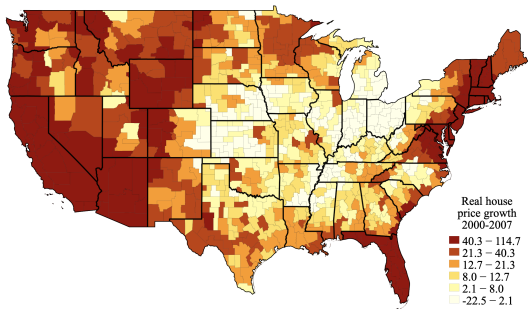


House Price Contagion and U.S. City Migration Networks

Gregor Schubert
Harvard University

February 26, 2021

Motivation: Cross-sectional variation in house price growth



Measure	Mean	S.D.	10th Pctl.	90th Pctl.
<i>Real house price growth '00-'07</i>	40%	37%	0%	91%

Time series

Motivation: Migration spillover examples

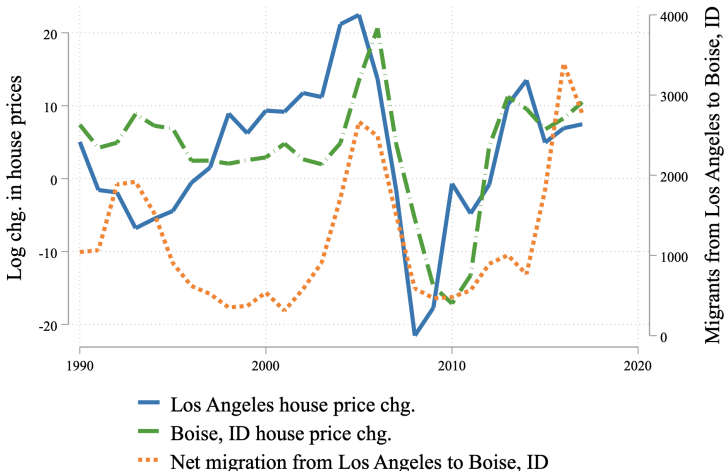
The Californians Are Coming. So Is Their Housing Crisis (NYT, Feb. 12th, 2021):

“Californians, fleeing high home prices, are moving to Idaho in droves...Is it possible to import California’s growth without also importing its housing problems?”

Motivation: Migration spillover examples

The Californians Are Coming. So Is Their Housing Crisis (NYT, Feb. 12th, 2021):

“Californians, fleeing high home prices, are moving to Idaho in droves...Is it possible to import California’s growth without also importing its housing problems?”



This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?
 - ▶ Characteristics of U.S. inter-city migration networks

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?
 - ▶ Characteristics of U.S. inter-city **migration networks**
 - ▶ **Causal effect** on other cities through migration channel

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?
 - ▶ Characteristics of U.S. inter-city **migration networks**
 - ▶ **Causal effect** on other cities through migration channel
 - Short-run and long-run effects on house prices, population, mortgage lending, and construction

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?
 - ▶ Characteristics of U.S. inter-city **migration networks**
 - ▶ **Causal effect** on other cities through migration channel
 - ▶ **Predictive power** of spillovers for historical cross-section & city co-movement

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?
 - ▶ Characteristics of U.S. inter-city **migration networks**
 - ▶ **Causal effect** on other cities through migration channel
 - ▶ **Predictive power** of spillovers for historical cross-section & city co-movement
2. Aggregate importance of migration spillovers & effect of changes in fundamentals (*not today - see paper*)

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?
 - ▶ Characteristics of U.S. inter-city **migration networks**
 - ▶ **Causal effect** on other cities through migration channel
 - ▶ **Predictive power** of spillovers for historical cross-section & city co-movement
2. Aggregate importance of migration spillovers & effect of changes in fundamentals (*not today - see paper*)
 - ▶ Dynamic spatial equilibrium model

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?
 - ▶ Characteristics of U.S. inter-city **migration networks**
 - ▶ **Causal effect** on other cities through migration channel
 - ▶ **Predictive power** of spillovers for historical cross-section & city co-movement
2. Aggregate importance of migration spillovers & effect of changes in fundamentals (*not today - see paper*)
 - ▶ Dynamic spatial equilibrium model
 - ▶ Estimation of key structural parameters in recent U.S. data

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?
 - ▶ Characteristics of U.S. inter-city **migration networks**
 - ▶ **Causal effect** on other cities through migration channel
 - ▶ **Predictive power** of spillovers for historical cross-section & city co-movement
2. Aggregate importance of migration spillovers & effect of changes in fundamentals (*not today - see paper*)
 - ▶ Dynamic spatial equilibrium model
 - ▶ Estimation of key structural parameters in recent U.S. data
 - ▶ Simulate impact of wage shocks on distribution of house price growth under different scenarios:

This paper

Research question: Can migration spillovers between cities explain spatial differences in house price growth and shock propagation between cities?

1. Do house price changes spill over between migration-linked cities?
 - ▶ Characteristics of U.S. inter-city **migration networks**
 - ▶ **Causal effect** on other cities through migration channel
 - ▶ **Predictive power** of spillovers for historical cross-section & city co-movement
2. Aggregate importance of migration spillovers & effect of changes in fundamentals (*not today - see paper*)
 - ▶ Dynamic spatial equilibrium model
 - ▶ Estimation of key structural parameters in recent U.S. data
 - ▶ Simulate impact of wage shocks on distribution of house price growth under different scenarios:
 - **Mobility:** changes motivated by secular decline Mobility trends
 - **Supply constraints:** reduction in most constrained cities

Preview of findings

1. Large house price spillover effects between cities

Preview of findings

1. Large house price spillover effects between cities

- ▶ 10 ppt house price increase in **other** cities \Rightarrow ~ 6 ppt Δ in house prices; ~ 2 ppt Δ in population in the long run

Preview of findings

1. Large house price spillover effects between cities

- ▶ 10 ppt house price increase in **other** cities \Rightarrow ~ 6 ppt Δ in house prices; ~ 2 ppt Δ in population in the long run
- ▶ Mortgage credit & construction effects support mechanism

Preview of findings

1. Large house price spillover effects between cities

- ▶ 10 ppt house price increase in **other** cities \Rightarrow ~ 6 ppt Δ in house prices; ~ 2 ppt Δ in population in the long run
- ▶ Mortgage credit & construction effects support mechanism
- ▶ Spillovers from interest rate declines explain 32% of cross-sectional house price variation 1995-2007

Preview of findings

1. Large house price spillover effects between cities

- ▶ 10 ppt house price increase in **other** cities \Rightarrow ~ 6 ppt Δ in house prices; ~ 2 ppt Δ in population in the long run
- ▶ Mortgage credit & construction effects support mechanism
- ▶ Spillovers from interest rate declines explain 32% of cross-sectional house price variation 1995-2007
- ▶ Migration links are better predictors of co-movement between housing markets than alternatives

Preview of findings

1. Large house price spillover effects between cities
 - ▶ 10 ppt house price increase in **other** cities \Rightarrow ~ 6 ppt Δ in house prices; ~ 2 ppt Δ in population in the long run
 - ▶ Mortgage credit & construction effects support mechanism
 - ▶ Spillovers from interest rate declines explain 32% of cross-sectional house price variation 1995-2007
 - ▶ Migration links are better predictors of co-movement between housing markets than alternatives
2. Aggregate effect of mobility and housing supply constraints (*not today - see paper*)
 - ▶ More mobility results in less dispersed house price growth

Preview of findings

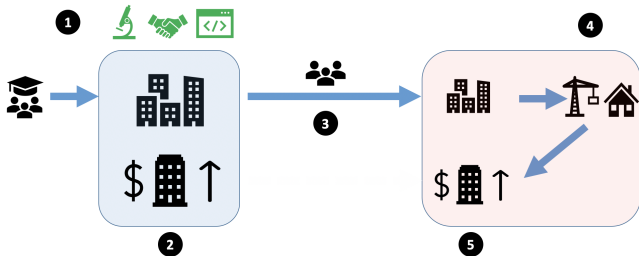
1. Large house price spillover effects between cities

- ▶ 10 ppt house price increase in **other** cities \Rightarrow ~ 6 ppt Δ in house prices; ~ 2 ppt Δ in population in the long run
- ▶ Mortgage credit & construction effects support mechanism
- ▶ Spillovers from interest rate declines explain 32% of cross-sectional house price variation 1995-2007
- ▶ Migration links are better predictors of co-movement between housing markets than alternatives

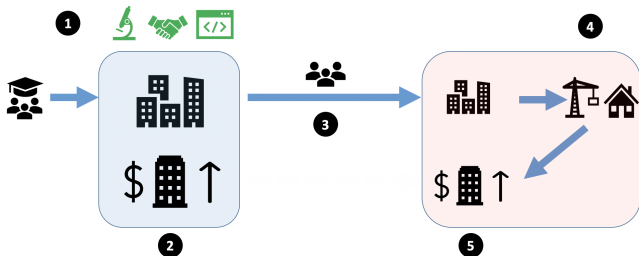
2. Aggregate effect of mobility and housing supply constraints (*not today - see paper*)

- ▶ More mobility results in less dispersed house price growth
- ▶ Lower supply constraints reduce dispersion & effect is larger with less mobility

Migration spillover mechanism

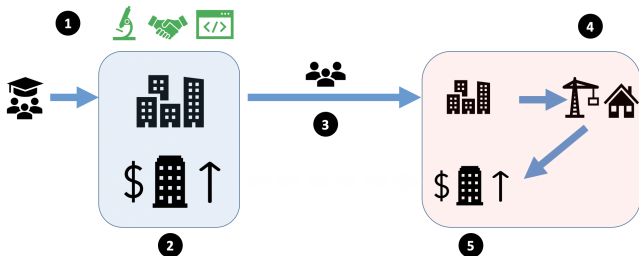


Migration spillover mechanism



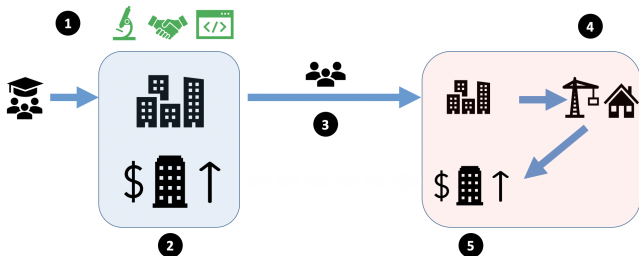
- ① Economic shock: wages \uparrow & inflows \uparrow

Migration spillover mechanism



- 1 Economic shock: wages \uparrow & inflows \uparrow
- 2 House prices \uparrow if supply-constrained

Migration spillover mechanism

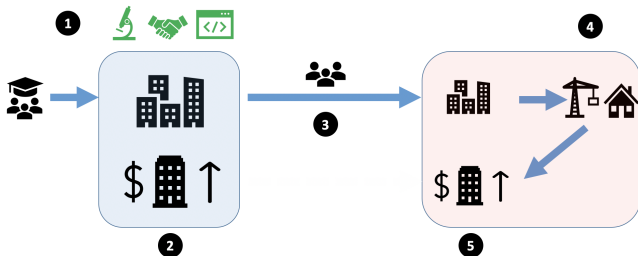


① Economic shock: wages \uparrow & inflows \uparrow

② House prices \uparrow if supply-constrained

③ Outflows to mig.-linked cities

Migration spillover mechanism



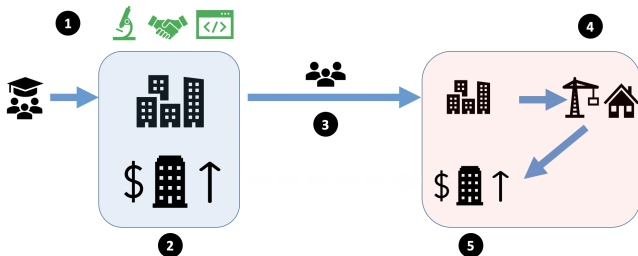
① Economic shock: wages \uparrow & inflows \uparrow

② House prices \uparrow if supply-constrained

③ Outflows to mig.-linked cities

④ Destination housing demand \uparrow

Migration spillover mechanism



① Economic shock: wages \uparrow & inflows \uparrow

② House prices \uparrow if supply-constrained

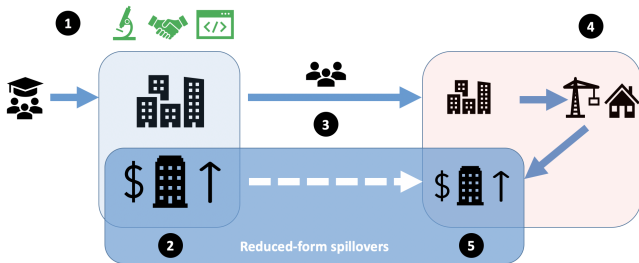
③ Outflows to mig.-linked cities

④ Destination housing demand \uparrow

⑤ Destination house prices \uparrow

Boston to Portland Example

Migration spillover mechanism



① Economic shock: wages \uparrow & inflows \uparrow

② House prices \uparrow if supply-constrained

③ Outflows to mig.-linked cities

④ Destination housing demand \uparrow

⑤ Destination house prices \uparrow

Boston to Portland Example

Case study: Superstar city migration spillovers

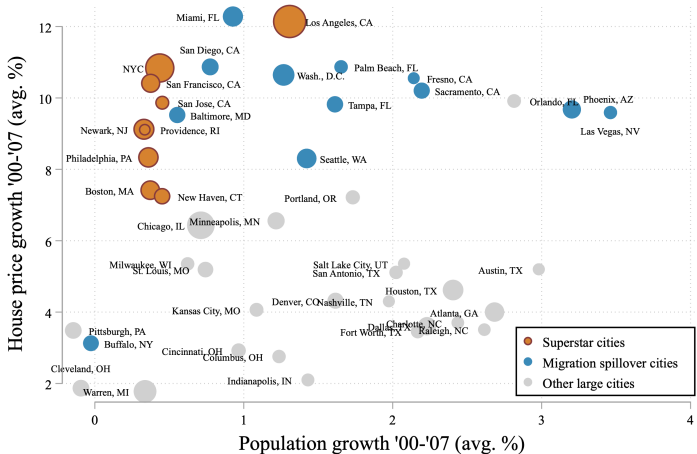
- ▶ **“Superstars”**: high demand & inelastic supply ‘70-‘00 (Gyourko et al., 2013)

Case study: Superstar city migration spillovers

- ▶ **“Superstars”**: high demand & inelastic supply ‘70-‘00 (Gyourko et al., 2013)
- ▶ Top 4 migration destinations 1990-2000 from superstars: **“spillover cities”**

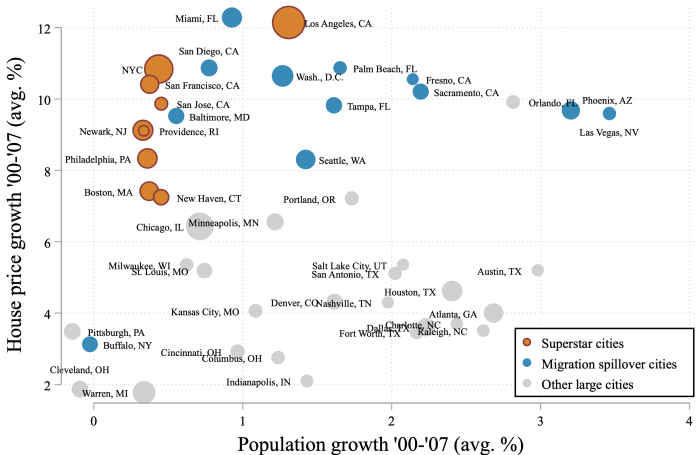
Case study: Superstar city migration spillovers

- **"Superstars"**: high demand & inelastic supply '70-'00 (Gyourko et al., 2013)
- Top 4 migration destinations 1990-2000 from superstars: **"spillover cities"**



Case study: Superstar city migration spillovers

- ▶ **“Superstars”**: high demand & inelastic supply ‘70-‘00 (Gyourko et al., 2013)
- ▶ Top 4 migration destinations 1990-2000 from superstars: **“spillover cities”**



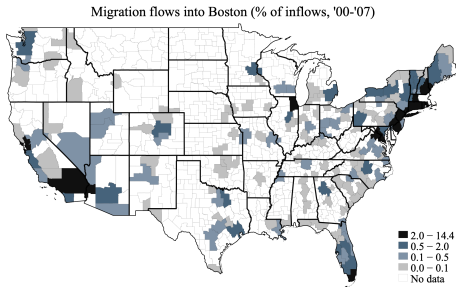
“Phoenix, Las Vegas, the Inland Empire of California, and much of South Florida, clearly experienced an unusual event in the boom of the 2000s.” (Sinai, 2012)

Migration networks between U.S. cities

“Migration links” for city i : non-zero flows from/to other cities k in IRS data.

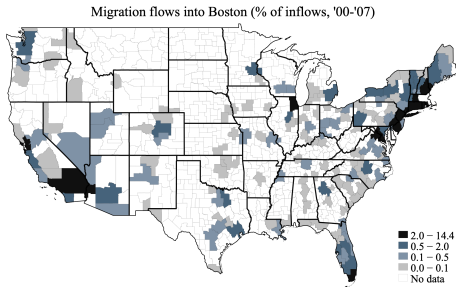
Migration networks between U.S. cities

“Migration links” for city i : non-zero flows from/to other cities k in IRS data.



Migration networks between U.S. cities

“Migration links” for city i : non-zero flows from/to other cities k in IRS data.

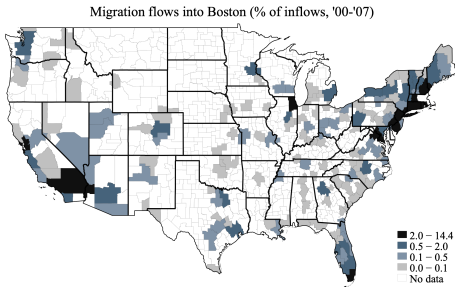


U.S. city migration networks are...

1. ... **sparse and persistent**: avg. city has 30 links; 80% persist after 10 years [Table](#)

Migration networks between U.S. cities

“Migration links” for city i : non-zero flows from/to other cities k in IRS data.



U.S. city migration networks are...

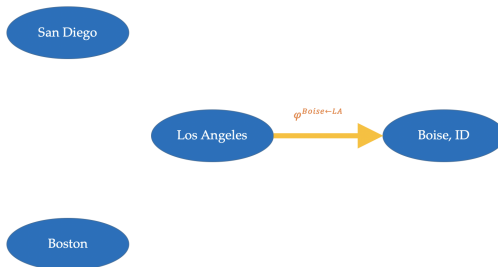
1. ... **sparse and persistent**: avg. city has 30 links; 80% persist after 10 years [Table](#)
2. ...driven by similarity in characteristics [Migration cost analysis](#)

Defining migration exposure

Exposure to other cities: migration links (constant at '90-'95 value)

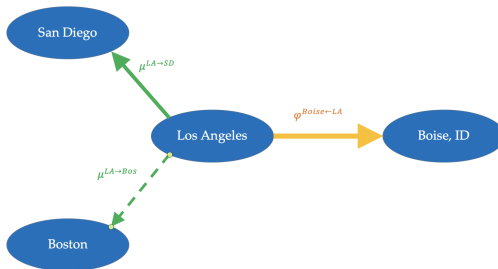
Defining migration exposure

Exposure to other cities: migration links (constant at '90-'95 value)



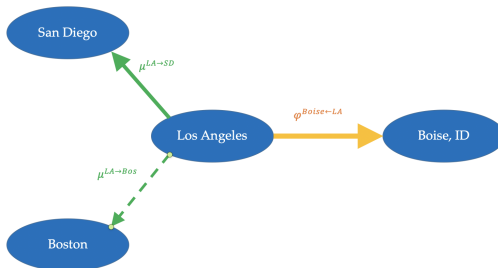
Defining migration exposure

Exposure to other cities: migration links (constant at '90-'95 value)



Defining migration exposure

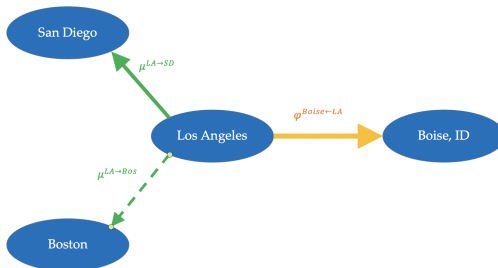
Exposure to other cities: migration links (constant at '90-'95 value)



Sum over all direct & indirect links \rightarrow migration exposure ψ_{90-95}^{ij} (0 to 1)

Defining migration exposure

Exposure to other cities: migration links (constant at '90-'95 value)

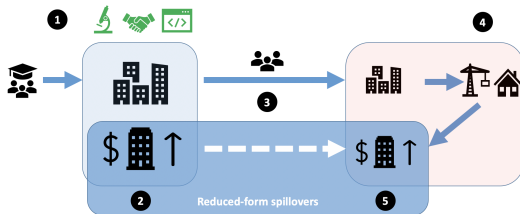


Sum over all direct & indirect links → migration exposure ψ_{90-95}^{ij} (0 to 1)

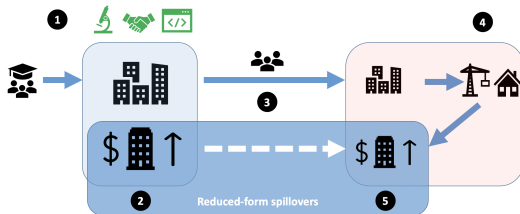
Network exposure to house price growth:

$$\Delta \mathcal{P}_{it}^{NW} = \sum_{j:j \neq i} \underbrace{\psi_{90-95}^{ij}}_{\text{Mig. exposure}} \Delta \ln P_{jt}$$

House price spillover estimation



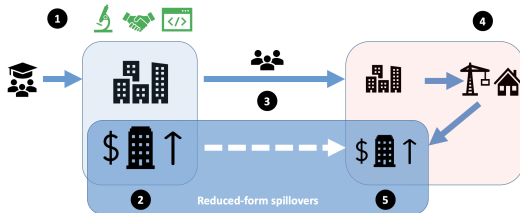
House price spillover estimation



Estimating equation:

$$\underbrace{\sum_{k=1}^h \Delta \ln P_{i,t-1+h}}_{\text{Cumulative chg. in prices}} = \alpha_i + \alpha_t + \underbrace{\tilde{\eta}_h^{nw}}_{\text{Spillover effect}} \underbrace{\Delta \mathcal{P}_{it}^{NW}}_{\text{Network house price chg.}} + \underbrace{\beta'_{cum} \Gamma_{it}}_{\text{Control variables}} + \tilde{\xi}_{i,t-1+h}^{P,cum}$$

House price spillover estimation



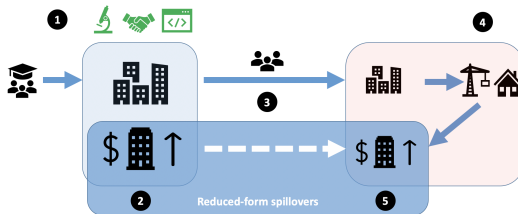
Estimating equation:

$$\underbrace{\sum_{k=1}^h \Delta \ln P_{i,t-1+h}}_{\text{Cumulative chg. in prices}} = \alpha_i + \alpha_t + \underbrace{\tilde{\eta}_h^{nw}}_{\text{Spillover effect}} \underbrace{\Delta \mathcal{P}_{it}^{NW}}_{\text{Network house price chg.}} + \underbrace{\beta'_{cum} \Gamma_{it}}_{\text{Control variables}} + \tilde{\xi}_{i,t-1+h}^{P,cum}$$

Ideal experiment:

- ▶ Exogenous shock to some cities' house prices
- ▶ "Treatment" is exposure through migration links to shocked cities

House price spillover estimation



Estimating equation:

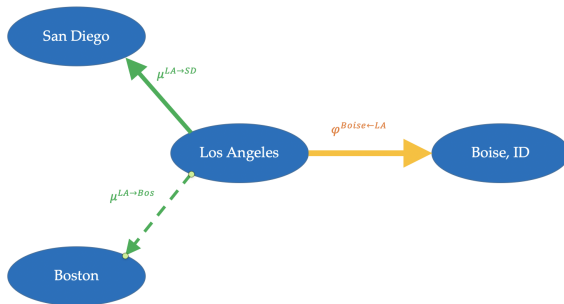
$$\underbrace{\sum_{k=1}^h \Delta \ln P_{i,t-1+h}}_{\text{Cumulative chg. in prices}} = \alpha_i + \alpha_t + \underbrace{\tilde{\eta}_h^{nw}}_{\text{Spillover effect}} \underbrace{\Delta \mathcal{P}_{it}^{NW}}_{\text{Network house price chg.}} + \underbrace{\beta'_{cum} \Gamma_{it}}_{\text{Control variables}} + \tilde{\xi}_{i,t-1+h}^{P,cum}$$

Ideal experiment:

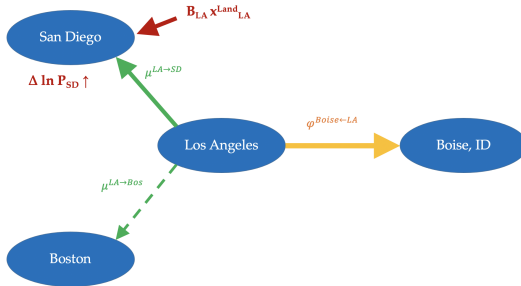
- ▶ Exogenous shock to some cities' house prices
- ▶ "Treatment" is exposure through migration links to shocked cities

⇒ **Estimation:** use exogenous variation in $\Delta \mathcal{P}_{it}^{NW}$ due to shocks

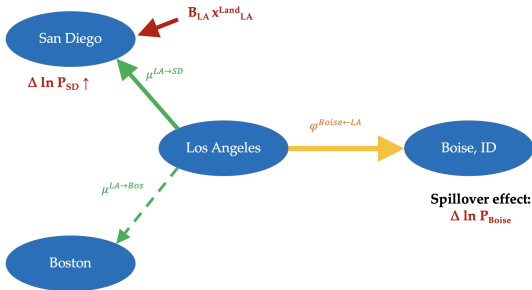
Estimation approach



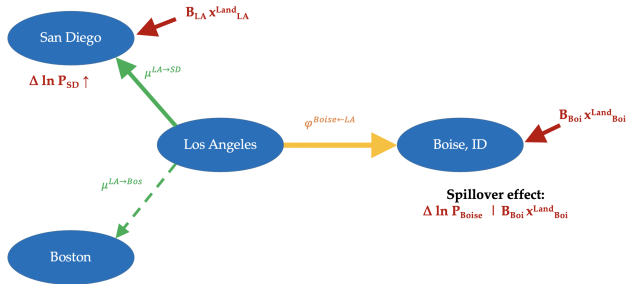
Estimation approach



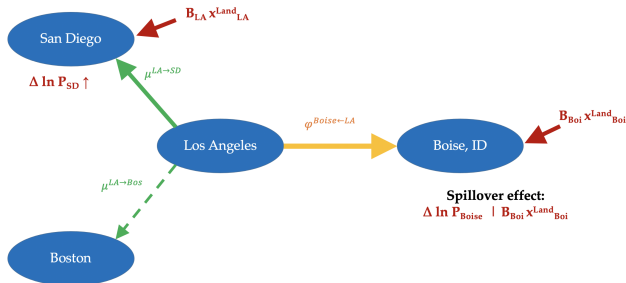
Estimation approach



Estimation approach

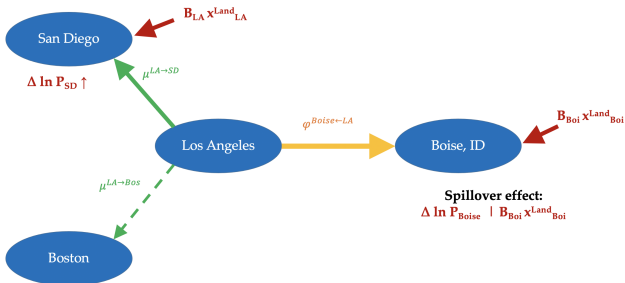


Estimation approach



City-level shock: Wage changes due to “exposure” (=1990 industry structure) to national industry-level wage trends in *other* cities.

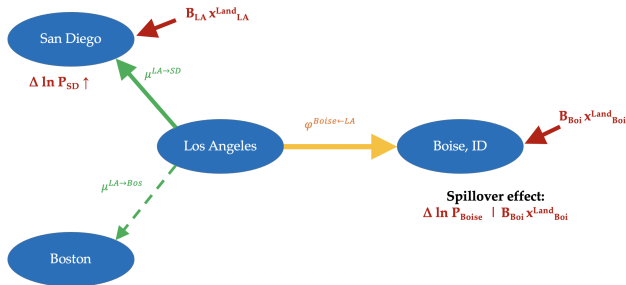
Estimation approach



City-level shock: Wage changes due to “exposure” (=1990 industry structure) to national industry-level wage trends in *other* cities.

- Interact with supply constraint: share of land unavailable for construction

Estimation approach

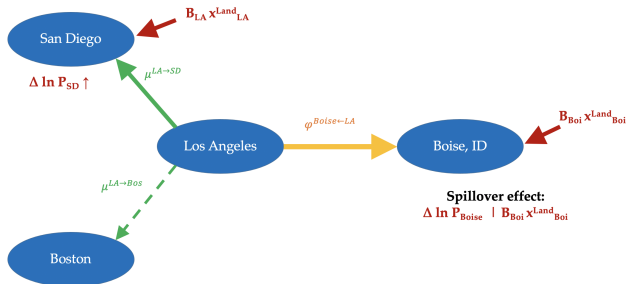


City-level shock: Wage changes due to “exposure” (=1990 industry structure) to national industry-level wage trends in *other* cities.

- Interact with supply constraint: share of land unavailable for construction

Identification of causal effect: Use migration exposure to **shocks in other cities** to estimate effect on house prices in city i due to migration channel.

Estimation approach



City-level shock: Wage changes due to “exposure” (=1990 industry structure) to national industry-level wage trends in *other* cities.

- Interact with supply constraint: share of land unavailable for construction

Identification of causal effect: Use migration exposure to **shocks in other cities** to estimate effect on house prices in city i due to migration channel.

- Control for city characteristics and common trends

Exclusion restriction

Identification details

Results table

Cumulative effects on house prices and population

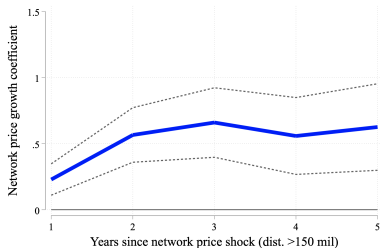
Estimated on data from 586 CZs for 1991-2017:

$$\underbrace{\sum_{k=1}^h \Delta \ln Y_{i,t-1+h}}_{\text{Cumulative chg. in } Y} = \alpha_i + \alpha_t + \underbrace{\tilde{\eta}_h^{nw}}_{\text{Spillover effect}} \underbrace{\Delta \mathcal{P}_{it}^{NW}}_{\text{Network house price chg.}} + \underbrace{\beta'_{cum} \Gamma_{it}}_{\text{Control variables}} + \tilde{\xi}_{i,t-1+h}^{P,cum}$$

Cumulative effects on house prices and population

Estimated on data from 586 CZs for 1991-2017:

$$\underbrace{\sum_{k=1}^h \Delta \ln Y_{i,t-1+h}}_{\text{Cumulative chg. in } Y} = \alpha_i + \alpha_t + \underbrace{\tilde{\eta}_h^{nw}}_{\text{Spillover effect}} \underbrace{\Delta \mathcal{P}_{it}^{NW}}_{\text{Network house price chg.}} + \underbrace{\beta'_{cum} \Gamma_{it}}_{\text{Control variables}} + \xi_{i,t-1+h}^{P,cum}$$



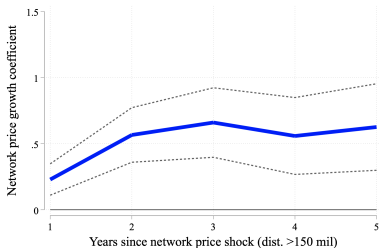
(a) House price effect (log pts)

Long-run effects of 10 ppt increase in house prices in other cities: ~ 6 ppt
 Δ in house prices

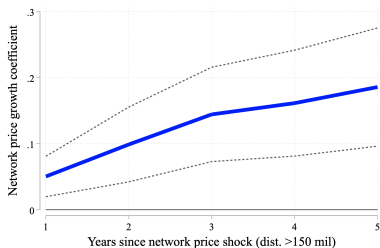
Cumulative effects on house prices and population

Estimated on data from 586 CZs for 1991-2017:

$$\underbrace{\sum_{k=1}^h \Delta \ln Y_{i,t-1+h}}_{\text{Cumulative chg. in } Y} = \alpha_i + \alpha_t + \underbrace{\tilde{\eta}_h^{nw}}_{\text{Spillover effect}} \underbrace{\Delta \mathcal{P}_{it}^{NW}}_{\text{Network house price chg.}} + \underbrace{\beta'_{cum} \Gamma_{it}}_{\text{Control variables}} + \tilde{\xi}_{i,t-1+h}^{P,cum}$$



(a) House price effect (log pts)



(b) Population effect (log pts)

Long-run effects of 10 ppt increase in house prices in other cities: **~ 6 ppt**
Δ in house prices and **~ 2 ppt Δ in population.**

Robustness checks & additional results

Robustness checks & alternative specifications

- ▶ Include neighboring cities Neighbor results
- ▶ Heterogeneity in spillover effect by supply constraints Heterogeneity
- ▶ Allow for extrapolation in house prices Extrapolation

Robustness checks & additional results

Robustness checks & alternative specifications

- ▶ Include neighboring cities **Neighbor results**
- ▶ Heterogeneity in spillover effect by supply constraints **Heterogeneity**
- ▶ Allow for extrapolation in house prices **Extrapolation**

Additional spillover effects:

- ▶ **Mortgage lending** increases after spillover shock **Mortgage lending**
- ▶ **Construction** increases after spillover shock (with a lag) **Permits**

Robustness checks & additional results

Robustness checks & alternative specifications

- ▶ Include neighboring cities **Neighbor results**
- ▶ Heterogeneity in spillover effect by supply constraints **Heterogeneity**
- ▶ Allow for extrapolation in house prices **Extrapolation**

Additional spillover effects:

- ▶ **Mortgage lending** increases after spillover shock **Mortgage lending**
- ▶ **Construction** increases after spillover shock (with a lag) **Permits**

Additional evidence for the mechanism:

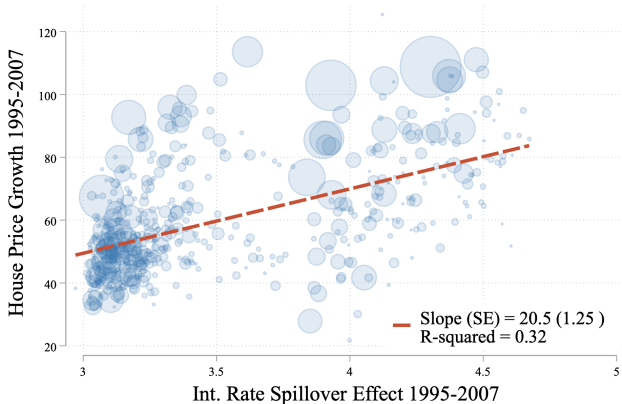
- ▶ **Displacement causing spillovers**
 - ▶ More educated workers move to more expensive cities **Graph**
 - ▶ Inflows of college workers predict non-college outflows **Graph**
 - ▶ Workers move for housing reasons during boom **CPS**
- ▶ **Construction sector congestion**
 - ▶ Low housing vacancies in booming cities **Graph**
 - ▶ Procyclical time-to-build delays in construction **TTB Graph**

Importance of spillover effects: explaining cross-section

Spillover example: Indirect effect of interest rate decline + supply constraints on house prices in run-up to 2000s boom (Glaeser et al., 2012). [Methodology](#)

Importance of spillover effects: explaining cross-section

Spillover example: Indirect effect of interest rate decline + supply constraints on house prices in run-up to 2000s boom (Glaeser et al., 2012). Methodology



Wage shock example

Beta cross-section

Predicting bilateral correlation

Implications for policy makers & other stakeholders

1. **Macro policy & financial regulation:** spillover effects
change estimate of speculation & response

Implications for policy makers & other stakeholders

1. **Macro policy & financial regulation:** spillover effects change estimate of speculation & response
2. **Local policy makers & developers:** anticipate local housing demand.

Implications for policy makers & other stakeholders

1. **Macro policy & financial regulation:** spillover effects change estimate of speculation & response
2. **Local policy makers & developers:** anticipate local housing demand.
 - ▶ Reduced construction lags \Rightarrow stable prices + less political conflict over displacement

Implications for policy makers & other stakeholders

1. **Macro policy & financial regulation:** spillover effects change estimate of speculation & response
2. **Local policy makers & developers:** anticipate local housing demand.
 - ▶ Reduced construction lags \Rightarrow stable prices + less political conflict over displacement
 - ▶ Spillover externalities: need for inter-city coordination

Implications for policy makers & other stakeholders

1. **Macro policy & financial regulation:** spillover effects change estimate of speculation & response
2. **Local policy makers & developers:** anticipate local housing demand.
 - ▶ Reduced construction lags \Rightarrow stable prices + less political conflict over displacement
 - ▶ Spillover externalities: need for inter-city coordination
3. **Real estate investors:** improve portfolio risk optimization

Conclusion & summary

1. Spillovers from house price changes in migration-linked cities
 - ▶ Long-run pass-through to linked-city prices of **63%**

Conclusion & summary

1. Spillovers from house price changes in migration-linked cities
 - ▶ Long-run pass-through to linked-city prices of **63%**
 - ▶ Population, mortgage credit and construction increase

Conclusion & summary

1. Spillovers from house price changes in migration-linked cities
 - ▶ Long-run pass-through to linked-city prices of **63%**
 - ▶ Population, mortgage credit and construction increase
2. Migration links explain cross-section of house price dynamics
 - ▶ Historical shocks: interest rate decline spillovers explain **32%** of variation in run-up to 2000s boom

Conclusion & summary

1. Spillovers from house price changes in migration-linked cities
 - ▶ Long-run pass-through to linked-city prices of **63%**
 - ▶ Population, mortgage credit and construction increase
2. Migration links explain cross-section of house price dynamics
 - ▶ Historical shocks: interest rate decline spillovers explain **32%** of variation in run-up to 2000s boom
 - ▶ Migration links predict correlation in housing markets between cities

Conclusion & summary

1. Spillovers from house price changes in migration-linked cities
 - ▶ Long-run pass-through to linked-city prices of **63%**
 - ▶ Population, mortgage credit and construction increase
2. Migration links explain cross-section of house price dynamics
 - ▶ Historical shocks: interest rate decline spillovers explain **32%** of variation in run-up to 2000s boom
 - ▶ Migration links predict correlation in housing markets between cities
 - ▶ Lower mobility raises dispersion in house price growth Quant. analysis

⇒ *Opportunities for further work: (1) Other financial market effects; (2) Pricing of migration risk in real estate; (3) Remote work & Covid*

Thank you for listening!
gschubert@g.harvard.edu

Appendix: not included in this file

Link to paper

For additional details, please see the underlying research paper, available at:

<https://sites.google.com/view/gregorschubert>