Speculations and the U.S. Housing Boom

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The views expressed in this paper are those of the authors and do not necessarily represent those of the IMF or IMF policy nor the SNB or SNB policy.

Explaining Housing Booms

- U.S. experienced unprecedented boom in real house prices between 1996 and 2006 ($> 80\%$).
- Several authors emphasized difficulty to explain price increase by fundamentals using their respective model
- "Unrealistic expectations about future prices" drive housing price
- Indirect attribution of gap between observed and fundamental-based price to speculation
- Can speculative demand be identified directly?
- How much has it contributed to U.S. house price increase?

Role for Speculation

Contribution

- Direct identification of speculation shock via the vacancy rate
- Use VAR and sign restriction to idenitify traditional demand, supply, and mortgage rate shocks (Jarocinski and Smets, 2008)

Findings

- Shocks can account for 80 percent of house price increase.
- Speculation and interest rate most important drivers (each 1/3 of the increase during the boom)
- Recent contribution of speculation shock historically exceptional

Diverging views on drivers of housing boom

Monetary policy:

- Significant: Taylor (2007) and Jarocinski and Smets (2008)
- Limited: Glaeser et al (2011) (modified) user cost model explains about 20% of increase. Del Negro and Otrok (2007), VAR results limited impact.

Financing conditions:

- Significant: Declining credit standards, higher LTV (Duca et al 2010; Mian and Sufi 2009; Kuttner, 2012; Dell'Ariccia et al, 2012)
- Limited: Glaeser et al (2012) find no convincing evidence that changes in approval rates or LTV levels explain bulk of house prices boom

Supply and Demand shocks:

- Significant: Regulatory and physical constraints cause stronger impact of other shocks at sub-national level (Glaeser et al, 2011; Anundsen und Heeboll, 2013; and Huang and Tang, 2012)
- Limited relevance at national level (Aura and Davidoff 2008)

Few direct assessments of the role of speculation

Speculations:

- **Survey**:
  - Price responds to survey measure of expectations about future prices (Lambertini et al, 2013)
  - Case and Shiller (2003) survey data show "unrealistic expectations about future prices" supported by Glaeser et al (2011)
- **Residual**:
  - Large price-rent ratio var. decomp. residual implies large contribution of expected rent growth (Campbell et al 2009)
  - No relevance: Follow fundamentals (Himmelberg et al 2005)

Weaknesses:

- Survey price expectations potentially react to other shocks
- Doesn't measure the residual buyer/seller
- Residual reflects other fundamentals (model mis-specification)

Estimation

- Bayesian VAR

$$\mathbf{y}_t = \sum_{i=1}^{p} \mathbf{A}_i \mathbf{y}_{t-i} + \mathbf{e}_t, \quad \text{with} \quad \mathbf{e}_t \sim \mathrm{N}(\mathbf{0}, \Sigma) \quad \forall\ t = 1, ..., T \qquad (1)$$

- $\mathbf{y}_t$ is a vector of seven variables

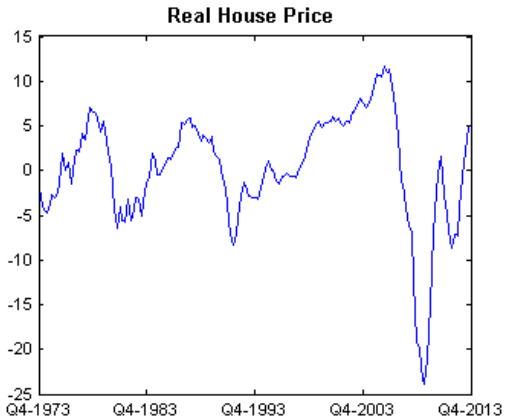
$$\mathbf{y}_t = \begin{pmatrix} \triangle P_t & R_t & Inv_t & V_t & r_t & LTV_t & \triangle RGDP_t \end{pmatrix}^T$$

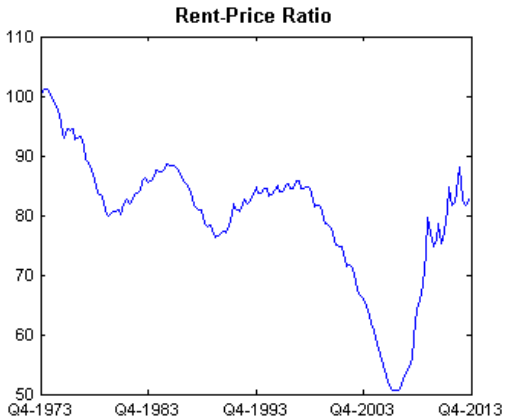
- Uninformative prior and a lag length of 2
- Data covers the period form 1973Q3-2013Q4

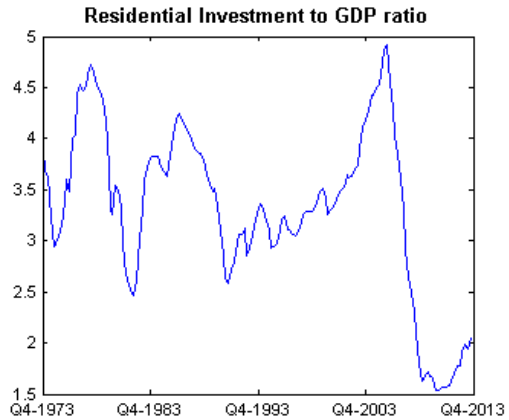
Sources and Definitons

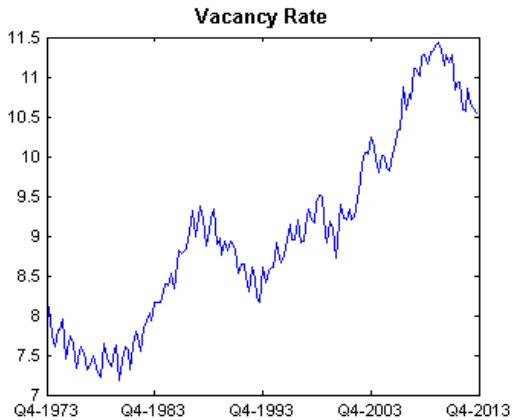
- $\triangle P_t$: first difference of (log) Shiller (2000) real house price index
- R_t: (log) ratio of primary rent CPI component (BLS) and nominal Shiller house price index
- Inv_t: (log) ratio of private residential construction investment to GDP
- V_t: ratio of vacant houses relative to total housing stock excl. seasonal factos (Census Bureau)
- r_t: rate on purchase of existing single family homes (FHFA) less 10-year-ahead forecast of inflation rate (FED SPF).
- LTV_t: loan-to-value ratio (FHFA).
- $\triangle RGDP_t$: first difference of (log) U.S. real GDP (BEA).

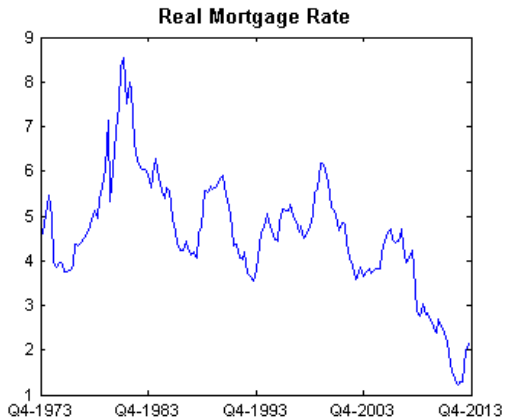
Evolution

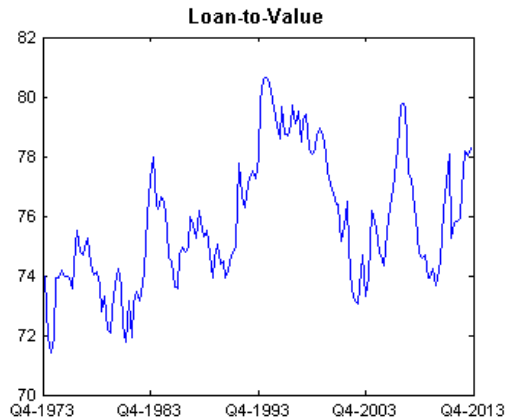

Real House Price
15
10
5
0
-5
-10
-15
-20
-25
Q4-1973
Q4-1983
Q4-1993
Q4-2003
Q4-2013


Rent-Price Ratio
110
100
90
80
70
60
50
Q4-1973
Q4-1983
Q4-1993
Q4-2003
Q4-2013


Residential Investment to GDP ratio
5
4.5
4
3.5
3
2.5
2
1.5
Q4-1973
Q4-1983
Q4-1993
Q4-2003
Q4-2013


Vacancy Rate
11.5
11
10.5
10
9.5
9
8.5
8
7.5
7
Q4-1973
Q4-1983
Q4-1993
Q4-2003
Q4-2013


Real Mortgage Rate
9
8
7
6
5
4
3
2
1
Q4-1973
Q4-1983
Q4-1993
Q4-2003
Q4-2013


Loan-to-Value
82
80
78
76
74
72
70
Q4-1973
Q4-1983
Q4-1993
Q4-2003
Q4-2013

Key assumptions underlying shock identification

1. Housing prices are forward looking
2. Housing supply is upward sloping
3. Housing demand is downward sloping
4. Supply of credit is not perfectly elastic
5. Search and match frictions in housing market

Concept: Speculation shock

Definiton:

Change in expectation about future house prices

Intuition:

Prospect of being able to sell at higher price in future leads to higher prices and higher vacancies now

Identification: Speculation and Mortgage Rate Shocks

Speculation Shock:

- Time to build creates incentive to start building under prospect of higher future prices
- Increased construction and higher prices lead to higher credit demand
- Higher mortgage rates as result of not perfectly elastic credit supply
- Search and matching frictions (Wheaton, 1990) cause increase in vacancies as supply increased and current demand unchanged (Leung and Tse, 2012)

Mortgage rate shock:

- Lower interest rate causes higher demand for housing
- Pushing up prices (user cost approach)
- Generates construction activity for upward sloping housing supply

Identification: "Traditional" Shocks

Supply Shock:

- Upward shift of supply curve leads to higher prices and lower quantities
- Less housing supply for given demand implies lower vacancy rate

Demand shock:

- Updward shift of demand curve leads to higher prices and quantities
- Mortgage rate increases due to not perfectly elastic credit supply.
- Higher demand leads to lower vacancies (Head et al., 2014) due to time to build

Implied Sign-restrictions

Table 1: Baseline Shock Identification

	Shock to:			
	Supply	Demand	Interest	Expectations
House prices (∂P_t)	> 0	> 0	> 0	> 0
Investment (∂Inv_t)	< 0	> 0	> 0	> 0
Mortgage rate (∂r_t)		> 0	< 0	> 0
Vacancy rate (∂V_t)	< 0	< 0		> 0

Computational Implementation

- Sample A_i and Σ from posterior distribution
- Reduced errors (e_t) combination of structural shocks (v_t) and contemporaneous response of endogenous variables to shocks (B)

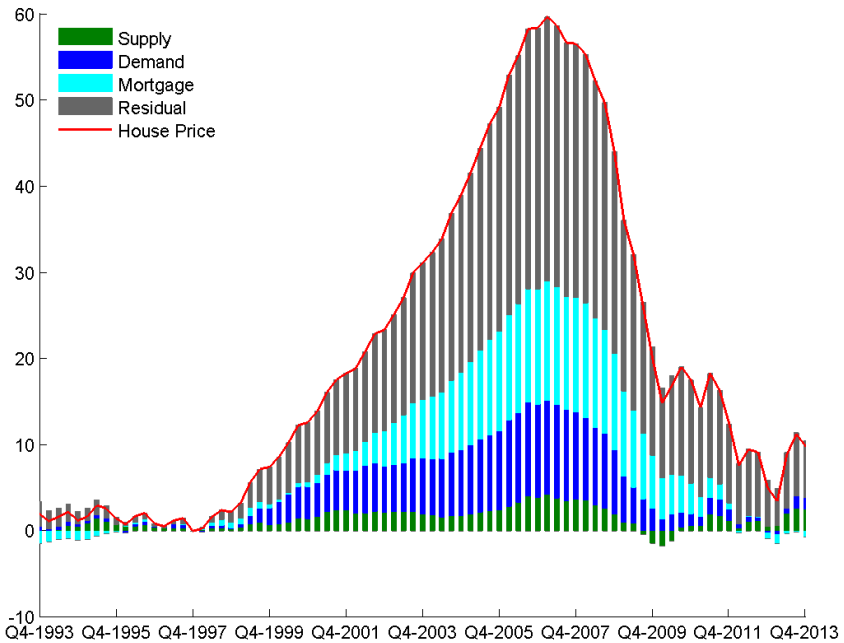
$$e_t = B \cdot v_t$$

$$\Sigma = E(e_t e_t') = E(B v_t v_t' B') = BB'$$

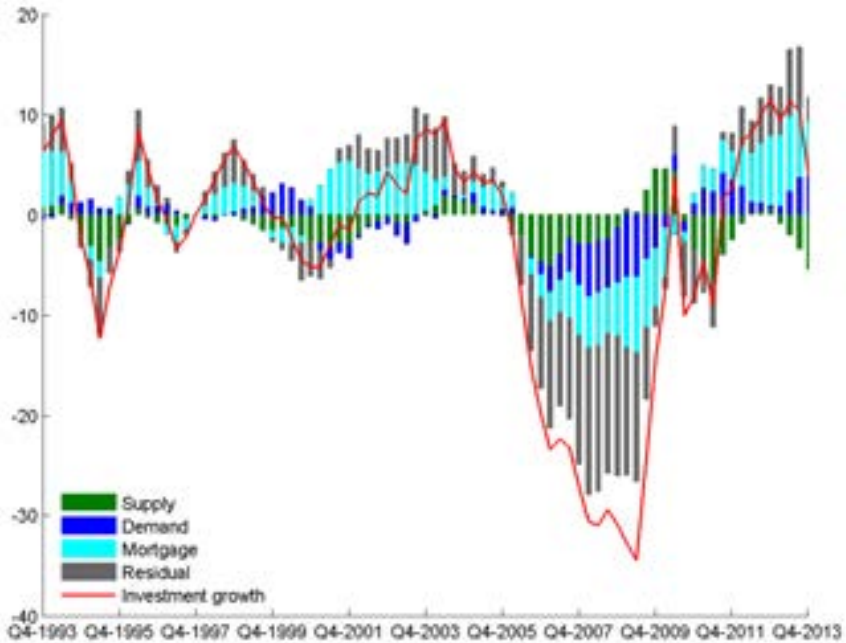
with $E(v_t' v_t) = I$

- Sample candidate matrices B using Cholesky factorization V of Σ.
- Multiply V with a random orthonormal matrix Q such that $B = VQ$
- If IRF implied by B consistent with all sign restrictions, keep the draw.
- Repeat 500,000 times.

Contribution based on traditional shocks

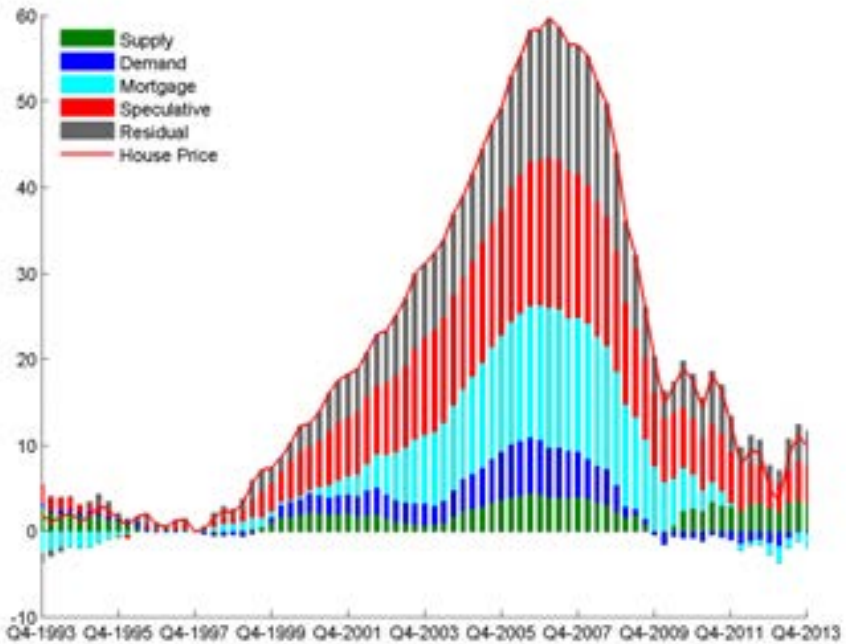


Real Housing Price

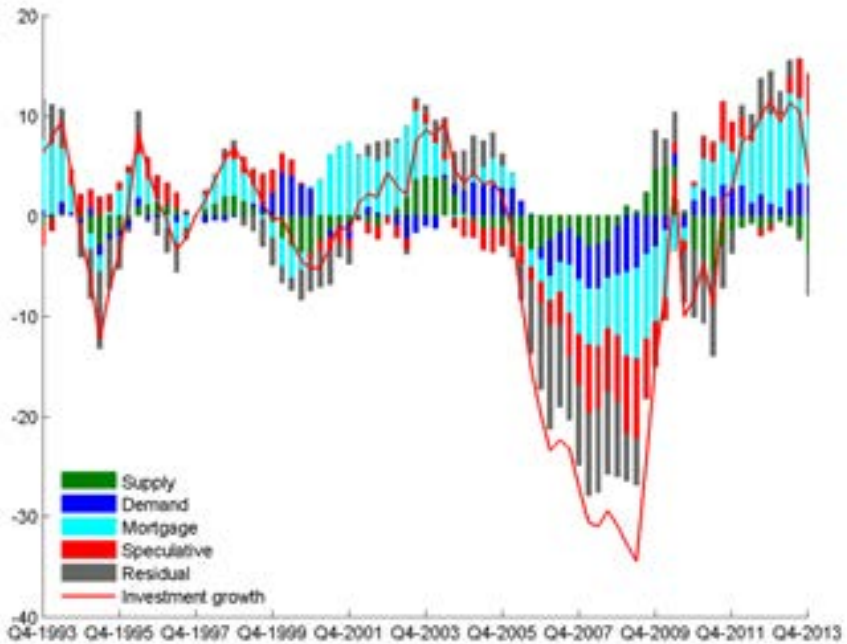


Real Investment Growth

Contribution including speculative shocks

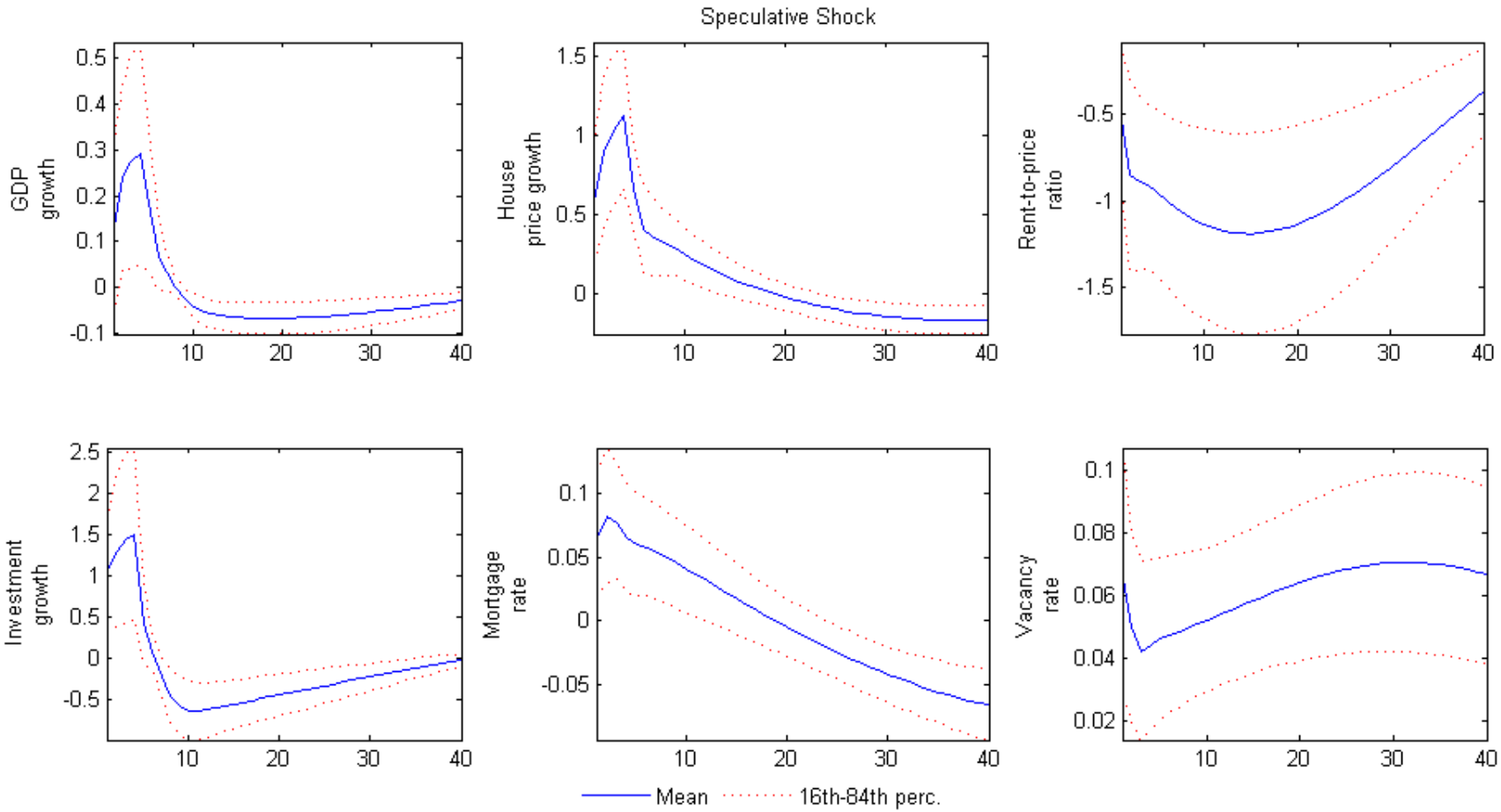


Real Housing Price

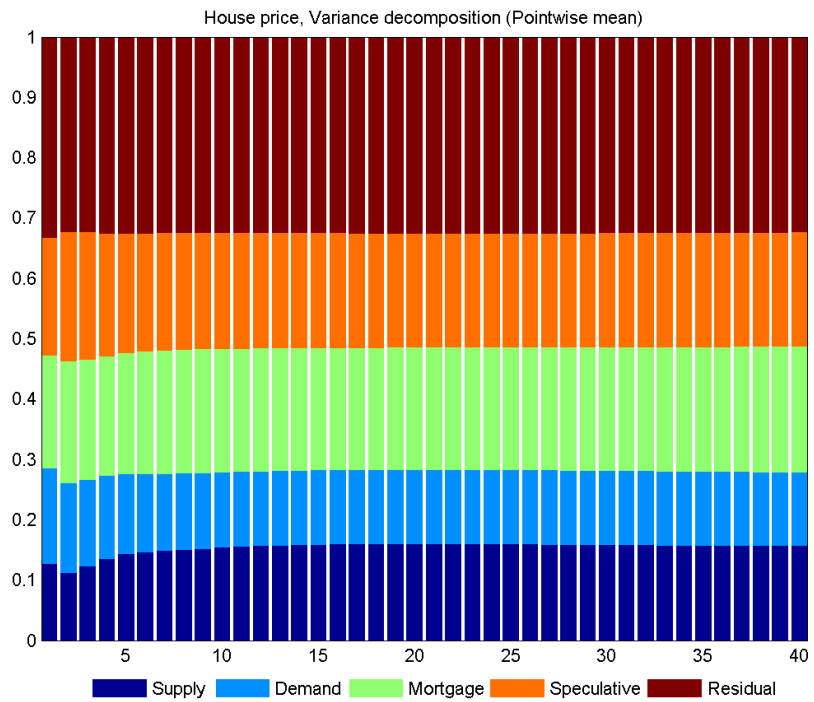


Real Investment Growth

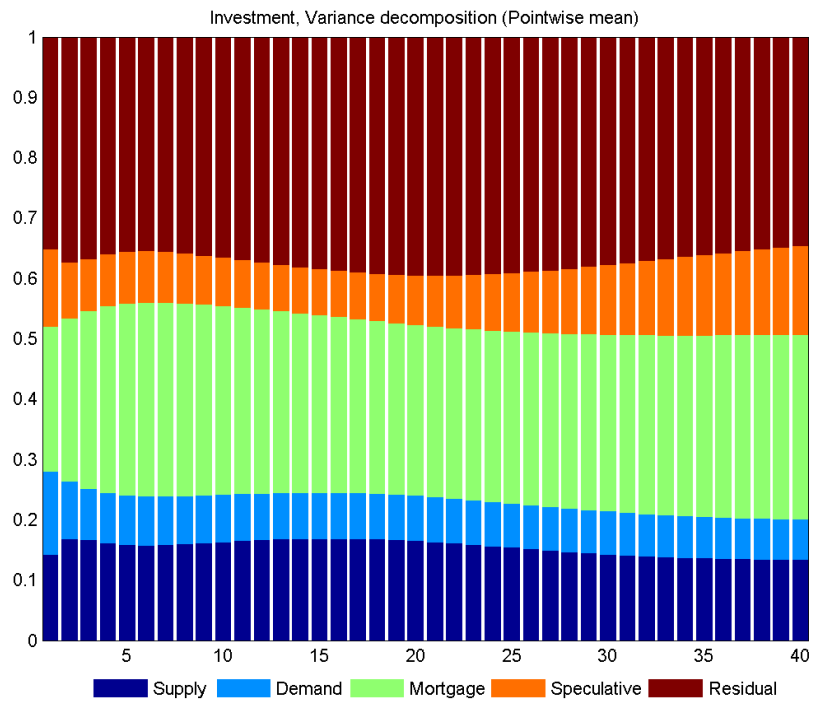
Underlying IRFs: Speculation Shock



Variance decomposition: prices and quantities



Real Housing Price



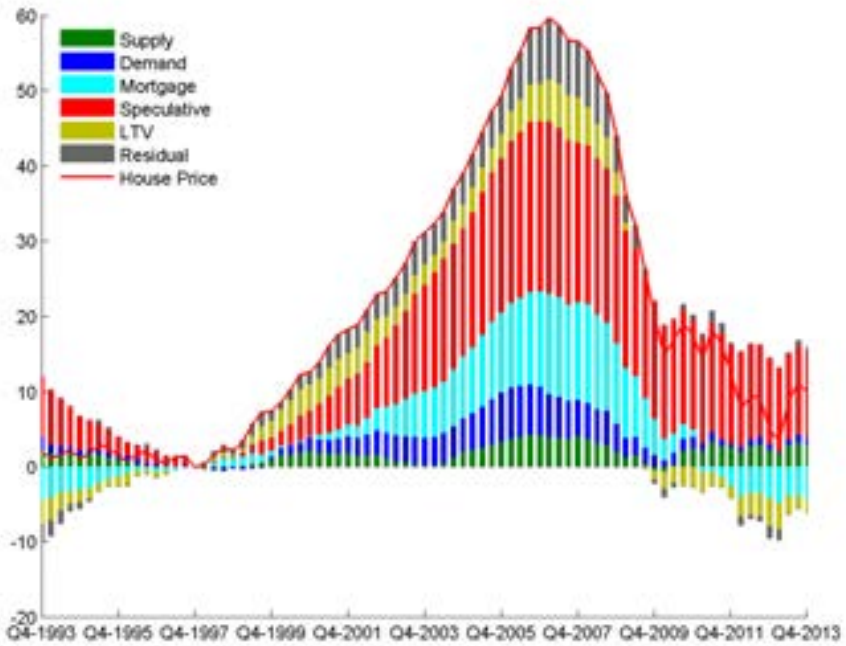
Residential Investment

Accounting for LTV shocks

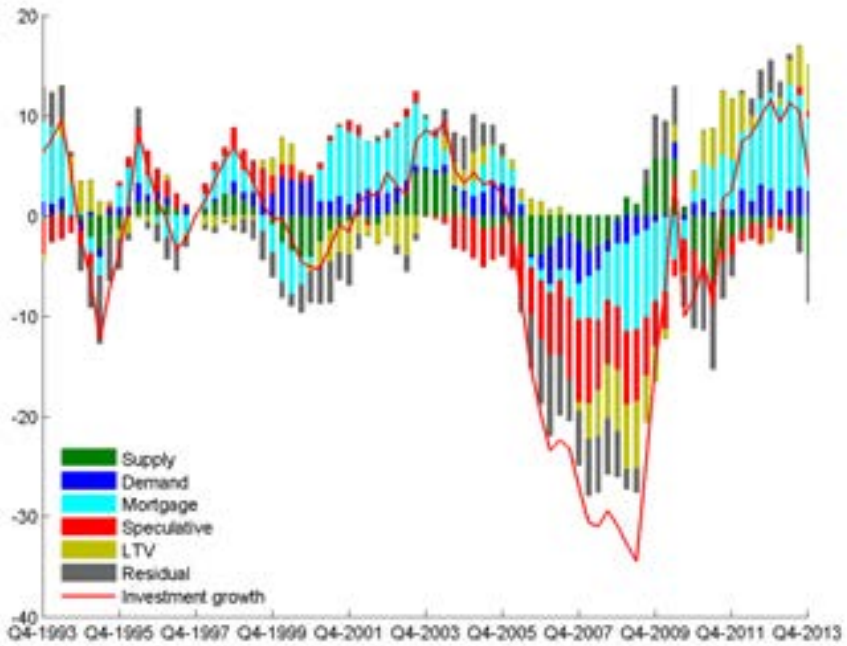
Table 2: Shock Identification including LTV Shock

			Shock to:		
	Supply	Demand	Interest	Expectations	LTV
House prices (∂P_t)	> 0	> 0	> 0	> 0	> 0
Investment (∂Inv_t)	< 0	> 0	> 0	> 0	> 0
Mortgage rate (∂r_t)		> 0	< 0	> 0	> 0
Vacancy rate (∂V_t)	< 0	< 0		> 0	
Loan-to-Value (∂LTV_t)		< 0		< 0	> 0

Results LTV shocks



Real Housing Price



Real investment Growth

Conclusion

Summary of main results

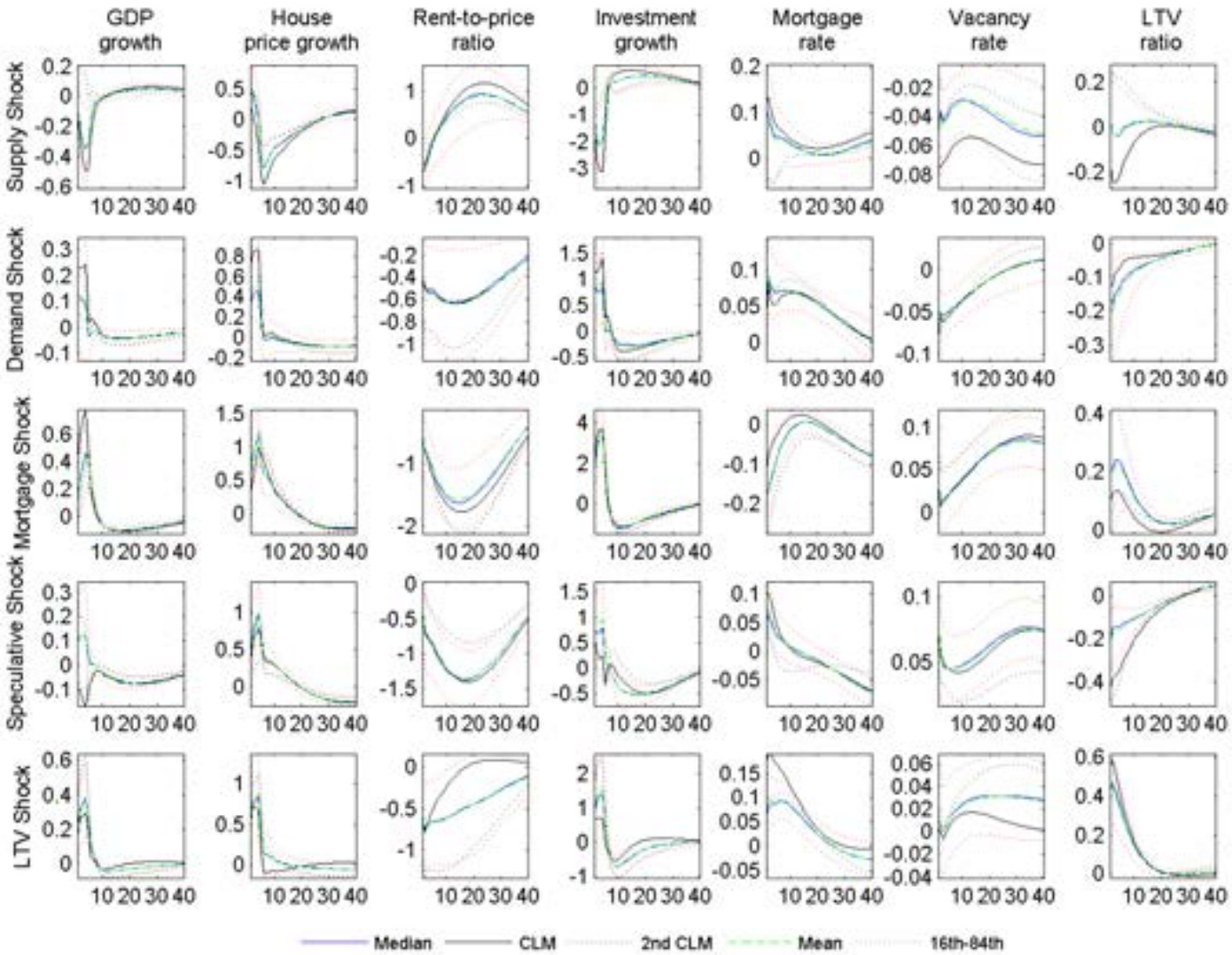
- Use sign restriction on vacancy rate to directly identify and quantify speculation shocks
- Speculation shocks disruptive to economy supporting "unrealistic" in Case and Shiller (2003)'s "unrealistic expectations about future prices"
- Speculation contributed significantly ($\approx 1/3$) to pre-crisis price hike, but historically less relevant
- For prices comparable to mortgage rate shock in recent boom
- For residential investment, mortgage rate shock as relevant as all other shocks jointly

Conclusion

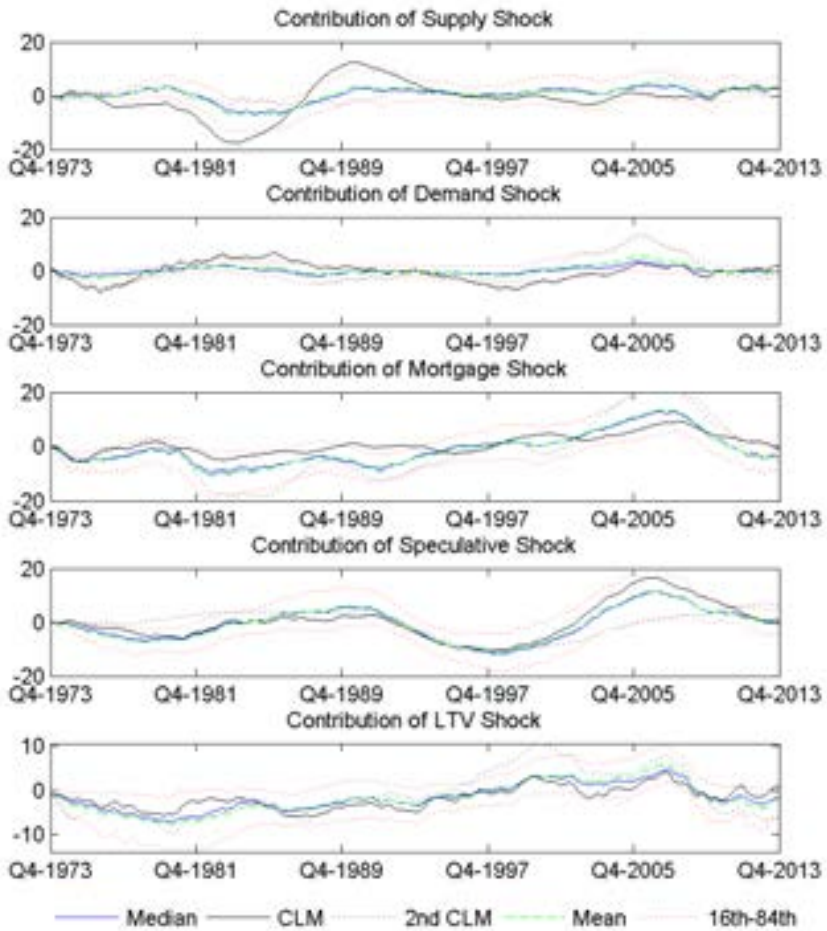
Caveats and future research

- Provide a formal micro-based model
- Criteria for model selection
- What drives speculation?
- Interaction between interest rate policy and speculation?

All IRFs: Model including LTV



Decomposition based on various models



Speculative (demand) shock - model sketch (1/2)

User cost relationship

Higher expected future return causes higher current price

$$P_t = \sum_{i=0}^{T} \frac{E_t\left[R_{t+i}\right]}{(1 + r_{t+i} + \delta)} + E[P_{t+T}] \tag{2}$$

Housing supply equation

Higher prices increase housing supply

$$H^S_{t+1} = (1 - \delta)H^S_t + g\left[\frac{P_t}{c(H^S_t)}\right] H^S_t \tag{3}$$

Speculative (demand) shock - model sketch (1/2)

Financing cost

Increased demand for loans, higher economic activity, and higher prices increase interest rates

$$r_t = i_t^{MP} + \psi\left(\widehat{\kappa H_t^S P_t}\right) \tag{4}$$

Vacancy rate

Higher supply and unchanged physical demand for housing cause higher vacancy rate

$$V_t = H_t^S - H_t^D \tag{5}$$