Location, Location, Location: Industrial Structure and the Distribution of House Price Growth

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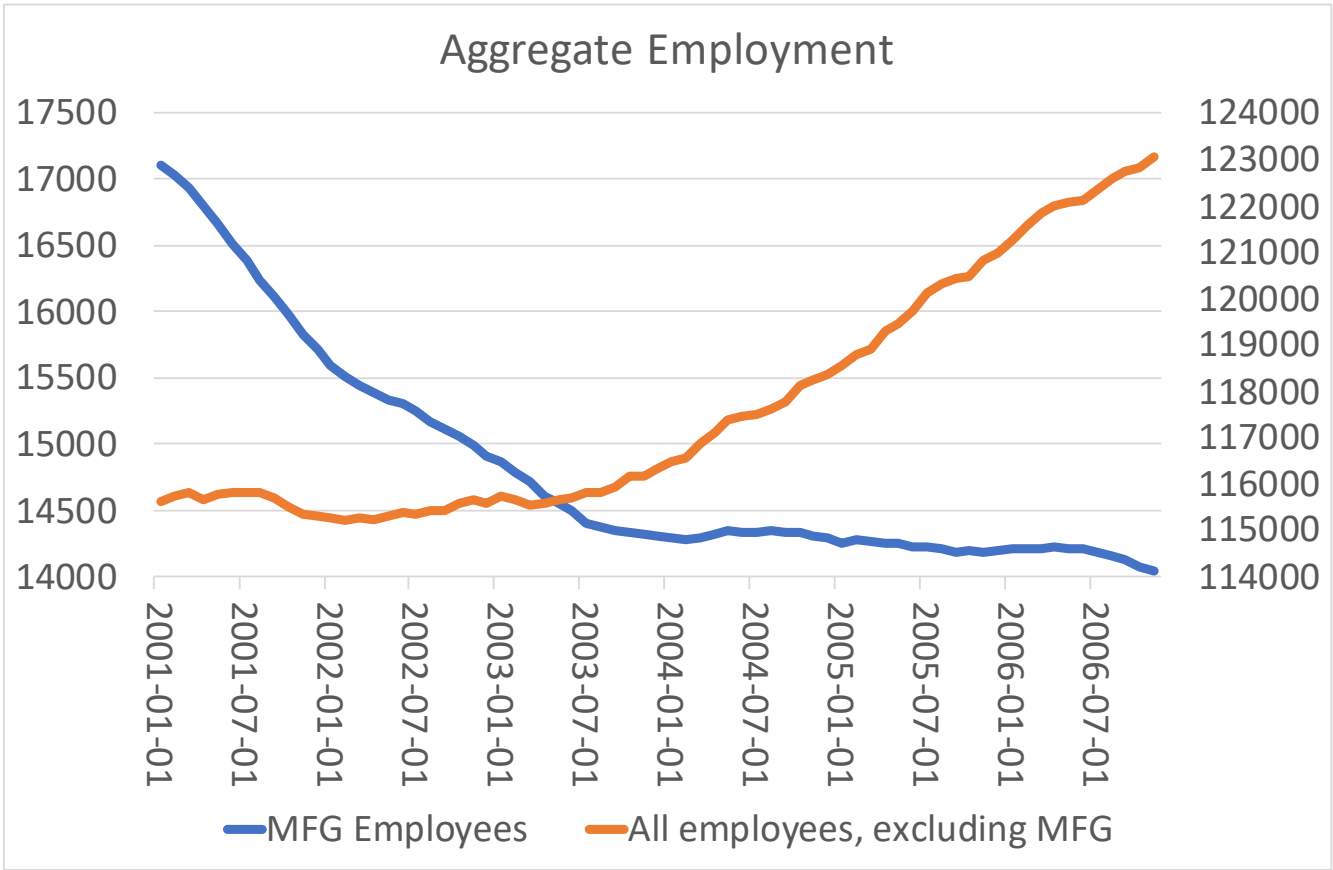
Preliminary, incomplete and questionable

Motivation: why are we here?

- MFG employment has plunged in the US in last few decades



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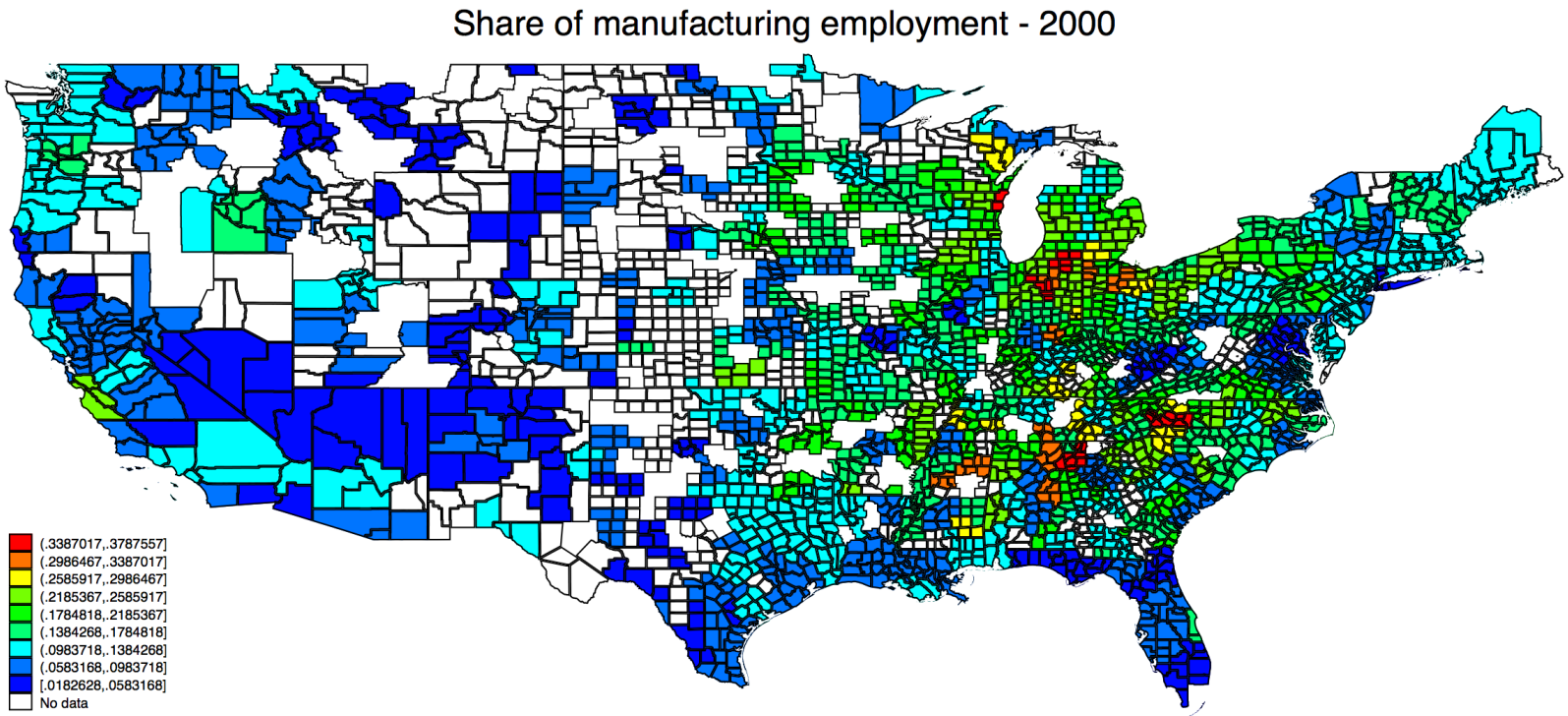

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Result: significant cross-sectional geographic variation in various outcomes

- Employment dynamics: Jaimovich & Siu (2014); Autor, Dorn and Hanson (2013) ; Ebenstein et al. (2014), etc.
- Health and social outcomes: Adda and Fawaz (2017); Pierce and Schott (2016); Autor, Dorn, Hanson (2018)

Motivation: what do we do?

- Study the impact of cross-sectional variation in income & employment:
  1. On house prices
  2. And especially: impact at different parts of the housing distribution

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Motivation: what do we do?

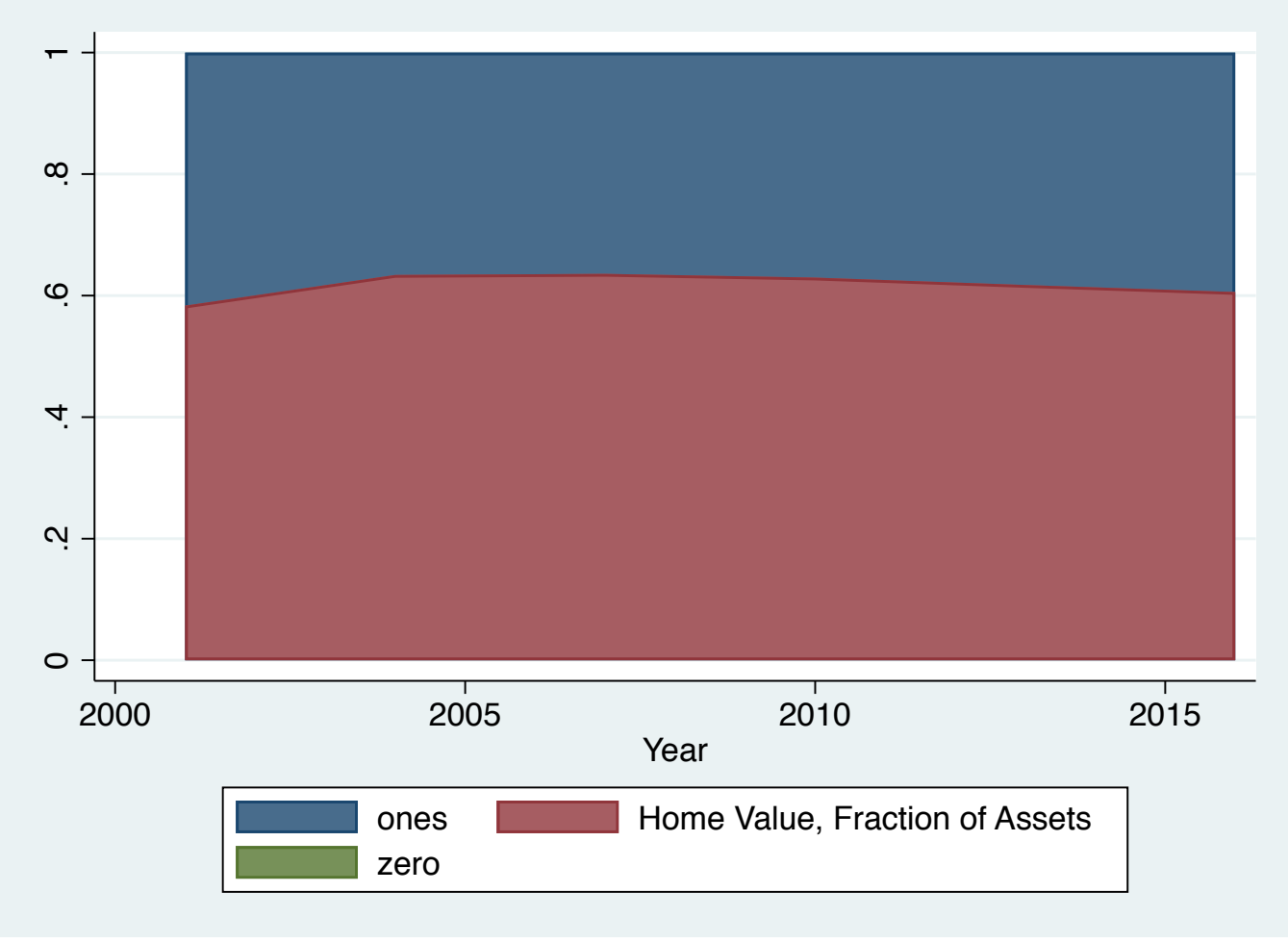
- Study the impact of cross-sectional variation in income & employment:
  1. On house prices
  2. And especially: impact at different parts of the housing distribution
- How do we do it? with a new microdataset.
- Why is this interesting?
  1. Housing is a big component of American wealth
  2. Price growth varies substantially across regions
  3. ...and effects vary across the housing distribution
     - Impact on housing and wealth inequality
  4. Growing literature about the impact of housing price movement
     $\rightarrow$ We contribute by identifying structural sources

Structure of the paper

1. Distributional changes in housing
2. Effects of manufacturing exposure on:
    - labor outcomes across regions
    - house price growth across regions
3. Distributional analysis: exploiting micro house price data
4. Effects of MFG exposure on housing inequality
5. Analytical model (*not today*)

Housing is a big deal

- Housing accounts for about 60%s of total assets (SCF)



→ **Takeaway:** Housing inequality has a 1st order effect on wealth inequality

Housing inequality in micro-level data

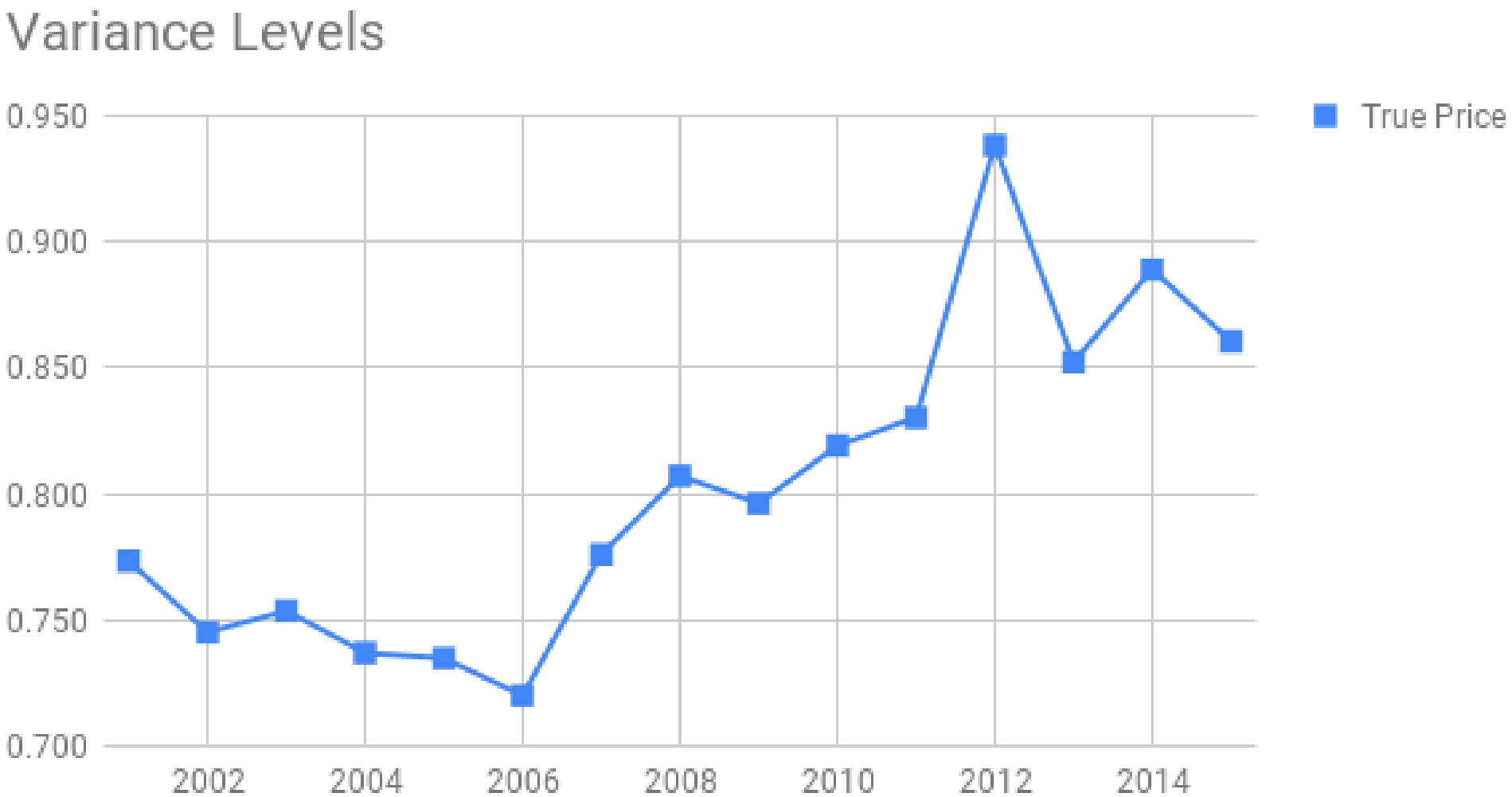
- What happened to the cross sectional variance of house prices?

Housing inequality in micro-level data

- What happened to the cross sectional variance of house prices?

- Zillow database
  - 80+ million observations; 2 to 5 million per year starting in 2001
  - Wide geographical coverage
  - Source: "*Zillow receives information about property sales from the municipal office responsible for recording real estate transaction.*"
  - Transaction and not self-assessment
  - Can control for house characteristics $\rightarrow$ useful down the road

House price variance



What is behind the fluctuations in house price variance?

- What explains the time series evolution of the cross-sectional variance?
- Consider a house living in a cell defined by two dimensions:
  1. Geography (CZ)
  2. "Tercile price level" (within a CZ)

What is behind the fluctuations in house price variance?

- What explains the time series evolution of the cross-sectional variance?
- Consider a house living in a cell defined by two dimensions:
  1. Geography (CZ)
  2. "Tercile price level" (within a CZ)
- **Objective**: identify the main contributors to the changes in the distribution of house prices
  $\rightarrow$ Gives us an idea of where we should look later on
- **Approach**: use counterfactuals based on variance decomposition

Variance Decomposition - Counterfactuals

$$P_{i,Y,C,T} \equiv E(P_{i,Y,C,T}) + SD(P_{i,Y,C,T}) \times \frac{P_{i,Y,C,T} - E(P_{i,Y,C,T})}{SD(P_{i,Y,C,T})}$$

Variance Decomposition - Counterfactuals

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CF1: SHUT DOWN THE AVERAGE SHIFT IN WITHIN-(TERCILE X CZ) CELL VARIANCE CHANGES

$$P^{CF1}_{i,Y,C,T} = E(P_{i,1,C,T}) + \left[\begin{array}{c} SD(P_{i,Y,C,T}) \\ - \\ E\left(\Delta SD(P_{i,(1,Y),C,T})\right) \end{array} \right] \times \frac{P_{i,Y,C,T} - E(P_{i,Y,C,T})}{SD(P_{i,Y,C,T})}$$

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CF2: SHUT DOWN THE HETEROGENEITY IN THE SHIFT IN WITHIN-(TERCILE X CZ) CELL VARIANCE CHANGES

$$P^{CF2}_{i,Y,C,T} = E(P_{i,1,C,T}) + \left[\begin{array}{c} SD(P_{i,1,C,T}) \\ + \\ E\left(\Delta SD(P_{i,(1,Y),C,T})\right) \end{array} \right] \times \frac{P_{i,Y,C,T} - E(P_{i,Y,C,T})}{SD(P_{i,Y,C,T})}$$

Variance Decomposition - Counterfactuals

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CF3: SHUT DOWN THE HETEROGENEITY IN GROWTH RATES

$$P^{CF3}_{i,Y,C,T} = \left[\begin{array}{c} E(P_{i,1,C,T}) \\ + \\ E\left(\Delta E(P_{i,(1,Y),C,T})\right) \end{array} \right] + SD(P_{i,Y,C,T}) \times \frac{P_{i,Y,C,T} - E(P_{i,Y,C,T})}{SD(P_{i,Y,C,T})}$$

Micro level data

- Challenge in constructing "price level cell": time variation in the types of houses on the market

Micro level data

- Challenge in constructing "price level cell": time variation in the types of houses on the market
- Two approaches:
  1. Hedonic:
     - Pros: coverage
     - Con: unobserved heterogeneity
  2. Repeat sales (not today, similar results):
     - Pros: (almost) perfect control
     - Cons : limited coverage

Hedonic approach

- Using all transactions in **2001**: Regress the price of house i on a number of characteristics:

$$\log P_{i,2001} = \beta_0 + \beta_1 \log sqft_i + \beta_2 AGE_i + \beta_3 ROOMS_i + \beta_4 BATH_i$$
$$+ \beta_5 BED_i + \beta_6 STORIES_i + \beta_6 GARAGE_i + \sum^{j} ZIP_i^j + \epsilon_i$$

- Fit: $Adj.R^2 = 0.52$

Hedonic approach

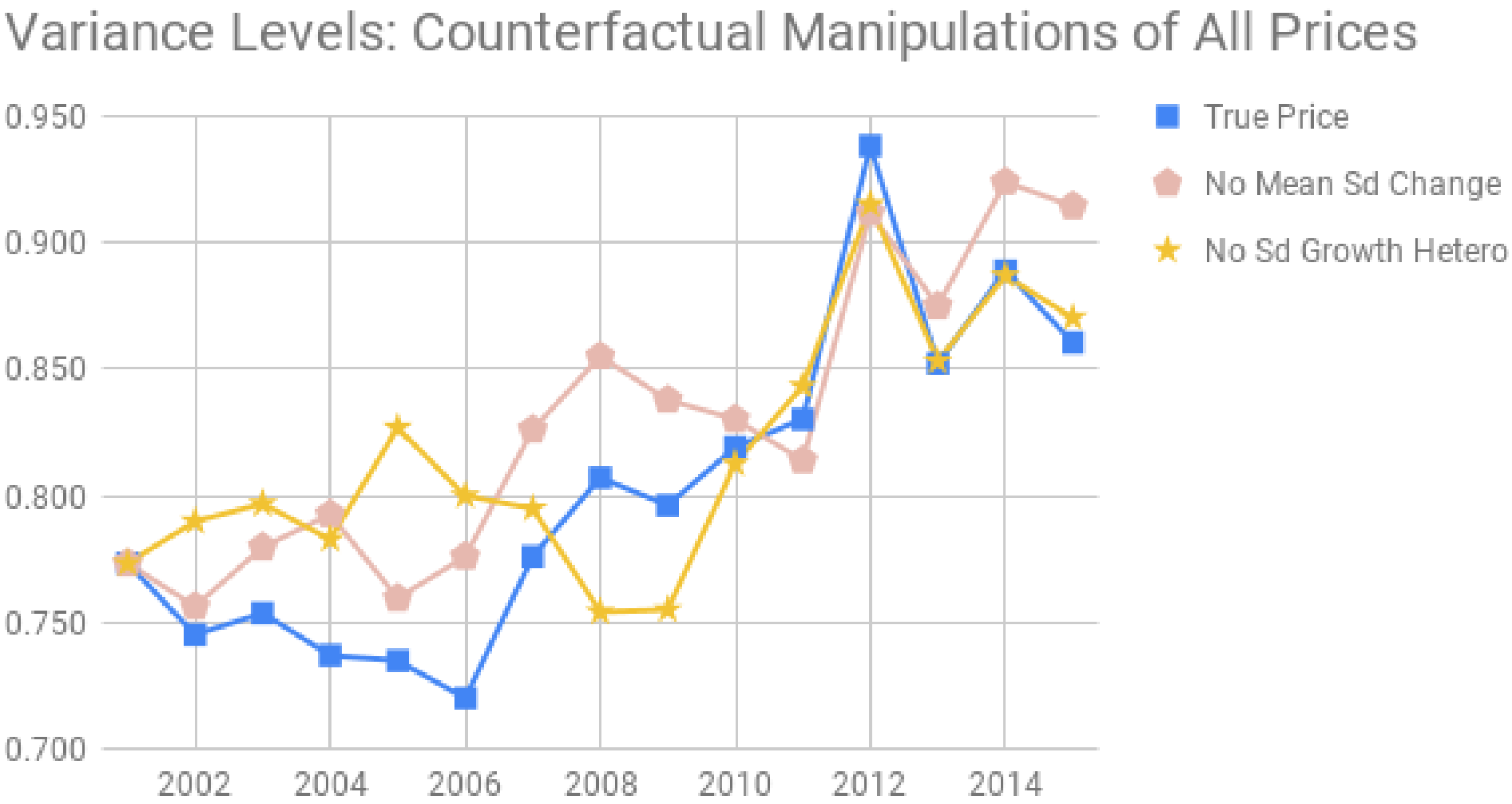
1. Split the distribution of predicted $\widehat{\log P_{i,2001}}$ into terciles at each CZ.
2. For each transaction (house i, time t): create $\widehat{\log P_{i,t}^{2001}}$, the predicted 2001-based price based on the house characteristics
3. Assign a 2001-based decile to each house transaction.

Housing Inequality - Counterfactuals

- **Question:** Had we "shut" down one of the three channels, would we have ended with a significantly different cross-sectional dispersion?

- **Question:** Which channel contributes most to the cross-sectional dispersion?

Housing Inequality - Counterfactuals



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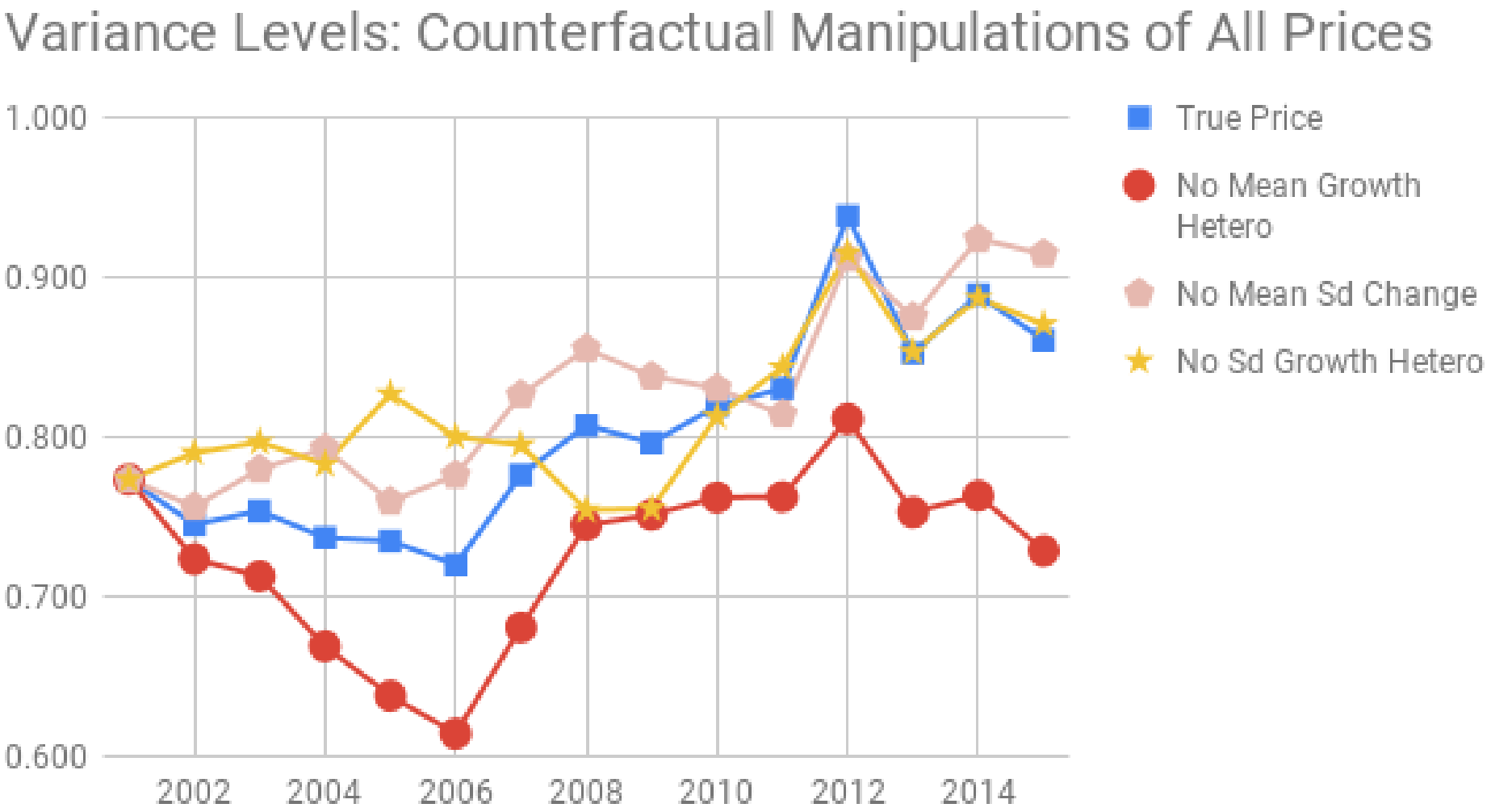

What's behind the fluctuations in dispersion?

- **Takeaway so far:** heterogenous growth across cells ($CZ \times Tercile$) matters most

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- **Question:** Is there a part of the distribution that saw more action?

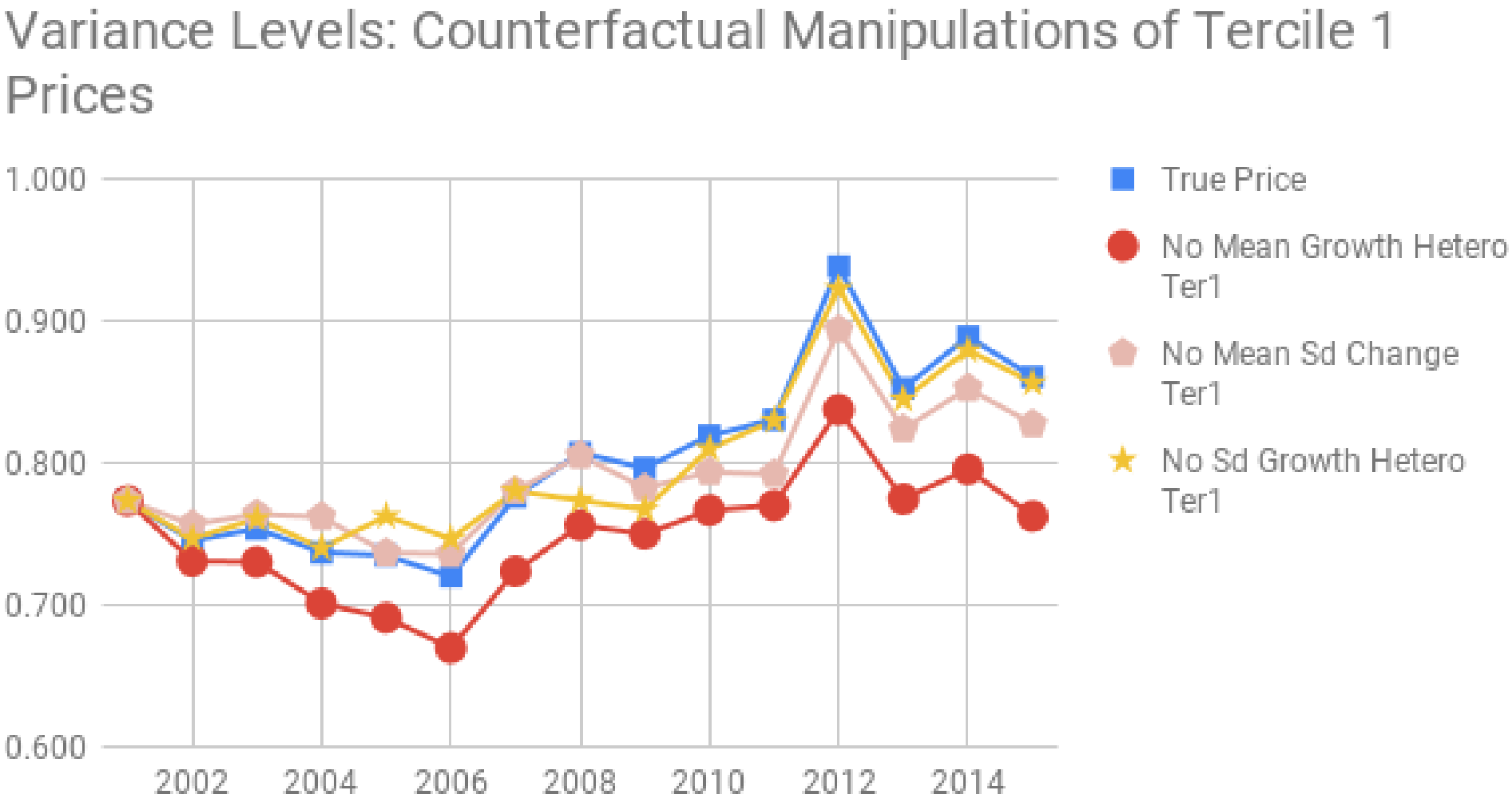
	Overall Variance
2001	0.776
2006	0.723
2015	0.860

Dispersion within terciles

- **Finding:** More action seems to happen at the bottom of the price distribution

	Overall Variance	Tercile 1	Tercile 2	Tercile 3
2001	0.776	0.849	0.731	0.746
2006	0.723	0.879	0.652	0.634
2015	0.860	1.281	0.768	0.528

Housing Inequality - Counterfactuals



- $1/2$ to $2/3$ of contribution is coming from 1st tercile alone

Quick Summary

Main takeaways

1. Housing accounts for around 2/3 of total U.S. wealth
2. Differences in the mean $(CZ \times Tercile)$ growth rate account for most of time variation in the cross-sectional variance of housing
3. The bottom of the distribution accounts for most changes in the cross-sectional variance

Quick Summary

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1. Housing accounts for around 2/3 of total U.S. wealth
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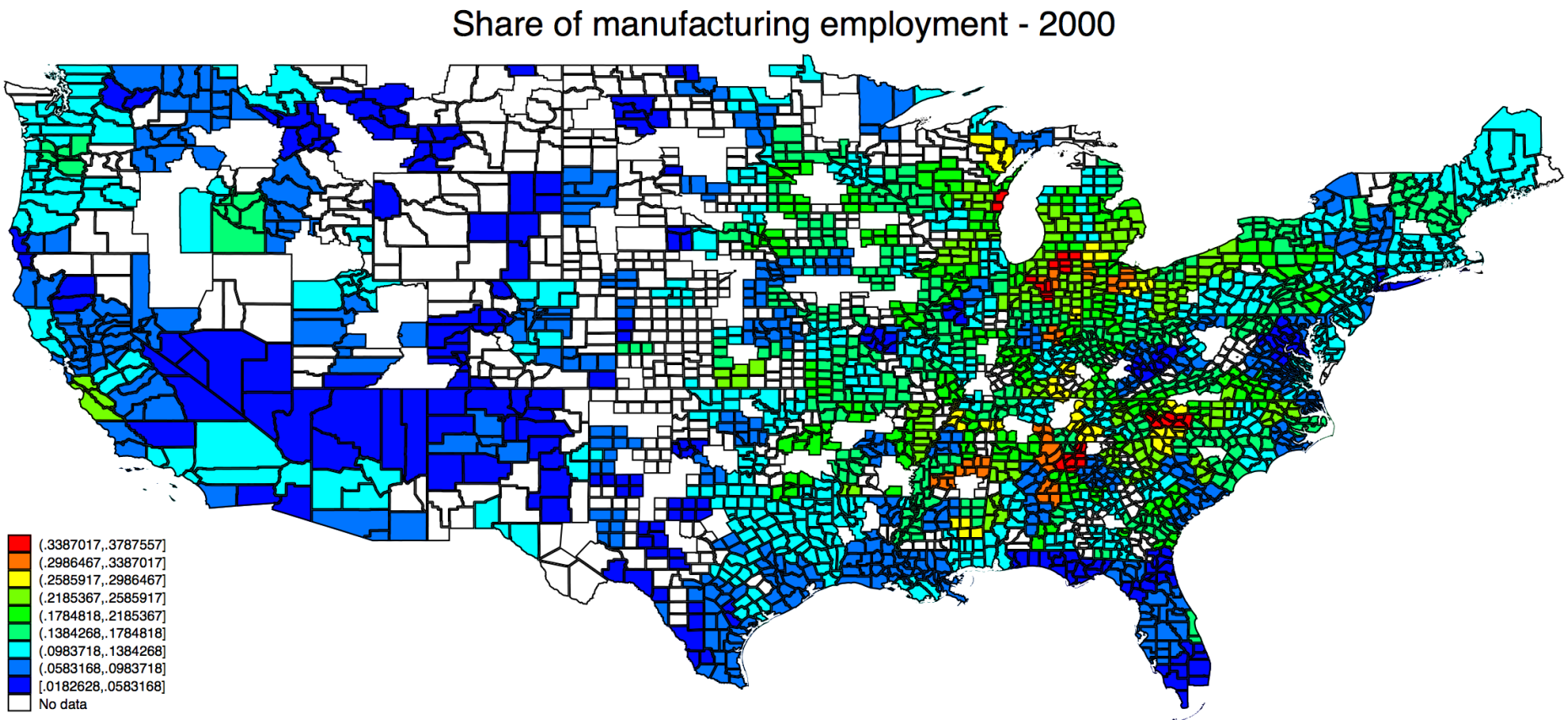
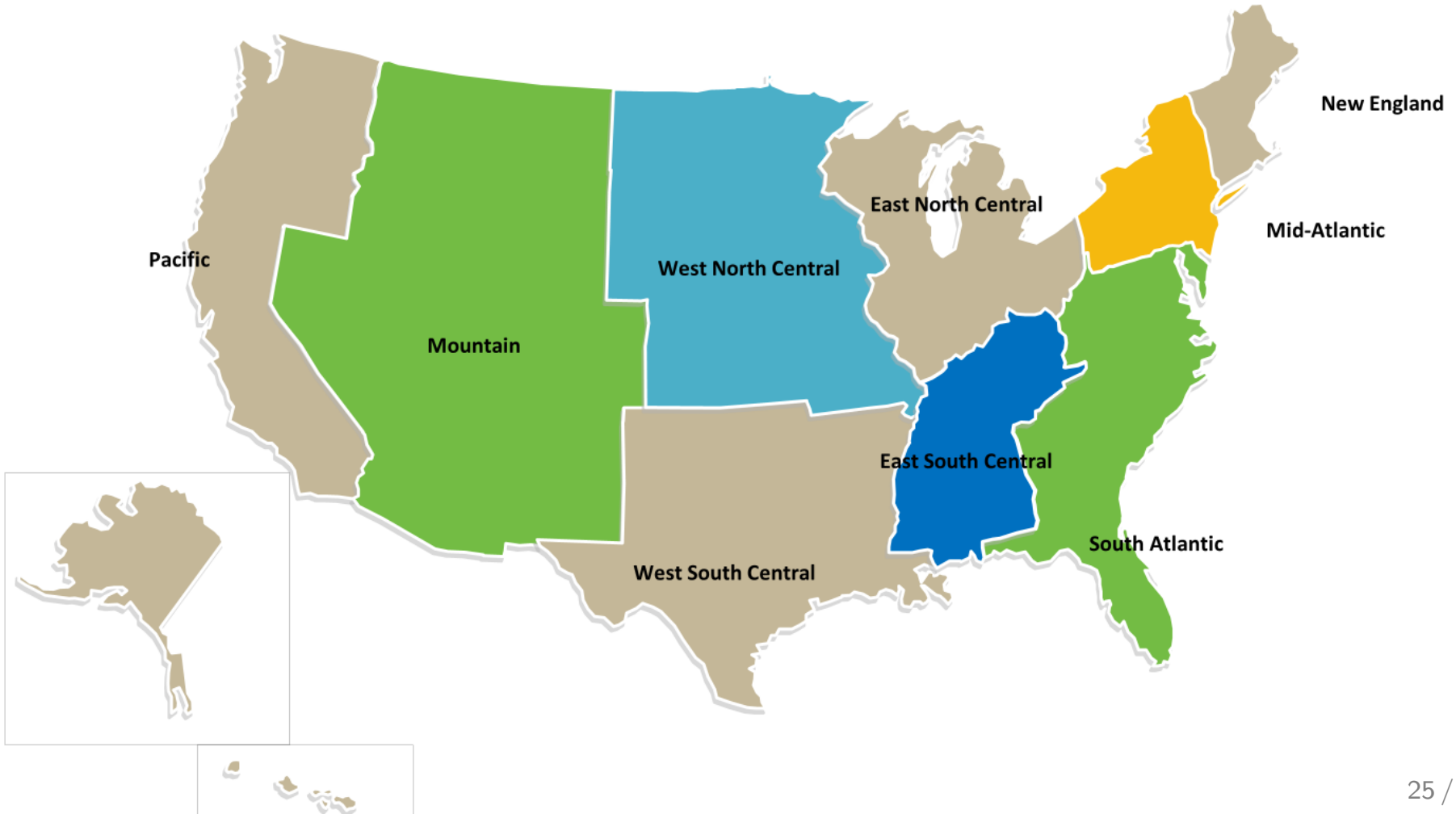
Implications

1. If we want to understand the evolution of housing inequality, it makes sense to study the evolution of the cross sectional growth rates
2. We need to do it in a way that allows for heterogeneity in the initial distribution (terciles) $\rightarrow$ exploit micro data

Heterogeneous Exposure to Manufacturing



Confounding regional characteristics?



Time Periods

For the rest of the talk:

- First, focus on period 2001-2006: Rapid house price buildup
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Start by verifying impact on labor market outcomes (IPUMS data)

- Run a regression of labor market variable (Δ wage, mfg empl, etc.) on:
  - Manufacturing exposure in 2001
  - Various controls in 2001
  - Census Division fixed effects

Manufacturing, Income and Employment

Table: Labor Market changes + Controls +Div Dummies

	(1) Wages	(2) MFG	(3) Cons	(4) Other	(5) NW	(6) LOG NW
MFG Share	-0.326***	-0.160***	-0.0528**	0.0555	0.158***	0.464***
	(0.003)	(0.000)	(0.019)	(0.112)	(0.000)	(0.000)
Pct routine cognitive	0.000426	-0.0207	-0.0381	0.138	-0.0791	-0.108
	(0.999)	(0.810)	(0.667)	(0.256)	(0.482)	(0.759)
Some college	0.00845	-0.0155	-0.0254	-0.0521	0.0930*	0.190
	(0.938)	(0.542)	(0.222)	(0.212)	(0.051)	(0.190)
Pct employed female	-0.430	0.0339	0.0934	-0.0431	-0.0841	-0.350
	(0.104)	(0.703)	(0.254)	(0.790)	(0.613)	(0.508)
Pct pop foreign born	0.0715	0.0140	0.0301**	0.103***	-0.147***	-0.457***
	(0.236)	(0.432)	(0.035)	(0.005)	(0.000)	(0.000)
Offshorability index	0.0208	-0.0174	-0.0170	0.00724	0.0271	0.163
	(0.829)	(0.511)	(0.401)	(0.854)	(0.596)	(0.327)
Observations	179	179	179	179	179	179
Adjusted R^2	0.357	0.494	0.236	0.175	0.497	0.447

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Quantitative interpretation

Table: Quantitative interpretation

	MFG	Wages	MFG likelihood	NW likelihood	Log NW
25%	0.087	0.047	-0.029	-0.008	-0.026
75%	0.185	0.126	-0.009	0.019	0.063
IQR	0.098	0.079	0.019	0.027	0.090
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% Explained		40.36%	80.81%	57.46%	50.64%

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Confirmed: Mfg exposure numbers matter a lot for flows

Question: How much variation does it explain for stock variables like wealth?

Manufacturing exposure and house prices

- So far: impact on wages, employment, & establishments
- Next: what is the impact on house prices?
- Ultimately: effect across the distribution

Manufacturing exposure and house prices

- So far: impact on wages, employment, $\&$ establishments
- Next: what is the impact on house prices?
- Ultimately: effect across the distribution

- But first a quickie: does MFG exposure impact **average** house prices?
  - Use FHFA CZ-level house price indices
  - Regress ΔP_H for 2001-2006 on 2001 MFG share and controls

Large heterogeneity in house price changes

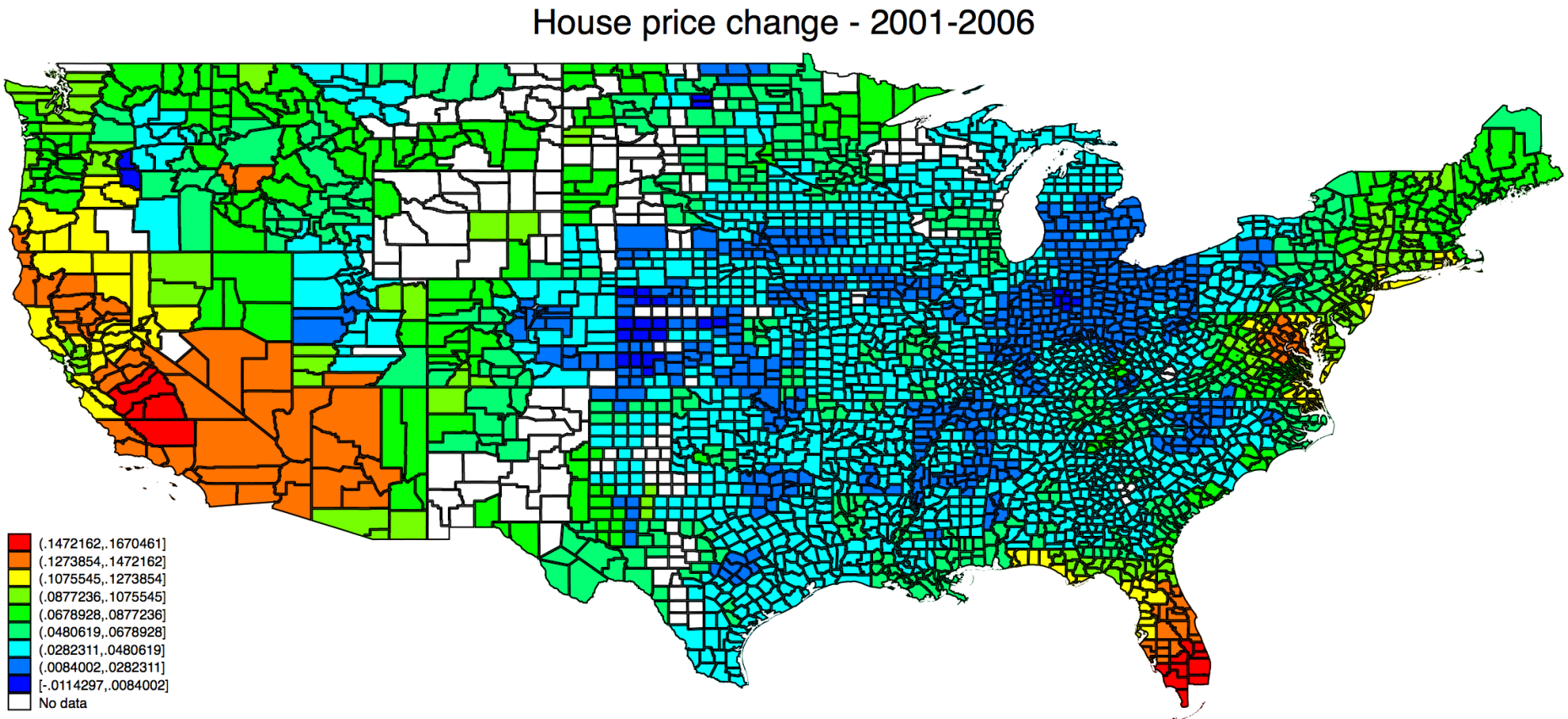


Table: Moments of house price change, 2001-2006

	mean	sd	p10	p25	p50	p75	p90
Shocks gap	0.0563	0.0347	0.0233	0.0324	0.0433	0.0740	0.113
Observations	411						

Manufacturing, elasticities and house prices

Table: House price change, manufacturing and controls, 2001-2006

	(1) None	(2) Region	(3) Division
MFG Share	-0.146***	-0.0959**	-0.140***
	(0.000)	(0.035)	(0.003)
Supply elasticity	-0.0103***	-0.00918**	-0.00762**
	(0.007)	(0.014)	(0.010)
Pct routine cognitive	-0.187	-0.158	-0.130
	(0.159)	(0.209)	(0.222)
Some college	0.0589	0.0448*	0.0123
	(0.120)	(0.088)	(0.639)
Pct employed female	0.228	0.381**	0.181*
	(0.204)	(0.016)	(0.096)
Pct pop foreign born	0.255***	0.199***	0.171***
	(0.001)	(0.005)	(0.001)
Offshorability index	-0.111***	-0.0912***	-0.0710***
	(0.003)	(0.007)	(0.004)
Constant	-0.0106	-0.0778	0.0394
	(0.891)	(0.255)	(0.421)
Observations	411	411	411
Adjusted R^2	0.425	0.516	0.624

p-values in parentheses
$^{*}\ p < 0.1,\ ^{**}\ p < 0.05,\ ^{***}\ p < 0.01$

Interpretation - effect of mfg exposure

Table: Moments of manufacturing share, 2000

	mean	sd	p25	p50	p75
Share of mfg	0.140	0.0707	0.0903	0.132	0.184
Observations	411				

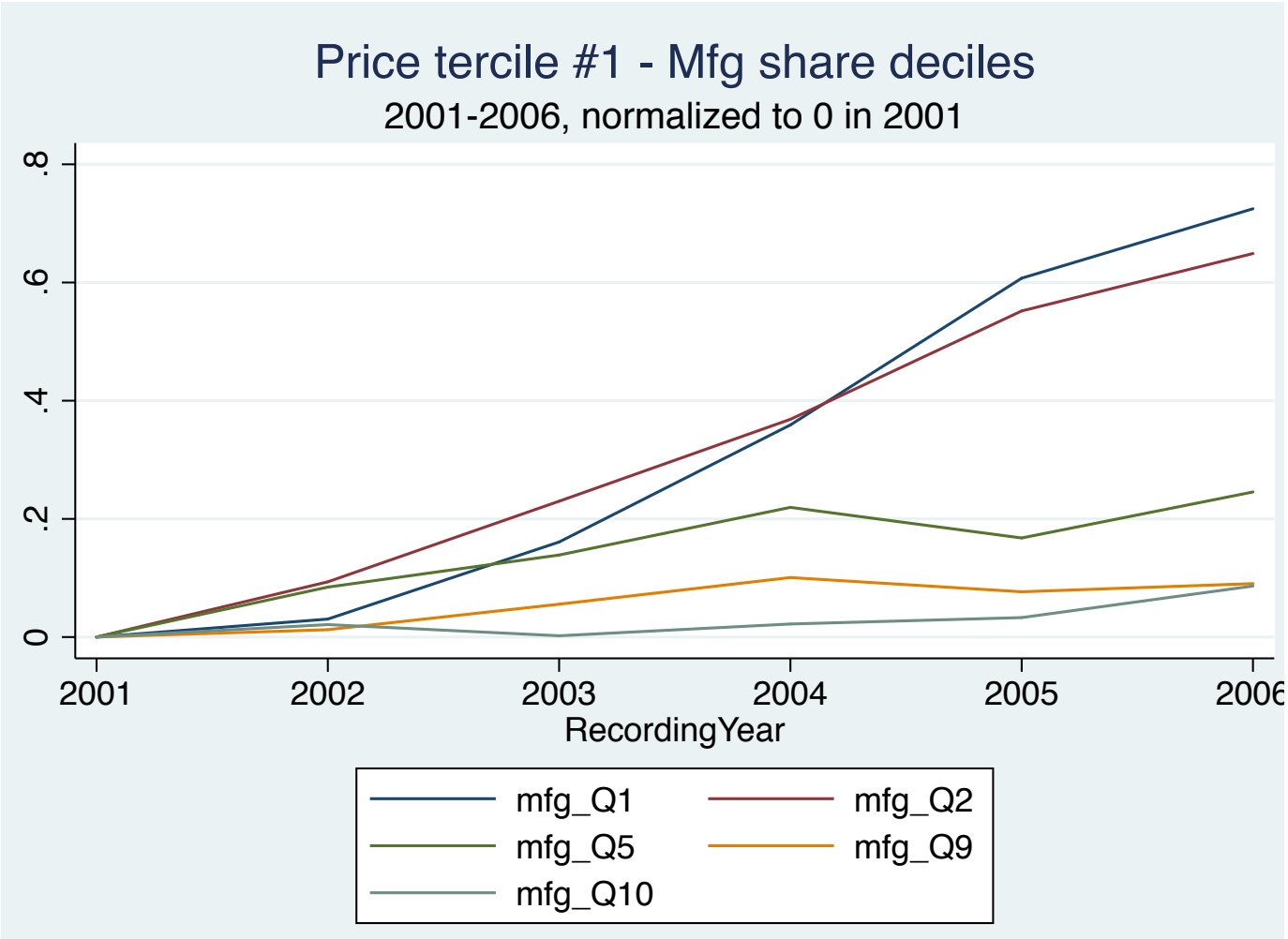
- From 25th to 75th pct of the CZs in terms of manufacturing share:
  - $\frac{.14 \times 0.094}{0.042} \approx 31\%$ of the IQR of ΔP_H

Distributional consequences

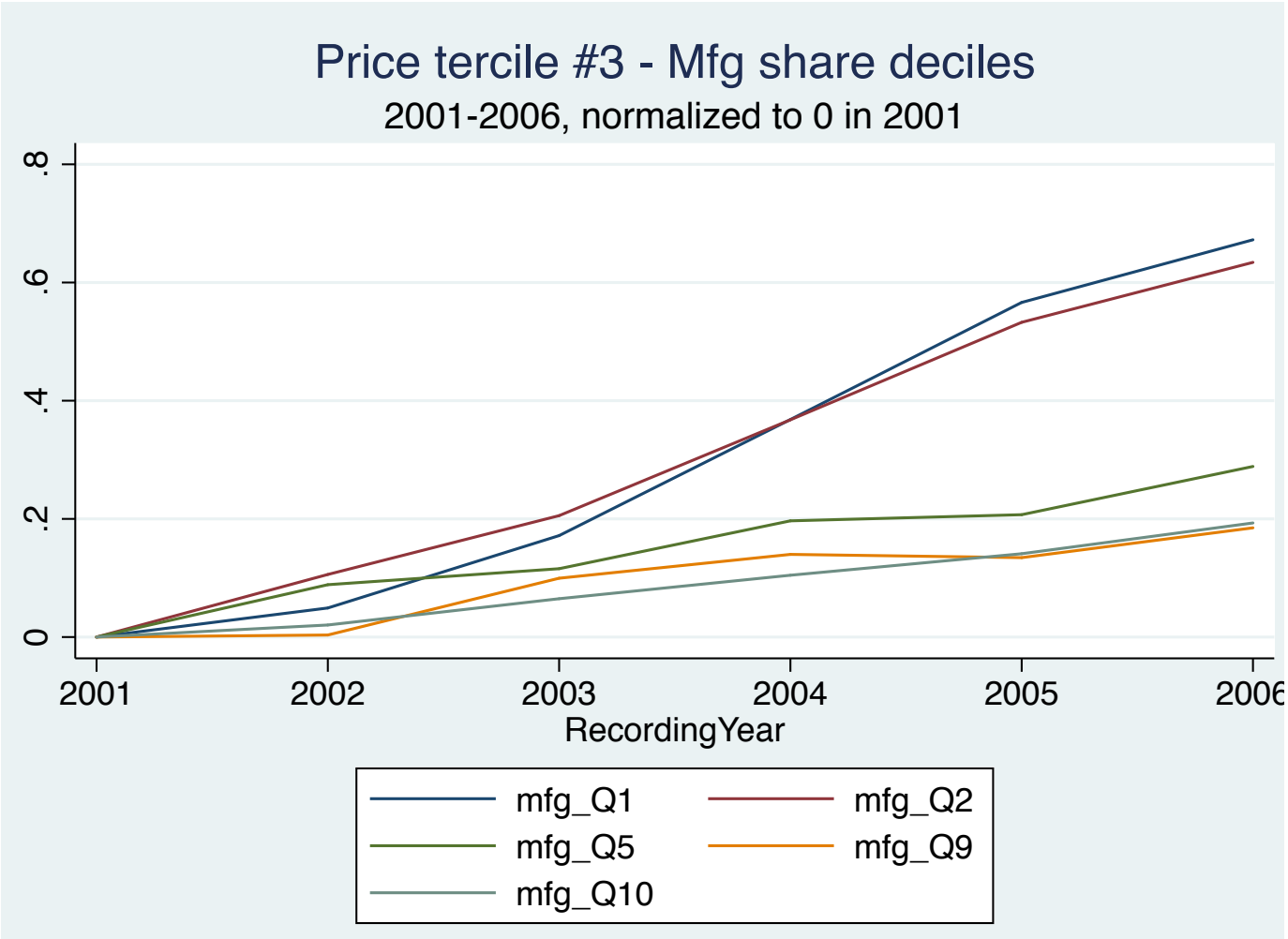
Next: ΔP_H across the housing price distribution

- Is the response of ΔP_H to MFG exposure significantly different at the bottom and top of the distribution?
- Are the effects "distribution neutral?"
- Are the effects long-lasting?

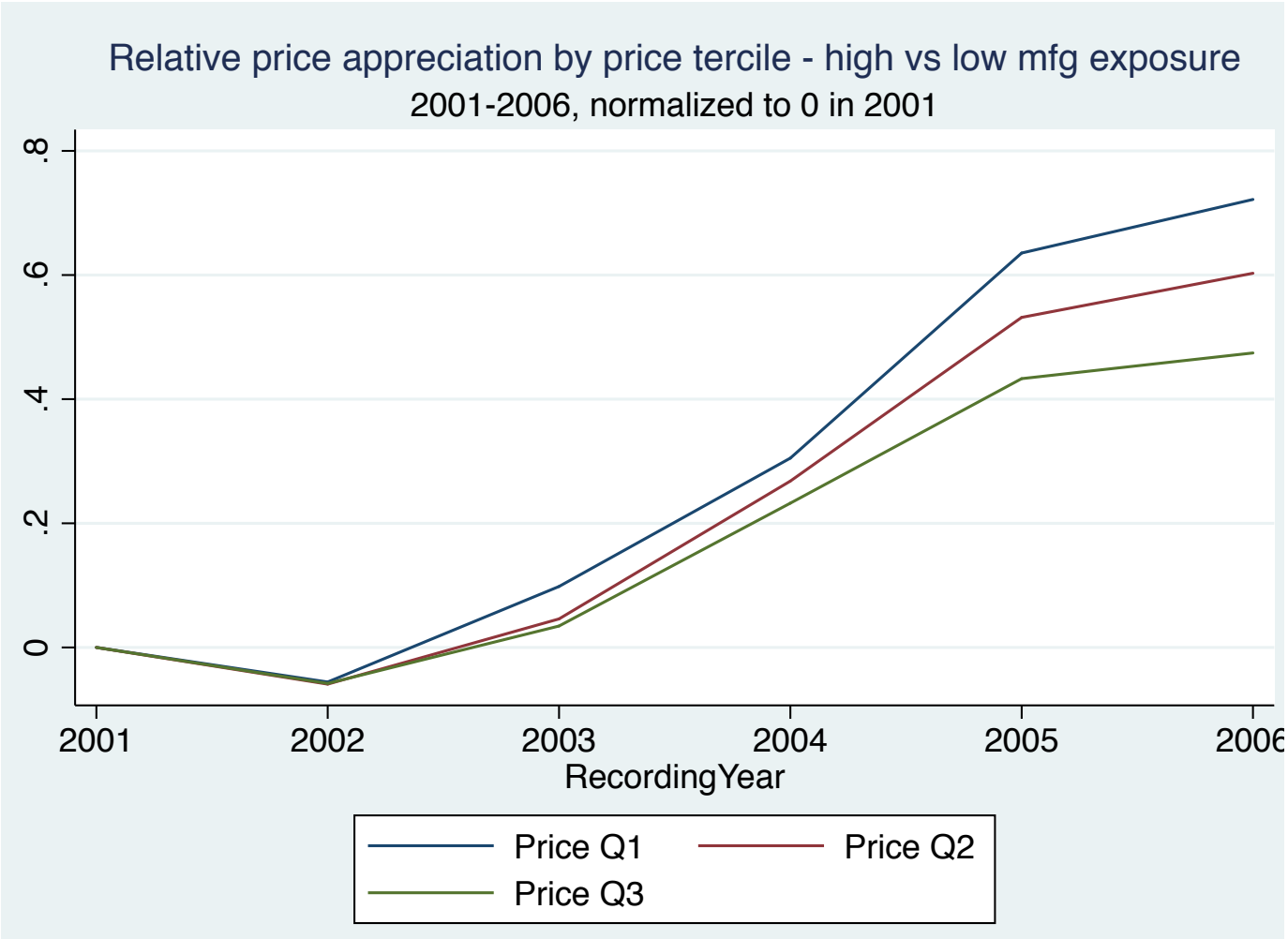
ΔP_H and manufacturing exposure - Tercile 1



ΔP_H and manufacturing exposure - Tercile 3



Manufacturing and house price distribution



Manufacturing and house price distribution

Table: ΔP and MFG across the distribution, 2001-2006

	(1) Parametric	(2) + controls	(3) Non-parametric	(4) + controls
MFG Share	-0.472***	-0.454***	-0.387***	-0.369***
	(0.001)	(0.001)	(0.002)	(0.001)
Tercile * MFG Share	0.0807***	0.0808***		
	(0.001)	(0.002)		
Tercile 2 * MFG			0.0668***	0.0671***
			(0.001)	(0.001)
Tercile 3 * MFG			0.161***	0.162***
			(0.001)	(0.002)
Constant	0.144***	0.352*	0.145***	0.353*
	(0.000)	(0.076)	(0.000)	(0.076)
Observations	535	535	535	535
Adjusted R^2	0.222	0.248	0.221	0.247

p-values in parentheses, Div FE
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Housing inequality and MFG exposure

Table: ΔP_H at different Terciles $\&$ MFG exposure

	Ter 1	Ter 2	Ter 3
MFG 25%	-0.024	-0.026	-0.031
MFG 75%	-0.060	-0.056	-0.051

- Remove all common factors (that would make it positive)
- High MFG exposure: Irrespective of tiers
  - Vis-a-vis low MFG exposure: Per annum around 3% lower ΔP_H
- Over 2001-2006: A widening of 15% in housing wealth inequality

Interpretation - effect of MFG exposure

- From 25th to 75th pct of the CZs in terms of MFG share:
  - Lower Tercile: $\frac{.369 \times 0.095}{0.09} \approx 40\%$ of the IQR of ΔP
  - Middle Tercile: $\frac{.3 \times 0.095}{0.085} \approx 30\%$ of the IQR of ΔP
  - Upper Tercile: $\frac{.2 \times 0.095}{0.07} \approx 25\%$ of the IQR of ΔP
- Quantitatively: the impact on house prices of being heavily exposed to manufacturing is 60% higher for the bottom tercile vs. the top

Bartik analysis

- Pre-existing MFG share regressions are equivalent to Bartik regressions with two sectors (MFG and "Other")
- Useful to isolate as a first stage the income $\&$ emp components projected by MFG for ΔP_H regressions

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- Pre-existing MFG share regressions are equivalent to Bartik regressions with two sectors (MFG and "Other")
- Useful to isolate as a first stage the income $\&$ emp components projected by MFG for ΔP_H regressions
- **Concern:** pre-existing MFG share as a whole may be correlated with a third factor ("amenities") that is affecting ΔP_H
- Alternatively: Use industrial composition ("Bartiks") **within** MFG and exploit the cross sectional variation
  - Basic idea: Different sectors within MFG evolved differently
  - Identifying assumption: composition with MFG industries is not "correlated" with "amenities"
  - Use Bartiks as first stage for different variables

Manufacturing and house price distribution

Table: House Price changes

	(1) +Controls+Saez Elasticity	(2) IV MFG Share	(3) IV Bartik
MFG Share	-0.369***		
	(0.001)		
Tercile 2 * Mfg Share	0.0671***		
	(0.001)		
Tercile 3 * Mfg Share	0.162***		
	(0.002)		
Wages		1.152***	0.828***
		(0.008)	(0.006)
Tercile 2 * Wages		-0.153***	-0.122**
		(0.003)	(0.037)
Tercile 3 * Wages		-0.371***	-0.275**
		(0.002)	(0.011)
Observations	535	535	535
Adjusted R^2	0.247	0.135	0.237
First Stage		25.23, 109.83, 109.83	24.60, 102.77, 102.77

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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- **Why?**

Interpretation - effect of MFG exposure

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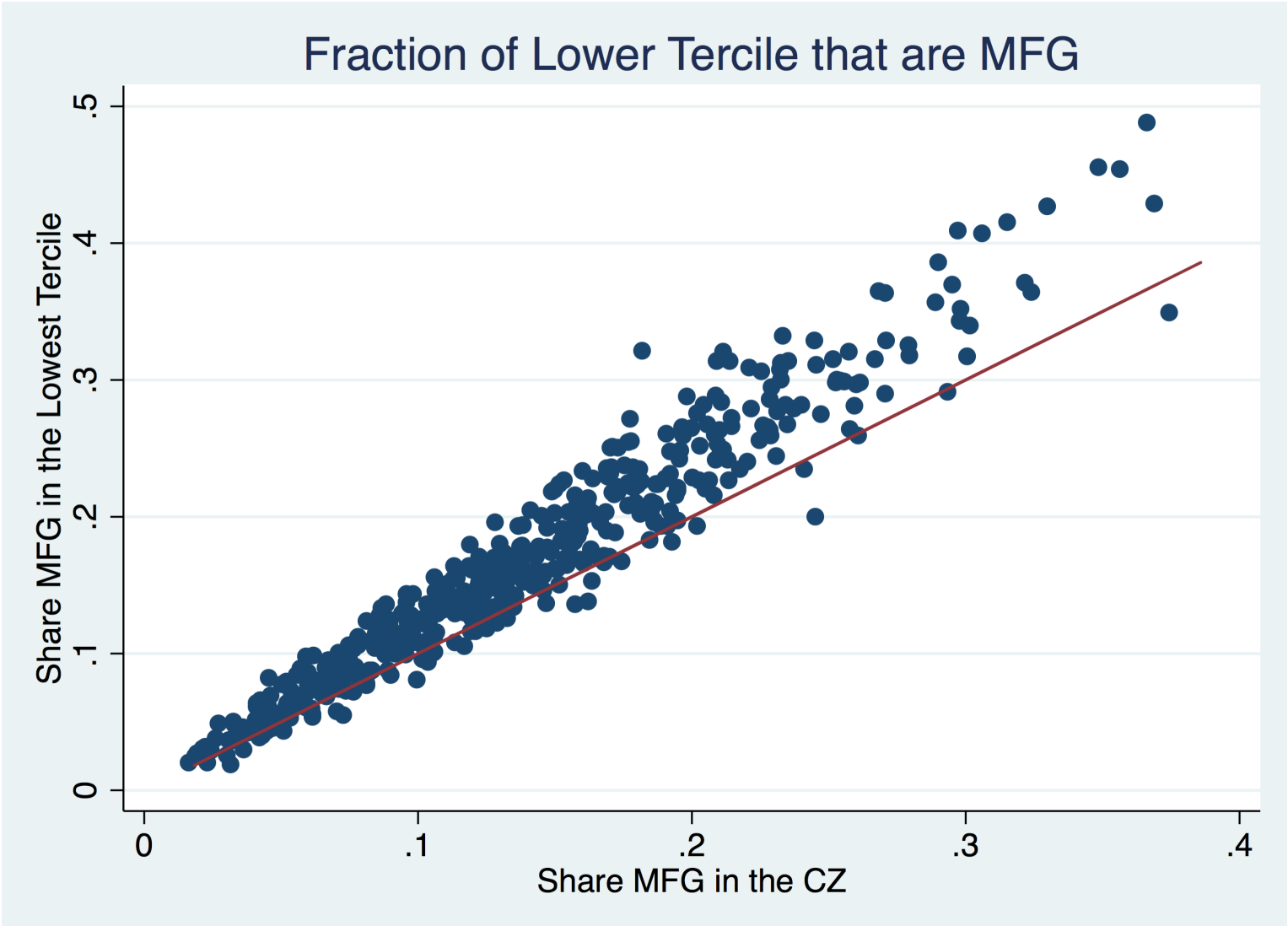
Interpretation - effect of MFG exposure

- Quantitatively: the impact on house prices of being heavily exposed to manufacturing is significantly higher for the bottom tercile vs. the top
- **Why?**
- If housing markets are (relatively) segmented...
  - Direct effect on the relevant parts of the housing distribution
- Where do manufacturing workers live?
  - Is there over representation in lowest ΔP_H tercile?
  - Conditional on industry: $\%$ of workers who live in lowest tercile of house price distribution (from ACS)

Where do mfg workers live in the P_H distribution?



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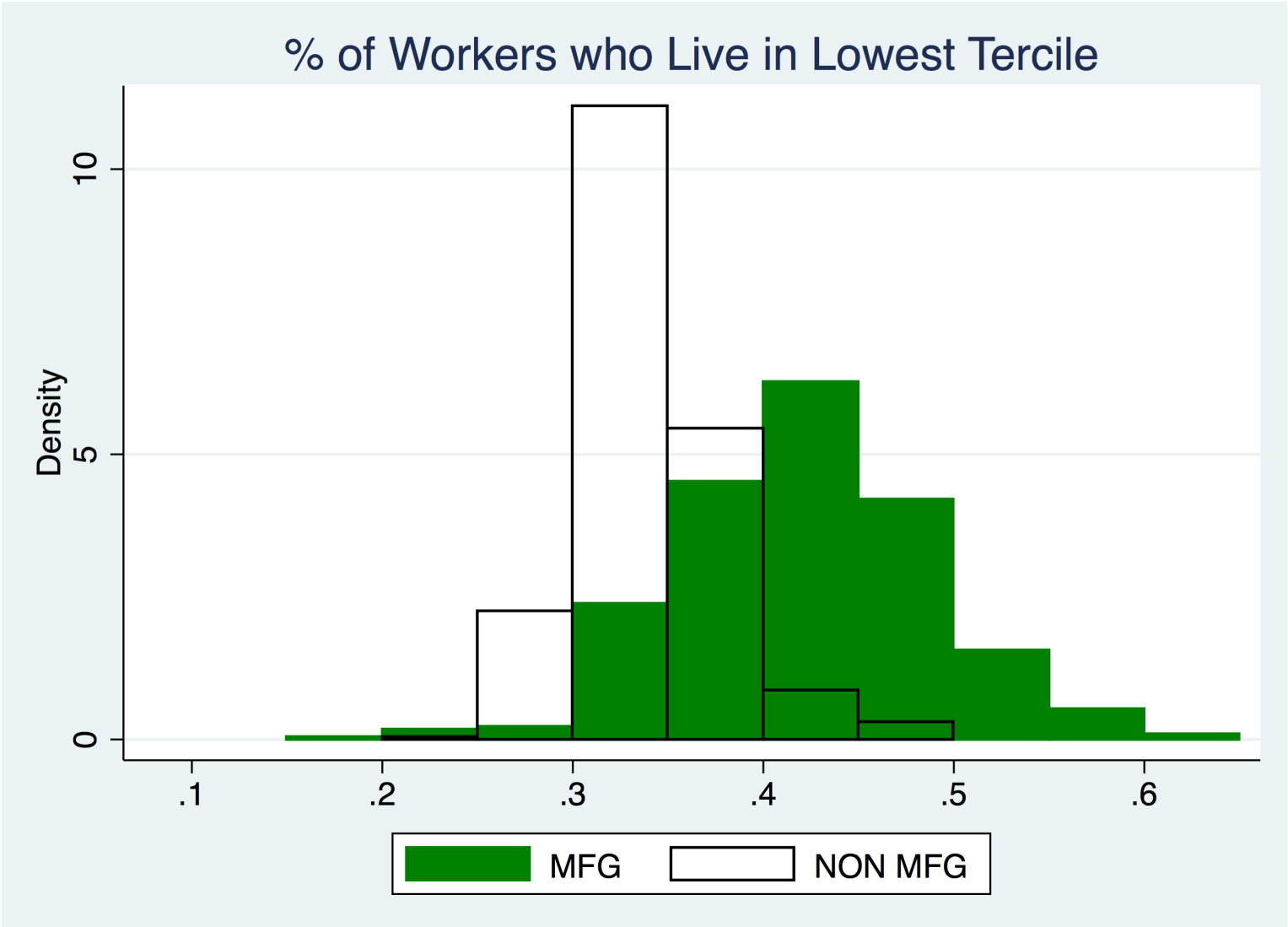


Summary of findings so far

1. Growth rate heterogeneith across CZ an important factor for overall variance
2. Areas with high MFG exposure saw a bigger fall in wages and employment
3. Effects translate to aggregate house price growth
4. Strongest effects are at the bottom of the house distribution
    - Consistent with the fact that MFG workers tend to live disproportionally in lower house terciles

The persistent effect of MFG exposure

So far, we have focused on the house price boom (2001-2006)

The persistent effect of MFG exposure

So far, we have focused on the house price boom (2001-2006)

- Does this all unwind during the Great Recession?
- Are the effects present at longer horizons or are they only temporary?

$\rightarrow$ Repeat the analysis for the 2001-2015 period (last year of our dataset)

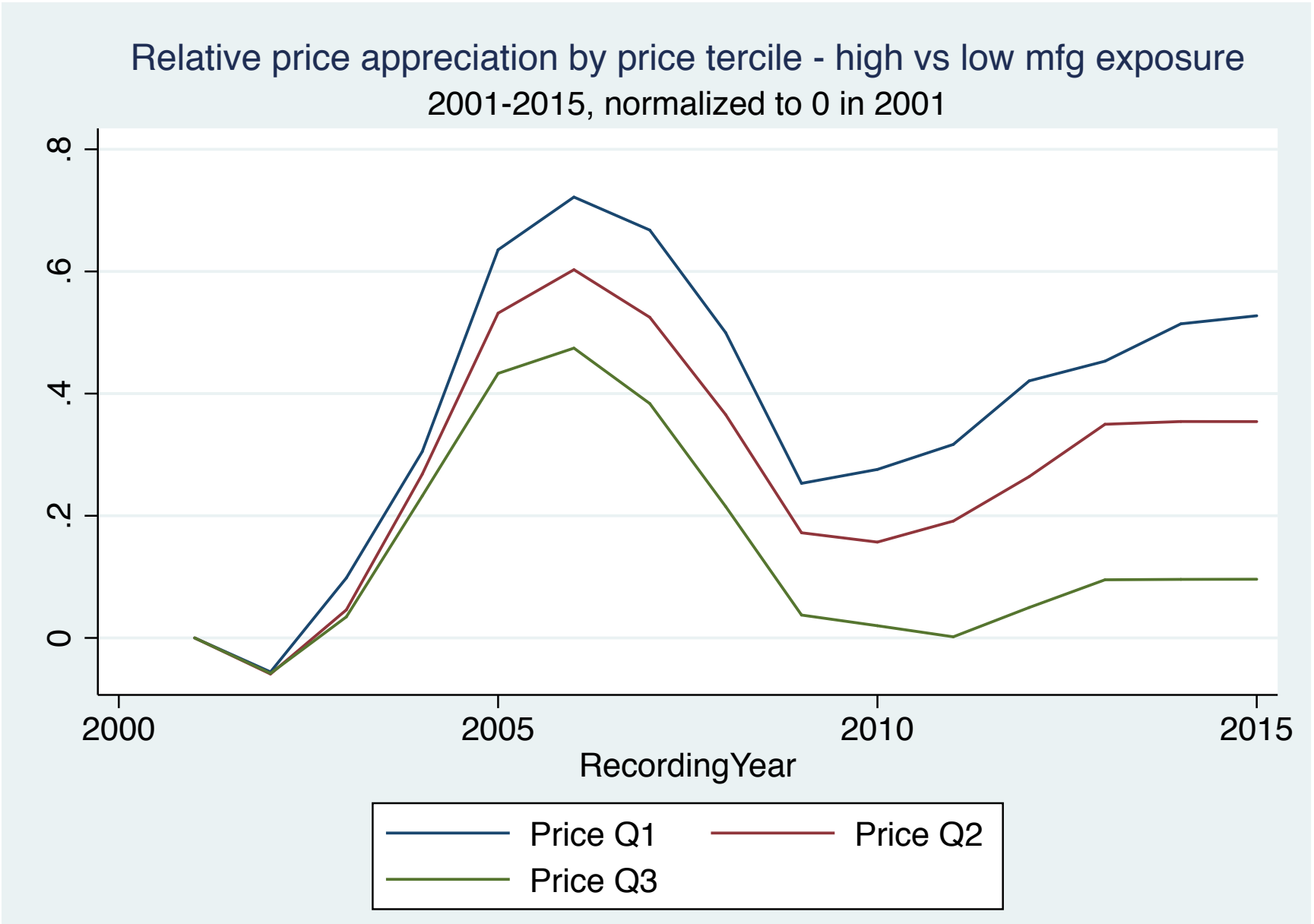
Manufacturing and house price distribution (2001-2015)

Table: Labor Market changes + Controls +Div Dummies

	(1) Wages	(2) MFG	(3) Cons	(4) Other	(5) NW	(6) LOG NW
MFG Share	-0.278**	-0.391***	0.0502***	0.318***	0.0230	0.0951
	(0.037)	(0.000)	(0.006)	(0.001)	(0.752)	(0.674)
Pct routine cognitive	0.425	0.563*	0.198**	-0.0780	-0.682	-2.084
	(0.139)	(0.061)	(0.043)	(0.823)	(0.116)	(0.138)
Some college	-0.0843	0.0700	0.0194	-0.214*	0.125	0.390
	(0.481)	(0.362)	(0.474)	(0.067)	(0.243)	(0.245)
Pct employed female	-0.846**	-0.0993	-0.0357	-0.387	0.522	1.594
	(0.033)	(0.713)	(0.706)	(0.294)	(0.186)	(0.194)
Pct pop foreign born	-0.0156	-0.142*	0.0185	0.265***	-0.142*	-0.381
	(0.858)	(0.054)	(0.384)	(0.002)	(0.096)	(0.163)
Offshorability index	0.154	0.0774	0.0268	-0.00238	-0.102	-0.289
	(0.101)	(0.459)	(0.378)	(0.981)	(0.365)	(0.444)
Observations	135	135	135	135	135	135
Adjusted R^2	0.347	0.549	0.178	0.272	0.246	0.225

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Persistent impact of mfg exposure...at the bottom



Manufacturing and house price distribution (2001-2015)

Table: House Price changes

	(1) +Controls+Saez Elasticity	(2) IV MFG Share	(3) IV Bartik
MFG Share	-0.0699*		
	(0.061)		
Tercile 2 * Mfg Share	0.0502***		
	(0.000)		
Tercile 3 * Mfg Share	0.106***		
	(0.000)		
Wages		0.310*	0.212**
		(0.066)	(0.026)
Tercile 2 * Wages		-0.134***	-0.104***
		(0.003)	(0.006)
Tercile 3 * Wages		-0.284***	-0.209***
		(0.000)	(0.000)
Observations	523	403	403
Adjusted R^2	0.406	0.356	0.408

p-values in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Housing inequality and MFG exposure

Table: ΔP_H at different Terciles $\&$ MFG exposure

	Ter 1	Ter 2	Ter 3
MFG 25%	-0.010	-0.002	0.005
MFG 75%	-0.017	-0.004	0.009

- High MFG exposure
  - Vis-a-vis low MFG exposure: Per annum around $2-3\%$ lower ΔP_H
- Over 2001-2015: A widening of $35\% - 50\%$ in housing wealth inequality

Summary of findings so far

1. Areas with high MFG exposure saw a bigger fall in wages and employment
2. Effects translate to aggregate house price growth
3. Strongest effect is at the bottom of the house distribution
    - Consistent with the fact that MFG workers tend to live disproportionally in lower house terciles
4. Effects are persistent and quantitatively significant

Role of MFG in Variance Decomposition

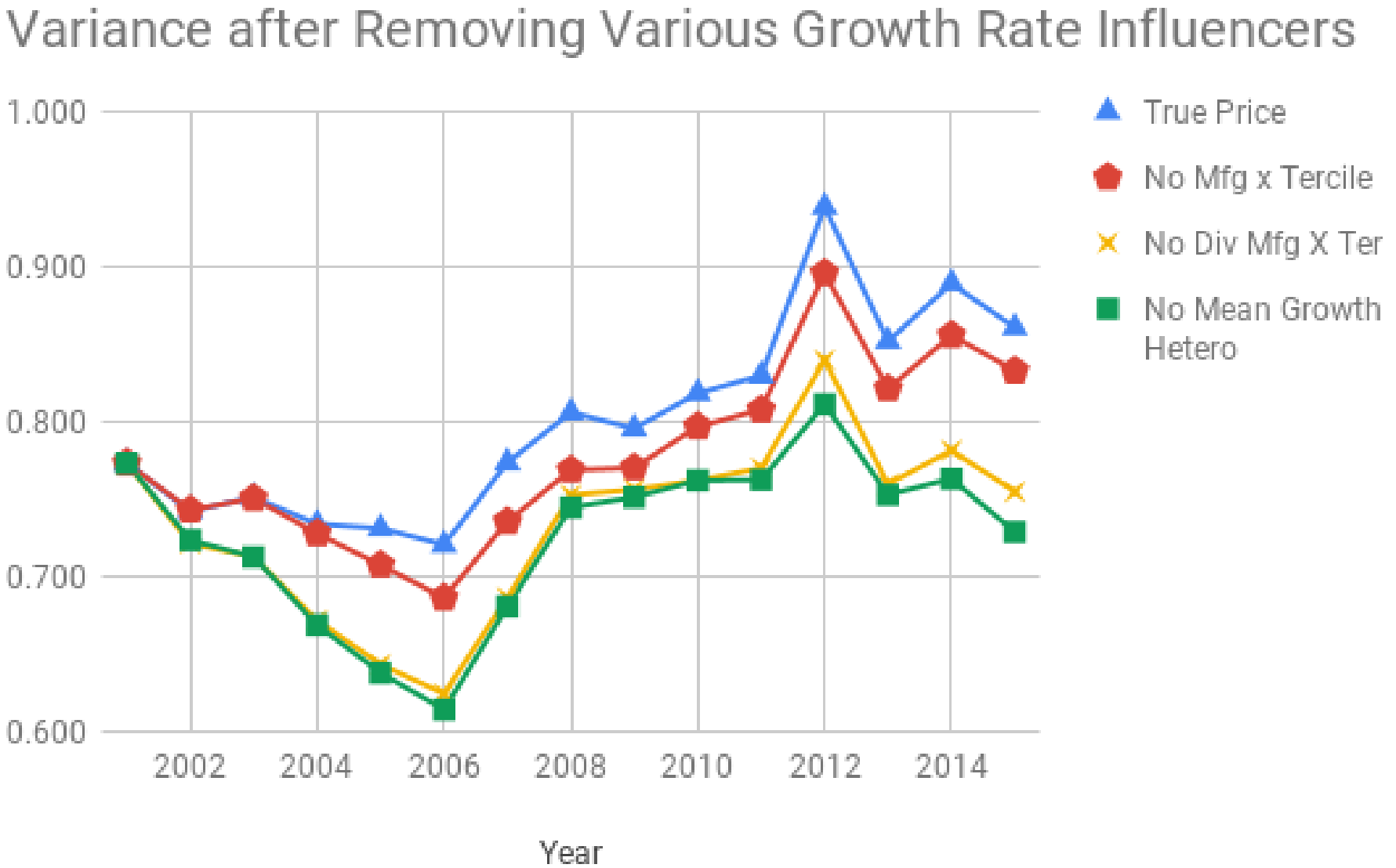
- Recall: The first-order factor for the time variation in the cross-sectional variance of house prices is the cross-sectional variance in the mean ($CZ \times Tercile$) growth rate
- How much of that is related to MFG?

Role of MFG in Variance Decomposition

- Recall: The first-order factor for the time variation in the cross-sectional variance of house prices is the cross-sectional variance in the mean ($CZ \times Tercile$) growth rate
- How much of that is related to MFG?

  $\rightarrow$ MFG accounts for about 30% of cross-CZ variation
- Use our empirical specification to remove the MFG effects

Role of MFG in Variance Decomposition



Conclusions

- MFG decline caused dramatic drops in income and employment
- Fall translates into house prices
- The drop is stronger at the bottom of the house price distribution where more MFG workers live.
- Analysis of cross sectional variance of housing $\rightarrow$ importance of variation in mean growth rates and relation to MFG
- Also: Model of income and housing segmentation consistent with empirical predictions