ONLINE APPENDIX FOR "HOUSING BOOMS, MANUFACTURING DECLINE, AND LABOR MARKET OUTCOMES"

Kerwin Kofi Charles[†] Erik Hurst[‡] Matthew J. Notowidigdo[§]

July 2017

A. Background on Properties of Frechet Distribution

This section provides a brief review of properties of Frechet distribution that are useful for proving main proposition in the main text.

Definition: A cumulative distribution function, F, is a single-variable Frechet(θ, s, m) distribution if

$$F(x) = \exp\left[-\left(\frac{x-m}{s}\right)^{-\theta}\right]$$

where θ, s, and m are shape, scale, and location parameters, respectively.

Definition: The gamma function $\Gamma(\cdot)$ is defined as

$$\Gamma(n) = \int_0^\infty x^{n-1}e^{-x}dx$$

Remark: If X is distributed as Frechet(θ, 1, 0), then

$$E[X] = \begin{cases} \Gamma(1-1/\theta) & \theta > 1 \\ \infty & 0 < \theta \leq 1 \end{cases}$$

Definition: A cumulative distribution function F is a multi-variate Frechet(N, θ) distribution (with scale 1 and location 0) if

$$F(x_1, x_2, ..., x_N) = \exp\left[-\sum_{i=1}^{N} x_i^{-\theta}\right]$$

Remark: A multi-variate Frechet is the joint distribution of N independent draws from single-variable Frechet with same shape parameter.

Remark: If $\{X_1, X_2, \ldots, X_N\}$ are N independent draws from a Frechet(θ, s, m) and X^* is the max of $\{ X_1, X_2, \ldots, X_N \}$, then X^* is distributed as Frechet(θ, $N^{1/\theta}$ s, m).

B. Results for General Model with Multiple Sectors and Groups ($G > 1$ and $M > 1$)

B.1. Probability of Choosing Sector *s*

The probability of individual i in group g choosing sector s is given by

$$P_{igs} = \Pr[\log(w_s e_{is} z_{gs}) \geq \log(w_m e_{im} z_{gm}) \ \forall m]$$

$$= \Pr\left[\frac{w_s z_{gs}}{w_m z_{gm}} e_{is} \geq e_{im} \ \forall m\right]$$

Using property of Frechet distributions above, we can derive following expression:

$$P_{gs} = \frac{(w_s z_{gs})^{\theta}}{\sum_{m=0}^{M} (w_m z_{gm})^{\theta}}$$

This is the same formula for all sectors including non-work sector ($s = 0$).

B.2. Conditional expected value of efficiency terms

The expected value of efficiency term given wages is given by

$$E[e_{igs} \mid \text{choosing } s] = \frac{\left(\sum_{m=0}^{M} (w_m z_{gm})^{\theta}\right)^{1/\theta}}{w_s z_{gs}} * \Gamma(1 - 1/\theta)$$

B.3. Labor Supply

Total labor supply into sector is given by the following:

$$H_s^{\text{supply}} = \sum_{g=1}^{G} H_{gs}^{\text{supply}}$$

The labor supply for sector s from group g depends on share of unit measure of individuals in group *g* multiplied by probability sector s is selected among the individuals in that group and multipled by the (conditional) expected value of efficiency term for this group choosing sector s in group g). This is given by the following expression:

$$H_{gs}^{\text{supply}} = q_g * P_{gs} * E[e_{igs} \mid \text{choosing } s]$$

B.4. Labor Demand

The aggregate production function is given by following CES function:

$$Y(H_1, H_2, ..., H_M) = \left[\sum_{m=1}^{M} (A_m H_m)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

The total efficiency units of labor supplied to sector is given by

$$H_m = \sum_{g=1}^{G} H_{gm}$$

By taking first-order condition in each sector, we have following equation for labor demand:

$$H_m^{\text{demand}} = Y\left(\frac{A_s^{\frac{\sigma-1}{\sigma}}}{w_s}\right)^{\sigma}$$

Imposing zero profit condition gives following expression relating wages and (exogenous) sector-specific shifters:

$$1 = \sum_{m=1}^{M}\left(\frac{A_m}{w_m}\right)^{\sigma-1}$$

Normalizing $w_0 = 1$, we have equilibrium wages given by following expressions, which are derived by setting labor demand equal to labor supply for each sector $s = 1,\ldots,M$:

$$\Gamma(1-1/\theta) * \sum_{g=1}^{G}\left(q_g (w_s z_{gs})^{\theta-1}\left(\sum_{m=0}^{M}(w_m z_{gm})^{\theta}\right)^{(1/\theta)-1}\right) = Y\left(\frac{A_s^{\frac{\sigma-1}{\sigma}}}{w_s}\right)^{\sigma}$$

Proposition: The ratio of averages wages across sectors is not affected by sector-specific shifters, meaning that average wages in all sectors decline by the same proportion for each demographic group in response to any combination of sectoral shocks.

Proof:

Take ratio of average wages for any group g in any two sectors s and t:

$$\frac{w_s E[e_{igs} \mid \text{choosing } s]}{w_t E[e_{igt} \mid \text{choosing } t]} = \frac{w_s \frac{\left(\sum_{m=0}^{M}(w_m z_{gm})^{\theta}\right)^{1/\theta}}{w_s z_{gs}} * \Gamma(1-1/\theta)}{w_t \frac{\left(\sum_{m=0}^{M}(w_m z_{gm})^{\theta}\right)^{1/\theta}}{w_t z_{gt}} * \Gamma(1-1/\theta)}$$

$$= \frac{z_{gs}}{z_{gt}}$$

C. Proof of Proposition in Main Text (for $G = 1$)

Proposition: In the case with a single group ($G = 1$) and arbitrary number of sectors ($M > 1$), a negative shock to sector m (i.e., a reduction in A_m) reduces employment and average wages in

sector *m* and increases the share of the population in the non-work sector and in the other work sectors. The ratio of averages wages across sectors is not affected by the shock, meaning that average wages in all sectors decline by the same proportion in response to any combination of sectoral shocks.

Proof:

The last part of the proportion is true in general case where $G \geq 1$, so it is implied by result above. To prove the remainder of proposition, we first derive result for ratio of wage (per efficiency unit) in each combination of sectors *s* and *t*. To do this, we start with equilibrium condition for sector s when there is a single group ($G = 1$):

$$(w_s z_{gs})^{\theta-1} \cdot \left(\sum_{m=0}^{M} \left(w_m z_{gm} \right)^{\theta} \right)^{\frac{1-\theta}{\theta}} \cdot \Gamma(1-\frac{1}{\theta}) = Y \cdot \left(\frac{A_s^{\frac{\sigma-1}{\sigma}}}{w_s} \right)^{\sigma}$$

Next, we take ratio across sectors *s* and *t*:

$$\left(\frac{w_s z_{gs}}{w_t z_{gt}} \right)^{\theta-1} = \left(\left(\frac{A_s}{A_t} \right)^{\frac{\sigma-1}{\sigma}} \cdot \frac{w_t}{w_s} \right)^{\sigma}$$

$$\frac{w_s}{w_t} = \left(\frac{A_s}{A_t} \right)^{\frac{\sigma-1}{\theta+\sigma-1}} \cdot \left(\frac{z_{gt}}{z_{gs}} \right)^{\frac{\theta-1}{\theta+\sigma-1}}$$

We next use the zero-profit condition to derive closed-form expression for w_s:

$$w_s = A_s^{\frac{\sigma-1}{\theta+\sigma-1}} z_s^{-\frac{\theta-1}{\theta+\sigma-1}} \left[\sum_{m=1}^{M} A_m^{\frac{\theta(\sigma-1)}{\theta+\sigma-1}} z_m^{\frac{(\theta-1)(\sigma-1)}{\theta+\sigma-1}} \right]^{\frac{1}{\sigma-1}}$$

From this expression we can then solve for P_s

$$P_s = \frac{A_s^{\frac{\theta(\sigma-1)}{\theta+\sigma-1}} z_s^{\frac{\theta\sigma}{\theta+\sigma-1}}}{z_0^{\theta} + \sum_{m=1}^{M} A_m^{\frac{\theta(\sigma-1)}{\theta+\sigma-1}} z_m^{\frac{\theta\sigma}{\theta+\sigma-1}}}$$

With this expression, the proposition is straightforward given restrictions on θ and σ.

Online Appendix Table OA.1
Employment Response to Housing Demand Change and Manufacturing Decline: Full Set of Estimated Coefficients

Dependent Variable is Change in Employment to Population Ratio, 2000-2006

Sample:	Non-College Men (1)	College Men (2)	Non-College Women (3)	College Women (4)	All Men and Women (5)
Housing Demand Change	0.029	0.009	0.014	0.004	0.018
	(0.008)	(0.004)	(0.002)	(0.003)	(0.003)
	[0.000]	[0.013]	[0.000]	[0.271]	[0.000]
Manufacturing Decline [Partial Effect]	-0.098	-0.184	-0.457	-0.292	-0.266
	(0.210)	(0.086)	(0.142)	(0.134)	(0.116)
	[0.645]	[0.037]	[0.002]	[0.034]	[0.027]
Manufacturing Decline [Total Effect]	-0.747	-0.392	-0.769	-0.373	-0.657
	(0.270)	(0.125)	(0.165)	(0.149)	(0.155)
	[0.008]	[0.003]	[0.000]	[0.016]	[0.000]
Standardized (1σ) effects:					
Housing demand change	0.017	0.005	0.008	0.002	0.010
Manufacturing decline	-0.008	-0.004	-0.008	-0.004	-0.007
Baseline controls (year 2000 values):					
Log Population	0.003	0.002	0.002	0.001	0.002
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
	[0.228]	[0.096]	[0.172]	[0.533]	[0.070]
Share of Employed Workers with College Degree	0.135	0.013	0.099	-0.029	0.064
	(0.034)	(0.016)	(0.025)	(0.019)	(0.022)
	[0.000]	[0.425]	[0.000]	[0.141]	[0.005]
Share of Women Employed	-0.389	-0.037	-0.305	-0.057	-0.274
	(0.073)	(0.027)	(0.047)	(0.031)	(0.041)
	[0.000]	[0.183]	[0.000]	[0.074]	[0.000]
N	275	275	275	275	275
R^2	0.72	0.28	0.67	0.13	0.78
Include baseline controls	y	y	y	y	y

Notes: This table reports results of estimating equations (5) and (6) by OLS for various demographic groups. A 0.1 unit increase in the Housing Demand Change represents a 10 log point increase in housing demand, while a 0.01 unit decrease in Manufacturing Decline variable corresponds to a 1 percentage point decrease in predicted share of population employed in manufacturing. The baseline controls include the initial (year 2000) values of the share of employed workers with a college degree, the share of women in the labor force, and the log population in the MSA. The standardized effects rescale the coefficient by a one standard deviation change using the cross-MSA standard deviation. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each state, are in parentheses and p-values are in brackets.

Online Appendix Table OA.2
First Stage for Housing Demand Change Using Magnitude of Structural Break in House Prices as Instrumental Variable

Dependent variable:	Housing Demand Change, 2000-2006		Change in Share of Non-College Men Employed in Manufacturing, 2000-2006
	(1)	(2)	(3)
Magnitude of Structural Break in House Prices	4.333	3.909	0.025
[Housing Boom Instrument]	(0.814)	(0.734)	(0.020)
	[0.000]	[0.000]	[0.207]
Predicted Manufacturing Decline		13.790	1.202
		(3.989)	(0.080)
		[0.001]	[0.000]
Standardized (1σ) effects:			
Change in housing demand instrument	0.293	0.264	
Manufacturing decline		0.111	
First-stage F-statistic	28.34	28.36	
R^2	0.60	0.64	0.40
Include baseline controls	y	y	y

Notes: N=275 in all columns. This table reports results of estimating equation (6) by OLS. The baseline control variables included are initial (year 2000) values of the share of employed workers with a college degree, the share of women in labor force, and log population. The Magnitude of Structural Break in House Prices corresponds to the estimated MSA-specific magnitude of structural break in house price as estimated from 2000-2006 quarterly house price data (from FHFA), where the structural break is constrained to be between 2001-2005 (inclusive). The structural break procedure is carried out MSA-by-MSA by regressing (residualized) log house prices on a quadratic time trend and a structural break term, where the timing of the structural break is selected to maximize the R^2 of the time-series regression. The standardized effects rescale the coefficient by a one standard deviation change using the cross-MSA standard deviation. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each state, are in parentheses and p-values are in brackets.

Online Appendix Table OA.3 **[IV Estimates of Table 2]**
Employment and Construction Employment Share Response to
Housing Demand Change and Manufacturing Decline

Sample:	Non-College Men	College Men	Non-College Women	College Women	All Men and Women
	(1)	(2)	(3)	(4)	(5)
Panel A: Dependent Variable is Change in Employment to Population Ratio, 2000-2006					
Housing Demand Change	0.029	0.008	0.005	-0.002	0.013
	(0.011)	(0.003)	(0.006)	(0.005)	(0.005)
	[0.005]	[0.003]	[0.452]	[0.687]	[0.005]
Manufacturing Decline	-0.499	-0.323	-0.728	-0.389	-0.549
	(0.218)	(0.109)	(0.137)	(0.149)	(0.119)
	[0.027]	[0.005]	[0.000]	[0.012]	[0.000]
Standardized (1σ*) effects:*					
Housing demand change	0.017	0.005	0.003	-0.001	0.007
Manufacturing decline	-0.005	-0.003	-0.008	-0.004	-0.006
First stage F-statistic	28.40	28.40	28.40	28.40	28.40
Panel B: Dependent Variable is Change in Share Employed in Construction and FIRE, 2000-2006					
Housing Demand Change	0.029	0.001	0.008	0.006	0.013
	(0.010)	(0.003)	(0.002)	(0.004)	(0.005)
	[0.003]	[0.683]	[0.001]	[0.094]	[0.005]
Manufacturing Decline	-0.196	-0.232	-0.088	0.181	-0.111
	(0.236)	(0.128)	(0.100)	(0.105)	(0.128)
	[0.412]	[0.078]	[0.386]	[0.092]	[0.393]
Standardized (1σ*) effects:*					
Housing demand change	0.016	0.001	0.004	0.004	0.008
Manufacturing decline	-0.002	-0.002	-0.001	0.002	-0.001
First stage F-statistic	28.40	28.40	28.40	28.40	28.40
N	275	275	275	275	275
Include baseline controls	y	y	y	y	y

Notes: This table reports results of estimating equations (5) and (6) by IV for various demographic groups. A 0.1 unit increase in the Housing Demand Change represents a 10 log point increase in housing demand, while a 0.01 unit decrease in Manufacturing Decline variable corresponds to a 1 percentage point decrease in predicted share of population employed in manufacturing. The baseline controls include the initial (year 2000) values of the share of employed workers with a college degree, the share of women in the labor force, and the log population in the MSA. The standardized effects rescale the coefficient by a one standard deviation change using the cross-MSA standard deviation. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each state, are in parentheses and p-values are in brackets.

Online Appendix Table OA.4 **[IV Estimates of Table 3]**
Employment Response to Housing Demand Change and Manufacturing Decline,

Dependent Variable is Change in Employment to Population Ratio, 2000-2006						
Restriction:	Age 21-35		Age 36-55		Drop Immigrants	
Sample:	Non-College Men	All Men and Women	Non-College Men	All Men and Women	Non-College Men	All Men and Women
	(1)	(2)	(3)	(4)	(3)	(4)
Housing Demand Change	0.038	0.018	0.021	0.010	0.012	0.005
	(0.017)	(0.006)	(0.009)	(0.005)	(0.008)	(0.005)
	[0.029]	[0.001]	[0.016]	[0.061]	[0.137]	[0.332]
Manufacturing Decline	-0.224	-0.335	-0.683	-0.676	-0.710	-0.703
	(0.226)	(0.114)	(0.182)	(0.144)	(0.117)	(0.094)
	[0.328]	[0.005]	[0.001]	[0.000]	[0.000]	[0.000]
Standardized (1σ) effects						
Housing demand change	0.021	0.010	0.012	0.005	0.007	0.003
Manufacturing decline	-0.005	-0.005	-0.009	-0.006	-0.011	-0.008
Include baseline controls	y	y	y	y	y	y

Notes: N=275 in all columns. This table reports IV estimates analogous to columns (1) and (5) in Table 2 for alternative samples of either non-college men or all prime-aged men and women, using the same set of baseline controls. See Table 2 for more details. The standardized effects rescale the coefficient by a one standard deviation change using the cross-MSA standard deviation. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each state, are in parentheses and p-values are in brackets.

Online Appendix OA.5 **[IV Estimates of Table 5]**
Sectoral Wage Responses to Housing Demand Change and Manufacturing Decline

Sample:	Average Log Wage, All Sectors	Sectoral Wage Responses: Manufacturing Only	Sectoral Wage Responses: Construction and FIRE Only	Sectoral Wage Responses: All Other Sectors, Excl. Manuf. and Construction/FIRE
	(1)	(2)	(3)	(4)
Panel A: Sectoral Wage Responses for Non-College Men, 2000-2006				
Housing Demand Change	0.048	0.050	0.048	0.053
	(0.012)	(0.012)	(0.011)	(0.013)
	[0.000]	[0.000]	[0.000]	[0.000]
Manufacturing Decline	-1.602	-1.421	-1.604	-1.348
	(0.322)	(0.374)	(0.323)	(0.373)
	[0.000]	[0.000]	[0.000]	[0.001]
Standardized (1σ) effects:				
Housing demand change	0.027	0.029	0.028	0.030
Manufacturing decline	-0.017	-0.015	-0.017	-0.014
First stage F-statistic	28.40	28.40	28.40	28.40
Panel B: Sectoral Wage Responses for All Men and Women, 2000-2006				
Housing Demand Change	0.040	0.041	0.040	0.042
	(0.011)	(0.011)	(0.010)	(0.011)
	[0.000]	[0.000]	[0.000]	[0.000]
Manufacturing Decline	-0.870	-0.800	-0.761	-0.665
	(0.283)	(0.312)	(0.298)	(0.326)
	[0.004]	[0.014]	[0.014]	[0.048]
Standardized (1σ) effects:				
Housing demand change	0.023	0.024	0.023	0.024
Manufacturing decline	-0.009	-0.008	-0.008	-0.007
First stage F-statistic	28.40	28.40	28.40	28.40
N	275	275	275	275
Include baseline controls	y	y	y	y

Notes: This table reports results of estimating equations (5) and (6) by OLS for various demographic groups. A 0.1 unit increase in the Predicted Housing Demand Change represents a 10 percent increase in housing demand, while a 0.1 unit change in Predicted Manufacturing Decline variable corresponds to a 10 percentage point change in predicted share of population employed in manufacturing. The baseline controls include the initial (year 2000) values of the share of employed workers with a college degree, the share of women in the labor force, and the log population in the MSA. The standardized effects rescale the coefficient by a one standard deviation change using the cross-MSA standard deviation. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each state, are in parentheses and p-values are in brackets.

Online Appendix Table OA.6 **[IV Estimates of Table 6]**
Employment Response to Housing Demand Change and Manufacturing Decline: Longer Run Results

Dependent Variable is Change in Employment to Population Ratio				
Change defined across following years:	2000-2006		2000-2012	
Sample:	Non-College Men	All Men and Women	Non-College Men	All Men and Women
	(1)	(2)	(3)	(4)
Predicted Housing Demand Change, 2000-2006	0.029	0.013	0.001	-0.005
	(0.011)	(0.005)	(0.019)	(0.009)
	[0.005]	[0.005]	[0.977]	[0.609]
Predicted Manufacturing Decline, 2000-2006	-0.499	-0.549	-0.456	-0.522
	(0.218)	(0.119)	(0.378)	(0.194)
	[0.027]	[0.000]	[0.235]	[0.010]
Standardized (1σ) effects:				
Housing demand change	0.017	0.007	0.000	-0.003
Manufacturing decline	-0.005	-0.006	-0.005	-0.005
First stage F-statistic	28.40	28.40	28.40	28.40
Include baseline controls	y	y	y	y

Notes: N=275 in all columns. This table reports IV estimates analogous to columns (1) and (5) in Table 2 for alternative sample periods for dependent variable (but keeping right-hand side variables the same). See Table 2 for more details. The standardized effects rescale the coefficient by a one standard deviation change using the cross-MSA standard deviation. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each state, are in parentheses and p-values are in brackets.

Online Appendix Table OA.7 **[IV Estimates of Table 7]**
Decomposing Employment Responses into Non-participation and Unemployment

Dependent variable:	Change in Employment to Population Ratio, 2000-2006		Change in Non-participant/Population Ratio, 2000-2006		Change in Unemployed/Population Ratio, 2000-2006	
Sample:	Non-College Men	All Men and Women	Non-College Men	All Men and Women	Non-College Men	All Men and Women
	(1)	(2)	(3)	(4)	(5)	(6)
Housing Demand Change	0.029	0.013	-0.014	-0.011	-0.015	-0.002
	(0.011)	(0.005)	(0.005)	(0.003)	(0.008)	(0.003)
	[0.005]	[0.005]	[0.002]	[0.000]	[0.061]	[0.527]
Manufacturing Decline	-0.499	-0.549	0.298	0.227	0.201	0.323
	(0.218)	(0.119)	(0.111)	(0.069)	(0.192)	(0.111)
	[0.027]	[0.000]	[0.010]	[0.002]	[0.301]	[0.006]
Standardized (1σ) effects						
Housing demand change	0.017	0.007	-0.008	-0.006	-0.009	-0.001
Manufacturing decline	-0.005	-0.006	0.003	0.002	0.002	0.003
First stage F-statistic	28.397	28.397	28.397	28.397	28.397	28.397
Include baseline controls	y	y	y	y	y	y

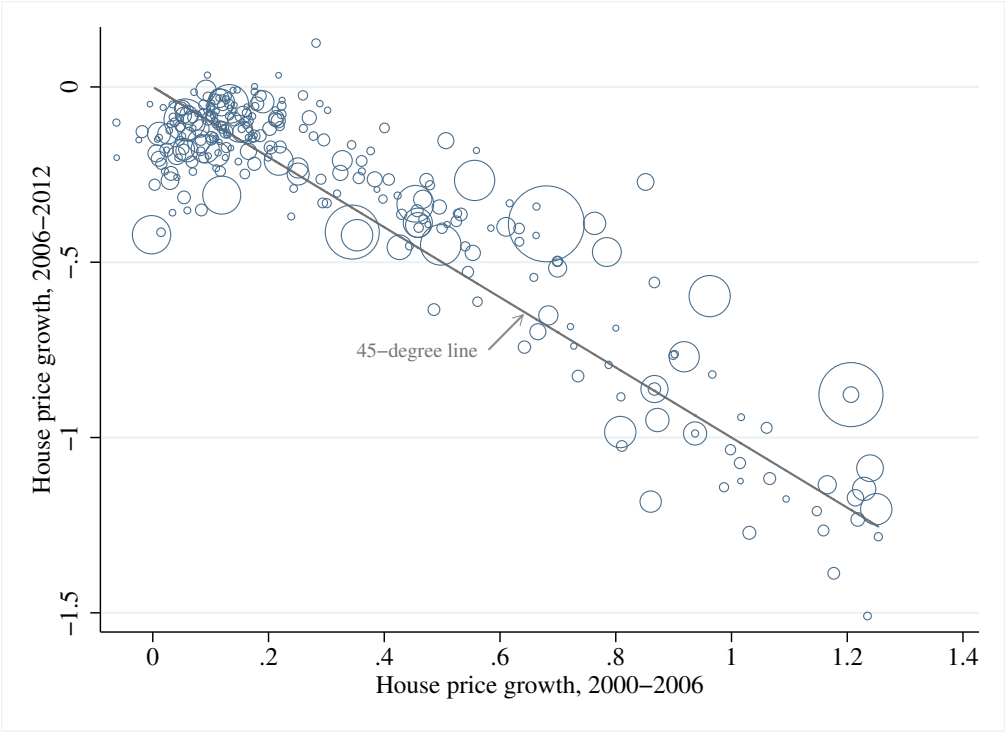
Notes: N=275 in all columns. This table reports IV estimates analogous to columns (1) and (5) in Table 2 for alternative dependent variables, allowing the overall employment effect to be decomposed into a change in unemployment rate and change in labor force participation rate. See Table 2 for more details. The standardized effects rescale the coefficient by a one standard deviation change using the cross-MSA standard deviation. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each state, are in parentheses and p-values are in brackets.

Online Appendix Table OA.8 **[IV Estimates of Table 8]**
Wage and Population Response to Housing Demand Change and Manufacturing Decline

Sample:	Non-College Men	College Men	Non-College Women	College Women	All Men and Women
	(1)	(2)	(3)	(4)	(5)
	Dependent Variable is Change in Population, 2000-2006				
Housing Demand Change	0.051	0.056	0.045	0.063	0.053
	(0.069)	(0.033)	(0.065)	(0.031)	(0.055)
	[0.457]	[0.093]	[0.489]	[0.040]	[0.334]
Manufacturing Decline	-1.319	-1.010	-1.462	-0.838	-1.282
	(0.759)	(0.713)	(0.794)	(0.755)	(0.718)
	[0.089]	[0.163]	[0.072]	[0.273]	[0.081]
Standardized (1σ) effects:					
Housing demand change	0.029	0.032	0.026	0.036	0.030
Manufacturing decline	-0.014	-0.010	-0.015	-0.009	-0.013
First stage F-statistic	28.40	28.40	28.40	28.40	28.40
N	275	275	275	275	275
Include baseline controls	y	y	y	y	y

Notes: This table reports results of estimating equations (5) and (6) by IV for various demographic groups. A 0.1 unit increase in the Predicted Housing Demand Change represents a 10 percent increase in housing demand, while a 0.1 unit change in Predicted Manufacturing Decline variable corresponds to a 10 percentage point change in predicted share of population employed in manufacturing. The baseline controls include the initial (year 2000) values of the share of employed workers with a college degree, the share of women in the labor force, and the log population in the MSA. The standardized effects rescale the coefficient by a one standard deviation change using the cross-MSA standard deviation. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each state, are in parentheses and p-values are in brackets.

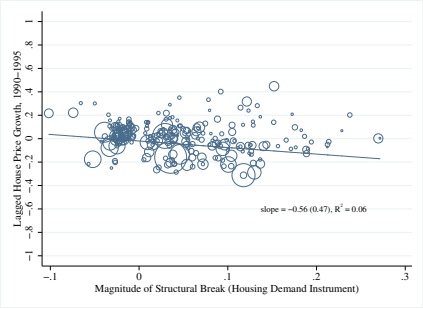
Online Appendix Figure OA.1: House Price Growth, 2006-2012 versus 2000-2006



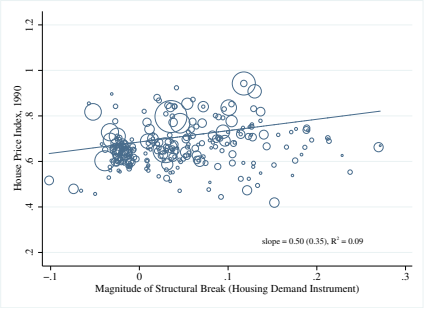
Notes: This figure shows the correlation between the change in house prices in 2000-2006 and the change in house prices in 2006-2012 for the 275 MSAs in our baseline sample. The dotted line is a 45-degree line (i.e., slope of -1).

Online Appendix Figure OA.2: Lack of Correlation Between Structural Break Instrument and ...

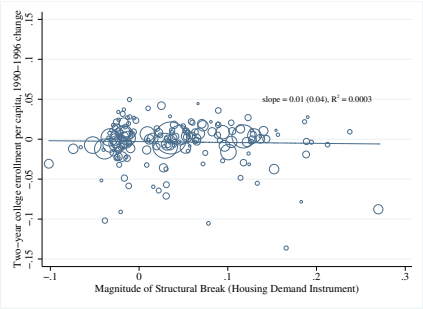
Lagged Change in House Price Index, 1990-1995



Lagged House Price Index, 1990

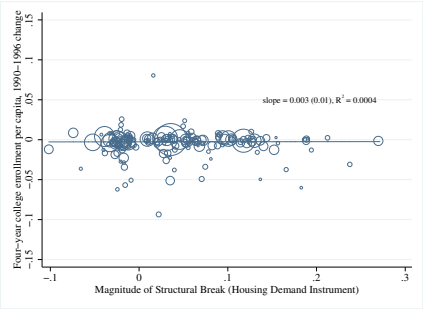


Change in Two-Year Enrollment Per Capita, 1990-1995



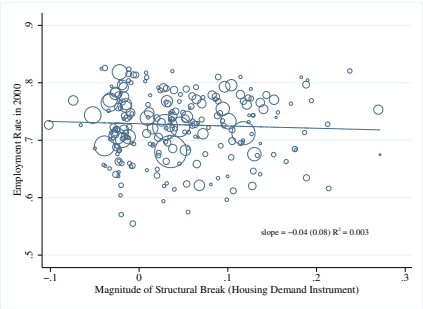
Two-Year Enrollment Per Capita, 1990

Change in Four-Year Enrollment Per Capita, 1990-1995

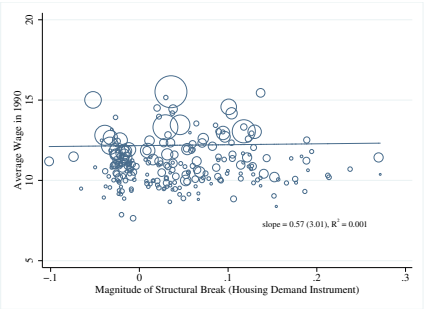


Four-Year Enrollment Per Capita, 1990

Employment Rate, 1990

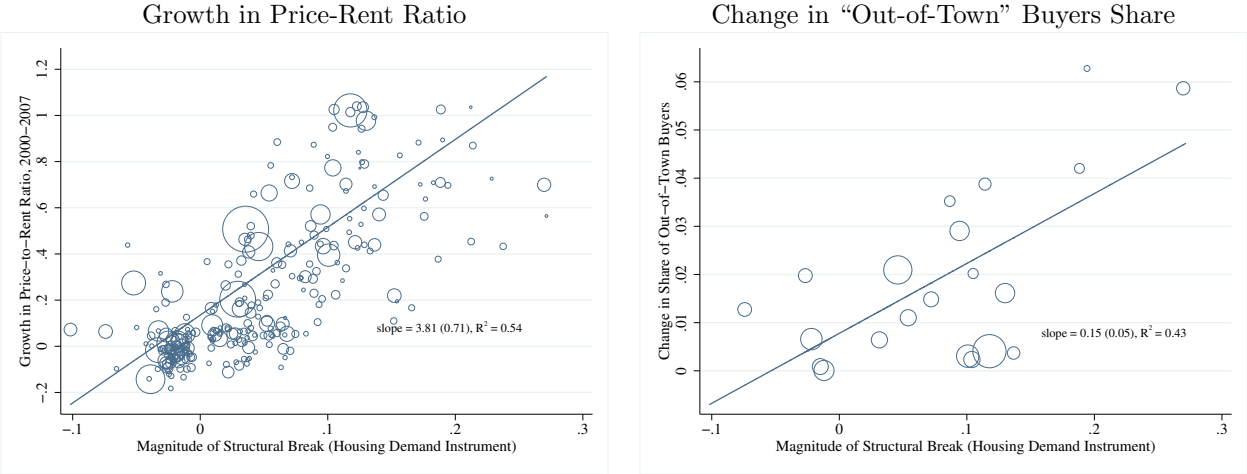


Average Wages, 1990



Notes: This figure reports the correlation between the structural break instrument used in the IV specifications and lagged levels and changes in house prices, emlpoyment rate, wages, and two-year and four-year college enrollment (per capita).

Online Appendix Figure OA.3: Significant Correlation Between Structural Break Instrument and ...



Notes: This figure reports the correlation between the structural break instrument used in the IV specifications and the growth in the price-rent ratio and the change in the share of "out-of-town" buyers, which can be interpreted as proxies for speculation. See text for details of the price-rent ratio calculation and the source of the "out of town" buyer share .