Explaining House Price Dynamics:

Isolating the Role of Non-Fundamentals

David C. Ling[a], Joseph Ooi[b] & Thao Le[b]

[a]University of Florida, [b]National University of Singapore

This paper was presented at **Housing, Stability and the Macroeconomy: International Perspectives** conference, November 14-15 2013. The conference was sponsored by the Federal Reserve Bank of Dallas, the International Monetary Fund, and the *Journal of Money, Credit and Banking*. The conference was held at Federal Reserve Bank of Dallas (http://dallasfed.org).

Explaining House Price Dynamics:
Isolating the Role of Non-Fundamentals

David C. Ling*, Joseph Ooi# & Thao Le #

*University of Florida,
National University of Singapore

Background & Motivation

- Latest U.S. housing boom/bust has generated increased interest in house price (HP) dynamics
- Economists agree HPs determined, in long-run, by construction costs & economic fundamentals
  - HH income, population growth, employment, interest rates, etc.
- But… empirical literature largely concludes the magnitude, persistence, and volatility of HP Δs often can't be explained by Δs in fundamentals
  - despite variation in modeling techniques & data
    - e.g., Duca et al., 2011; Gelain & Lansing, 2013; Glaeser et al., 2010; Lai & Van Order, 2010; Mikhed & Zemcik, 2009; Shiller, 2005

Background & Motivation

- Survey-based evidence suggests home buyers often extrapolate past HP trends
  - e.g., Case & Shiller (2003): respondents expected HPs to ↑12-16% **per year** over next **ten** years
    - implying > a 3-fold ↑ in HP!
- More formally…
  - recent research shows that models with moving- average expectations outperform rational (fundamentals-based) models in predicting HP levels & volatility
    - e.g., Gelain & Lansing (2013), Granziera & Kozicki (2012), Burnside et al. (2013)

Background & Motivation

- So…evidence suggests backward-looking, non-fundamentals-based expectations help explain HP booms & busts
- However, according to Glaeser, Gottlieb & Gyourko (2013):
  - We know little about the process that creates & sustains non-fundamentals-based expectations
    - including simple moving-average forecasts
  - Understanding the role of non-fundamentals-based "sentiment" in HP dynamics is a pressing research topic

What Do We Do?

- Use quarterly VAR models to examine dynamic short-run relation between real HPs & the “sentiment” of 3 major agents in U.S. housing market:
  - potential home buyers (demand side)
  - home builders (supply side)
  - Home mortgage lenders (credit suppliers)

What Do We Do?

- Not arguing sentiment-pricing spirals are initiated by an exogenous shock to sentiment
- Instead, we model quarterly interaction between HPs & sentiment, as well as market liquidity (ML), in a VAR model
  - All 3 variables treated as endogenous
  - Quantify feedback effects while controlling for endogeneity
  - Provide evidence on amplifying mechanisms that drive HP booms & busts

A direct and dynamic model	allowing for a feedback mechanism between house prices, sentiment, & market liquidity

What (Else) Do We Do?

- If periods of optimism (pessimism) cause HPs to overshoot (undershoot) in short run

  $\Longrightarrow$ a negative relation between sentiment and cumulative **long-run** price Δs as HPs revert to fundamental values

- We estimate long-run effects of sentiment using an overlapping price Δ regression model

Long-run regression model	Designed to measure persistence in sentiment effects

How Do We Define Sentiment?

- Consistent with Baker & Wurgler (2007), we define housing sentiment as,

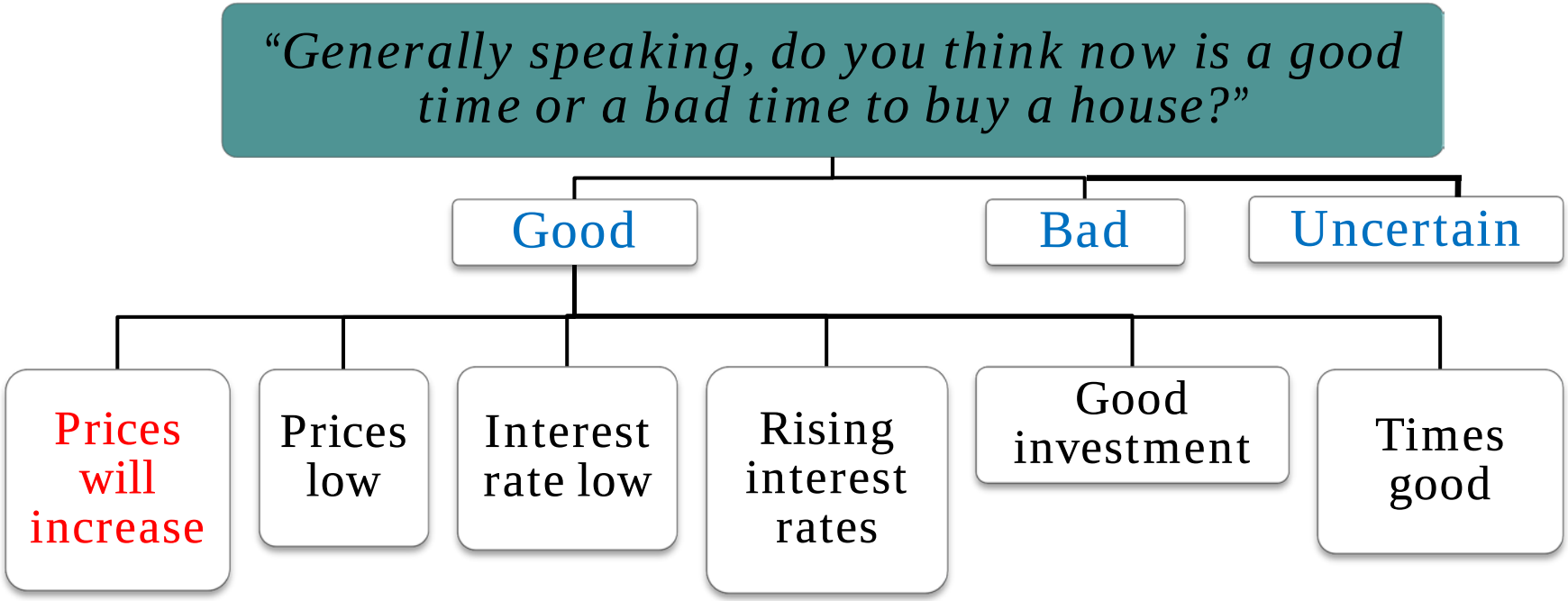
  the misguided belief about the growth in housing prices, the risk of house price appreciation, or both, that cannot be justified by the current economic information set available to housing market participants

How Do We Measure Sentiment?

Direct measures of sentiment	Use survey data on market perceptions of home: • buyers (demand-side) • builders (supply-side) • mortgage lenders (credit suppliers)

1. Home buyer sentiment (*BUYER*)

Survey of Consumers by Univ. of Michigan; ≈ 500 U.S. households



BUYER = % of respondents thinking it's a good time to buy because prices will increase

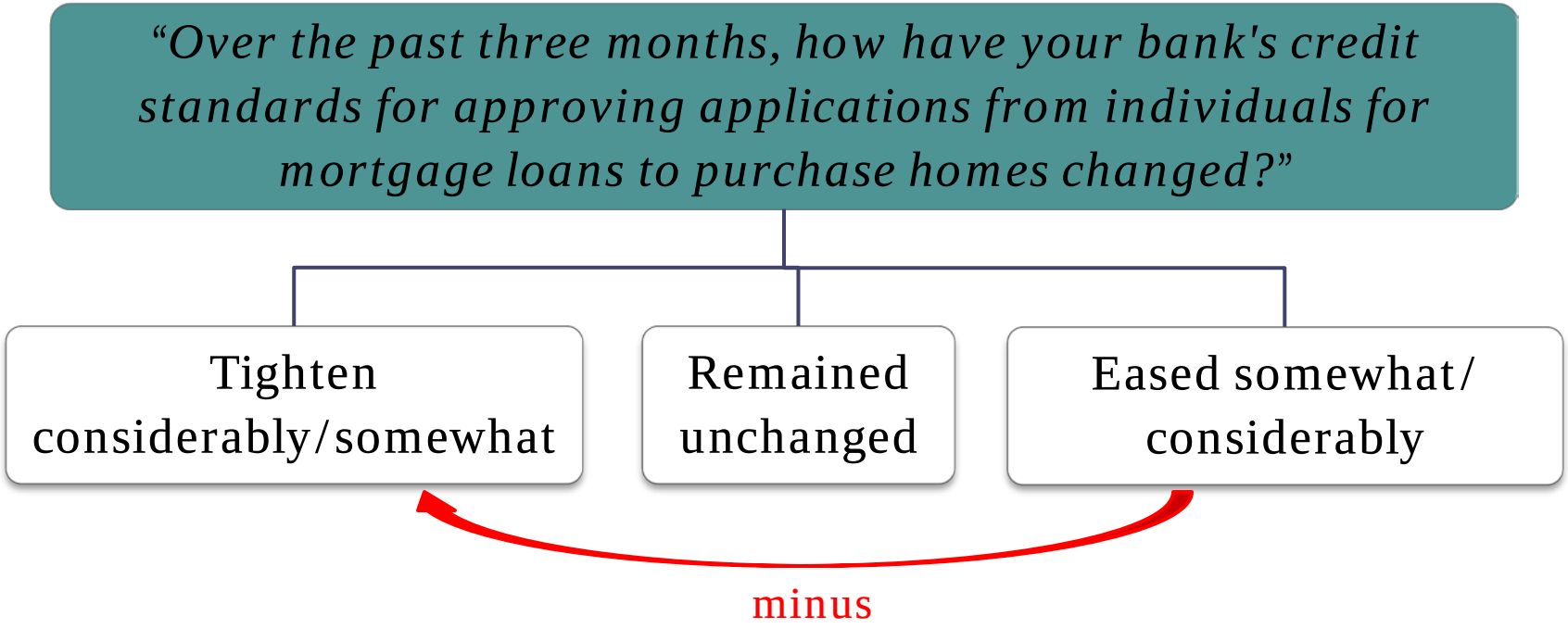
2. Builder sentiment (*BUILDER*)

- National Association of Home Builders (NAHB)/ *Wells Fargo Housing Market Index*
- A monthly index of "builder confidence"
- ≈ 400 builders are asked to rate:
  - Current sales
  - Sales expectations for next 6 months
  - Traffic of prospective buyers
- A composite index # over 50 indicates more builders view sales conditions as good rather than poor

BUILDER = NAHB/Wells Fargo Housing Market Index

3. Lender sentiment (*LENDER*)

- *Senior Loan Officer Opinion Survey on Bank Lending Practices* by FED; 60 large U.S. banks, conducted quarterly



LENDER = Net % of banks easing their lending standards

Lender Sentiment is a Measure of Credit Availability

- A growing literature finds evidence of a **causal relation** between Δs in credit availability (underwriting standards) & subsequent HP movements
  - e.g., Anderson et al., 2011; Duca, et al., 2011; Duca et al., 2012; Mayer and Sinai, 2009; Mian and Sufi, 2009; and Taylor, 2009
- But…identifying exogenous Δs in credit supply is challenging
  - Adelino et al., 2012; Aron, et al., 2012
- Moreover, some researchers argue that causality runs in the opposite direction!
  - i.e., credit availability is endogenous w.r.t. HP changes & speculative demand for housing
    - Gelain & Lansing, 2013; Dell' Ariccia et al., 2012; Goetzmann, et al., 2012

Orthogonalize sentiment measures w.r.t. fundamentals

- *BUYER*, *BUILDER & LENDER* likely contain information about current (and projected) economic fundamentals

- We orthogonalize *BUYER*, *BUILDER & LENDER* against contemporaneous & lagged macro variables:
  - Population between 20-30 years old
  - GDP
  - Income
  - Unemployment rate
  - Interest rate

In VAR, we use residuals from these 3 regressions as our proxies for buyer, builder, and lender sentiment

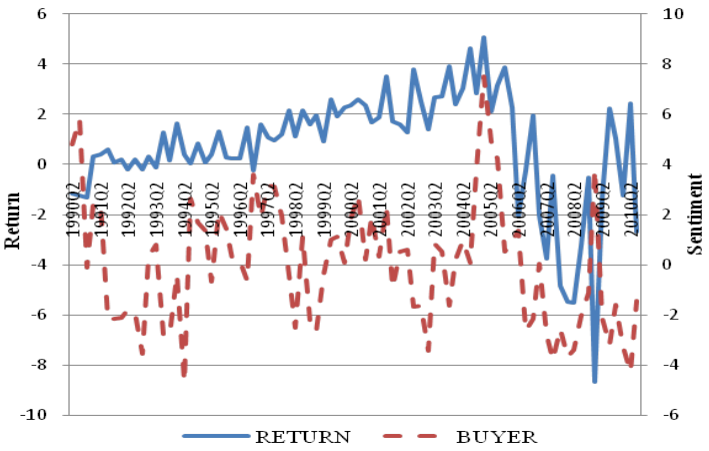
Composite sentiment index

- Our 3 sentiment indices are correlated (Table 3)
- Thus...likely to have a common component
- So...we construct a composite sentiment index (*PCSENT*) as first principal component of the 3 series
  - similar to Baker and Wurgler (2007)

Data: Figure 1

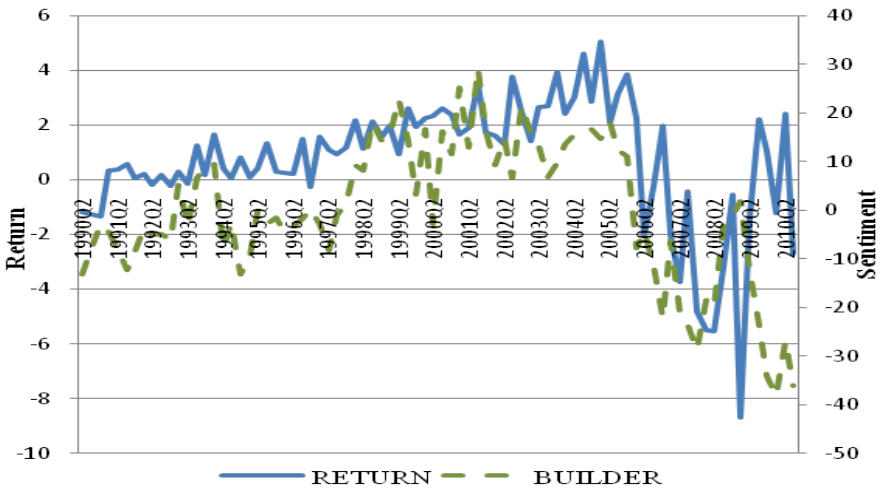
Corr = 0.210

Panel A: Buyer Sentiment and Housing Returns



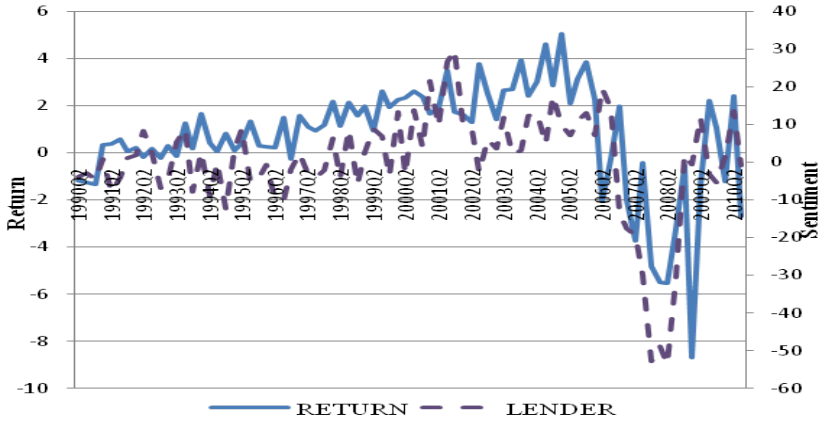
Corr = 0.552

Panel B: Builder Sentiment and Housing Returns

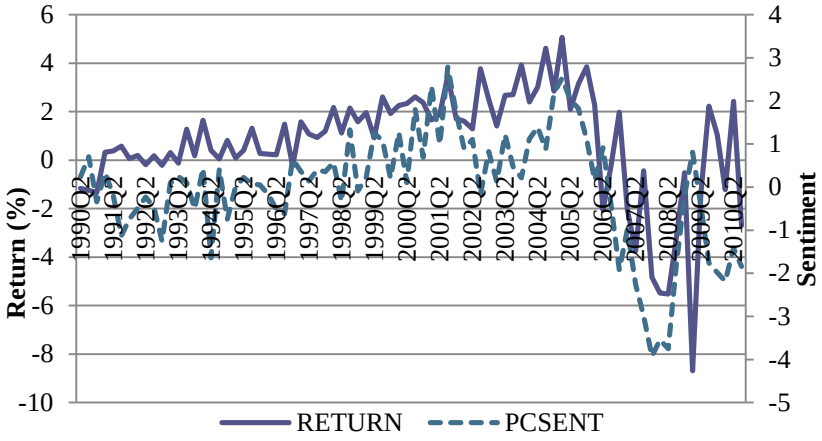


Corr = 0.609

Panel C: Lender Sentiment and Housing Returns



Corr = 0.600



VAR Model

% change in real HPs in quarter t (Case & Shiller National Home Price Index)

Control variables (all in % changes): population between 20-30 years old, real GDP, real income, unemployment rate, mortgage rate, lagged supply.

$$RETURN_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} SENT_{t-i} + \sum_{i=1}^{q} \gamma_{1i} RETURN_{t-i} + \sum_{i=1}^{k} \theta_{1i} TURN_{t-i} + \delta_1 z_t + \upsilon_{1t} \quad (1)$$

$$SENT_t = \alpha_2 + \sum_{i=1}^{p} \beta_{2i} SENT_{t-i} + \sum_{i=1}^{q} \gamma_{2i} RETURN_{t-i} + \sum_{i=1}^{k} \theta_{2i} TURN_{t-i} + \upsilon_{2t} \quad (2)$$

$$TURN_t = \alpha_3 + \sum_{i=1}^{p} \beta_{3i} SENT_{t-i} + \sum_{i=1}^{q} \gamma_{3i} RETURN_{t-i} + \sum_{i=1}^{k} \theta_{3i} TURN_{t-i} + \delta_3 z_t + \upsilon_{3t} \quad (3)$$

Represents sentiment indices at time t:

- Homebuyer sentiment (*BUYER*)
- Builder sentiment (*BUILDER*)
- Lender sentiment (*LENDER*)
- Composite sentiment (*PCSENT*)

% change in ratio of total sales of single-family homes to existing housing stock

Results: buyer & builder models (Table 4)#

Variable (t-4 to t-1)	Buyer Sentiment Model			Builder Sentiment Model		
	RETURN (1)	*SENT* (2)	*TURN* (3)	*RETURN* (4)	*SENT* (5)	*TURN* (6)
SENT	0.187***	0.325***	0.653*	0.08***	0.671***	0.266***
RETURN	0.562***	0.501***	-0.189	0.257***	1.598	-1.23
TURN	0.333***	-0.209	0.081	0.324***	-0.068	-0.018*
Control variables	*Yes*	*No*	*Yes*	*Yes*	*No*	*Yes*
Obs	78	78	78	78	78	78
R^2	0.764	0.417	0.325	0.764	0.758	0.371

#Coefficients are sums of lagged coefficients; significance based on F-test of joint significance

↑sentiment predicts ↑price appreciation & ↑ liquidity

Results: buyer & builder models (Table 4)

Variable (t-4 to t-1)	Buyer Sentiment Model			Builder Sentiment Model		
	RETURN (1)	*SENT* (2)	*TURN* (3)	*RETURN* (4)	*SENT* (5)	*TURN* (6)
SENT	0.187***	0.325***	0.653*	0.08***	0.671***	0.266***
RETURN	0.562***	0.501***	-0.189	0.257***	1.598	-1.23
TURN	0.333***	-0.209	0.081	0.324***	-0.068	-0.018*
Control variables	*Yes*	*No*	*Yes*	*Yes*	*No*	*Yes*
Obs	78	78	78	78	78	78
R^2	0.764	0.417	0.325	0.764	0.758	0.371

↑price appreciation predicts↑sentiment in "buyer" but not "builder" model

Results: buyer & builder models (Table 4)

Variable (t-4 to t-1)	Buyer Sentiment Model			Builder Sentiment Model		
	RETURN (1)	*SENT* (2)	*TURN* (3)	*RETURN* (4)	*SENT* (5)	*TURN* (6)
SENT	0.187***	0.325***	0.653*	0.08***	0.671***	0.266***
RETURN	0.562***	0.501***	-0.189	0.257***	1.598	-1.23
TURN	0.333***	-0.209	0.081	0.324***	-0.068	-0.018*
Control variables	*Yes*	*No*	*Yes*	*Yes*	*No*	*Yes*
Obs	78	78	78	78	78	78
R^2	0.764	0.417	0.325	0.764	0.758	0.371

↑turnover (liquidity) predicts ↑returns

Results: lender & composite models (Tables 4 & 5)

Variable (t-4 to t-1)	Lender Sentiment Model			Composite Sentiment Model		
	RETURN (7)	*SENT* (8)	*TURN* (9)	*RETURN* (10)	*SENT* (11)	*TURN* (12)
SENT	0.05***	0.262***	0.087	1.014***	0.212***	3.101***
RETURN	0.472***	2.939***	-0.096	0.102**	0.419***	-1.54*
TURN	0.211***	0.674*	-0.271	0.271***	-0.0332	-0.078*
Control variables	*Yes*	*No*	*Yes*	Yes	No	Yes
Obs	78	78	78	78	78	78
R^2	0.759	0.678	0.323	0.803	0.728	0.394

↑sentiment predicts↑price appreciation & ↑liquidity in composite model

Results: lender & composite models (Tables 4 & 5)

Variable (t-4 to t-1)	Lender Sentiment Model			Composite Sentiment Model		
	RETURN (7)	*SENT* (8)	*TURN* (9)	*RETURN* (10)	*SENT* (11)	*TURN* (12)
SENT	0.05***	0.262***	0.087	1.014***	0.212***	3.101***
RETURN	0.472***	2.939***	-0.096	0.102**	0.419***	-1.54*
TURN	0.211***	0.674*	-0.271	0.271***	-0.0332	-0.078*
Control variables	*Yes*	*No*	*Yes*	Yes	No	Yes
Obs	78	78	78	78	78	78
R^2	0.759	0.678	0.323	0.803	0.728	0.394

↑price appreciation predicts ↑sentiment in both "lender" & "composite" models

Results: lender & composite models (Tables 4 & 5)

Variable (t-4 to t-1)	Lender Sentiment Model			Composite Sentiment Model		
	RETURN (7)	*SENT* (8)	*TURN* (9)	*RETURN* (10)	*SENT* (11)	*TURN* (12)
SENT	0.05***	0.262***	0.087	1.014***	0.212***	3.101***
RETURN	0.472***	2.939***	-0.096	0.102**	0.419***	-1.54*
TURN	0.211***	0.674*	-0.271	0.271***	-0.0332	-0.078*
Control variables	*Yes*	*No*	*Yes*	Yes	No	Yes
Obs	78	78	78	78	78	78
R^2	0.759	0.678	0.323	0.803	0.728	0.394

↑turnover (liquidity) predicts↑returns

Economic Significance?

- Impulse response functions
  - One S.D. shock in sentiment produces a cumulative price increase of 22-80 bps over next 3 quarters
  - These price responses are **economically significant**
    - Mean real price Δ over sample period is 0.71% per quarter (Table 1)
  - Effect of sentiment shock is persistent over a sustained period

Four-Equation VAR Model

- A potential challenge associated with identifying supply-side (demand-side) sentiment effects is isolating it from demand-side (supply-side) effects
- We therefore estimate two 4-equation VAR models:

$$[RETURN_t, BUYER_t, LENDER_t, TURN_t]$$

$$[RETURN_t, BUYER_t, BUILDER_t, TURN_t]$$

***Result**: Adding BUYER to control for demand-side effects does **not** alter the positive relation between LENDER/BUILDER & house price appreciation*

Long-run regressions (Table 9)

Return horizon	k	coeff. $PCSENT_t$	Bootstrapped St. Err.	R^2
One-year	4	1.575***	0.14	0.709
Two-year	8	1.100***	0.12	0.475
Three-year	12	0.888***	0.11	0.301
Four-year	16	0.174*	0.09	0.167
Five-year	20	-0.059	0.10	0.104

- Market susceptible to prolonged periods of sentiment-induced mispricing
  - Prices diverge from fundamental values for as long as 3 years
  - However, coefficient magnitudes decrease as return horizon increases

Additional Robustness Tests

1. Orthoganalize sentiment indices against **predicted** macro variables

Results: Using predicted macro variables

Variable (t-4 to t-1)	Composite Sentiment Model		
	RETURN (10)	*SENT* (11)	*TURN* (12)
SENT	0.819***	0.556***	2.913***
RETURN	0.222**	0.170	-1.380
TURN	0.294***	0.071	-0.033*
Control variables	Yes	No	Yes
Obs	78	78	78
R^2	0.785	0.656	0.302

- Results are unchanged except….
- HP changes no longer predict sentiment

Additional Robustness Tests

1. Orthoganalize sentiment indices against **predicted** macro variables
2. Federal Housing Finance Agency (FHFA) HP index in place of S&P/Case-Shiller index.
3. Sub-period analysis: (1) normal market & (2) boom/bust market
4. MSA-Level Analysis
5. In-sample forecasts
6. *VOLUME* in place of *TURN*

Summary of Key Findings

- Housing market sentiment predicts real HP changes in subsequent quarters
  - A one S.D. shock to sentiment produces a 22-80 bp ↑ in real HP appreciation over next 3 quarters
- Sentiment's **effect is persistent** over a sustained period
  - Correction process may take up to 3 years
- Market liquidity is a significant determinant of HP changes
- Evidence of feedback between HPs, sentiment & turnover:
  - past HP Δs **predict** home buyer & lender sentiment;
  - past HP Δs **do not predict** builder sentiment

Explaining House Price Dynamics:
Isolating the Role of Non-Fundamentals

David C. Ling*, Joseph Ooi# & Thao Le #

*University of Florida,
National University of Singapore

Primary Research Questions

1. Does sentiment predict Δs in HPs, over & above impact of lagged HP Δs, ML, & fundamentals?

$$RETURN_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} SENT_{t-i} + \sum_{i=1}^{q} \gamma_{1i} RETURN_{t-i} + \sum_{i=1}^{k} \theta_{1i} TURN_{t-i} + \delta_1 z_t + \upsilon_{1t}$$

Primary Research Questions

1. Does sentiment predict Δs in HPs, over & above impact of lagged HP Δs, ML, & fundamentals?

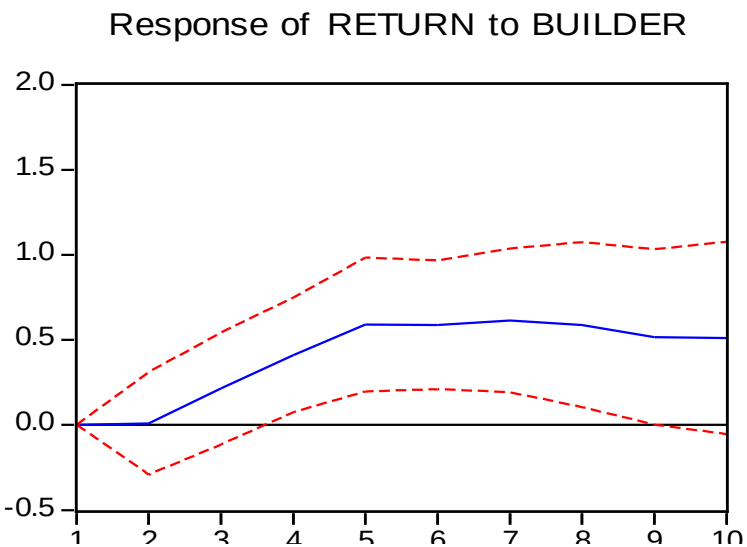
$$RETURN_t = \alpha_1 + \sum_{i=1}^{p} \beta_{1i} SENT_{t-i} + \sum_{i=1}^{q} \gamma_{1i} RETURN_{t-i} + \sum_{i=1}^{k} \theta_{1i} TURN_{t-i} + \delta_1 z_t + \upsilon_{1t}$$

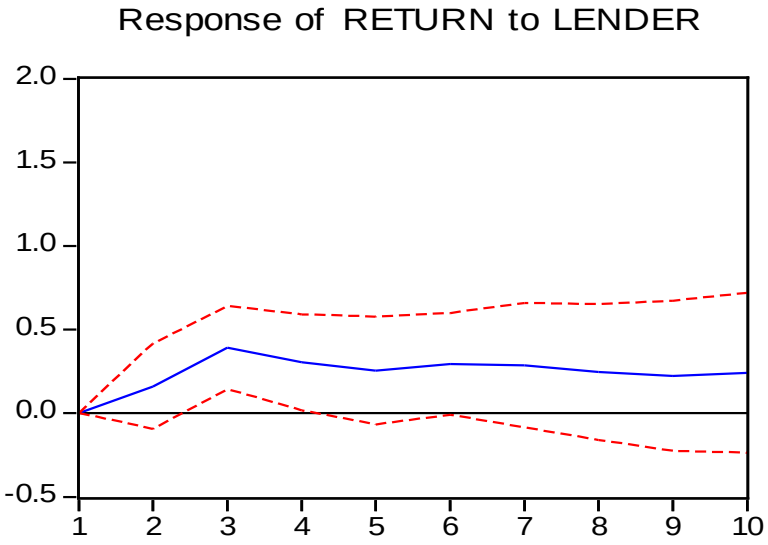
2. Do Δs in HPs predict sentiment, over & above the impact of lagged sentiment, ML, & fundamentals?

$$SENT_t = \alpha_2 + \sum_{i=1}^{p} \beta_{2i} SENT_{t-i} + \sum_{i=1}^{q} \gamma_{2i} RETURN_{t-i} + \sum_{i=1}^{k} \theta_{2i} TURN_{t-i} + \upsilon_{2t}$$

3. Do Δs in ML predict Δs in HPs or sentiment, over & above impact of HPs, lagged sentiment, & fundamentals?

Impulse Response Functions





- Effect of shock in sentiment is persistent over a sustained period
- One S.D. shock in sentiment is associated with cumulative price increase of 22-80 bps over next 3 quarters

Data: Measuring Credit Availability

- *LENDER*
  - Net % of banks reporting a loosening of credit standards for home loans

35
- Eased considerably
- Eased somewhat

5
- Remained essentially unchanged

20
- Tightened somewhat
- Tightened considerably

LENDER = (35-20)/60 = 25%

Correlation matrix

Variable		BUYER	BUILDER	LENDER	PCSENT	TURN
Sentiment indices						
Buyer sentiment	**BUYER**	1.00				
Builder sentiment	**BUILDER**	0.360*	1.00			
Lender sentiment	**LENDER**	0.332*	0.560*	1.00		
Composite index	**PCSENT**	0.681*	0.837*	0.824*		
House prices						
House price change	**RETURN**	0.210	0.552*	0.609*	0.600*	0.349*
Market liquidity proxies						
Turnover rate	**TURN**	0.043	0.305*	0.171	0.231*	
Trading volume	**VOLUME**	0.043	0.316*	0.177	0.238*	0.997*

Our sentiment indices are positively and significantly correlated.

Endogenous Variables

1990Q2 – 2010Q3

Definition	Variable	Mean	St.D.	Min	Max	Serial correlation	DF test (p-value)
House prices							
Real change in Case-Shiller price index (percentage)	*RETURN*	0.71	2.31	-8.68	5.07	0.60***	0.000
Sentiment indices							
	BUYER	0.00	2.52	-4.67	7.53	0.52***	0.000
	BUILDER	0.00	14.65	-38.06	28.98	0.82***	0.014
	LENDER	0.00	14.55	-53.67	29.75	0.72***	0.000
First principal component derived from *BUYER*, *BUILDER* and *LENDER*	*PCSENT*	0.00	1.36	-3.92	2.78	0.75***	0.001
Market liquidity proxies							
Change in the ratio of total sales of (new and existing) single-family homes to existing housing stock (percentage)	*TURN*	-0.05	5.32	-24.42	10.78	-0.06	0.000
Change in total sales of (new and existing) single-family homes (percentage)	*VOLUME*	0.37	5.51	-24.35	13.21	-0.18	0.000

Sub-period analysis

Variable (t-4 to t-1)	1990Q2-1997Q4			1998Q1-2010Q3		
	RETURN	*PCSENT*	*TURN*	*RETURN*	*PCSENT*	*TURN*
PCSENT	1.17***	-0.3519	7.07***	0.86***	0.19***	2.53***
RETURN	-0.0272	0.68**	-1.935	0.014***	0.48***	-1.291
TURN	0.02157	-0.0913	0.01***	0.52***	-0.071	0.08***
Control variables	Yes	No	Yes	Yes	No	Yes
Obs	27	27	27	51	51	51
R^2	0.827	0.373	0.829	0.877	0.801	0.489

- There seems to be a sentiment-induced mispricing component in house prices, regardless of market conditions.
- In the second sub-period, sentiment appears more predictable. It could be predicted by its previous values.

MSA-level Analysis

- We repeat the analysis using data on 19 MSAs tracked by the S&P/Case-Shiller indices over 1990-2012.
- For each market, we run VAR models using local MSA returns, national turnover, national sentiment (*PCSENT*) and national macroeconomic variables.
- *PCSENT* is positive and significant in 17 of 19 MSAs. National sentiment can predict MSA-level returns.
- In 11 of the 14 MSAs that experienced price appreciation over the sample period, *RETURN* in the sentiment equation is positive and significant.
  - In the five worst performing markets, where price appreciation was negative over our sample period, MSA-level returns do not predict national sentiment.

In-sample forecast accuracy

- Estimate two models on the full sample period:

$$RETURN_t = \alpha + \sum_{i=1}^{4} \beta_i PCSENT_{t-i} + \sum_{i=1}^{4} \gamma_i RETURN_{t-i} + \sum_{i=1}^{4} \theta_i TURN_{t-i} + \delta z_t + \nu_t \quad (1)$$

$$RETURN_t = \alpha + \sum_{i=1}^{4} \gamma_i RETURN_{t-i} + \sum_{i=1}^{4} \theta_i TURN_{t-i} + \delta z_t + \nu_t \quad (5)$$

- Use the estimated coefficients to forecast house price changes between 1998Q1-2010Q3 & calculate forecast errors for both models.

The model with the sentiment variable has better prediction power than the conventional model (5).

	With sentiment	Without sentiment
Mean Error	0.0087	0.1085
Mean Squared Error	1.3340	2.7512
Mean Percentage Error	28%	54%

Long-run regression

- In the long run, we should observe a negative relationship between cumulative long-run returns and sentiment as prices revert to their fundamental values over time. Long-run regression model:

$$(RETURN_{t+1} + \cdots + RETURN_{t+k})/k = \alpha(k) + \theta(k)z_t + \beta(k)PCSENT_t + \varepsilon_t$$

- The test is carried out for one- to five-year horizons (k = 4 to 20). Two potential issues:
  - Overlapping observations in the dependent variable (RETURNs)
  - Persistent explanatory variable (PCSENT) with a finite sample setting

=> We use a bootstrap simulation procedure similar to Brown and Cliff (2005) and Ling, Naranjo and Scheick (2013) to adjust the estimated coefficients.

But Don't We Know Sentiment Matters?

- No research has tested directly the dynamic relation between market-wide sentiment & HP dynamics
- Instead, sentiment is often **inferred** indirectly as price deviations from fundamental values (Mayer 2011)
  - E.g., Abraham & Hendershott (1996) use difference between actual HPs & a "fundamental" price level to explain large subsequent declines in real HPs
- However, can't observe fundamental housing values
  - makes it difficult to attribute observed deviations to actual mispricing (sentiment) or model misspecification

What Do We Do?

- By examining dynamic interaction of HPs, ML, & sentiment, we provide evidence on amplifying mechanisms that drive HP booms & busts
  - Important because theory predicts Δs in sentiment & HP may be mutually reinforcing, especially when markets are illiquid

A direct and dynamic model	allowing for a feedback mechanism between house prices, sentiment, & market liquidity