Rural-Urban Migration, Structural Transformation, and Housing Markets in China

Carlos Garriga ¹  Aaron Hedlund ²  Yang Tang ³  Ping Wang ⁴

¹Federal Reserve Bank of St. Louis
²Univ. of Missouri, St. Louis Fed, and CGO
³Nanyang Technological University
⁴Wash U, St. Louis Fed, and NBER

QSPS, September 2019

The views expressed are those of the authors and not necessarily of the Federal Reserve Bank of St. Louis or the Federal Reserve System.
LONGER TERM AGENDA

1. What drives housing (especially prices)?
   - Fundamentals (demographics, preferences, structural transformation/urbanization in modern economies)
   - Expectations
   - Credit
   - Liquidity

\[ P_t = \underbrace{R_t}_{\text{fundamentals}} + \underbrace{E}_{\text{expectations}} \left\{ \Gamma_{t,t+1} (1 - \tau_{t+1}) P_{t+1} \right\} + \underbrace{\mu_t \theta P_t}_{\text{credit}} \]

2. How does housing impact the macroeconomy?

3. What are the policy implications?
Motivating Facts

- Chinese house prices tripled in the span of 13 years, whereas agricultural prices only increased by 30%.

- Productivity has also risen significantly but not as much.
**Motivating Facts**

- Large population shift from rural to urban areas.

- However, smaller decline in agricultural output share and nearly flat income gap.

- Suggests declining mobility costs or rising urban amenities ⇒ lower net mobility costs.
TODAY’S TALK

Explore China’s structural transformation and housing boom.

1. How much of the Chinese housing boom can be explained by structural transformation?
   - Rising productivity boosts income and housing demand.
   - Rural-urban migration further increases housing demand.
   - Constrained land supply limits construction.

2. How do rising housing costs affect the extent and speed of structural transformation?
   - Expensive urban housing is a deterrent to migration.

3. What is the impact of land and permitting policies?
   - Land supply affects house prices and possibly migration.
   - Hukou permits slow the transition from renting to owning.
**Model Summary: I**

**All Households**
- Utility $u(x_{ft}, x_{mt}, x_{ht})$.

**Rural Households**
- Deterministic, inelastic agricultural income.
- Agents live in farm houses at zero cost: $x_{ht} = h_f$.
- No access to financial markets.

**Urban Households**
- Stochastic income $w_t e_t s_t: \int e_t s_t d\phi_{urban} = \mu_{urban}^t$.
- Rent $x_{ht} = h_a$ at flow cost $p_a$.
- Hukou permit holders can buy $h \in \mathcal{H} = \{h_1, h_2\}$ at price $p_{ht}$ and receive $x_{ht} = h > h_a$. Adjustment costs $\tau_b$ and $\tau_s$.
- Access to saving (all) and borrowing (homeowners only).
Model Summary: II

Migration
- Rural workers differentiated by mobility cost $\epsilon \sim F(\epsilon)$.
- Movers draw $e_t$ and $s_t \sim \Pi_s$. No reverse migration.
- $\mu_t^{rural} = \mu_{t-1}^{rural} - \text{migration}_{rural \rightarrow urban,t}; \mu_t^{rural} + \mu_t^{urban} = 1$.

Technology
- Agriculture: $Y_{ft} = Z_{ft}N_{ft}$ where $N_{ft} = \mu_t^{rural}$.
- "Manufacturing:" $Y_{mt} = Z_{mt}N_{mt}$.
- Housing construction: $Y_{ht} = F_h(L_{ht}, S_{ht}, N_{ht})$.
  - $L_{ht}$ is supplied by the government.
- Apartment space: $Y_{at} = Z_aS_{at}$ ⇒ “rent” $p_a = 1/Z_a$.
  - Isomorphic to durable apartments and risk neutral absentee landlords: $P_a = 1/Z_a = p_a + \frac{1-\delta_a}{1+i}P_a \Rightarrow p_a = \frac{i+\delta_a}{1+i}1/Z_a$. 
MODEL SUMMARY: III

Financial Markets

► Risk-free saving at rate $i_t$.

► Long-term mortgages with rate $r_t$ that amortize at rate $\gamma$.
  ► Maximum loan-to-value at origination of $\theta$.
  ► No default, no refinancing.

Market Clearing

► Tradable goods and financial services (open economy); nontradable housing.

► Exogenous $i_t, r_t, p_{ft}$; endogenous $p_a, w_t, p_{ht}$.

► Urban labor market clearing: $N_{ht} + N_{mt} = \mu_t^{urban}$.

► Housing: $\int h^*_t d\Phi_t^{rent} + \delta_h H_{t-1} = \int h\mathbf{1}_{sell*} d\Phi_t^{own} + Y_{ht}$. Law of motion $H_t = (1 - \delta_h)H_{t-1} + Y_{ht}$.
**Household Decision Problems**

- Rural households:

\[
V_{t}^{rural}(\epsilon) = \max_{x_{mt}, x_{ft}} u(x_{mt}, x_{ft}, h_{f}) + \beta \max \left\{ V_{t+1}^{rural}(\epsilon), \mathbb{E}V_{t+1}^{rent,0}(y_{t+1}, s_{t+1}) - \delta_{t+1}\epsilon \right\}
\]

such that

\[
p_{ft}x_{ft} + x_{mt} = p_{ft}Z_{ft}
\]

\[
y_{t+1} = w_{t+1}e_{t+1}s_{t+1} + \bar{T}_{t+1}
\]

⇒ migrate next period if \( \epsilon \leq \epsilon^{*} \) where \( \epsilon^{*} = \frac{\mathbb{E}V_{t+1}^{rent,0}(y_{t+1}, s_{t+1}) - V_{t+1}^{rural}(\epsilon^{*})}{\delta_{t+1}} \)

- Urban renters without hukou permits:

\[
V_{t}^{rent,0}(y_{t}, s_{t}) = \max_{x_{ft}, x_{mt}, b_{t+1}} u(x_{ft}, x_{mt}, h_{a}) + \beta \mathbb{E} \left[ (1 - \eta)V_{t+1}^{rent,0}(y_{t+1}, s_{t+1}) + \eta \max \{ V_{t+1}^{rent,1}(y_{t+1}, s_{t+1}), V_{t+1}^{buy}(y_{t+1}, s_{t+1}) \} \right]
\]

such that

\[
p_{ft}x_{ft} + x_{mt} + p_{a}h_{a} + b_{t+1} = y_{t}
\]

\[
y_{t+1} = w_{t+1}e_{t+1}s_{t+1} + (1 + i_{t+1})b_{t+1} + \bar{T}_{t+1}
\]
HOUSEHOLD DECISION PROBLEMS

- Urban renters with hukou permits:

\[
V_{t}^{\text{rent},1}(y_{t},s_{t}) = \max_{x_{ft},x_{mt},b_{t+1}} u(x_{ft}, x_{mt}, h_{a}) + \beta \mathbb{E} \left[ \max \left\{ V_{t+1}^{\text{rent},1}(y_{t+1}, s_{t+1}), V_{t+1}^{\text{buy}}(y_{t+1}, s_{t+1}) \right\} \right]
\]

such that
\[
p_{ft}x_{ft} + x_{mt} + p_{a}h_{a} + b_{t+1} = y_{t}
\]
\[
y_{t+1} = w_{t+1}e_{t+1}s_{t+1} + (1 + i_{t+1})b_{t+1} + T_{t+1}
\]

- Buyers:

\[
V_{t}^{\text{buy}}(y_{t},s_{t}) = \max_{x_{ft},x_{mt},b_{t+1},d_{t+1},h_{t+1} \in \mathcal{H}} u(x_{ft}, x_{mt}, h_{t+1}) + \beta \mathbb{E} \left[ \max \left\{ V_{t+1}^{\text{rent},0}(y_{t+1}^{\text{rent}}, s_{t+1}), V_{t+1}^{\text{own}}(y_{t+1}^{\text{own}}, h_{t+1}, d_{t+1}, s_{t+1}) \right\} \right]
\]

such that
\[
p_{ft}x_{ft} + x_{mt} + (1 + \tau_{b})p_{ht}h_{t+1} + b_{t+1} = y_{t} + d_{t+1}
\]
\[
y_{t+1}^{\text{rent}} = w_{t+1}e_{t+1}s_{t+1} + (1 + i_{t+1})b_{t+1} + (1 - \tau_{s})p_{ht+1}h_{t+1} - (1 + r_{t+1})d_{t+1} + T_{t+1}
\]
\[
y_{t+1}^{\text{own}} = w_{t+1}e_{t+1}s_{t+1} + (1 + i_{t+1})b_{t+1}
\]
\[
d_{t+1} \leq \theta p_{ht}h_{t+1}
\]
HOUSEHOLD DECISION PROBLEMS

▶ Owners:

\[
V_{t+1}^{own}(y_t, h, d_t, s_t) = \max_{x_{ft}, x_{mt}, b_{t+1}} u(x_{ft}, x_{mt}, h) + \beta \mathbb{E} \left[ \max \left\{ V_{t+1}^{rent,0}(y_{t+1}^{rent}, s_{t+1}), V_{t+1}^{own}(y_{t+1}^{own}, h, d_{t+1}, s_{t+1}) \right\} \right]
\]

such that

\[
p_{ft} x_{ft} + x_{mt} + b_{t+1} + (\gamma + r_t) d_t = y_t
\]

\[
d_{t+1} = (1 - \gamma) d_t
\]

\[
y_{t+1}^{rent} = \omega_{t+1} e_{t+1} s_{t+1} + (1 + i_{t+1}) b_{t+1} + (1 - \tau_s) p_{h, t+1} h - (1 + r_{t+1}) d_{t+1} + T_{t+1}
\]

\[
y_{t+1}^{own} = \omega_{t+1} e_{t+1} s_{t+1} + (1 + i_{t+1}) b_{t+1}
\]
PARAMETRIZATION

▶ Preferences:

\[ u(x_f, x_m, h) = \left( \left[ \phi_X X^\rho + (1 - \phi_X) h^\rho \right]^{\frac{1}{\rho}} \right)^{1-\sigma} \]

where

\[ X = \left[ \phi_f (x_f - x_f)^\nu + (1 - \phi_f) x_m^\nu \right]^{\frac{1}{\nu}} \]

▶ Mobility costs:

\[ F(\epsilon) = 1 - \left( \frac{\epsilon}{\bar{\epsilon}} \right)^\kappa \]

▶ Housing construction:

\[ Y_h = Z_h L_h^{\alpha_L} \left( S_h^{\alpha_S N_h^{1-\alpha_s}} \right)^{1-\alpha_L} \]

with \( \alpha_L = 0.33 \) and \( \alpha_S = 0.3 \).
PARAMETRIZATION

- $Z_{m0}$ normalized to 1; $Z_{f0}$ set to ensure $\mu_0^{rural}$ at price $p_{f0} = 1$; $Z_{h0}$ set to ensure $p_{h0} = 1$; $Z_a$ set such that $p_a = 0.05$.

- Urban income process:

\[
\ln(s_{t+1}) = \rho_s \ln(s_t) + \varepsilon_{t+1} \\
\varepsilon_{t+1} \sim \mathcal{N}(0, \sigma^2_{\varepsilon}) \\
\ln(e_t) \sim \mathcal{N}(0, \sigma^2_{\varepsilon})
\]

with $\rho_s = 0.9172$, $\sigma^2_{\varepsilon} = 0.0469$, $\sigma^2_{\varepsilon} = 0.032$ from Fan et al (2010).

- Government income floor:

\[
\max\{wy + pah_a + pfxf, wes\}
\]

where $y = 0.5es$
Quantitative Experiments

- Calibrate the economy to match Chinese population and GDP shares in both 2001 and 2014.
- Back out the path of mobility costs that replicates the observed path of urbanization.
- Solve for the equilibrium path of house prices.
- Two sets of experiments: counterfactuals and policy.
- The baseline path of mobility costs is left unchanged.
Baseline Results

- The model captures two-thirds of the house price boom.
- Matches the decline in agriculture-to-GDP.
- Increased migration implies declining mobility costs.
**Counterfactual I: Agricultural Productivity**

- 200% greater migration to the city.
- 23% higher house prices from 2001 – 2014.
COUNTERFACTUAL II: NET MOBILITY COSTS

- No migration.
- The lack of population inflows mitigates the house price increase (by 14% in the long run); ownership rate rises.
If house prices hadn’t risen, China would have reached its current urban population share 7 years earlier.
POLICY I: TIGHTEN BORROWING LIMITS

- No long run effect.
- Short run slow down in house price appreciation—but also structural transformation.
Policy II: Reduce Hukou Delays

- More rapid house price growth slows urbanization.
**Policy III: Increase Land Supply**

- Slows house price growth and increases urbanization.

![Graphs showing urban population, house prices, ownership rate, agriculture GDP share, manufacturing GDP share, and housing GDP share comparisons between baseline and counterfactual scenarios.](image_url)
CONCLUSIONS

- Develop a quantitative theory of house prices, structural transformation, and urbanization.

- Structural transformation can account for two-thirds of the housing boom.

- Rising house prices slow and reduce structural transformation.

- Efforts to slow house price growth by tightening credit harms structural transformation.

- Increasing land supply slows house price growth and accelerates structural transformation.