Land Prices and Unemployment[1]

Zheng Liu[a] Jianjun Miao[b] Tao Zha[c]

[a]FRB San Francisco

[b]Boston University

[c]FRB Atlanta, Emory University, and NBER

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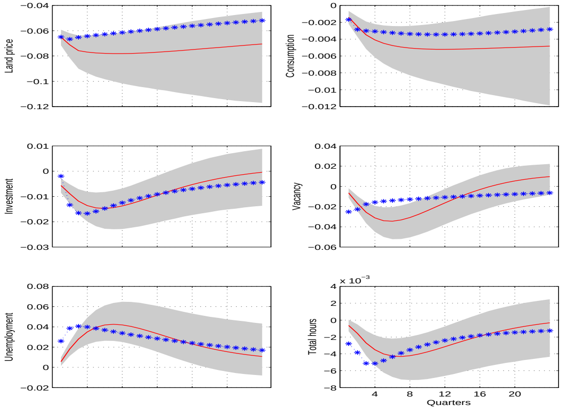
[1]The views expressed herein are those of the authors and do not necessarily reflect the views of the Federal Reserve Banks of Atlanta and San Francisco or the Federal Reserve System.

Land prices and unemployment comove over business cycles

Negative shock to land price raises unemployment and lowers macro quantities

Challenges



What does this paper do?

- Provide a structural analysis of dynamic links between land prices and unemployment
- Show empirical relevance of this structural analysis
- Key features: incorporate labor search frictions and financial frictions in a unified DSGE framework to fit U.S. time series

Challenges

- Theory: no obvious transmission mechanism to link land-price dynamics to unemployment fluctuations
  - Impaired balance sheets reduce consumption (Iacoviello 2005; Mian-Sufi 2012; Mian-Sufi-Rao 2013)
  - Drops in collateral value reduce business investment (Gan 2007; Chaney, et al. 2012; Liu-Wang-Zha 2013)
- Empirics: Hard to generate large volatility of labor market (Shimer 2005)
- Question: Can our structural model link land-price fluctuations to large volatility of unemployment?
  - Short answer: "Yes." Styled facts

Economic environment

- Households: patient
  - Some members employed, others not
  - All members consume goods and housing services
  - Provide loans
- Capitalists: impatient
  - Produce capital (investment) and consume goods
  - Borrow against collateral value (land and capital)
  - Own firms
- Firms: Produce final goods using labor, land, and capital as inputs
- Labor market: DMP search and matching frictions.

Households

- Household family's utility function:

$$E \sum_{t=0}^{\infty} \beta_h^t \left[\frac{\left(L_{ht}^{\varphi_{Lt}} \left(C_{ht} - \eta_h C_{ht-1} \right) / Z_t^p \right)^{1-\gamma}}{1-\gamma} - \chi g\left(h_t\right) N_t \right]$$

- Budget constraint

$$C_{ht} + \frac{B_{ht}}{R_t} + Q_{lt}\left(L_{ht} - L_{h,t-1}\right) = B_{ht-1} + W_t h_t N_t + b Z_t^p \left(1 - N_t\right) - T_t.$$

- Important features:
  - Housing demand shock (φ_{Lt}): main source of land-price fluctuations (Iacoviello-Neri, 2010; Liu-Wang-Zha, 2013)
  - Non-separable utility: muted wage responses to housing demand shocks and large labor-market volatility

Capitalists

- Utility function:

$$E\sum_{t=0}^{\infty}\beta_c^t \ln\left(C_{ct}-\eta_c C_{ct-1}\right), \quad \beta_c<\beta_h$$

- Flow-of-funds constraint:

$$C_{ct}+Q_{lt}\left(L_{ct}-L_{c,t-1}\right)+I_t+\Phi\left(e_t\right)K_{t-1}+B_{c,t-1}= \frac{B_{ct}}{R_t}+R_{kt}e_tK_{t-1}+R_{lt}L_{c,t-1}+\Pi_t.$$

- Collateral constraint:

$$B_{ct}\leq \xi_t \mathrm{E}_t\left(\omega_1 Q_{l,t+1}L_{ct}+\omega_2 Q_{k,t+1}K_t\right),$$

- Capital law of motion:

$$K_t=\left(1-\delta\right)K_{t-1}+\left[1-\frac{\Omega}{2}\left(\frac{I_t}{I_{t-1}}-\bar{\gamma}_I\right)^2\right]I_t.$$

Labor market

- Matching function:

$$m_t = \varphi_{mt} u_t^a v_t^{1-a},$$

- Employment dynamics:

$$N_t = (1-\rho)\, N_{t-1} + m_t.$$

- Searching workers:

$$u_t = 1 - (1-\rho) N_{t-1}.$$

- Unemployment rate:

$$U_t = u_t - m_t = 1 - N_t.$$

Firms

- Production function:

$$y_t = Z_t^{1-\alpha+\phi\alpha}\left(l_{ct}^{\phi}k_t^{1-\phi}\right)^{\alpha}h_t^{1-\alpha}.$$

- Match value:

$$J_t^F = \max_{k_t,l_{ct}} \; \pi_t - W_t h_t + E_t \frac{\beta_c \Lambda_{ct+1}}{\Lambda_{ct}}\left[(1-\rho)\,J_{t+1}^F + \rho V_{t+1}\right],$$

where $\pi_t = y_t - R_{kt}k_t - R_{lt}l_{ct}$.

- Vacancy value:

$$V_t = -\kappa Z_t^p + q_t^v J_t^F + (1-q_t^v)\,E_t \frac{\beta_c \Lambda_{c,t+1}}{\Lambda_{ct}} V_{t+1}$$

- Free entry: $V_t = 0 \Rightarrow$

$$\frac{\kappa Z_t^p}{q_t^v} = J_t^F$$

Worker value functions and Nash bargaining

- Value of employment:

$$J_t^W = W_t h_t - \frac{\chi g\left(h_t\right)}{\Lambda_{ht}}$$
$$+E_t \frac{\beta_h \Lambda_{h,t+1}}{\Lambda_{ht}} \left[\left(1-\rho\left(1-q_{t+1}^u\right)\right) J_{t+1}^W + \rho\left(1-q_{t+1}^u\right) J_{t+1}^U\right].$$

- Value of unemployment:

$$J_t^U = bZ_t^p + E_t \frac{\beta_h \Lambda_{h,t+1}}{\Lambda_{ht}} \left[q_{t+1}^u J_{t+1}^W + \left(1-q_{t+1}^u\right) J_{t+1}^U\right].$$

- Nash bargaining problem:

$$\max_{W_t, h_t} \quad \left(J_t^W - J_t^U\right)^{\frac{\vartheta_t}{1+\vartheta_t}} \left(J_t^F - V_t\right)^{\frac{1}{1+\vartheta_t}},$$

Government policy and market clearing conditions

- Government budget

$$bZ_t^p(1 - N_t) = T_t.$$

- Goods market clearing

$$C_t + I_t + \Phi(e_t) K_{t-1} + \kappa Z_t^p v_t = Y_t.$$

- Aggregate output

$$Y_t = \left[(Z_t L_{c,t-1})^{\phi} (e_t K_{t-1})^{1-\phi} \right]^{\alpha} (Z_t h_t N_t)^{1-\alpha}.$$

- Housing market clearing

$$L_{ct} + L_{ht} = \bar{L}.$$

- Bond market clearing

$$B_{ct} = B_{ht} \equiv B_t.$$

- Capital market clearing

$$e_t K_{t-1} = N_t k_t.$$

Quarterly time series data from 1976:Q1-2013:Q1

1. Land price: Constructed from CoreLogic house price based on Davis-Heathcote (2007) approach
2. Consumption: Real per capita consumption of nondurables and non-housing services.
3. Investment: Real per capita business investment (consumer durable plus investment in equipment and intellectual property).
4. Labor hours: total hours in nonfarm business sector.
5. Vacancy rate: Combining JOLTS (post 2001) and Barnichon (2010) help-wanted index (pre-2001)
6. Unemployment rate

Estimation strategy

(1) Calibrate several steady state ratios and a subset of parameters ▸ Calibration

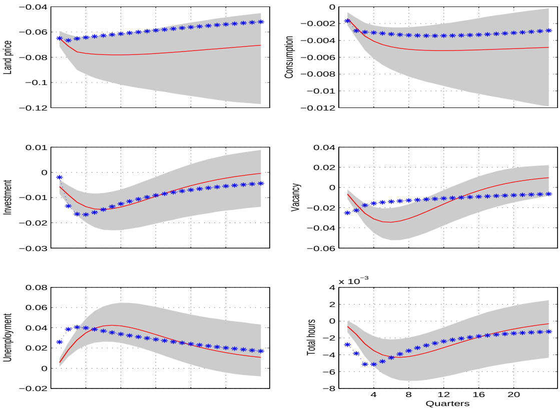
(2) Estimate parameters that do not affect steady state, including habit, adjustment costs, utilization rate, and shock processes ▸ Structural parameters ▸ Shock parameters

(3) Given (1) and (2), obtain remaining parameters using steady-state restrictions — a recursive procedure.

Estimation results

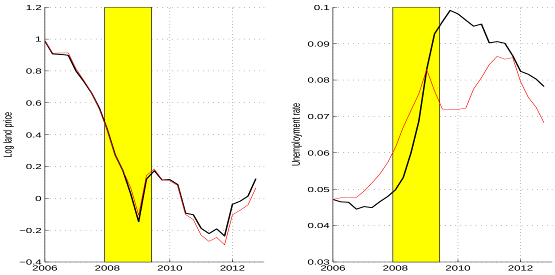
- Land price fluctuations primarily driven by housing demand shocks
- Model fits data well along both dimensions: comovement and volatility Comovement
  - A 10% drop in land price $\Rightarrow$ unemployment rises by 0.34 percentage points (relative to ss)
- Great Recession: housing demand accounts for 2.5 percentage point increases in unemployment Great Recession
- Model generates Shimer's (2005) volatility ratio: std of labor-market tightness relative to that of labor productivity
  - Shimer ratio $= 27.47$ in simulated data from estimated model (compared to 24.91 in actual data)

Land price and unemployment: data vs model



Great Recession

▸ Estimation results



Transmission mechanism

- Credit channel: land price and unemployment comove (through collateral constraints)
- Labor channel: effects of housing demand shocks on unemployment amplified (non-separable preferences)

Credit channel

$$J_t^F = F(k_t, l_t, h_t) - W_t h_t + E_t \frac{\beta_c \Lambda_{ct+1}}{\Lambda_{ct}} (1-\rho) J_{t+1}^F$$

A negative housing demand shock

$\rightarrow$ fall of land price and tightened borrowing capacity

$\rightarrow$ reductions in business investment and land acquisition (further depressing land price)

$\rightarrow$ lower current investment leads to lower future K

$\rightarrow$ reduced future marginal product of workers

$\rightarrow$ fall of PV of new match (for any given W and h)

$\rightarrow$ fewer vacancies posting

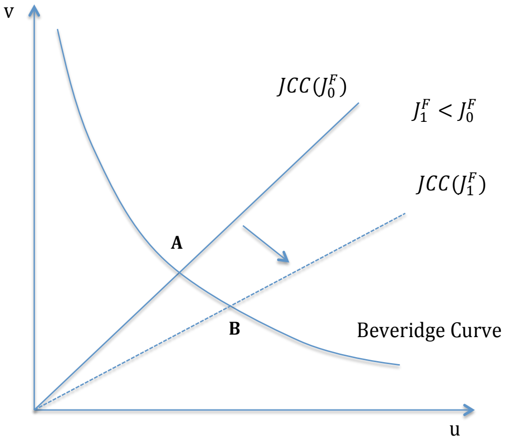
$\rightarrow$ lower job finding rate and higher U

$\rightarrow$ reduced household income

$\rightarrow$ further reductions in housing demand and land price

Transmission through credit channel with search frictions

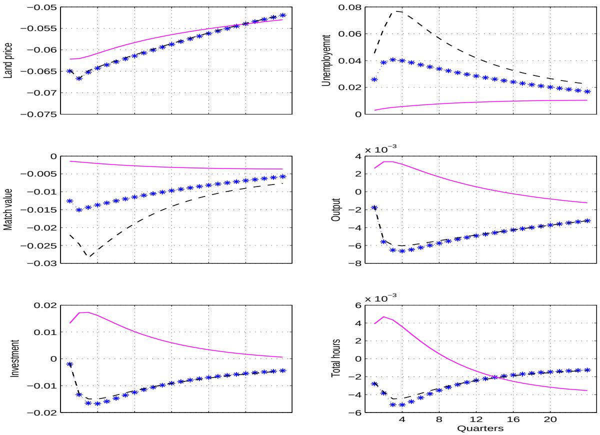
- Beveridge curve (BC): $\rho(1-u) = \varphi_m u^a v^{1-a}$
- Job creation curve (JCC): $\frac{\kappa}{q^v} = J^F$



Importance of credit channel

- Consider a counterfactual economy with constant debt limit for capitalists
- Declines in land price have no effect on borrowing capacity
- Lower land price free up resources for investment spending
  - → land price and consumption fall, while investment, output and hours rise —no comovement
  - → Muted impact of housing demand shock on match value and unemployment —small volatility

No credit channel (solid lines)



Labor channel

- Declines in land price reduce investment and hiring through credit channel
- But drop in wages can blunt the impact of the shock on labor market (Shimer, 2005)
- Labor channel: non-separable preferences $\rightarrow$ endogenous wage rigidities

Technology shock

The labor channel and endogenous wage rigidities

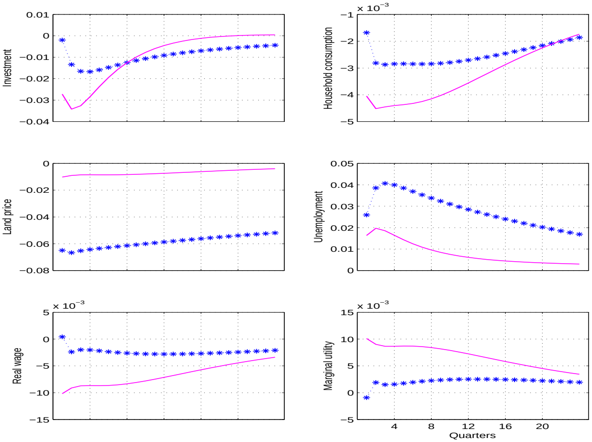
- Nash bargained wage equation:

$$W_t = \frac{\chi g\left(h_t\right)/h_t}{\Lambda_{ht}} + bZ_t^p/h_t + \frac{1}{h_t}\left[\vartheta_t J_t^F - \mathrm{E}_t \frac{\beta_h \Lambda_{h,t+1}}{\Lambda_{ht}}\left(\left(1-\rho\right)\left(1-q_{t+1}^u\right)\vartheta_{t+1}J_{t+1}^F\right)\right].$$

- Technology shock: muted impact on unemployment because wage declines
  - Tech shock reduces match value and vacancy postings, prolongs unemployment duration $(1/q^u) \to$ wage falls
  - Tech shock also lowers consumption and raises marginal utility $\to$ further declines in wage
- Housing demand shock: large impact on unemployment because wage is endogenously rigid
  - Non-separable utility $\to$ housing demand shock directly lowers marginal utility $(\Lambda_{ht}) \to$ offsetting downward pressures on wage

Housingvstech

Housing demand shock vs. technology shock

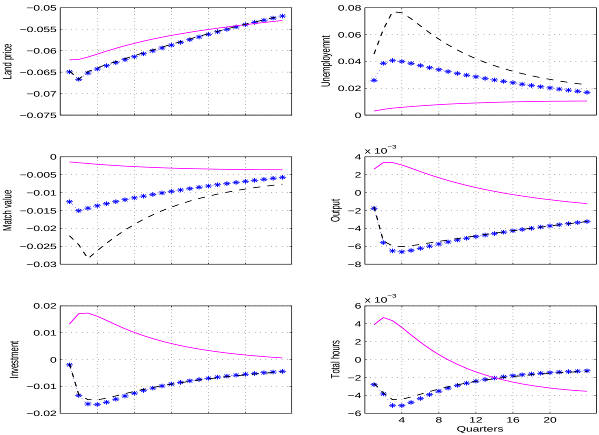


Intensive margin important

- Counterfactual: inelastic supply of labor hours (no intensive margin)
- Match value falls more than that in estimated model because firms cannot cut costs by reducing hours
- Overshooting of unemployment dynamics

InelasticLaborHours

Inelastic hours for employed worker (dashed lines)



Conclusion

- Credit channel and labor channel reinforce each other to transmit fluctuations in land price into
  - persistent movement in unemployment
  - and large volatility of the labor market
- Persistence and volatility are both large enough to be consistent with U.S. data.
- DSGE framework provides essential ingredients for further research on interactions between housing market and labor market over the business cycle

Structural parameters: Calibrated

Parameter	Description	value
a	Share parameter in match function	0.50
b/W	Replacement ratio	0.75
α	Capital income share	0.33
γ	Risk aversion for household	2
ρ	Job separation rate	0.12
U	Unemployment rate	5.5%

Consistent with Kocherlakota (1996), Lucas Jr. (2003), Hall and Milgrom (2008), Blanchard and Galí (2010), Christiano, Eichenbaum, and Trabandt (2013). Back to estimation strategy

Structural parameters: Estimated

	Prior			Posterior		
Parameter	Distribution	low	high	Mode	Low	High
η_c	Beta	0.025	0.776	0.982	0.973	0.989
η_h	Beta	0.025	0.776	0.219	0.148	0.302
Ω	Gamma	0.171	10.00	0.142	0.105	0.216
γ_2	Gamma	0.171	10.00	1.009	0.537	1.498
ν	Gamma	0.086	5.000	0.027	0.013	0.049
ω_2	Gamma	0.048	2.821	0.142	0.123	0.157
$100(\lambda_z - 1)$	Gamma	0.100	1.500	0.495	0.421	0.551
δ	Simulated	0.043	0.051	0.047	0.047	0.048
β_h	Simulated	0.991	0.999	0.995	0.994	0.996
β_c	Simulated	0.968	0.997	0.989	0.989	0.989
ϕ	Simulated	0.032	0.085	0.050	0.048	0.054
γ_1	Simulated	0.060	0.064	0.063	0.063	0.063
φ_L	Simulated	0.003	0.031	0.018	0.016	0.021
χ	Simulated	0.014	0.527	0.254	0.233	0.284

See Keane and Rogerson (2011).

Back to estimation strategy

Estimated values of shock parameters

Parameter	Prior			Posterior		
	Distribution	low	high	Mode	Low	High
ρ_L	Beta	0.025	0.776	0.998	0.997	0.999
ρ_ϑ	Beta	0.025	0.776	0.958	0.931	0.983
ρ_m	Beta	0.025	0.776	0.990	0.972	0.997
ρ_{zp}	Beta	0.025	0.776	0.256	0.138	0.369
ρ_{zm}	Beta	0.025	0.776	0.913	0.854	0.932
ρ_ξ	Beta	0.025	0.776	0.977	0.938	0.987
σ_L	Inv-Gamma	1.00e-04	2.000	0.097	0.089	0.133
σ_ϑ	Inv-Gamma	1.00e-04	2.000	0.078	0.071	0.088
σ_m	Inv-Gamma	1.00e-04	2.000	0.019	0.017	0.021
σ_{zp}	Inv-Gamma	1.00e-04	2.000	0.012	0.010	0.013
σ_{zm}	Inv-Gamma	1.00e-04	2.000	0.014	0.013	0.016
σ_ξ	Inv-Gamma	1.00e-04	2.000	0.026	0.024	0.041

Back to estimation strategy