The Missing Internal Devaluation Puzzle:
Nominal and Real Adjustment to the Great Recession within the US

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Disclaimer

The views expressed in this paper are those

of the authors and do not necessarily reflect those

of the Federal Reserve System or the European Central Bank.

Research Question

To what extent relative prices respond

to asymmetric shocks across US areas ?

First Evidence (Great Recession)

$$RER_{ex.\,rents} = \left(30.4 * RER_{services} + 36.4 * RER_{goods}\right) / \left(30.4 + 36.4\right)$$
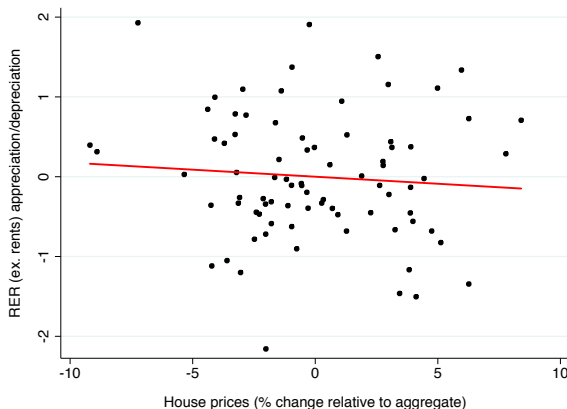
Our approach

- Carry out a systematic analysis of the evidence of relative prices adjustment to housing bust during the Great Recession in the US.

- **Contribution:** offer a rich decomposition of real exchange rate adjustment for goods and services across US locations (MSAs).

- Exploit the BEA dataset on Regional Price Parity (RPPs), combined with regional data on measures of sectoral costs and activity.

- Empirical model: regressing (OLS and IV) RPPs on local house prices.

Results: 5 regularities

1. Lack of real exchange rate adjustment to large and asymmetric demand shock within the US.

2. This lack of adjustment masks relative price movement for goods and services:

   - Relative price of services significantly increases when house prices fall.
   - Relative price of goods is barely affected.
   - As expected, rents appear positively correlated to house prices.

3. Large responses in employment in the service and distribution sector but not in goods producing industries (manufacturing).

4. Little (or no) correlation of wages (both, nominal and real) to house prices.

5. Sectoral labor shares (markups) do not significantly respond to housing prices.

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Literature review

This paper relates to several previous contributions investigating regional prices and wages adjustment and regional business cycles, after the seminal paper by Blanchard and Katz (1992). A non-exhaustive list includes:

- Papers looking at employment and demand effects of housing price shocks: Mian, Rao and Sufi (2013), Mian and Sufi (2014), Aladangady (2016).

- Papers using store-level price data: Stroebl and Vavra (2014), Kaplan, Mitman and Violante (2016).

- Rich models of sectoral and regional adjustment to asymmetric demand shocks in currency areas: Philippon and Midrigan (2014), Martin and Philippon (2017), Beraja et al. (2016) -- and Nakamura and Steinsson (2014) for fiscal shocks.

Structure of this Presentation

1. The theoretical background.

2. The empirical model.

3. The Dataset.

4. Results.

5. Conclusions.

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Theory

- The real exchange rate (ex. rents) can be expressed as the sum of the relative prices of goods and services:

$$RER_t^I = (1 - \alpha_S)\left(p_{G,t}^I - p_{G,t}\right) + \alpha_S\left(p_{S,t}^I - p_{S,t}\right)$$

- The price of goods at consumer level can be further decomposed as:

$$p_{G,t}^I = (1 - \delta)\,p_{T,t}^I + \delta p_{NT,t}^I$$

- Define relative price of goods (G), tradable manufacturing (T), services (S) and distribution (N) as, respectively, $\widehat{\mathcal{T}}_{j,t}^I = \left(p_{j,t}^I - p_{j,t}\right)$ with $j = G, T, S, N$.

Theory

- Relying on standard New Keynesian Phillips Curve theory and assuming the same Phillips curve slope across location, for each sector j :

$$\pi_{j,t}^l - \pi_{j,t} = \kappa_j \sum_{s=0}^{\infty} \beta^s E_t \left[\left(\widehat{mc}_{j,t+s}^l - \widehat{\mathcal{T}}_{j,t+s}^l - \widehat{mc}_{j,t+s} \right) + \left(\widehat{\mu}_{j,t+s}^l - \widehat{\mu}_{j,t+s} \right) \right].$$

- Inflation differentials across location are given by the discounted sum of (i) the expected differential in the real marginal cost in terms of the aggregate price level $\left(\widehat{mc}_{j,t+s}^l - \widehat{\mathcal{T}}_{j,t+s}^l - \widehat{mc}_{j,t+s} \right)$, (ii) the expected differential in the markups $\left(\widehat{\mu}_{j,t+s}^l - \widehat{\mu}_{j,t+s} \right)$.

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Theory

Solving directly for the relative price $\widehat{\mathcal{T}}_{j,t}^{l}$:

$$\widehat{\mathcal{T}}_{j,t}^{l} = \nu_{j}\widehat{\mathcal{T}}_{j,t-1}^{l} + \kappa_{j}\sum_{s=0}^{\infty}\nu_{2}^{-s-1}E_{t}\left[\left(\widehat{MC}_{j,t+s}^{l} - \widehat{MC}_{j,t+s}\right) + \left(\widehat{\mu}_{j,t+s}^{l} - \widehat{\mu}_{j,t+s}\right)\right].$$

where $\widehat{MC}_{j,t}^{l} - \widehat{MC}_{j,t}$ is the marginal cost differential in *nominal* terms.

- Asymmetric shocks affecting relative *nominal* marginal costs will be absorbed through movements in relative prices.

Theory

Solving directly for the relative price $\widehat{\mathcal{T}}_{j,t}^{I}$:

$$\widehat{\mathcal{T}}_{j,t}^{I} = \nu_j \widehat{\mathcal{T}}_{j,t-1}^{I} + \kappa_j \sum_{s=0}^{\infty} \nu_2^{-s-1} E_t \left[\left(\widehat{MC}_{j,t+s}^{I} - \widehat{MC}_{j,t+s} \right) + \left(\widehat{\mu}_{j,t+s}^{I} - \widehat{\mu}_{j,t+s} \right) \right].$$

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Theory

Assuming that the slope of the Phillips curve is the same across all locations:

$$\widehat{\mathcal{T}}_{j,t}^{l} = \nu_j \widehat{\mathcal{T}}_{j,t-1}^{l} + \kappa_j \left[\overline{\mathcal{MC}}_{j,t}^{l} + \overline{\mu}_{j,t}^{l} \right]$$

where we have defined

$$\overline{\mathcal{MC}}_{j,t}^{l} = \sum_{s=0}^{\infty} \nu_{j2}^{-s-1} E_t \left(\widehat{MC}_{j,t+s}^{l} - \widehat{MC}_{j,t+s} \right)$$

$$\overline{\mu}_{j,t}^{l} = \sum_{s=0}^{\infty} \nu_{j2}^{-s-1} E_t \left(\widehat{\mu}_{j,t+s}^{l} - \widehat{\mu}_{j,t+s} \right).$$

Theory

The variable $\left[\overline{\mathcal{MC}}_{j,t}^{l} + \overline{\mu}_{j,t}^{l}\right]$ is a function of several shocks. We are interested in relative price adjustment to local demand shocks, especially during the Great Recession, when the housing bust had large and asymmetric effects within the US (Mian-Sufi). Following the literature we can capture demand shocks with hp_t^l:

$$\widehat{\mathcal{T}}_{j,t}^{l} = \delta_0^l + \delta_1 hp_t^l + \eta_j \widehat{\mathcal{T}}_{j,t-1}^l + u_{jt}.$$

- However, because hp_t^l might be correlated with other shocks (in u_{jt}) we need an instrument.
- Instrument: estimates of housing supply elasticities from Saiz (2010) interacted with a time-varying variable, the 10-y US interest rate (as in Aladangady (forthfcoming, AER), Sraer et al. (AER, 2012)).

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Empirical Model

- Baseline strategy consists of panel regression of the log-level of the dependent variable on the log-level of local house prices, controlling for other MSA observables:

$$y_{l,t} = \alpha_l + \gamma_t + \beta \cdot hp_{l,t} + \theta X_{l,t} + \varepsilon_{l,t}$$

- Dependent variables: (log of) MSA consumer price levels in each sector $j = G, S, NT$, the log of nominal (and real consumption) wages again for each sector $j = G, S, NT$, the log of sectoral employment, number of firms and establishments, and labor shares. We also look at additional variables, including population, unemployment and unit labor costs at MSA level.

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Estimation

- Following Mian and Sufi (2014) and Stroebl and Vavra (2014), and Aladangady (2016) we run both, OLS and IV.

- House prices can respond to other (supply) shocks, which also affect marginal costs and prices confounding the transmission of demand movements.

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- Intuition: higher interest rates whould have a less negative impact on house prices if supply is more elastic.

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Dataset

- Regional consumer price levels (RPPs) are from the BEA Regional Price Parity dataset (381 MSAs over the period 2008 - 2014.).
  - Out of 381, we keep the largest 77 MSAs with non repeated RPPs for goods and services over the period.

- For a subset of 26 MSAs (the most populated) we have longer time series for CPI inflation rates from 1984.

- Employment and payroll data (2 and 4-digit NAICS level) are from the Census County Business Patterns (CBP) dataset.
  - Sector definitions closely match goods and services in BEA RPPs (different because broader than Mian and Sufi (2014)).

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1 The Theoretical Background

2 Empirical Model

3 Dataset

4 Results

5 Conclusions

Baseline - RPPs - First stage

	Dep. Var.: HP
Instrument	0.02***
	[0.01]
Obs.	308
R^2	0.15

Robust std. errors clustered by MSAs in brackets. All regressions include a set of demographic controls, time and MSA fixed effects. The dependent variable is the log of MSA CPI. HP is the log of MSA house price. Instrument: interaction between Saiz (2010) elasticities and the 10-y US interest rate.

Baseline - RPPs

	All		Goods		Services (ex rents)		Rents	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	**0.04****	**-0.01**	**0.02**	**0.06**	**0.02**	**-0.11***	**0.07**	**0.08**
	[0.02]	[0.08]	[0.02]	[0.04]	[0.03]	[0.08]	[0.04]	[0.09]
Obs.	308	308	308	308	308	308	308	308
R^2	0.07	-	0.03	-	0.05	-	0.40	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA CPI. HP is the log of MSA house price.

FirstStage

26 largest MSAs - CPI - entire sample (1984 - 2011)

	Goods Durables		Goods Non Durables		Rents		Services (ex rents)	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	0.05	0.16	0.02	0.06	0.30***	0.60***	-0.14***	-0.27***
	[0.06]	[0.17]	[0.02]	[0.06]	[0.03]	[0.10]	[0.02]	[0.08]
Obs.	682	682	682	682	682	682	682	682

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA CPI. HP is the log of MSA house price.

All

26 largest MSAs - CPI - pre 2006

	Goods Durables		Goods Non Durables		Rents		Services (ex rents)	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	**0.05**	**0.21**	**0.02***	**0.11***	**0.27***	**0.42***	**-0.13***	**-0.15***
	[0.05]	[0.18]	[0.01]	[0.06]	[0.03]	[0.11]	[0.02]	[0.08]
Obs.	506	506	506	506	506	506	506	506

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA CPI. HP is the log of MSA house price.

All

Local employment (2-digit NAICS) full MSA sample

	Goods		Services		Distribution		Construction	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	**0.30****	**0.09**	**0.16*****	**0.26****	**0.17*****	**0.43*****	**0.96*****	**1.35*****
	[0.12]	[0.30]	[0.05]	[0.13]	[0.03]	[0.09]	[0.13]	[0.33]
Obs.	303	303	303	303	303	303	303	303
R^2	0.81	-	0.37	-	0.83	-	0.87	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA employment. HP is the log of MSA house price.

Mian and Sufi

Population and Unemployment

	Total Population		Unemployment	
	OLS	IV	OLS	IV
HP	**-0.01**	**-0.01**	**-0.07***	**-0.09***
	[0.02]	[0.02]	[0.01]	[0.02]
Obs.	308	308	276	276
R^2	0.64	-	0.91	-

Robust std. errors in brackets.

Summary of results so far

- With the exception of rents, hard to see any internal devaluation adjustment.

- Good prices weakly correlated to HP.

- Services have, if anything, the "wrong" sign despite large fall in employment.

- Large responses in employment in the service and distribution sector but not in goods producing industries (manufacturing).

- What about the determinants of price dynamics like wages and markups?

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Nominal Wages (2-digit NAICS) full MSA sample

	Goods		Services		Distribution		Construction	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	-0.01	-0.17	0.04	-0.08	-0.06	-0.13	0.03	0.19
	[0.06]	[0.18]	[0.04]	[0.19]	[0.06]	[0.11]	[0.07]	[0.11]
Obs.	303	303	303	303	303	303	303	303
R^2	0.73	-	0.68	-	0.69	-	0.58	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA nominal wages. HP is the log of MSA house price.

Mian and Sufi

Real Wages (2-digit NAICS) full MSA sample

	Goods		Services		Distribution		Construction	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	-0.05	-0.16	0.00	-0.08	-0.10	-0.13	-0.01	0.19
	[0.07]	[0.18]	[0.05]	[0.19]	[0.06]	[0.10]	[0.08]	[0.12]
Obs.	303	303	303	303	303	303	303	303
R^2	0.73	-	0.68	-	0.70	-	0.58	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA real wages. HP is the log of MSA house price.

Wages - Labor share - ULC

	Wage/employee		Labor share		ULC	
	OLS	IV	OLS	IV	OLS	IV
HP	**0.04**	**-0.06**	**1.19**	**1.83**	**1.82**	**1.57**
	[0.04]	[0.12]	[1.58]	[2.11]	[2.12]	[1.78]
Obs.	303	303	308	308	308	308
R^2	0.77	-	0.07	-	0.11	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

HP is the log of MSA house price.

Markups: Labor share (inverse of markups)

	Goods		Services		Distribution		Construction	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	**14.25**	**-7.56**	**-0.74**	**3.23**	**0.49***	**0.07**	**-0.02***	**-0.02**
	[14.48]	[8.47]	[2.26]	[5.07]	[0.28]	[0.50]	[0.01]	[0.02]
Obs.	265	256	298	296	299	298	252	248
R^2	0.02	-	0.04	-	0.03	-	0.43	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA number of establishments. HP is the log of MSA house price.

RPP controlling for # firms

	All		Goods		Services		Rents	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	0.02	-0.03	0.01	0.06	0.01	-0.14*	0.03	0.04
	[0.02]	[0.05]	[0.02]	[0.05]	[0.03]	[0.08]	[0.04]	[0.09]
Obs.	296	296	296	296	296	296	296	296
R^2	0.12	-	0.04	-	0.07	-	0.41	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA number of establishments. HP is the log of MSA house price.

Future research - BLS micro dataset since 1986

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REVISION PSU DE...ON - 94 PSU'S (91 AREAS)

DATE : JAN 17, 1997

REVISED PSU                          [3] PRICING CYCLE  LINK MONTH   PUBLICATION CYCLE
                                                        NEW PSU'S

A101  NEW YORK METRO AREA                  1                         MONTHLY
A102  PHILADELPHIA                         1                         MONTHLY
A103  BOSTON                               3                         BI-MONTHLY
A104  PITTSBURGH                           2                         BI-MONTHLY
A105  BUFFALO                              2                         SEMI-ANNUAL
A109  NEW YORK CITY [1]                    1
A110  N.Y. SUBURBS [1]                     1
A111  N.J. SUBURBS [1]                     1
A207  CHICAGO                              1                         MONTHLY
A208  DETROIT                              2                         BI-MONTHLY
A209  ST. LOUIS                            3                         BI-MONTHLY
A210  CLEVELAND                            3                         BI-MONTHLY
A211  MINNEAPOLIS                          2                         SEMI-ANNUAL
A212  MILWAUKEE                            2                         SEMI-ANNUAL
A213  CINCINNATI                           2                         SEMI-ANNUAL
A214  KANSAS CITY                          3                         SEMI-ANNUAL
A215  COLUMBUS                             2                         NOT PUBLISHED
A315  WASHINGTON, D.C.                     3                         BI-MONTHLY
A316  DALLAS-FORT WORTH                    2                         BI-MONTHLY
A317  BALTIMORE                            3                         BI-MONTHLY
A318  HOUSTON                              2                         BI-MONTHLY
A319  ATLANTA                              2                         SEMI-ANNUAL
A320  MIAMI-FT LAUDERDALE                  3                         BI-MONTHLY
A321  TAMPA                                2                         NOT PUBLISHED
A322  NEW ORLEANS                          3                         NOT PUBLISHED
A419  LOS ANGELES [2]                      1
A420  GREATER LOS ANGELES [2]              1
A421  LOS ANGELES METRO AREA               1                         MONTHLY
A422  SAN FRANCISCO                        1                         MONTHLY
A423  SEATTLE                              2                         SEMI-ANNUAL
A424  SAN DIEGO                            2                         SEMI-ANNUAL
A425  PORTLAND, OR                         3                         SEMI-ANNUAL
A426  HONOLULU                             2                         SEMI-ANNUAL
A427  ANCHORAGE                            2                         SEMI-ANNUAL
A429* PHOENIX                              3        NOV 86           NOT PUBLISHED
A433  DENVER                               2                         SEMI-ANNUAL

L102* HARTFORD, CT                         3        NOV 86           B100, MONTHLY
L104* SYRACUSE, NY                         3        JUL 87
B104  ROCHESTER (DROP PSU)                 3        JUL 87
L106  SPRINGFIELD, MA                      2
L108  NORTHEAST PA                         2
L210* FLINT, MI                            2        AUG 87           B200, MONTHLY
C214  ROCK ISLAND (DROP PSU)               3        AUG 87
L212* DAYTON, OH                           2        DEC 87
B215  TOLEDO (DROP PSU)                    2        DEC 87
L214* YOUNGSTOWN, OH                       3        NOV 88
B211  GRAND RAPIDS (DROP PSU)              3        NOV 88
L216  INDIANAPOLIS, IN                     3
L318  RICHMOND, VA                         2                         B300, MONTHLY
L320* JACKSONVILLE, FL                     2        DEC 88
B322  MEMPHIS (DROP PSU)                   3        DEC 88
L322* CHARLOTTE, NC                        3        NOV 86
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Conclusions

- With the exception of rents, there has been virtually no internal relative price adjustment during the crisis.

- Our results are puzzling in light of macro and international theory.

    - The bulk of adjustment to local demand shocks should fall in sectors with the largest incidence of nontradability in production.

    - The elasticity of employment is highest in services and distribution.

    - However, the composition of adjustment falls almost exclusively on employment. Relative prices, if anything, moves the wrong way.

- A key question is whether an adjustment mechanism that does not seem to play a crucial role in correcting regional imbalances in a mature currency area like the US, as shown in this paper, could be expected to ever play a significant role in the euro area, even after reforms in labor, goods and financial markets.

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Thank you

Local employment - 2-digit NAICS

	Tradable		Non Tradable		Construction		Other	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	**0.31****	**0.09**	**0.19*****	**0.44*****	**0.96*****	**1.35*****	**0.13*****	**0.22***
	[0.12]	[0.31]	[0.05]	[0.11]	[0.13]	[0.33]	[0.05]	[0.12]
Obs.	303	303	303	303	303	303	303	303
R^2	0.80	-	0.61	-	0.87	-	0.31	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA employment. HP is the log of MSA house price.

BACK

Nominal Wages - 2-digit NAICS

	Tradable		Non Tradable		Construction		Other	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	**-0.02**	**-0.19**	**-0.05***	**-0.08**	**0.03**	**0.19**	**0.05**	**-0.05**
	[0.06]	[0.17]	[0.03]	[0.09]	[0.07]	[0.11]	[0.04]	[0.16]
Obs.	303	303	303	303	303	303	303	303
R^2	0.73	-	0.61	-	0.58	-	0.66	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA nominal wages. HP is the log of MSA house price.

Real Wages - 2-digit NAICS

	Tradable			Non Tradable			Construction			Other	
	OLS	IV		OLS	IV		OLS	IV		OLS	IV
HP	-0.06	-0.18		-0.09***	-0.07		-0.01	0.19		0.01	-0.05
	[0.07]	[0.18]		[0.03]	[0.09]		[0.08]	[0.12]		[0.04]	[0.17]
Obs.	303	303		303	303		303	303		303	303
R^2	0.73	-		0.66	-		0.58	-		0.66	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA real wages. HP is the log of MSA house price.

26 largest MSAs - CPI - entire sample (1984 - 2011)

	Goods Durables	
	OLS	IV
HP	**0.11*****	**0.29*****
	[0.01]	[0.05]
Obs.	793	731

Robust std. errors clustered by MSAs in brackets. All regressions include a set of demographic controls, time and MSA fixed effects. The dependent variable is the log of MSA CPI. HP is the log of MSA house price.

BACK

26 largest MSAs - CPI - pre 2006

	Goods Durables	
	OLS	IV
HP	**0.10***	**0.26***
	[0.012]	[0.06]
Obs.	577	531

Robust std. errors clustered by MSAs in brackets. All regressions include a set of demographic controls, time and MSA fixed effects. The dependent variable is the log of MSA CPI. HP is the log of MSA house price.

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# Details - Sectors classifications at 2 digits NAICS level

- **"Goods"** industries: "Agriculture, forestry, fishing, and hunting" (NAICS #11), "Mining, quarrying, and oil and gas extraction" (NAICS #21), "Manufacturing" (NAICS #31, #33).

- **"Construction"** industries: "Construction" - NAICS #23.

- **"Distribution"** industries: "Wholesale trade" (NAICS #42), and "Retail trade" (NAICS #44, #45).

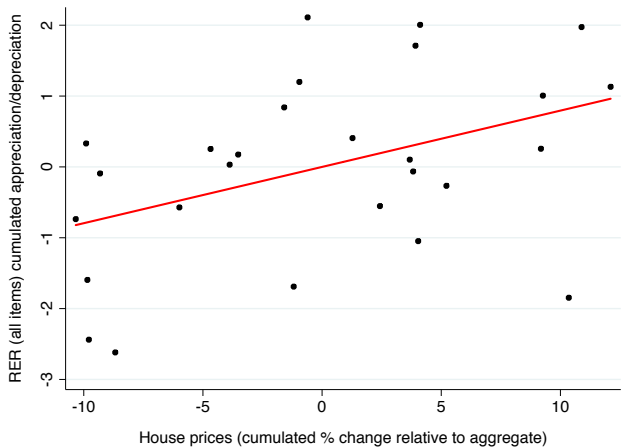- **"Services"** industries: all remaining industries.

BACK

First Evidence (Great Recession) - including rents

BACK

First Evidence (Cumulated '08-'11 change)

BACK
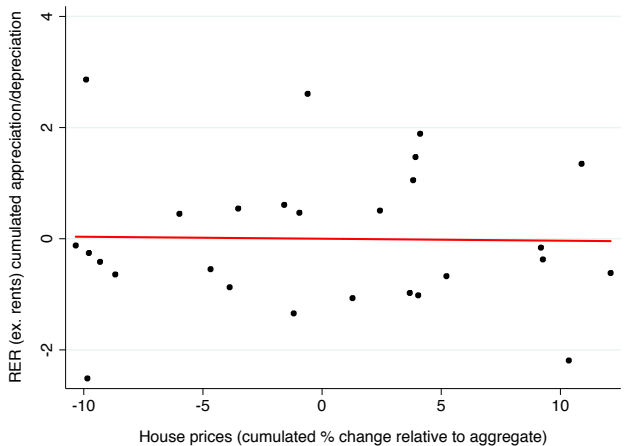
First Evidence (Cumulated '08-'11) - including rents

BACK

Number of establishments

	Goods		Services		Distribution		Construction	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	**0.22*****	**0.26****	**0.08*****	**0.09**	**0.07*****	**0.14****	**0.22*****	**0.18**
	[0.06]	[0.13]	[0.02]	[0.06]	[0.03]	[0.07]	[0.04]	[0.12]
Obs.	296	296	296	296	296	296	296	296
R^2	0.83	-	0.58	-	0.79	-	0.80	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA number of establishments. HP is the log of MSA house price.

Number of firms

	Goods		Services		Distribution		Construction	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
HP	**0.21***	**0.23**	**0.08***	**0.09**	**0.06***	**0.10**	**0.25***	**0.22***
	[0.07]	[0.13]	[0.02]	[0.06]	[0.03]	[0.07]	[0.04]	[0.13]
Obs.	296	296	296	296	296	296	296	296
R^2	0.82	-	0.58	-	0.85	-	0.78	-

Robust std. errors clustered by MSAs in brackets.

All regressions include a set of demographic controls, time and MSA fixed effects.

The dependent variable is the log of MSA number of establishments. HP is the log of MSA house price.