The Effect of House Prices on Household Borrowing: A New Approach

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Do House Prices Drive Borrowing?

- House prices are strongly correlated with household borrowing and consumption over the business cycle

  Consumption Borrowing Leverage

- These co-movements were especially strong around the Great Recession $\rightarrow$ central to the current recession narrative

Empirical Challenge

- House price variation is not exogenous
- Recent literature uses regional house price variation
  - Confounding regional factors (e.g. income expectations) that drive both house prices and borrowing/consumption
- State of the art: IV using local housing supply elasticities
  - Topography-based housing supply elasticities
  - Proximity to oceans and mountains
  - Debate about the exclusion restriction and defiers

Our Approach

- Administrative mortgage data from the UK between 2005-2015
  - We study borrowing decisions by refinancers
- Three advantages
  1. **Individual house prices**
     - Non-parametric estimates of the borrowing response to house prices.
     - Non-parametric, multi-dimensional, heterogeneity analysis.
  2. **Panel data**
     - We can control for key confounders (e.g. regional shocks to income expectations) through fixed effects
     - Exploit individual and *within* individual variation in house prices.
  3. **Institutional setting facilitates identification**
     - We use Great Recession interacted with pre-determined contract choices as a quasi-experiment

Outline

1. **Institutional setting**
   - Refinancing in the UK
   - Sources of house price variation
2. **Do house prices affect borrowing?**
   - Yes, with an elasticity of 0.2 (less than recent estimates suggest)
3. **Why do house prices affect borrowing?**
   - Wealth vs collateral channel
   - Two tests suggest strong collateral effects

Institutional Setting and Data

Home Refinancing in the UK

- Frequent refinancing at quasi-exogenous times RefiTiming
  - Most mortgages come with a low interest rate for $N = 2$-5 years
  - Penalizing reset rate after N; large prepayment penalty before N
    $\Rightarrow$ Strong incentive to refinance every N years
- Home refinancing
  - House appraisal determines home equity
  - Borrower decides on equity extraction ("home equity loan")
  - This determines new loan-to-value (LTV) and interest rate

House Price Assessments

- We obtain house price information from mortgage appraisals
- Key advantages:
  - House price information at the household level
  - House price information at each refinance event
  - House price relevant for measuring collateral
- Potential concern: Appraisal bias?
  - There is a known appraisal bias in the US
  - But we find no such appraisal bias in the UK No Appraisal Bias

Sources of House Price Variation

- Large house price variation, but much of it is endogenous
  - Can we find plausibly exogenous variation?

- We absorb most of the variation with fixed effects:
  - Individual FE
  - Month FE
  - County $\times$ Year FE

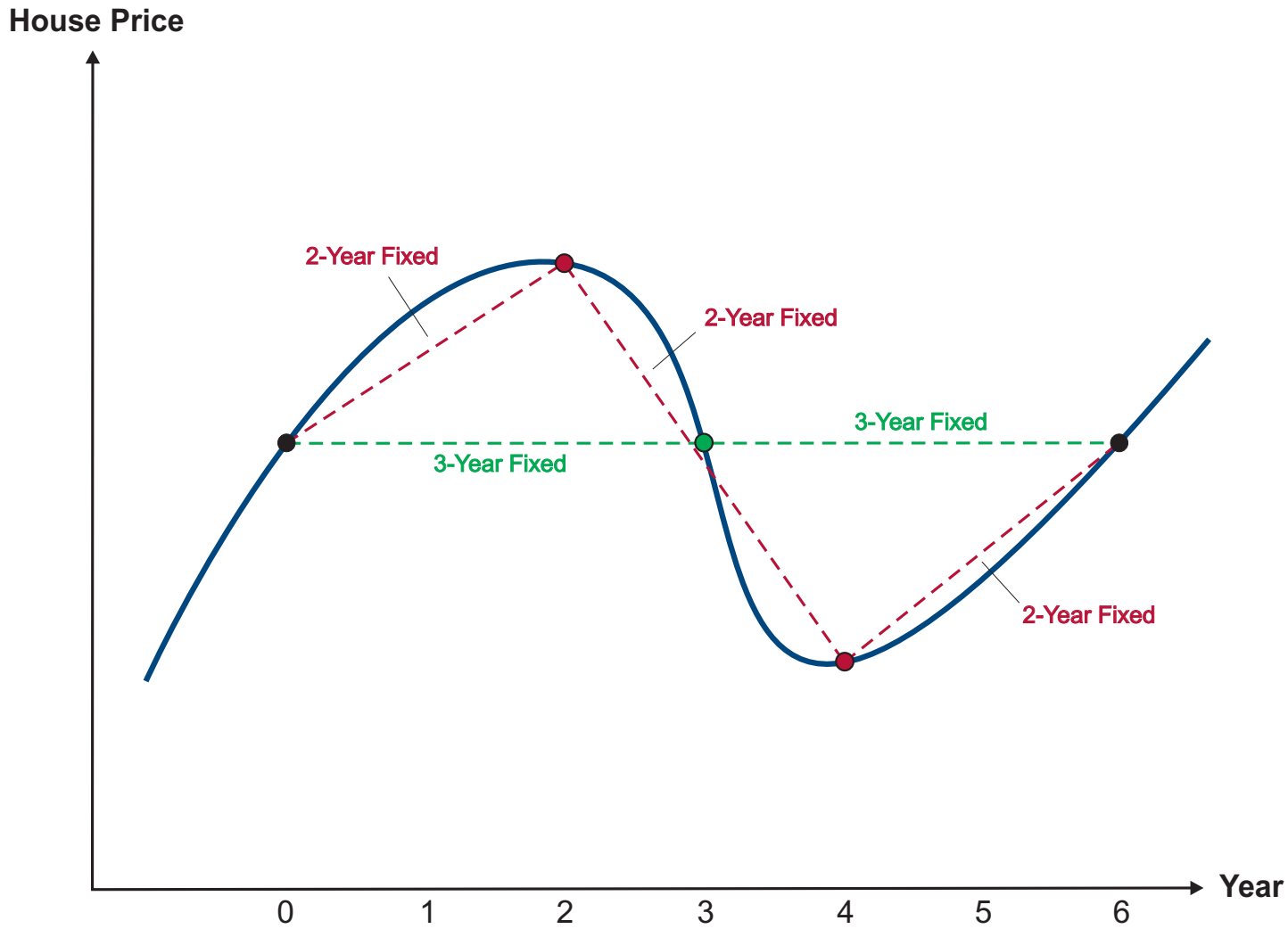
  Raw Variation Residual Variation

- What drives the residual variation?
  1. Variation in price growth across houses within counties
  2. Variation in (pre-determined) timing of refinance events

  House Prices 2005-15

Timing of Refinance Events and House Price Growth

Conceptual Graph



Empirical Graph

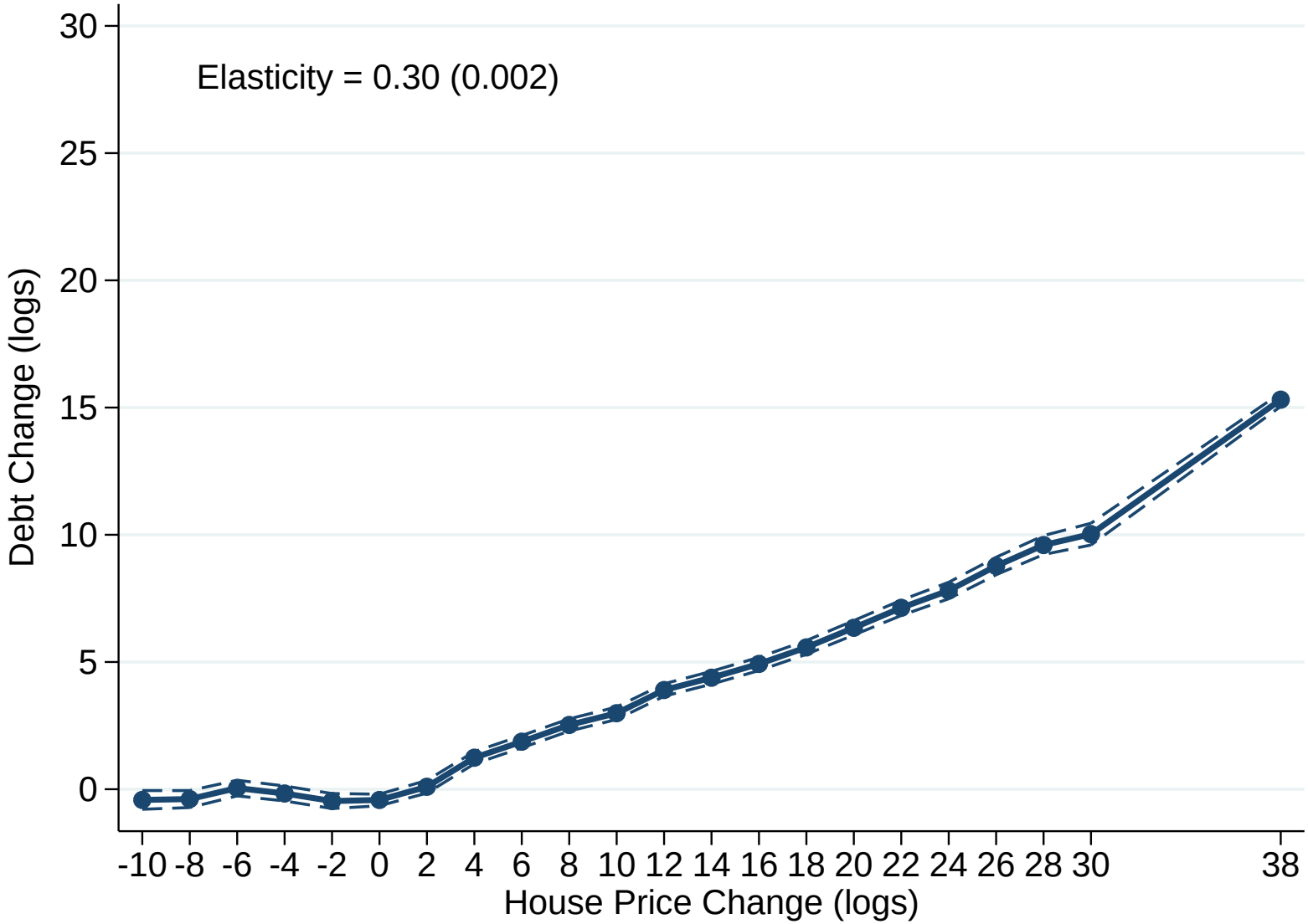
Do House Prices Affect Borrowing?

Baseline Specification

$$\Delta \log D_{it} = \sum_j \beta_j \cdot \mathbf{I}\left[\Delta \log P_{it} \in j\right] + \nu_{it} \tag{1}$$

- We consider two different outcomes:
  1. $\Delta \log D_{it} = \log D_{it} - \log D_{it-1} =$ debt growth
  2. $\Delta \log D_{it} = \log D_{it} - \log D_{it}^{P} =$ equity extraction
- Equation (1) with outcome (1) is similar to existing work, but using individual price variation

Baseline: Debt Growth vs House Price Growth



Equity Extraction

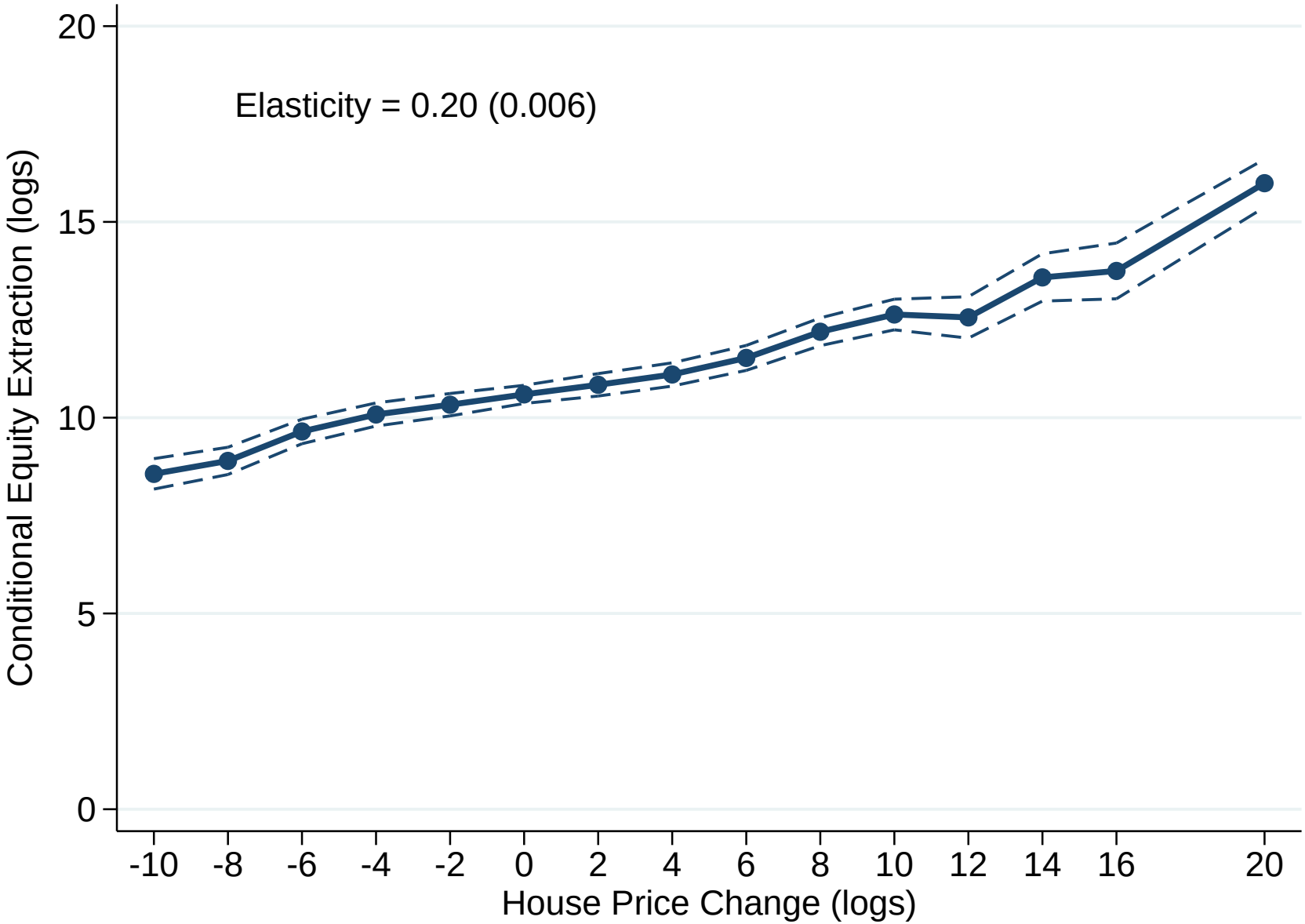
Fixed Effects Specification

$$\Delta \log D_{ict} = \sum_j \beta_j \cdot \mathbf{I}\left[\Delta \log P_{ict} \in j\right] + \alpha_i + \gamma_t + \delta_{ct} + \nu_{ict}$$

- Individual fixed effects imply we are exploiting *within-individual variation in price growth*
- County-by-time fixed effects absorb local time-varying factors (e.g. expectations)
- "county" = local planning authority = council
  - 32 in London, 418 in the UK

Equity Extraction vs House Price Growth

Adding Fixed Effects Individual&Time only Individual Controls



Robustness of FE Estimates

	(1)	(2)	(3)	(4)
Full Sample	**0.234**	**0.208**	**0.204**	**0.197**
	(0.002)	(0.005)	(0.006)	(0.006)
On-Time Sample	**0.245**	**0.183**	**0.175**	**0.166**
	(0.002)	(0.006)	(0.007)	(0.007)
Off-Time Sample	**0.317**	**0.269**	**0.263**	**0.252**
	(0.004)	(0.011)	(0.012)	(0.013)
Individual FE		×	×	×
Time FE		×	×	×
County × Time FE			×	×
Individual Controls				×

Descriptive Statistics IV Specification

Why Do House Prices Affect Borrowing?

Mechanisms

- **Wealth effect**
  - This depends on age and the lifecycle profile of housing
  - Borrowing elasticity should be increasing in age, all else equal
- **Collateral effect**
  - This depends on the amount of collateral
  - Borrowing elasticity should be increasing in LTV, all else equal
- **Key challenges**
  - We need causal estimates of elasticities across groups
  - We need to deal with correlated dimensions of heterogeneity (e.g., older people are less levered)

Heterogeneity

- We consider four key dimensions:
  - LTV (collateral effect)
  - Age (wealth effect)
  - Income
  - Income growth

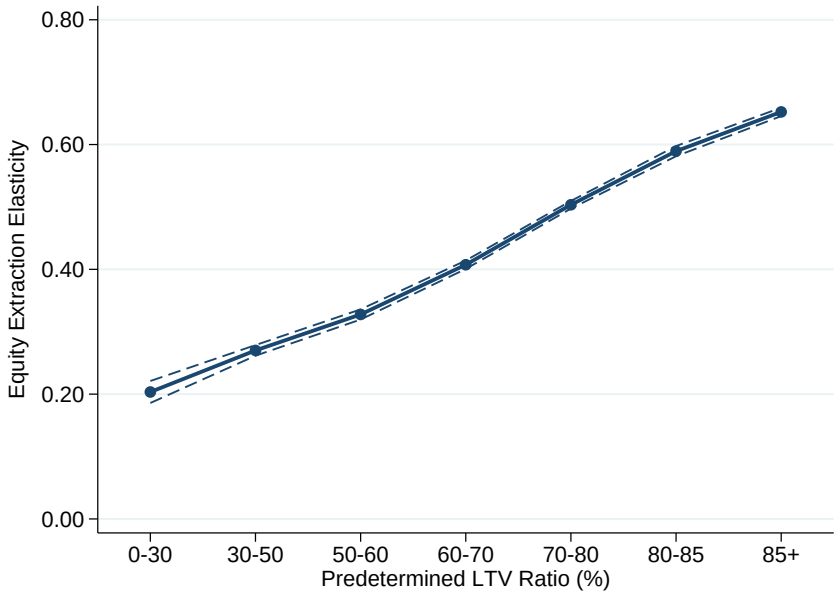
- We study these dimensions simultaneously:

$$\Delta \log D = \sum_k \sum_j \beta_j^k \cdot dum_j^k \cdot \Delta \log P + \sum_k \sum_j \lambda_j^k \cdot dum_j^k + \nu$$

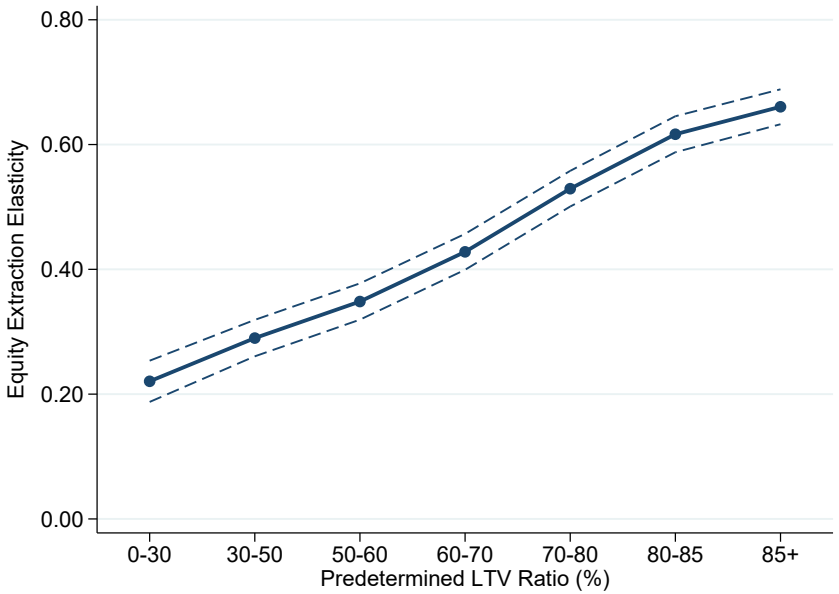
where k is heterogeneity category and j is bin with each category

Heterogeneity by Pre-LTV

No Other Controls



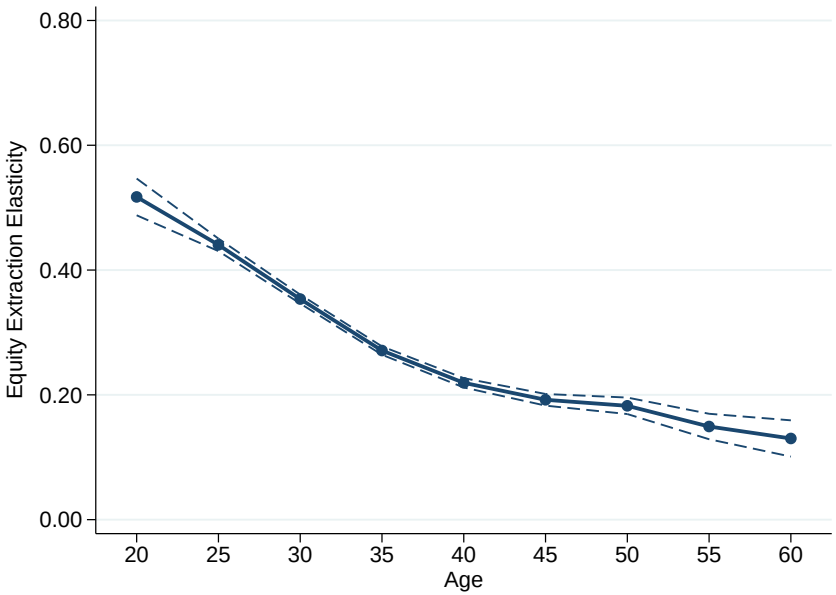
Controls for age, income, Δincome



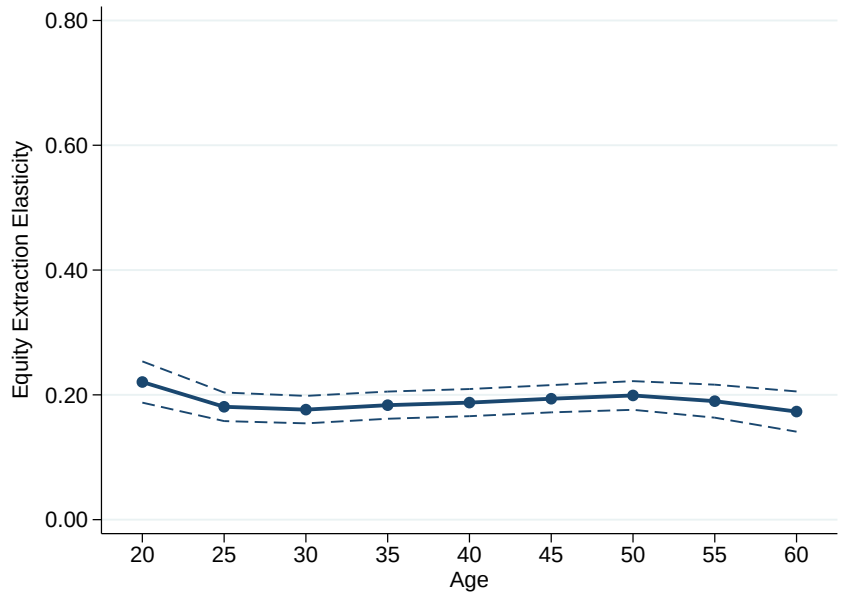
Nonlinear

Heterogeneity by Age

No Other Controls

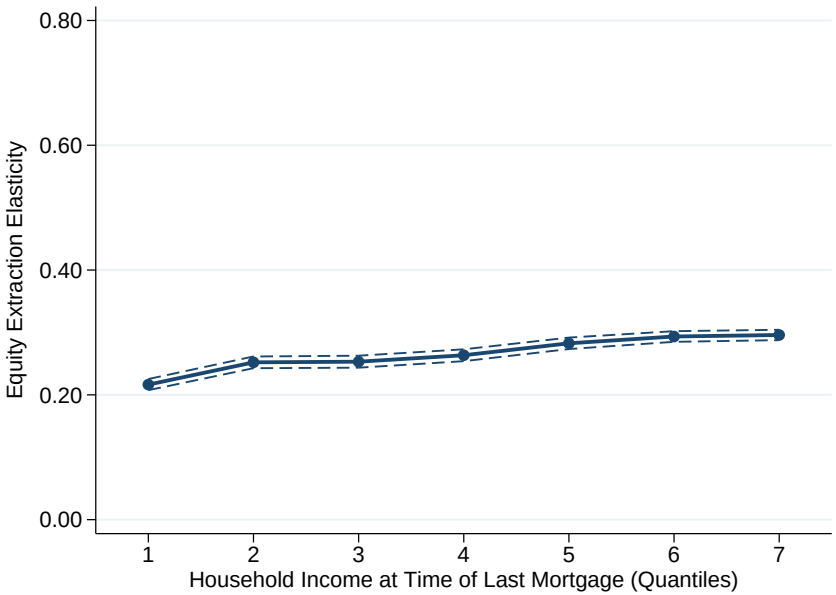


Controls for LTV, income, Δincome

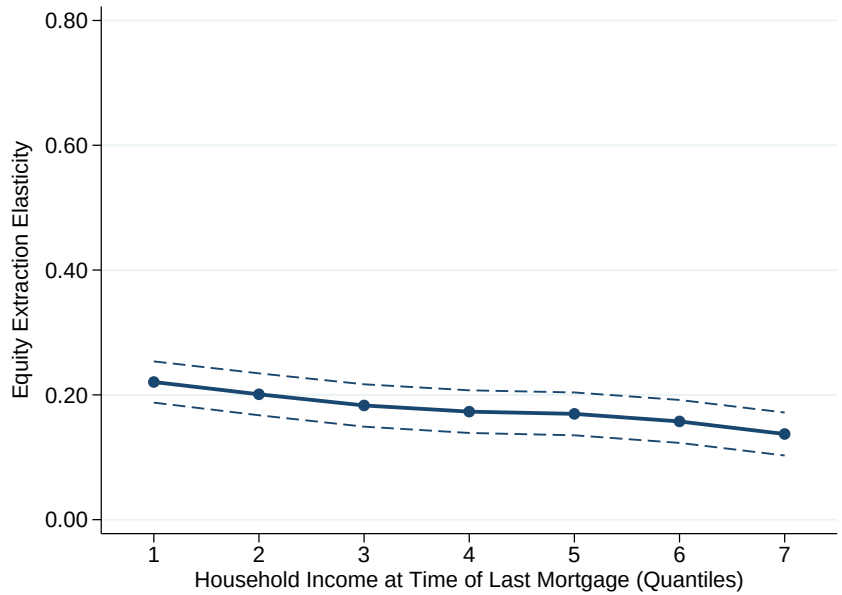


Heterogeneity by Income

No Other Controls

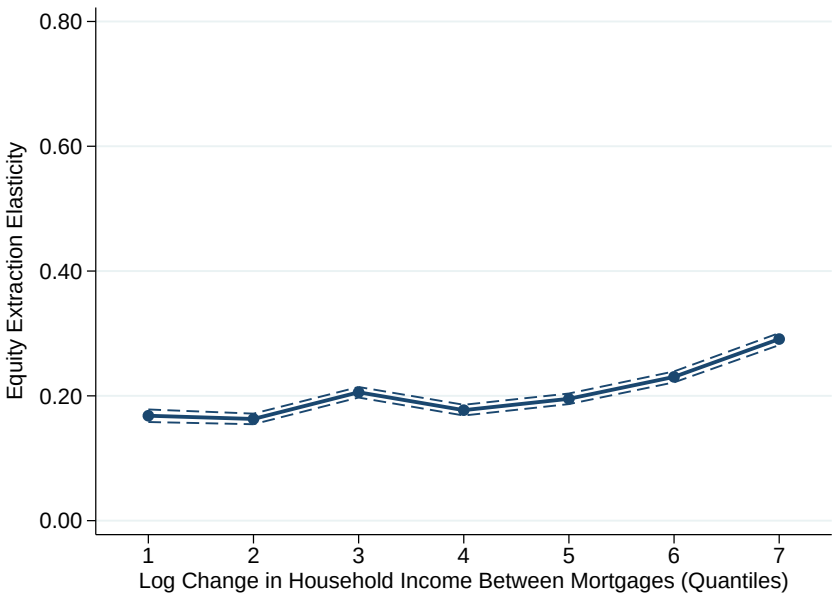


Controls for Age, LTV, Δincome



Heterogeneity by Income Growth

No Other Controls



Controls for Age, LTV, income

Heterogeneity Analysis Suggests Collateral Effects

- Higher-LTV households are more elastic to house prices
  - The effect is very strong and unaffected by rich controls
  - Consistent with collateral channel: House price growth relaxes credit constraints more when collateral is small
- Higher-age households are not more elastic to house prices
  - The effect is negative without controls, zero with controls
  - Suggestive evidence against wealth channel

Collateral Effects: A Test Using Interest Notches

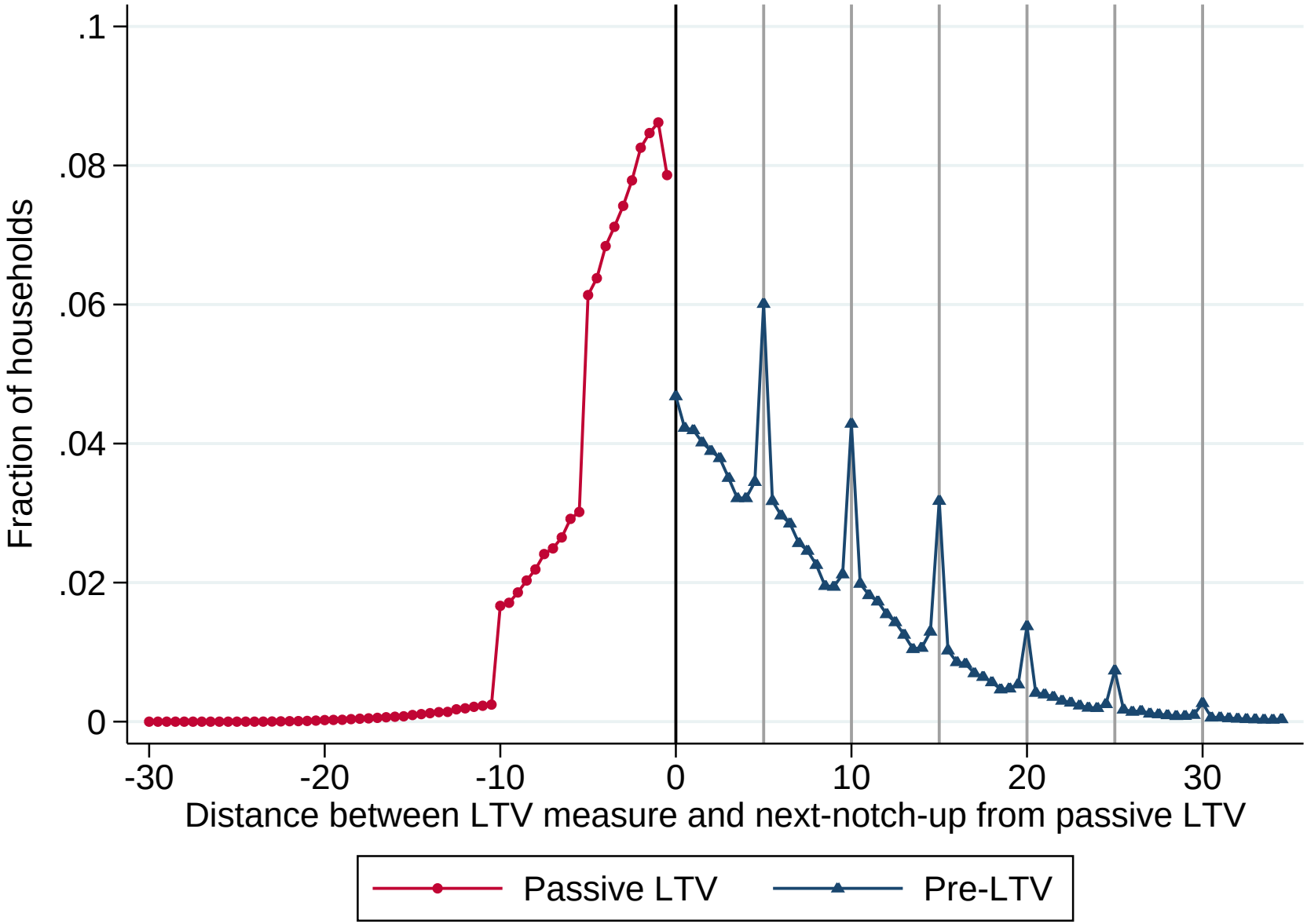
- Two views on collateral constraints:
  1. Hard constraint: Impossible to borrow below collateral threshold
  2. Soft constraint: Borrowing costs jump at collateral threshold

     $\rightarrow$ Corresponds to UK interest schedule Interest Notches

- Interest notches are useful for devising a test
  - A house price change relaxes (reinforces) collateral constraints if it pulls the household down (up) to lower (higher) notches Notches Moved Test
  - How does the elasticity wrt house price vary by interest notches moved due to the price variation?

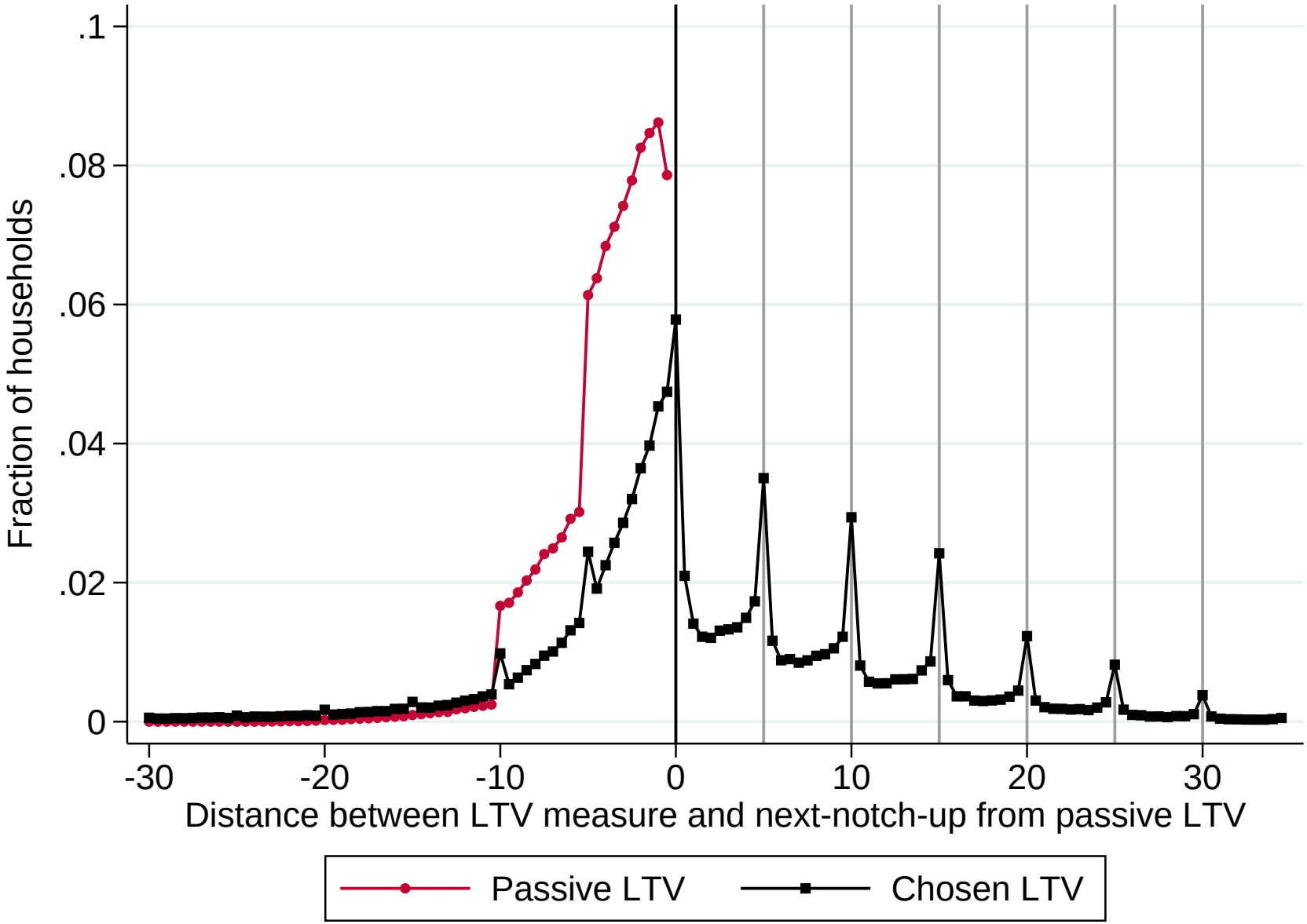
House Price Growth & Bunching ("Relaxed" Sample)

House Price Growth Removes Bunching at Interest Notches



House Price Growth & Bunching ("Relaxed" Sample)

Equity Extraction Recreates Bunching at Interest Notches

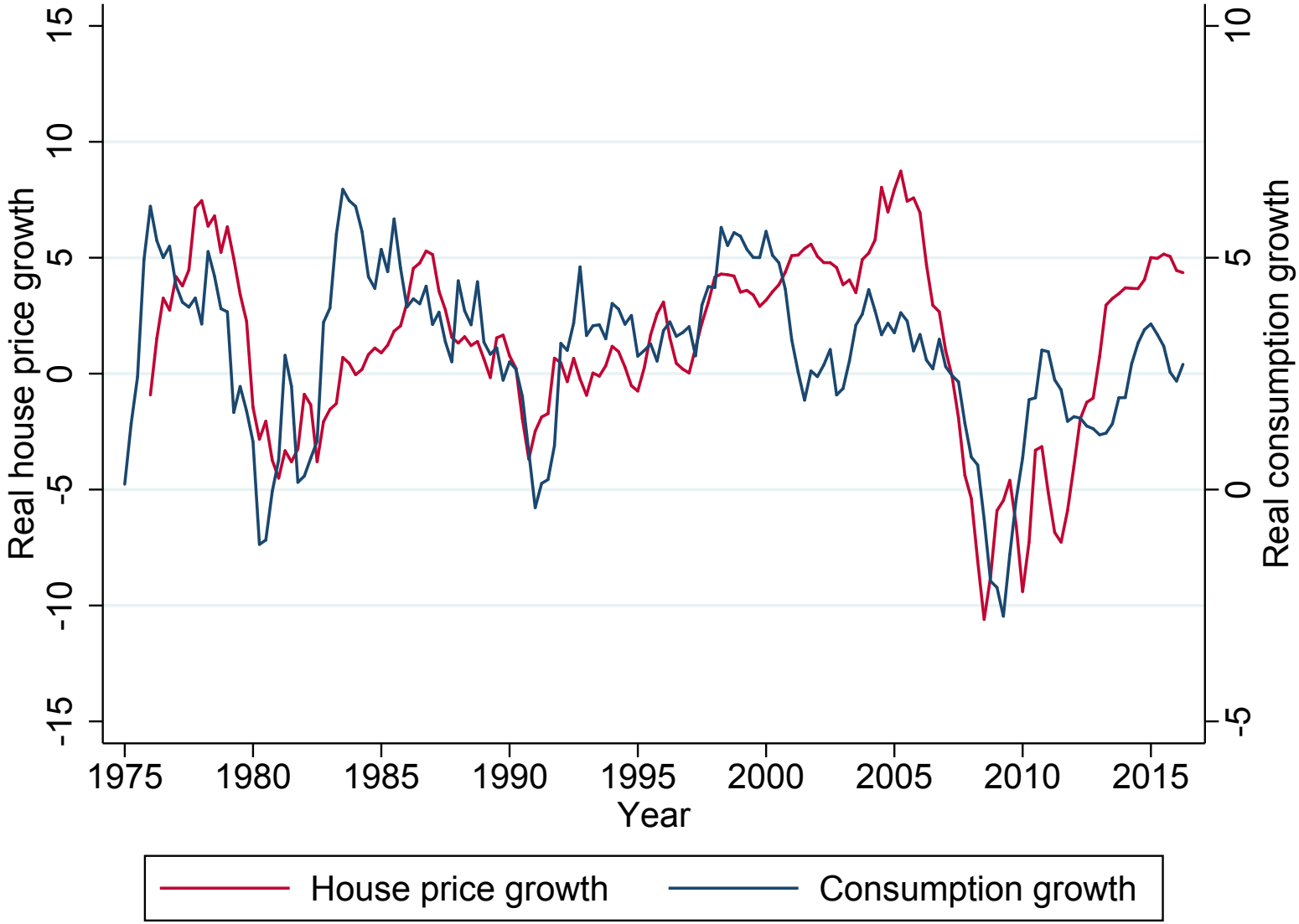


Conclusion

Conclusion

- We address a classic question in macro and finance:
  - Do house prices affect borrowing and why?
  - Important for policy and for business cycles
- We use a different empirical approach than previous work
  - Admin data with individual house prices
  - Panel approach that exploits the dynamics of the data
  - Great Recession $\times$ pre-contract choices as quasi-experiment
- We find clear effects of house prices on borrowing, driven by collateral effects
  - Size of elasticity is smaller than recent US estimates

US House Price Growth vs Consumption Growth



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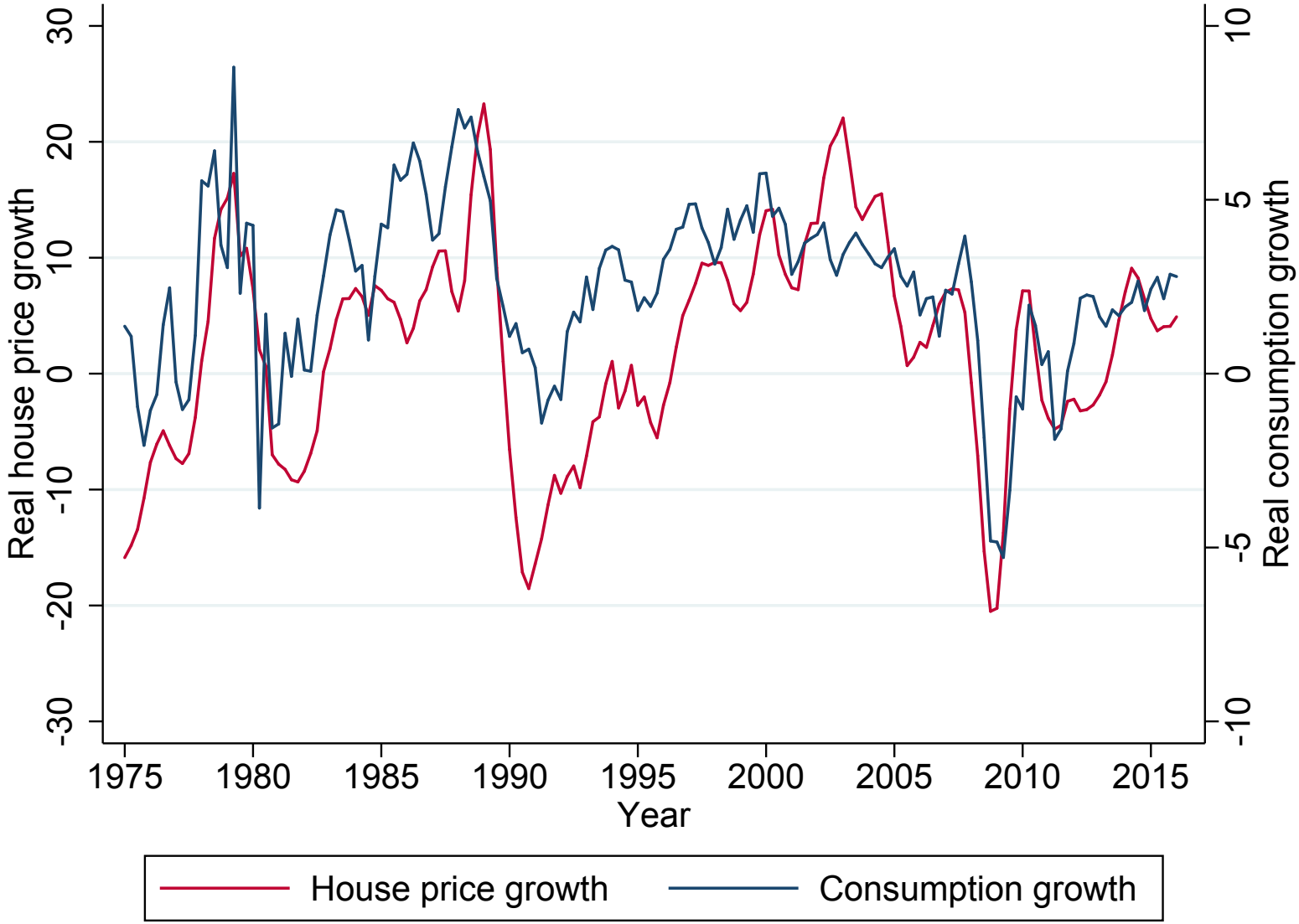
UK House Price Growth vs Consumption Growth



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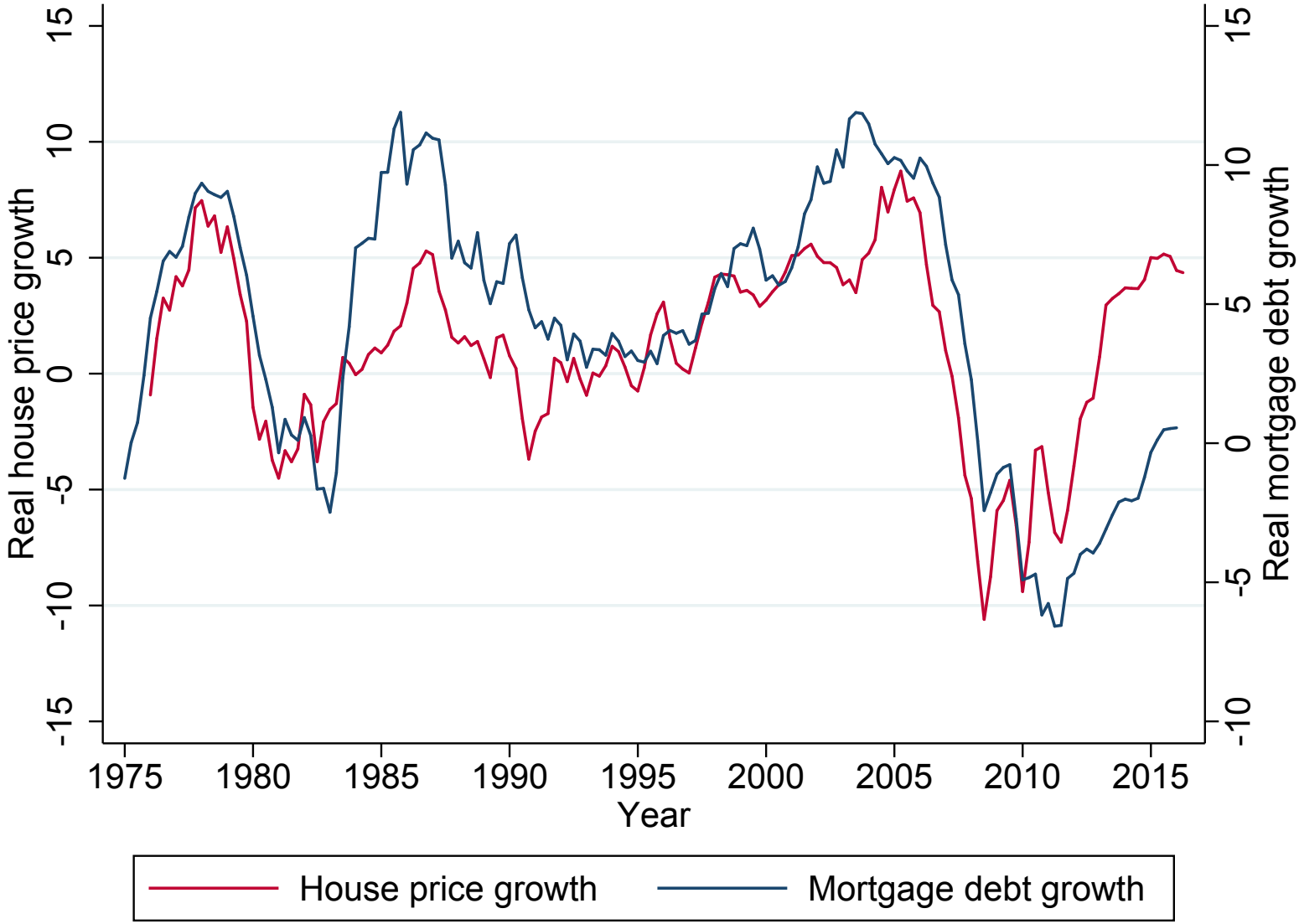
US House Price Growth vs Mortgage Debt Growth



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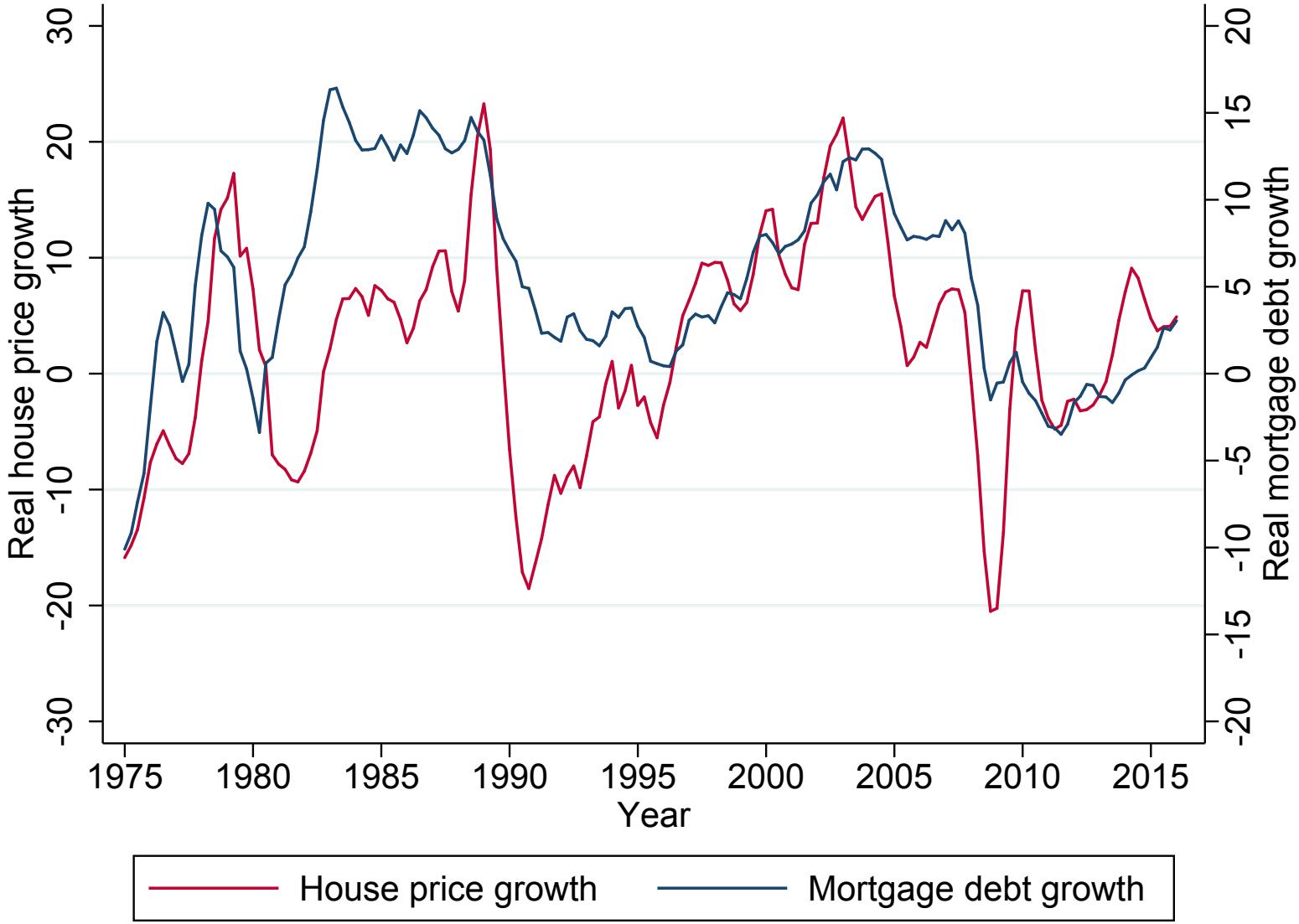
UK House Price Growth vs Mortgage Debt Growth



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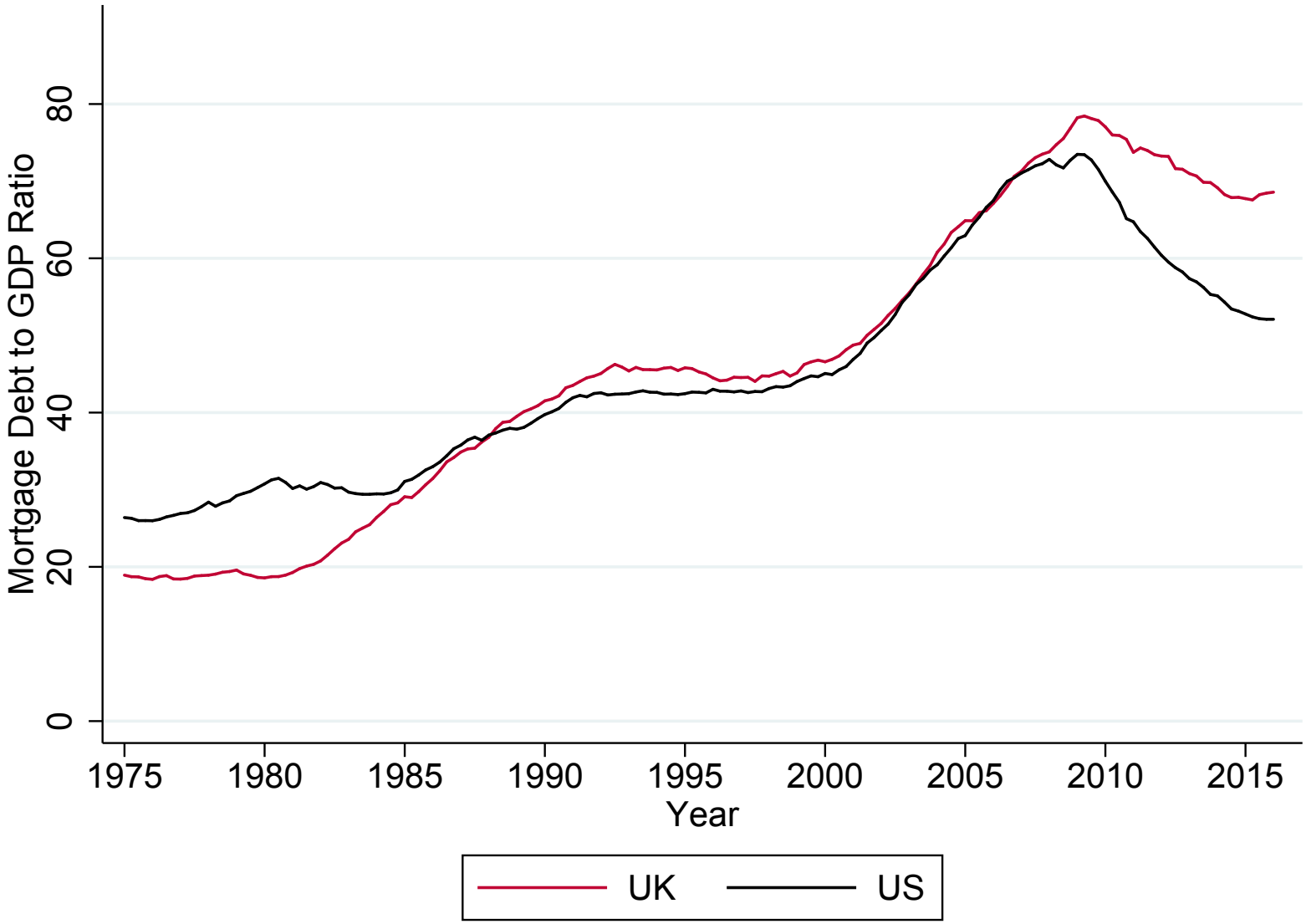
Household Leverage in the US vs the UK

Mortgage Debt To GDP Ratios



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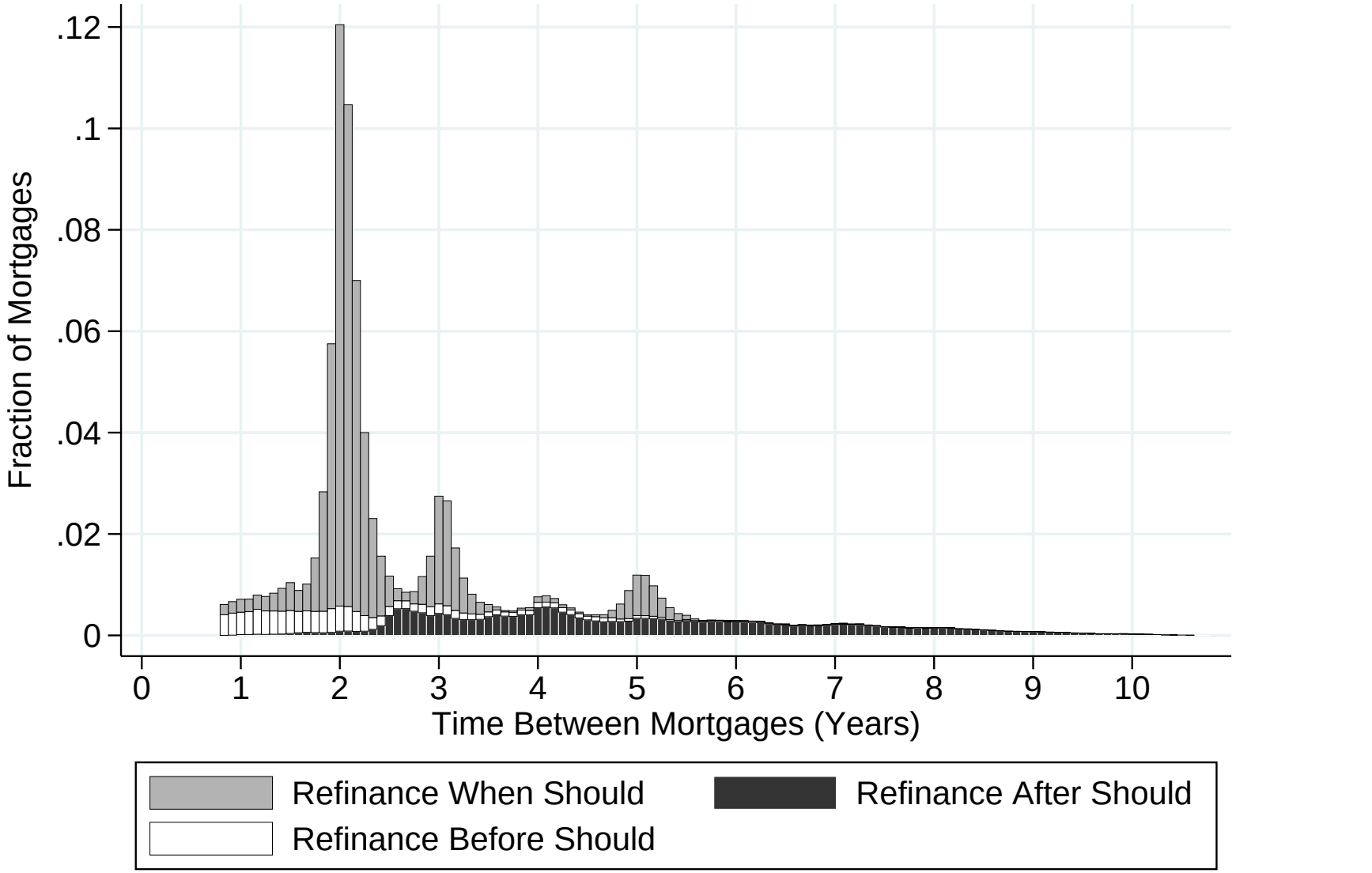
Majority Refinance Around Reset Rate Onset



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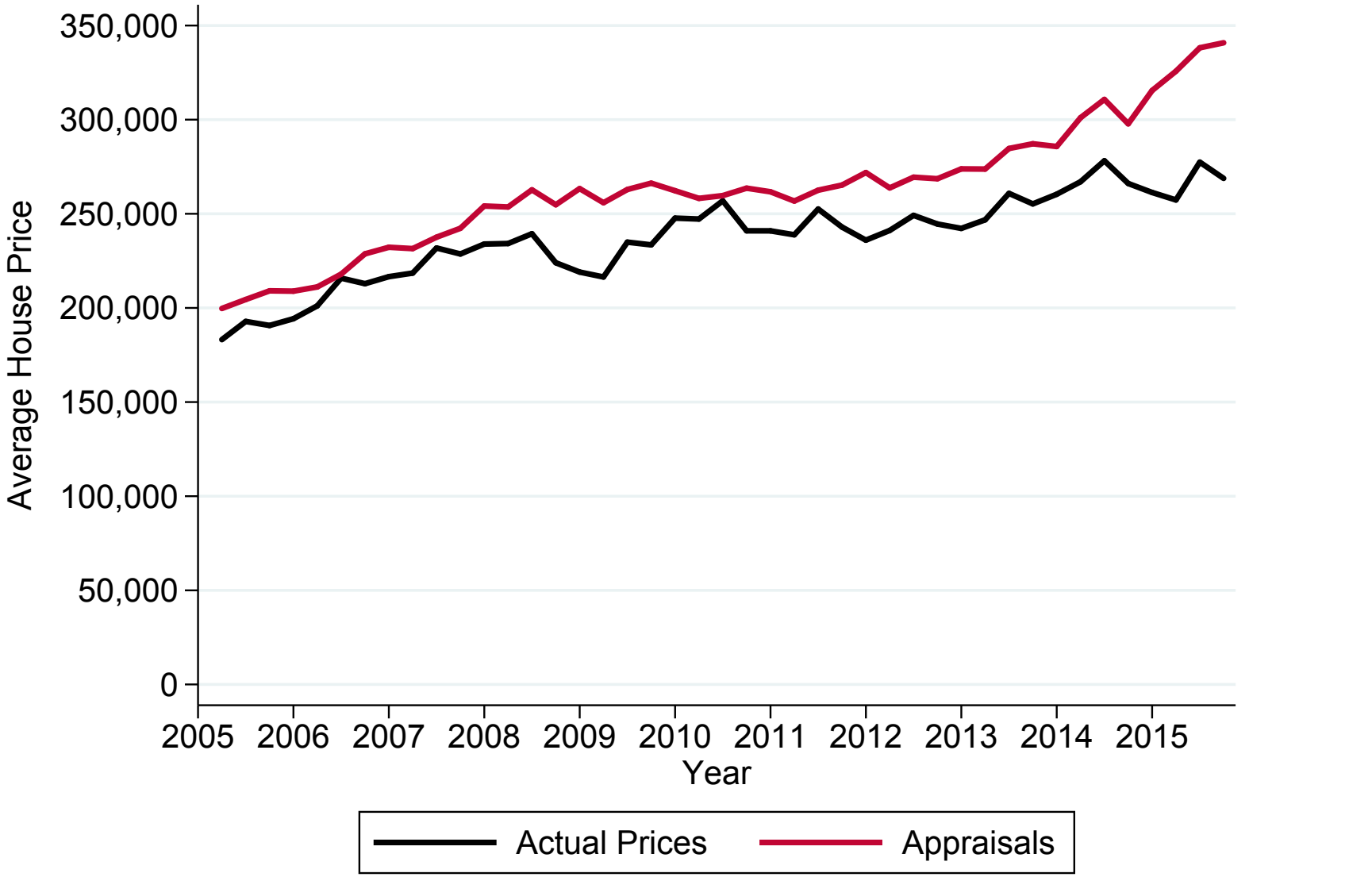
Prices vs Appraisals (Refinanced Homes)

Raw Series



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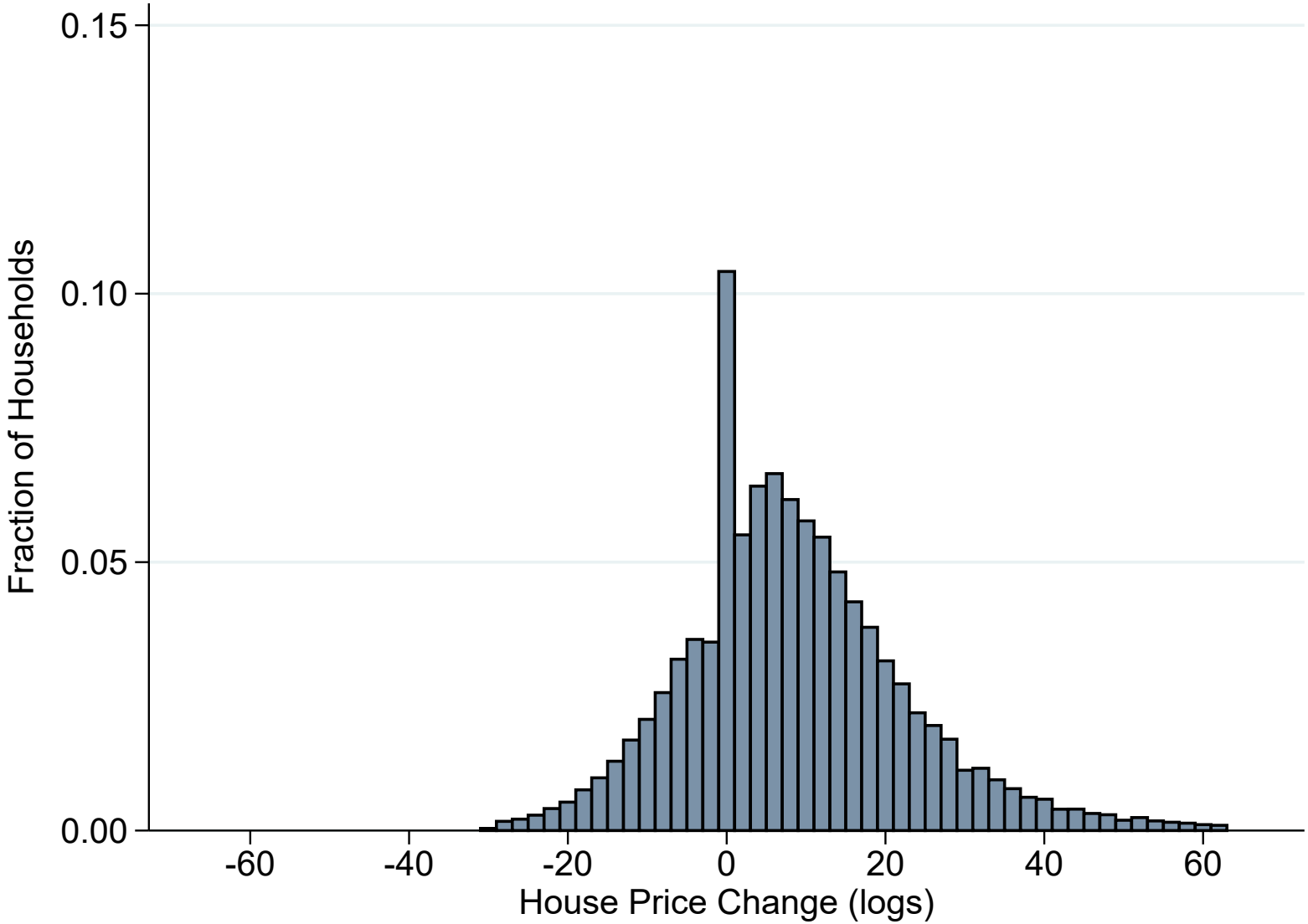
Distribution of Raw House Price Growth

Sample With $\geq$ 2 Mortgage Obs.



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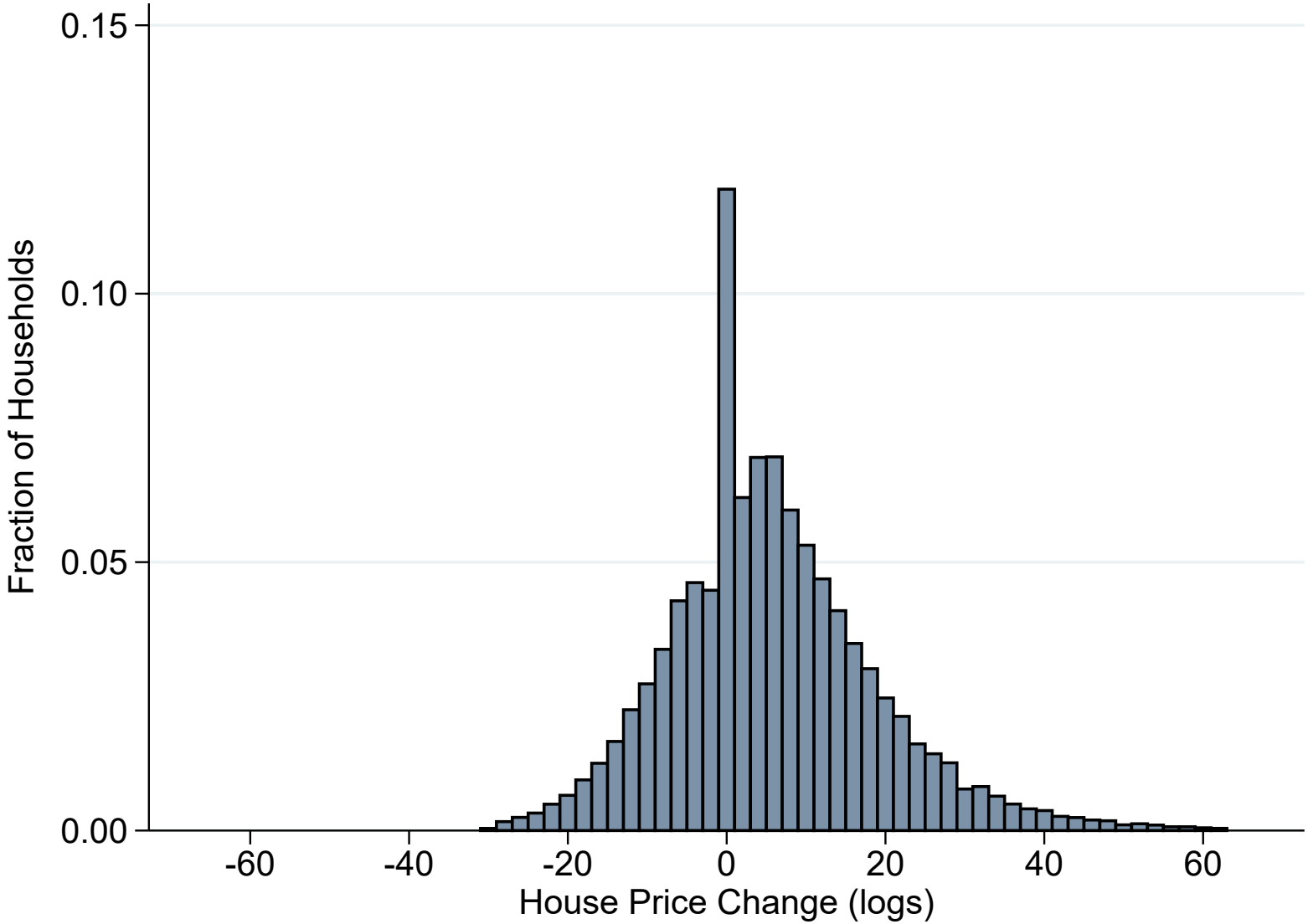
Distribution of Raw House Price Growth

Sample With $\geq$ 3 Mortgage Obs.



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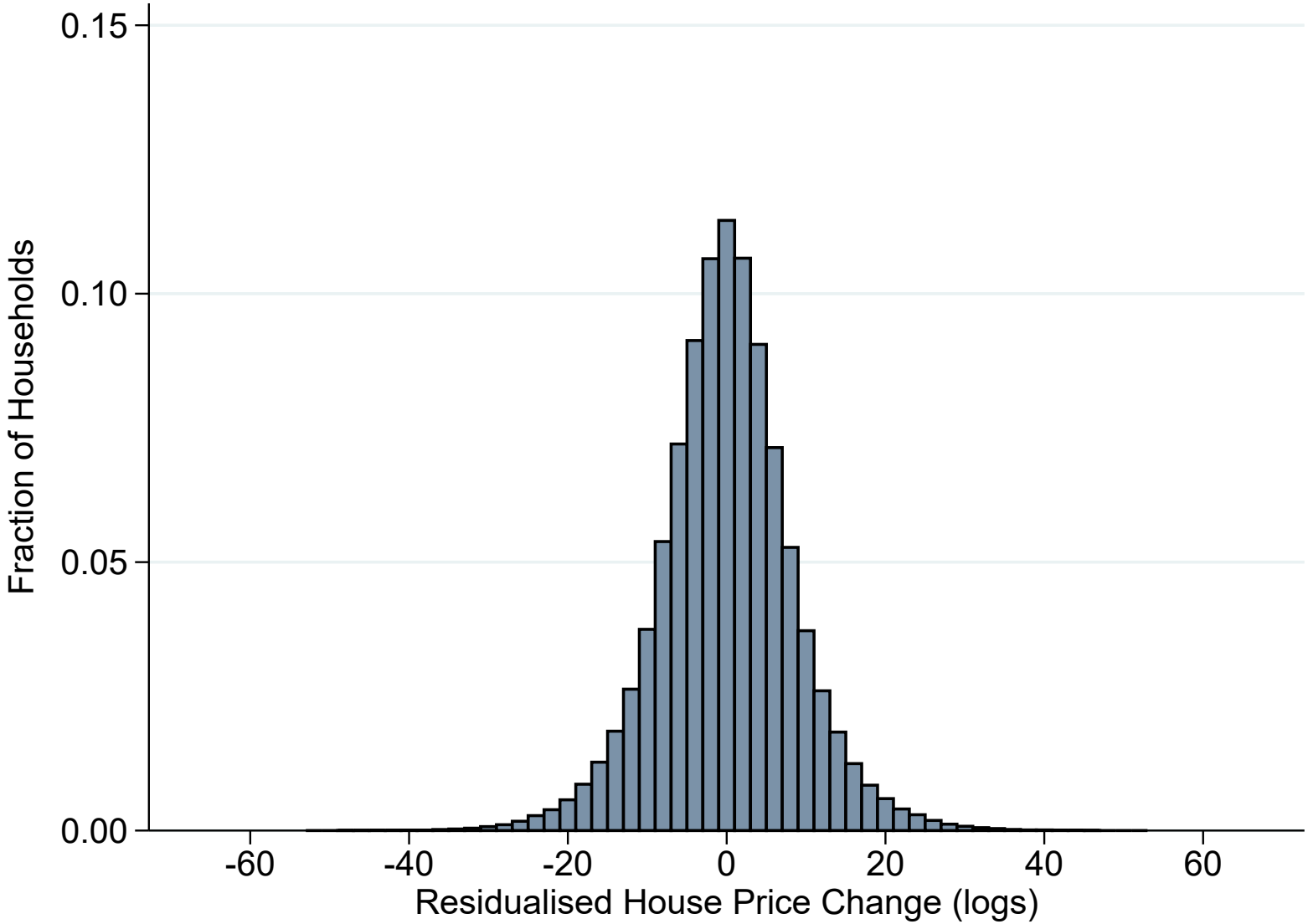
Distribution of Residual House Price Growth

Individual FE, Time FE, and County×Time FE



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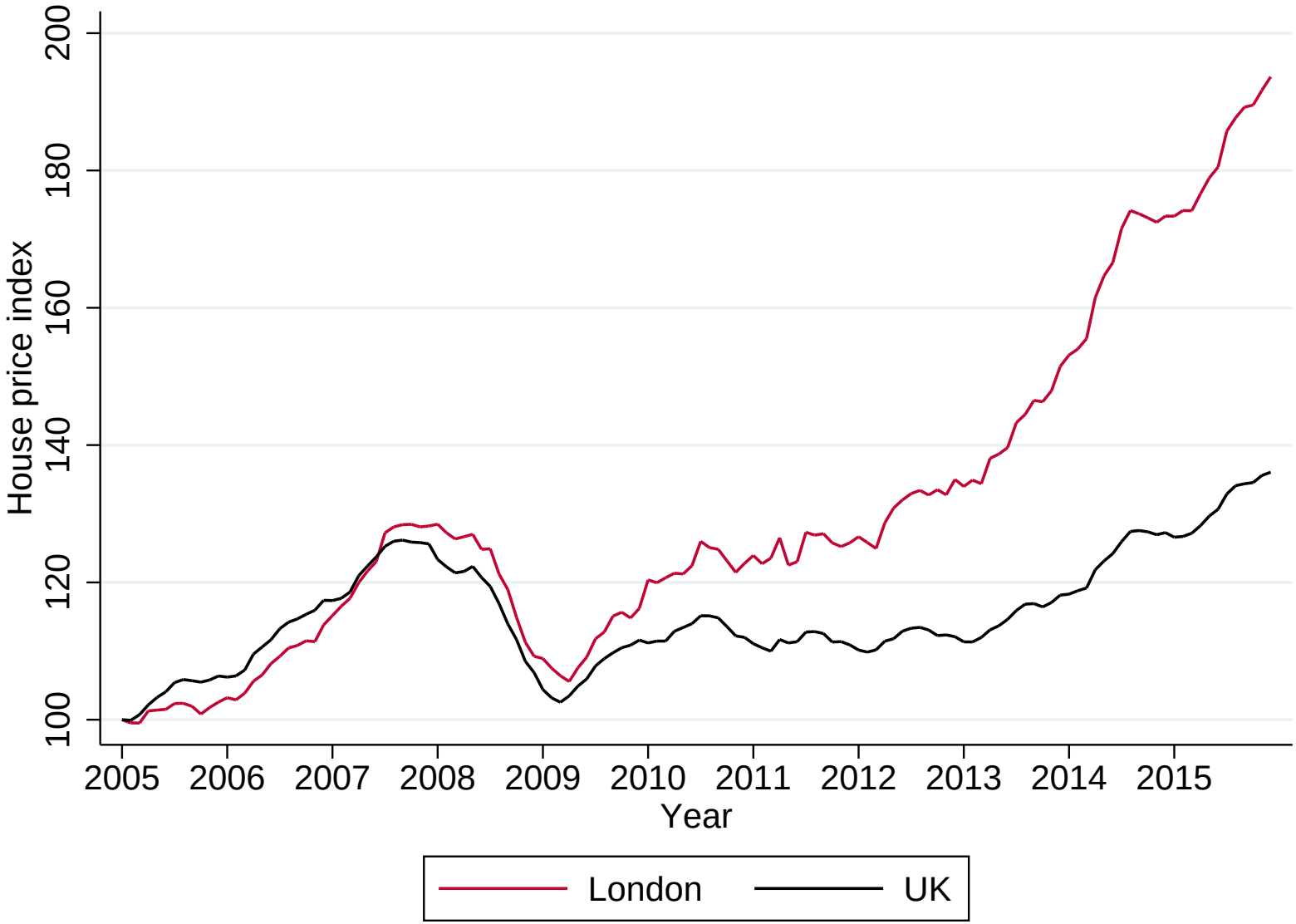
House Prices in the UK 2005-15



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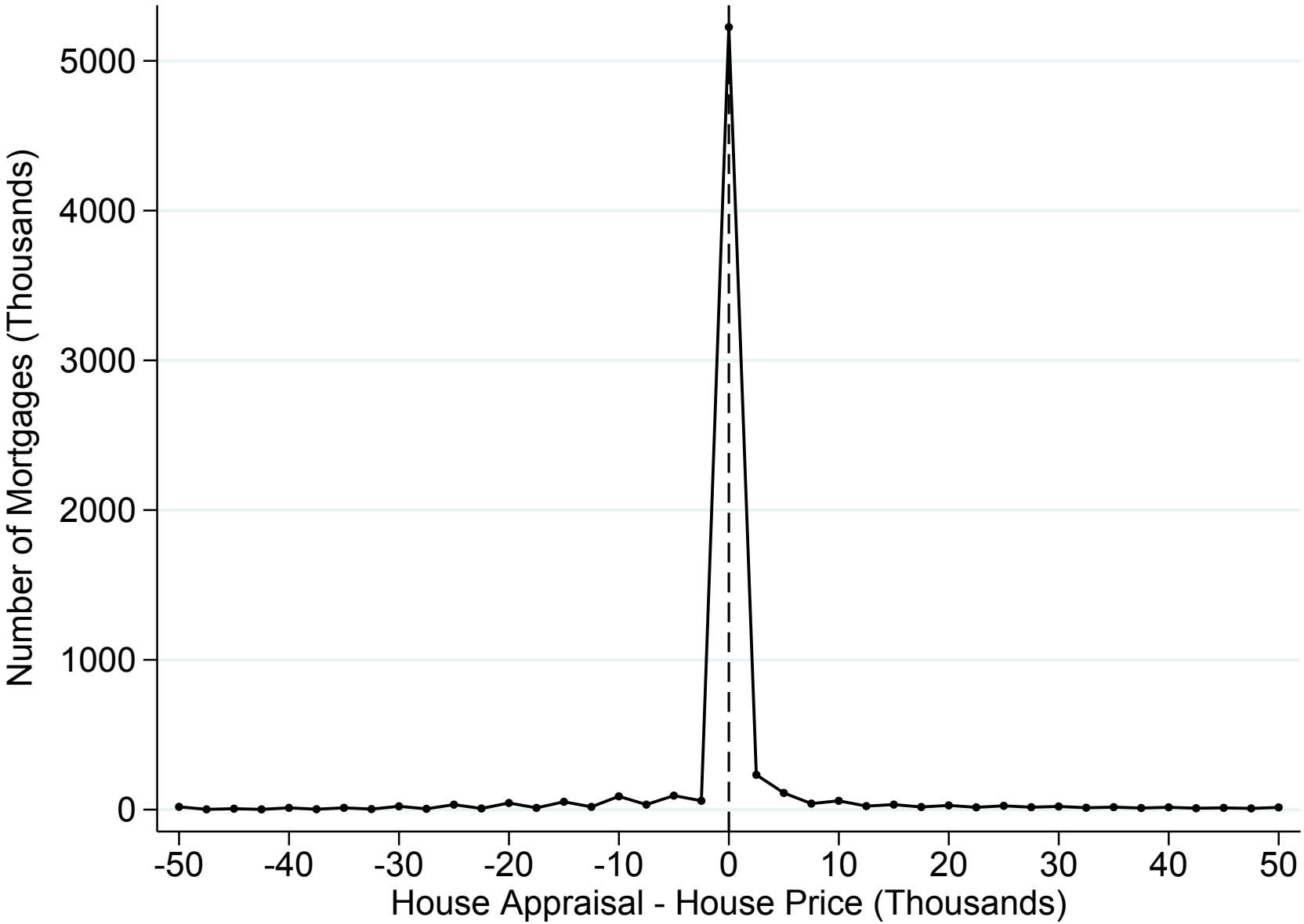
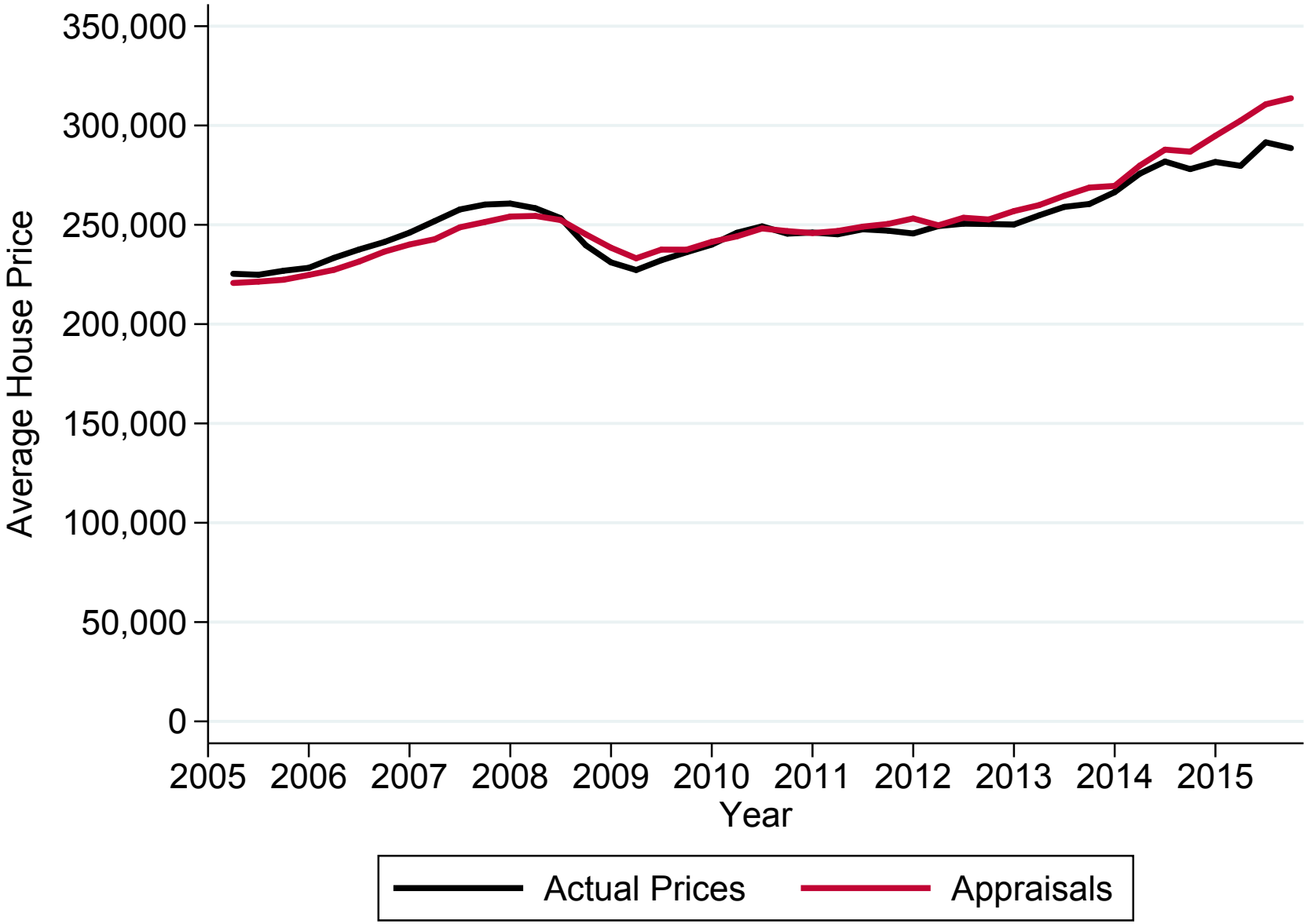
Prices vs Appraisals (New Purchases)

Distribution of Within-House Differences



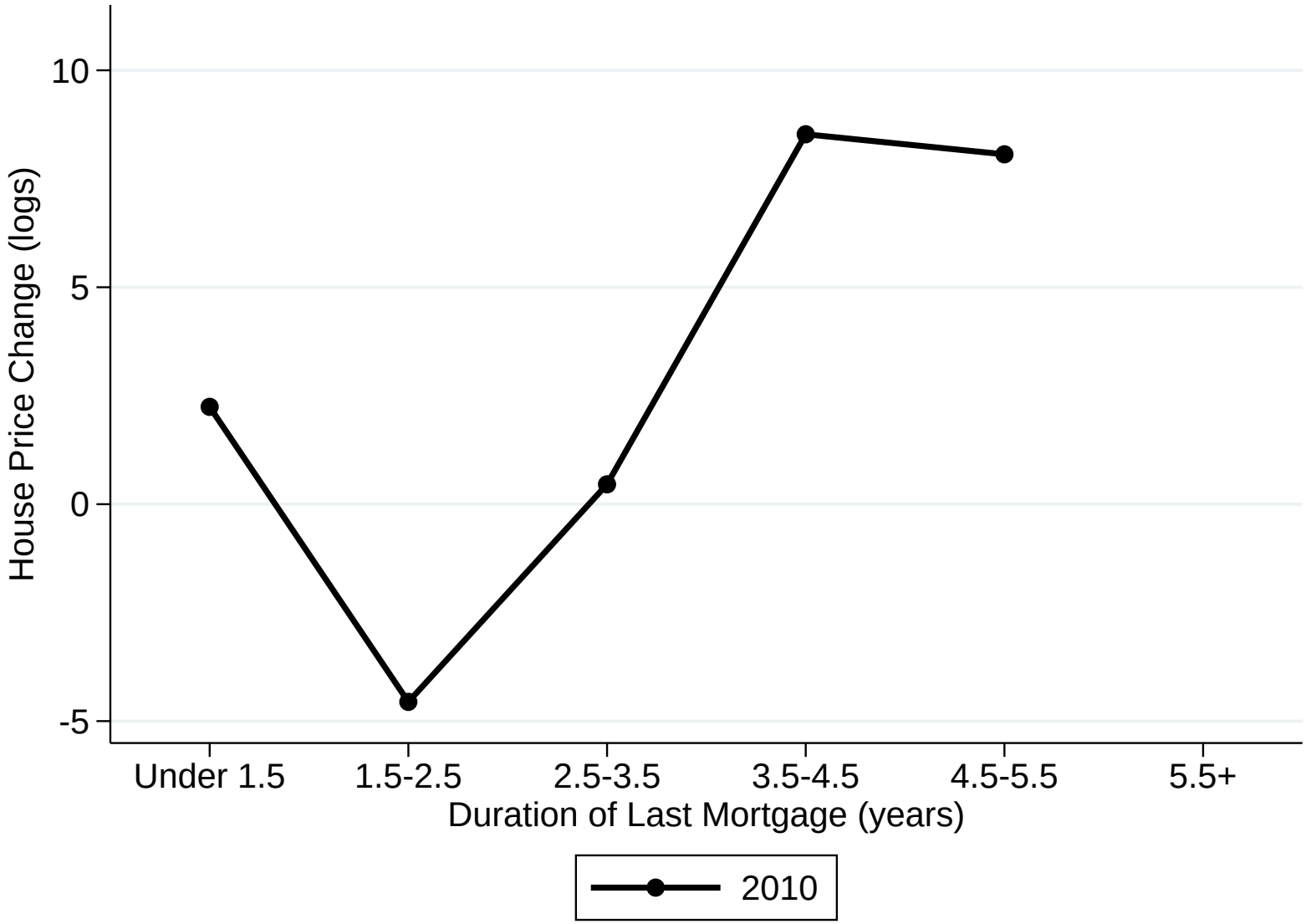
Prices vs Appraisals (Refinanced Homes)

Age and Postcode Adjusted Series Raw Back



Price Growth vs Last Duration × Time of Refinance

Variation in the Data



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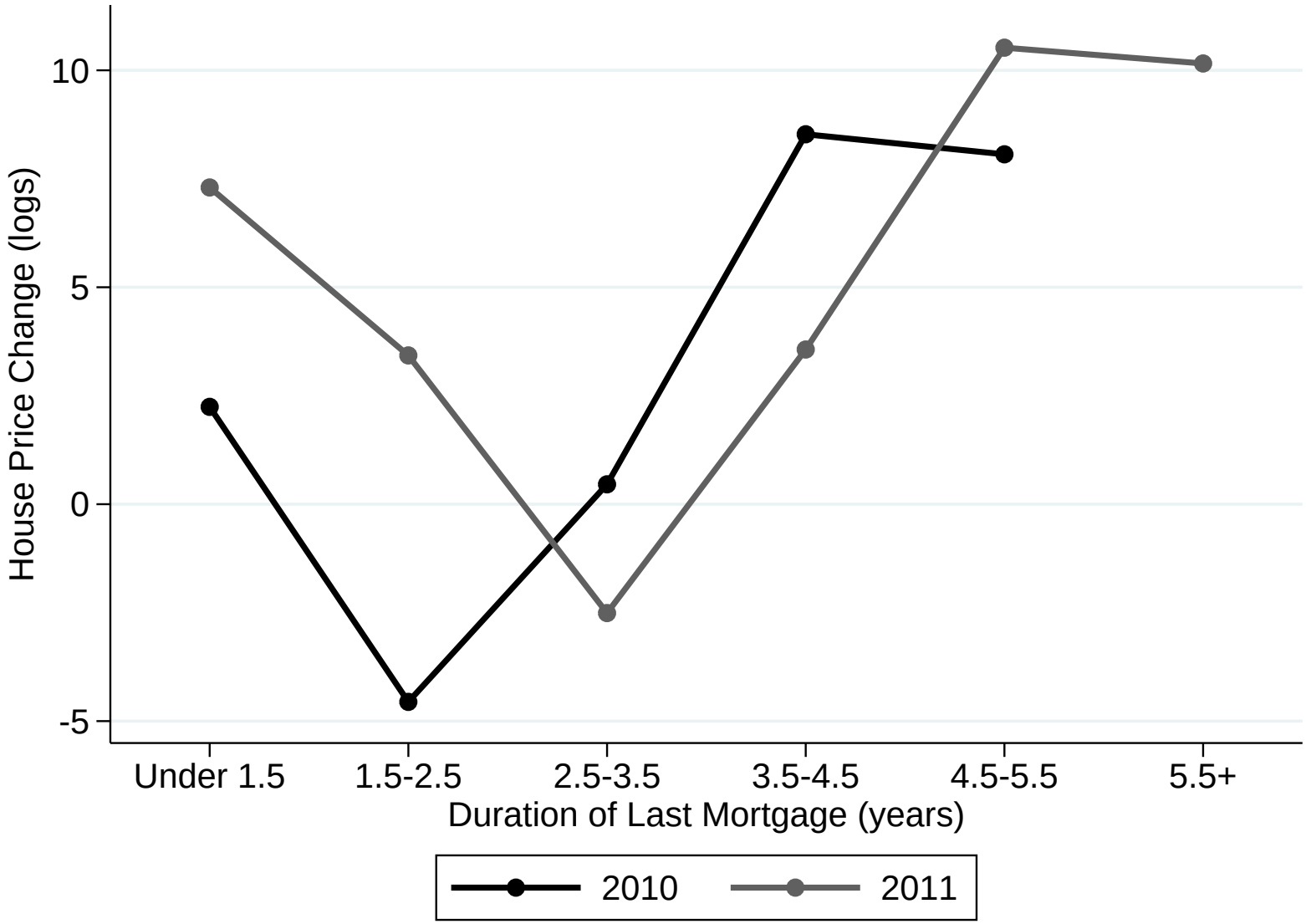
Price Growth vs Last Duration × Time of Refinance

Variation in the Data



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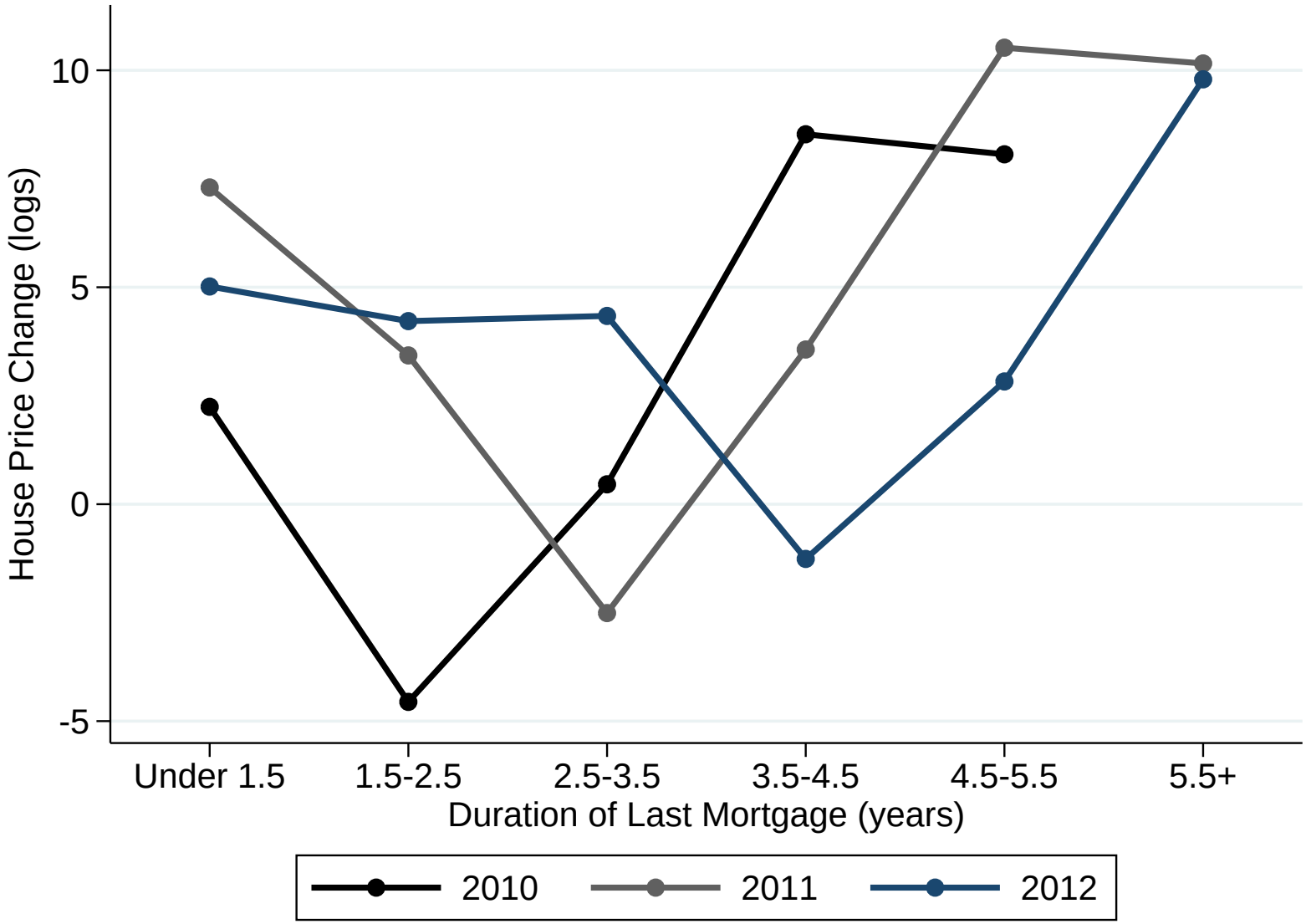
Price Growth vs Last Duration × Time of Refinance

Variation in the Data



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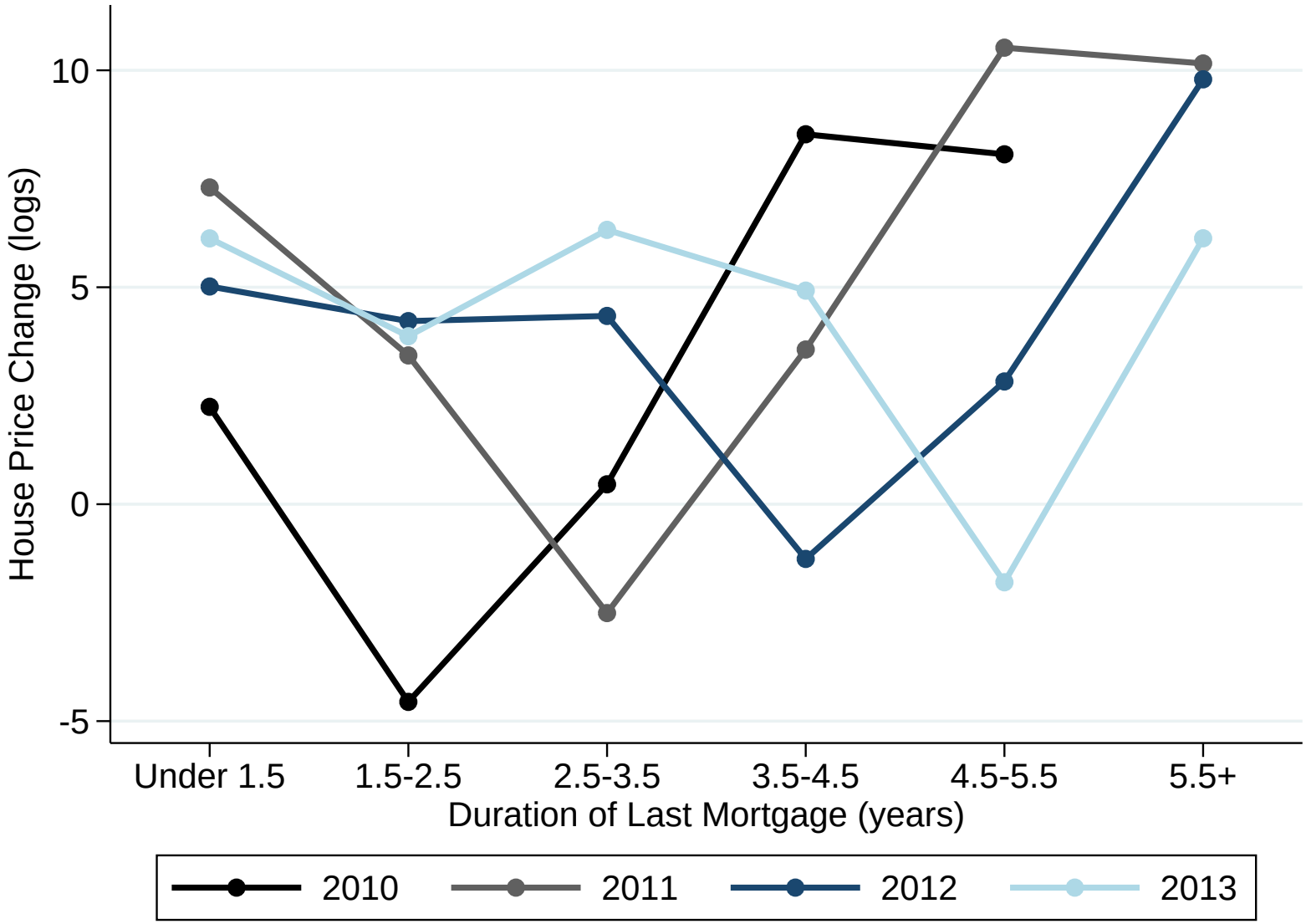
Price Growth vs Last Duration × Time of Refinance

Variation in the Data



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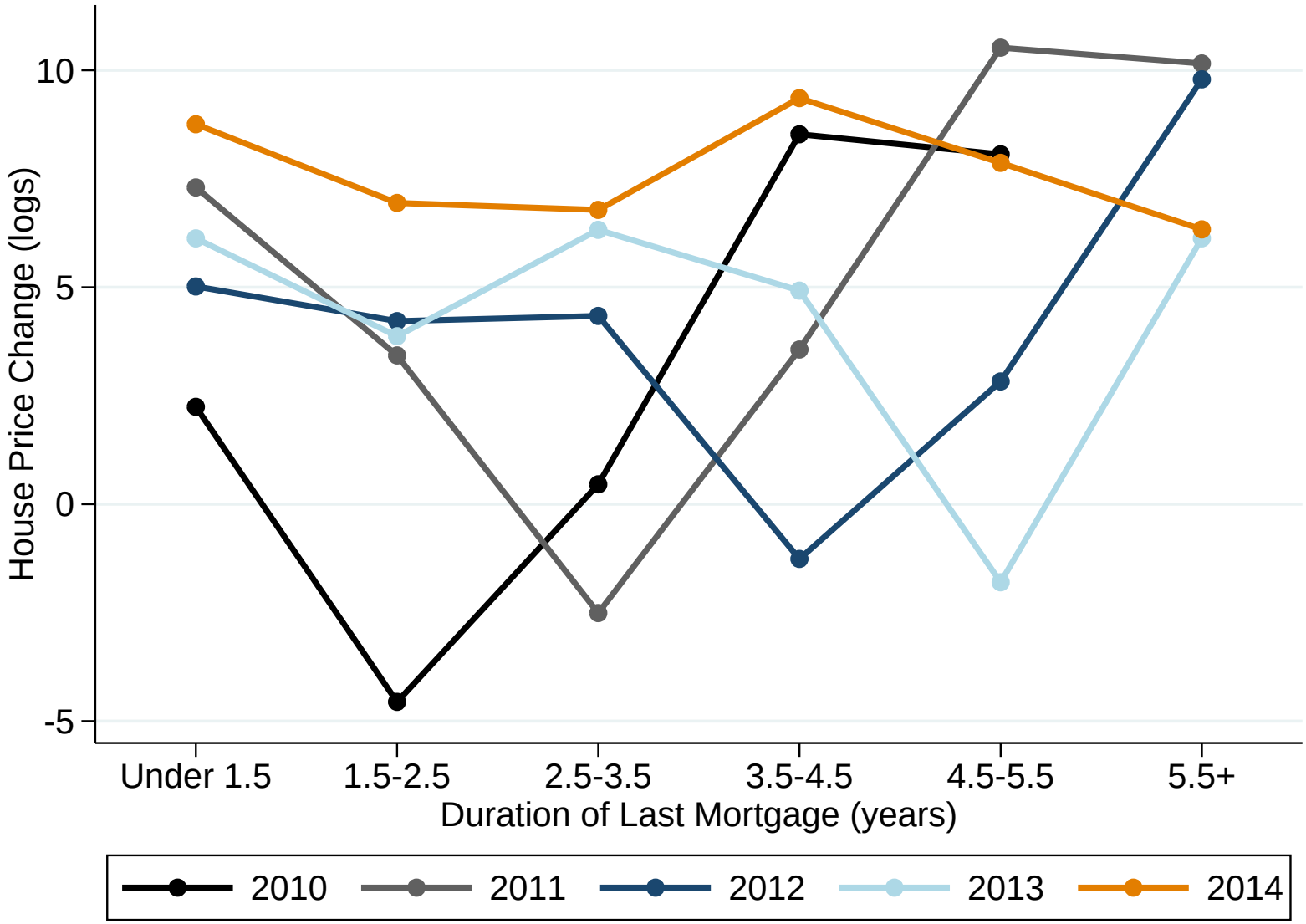
Price Growth vs Last Duration × Time of Refinance

Variation in the Data



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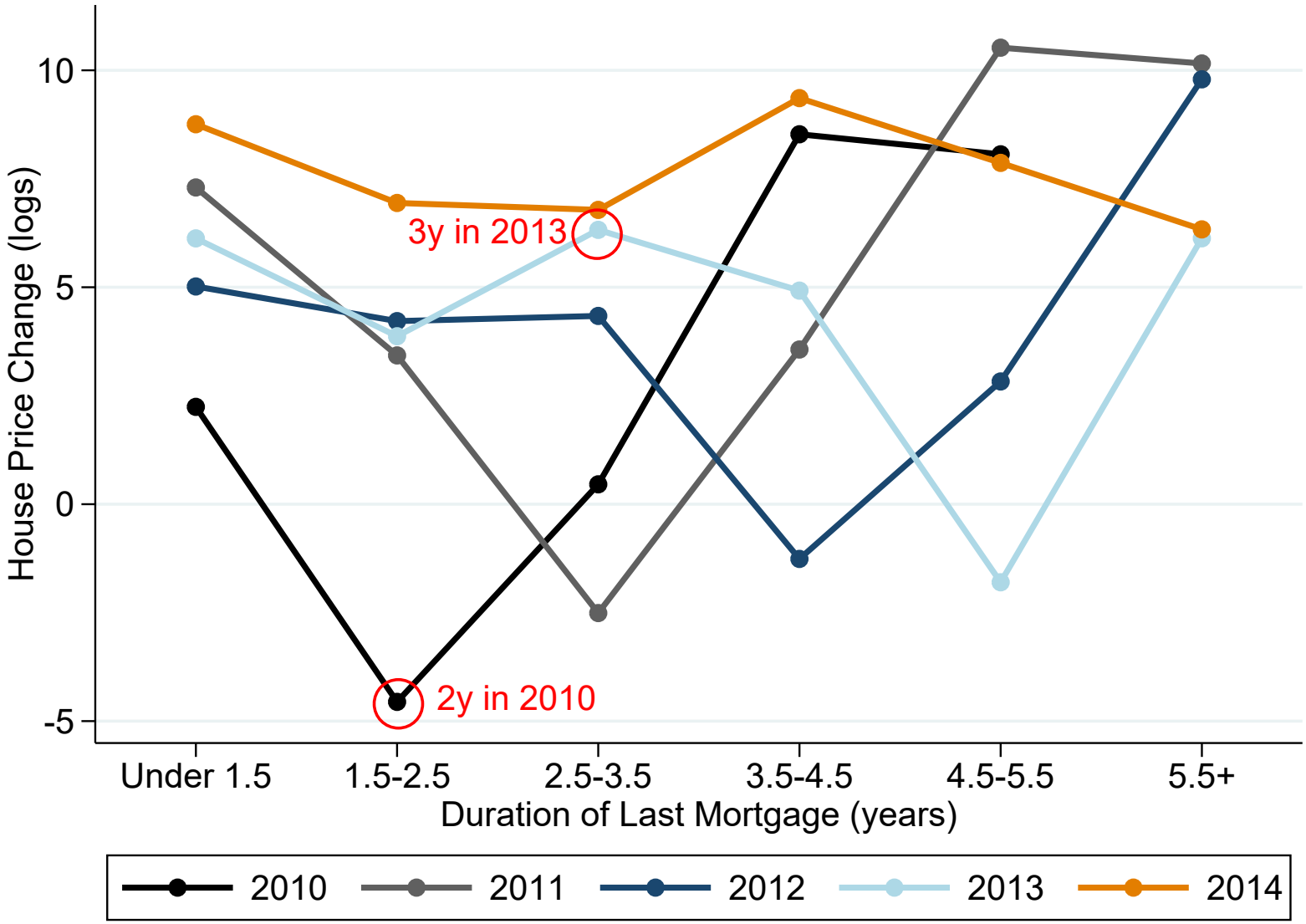
Price Growth vs Last Duration × Time of Refinance

Large Change in Price Growth



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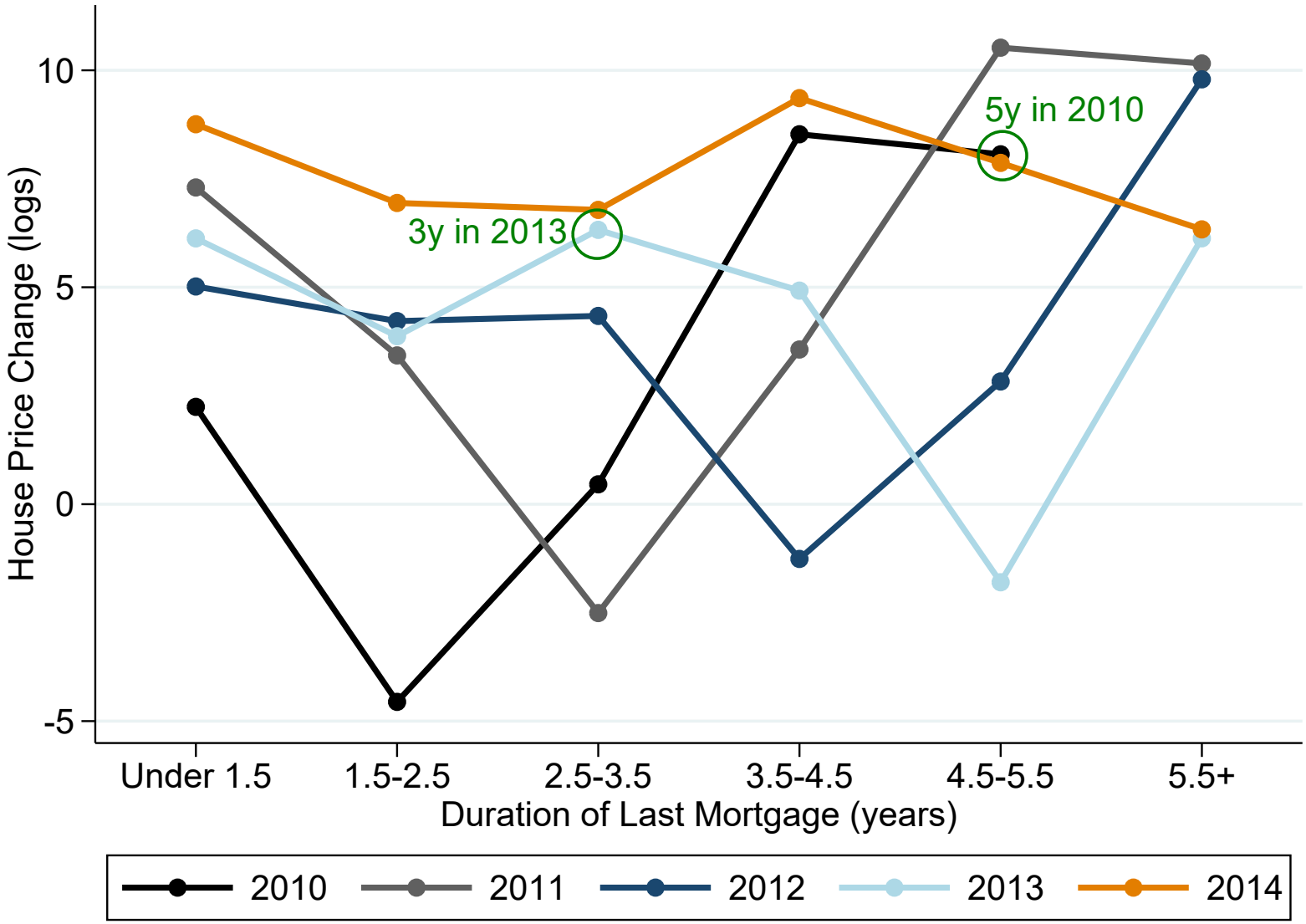
Price Growth vs Last Duration × Time of Refinance

Small Change in Price Growth



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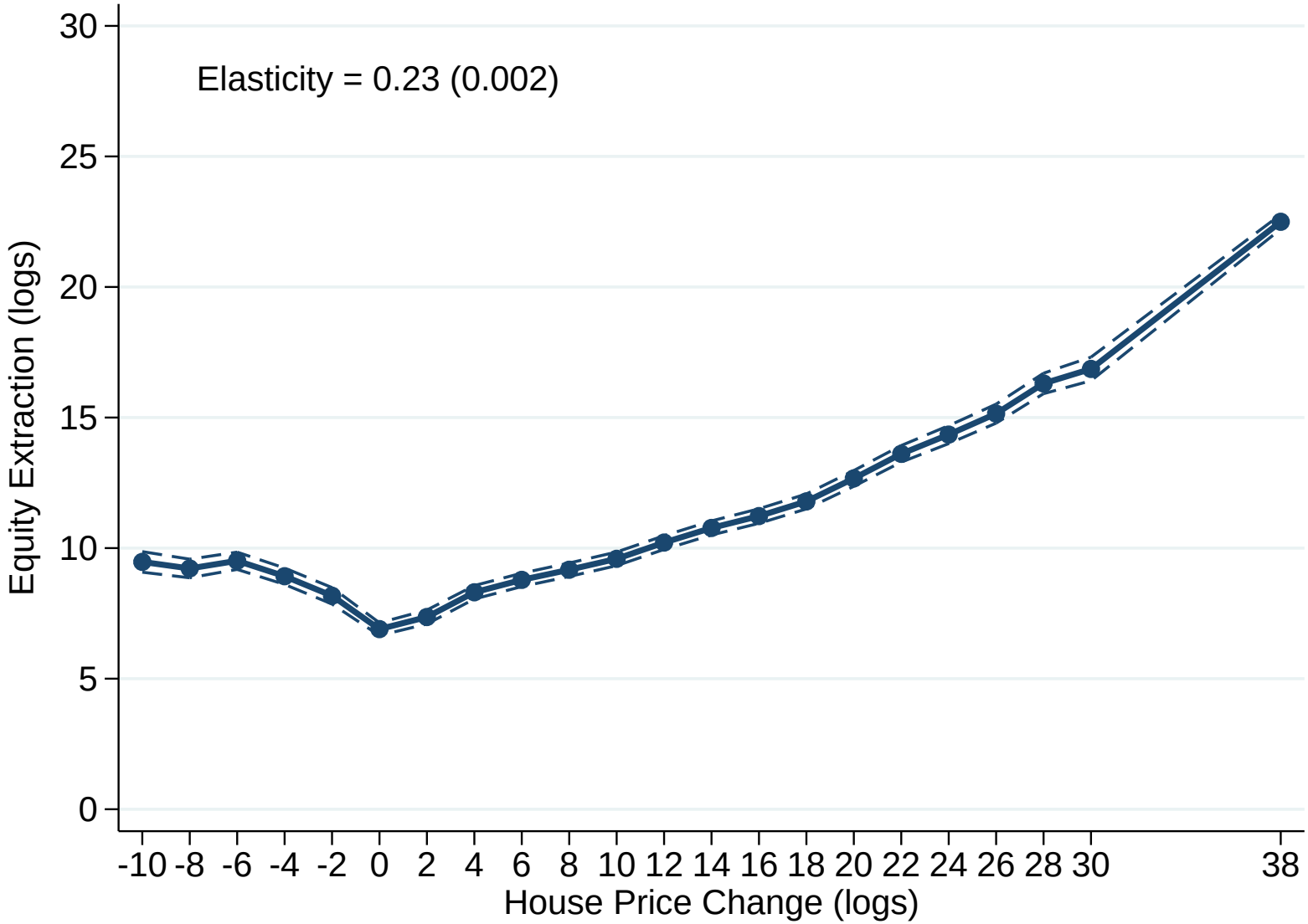
Baseline: Equity Extraction vs House Price Growth



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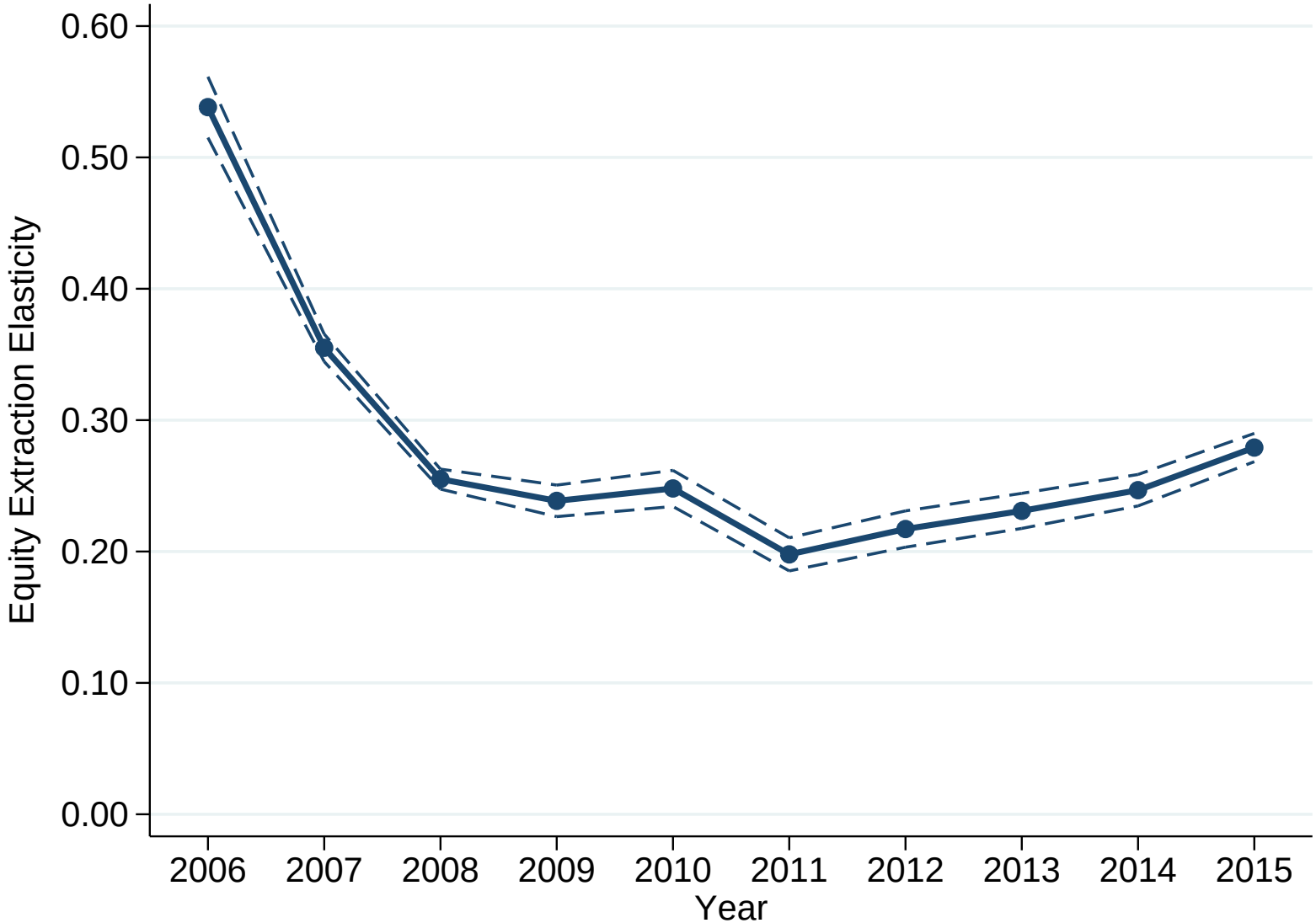
Baseline: Equity Extraction Elasticity By Year



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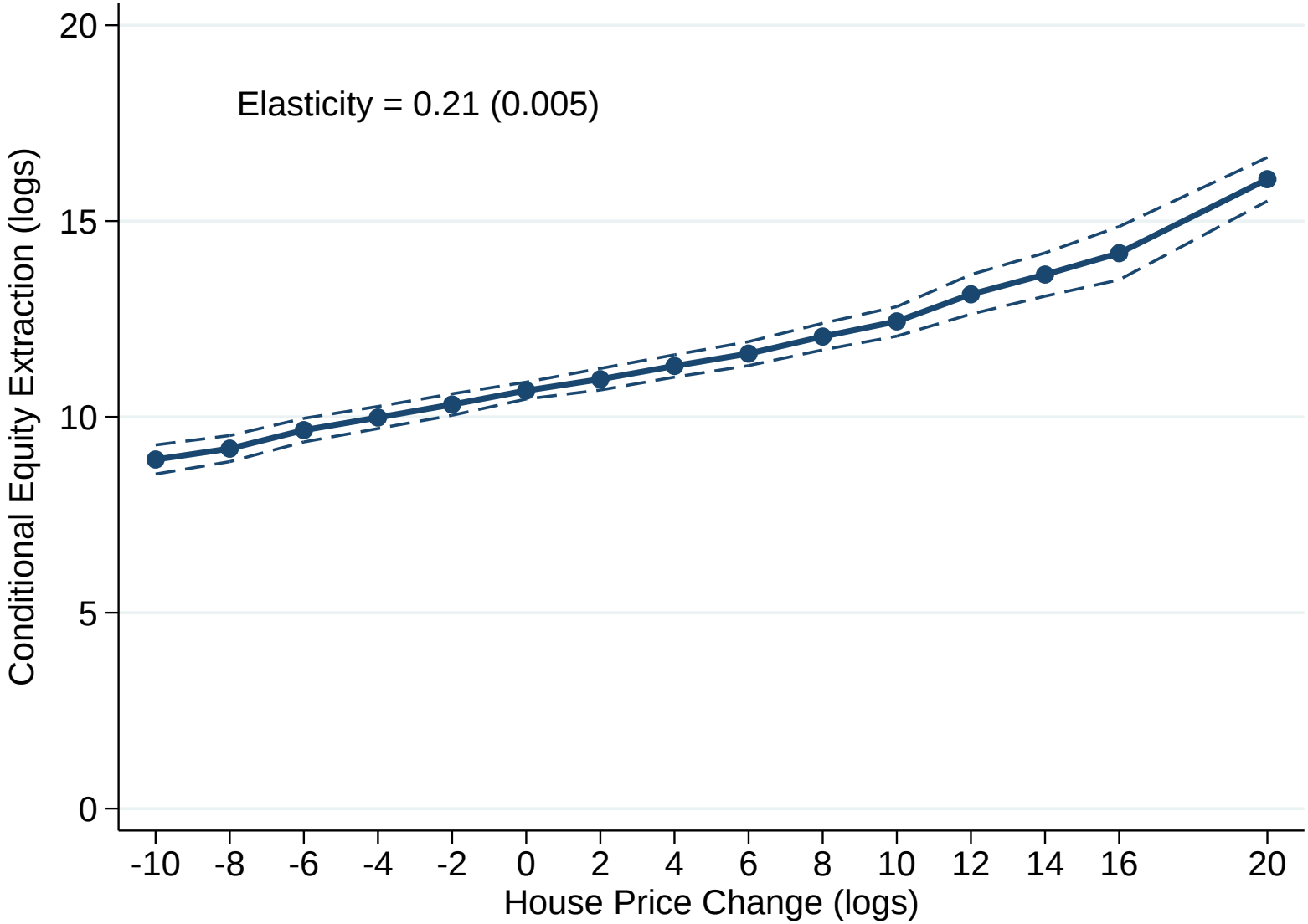
Equity Extraction vs House Price Growth

Individual and Time Fixed Effects



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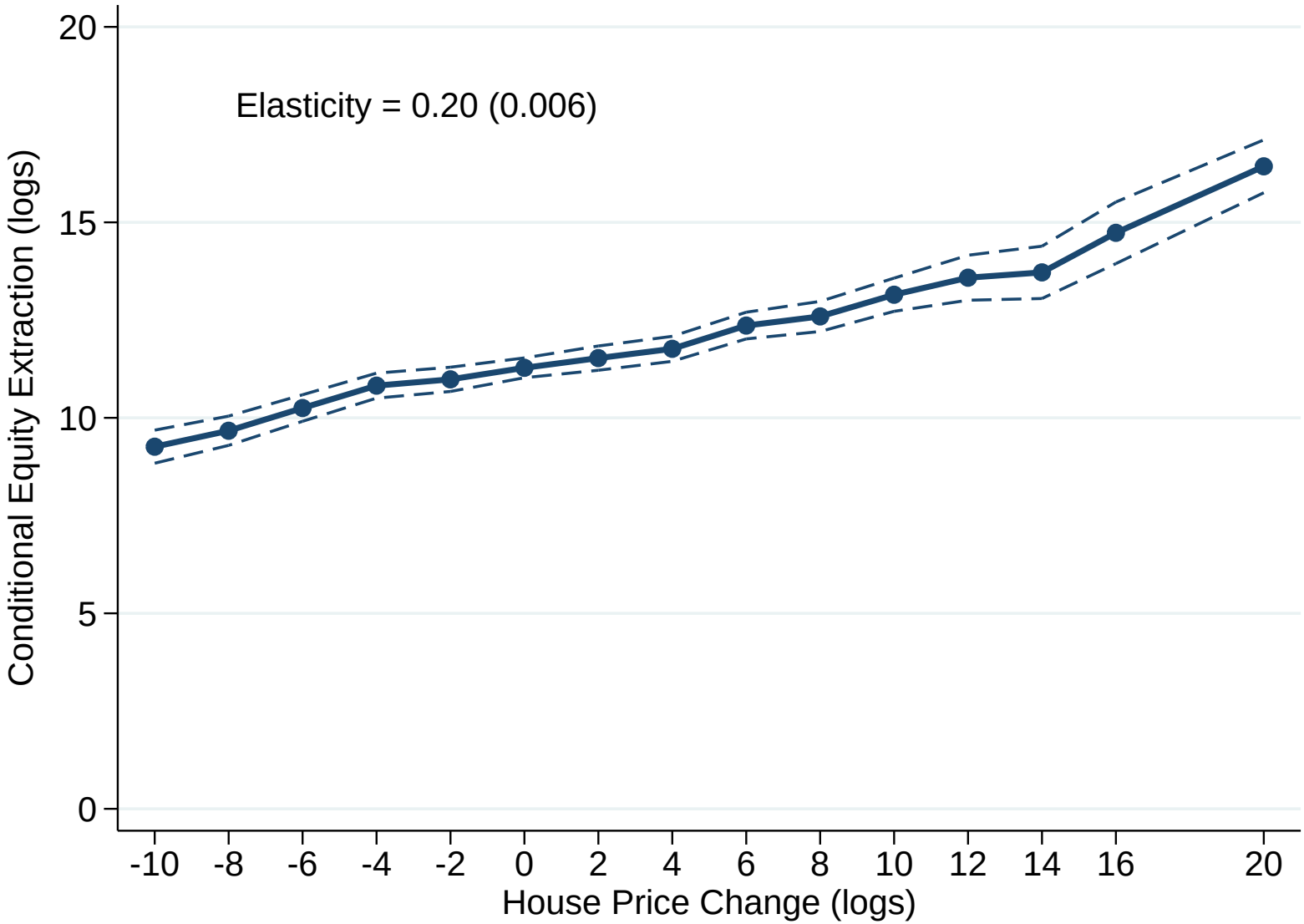
Equity Extraction vs House Price Growth

Adding Individual Controls



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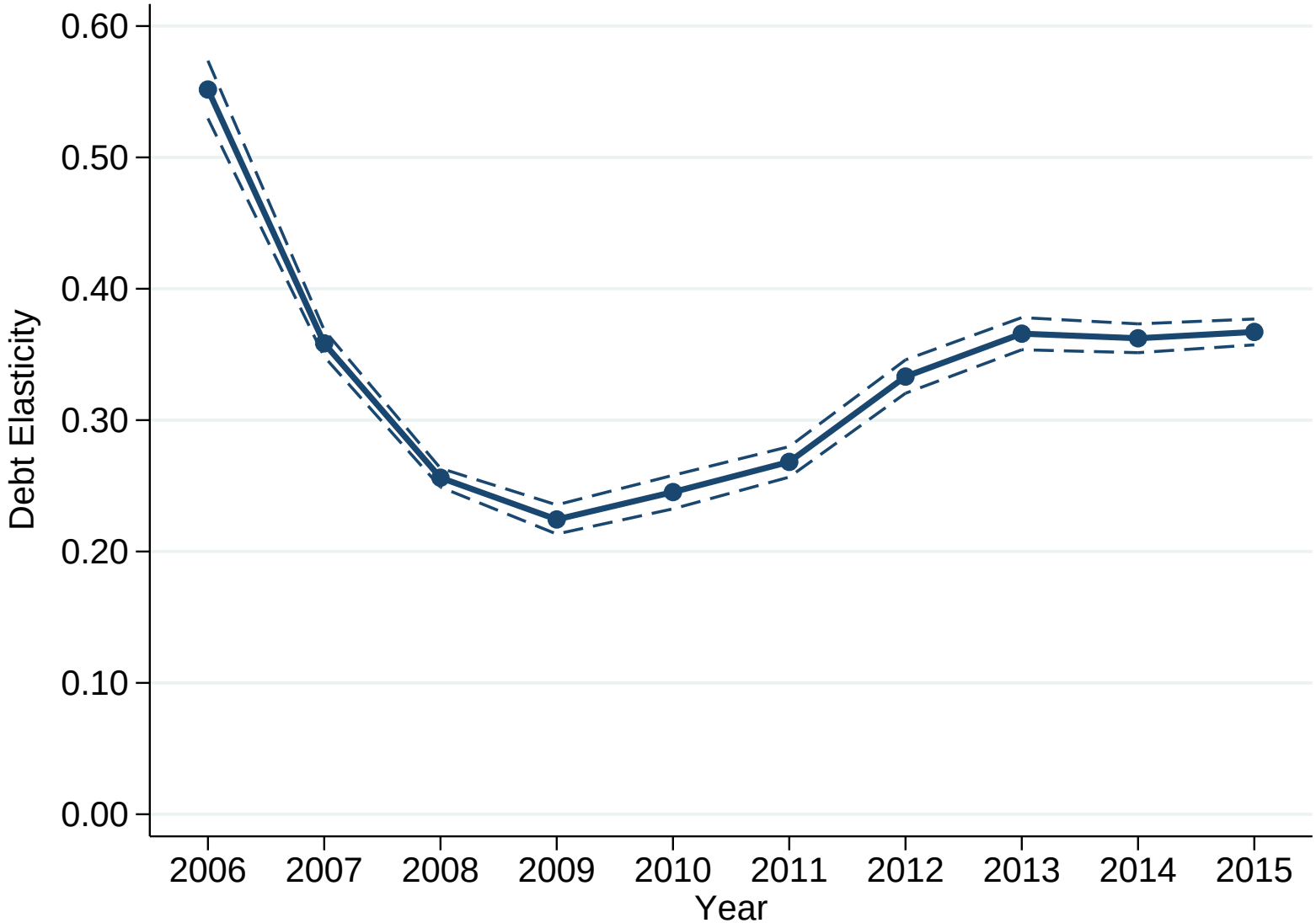
Baseline: Debt Elasticity Is Cyclical



Equity Extraction Elasticity

Elasticity Cycle

- Our boom elasticities are close to U.S. evidence from the boom (Mian & Sufi 2011), but our bust elasticities are smaller

- Two interpretations of the elasticity cycle:

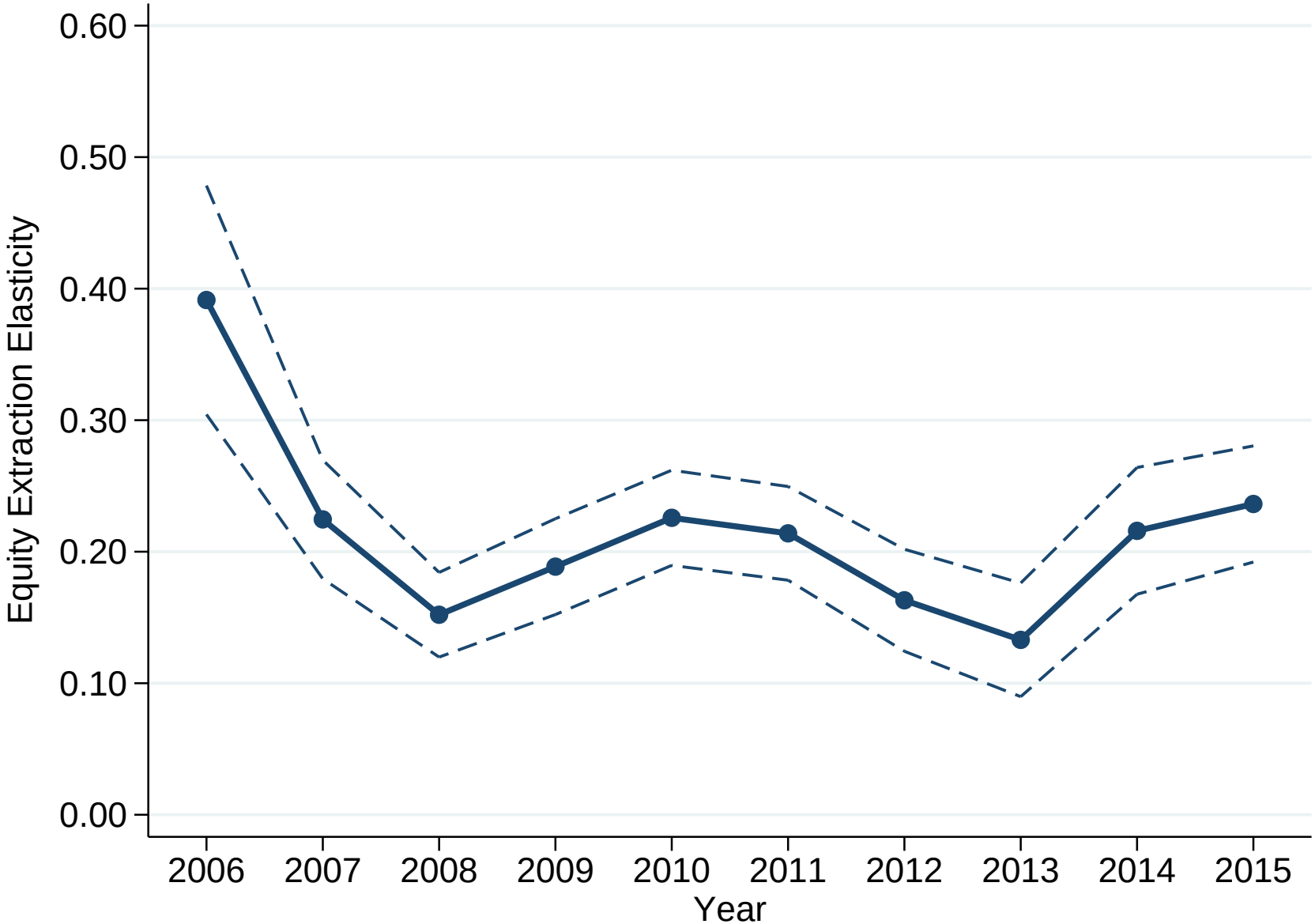
  1. Elasticities are biased:

     A cyclical omitted variable (e.g. expectations) is creating a spurious cyclical elasticity

  2. Elasticities are unbiased, but not structural:

     True elasticity depends on cyclical factors (e.g. expectations)

Elasticity Cycle Is Weaker, But Not Gone



IV Specification

- FE specification relied on
  1. Idiosyncratic variation across houses within counties
  2. Idiosyncratic variation in duration choices across homeowners

- Concerns with (1) $\rightarrow$ construct instruments based on (2)

- First stage:

$$\Delta \log P_{ict} = \rho \cdot \text{duration}_{it} \otimes \text{year}_t \otimes \text{region}_i + \text{controls} + \mu_{ict}$$

- Second stage:

$$\log D_{ict} - \log D^P_{ict} = \beta \cdot \Delta \widehat{\log P_{ict}} + \text{controls} + \nu_{ict}$$

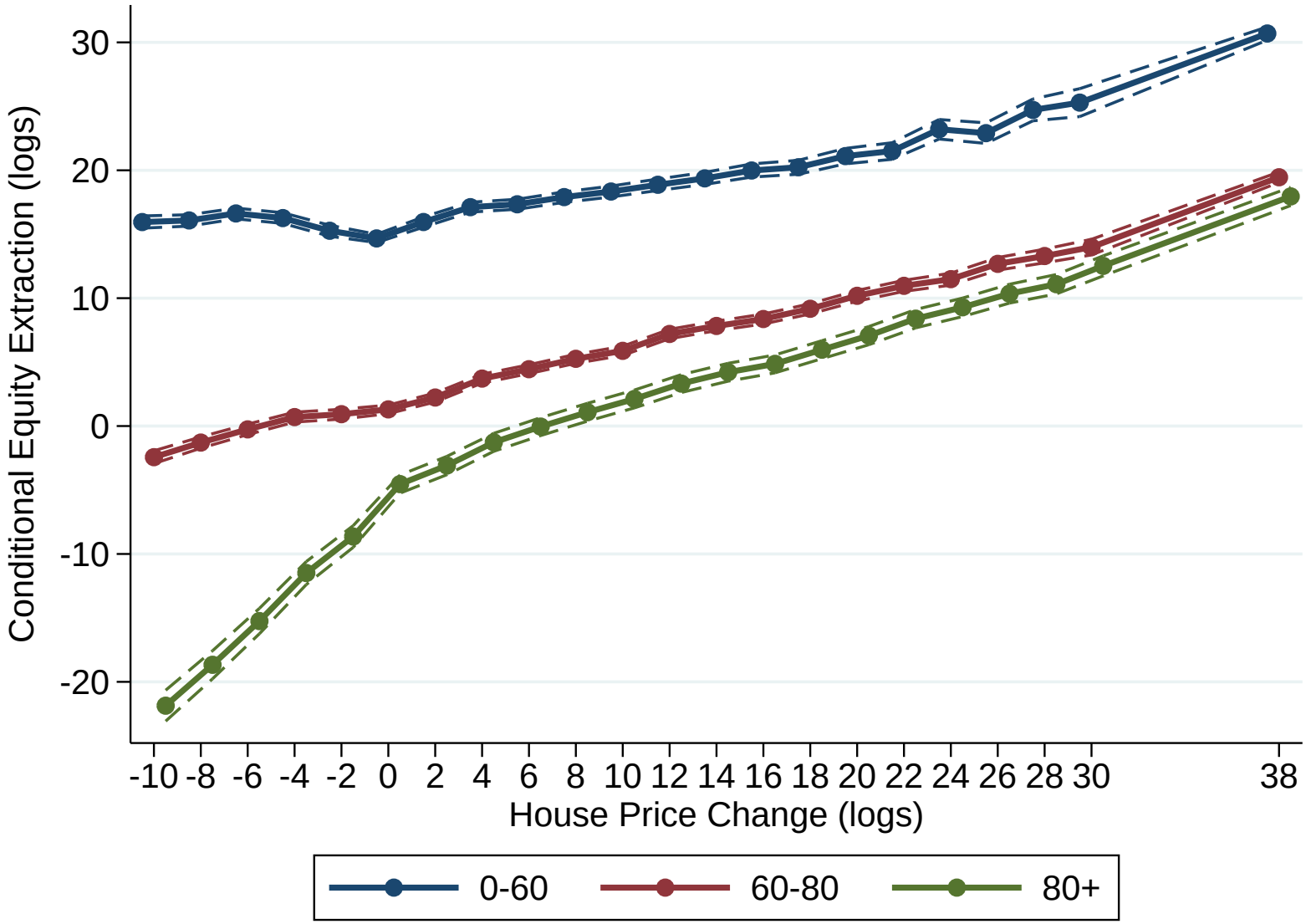
IV Estimates

Back

	(1)	(2)	(3)	(4)	(5)
IV Elasticity	**0.150**	**0.163**	**0.284**	**0.295**	**0.283**
	(0.004)	(0.004)	(0.026)	(0.056)	(0.056)
Contract Duration FE		×	×	×	×
Individual FE			×	×	×
Time FE			×	×	×
County × Time FE				×	×
Individual Controls					×

Heterogeneity by Pre-LTV

Nonparametric, No Other Controls



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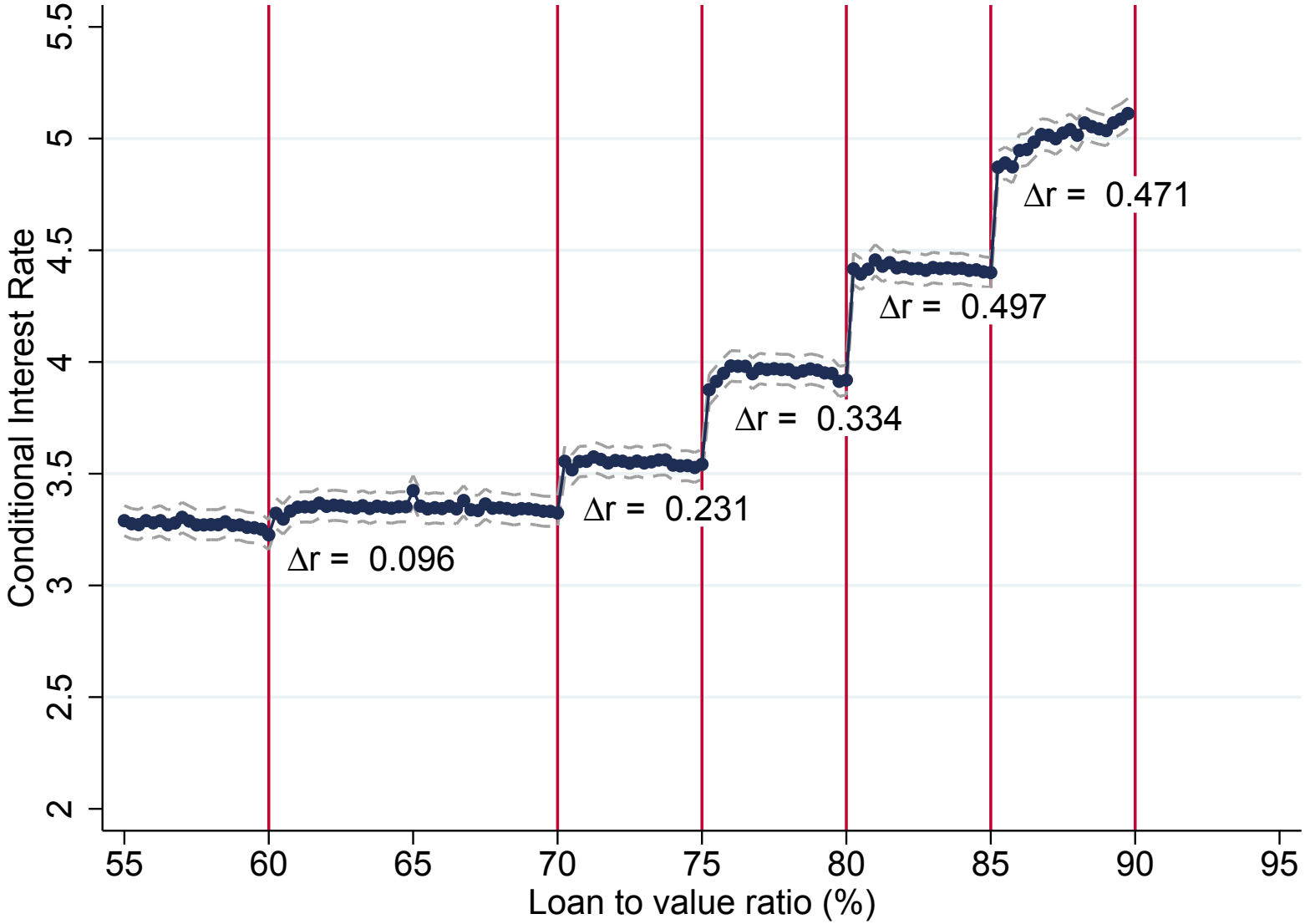
Mortgage Interest Notches

Best, Cloyne, Ilzetzki & Kleven (2015)



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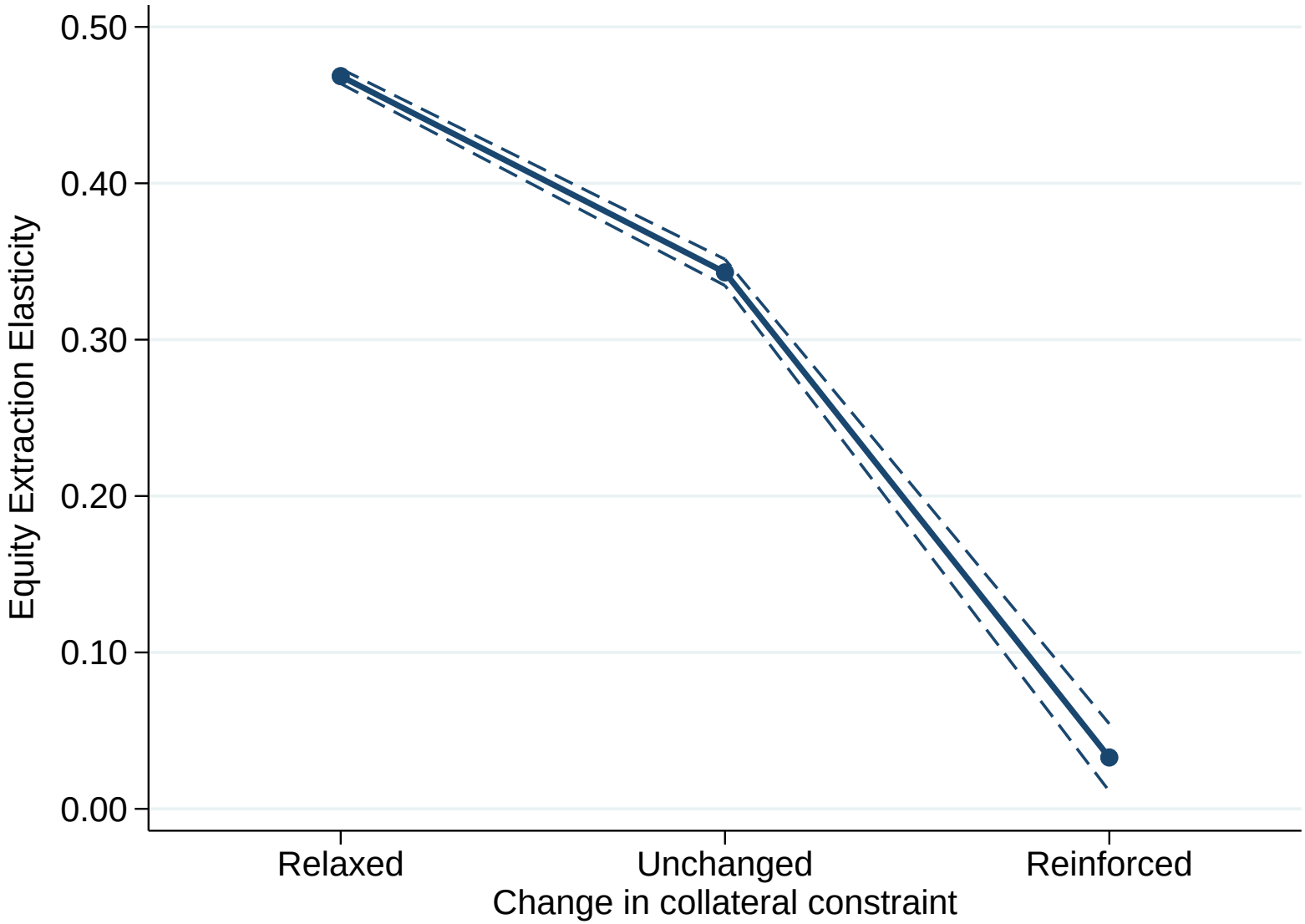
Elasticity by Notches Moved

All Years Pooled



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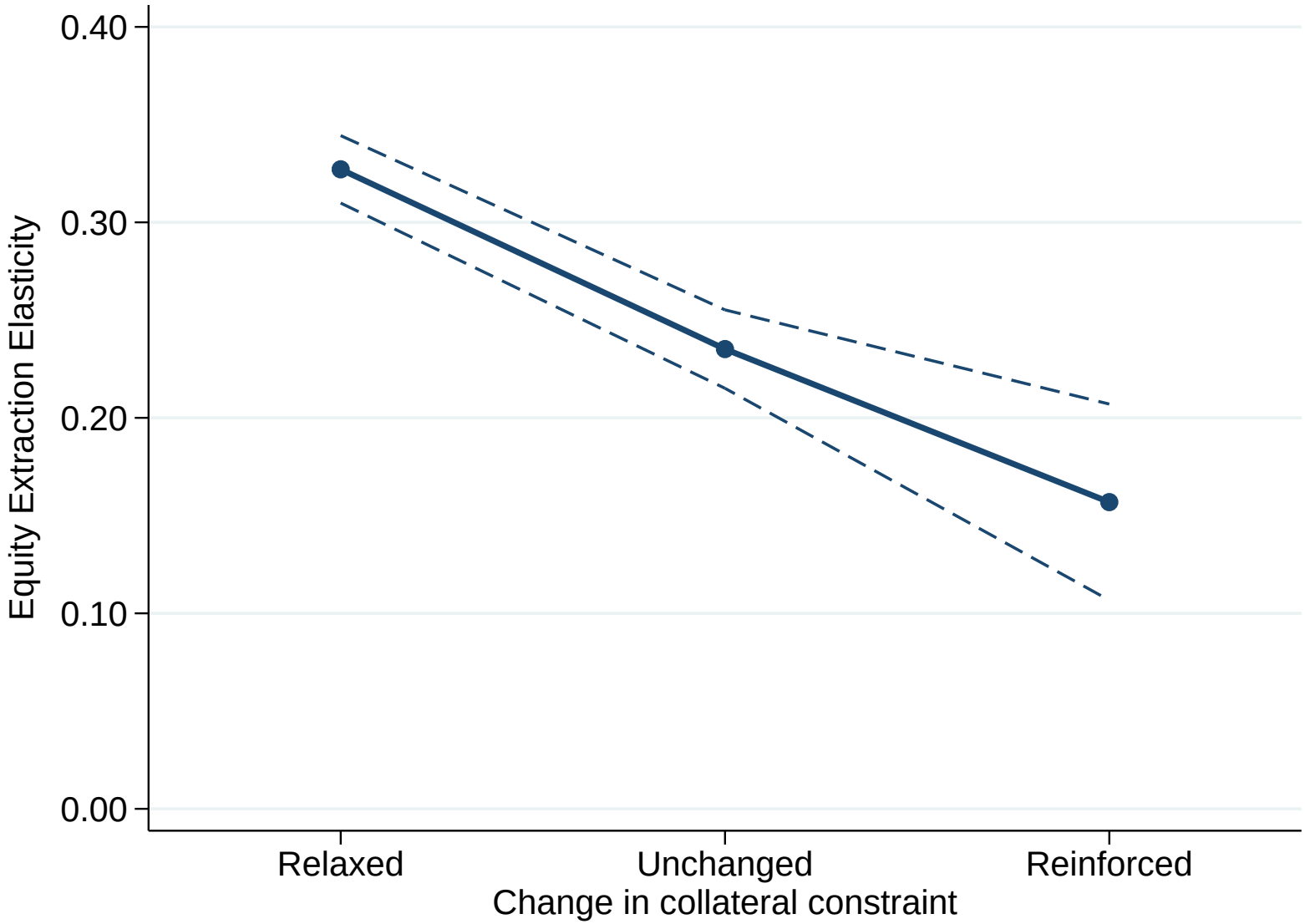
Elasticity by Notches Moved

Specification With Individual and Time Fixed Effects



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Descriptive Statistics

	On-Time Refinancers	Off-Time Refinancers	Missing Duration
Age	39.77	41.58	41.37
	(8.69)	(8.79)	(9.04)
Couple	0.55	0.53	0.54
	(0.50)	(0.50)	(0.50)
Income	54,516	53,443	62,006
	(48,424)	(52,356)	(108,734)
Income Change (logs)	0.08	0.11	0.07
	(0.31)	(0.38)	(0.37)
Interest Rate	4.22	3.60	3.97
	(1.51)	(1.33)	(1.53)
House Price	245,031	233,110	276,638
	(163,128)	(158,359)	(213,290)
LTV	61.56	63.04	60.72
	(18.30)	(19.27)	(19.27)

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