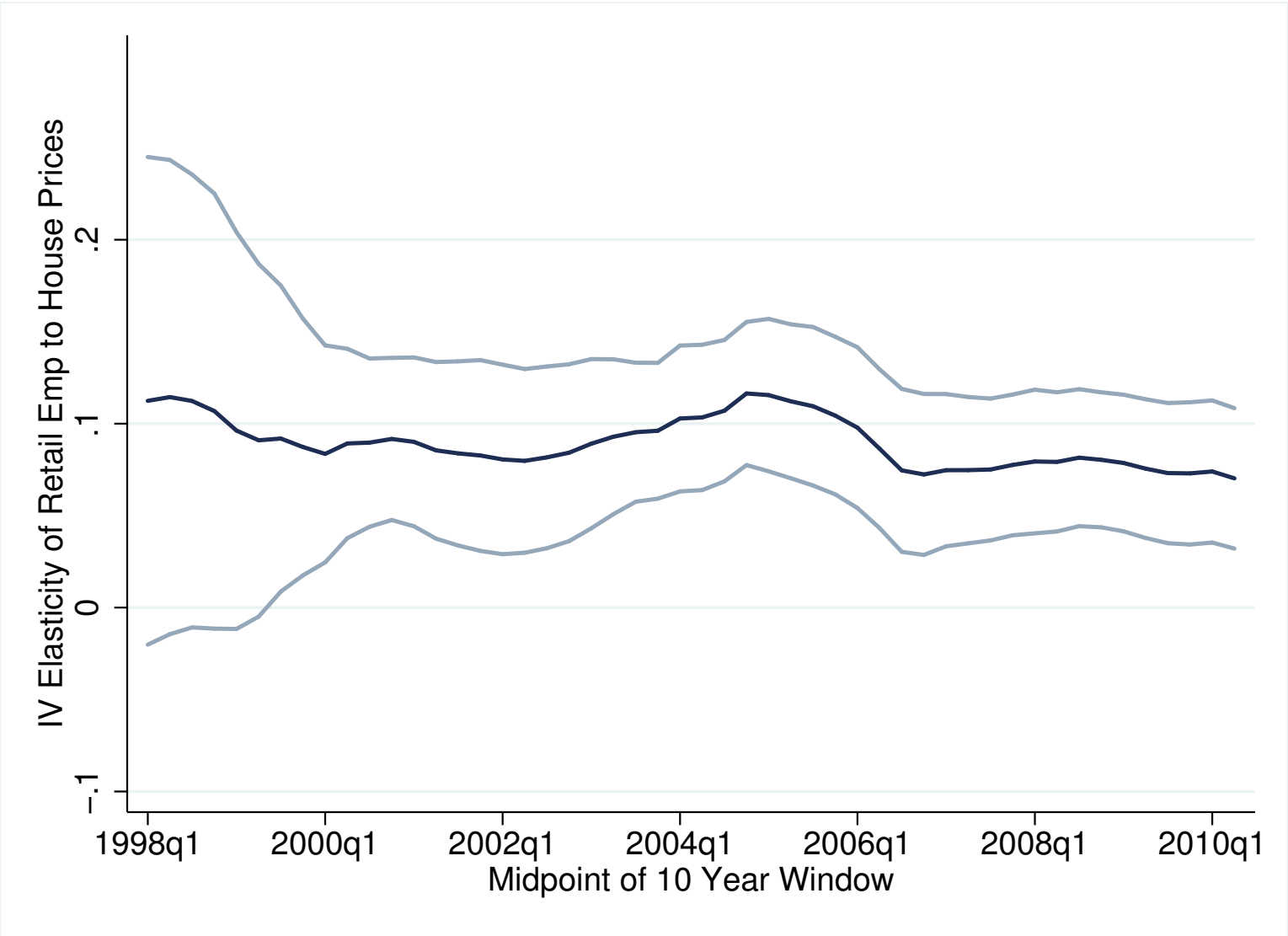
Return

CBP For Employment



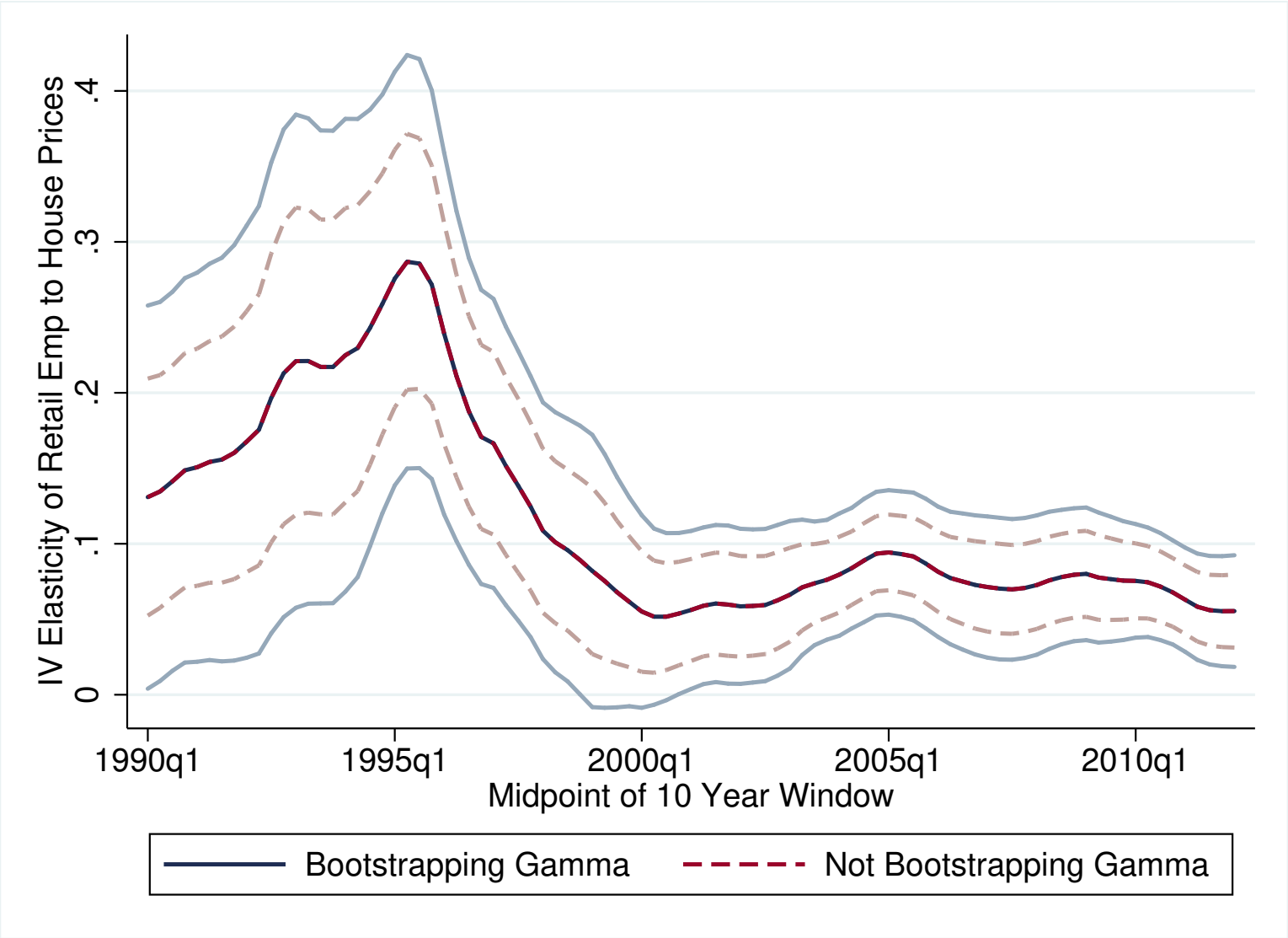
Return

FHFA Purchase Only HPI



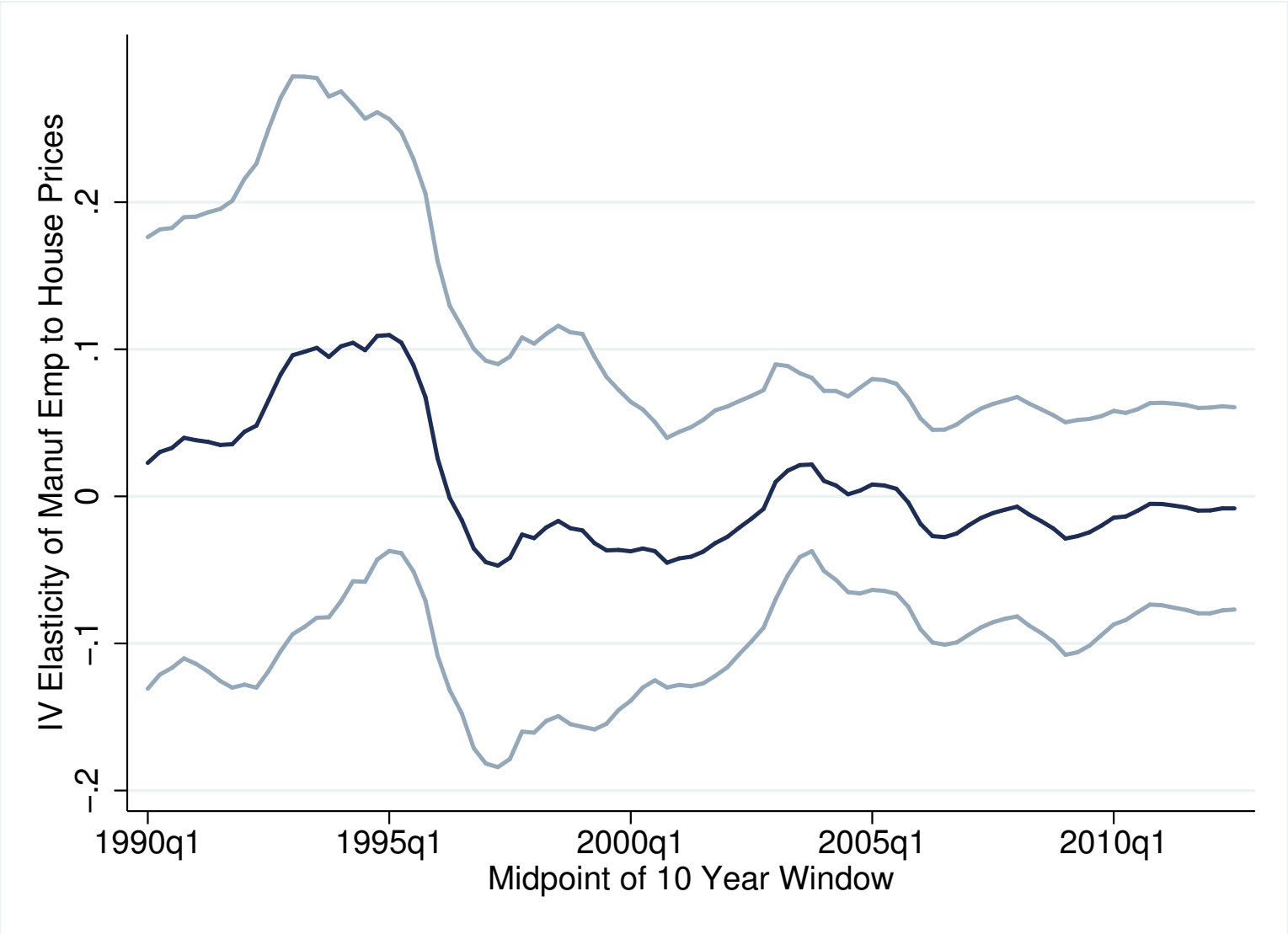
Return

Accounting For Sampling Error in γ_is



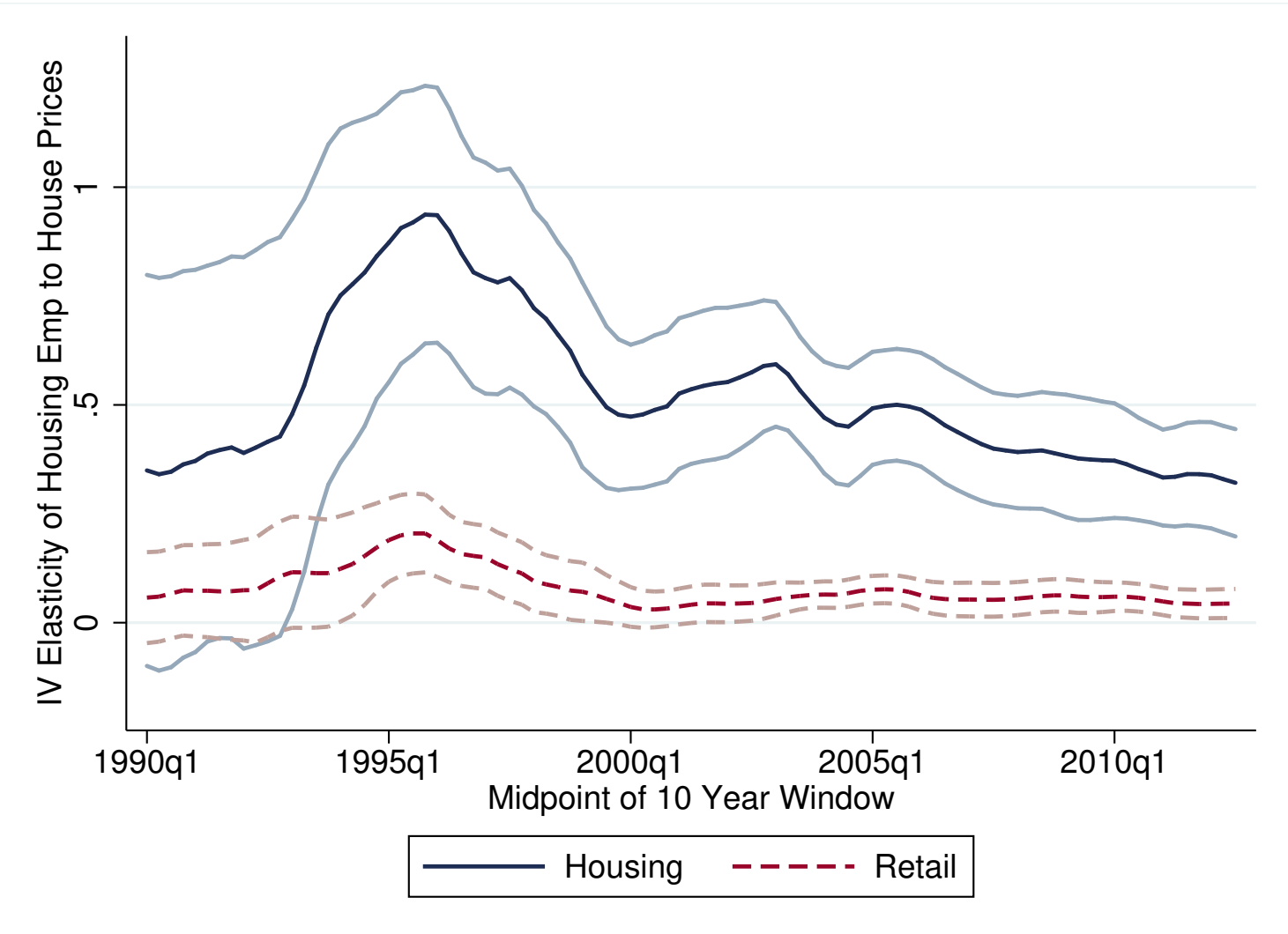
Return

Manufacturing: Imprecise Zero



Consistent with Mian and Sufi (2014) ▸ Return

Large Effects on Construction and Real Estate Employment



Construction and real estate is about 6.27% of total employment, has 0.343 elasticity. With upper bound MPC of 1, accounts for $\approx 1/6$ of overall effect. ▸ Return

Log-linearize Consumption Function

- Consumption function for city i (abstracting from dynamics):

$$c_{i,r,t} = c(p_{i,r,t}, \omega_{i,r,t}, \Omega_{r,t}, R_{r,t})$$

- Log-linearize and difference consumption function:

$$\Delta \tilde{c}_{i,r,t} = \underbrace{\phi_p}_{\beta} \Delta \tilde{p}_{i,r,t} + \underbrace{\phi_\Omega \Delta \Omega_{r,t} + \phi_R \Delta R_{r,t}}_{\xi_{r,t}} + \underbrace{\phi_\omega \Delta \omega_{i,r,t}}_{\varepsilon_{i,r,t}},$$

  where ϕ_x is the elasticity of consumption with respect to x.

- This is the consumption equation in the empirical model
- β is PE effect of house prices on consumption
- GE effects and direct effects of regional shocks absorbed by time fixed effects ($\xi_{r,t}$)

▸ Return

Log-linearized Housing Equation

- Housing demand in city i:

$$h_{i,r,t} = h(p_{i,r,t}, \omega_{i,r,t}, \Omega_{r,t}, R_{r,t})$$

- Housing supply in city i:

$$h_{i,r,t} = p_{i,r,t}^{g_i}$$

- Set supply equal to demand, log-linearize and difference:

$$\Delta p_t^i = \gamma_i \underbrace{(\psi_\Omega \Delta\Omega_{r,t} + \psi_R \Delta R_{r,t})}_{\nu_{r,t}} + \underbrace{\gamma_i (\psi_\omega \Delta\omega_{i,r,t})}_{\nu_{i,r,t}}$$

- where $\gamma_i = 1/(g_i - q_h)$

Return

Model: Preferences

- Preferences

$$\mathbb{E}\left[\sum_{t=1}^{T}\beta^{t}u(C_t,H_{t+1})+\beta^{T+1}B(W_{T+1})\right]$$

  where C is consumption, H denotes units of housing, and $B\left(W_{T+1}\right)$ is the bequest motive over terminal wealth.

- Period utility

$$u(C,H)=\frac{1}{1-\gamma}\left(C^{(\varepsilon-1)/\varepsilon}+\omega H^{(\varepsilon-1)/\varepsilon}\right)^{(1-\gamma)\varepsilon/(\varepsilon-1)}$$

  $1/\gamma=1/2$ is EIS, $\varepsilon=1.25$ is elasticity of substitution, $\omega=0.10$ is strength of preference for housing.

- Bequest motive: $B(W)=\frac{B_0}{1-\gamma}\left(W+B_1\right)^{(1-\gamma)}$
  $B_0=7.0$ captures the strength of the bequest motive and $B_1=1.24$ captures the non-homotheticity.

▸ Return

Income Process

- Annual log income:

$$y = \underbrace{\ell}_{\text{deterministic lifecycle}} + \underbrace{z}_{\text{persistent}} + \underbrace{\xi}_{\text{transitory}} .$$

- Lifecycle component:
  - Smoothed median income by age in 2001 SCF.
- Persistent component:

$$z' = \rho z + \eta$$

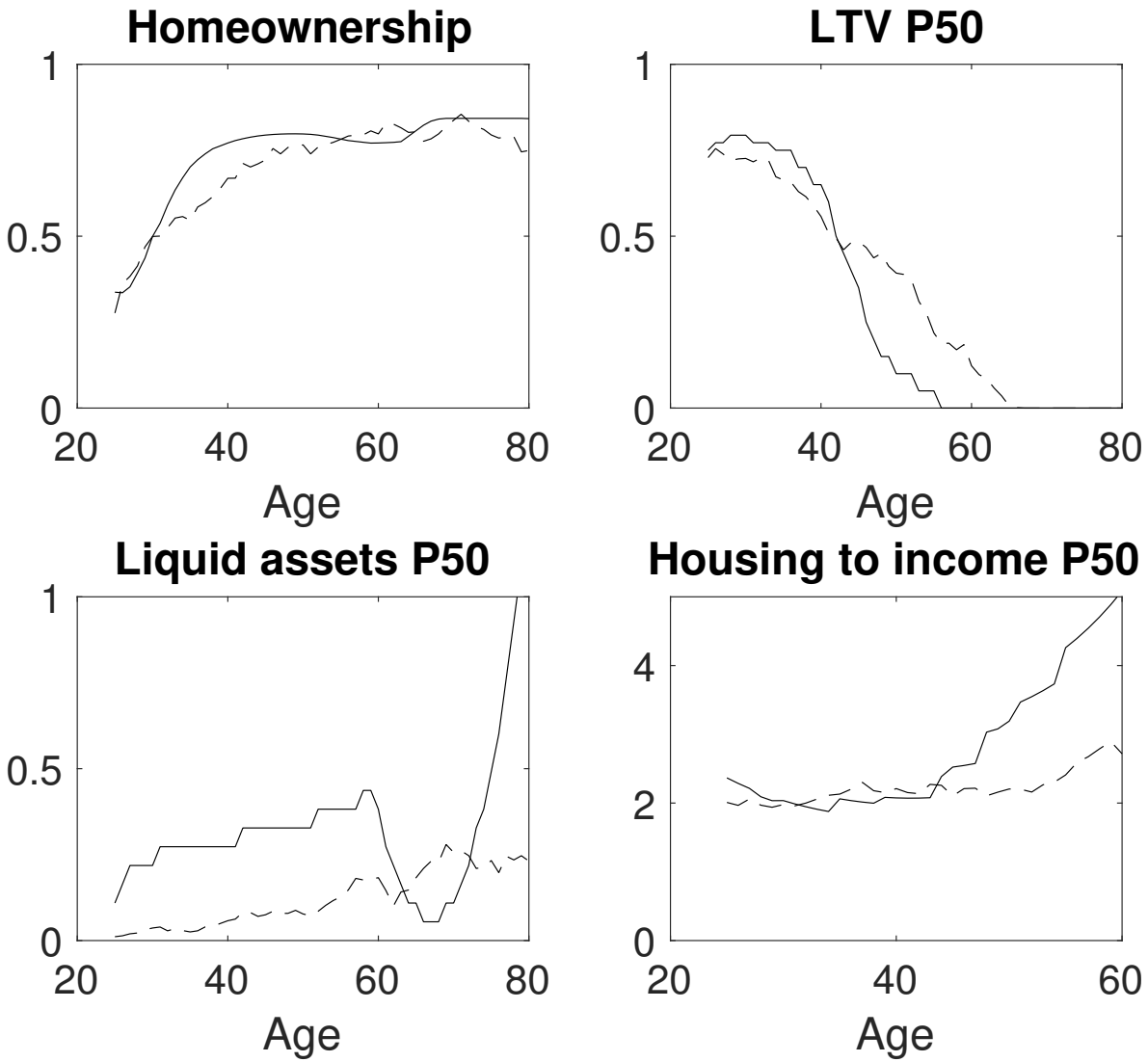
  - $\rho = 0.97$ for nearly linear increase over the lifecycle in the cross-sectional variance of log income
  - η drawn from mixture of two normals with parameters to match moments of earnings dynamics from SSA data reported by Guvenen et al. (2016)
- Transitory component: mimics i.i.d. draws from the distribution of weeks worked in 2001 (March 2002 CPS). Return

External Calibration

- Risk aversion parameter of $\gamma = 2$.
- Elasticity of substitution between housing and other consumption of $\varepsilon = 1.25$ (Piazzesi et al. 2007).
- Transaction costs:
  - Selling 6%
  - Buying 1%
- Borrowing limits:
  - "Conforming" loan up 80% LTV
  - "Non-conforming" loan up to 90% LTV
- Interest rates:
  - Liquid return (real) 1%
  - Mortgage rate 4%
  - Interest rate penalty on non-conforming loan rises to 80bps at 90% LTV (12% marginal rate after 80% LTV)

▸ Return

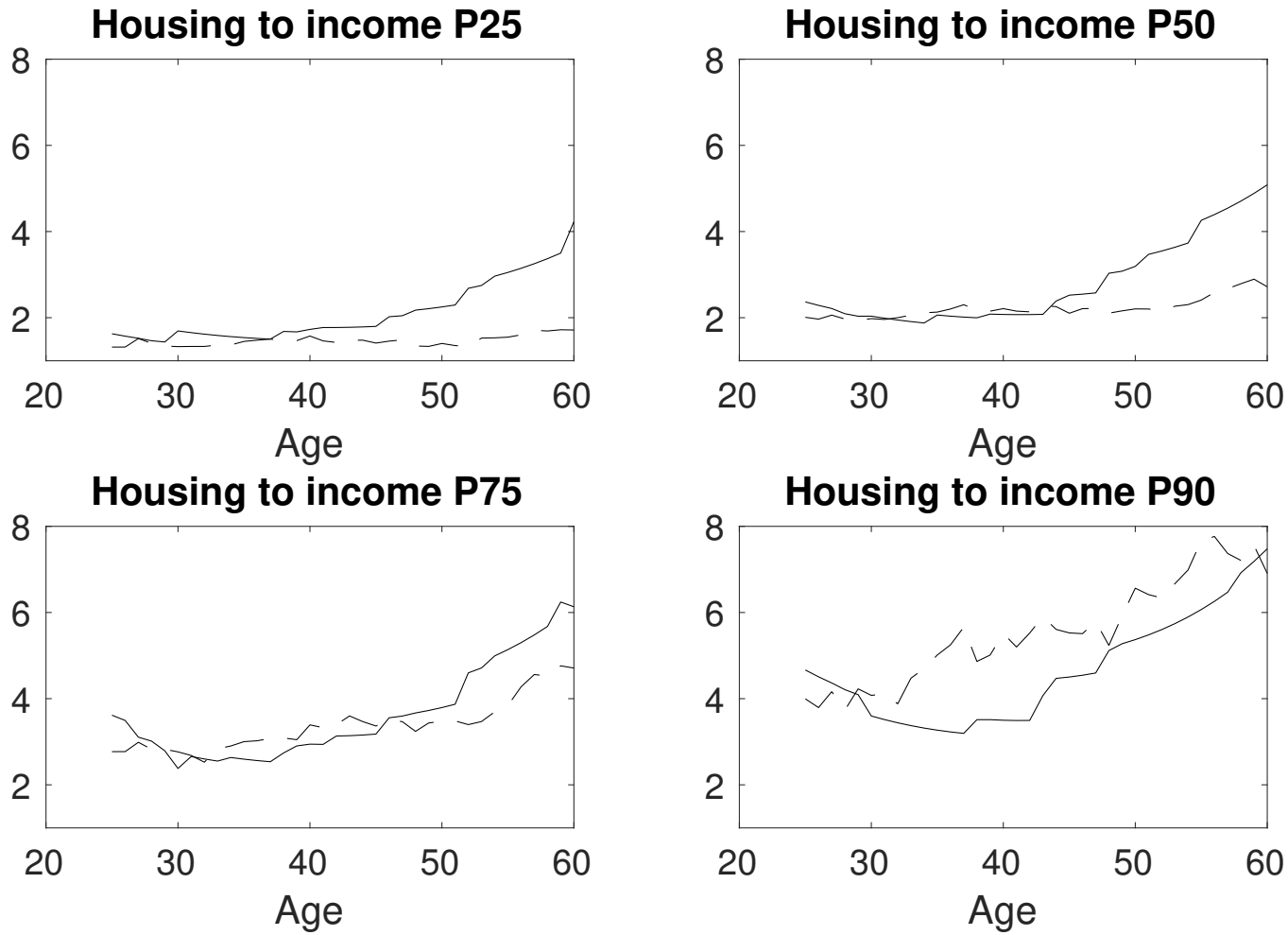
Calibration Fit



Solid line: Model; Broken line: Data.

▸ Return

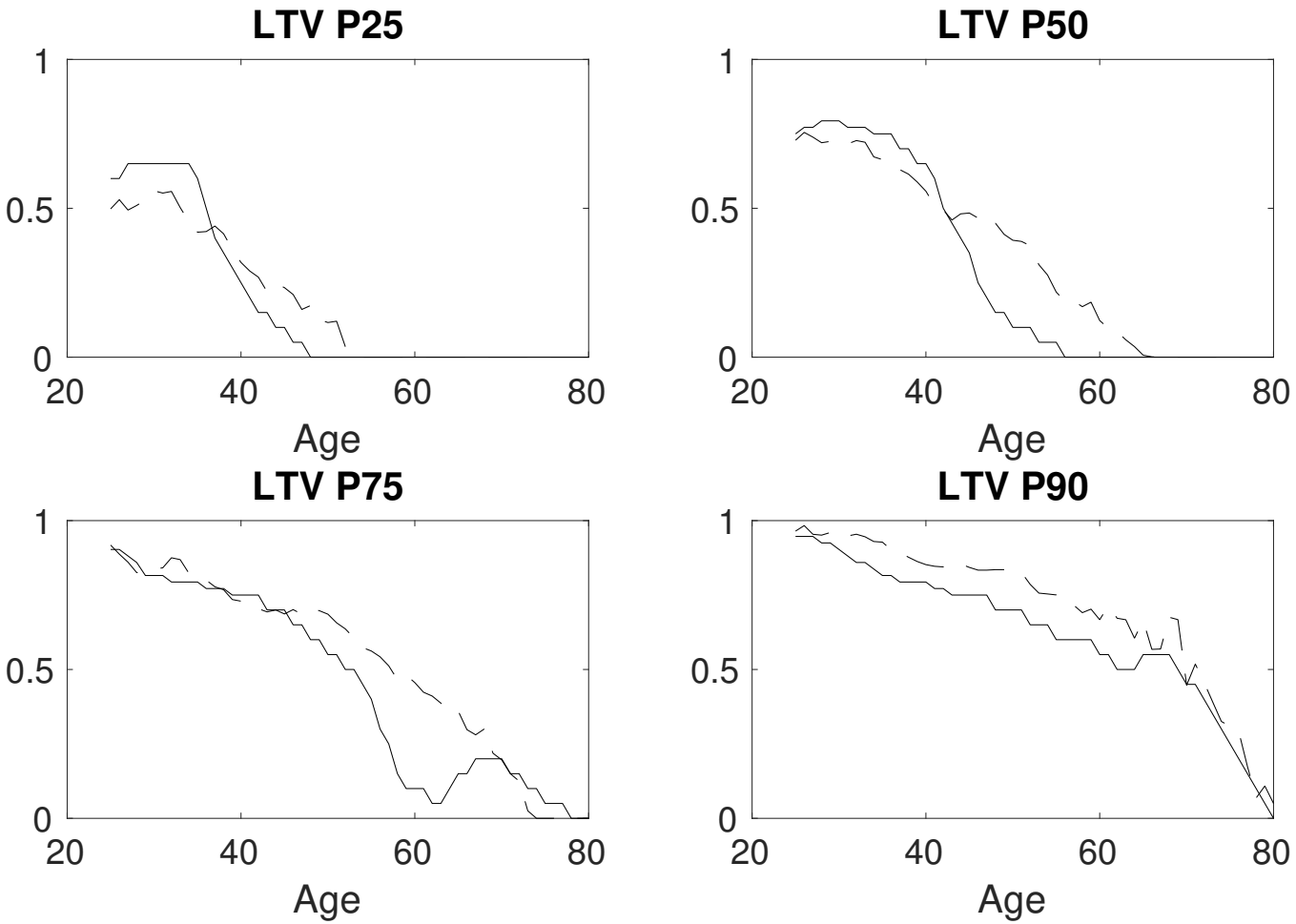
Calibration: Housing to Income



Solid line: Model; Broken line: Data.

Return

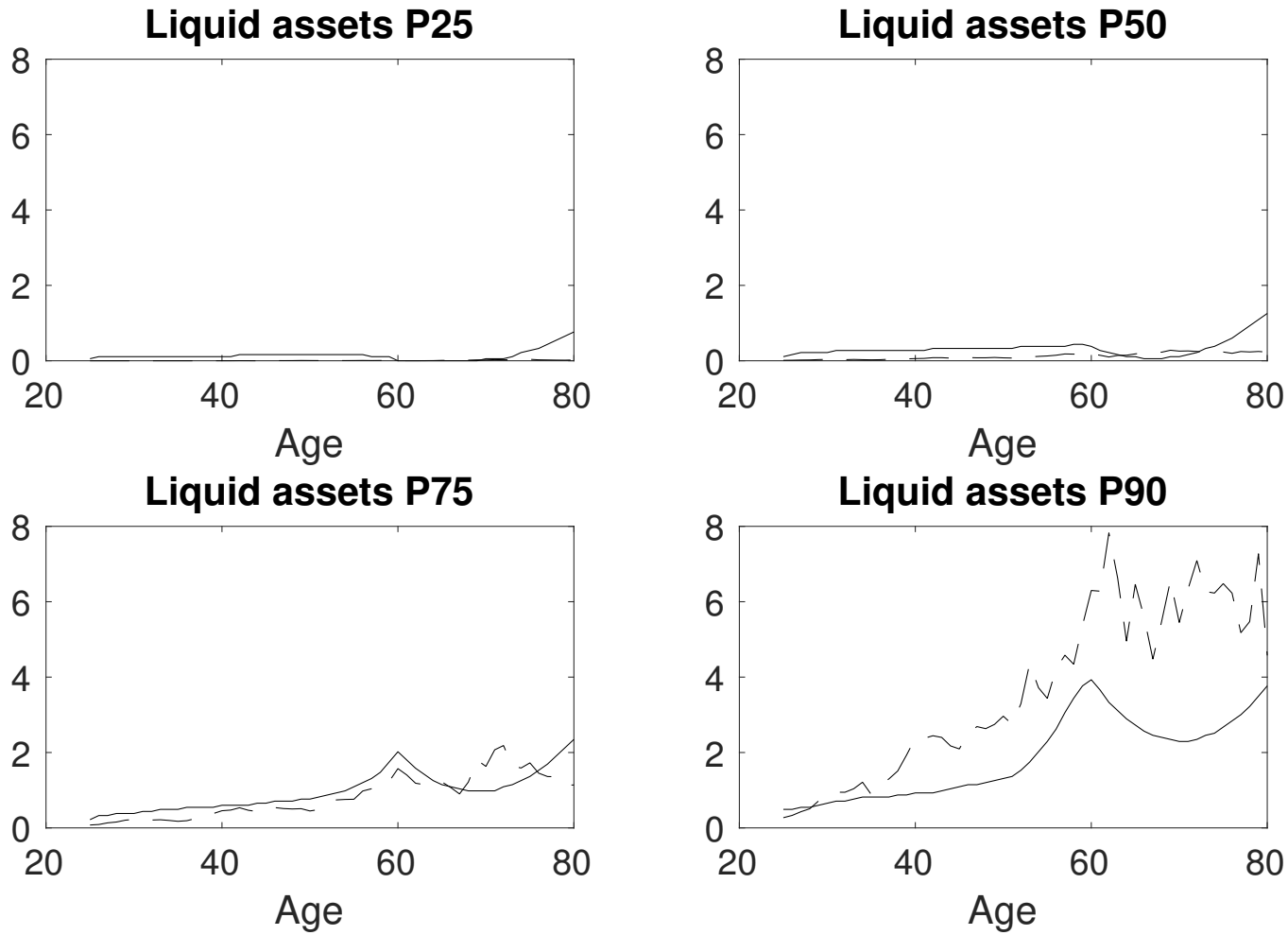
Calibration: LTV



Solid line: Model; Broken line: Data.

Return

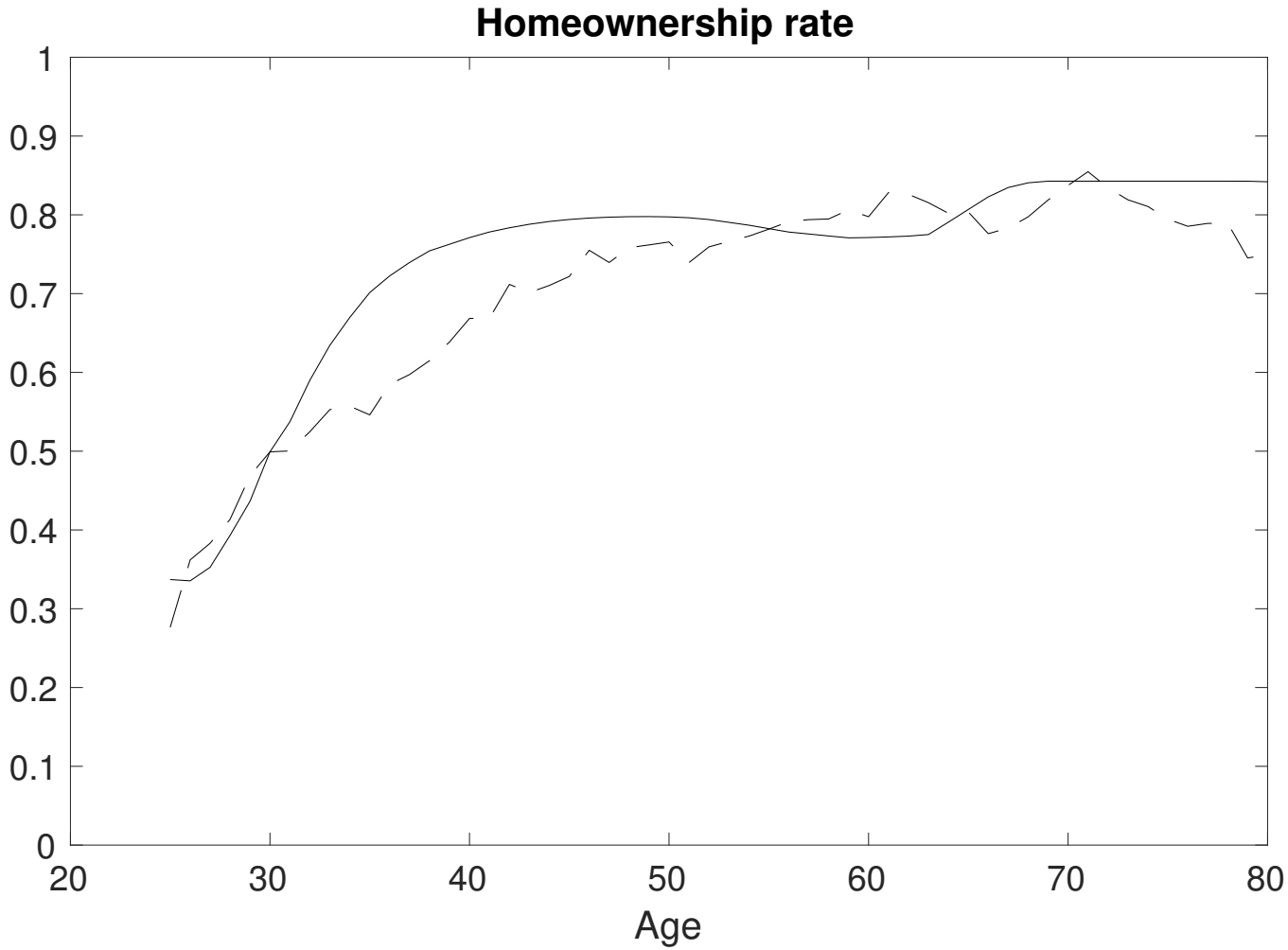
Calibration: Liquid Assets



Solid line: Model; Broken line: Data.

▸ Return

Calibration: Homeownership Rate



Solid line: Model; Broken line: Data.

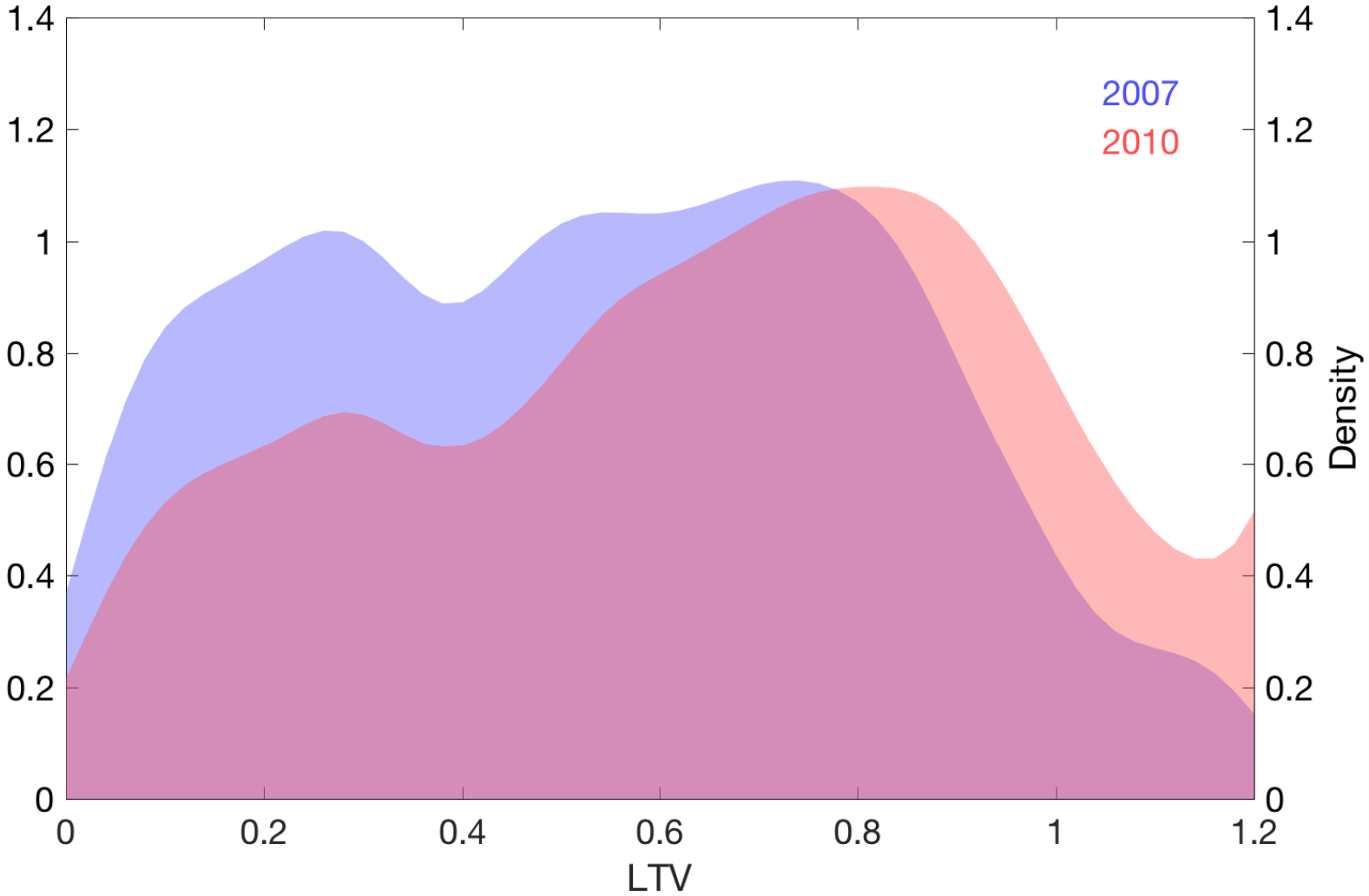
Return

Target for Refinancing Rate

- In practice some refinancing activity motivated by change in interest rates not liquidity needs.
  - But in model we have constant mortgage interest rates so we do not use the raw refinancing rate.
- We target liquidity motivated refinancing rate, which we construct using the work of Deng et al. (2000).
  - Deng et al. estimate a reduced-form model of mortgage refinancing that controls for the effect of changing interest rates.
  - Their model allows for heterogeneity in prepayment behavior.
  - We simulate a population of mortgage borrowers from their model without changes in interest rates.
  - Calculate the share of mortgages refinanced in a given year.

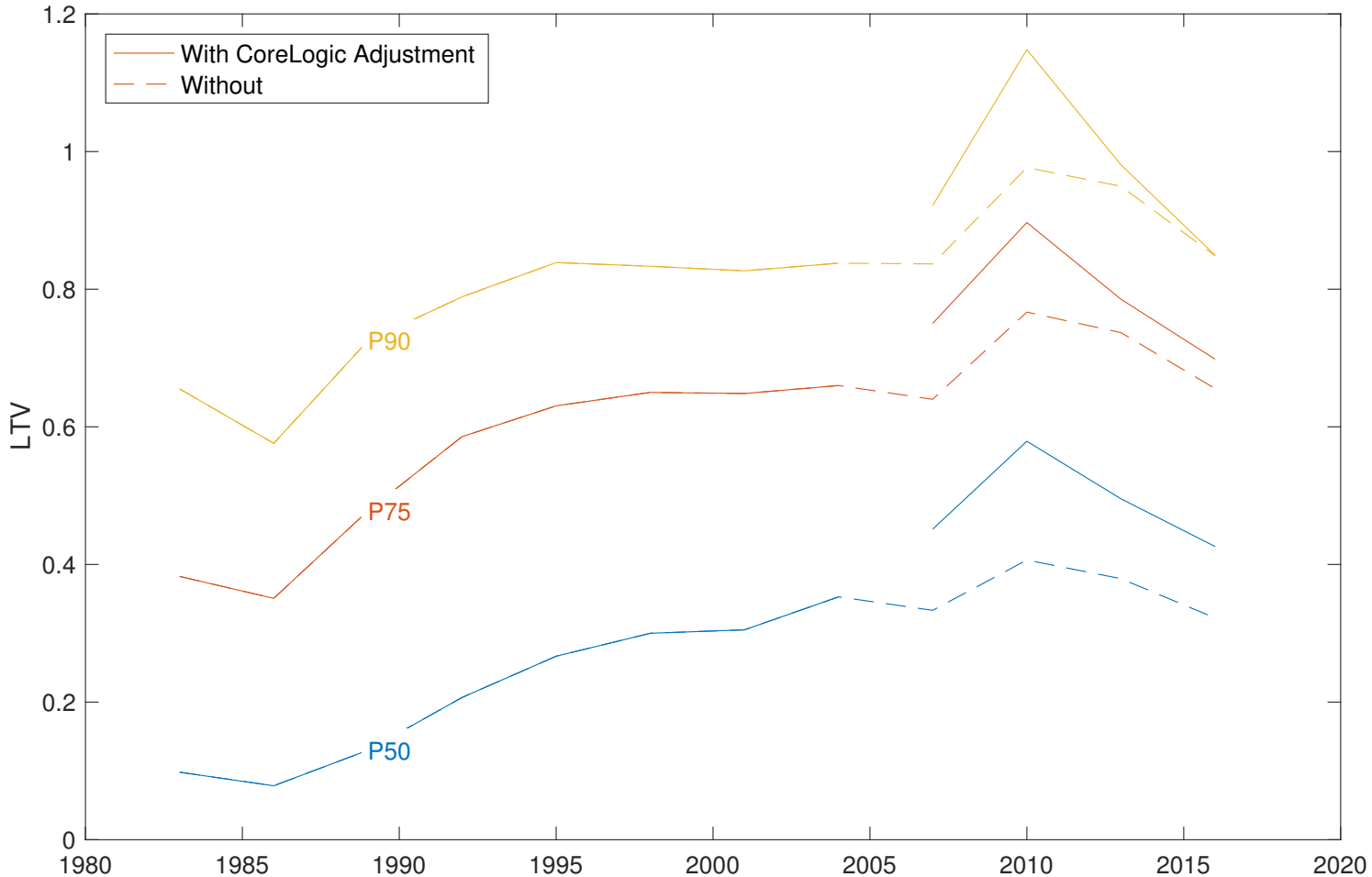
Return

Changes in LTV: Great Recession



- Dramatic increase in leverage 2007-2010 Return
- Conventional wisdom: Important for housing wealth effect in Great Recession

Great Leveraging



Return

Intuition for Housing Wealth Effect

1. $\beta < R^{-1} \Rightarrow$ High MPC out of wealth.
2. Increase in house prices raises ability to borrow today and increases implicit rent in the future.
   - With incomplete markets the two do not offset
3. When house prices rise, people substitute away from housing.
4. Life-cycle effect: plan to sell/downsize when old.
   - Added wealth more than offsets implicit rent for many households.

▸ Return

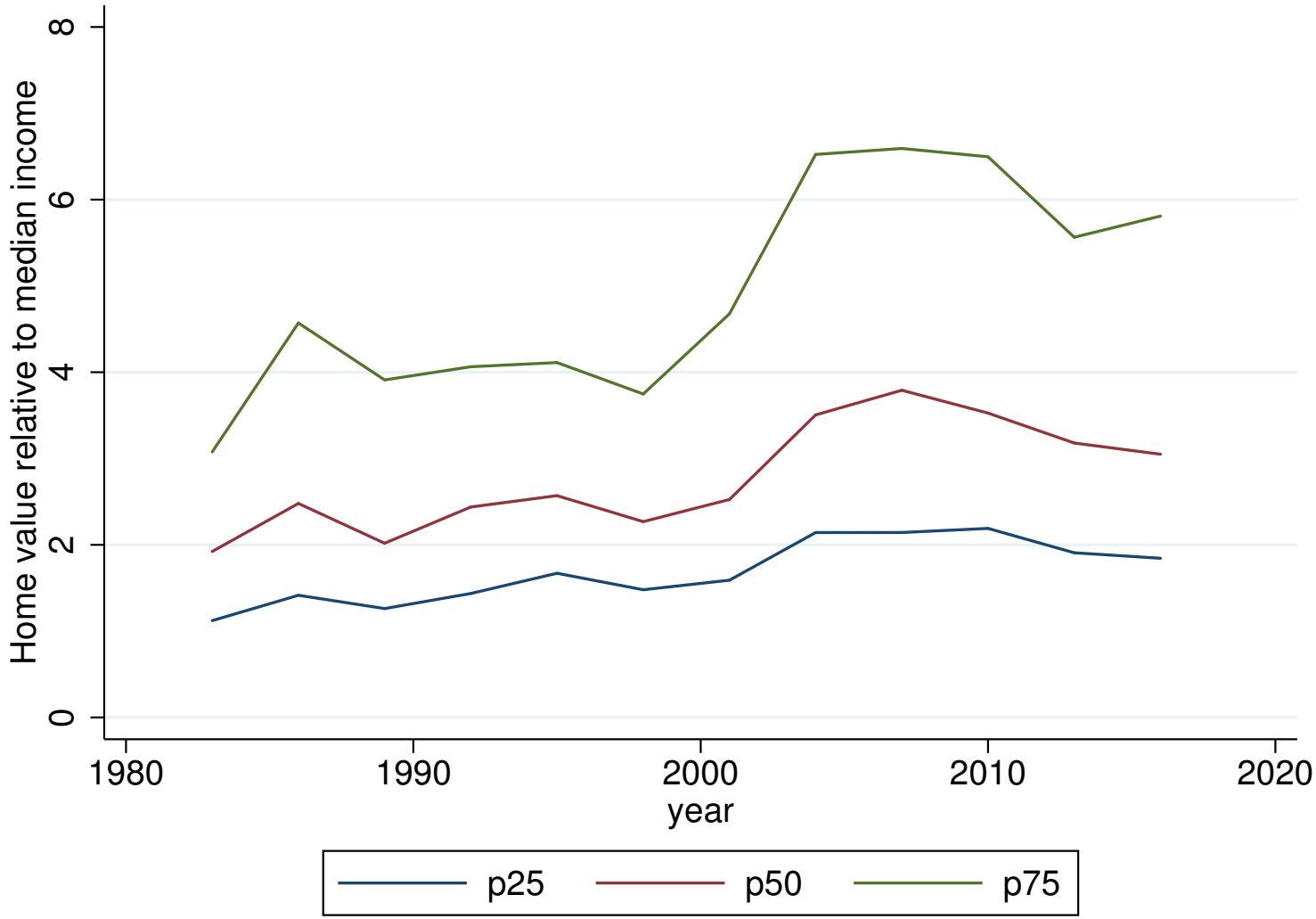
Decomposing Changes in the Distribution of Wealth

Example using LTV (analogous for Home Value):

- Start with SCF data from 2001.
- For each observation, replace the LTV using $F_t^{-1}\left(F_{2001}(\mathrm{LTV}_{2001})\right)$
- Where $F_t(\cdot)$ is the CDF of the marginal distribution of LTV for year t.
- In words, we use the data from 2001, but replace the marginal distribution of LTV with the one observed in year t keeping the ordering of LTV values the same.

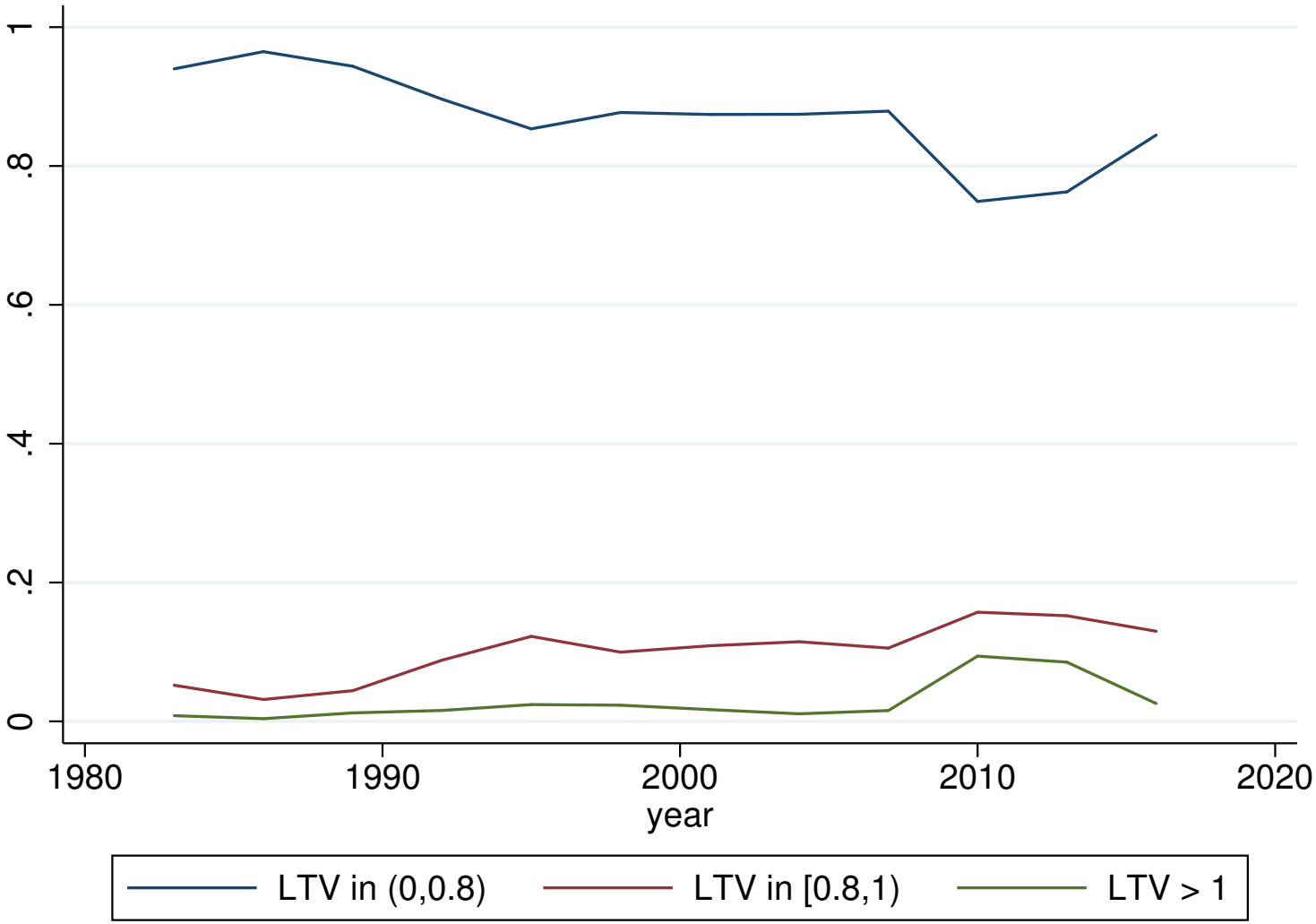
▸ Return

Home Values



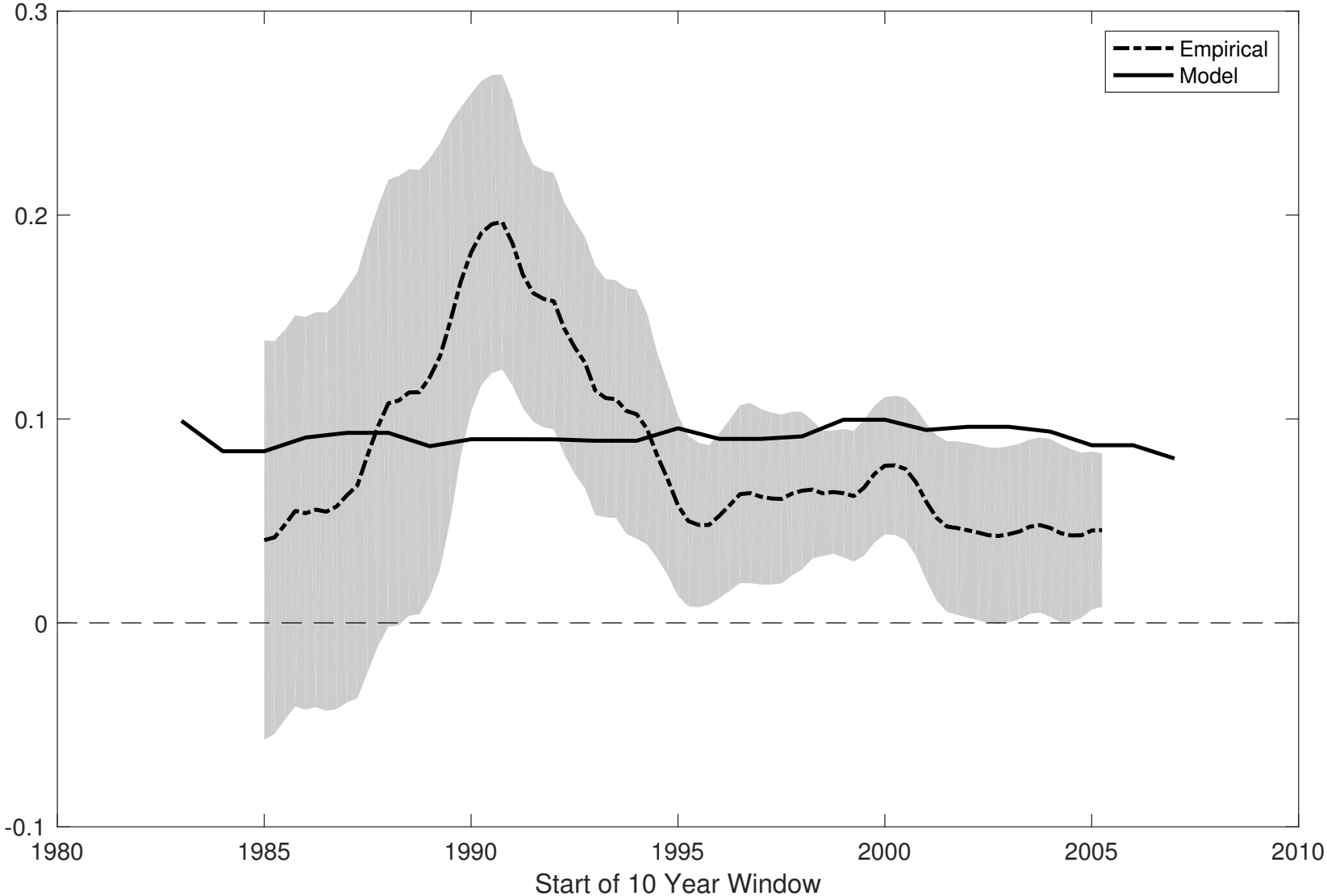
Return

LTV Percentiles



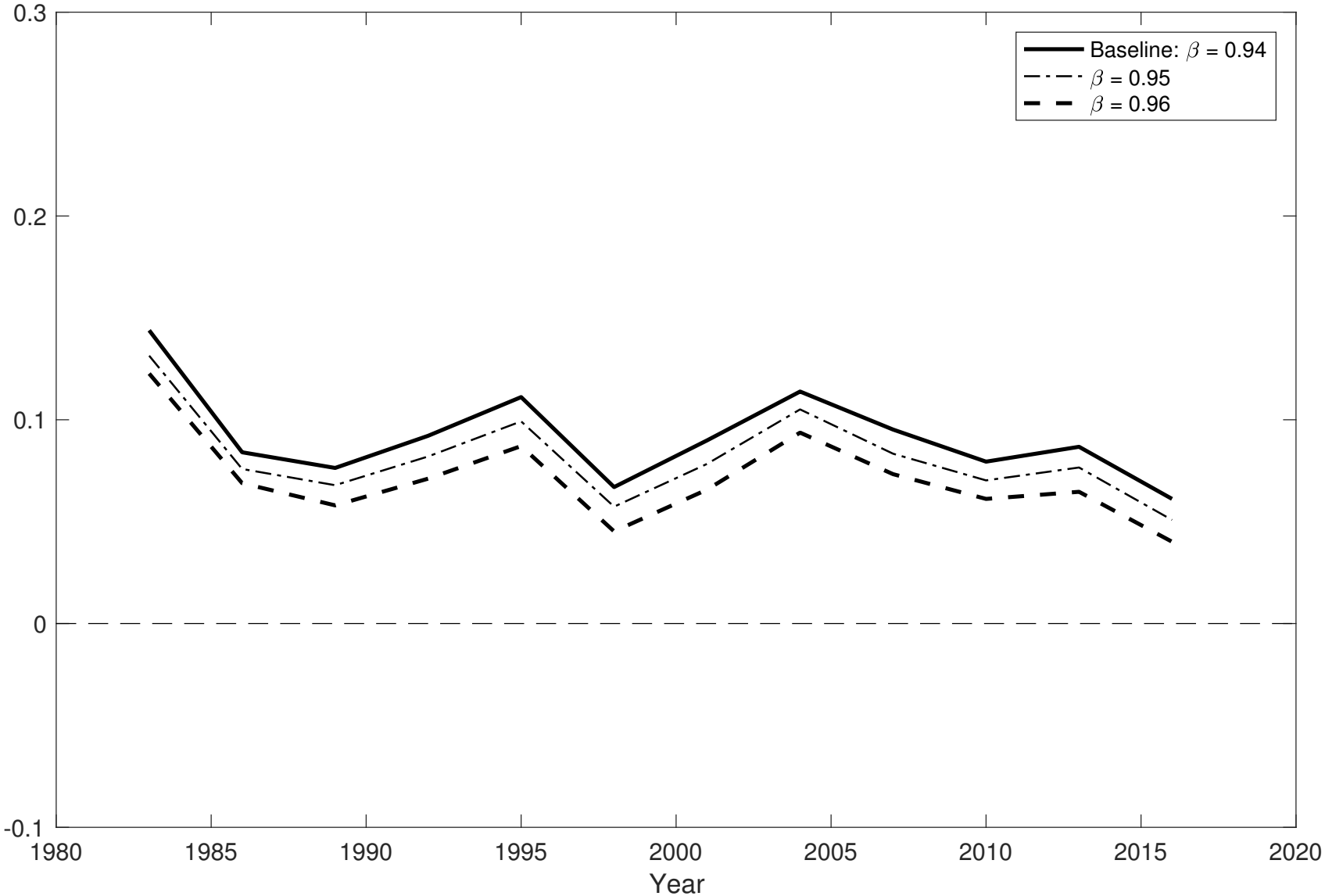
Return

Model vs. Data



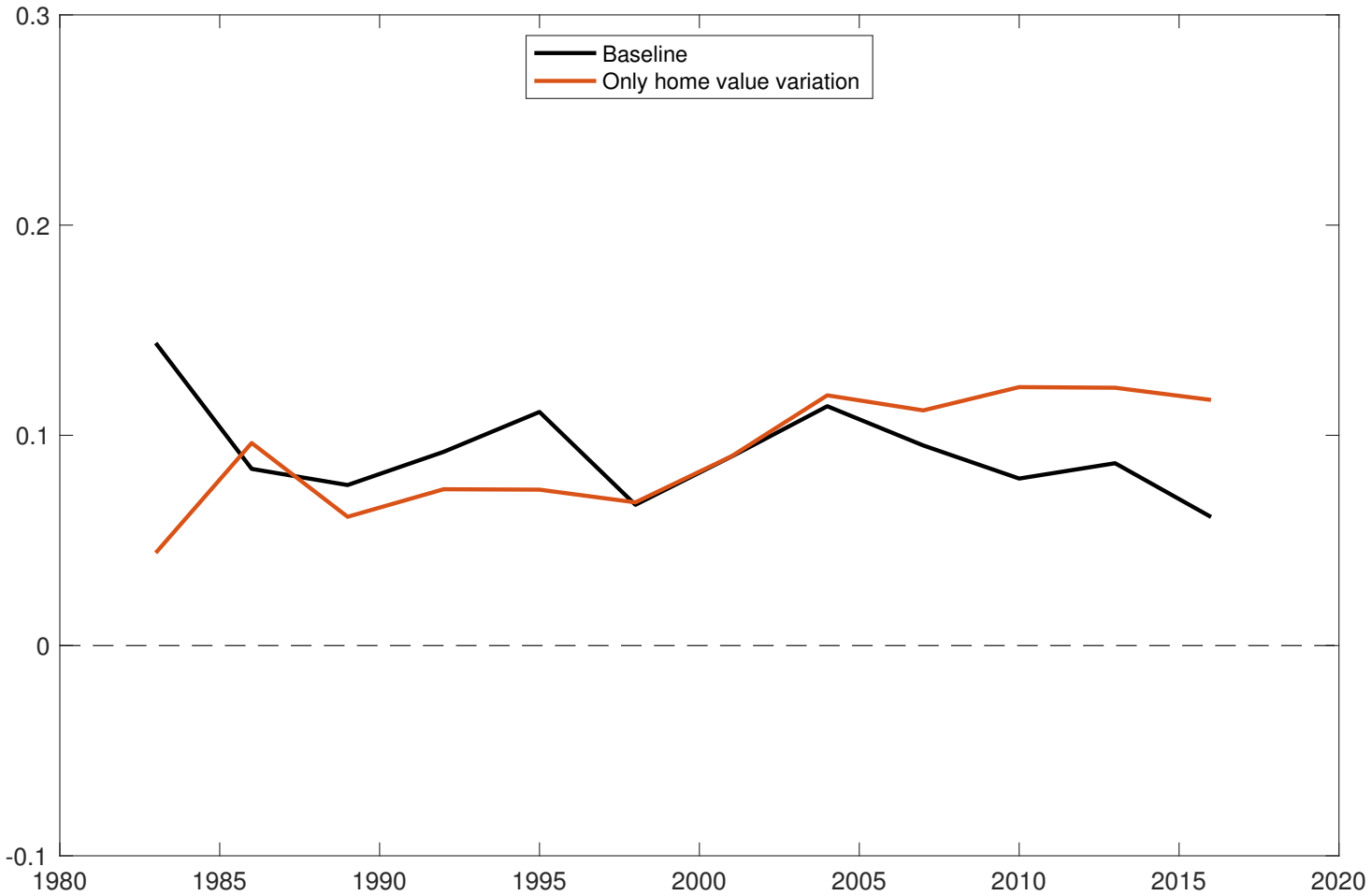
Return

Discount Rate and Housing Wealth Elasticity



Return

What Does Matter? Home Prices



- Counterfactual: Only marginal distribution of home values changes over time.
- Effect of house prices consistent with Berger et al. (2017).

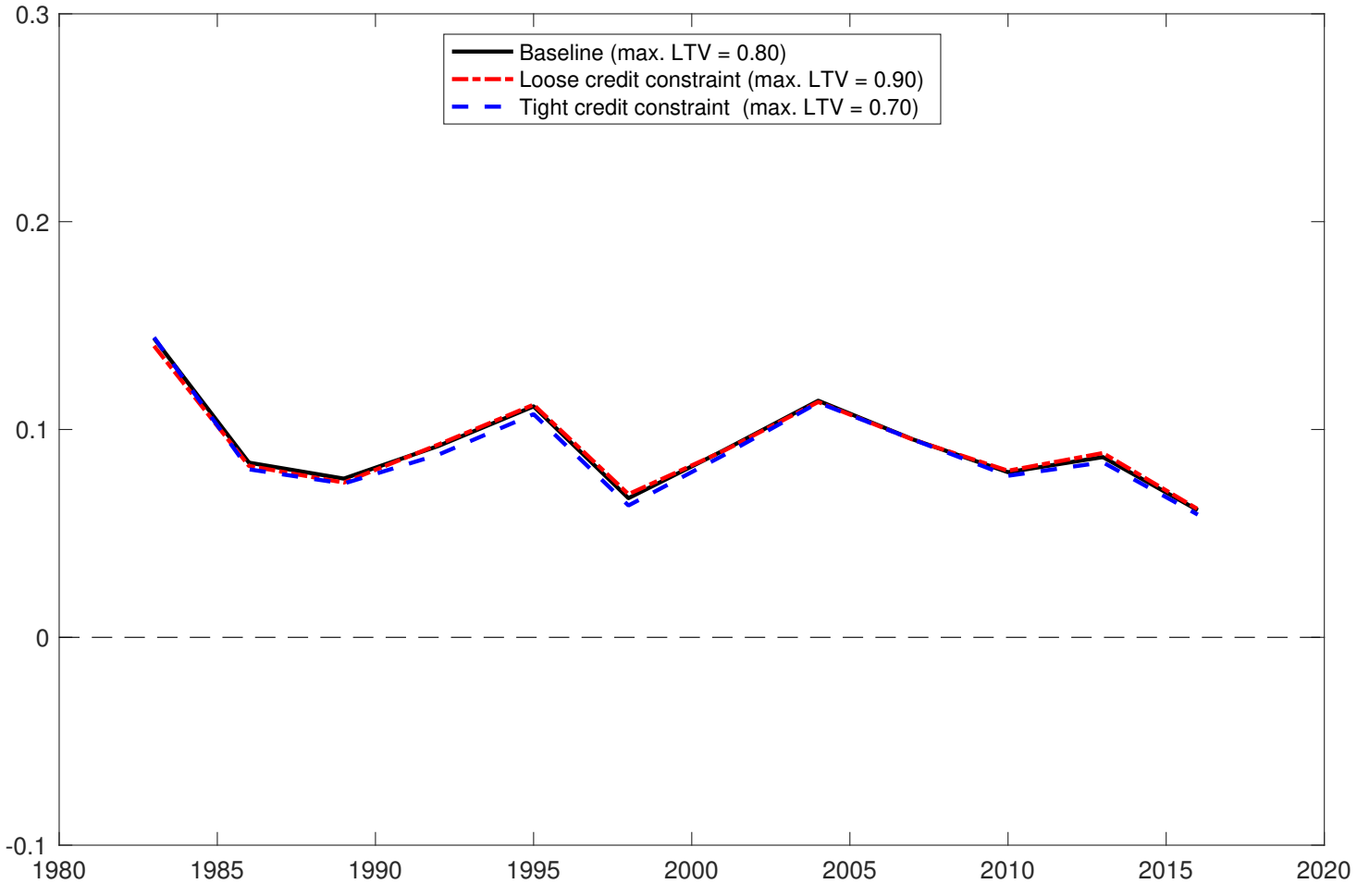
▸ Home Values ▸ Return

Credit Constraints

- Credit constraints also have little effect on aggregate elasticity
  - Presumably very important for *level* of consumption, just not *sensitivity* of response.
  - Also important for variation in elasticity across individuals
- Intuition:
  - Most of wealth effect driven by large number of households below 60% LTV.
  - For those above, mass moving into hump and past hump have offsetting effects.

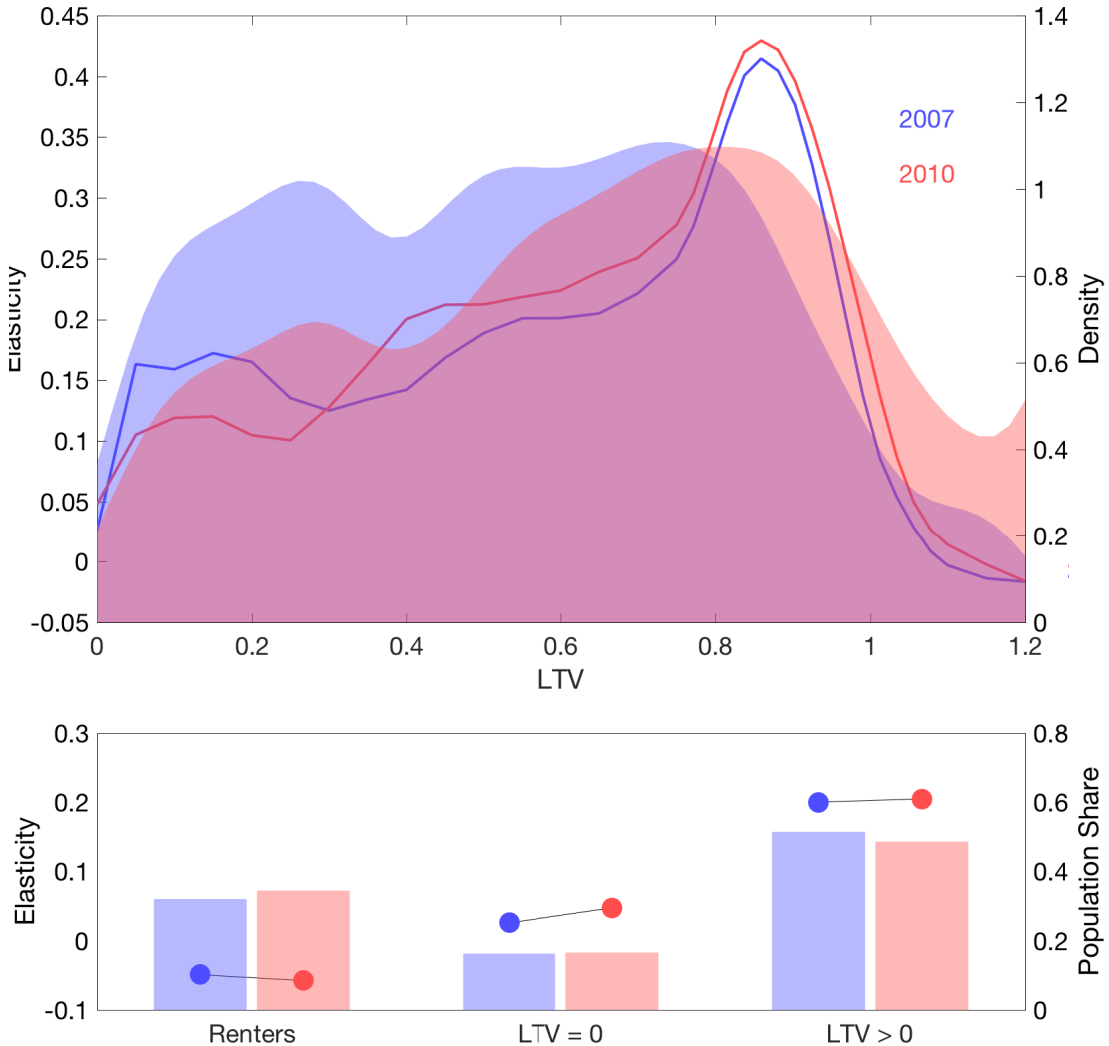
▸ Return

Credit Constraints and Elasticity



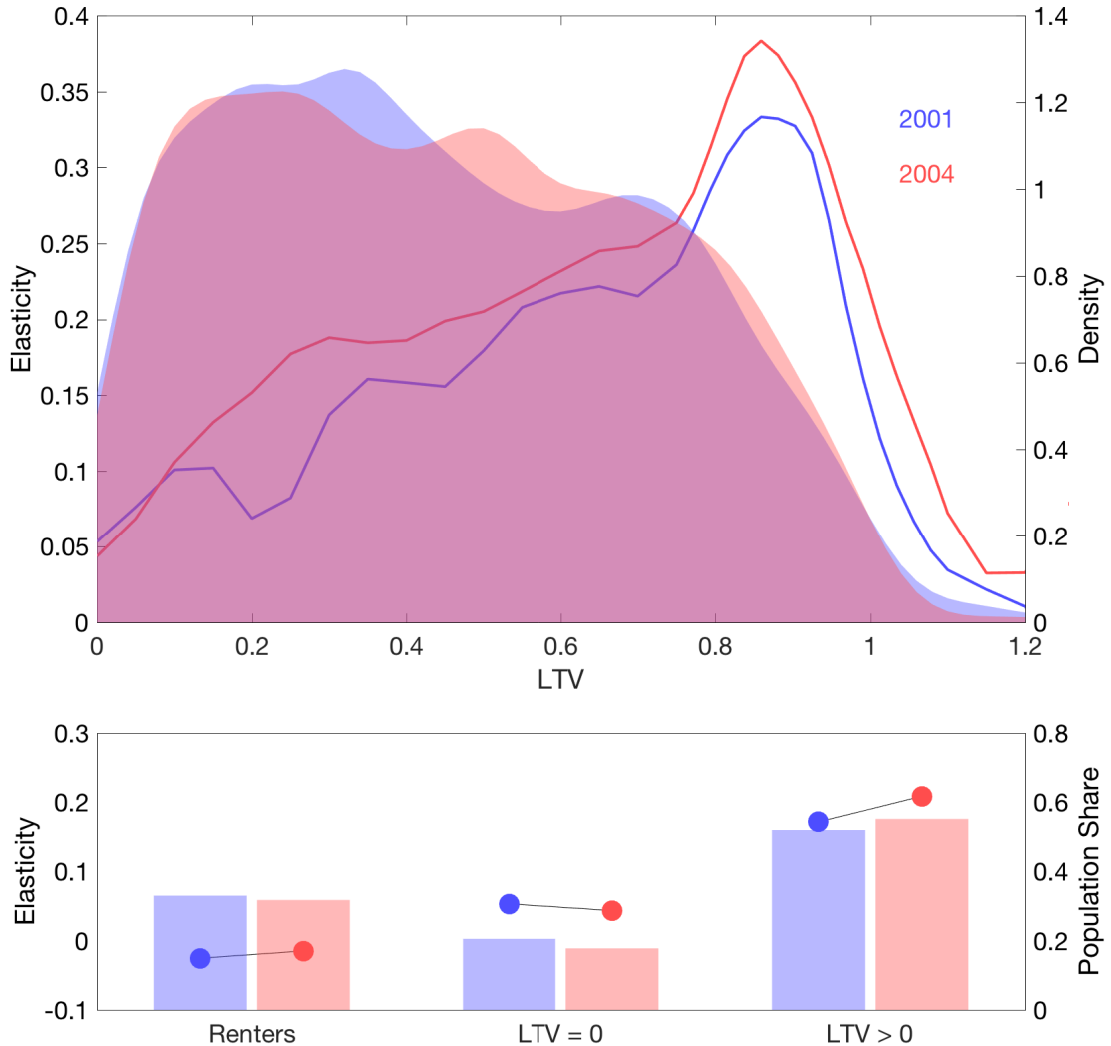
Return

Why Didn't Changing LTV's Do More?



Back

Consumption Elasticity: 2001 vs. 2004



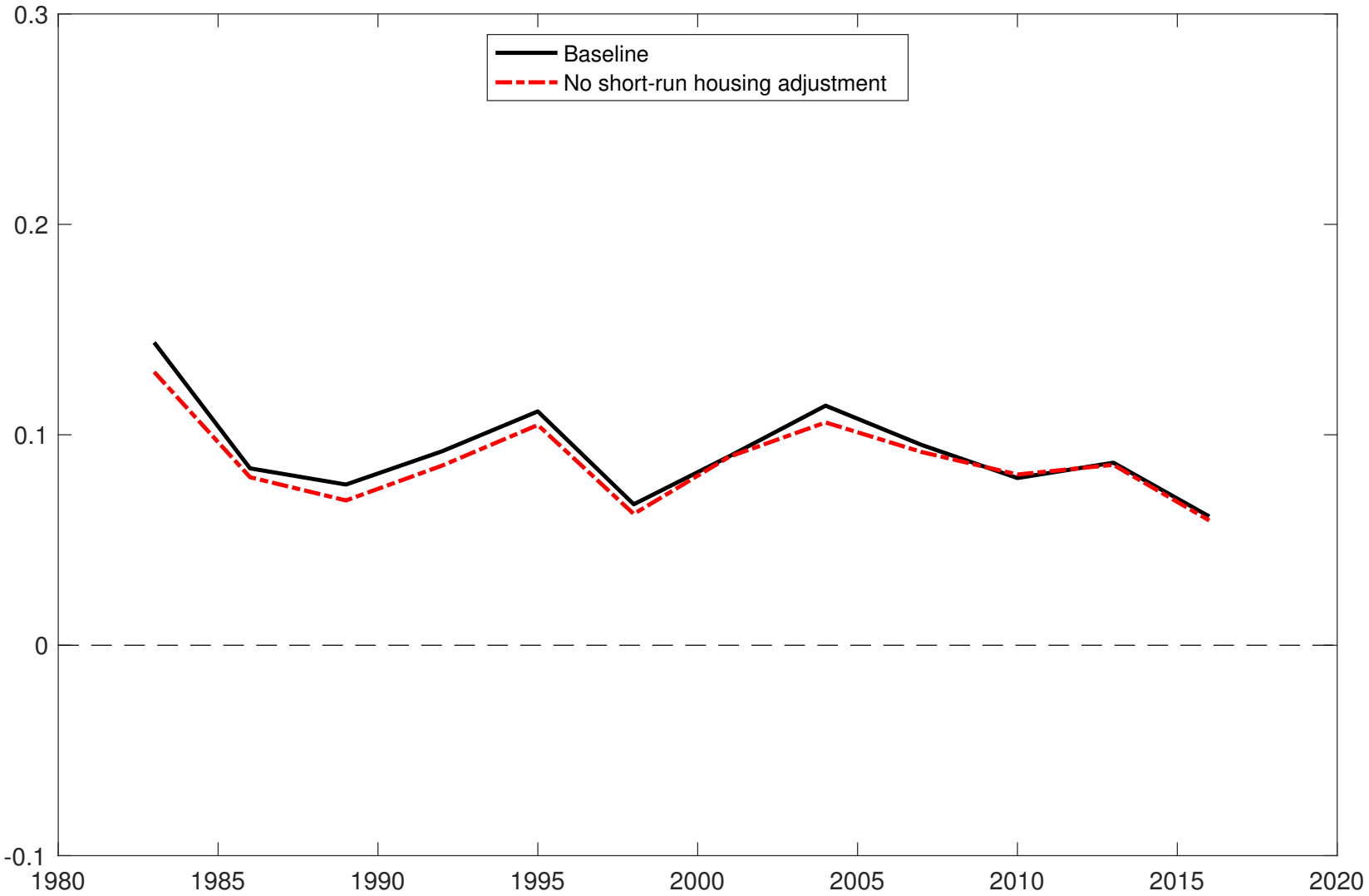
Back

No Short-Run Housing Supply Adjustment

- Housing supply is short-run inelastic.
  - Adjustment costs, time to build, durability of housing.
  - However, model price elasticity of housing demand is 0.15.
  - Does this play a role?
- Motivates alternate experiment with no- short-run change in housing demand.
  - Consider two cities with zero shot-run elasticity and different long-run elasticity.
  - Assume price rises 10% more in inelastic city in long run.
  - Solve for price path such that in short run neither city adjusts housing demand and plot housing wealth effect calculated by comparing these cities.
- Generates lower wealth effect because inelastic city not substituting out of housing in shot run, but weak effect.

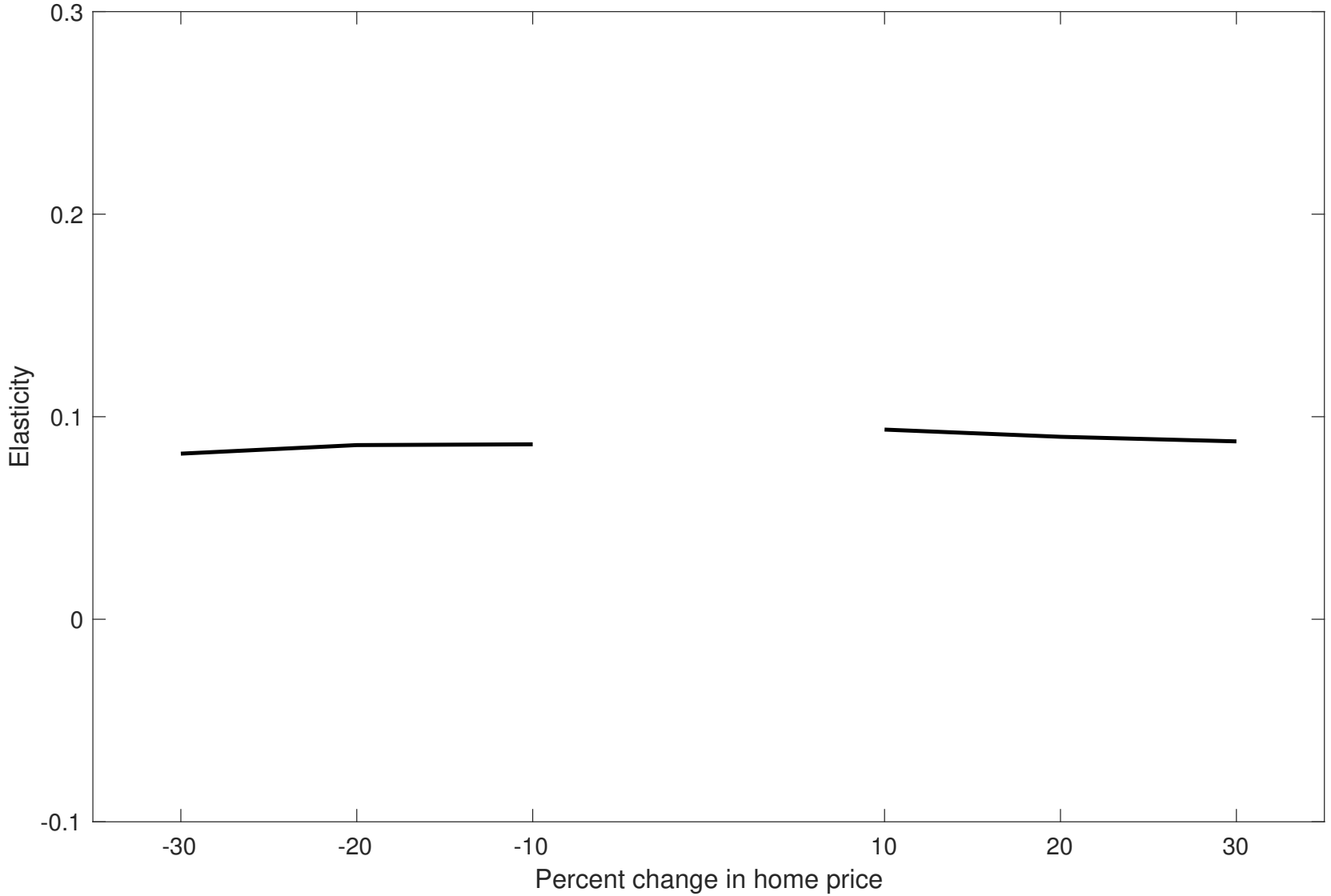
▸ Return

No Short-Run Housing Supply Adjustment



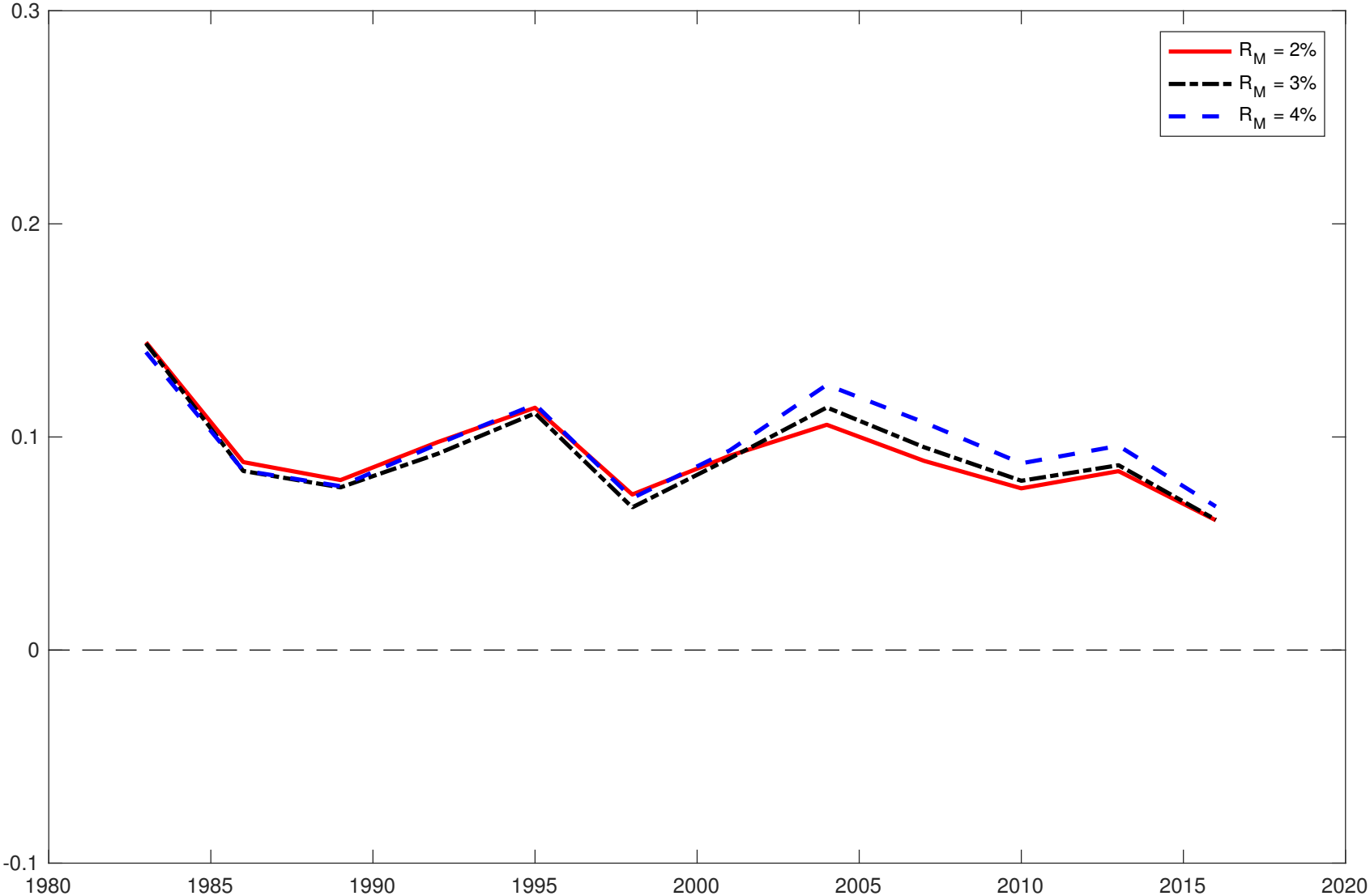
Return

Non-Linear Effects



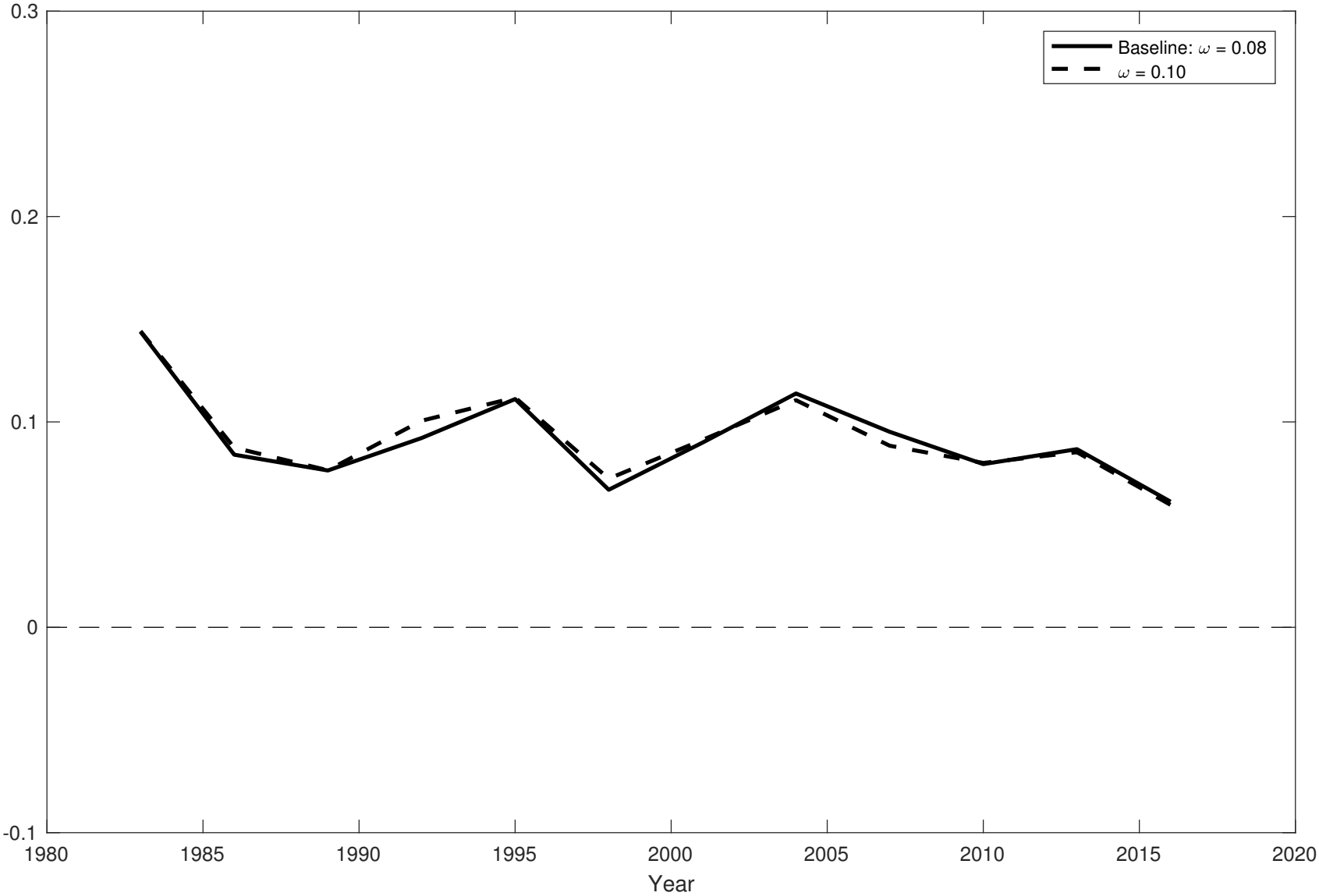
Return

Sensitivity to Interest Rates



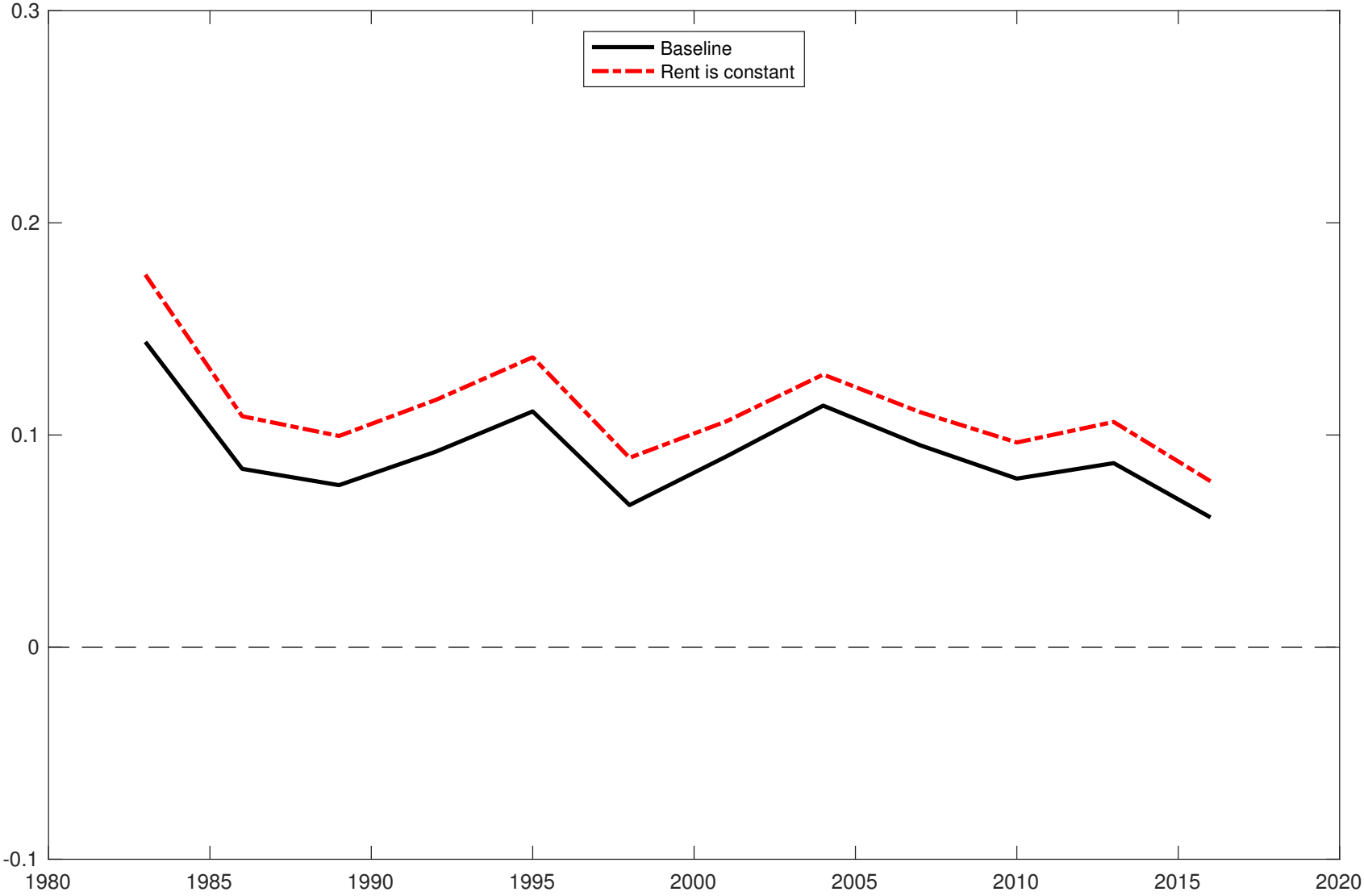
Return

Shocks to ω, Preference Parameter For Housing



Return

Constant Rent



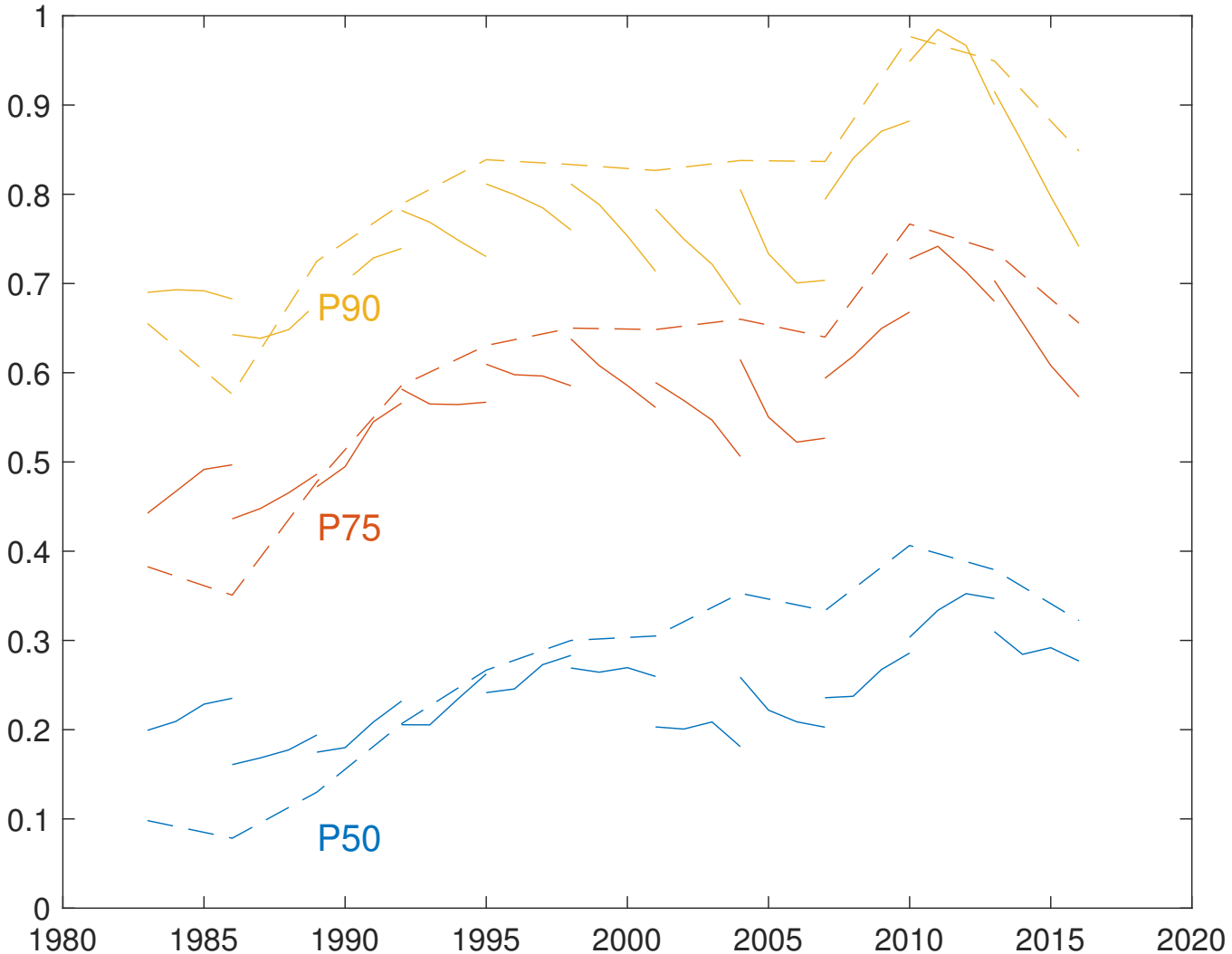
Return

Is the Model Consistent With the Evolution of Household Balance Sheets?

- Is the model internally consistent in terms of the evolution of household balance sheets?
- If not, do shocks required to match evolution change housing wealth effect?
- To evaluate these questions, take distribution of states at t, sequence of house prices, and look at model implied distribution at $t + 3$ holding aggregate income fixed.

Return

Is the Model Consistent With the Evolution of Household Balance Sheets?



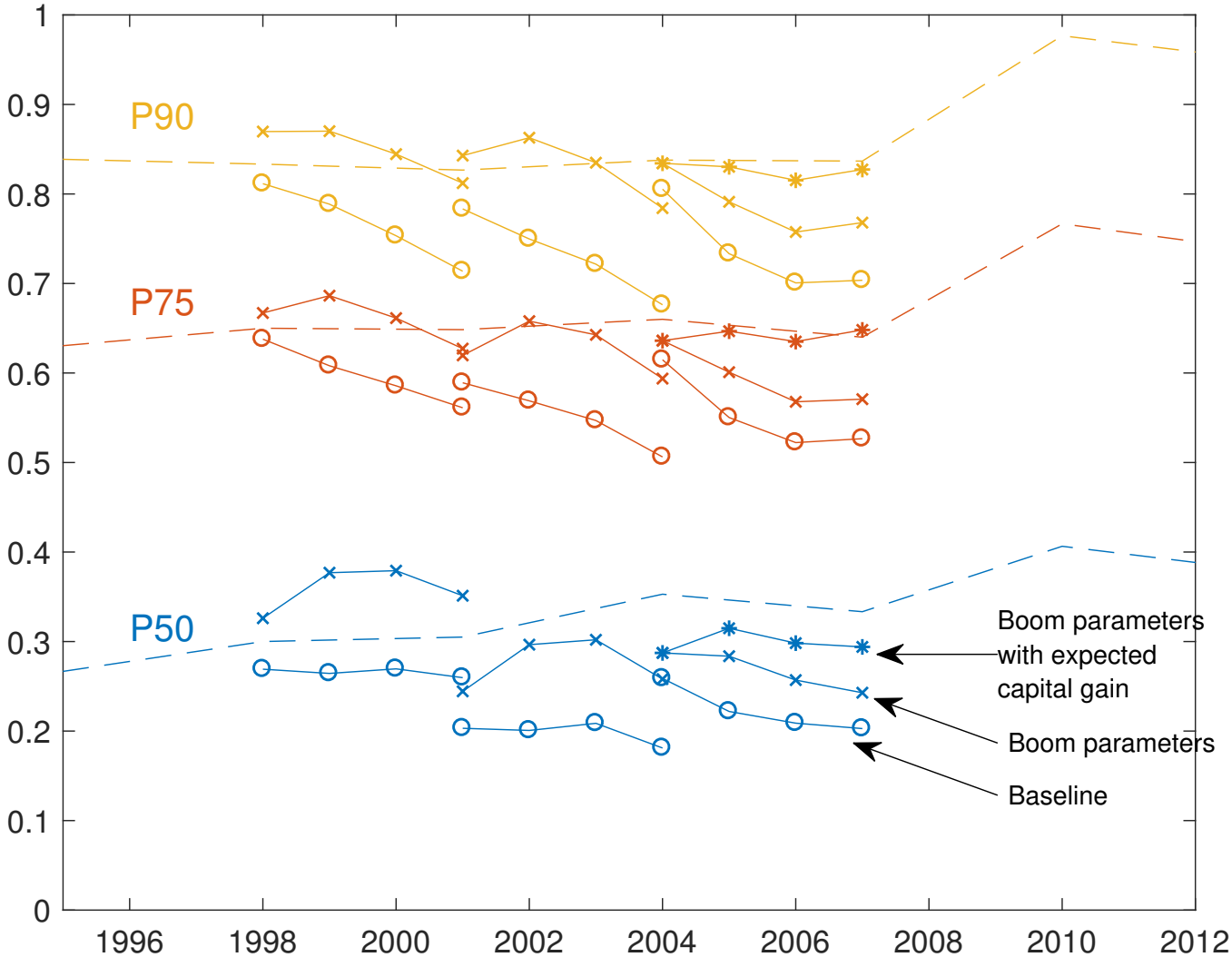
Return

Is the Model Consistent With the Evolution of Household Balance Sheets?

- Model matches increase in leverage 1980-1995, increase in leverage in Recession, and deleveraging after.
- But does not account for stable leverage in Boom.
- Does this matter?
  - To evaluate, introduce "boom" parameterizations
    1. LTV limit expands 80% to 95% and refinancing free
    2. Additional capital gain.
  - These parameterizations fit evolution of LTV distribution much better do not change elasticity much

▸ Return

Is the Model Consistent With the Evolution of Household Balance Sheets?



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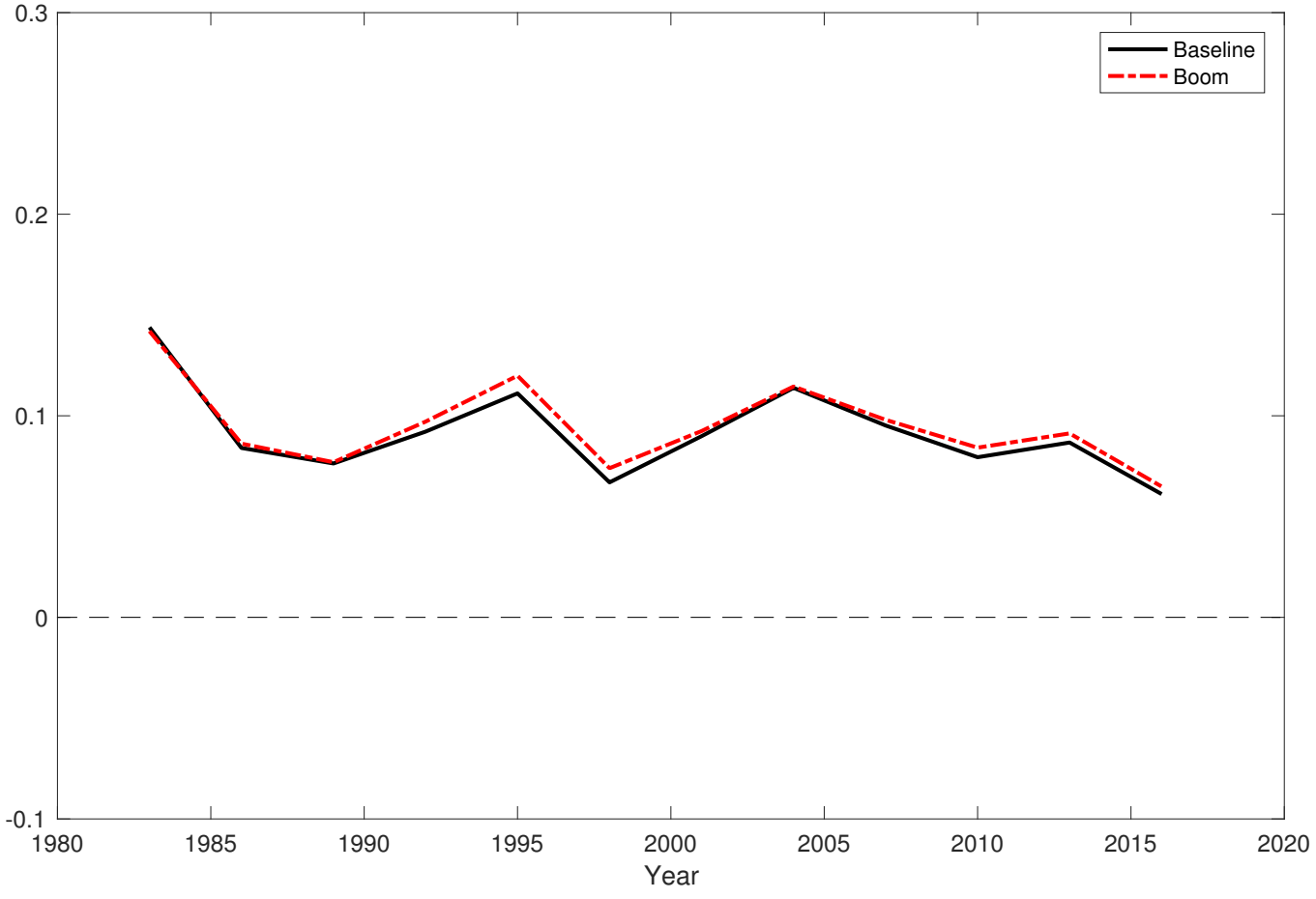
Is the Model Consistent With the Evolution of Household Balance Sheets?



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