Firms' Internal Networks and Local Economic Shocks

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Introduction

- Incomplete markets and credit constraints make it difficult to fully insure against local economic shocks.
  - Large regional risk-sharing literature rejects null of perfect insurance across regions.
  - Factor mobility can mitigate impacts of local economic shocks. However, movement of capital and labor across regions in the aftermath of shocks is sluggish.

- Economists have focused on role of public policy in alleviating impacts of local shocks, including regional transfers, redistributive taxation, and "place-based" policies targeting disadvantaged regions.
  - Persson and Tabellini (1996a, b), Glaeser and Gottlieb (2008), Farhi and Werning (2012), Kline and Moretti (2014), Moretti (2014), Beraja (2016), Hurst et al. (2016).

- Little is known about role of firms in provision of regional risk sharing, or how local shocks propagate across regions through firms' internal networks.
  - Input-output networks (Acemoglu et al. (2012), Acemoglu, Akcigit, and Kerr (2016), Barrot and Sauvagnat (2016)), financial networks (Peek and Rosengren (1997, 2000), Schnabl (2012), Gilje, Loutskina, and Strahan (2016)), social networks (Bailey et al. (2016)).

Introduction

- How do firms respond to local economic shocks?
  - Do they reallocate resources away from badly affected regions and toward less affected regions?
  - Or do they smooth out local economic shocks by spreading their impacts across multiple production units, and thus effectively across multiple regions?
- Build complete (spatial) network of firm‘s internal organization. Confidential establishment-level data from U.S. Census Bureau (LBD).
- Local employment shocks during Great Recession triggered by massive collapse in house prices.
  - Collapse in house prices caused sharp drop in consumer spending by households (Mian, Rao, and Sufi (2013), Stroebel and Vavra (2014), Kaplan, Mitman, and Violante (2016)).
  - Large employment losses in non-tradable sector: across different U.S. regions, those with larger declines in housing net worth experienced significantly larger declines in non-tradable employment (Mian and Sufi (2014), Giroud and Mueller (2017)).

Introduction

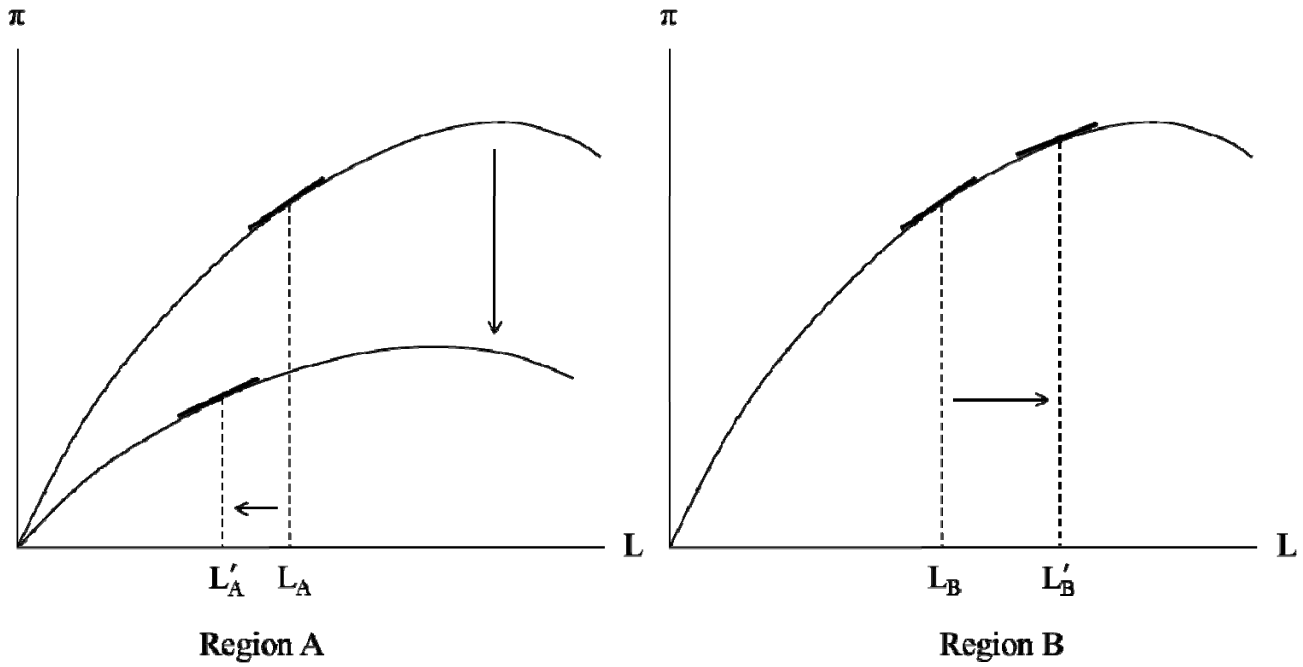
- Non-tradable employment (e.g., restaurants, supermarkets, retail stores): relies on local consumer demand.
  - Ideal setting to study employment effects of local consumer demand shocks, such as those originating from falling house prices (Mian Sufi (2014)).
  - Ideal setting to study whether local consumer demand shocks spill over to other regions through firms' internal networks of establishments.
  - While local consumer demand shocks may directly affect non-tradable employment at local level, should not directly affect non-tradable employment in distant regions.
- Many (remaining) identification challenges: common shocks to regions in which firm has establishments, direct demand spillovers from nearby regions, indirect demand spillovers through trade channel, etc.

Within-Firm Resource Reallocation

- Firm has two establishments: region A and region B.
- Firm allocates budgets across regions to equate marginal returns from investing. Financial constraint: scale of operations in each region is below first-best optimal level.
- Region A experiences adverse shock: HQ allocates smaller budget, and hence fewer resources (capital, labor), to region A.
- Region B?

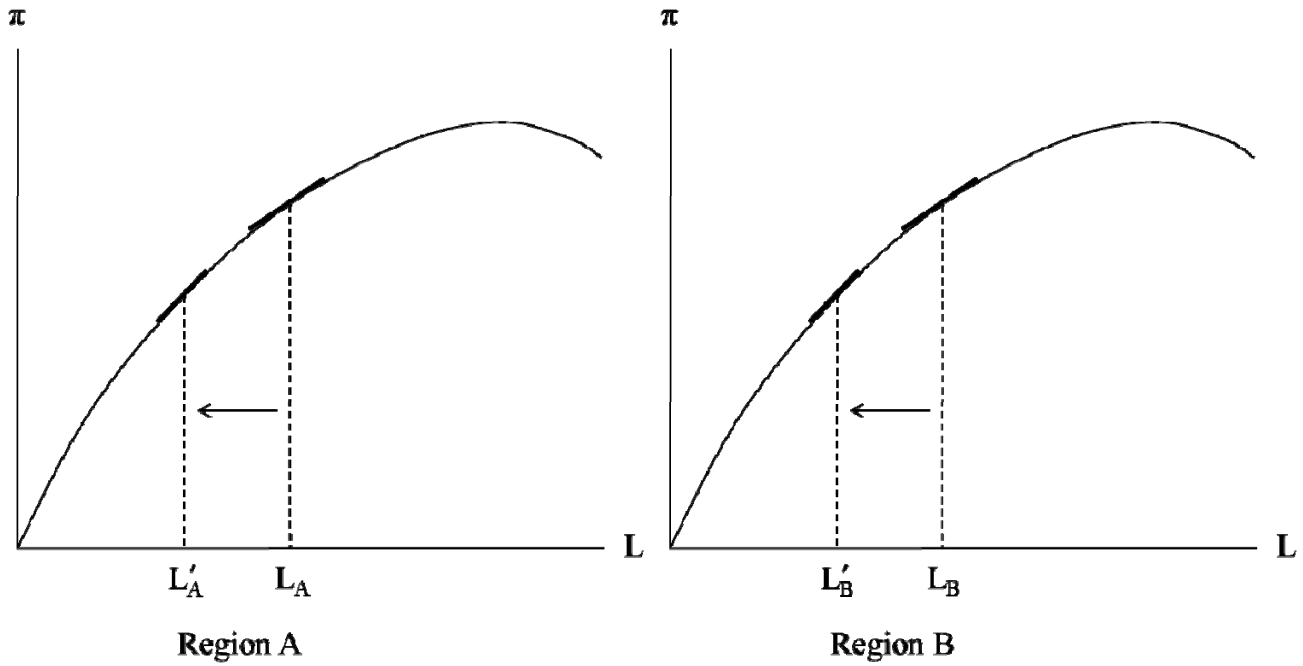
Within-Firm Resource Reallocation

- Shock to investment opportunities ("productivity shock"):
  - HQ allocates smaller budget, and hence fewer resources, to region A, which frees up resources for region B. Hence, capital/labor in region B expands.
  - Williamson (1975), Stein (1997), Giroud and Mueller (2015).



Within-Firm Resource Reallocation

- Shock to firm's budget constraint ("revenue shock"):
  - HQ spreads budget shock across regions to equate marginal returns from investing. Scales down operations both in region A and region B, effectively shifting resources from B to A ("cross-subsidization"). Hence, capital/labor in region B declines.
  - Lewellen (1971), Lamont (1997), Inderst and Mueller (2003).



Main Result

- Elasticity of non-tradable (establishment or county level) employment with respect to house prices in other regions linked through firms' internal networks is positive and between 1/5 (county level) and 1/3 (establishment level) of elasticity with respect to local house prices.
  - Firms equating marginal returns from investing spread impacts of local consumer demand shocks across multiple firm units, including units in distant regions.
  - Large regional spillover effects, echoing point made in Beraja, Hurst, and Ospina (2016) that it is difficult to draw inferences about aggregate activity based on local elasticities alone. Accounting for regional spillovers strengthens role of consumer demand in explaining sharp decline in U.S. employment during Great Recession.
  - While firms provide valuable insurance against local economic shocks, they do not provide full insurance: local elasticities are still 3 to 5 times larger than those with respect to shocks in other regions. Firms view drops in local consumer spending in part also as shocks to local investment opportunities?

Data

- Establishment-level data from U.S. Census Bureau's LBD.
  - All business establishments in U.S. with at least one paid employee.
  - E.g., restaurant, grocery store, gas station, department store.
- Match establishments to ZIP code-level house prices (Zillow).
  - $\Delta \text{Log}(\text{HP})_{06-09}$ highly correlated (86.3%) with "housing net worth shock" in Mian, Rao and Sufi (2013) and Mian and Sufi (2014), "Δ Housing Net Worth, 2006 – 2009."
- Establishment-level analysis: firms operating in multiple ZIP codes.
  - 385,000 non-tradable establishments accounting for 64.7% of non-tradable U.S. employment in 2006.
- County-level analysis: total non-tradable county-level employment.
  - 1,000 counties representing 85.5% of non-tradable U.S. employment in 2006.

Variables and Empirical Specification

Linkage-weighted % change in house prices in other ZIP codes ("$\Delta\text{Log}(\text{HP})_{06-09}$ (other)").

- Establishment-level analysis:

$$\Delta\text{Log}(\text{Emp}_i)_{07-09} = \alpha + \eta_1 \Delta\text{Log}(\text{HP}_k)_{06-09} + \eta_2 \sum_{l \neq k} \omega_{j,k,l} \Delta\text{Log}(\text{HP}_l)_{06-09} + \varepsilon_i$$

  - Linkage weights $\omega_{j,k,l}$ proportional to firm's non-tradable employment.
  - Local shock in ZIP code l matters more for establishment in ZIP code k if firm is more exposed to ZIP code l as measured by its employment relative to other ZIP codes.

- County-level analysis:

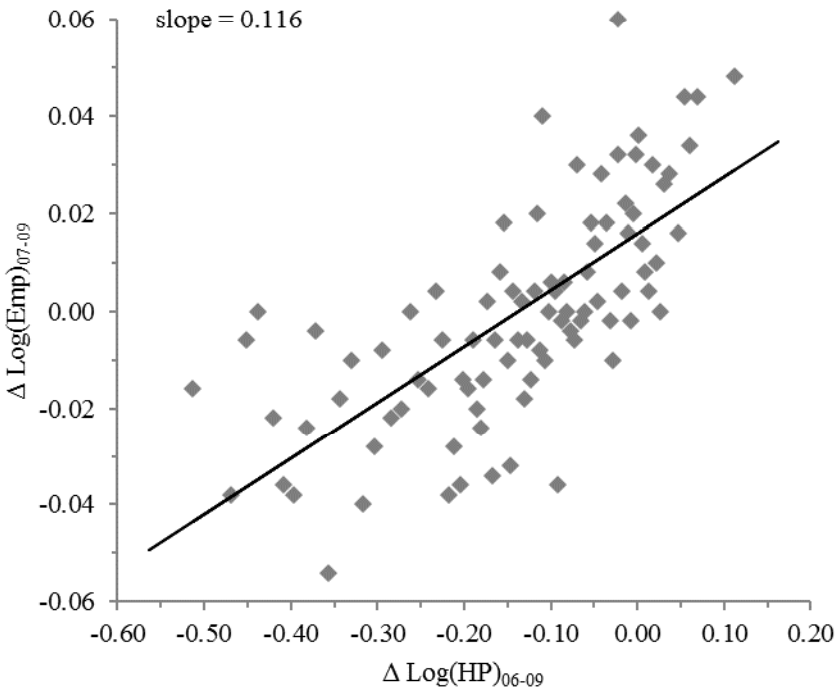
$$\Delta\text{Log}(\text{Emp}_i)_{07-09} = \alpha + \eta_1 \Delta\text{Log}(\text{HP}_i)_{06-09} + \eta_2 \sum_{j \neq i} \lambda_{i,j} \Delta\text{Log}(\text{HP}_j)_{06-09} + \varepsilon_i$$

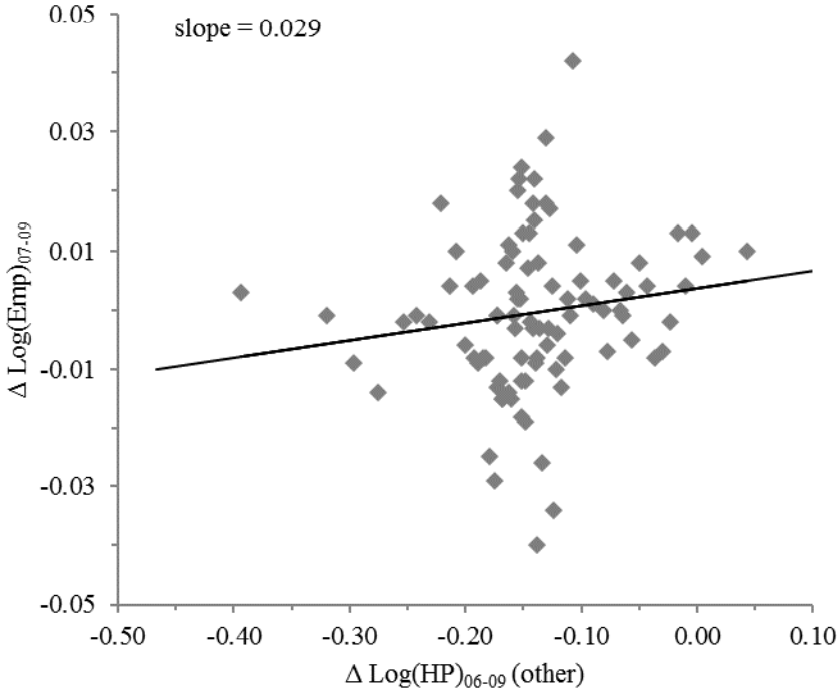
  - Local shock in county j matters more for county i if i) its establishments are more exposed to county j and ii) these establishments have high employment shares within county i.

Establishment-Level Plots

How does non-tradable establishment-level employment respond to local house price changes as well as to house price changes in other ZIP codes in which firm has establishments?

10% decline in local house prices ↔ 1.16% decline in non-tradable establishment-level employment.





Establishment-Level Evidence

Non-tradable establishment-level employment responds strongly to house price changes in other ZIP codes in which firm has establishments.

10% decline in local house prices ↔ 1.09% decline in non-tradable establishment-level employment.

	Δ Log(Emp)$_{07\text{-}09}$						
			Placebo tests				
			Equal weights	Population weights	Income weights	HH debt weights	Random ZIP codes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ Log(HP)$_{06\text{-}09}$	0.109***	0.091***	0.109***	0.109***	0.110***	0.109***	0.107***
	(0.020)	(0.023)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Δ Log(HP)$_{06\text{-}09}$ (other)		0.028***					
		(0.006)					
Δ Log(HP)$_{06\text{-}09}$ (other, placebo)			0.001	-0.001	-0.003	0.001	0.003
			(0.017)	(0.014)	(0.014)	(0.015)	(0.010)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Observations	385,000	385,000	385,000	385,000	385,000	385,000	385,000

Establishment-Level Evidence

Non-tradable establishment-level employment responds strongly to house price changes in other ZIP codes in which firm has establishments.

Elasticity of establishment-level employment with respect to house prices in other ZIP codes in which firm has establishments is about 30% of elasticity with respect to local house prices.

	Δ Log(Emp)$_{07\text{-}09}$						
			Equal weights	Population weights	Income weights	HH debt weights	Random ZIP codes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ Log(HP)$_{06\text{-}09}$	0.109***	0.091***	0.109***	0.109***	0.110***	0.109***	0.107***
	(0.020)	(0.023)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Δ Log(HP)$_{06\text{-}09}$ (other)		0.028***					
		(0.006)					
Δ Log(HP)$_{06\text{-}09}$ (other, placebo)			0.001	-0.001	-0.003	0.001	0.003
			(0.017)	(0.014)	(0.014)	(0.015)	(0.010)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Observations	385,000	385,000	385,000	385,000	385,000	385,000	385,000

Establishment-Level Evidence

Non-tradable establishment-level employment does *not generically* respond to house price changes in other ZIP codes.

	Δ Log(Emp)$_{07\text{-}09}$						
			Placebo tests				
			Equal weights	Population weights	Income weights	HH debt weights	Random ZIP codes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ Log(HP)$_{06\text{-}09}$	0.109***	0.091***	0.109***	0.109***	0.110***	0.109***	0.107***
	(0.020)	(0.023)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Δ Log(HP)$_{06\text{-}09}$ (other)		0.028***					
		(0.006)					
Δ Log(HP)$_{06\text{-}09}$ (other, placebo)			0.001	-0.001	-0.003	0.001	0.003
			(0.017)	(0.014)	(0.014)	(0.015)	(0.010)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Observations	385,000	385,000	385,000	385,000	385,000	385,000	385,000

Common Regional Shocks

Separating spillovers through firm's internal network from common shocks to regions in which firm has establishments.

	Δ Log(Emp)$_{07\text{-}09}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.026***	0.025***	0.024***	0.024***	0.025***	0.024***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Average income			0.004*			0.004*
			(0.002)			(0.002)
Average education				0.006*		0.005
				(0.004)		(0.004)
Average age					0.001	-0.001
					(0.003)	(0.004)
Industry fixed effects	Yes	–	–	–	–	–
ZIP code fixed effects	Yes	–	–	–	–	–
ZIP code × industry fixed effects	No	Yes	Yes	Yes	Yes	Yes
R-squared	0.29	0.29	0.29	0.29	0.29	0.29
Observations	385,000	385,000	385,000	385,000	385,000	385,000

Account for any shock at regional level as well as spillovers from one region to another. Compare non-tradable establishments in same ZIP code that are exposed to same regional shock but that belong to different firm networks.

Common Regional Shocks

Regional shocks may differentially affect establishments in different industries.

	Δ Log(Emp)$_{07\text{-}09}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.026***	0.025***	0.024***	0.024***	0.025***	0.024***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Average income			0.004*			0.004*
			(0.002)			(0.002)
Average education				0.006*		0.005
				(0.004)		(0.004)
Average age					0.001	-0.001
					(0.003)	(0.004)
Industry fixed effects	Yes	–	–	–	–	–
ZIP code fixed effects	Yes	–	–	–	–	–
ZIP code × industry fixed effects	No	Yes	Yes	Yes	Yes	Yes
R-squared	0.09	0.29	0.29	0.29	0.29	0.29
Observations	385,000	385,000	385,000	385,000	385,000	385,000

Direct Demand Spillovers

Results are not driven by direct demand spillovers from nearby regions.

	Δ Log(Emp)$_{07\text{-}09}$				
	(1)	(2)	(3)	(4)	(5)
Δ Log(HP)$_{06\text{-}09}$ (other, proximity)	0.011*				
	(0.007)				
Δ Log(HP)$_{06\text{-}09}$ (other)	0.020***				
	(0.006)				
Δ Log(HP)$_{06\text{-}09}$ (other, ZIP $\geq$ 50 miles)		0.022***			
		(0.005)			
Δ Log(HP)$_{06\text{-}09}$ (other, ZIP $\geq$ 100 miles)			0.022***		
			(0.005)		
Δ Log(HP)$_{06\text{-}09}$ (other, ZIP $\geq$ 200 miles)				0.020***	
				(0.004)	
Δ Log(HP)$_{06\text{-}09}$ (other, ZIP $\geq$ 250 miles)					0.019***
					(0.004)
ZIP code × industry fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.29	0.29	0.29	0.29	0.29
Observations	385,000	385,000	385,000	385,000	385,000

Scope of Firms' Regional Networks

Establishments belonging to firms with more expansive regional networks are less sensitive to (their own) local economic shocks.

	Δ Log(Emp)$_{07\text{-}09}$		
	Multi-ZIP	# ZIP	RN-HHI
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$ × RN	-0.027***	-0.013***	-0.522***
	(0.008)	(0.002)	(0.063)
RN	0.008***	0.005***	0.058**
	(0.001)	(0.001)	(0.024)
ZIP code × industry fixed effects	Yes	Yes	Yes
R-squared	0.20	0.29	0.29
Observations	910,300	385,000	385,000

Financial Constraints

Extent to which firms reallocate internal resources in response to local economic shocks depends on their financial constraints.

	Δ Log(Emp)$_{07\text{-}09}$		
	Leverage$_{06}$	KZ-index$_{06}$	WW-index$_{06}$
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$ × FC	0.130***	0.003**	0.051***
	(0.045)	(0.001)	(0.014)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.009	0.008	0.010
	(0.012)	(0.010)	(0.016)
Δ Log(HP)$_{06\text{-}09}$ (other) × FC	0.038**	0.001**	0.013**
	(0.015)	(0.000)	(0.006)
FC	-0.038***	-0.003**	-0.008**
	(0.006)	(0.001)	(0.004)
ZIP code × industry fixed effects	Yes	Yes	Yes
R-squared	0.42	0.42	0.42
Observations	124,100	124,100	124,100

Financial Constraints

Extent to which firms reallocate internal resources in response to local economic shocks depends on their financial constraints.

	Δ Log(Emp)$_{07\text{-}09}$		
	Leverage$_{06}$	KZ-index$_{06}$	WW-index$_{06}$
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$ × FC	0.130***	0.003**	0.051***
	(0.045)	(0.001)	(0.014)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.009	0.008	0.010
	(0.012)	(0.010)	(0.016)
Δ Log(HP)$_{06\text{-}09}$ (other) × FC	0.038**	0.001**	0.013**
	(0.015)	(0.000)	(0.006)
FC	-0.038***	-0.003**	-0.008**
	(0.006)	(0.001)	(0.004)
ZIP code × industry fixed effects	Yes	Yes	Yes
R-squared	0.42	0.42	0.42
Observations	124,100	124,100	124,100

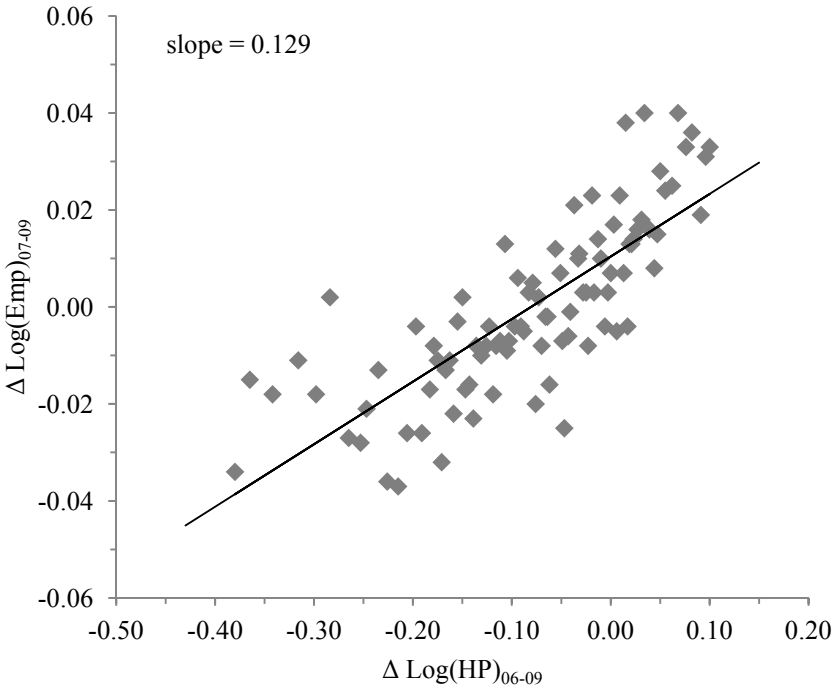
Aggregate County-Level Employment

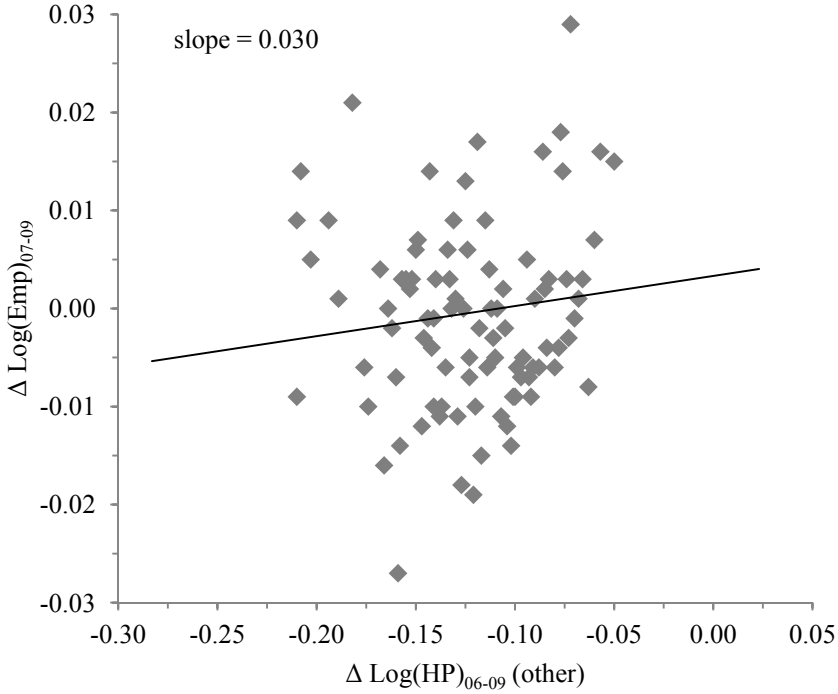
- Workers of multi-region firms that are laid off due to demand shocks in other regions may be re-employed by local firms.
  - GE adjustments impaired by wage and price stickiness.
  - Labor reallocation depends on search and matching frictions and labor adjustment costs. Labor market frictions particularly severe during Great Recession (Davis, Faberman, and Haltiwanger (2013), Şahin et al. (2014)).
- Does distribution of firm networks matter in aggregate? Examine total non-tradable employment at county level (including mom & pop shops).
  - Accounts for possibility that workers laid off due to demand shocks in other counties are re-employed either by other multi-county firms or by local single-county firms.

County-Level Plots

How does non-tradable county-level employment respond to local demand shocks as well as demand shocks in other counties linked through firms' internal networks of establishments?

Elasticity of county-level employment with respect to house prices in other counties linked through firms' internal networks is about 23% of elasticity with respect to local house prices.





County-Level Evidence

Non-tradable county-level employment responds strongly to demand shocks in other counties linked through firms' internal networks.

Elasticity of county-level employment with respect to house prices in other counties linked through firms' internal networks is about 20% of elasticity with respect to local house prices.

	Δ Log(Emp)$_{07\text{-}09}$						
			Equal weights	Population weights	Income weights	HH debt weights	Random counties
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ Log(HP)$_{06\text{-}09}$	0.122***	0.115***	0.123***	0.118***	0.122***	0.122***	0.122***
	(0.006)	(0.012)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Δ Log(HP)$_{06\text{-}09}$ (other)		0.024***					
		(0.007)					
Δ Log(HP)$_{06\text{-}09}$ (other, placebo)			0.007	0.009	0.002	0.001	0.002
			(0.041)	(0.010)	(0.015)	(0.013)	(0.028)
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Observations	1,000	1,000	1,000	1,000	1,000	1,000	1,000

Common County-Level Shocks

Counties which are more similar are more likely to be exposed to similar county-level shocks.

	Δ Log(Emp)$_{07-09}$				
	(1)	(2)	(3)	(4)	(5)
Δ Log(HP)$_{06-09}$	0.112***	0.114***	0.108***	0.115***	0.114***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
Δ Log(HP)$_{06-09}$ (other)	0.025***	0.024***	0.029***	0.024***	0.022***
	(0.007)	(0.007)	(0.008)	(0.007)	(0.006)
Δ Log(HP)$_{06-09}$ (other, income)	0.003				
	(0.015)				
Δ Log(HP)$_{06-09}$ (other, education)		0.004			
		(0.010)			
Δ Log(HP)$_{06-09}$ (other, age)			0.003		
			(0.013)		
Δ Log(HP)$_{06-09}$ (other, household debt)				0.001	
				(0.013)	
Δ Log(HP)$_{06-09}$ (other, non-tradable share)					0.003
					(0.012)
Demographic controls	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes
R-squared	0.17	0.17	0.17	0.17	0.17
Observations	1,000	1,000	1,000	1,000	1,000

Common County-Level Shocks

Linking counties in which house prices *did not fall* to counties in which house prices fell sharply ➲ less likely that spillovers are result of common county-level shocks that are correlated with house price changes.

	Δ Log(Emp)$_{07\text{-}09}$			
	Δ Log(HP)$_{06\text{-}09} > 0$		Δ Log(HP)$_{06\text{-}09} \pm 0.025$	
	(1)	(2)	(3)	(4)
Δ Log(HP)$_{06\text{-}09}$	0.018	0.014	0.003	0.003
	(0.050)	(0.051)	(0.012)	(0.012)
Δ Log(HP)$_{06\text{-}09}$ (other)		0.020**		0.022**
		(0.010)		(0.010)
Demographic controls	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes
R-squared	0.18	0.19	0.22	0.23
Observations	200	200	200	200

Direct Demand Spillovers

Results are not driven by direct demand spillovers from nearby counties.

	Δ Log(Emp)$_{07\text{-}09}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log(HP)$_{06\text{-}09}$	0.110***	0.115***	0.116***	0.116***	0.116***	0.116***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Δ Log(HP)$_{06\text{-}09}$ (other, proximity)	0.012*					
	(0.007)					
Δ Log(HP)$_{06\text{-}09}$ (other)	0.019***					
	(0.007)					
Δ Log(HP)$_{06\text{-}09}$ (other, counties $\geq$ 50 miles)		0.019***				
		(0.006)				
Δ Log(HP)$_{06\text{-}09}$ (other, counties $\geq$ 100 miles)			0.019***			
			(0.006)			
Δ Log(HP)$_{06\text{-}09}$ (other, counties $\geq$ 150 miles)				0.018***		
				(0.006)		
Δ Log(HP)$_{06\text{-}09}$ (other, counties $\geq$ 200 miles)					0.018***	
					(0.006)	
Δ Log(HP)$_{06\text{-}09}$ (other, counties $\geq$ 250 miles)						0.017***
						(0.006)
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.17	0.17	0.17	0.17	0.17	0.17
Observations	1,000	1,000	1,000	1,000	1,000	1,000

Conclusion

- Firms spread adverse impacts of local employment shocks across regions through internal networks of establishments.
  - Elasticity of non-tradable employment with respect to house prices in other regions linked through firms' internal networks is between 1/5 (county level) and 1/3 (establishment level) of elasticity with respect to local house prices.
  - Firms play important role in provision of regional risk sharing and propagation of local employment shocks across regions.
  - Consistent with literature arguing that firms provide insurance to workers against idiosyncratic shocks, especially if transitory (Guiso, Pistaferri, and Schivardi (2005)).
  - However, firms only provide partial insurance. Local elasticities are still 3 to 5 times larger than those with respect to shocks in other regions.

Thank you!

Instrumenting House Price Changes

	Housing supply elasticity			Share of unavailable land		
	First stage		Second stage	First stage		Second stage
	Δ Log(IIP)$_{06\text{-}09}$	Δ Log(IIP)$_{06\text{-}09}$ (other)	Δ Log(Emp)$_{07\text{-}09}$	Δ Log(IIP)$_{06\text{-}09}$	Δ Log(IIP)$_{06\text{-}09}$ (other)	Δ Log(Emp)$_{07\text{-}09}$
	(1)	(2)	(3)	(4)	(5)	(6)
Housing supply elasticity	0.069***	0.001				
	(0.010)	(0.014)				
Housing supply elasticity (other)	0.016	0.068***				
	(0.013)	(0.011)				
Share of unavailable land				-0.303***	-0.008	
				(0.084)	(0.078)	
Share of unavailable land (other)				-0.038	-0.294***	
				(0.070)	(0.082)	
Δ Log(HP)$_{06\text{-}09}$			0.114***			0.110***
			(0.016)			(0.015)
Δ Log(HP)$_{06\text{-}09}$ (other)			0.021**			0.025**
			(0.010)			(0.010)
County × industry controls	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.52	0.62	0.18	0.50	0.62	0.18
Observations	700	700	700	700	700	700