Mortgage Leverage and House Prices

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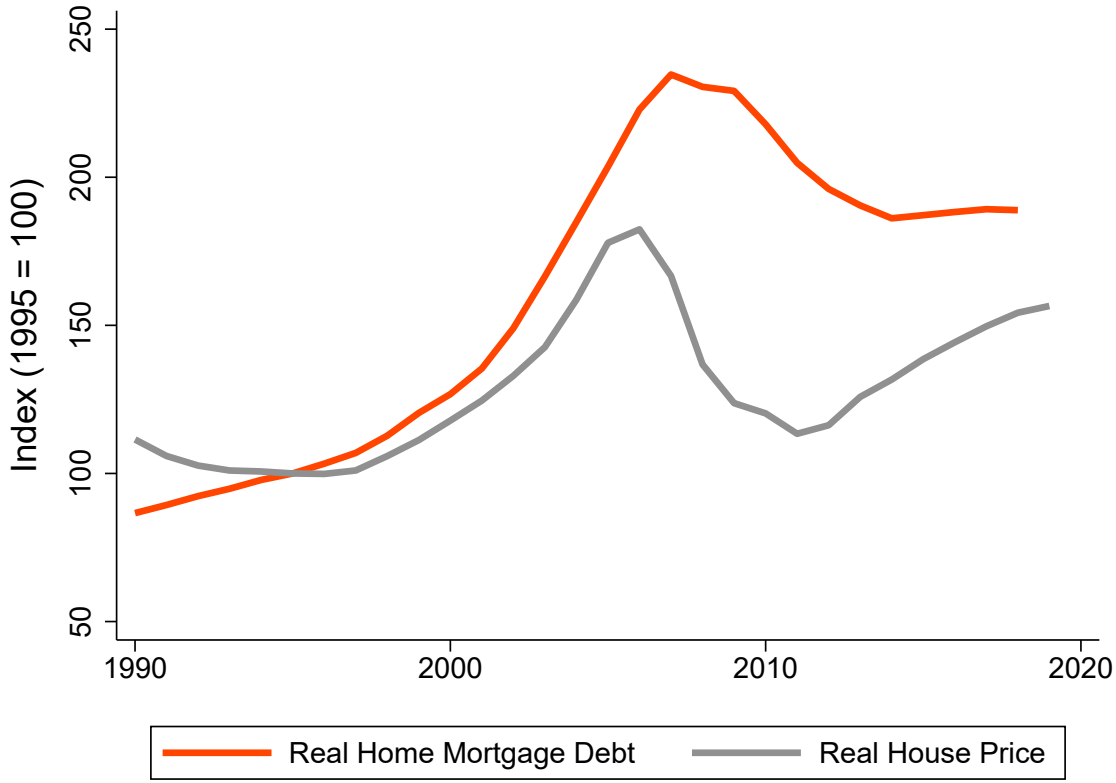
How do house prices respond to lending standards?

- Lenders limit mortgage payment size relative to income.
- How do house prices respond to changes in these rules?

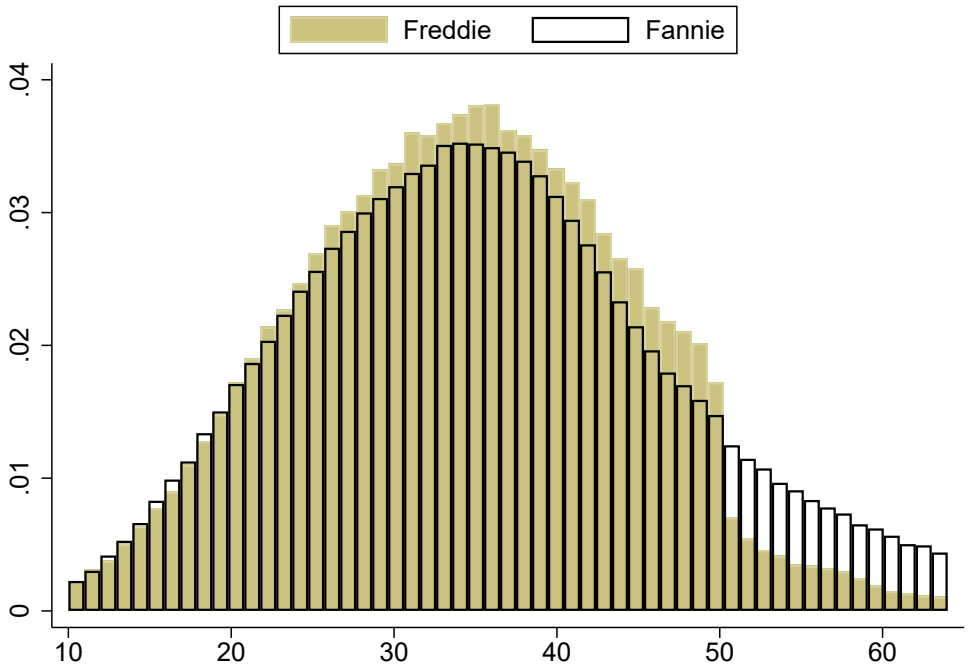
Important for understanding the boom, effects of regulation.



Approach

- Lenders rely on software created by Fannie Mae or Freddie Mac.
- In 1999 Freddie tightened DTI rules (not public).

$$\text{DTI} = \frac{\text{mortgage payment} + \text{other obligations}}{\text{income}}$$



- Counties affected differently, depends on lender ties to Freddie.

Main result

Debt-to-income limits have a large effect on house prices:

1. Consistent with response of constrained households in short run.
2. Continues to build over several years, suggesting feedback.

Institutional Background

Automated underwriting software

- Software:
  - Freddie's Loan Prospector (LP)
  - Fannie's Desktop Underwriter (DU)
- Determines if Fannie or Freddie will buy a mortgage:
  - Public rule: loan $<$ conforming limit ($453,100 in 2018).
  - **Proprietary rules** relating to income, collateral and credit score.
- Could also be used for subprime/jumbo loans:
  - "[Fannie and Freddie are] promoting the use of DU and LP for such non-conforming non-agency loan types as jumbos and subprime loans." *Mortgage Banking, 1999*

Software differences lead to local variation in DTI policy

Use Freddie Mac county market share from before the change.

Relationships exclusive and persistent.

Mortgage Banking, 1999:

- "It's very **expensive to do both** [Fannie and Freddie's software]. There's the upfront costs and there's all kinds of ancillary costs . . . So most lenders are opting to go with one based on where they have their primary business relationship."

- "As soon as one comes out with something, it's usually just a matter of time before the other does too. In the end they're pretty close overall. I'm not sure every correspondent, broker or lender really needs both systems. There's **tremendous overlap** and the product differentiation between the two is not a huge issue."

Data and descriptive statistics

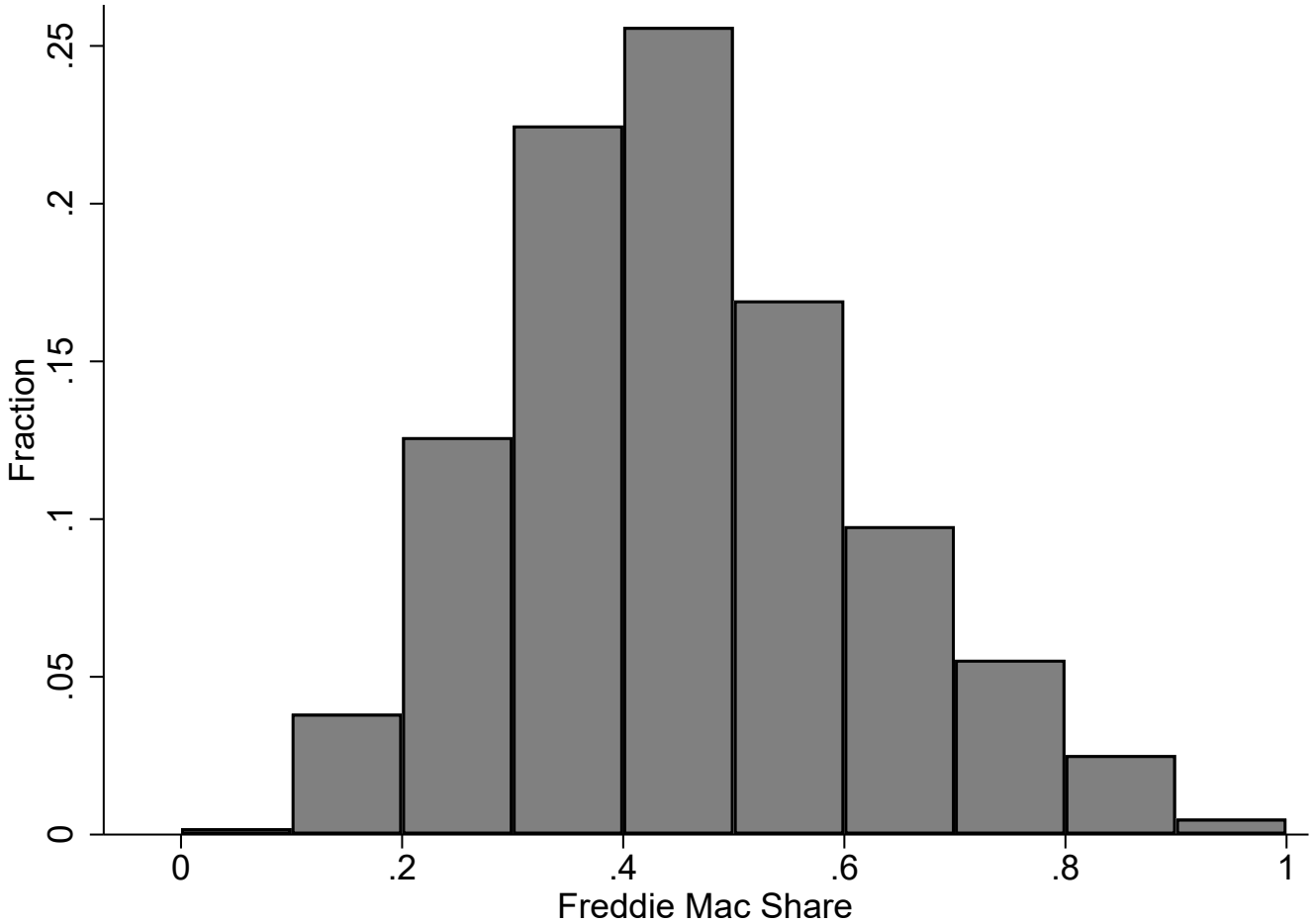
Data

1. Document policy change:
   - GSE Single Family Loan Performance
     - DTI, LTV, credit score for loans GSEs purchased.
     - Available from 1999.
   - GSE Public Use Database
     - Loan-to-income, LTV for loans GSEs purchased.
     - Available from 1993.

2. Calculate local exposure to Freddie Mac:
   - HMDA
     - Loan-to-income, census tract, lender, was loan sold to Fannie/Freddie.
     - Available from 1991.

3. Measure effect on house prices
   - CoreLogic county house price index.
   - Similar results using FHFA house prices.

County exposure to Freddie Mac (1998)



$$\text{Freddie}_c = \frac{\#\text{ Loans in county } c \text{ sold to Freddie}}{\#\text{ Loans in county } c \text{ sold to Freddie or Fannie}}$$

Freddie exposure and other variables

- Counties are similar with respect to a number of variables (average DTI, underserved share, subprime share, share sold to Fannie/Freddie)

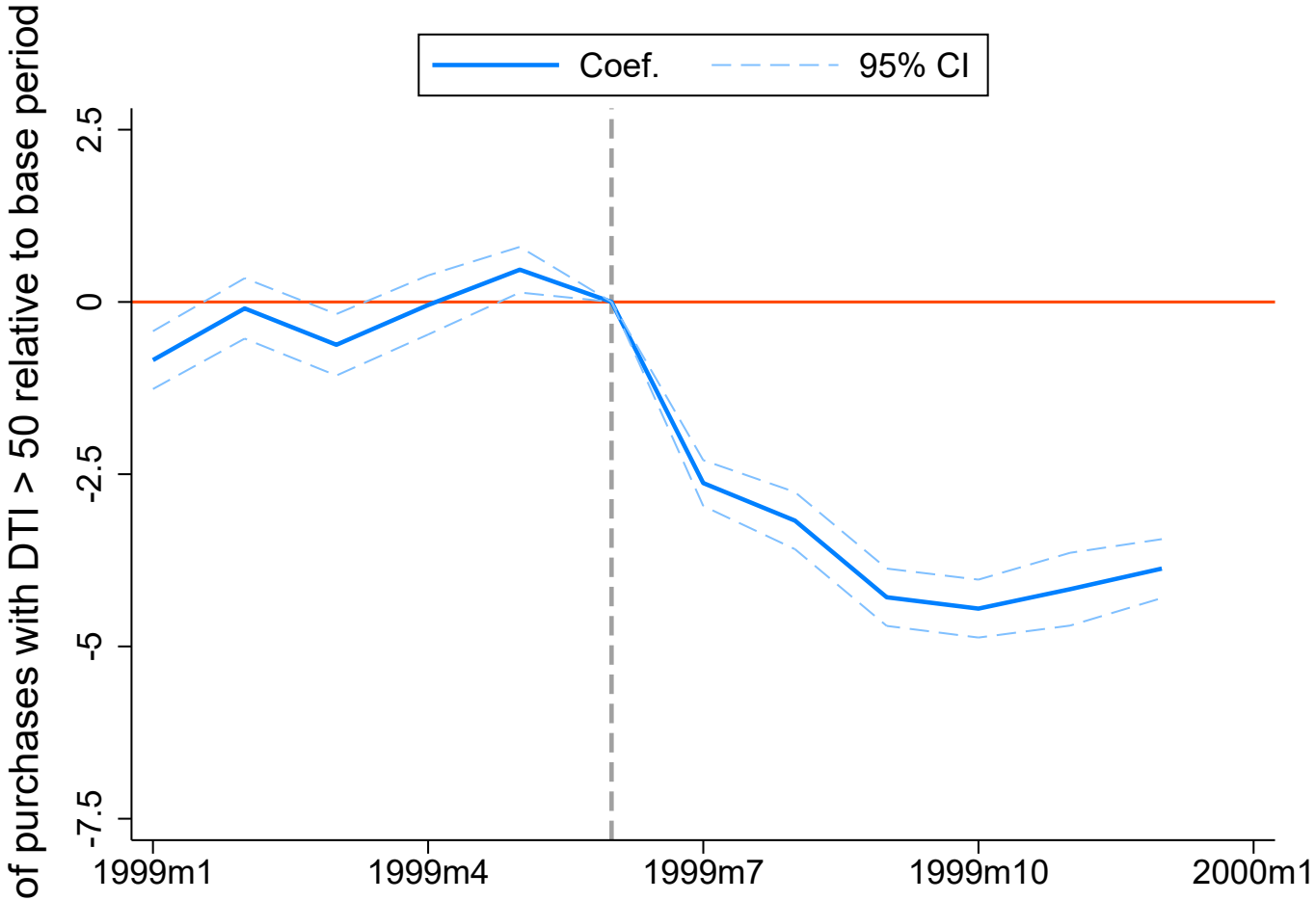
- Hower, high Freddie counties:
  - less coastal
  - less densely populated
  - lower median income

Approach: Within state variation, include controls and show divergence in prices coincides with policy [also similar results with reweighting].

Policy change

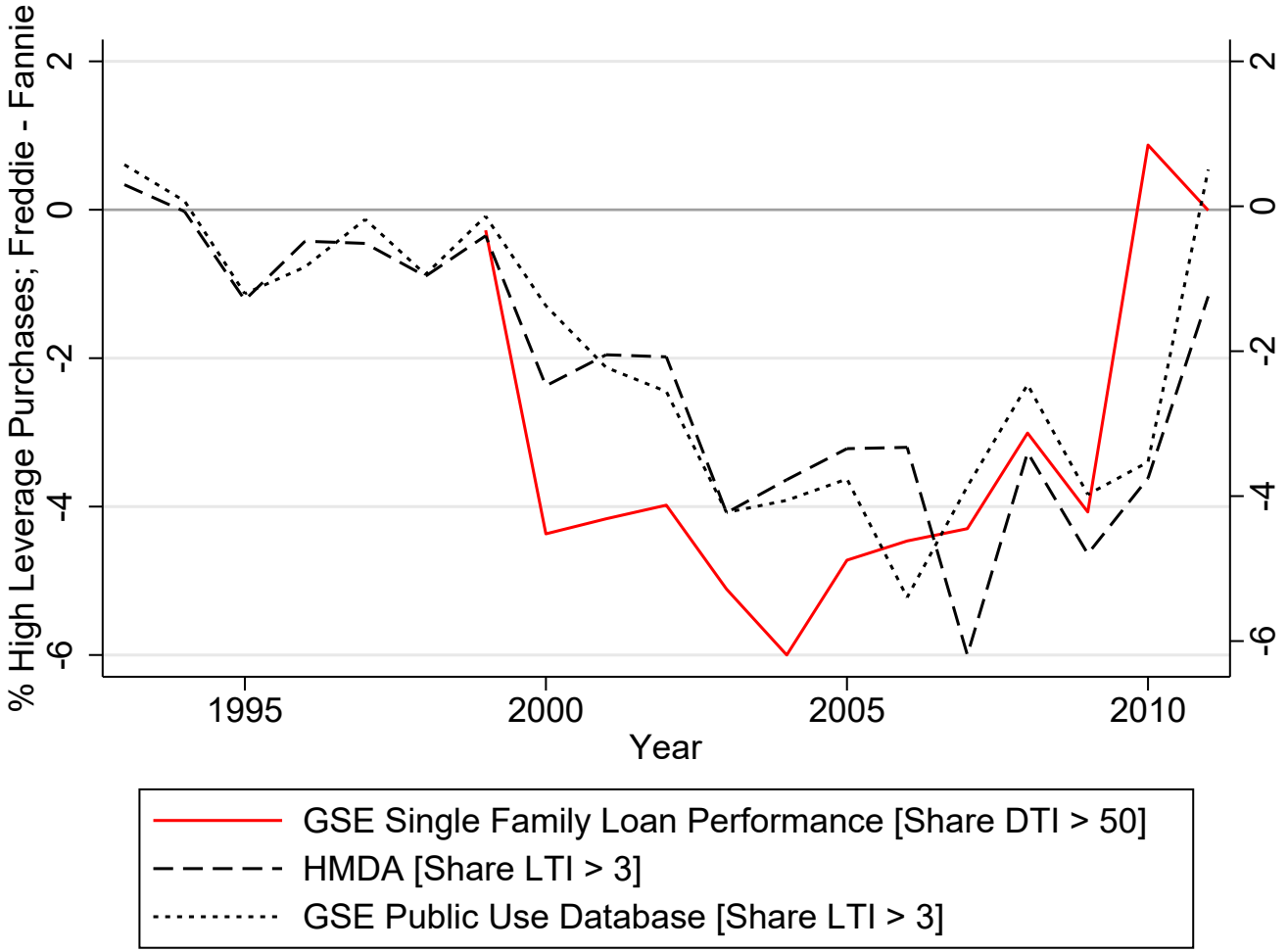
Timing of change

Change is not publicly announced → rely on data:



$$\mathbb{1}[\widetilde{DTI}_i > 50] = \gamma_s + \beta_t + \epsilon_i$$

Freddie applied tighter DTI rules until after the crisis



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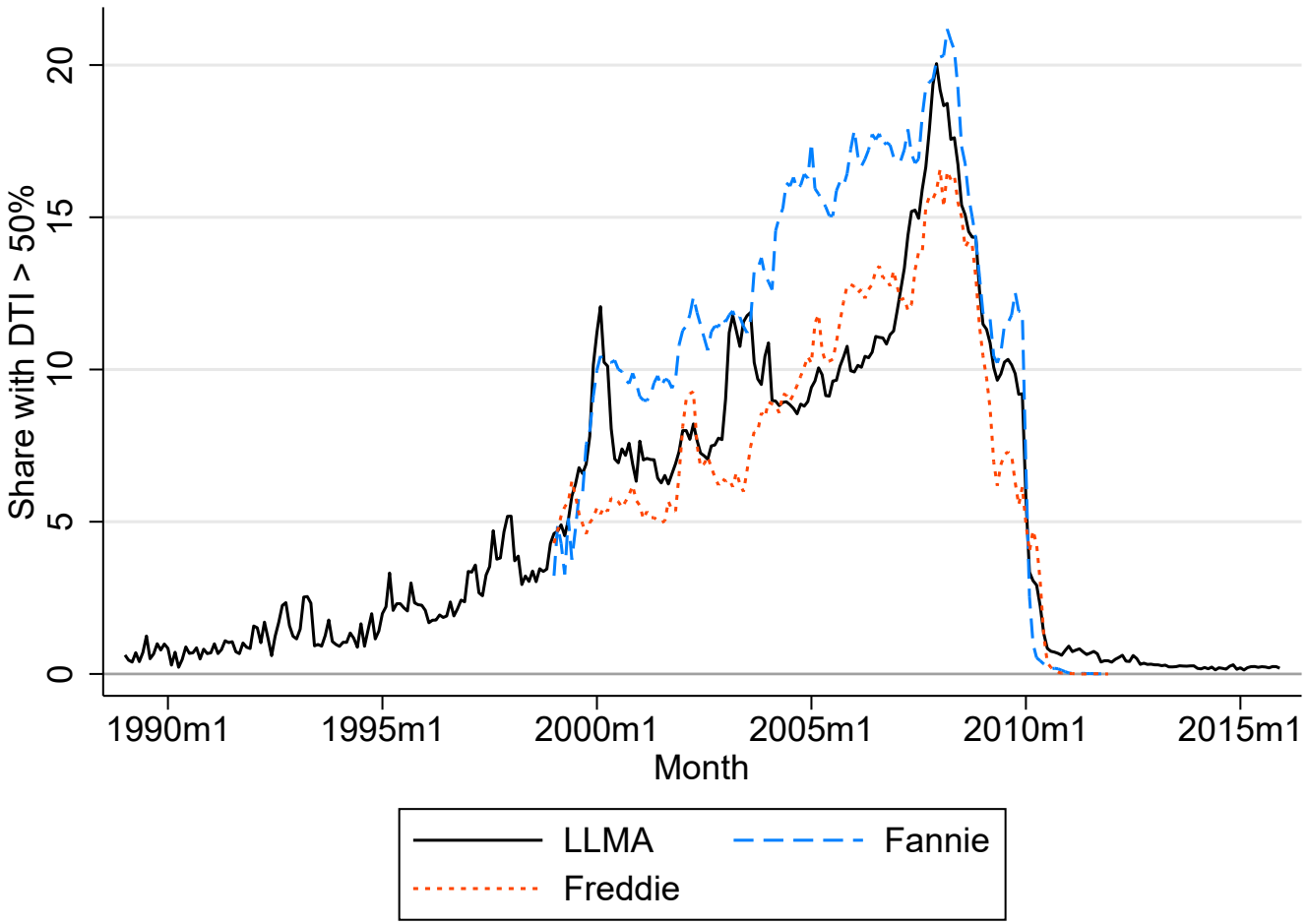


Results

Outline

Show that in more exposed counties (relative to less exposed):

1. High DTI lending declines.
2. House prices decline.
3. Price decline continues for several years after change.

High DTI share declines in more exposed counties

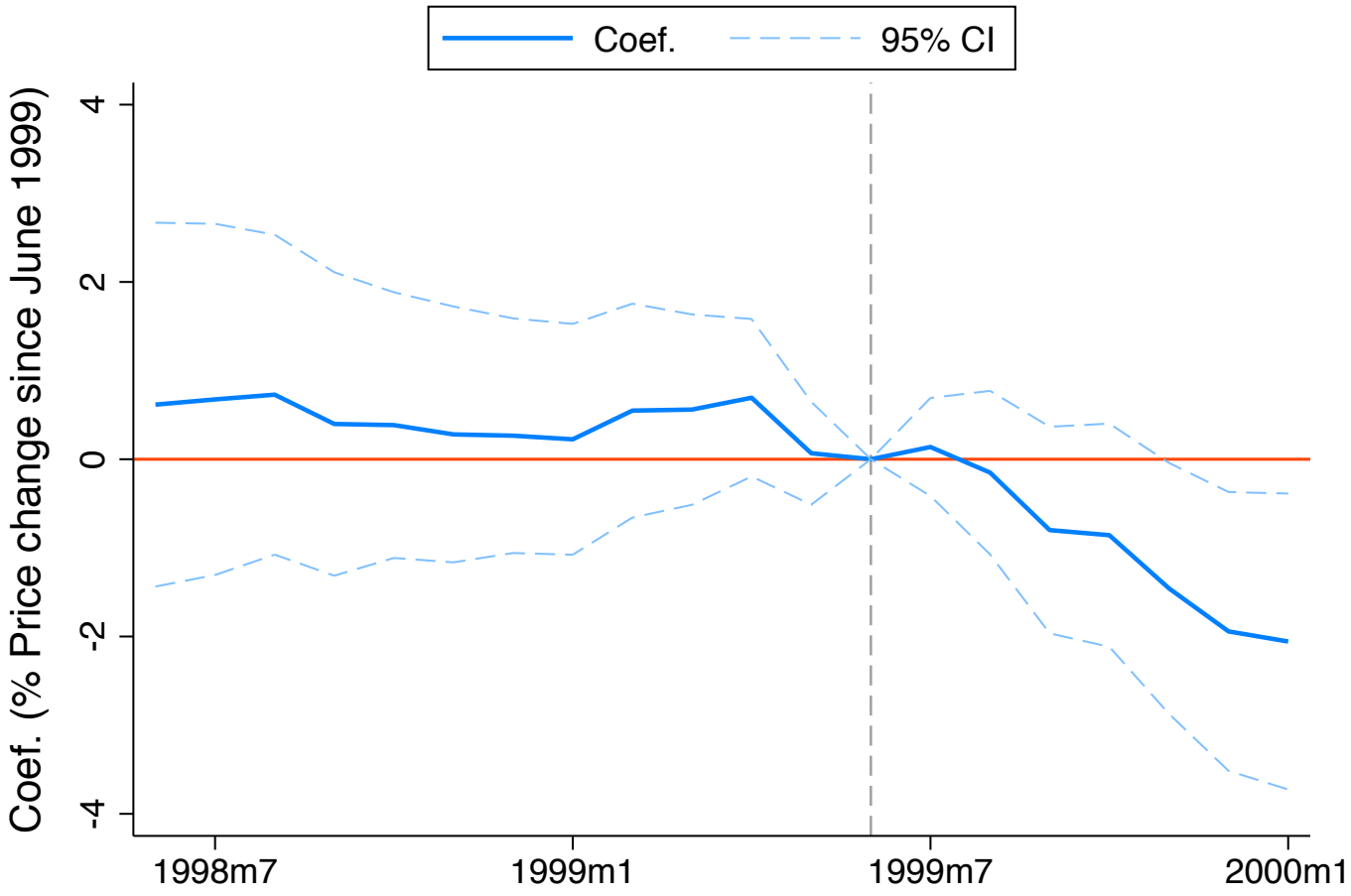
$$\text{High DTI}_{c,t} = \gamma_c + \gamma_{s,t} + \beta \text{Post}_t \cdot \text{Freddie}_{c,1998} + \alpha \text{Post}_t \cdot \text{Controls}_c + \epsilon_{c,t}$$

	Share DTI > 50	
	(1)	(2)
Post × Freddie	-3.79***	-2.80**
	(1.21)	(1.23)
County FE	X	X
State-Post FE	X	X
Controls		X
Number of Counties	1,197	1,195
Number of States	50	50
Number of Observations	2,394	2,390

Pre: Jan 1998 – Jun 1999; Post: Jul 1999 – Dec 2000.

Debt-to-income tightening reduces house prices

$$\log(\text{Price}_{c,t}) = \gamma_c + \gamma_{s,t} + \beta_t \text{Freddie Share}_{c,1998} + \epsilon_{c,t}$$



House prices decline in more exposed counties

$$\Delta \log(\text{Price}_c) = \gamma_s + \beta \text{Freddie share}_{c,1998} + \alpha \text{Controls}_c + \epsilon_c$$

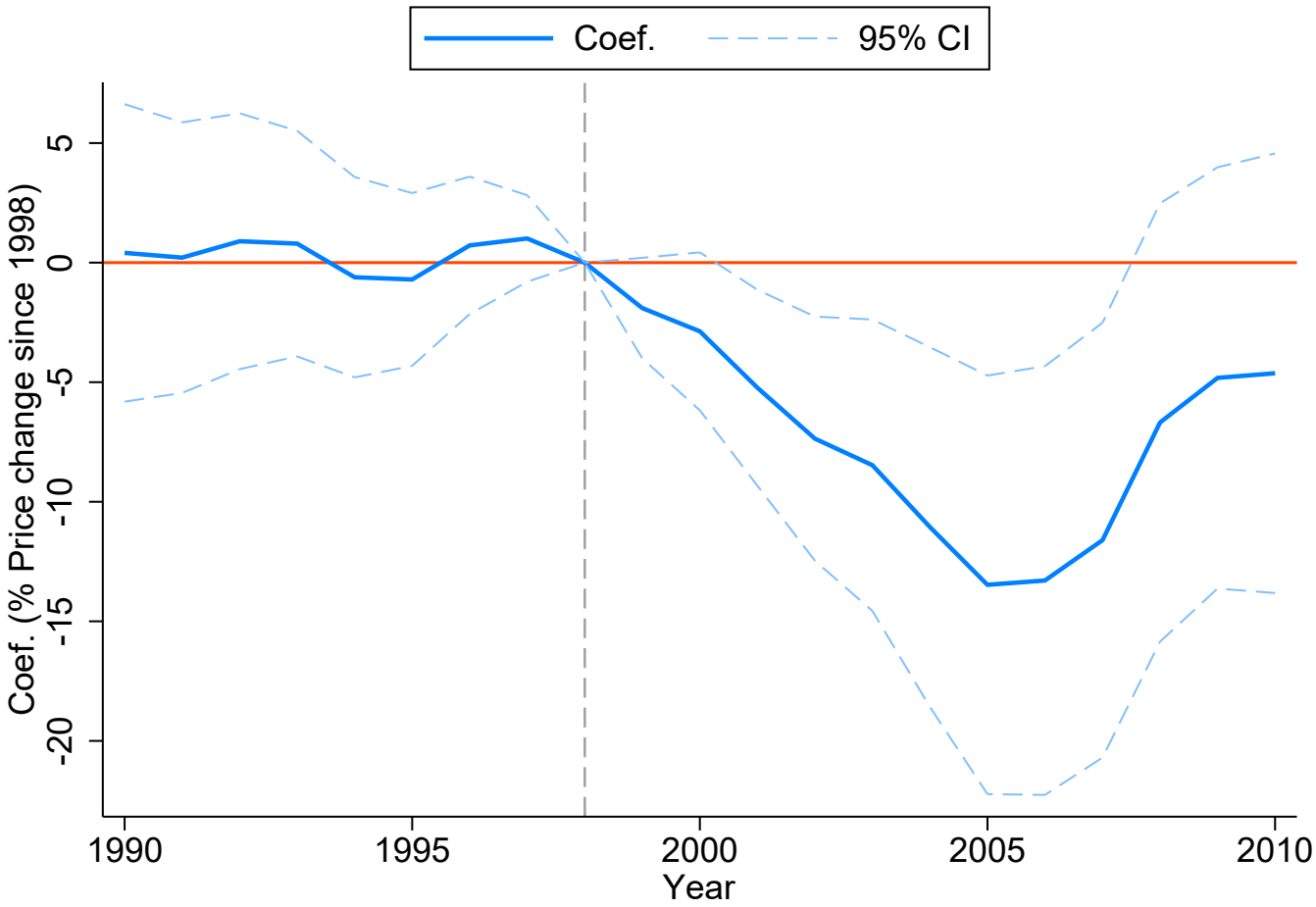
	Jun 1999 – Dec 1999	
	(1)	(2)
Freddie Share	-2.48***	-1.94**
	(0.78)	(0.80)
State FE	X	X
Controls		X
Number of Counties	996	996
Number of States	49	49
Number of Observations	996	996

Relative decline continues for several years

$$\Delta \log(\text{Price}_c) = \gamma_s + \beta \text{Freddie share}_{c,1998} + \alpha \text{Controls}_c + \epsilon_c$$

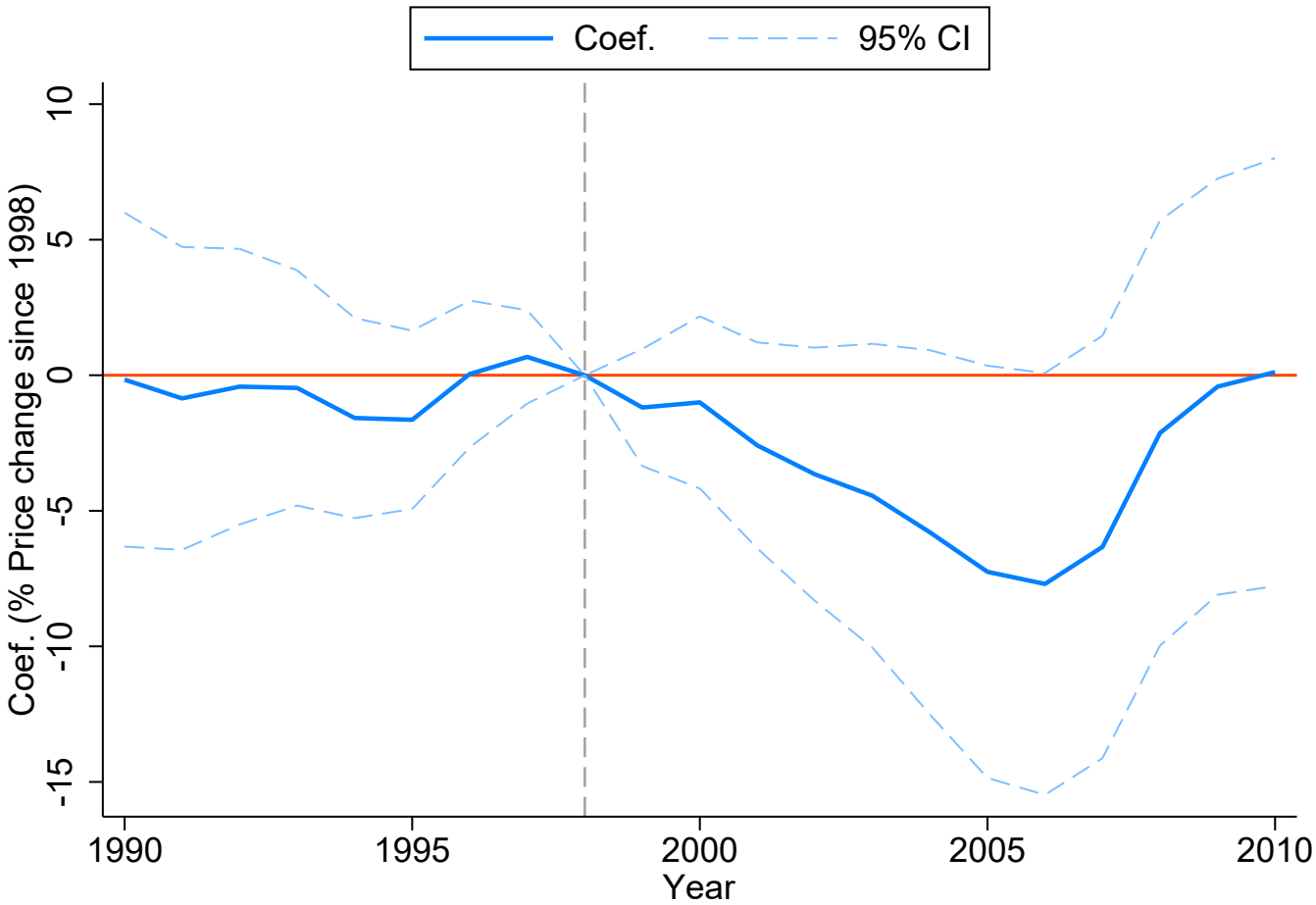
	Jun 1999 – Dec 2002	
	(1)	(2)
Freddie Share	-8.93***	-7.79***
	(2.72)	(2.57)
State FE	X	X
Controls		X
Number of Counties	996	996
Number of States	49	49
Number of Observations	996	996

House price response: 1990 – 2010



$$\log(\text{Price}_{c,t}) = \gamma_c + \gamma_{s,t} + \beta_t \text{Freddie Share}_{c,1998} + \alpha_t \text{Controls}_c + \epsilon_{c,t}$$

House price response excl. top 20 CBSAs: 1990 – 2010



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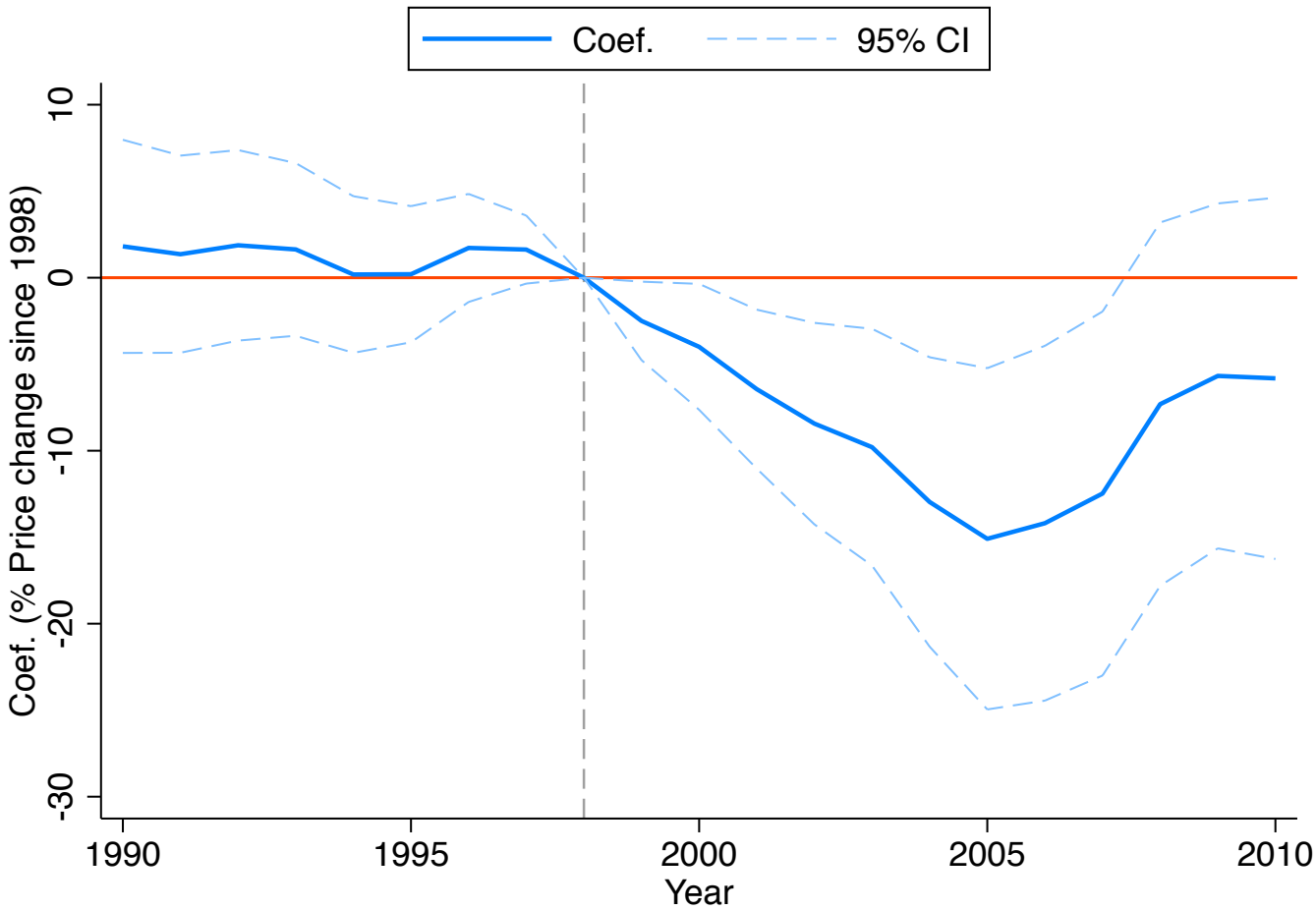
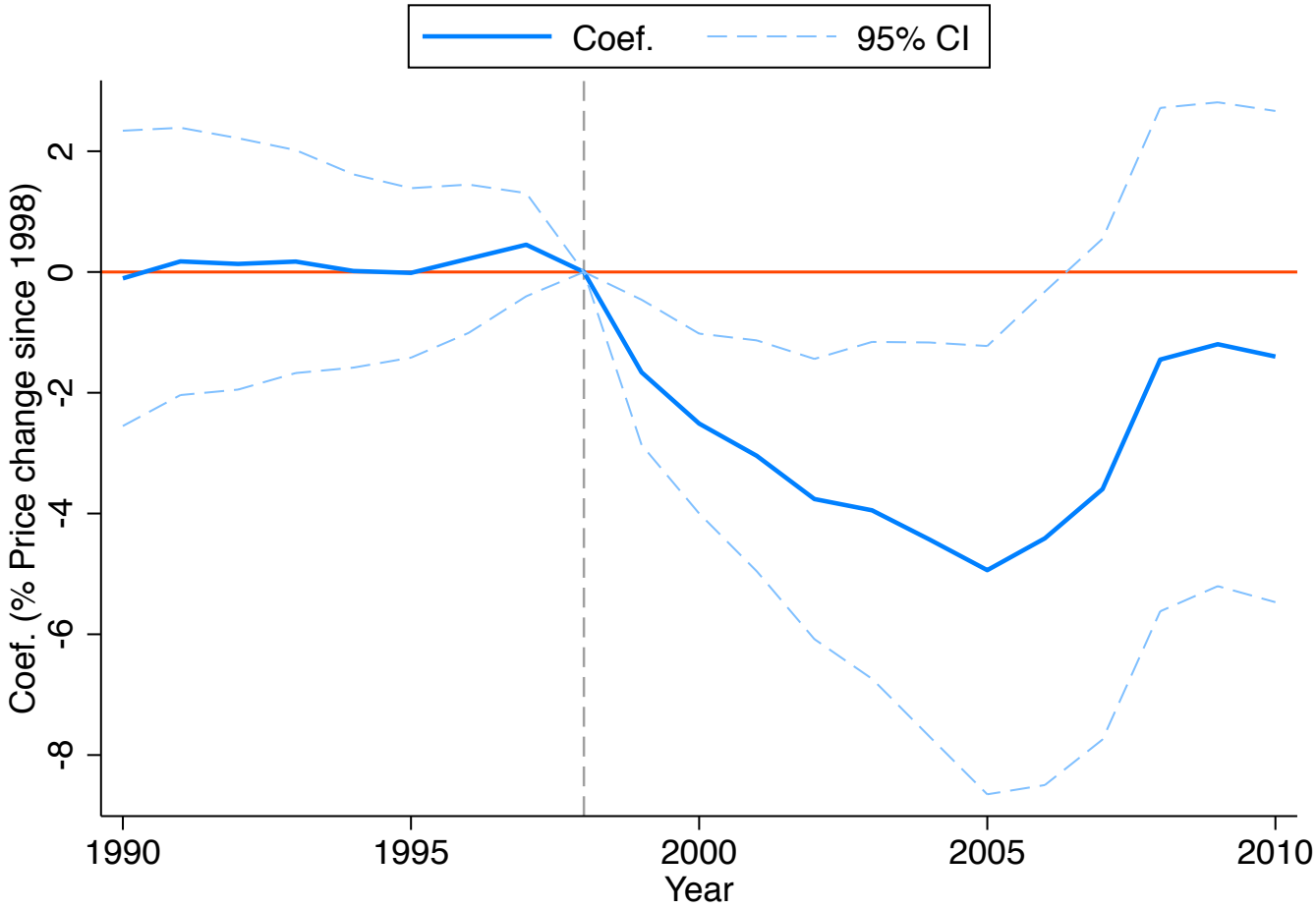
House price response excl. sand states: 1990 – 2010



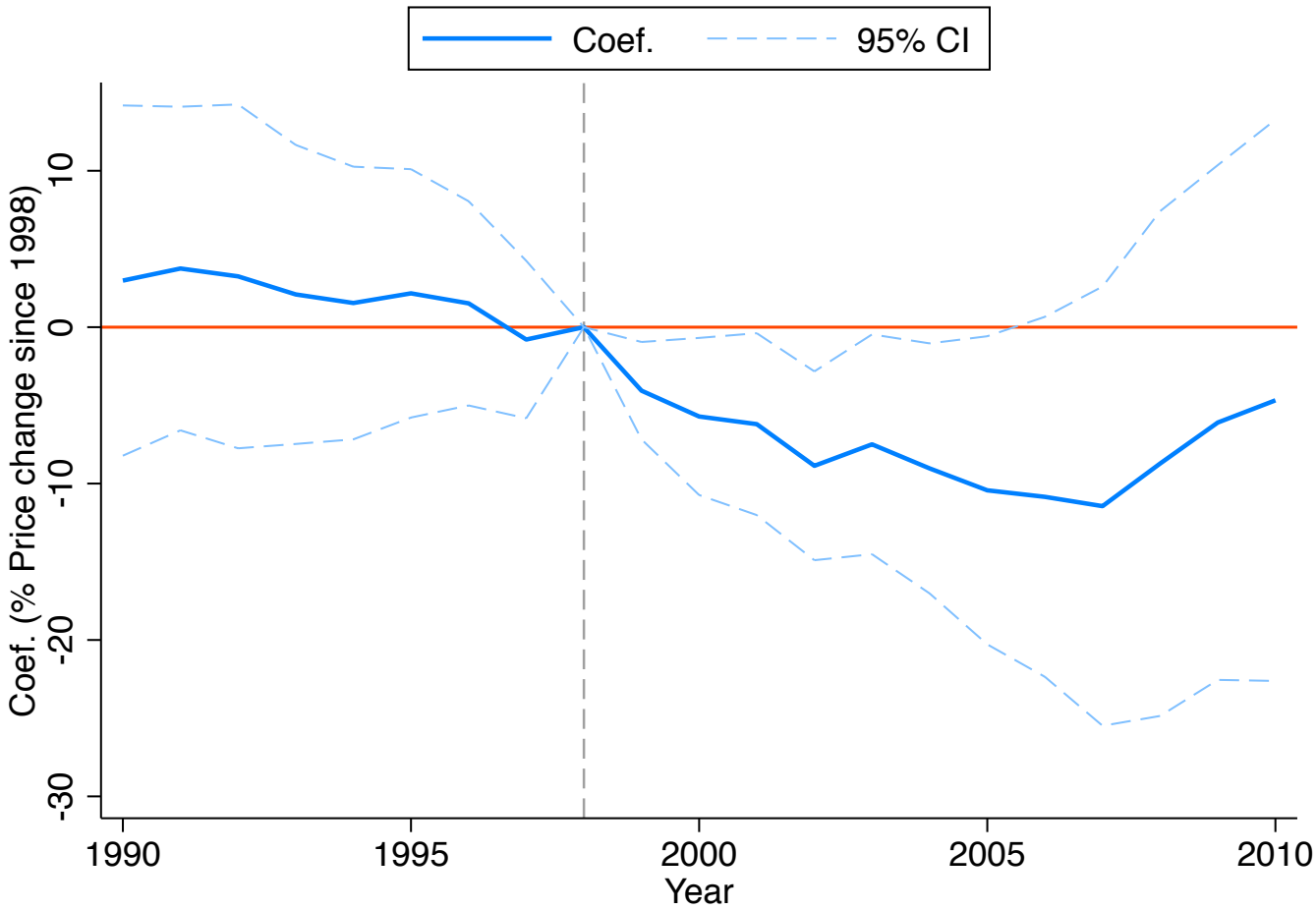
$$\log(\text{Price}_{c,t}) = \gamma_c + \gamma_{s,t} + \beta_t \text{Freddie Share}_{c,1998} + \alpha_t \text{Controls}_c + \epsilon_{c,t}$$

House price response (binary; reweighted): 1990 – 2010



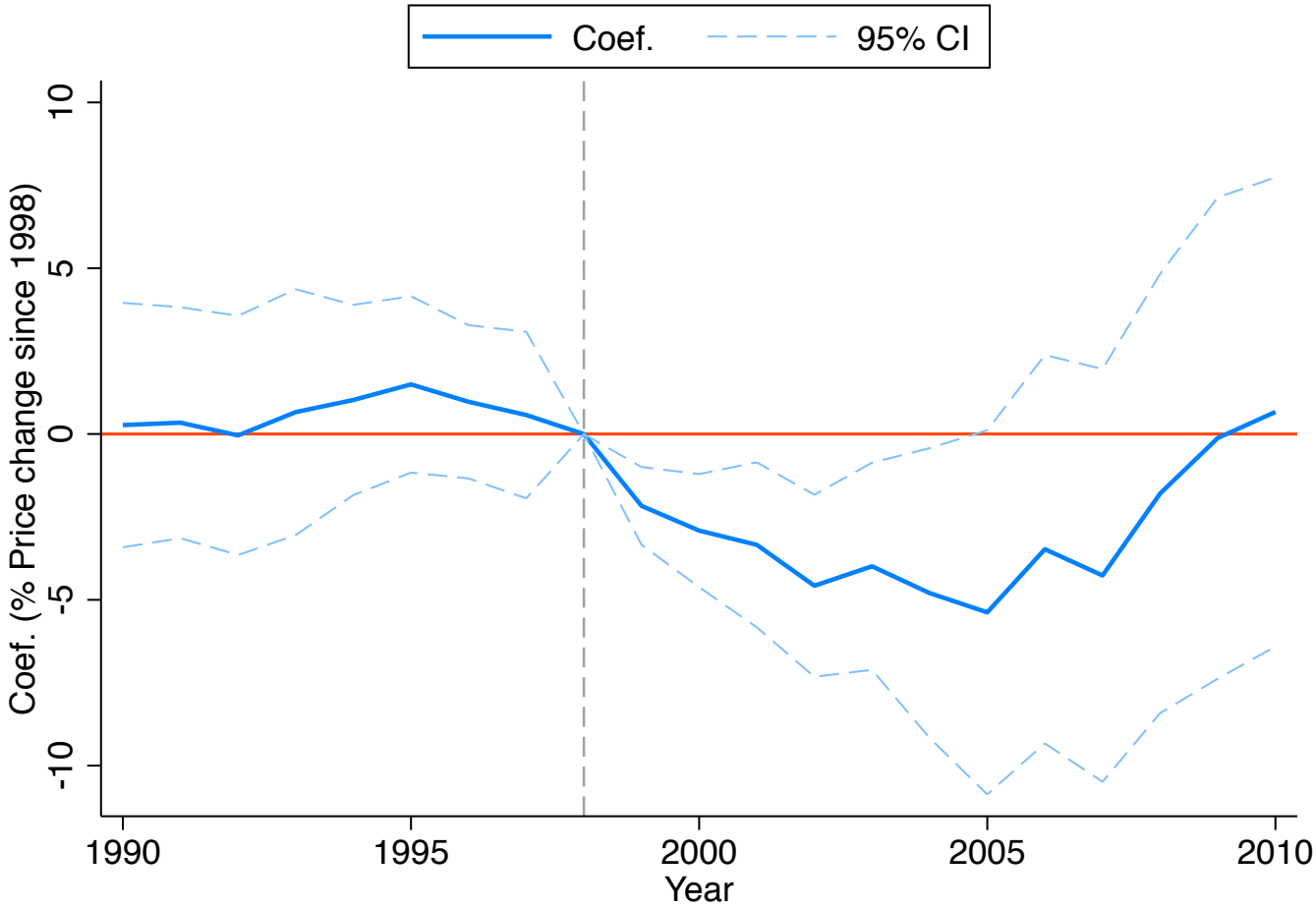
$$\log(\text{Price}_{c,t}) = \gamma_c + \gamma_{s,t} + \beta_t \text{High Freddie Share}_{c,1998} + \epsilon_{c,t}$$

House price response (CBSA FE): 1990 – 2010



$$\log(\text{Price}_{c,t}) = \gamma_c + \gamma_{cbsa,t} + \beta_t \text{Freddie Share}_{c,1998} + \epsilon_{c,t}$$

House price response (CBSA FE; binary; reweighted): 1990 – 2010



$$\log(\text{Price}_{c,t}) = \gamma_c + \gamma_{cbsa,t} + \beta_t \text{High Freddie Share}_{c,1998} + \epsilon_{c,t}$$

Model

Model of housing demand

- Receive utility from housing services and non-housing consumption:

$$u(H_i, C_i) = \alpha_i \log H_i + (1 - \alpha_i) \log C_i$$

- Allocate income across both, given cost of housing services:

$$y_i = C_i + uPH_i$$

  u is user cost *(interest rate + property tax + depreciation - price growth)*

But: must buy the housing asset (at price P) to consume housing.

Means choice is restricted by available downpayment and income in presence of LTV and DTI constraints.

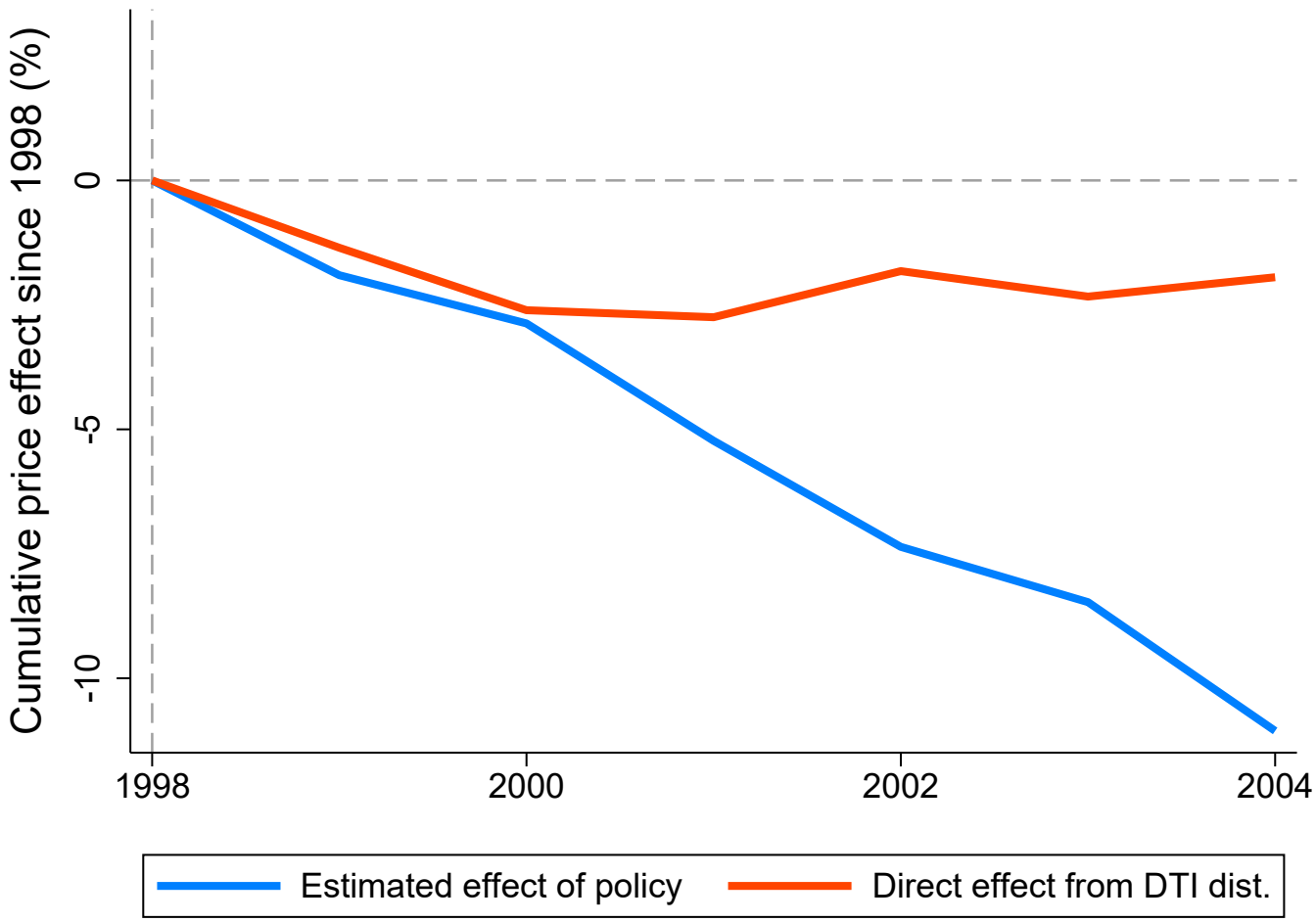
Back-of-the-envelope formula

If households above the new DTI cutoff (50%) respond by cutting loan size (i.e. holding income and downpayment fixed):

$$\%\Delta P \approx \frac{P(\text{constrained by DTI})}{1+\epsilon} \frac{\bar{y}}{f(r)P\bar{H}} \left(0.5 - \frac{\sum_i DTI_i \mathbb{1}[DTI_i > 50]}{\sum_i \mathbb{1}[DTI_i > 50]}\right)$$

- $f(r)$ is fixed rate payment per \$1 of debt, r is Freddie 30-year rate.
- Compute constrained share using diff. between Fannie and Freddie share $DTI > 50$, times share using mortgage.
- Use median income for $\bar{y}$ and median house price for $P\bar{H}$.
- ϵ is the housing supply elasticity.
- Compute mean DTI conditional on $DTI > 50$ using Fannie data.

Comparison with empirical results



Effect on unconstrained households

More exposed locations have weaker house price history.

With adaptive expectations, user cost is higher ($u = r + \tau + \delta - g$):

- Calibrate a rule to match Case, Shiller & Thompson (2012): $g = A(\lambda) \sum_{j=0}^{t-t_0} (1-\lambda)^j g_{t-j}$ where $\lambda = 0.11$.
- Compute g adjusting for policy effect and get $\%\Delta$user cost (difference between exposed and unexposed areas).

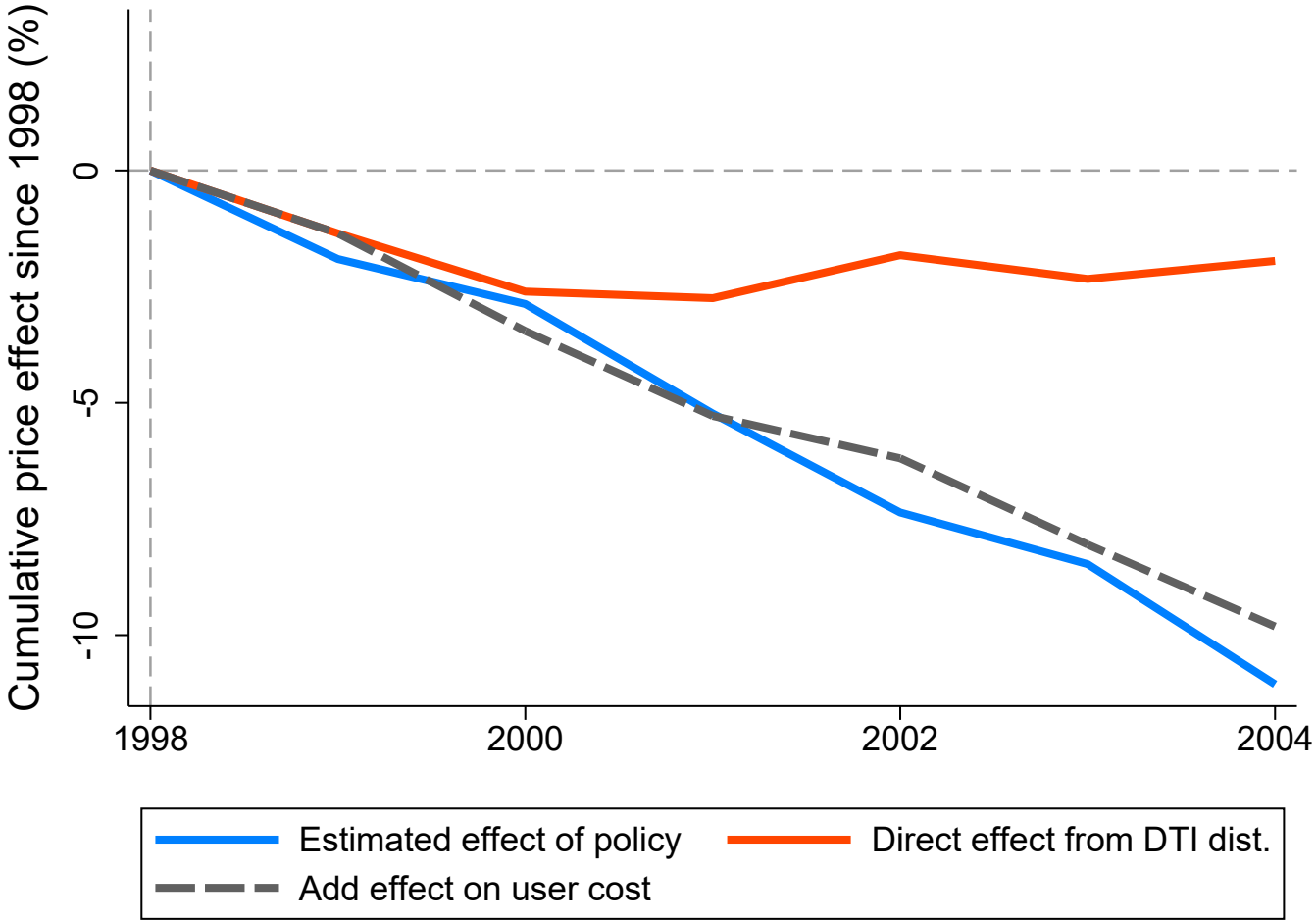
Effect on unconstrained households

More exposed locations have weaker house price history. With adaptive expectations, user cost is higher ($u = r + \tau + \delta - g$):

$$\%\Delta P \approx \frac{1}{1+\epsilon}\Bigg[- P(\text{responds to user cost change}) \cdot \%\Delta\textbf{user cost} + P(\text{constrained by DTI}) \cdot \frac{\bar{y}}{f(r)P\bar{H}}\left(0.5 - \frac{\sum_i DTI_i \mathbb{1}[DTI_i > 50]}{\sum_i \mathbb{1}[DTI_i > 50]}\right)\Bigg]$$

- Use $\delta = 2\%$, $\tau = 1.2\%$, $\epsilon = 0.1$.
- Assume high LTV and affected groups with DTI > 50 do not respond to user cost change.

Comparison with empirical results



Conclusion

- Debt-to-income policies have a large effect on house prices.
- The effect builds over time.
- Not just policy: policy + expectations?