Online Appendix for "The Incidence of Local Labor Demand Shocks"

March 2013

A Appendix

A.1 Data Appendix

U.S. Census Data

The sample of adults used in the analysis includes all individuals between the age of 18 and 64, were not in group quarters such as prisons and psychiatric institutions, and who lived in a metropolitan area available in the Census IPUMS. All available MSAs are used in analysis except for Biloxi-Gulfport, MS, Flint, MI, and Reno, NV. These MSAs are dropped because of obvious mismeasurement of the labor demand shock. Specifically, in at least one of the decades in the sample, these MSAs experienced a greater than one standard deviation labor demand shock according to the predicted labor demand instrument but experienced a greater than one standard deviation change in population and rental prices of the opposite magnitude. All results including these cities are similar.

Individuals are dropped if they report business income, farm income or work in farming or agriculture. Individual labor supply is measured by multiplying weeks worked times usual weekly hours worked. To be included in the sample of workers used to construct the predicted employment measure, the worker must be in the labor force and have positive and non-missing hours worked and annual income.

Individual hourly wages are computed by dividing yearly wage and salary income by the product of weeks worked and usual weekly hours worked. Topcoded yearly wage income values are multiplied by 1.5 and (following Autor and Dorn (2009)) hourly wages are set not to exceed this value divided by (50 weeks $\times$ 35 hours). Local area wage statistics are computed based on the sample of workers who work at least 35 weeks and at least 30 hours per week. Wages are deflated using the CPI-U series.

In order to construct an estimate of the local area wage premium, log wages of the sample described above are regressed on MSA fixed effects, a quadratic in potential experience (age $-$ years of education $-$ 6), 14 industry dummy variables, 6 occupation category dummy variables, and dummy variables for gender, veteran status, marital status, and race. This regression is run each decade and in each decade is run separately for workers with and without a college degree. In each case, the magnitude of the MSA fixed effects corresponds to the local area wage premium. All regressions and calculations of local area averages are computed using the Census individual sampling weights.

The rental price and housing value local area premiums are computed similarly to the wage premiums; namely, I regress the log of these variables on a quadratic in the number of bedrooms and the number of rooms and an interaction between number of bedrooms and number of rooms. These regressions and calculations of (unconditional) average rental prices and housing values use the Census household weights since the housing value and rental price data are reported at the household level. Topcoded rental prices and housing values are multiplied by 1.5.

Regional Economic Information System (REIS)

The REIS data come from the Bureau of Economic Analysis.[1] I aggregate the county-level data into MSAs using the 1990 MSA definitions. When a county spans multiple MSAs I use 1990 population weights to assign fractions of the county totals across the various MSAs.

County Business Patterns (CBP)

The County Business Patterns data are available from the U.S. Census Bureau and the ICPSR data repository.[2] I used the 1979, 1989, and 1997 CBP data to match the 1980, 1990, and 2000 Census data described above. The 1997 CBP data were chosen because the 1998 and 1999 CBP data use the NAICS industry codes, while the CBP data before 1997 used SIC codes. I use 3-digit SIC industry codes to construct the alternative measure of predicted employment. Roughly 35 percent of the county-by-industry employment cells are suppressed. In these cases, I observe the number of establishments in each establishment size bin and a flag indicating the range of actual employment. To compute predicted employment for these cells, I run a regression each year using the non-suppressed data and use this regression to compute predicted employment for suppressed cells from the fitted values. I then compare total county employment from the raw CBP data to the total county employment computed using the non-suppressed cells and the predicted employment values. If these two values are not within 1%, then I scale all of the predicted employment values by a scalar so as to make the two totals equal, and I then check again that the predicted values lie within the ranges indicated by the employment flag and I continue to repeat this procedure until the two totals are within 1%.

A.2 Comparative Statics

This subsection derives comparative statics for the model described in Section 2 in the special case when there are constant returns to scale ($a = 1$). The comparative statics are derived for the following three scenarios:

- Case 1: No mobility costs; constant housing supply elasticity
- Case 2: No mobility costs; concave housing supply curve
- Case 3: Large mobility costs; constant housing supply elasticity

Case 1: No mobility costs; constant housing supply elasticity

This case corresponds to the following restrictions on the housing supply curve and the mobility cost functions: $c^L(\Delta L_{it}) = 0$, $c^H(\Delta H_{it}) = 0$, and $\Delta H^S(\Delta p^h_{it}) = \sigma \cdot \Delta p^h_{it}$. With no mobility costs and a constant housing supply elasticity, the model readily admits a closed-form solution. Additionally, in this case all endogenous variables respond *symmetrically* – meaning that equal-sized positive and negative exogenous labor demand shocks cause positive and negative shifts of equal magnitude in all of the endogenous variables (Δw^H_{it}, Δw^L_{it}, ΔH_{it},

[1] See this website for more information: http://www.bea.gov/regional/reis/default.cfm#step2.

[2] I downloaded the 1989 and 1997 CBP data from the following URL: http://www.census.gov/econ/cbp/historical.htm. The 1979 CBP data were downloaded from ICPSR at the following URL: http://www.icpsr.umich.edu/icpsrweb/ICPSR/series/00022.

ΔL_{it}, Δp^h_{it}, Δt_{it}). Mathematically, this means that changes in the endogenous variables are linear functions of the exogenous labor demand shocks; i.e., $\Delta x_{it} = \bar{K}^x \Delta\theta_{it}$ where x is one of the endogenous variables in the model. To derive these results, first note that with no mobility costs, housing prices will respond symmetrically to both high-skill and low-skill wages:

$$\Delta p^h_{it} = \frac{1}{s^H_h}\Delta w^H_{it}$$
$$\Delta p^h_{it} = \left(\left((1-s^L_t) + s^L_t\Psi^L\right)/s^L_h\right)\Delta w^L_{it} \equiv \left(\Gamma^L/s^L_h\right)\Delta w^L_{it}$$

Next, note that with constant returns to scale, wages for high-skill and low-skill workers can be written as follows:

$$\pi \cdot \Delta w^H_{it} + (1-\pi)\cdot \Delta w^L_{it} = \Delta\theta_{it}$$

Combining the three previous expressions gives the following:

$$\Delta w^H_{it} = \left(s^H_h\Gamma^L/\left(\pi s^H_h\Gamma^L + (1-\pi)s^L_h\right)\right)\Delta\theta_{it} \equiv \bar{K}^{wH}\cdot\Delta\theta_{it}$$
$$\Delta w^L_{it} = \left(s^L_h/\left(\pi s^H_h\Gamma^L + (1-\pi)s^L_h\right)\right)\Delta\theta_{it} \equiv \bar{K}^{wL}\cdot\Delta\theta_{it}$$
$$\Delta p^h_{it} = \left(\Gamma^L/\left(\pi s^H_h\Gamma^L + (1-\pi)s^L_h\right)\right)\Delta\theta_{it} \equiv \bar{K}^{p}\cdot\Delta\theta_{it}$$

In other words, with no mobility costs for workers and firms, wages and housing prices respond symmetrically. Transfer payments will also respond symmetrically since transfer payments are a log-linear function of low-skill wages: i.e., $\Delta t^L_{it} = \Psi^L\cdot\bar{K}^{wL}\cdot\Delta\theta_{it} \equiv \bar{K}^t\cdot\Delta\theta_{it}$.

Finally, with a constant housing supply elasticity, the migration response is also symmetric, since ΔH_{it} and ΔL_{it} can be written as linear functions of Δw^H_{it}, Δw^L_{it}, and Δp^h_{it}. Simple algebra gives the following two expressions:

$$\Delta H_{it} = \bar{K}^H\Delta\theta_{it}$$
$$\Delta L_{it} = \bar{K}^L\Delta\theta_{it}$$

where $\bar{K}^H$ and $\bar{K}^L$ are constants that can be written in terms of the primitive parameters of the model (α, ρ, π, s^H_h, s^L_h, s^L_t).[3] In summary, the log-linearity of the housing supply curve and the absence of mobility costs implies that all endogenous variables respond symmetrically to the exogenous labor demand shock.

Case 2: No mobility costs; concave housing supply curve

Formally, this case can be written as follows: $c^L(\Delta L_{it}) = 0$, $c^H(\Delta H_{it}) = 0$, and $\Delta H^S(\Delta p^h_{it})$ is increasing in Δp^h_{it}. As in the previous case (and following the same derivation), wages, housing prices, and transfer payments all respond symmetrically, with the same constant terms

[3] The constants $\bar{K}^H$ and $\bar{K}^L$ are defined as follows:

$$\bar{K}^H = \frac{(\bar{K}^{wH} - \bar{K}^{wL}) - (\rho-1)(\bar{K}^{wH} + \Gamma\bar{K}^{wL} - \bar{K}^p(1+\sigma))}{2(\rho-1)s^H_h}$$
$$\bar{K}^L = \bar{K}^H - (\bar{K}^{wH} - \bar{K}^{wL})/(\rho-1)$$

as above:

$$\Delta w_{it}^H = \bar{K}^{wH}\Delta\theta_{it};\ \Delta w_{it}^L = \bar{K}^{wL}\Delta\theta_{it};\ \Delta p_{it}^h = \bar{K}^p\Delta\theta_{it};\ \Delta t_{it}^L = \bar{K}^t\Delta\theta_{it}$$

In case 2, however, population no longer responds symmetrically to the exogenous shock. To see this, go back to the housing market equilibrium condition and substitute the expressions above:

$$\bar{K}^p\Delta\theta_{it} + \Delta H^S(\bar{K}^p\Delta\theta_{it}) = (\bar{K}^{wH} + (1 - s_t^L)\bar{K}^{wL} + s_t^L\bar{K}^t)\Delta\theta_{it} + \Delta H_{it} + \Delta L_{it}$$

Since the elasticity of substitution between high-skill and low-skill labor is constant, we know that $\Delta w_{it}^H - \Delta w_{it}^L = (\rho - 1)(\Delta H_{it} - \Delta L_{it})$. Combining these two expressions gives the following expressions for ΔH_{it} and ΔL_{it}:

$$\Delta H_{it} = \frac{1}{2}(\Lambda^H\Delta\theta_{it} + \Delta H^S(\bar{K}_1^p\Delta\theta_{it}))$$
$$\Delta L_{it} = \frac{1}{2}\left(\Lambda^L\Delta\theta_{it} + \Delta H^S(\bar{K}_1^p\Delta\theta_{it})\right)$$

where Λ^H and Λ^L are constant terms.[4] Since $\Delta H^S(x)$ is increasing in x, these expressions imply that ΔH_{it} and ΔL_{it} are increasing in $\Delta\theta_{it}$. In other words, because the housing supply curve is concave, the responsiveness of high-skill and low-skill population to exogenous shocks is convex – positive local labor demand shocks increase population more than negative shocks reduce population. It is also possible to show that if $s_h^H < s_h^L < 1$ and $\Psi^L < 0$, and $s_t^L > 0$, then decreases in local labor demand will reduce the fraction high-skill workers in the population.[5]

Case 3: Large mobility costs; constant housing supply elasticity

Formally, this case can be defined as follows: $c^L(\Delta L_{it})$ and $c^H(\Delta H_{it})$ are declining and convex functions and $\Delta H^S(\Delta p_{it}^h) = \sigma\cdot\ \Delta p_{it}^h$. In this case, the convexity of the mobility cost functions imply that the mobility cost of the marginal migrant is greater in magnitude for decreases in population than for equal-sized increases in population. As mentioned in the introduction, one way this could arise is if the city is small relative to the rest of the world, so that the mobility cost of the marginal in-migrant is negligible. In this case, $c^H(\Delta H_{it})$ would be defined such that $c^H(\Delta H) = 0$ for all $\Delta H_{it} \geq 0$, but $c^H(\Delta H_{it})$ is decreasing in ΔH_{it} for all $\Delta H_{it} < 0$.

In the case where high-skill and low-skill labor differ only in productivity (i.e., $s_t^H = s_t^L = s_t$, $s_h^H = s_h^L = s_h$, $\Psi^H = \Psi^L = \Psi$, and $c^L(x) = c^H(x)\ \forall x$), it can be shown that wages still respond

[4] The constants Λ^H and Λ^L are defined as follows:

$$\Lambda^H = \bar{K}^p + \bar{K}^{wH} + \bar{K}^{wL} + (\bar{K}^{wH} - \bar{K}^{wL})/(\rho - 1)$$
$$\Lambda^L = \Lambda^H - 2(\bar{K}^{wH} - \bar{K}^{wL})/(\rho - 1)$$

[5] To see this, note that $\Delta H - \Delta L = \left(K^{wH} - K^{wL}\right)/(\rho - 1)\cdot\Delta\theta$. If $s_h^L > s_h^H$, $\Psi^L < 0$, and $s_t^L > 0$, then $\left(K^{wH} - K^{wL}\right) < 0$. Since $\rho - 1 < 0$ (since $\sigma_{H,L} > 0$), this implies $\left(K^{wH} - K^{wL}\right)/(\rho - 1) > 0$. Thus declines in $\Delta\theta$ will reduce $\Delta H - \Delta L$.

symmetrically as in the previous two cases. By simplifying the problem to make high-skill and low-skill workers identical except for their efficiency units of labor, it is straightforward to show that $\Delta w_{it}^H = \Delta w_{it}^L = \Delta\theta_{it}$ and that $\Delta H_{it} = \Delta L_{it}$. These simplifications result in the following expressions for housing market and labor supply conditions, respectively:

$$\begin{aligned} \Delta p_{it}^h \cdot (1+\sigma) - 2s_h(\Gamma\Delta\theta_{it} + \Delta H_{it}) = 0 \\ c(\Delta H_{it}) + \Gamma\Delta\theta_{it} - s_h \Delta p_{it}^h = 0 \end{aligned} \quad (1)$$

where $\Gamma = (1-s_t) + s_t\Psi$. Combining these expressions gives the following:

$$2s_h\Delta H_{it} - (1+\sigma)c(\Delta H_{it}) = (1+\sigma-2s_h)\Gamma\Delta\theta_{it}$$

Since $c(\Delta H_{it})$ is declining and convex, this implies that ΔH_{it} is convex in $\Delta\theta_{it}$.[6] Since ΔH_{it} is convex in $\Delta\theta_{it}$, then by equation (1), Δp_{it}^h is convex in $\Delta\theta_{it}$. In other words, unlike the other cases, in this case housing prices respond asymmetrically, where positive shocks increase housing prices more than negative shocks reduce housing prices. The intuition is that the convexity of mobility cost function makes out-migration disproportionately costly (as compared to in-migration). Because of these mobility costs, following negative shocks workers are willing to pay more for housing than they would in the absence of mobility costs, which bids up the price of housing following price declines.

A.3 Model Simulation Details

The data used to create Figure 3 are simulated from the model described in Section 2. The same parameters used in the GMM estimation are used in the simulation; i.e., $s_t^L = 0.05$, $s_h^L = 0.34$, $s_h^H = 0.30$, $\rho = 0.29$, $\pi = 0.37$. The returns-to-scale parameter $\alpha = 1$ is used, and the transfer payment elasticity used is $\Psi^L = -5.0$. The mobility cost functions and housing supply function are parameterized as they are in the GMM estimator: i.e., $c^L(x) = \sigma^L(\exp(\beta^L x) - 1)/\beta^L$, $c^H(x) = \sigma^H(\exp(\beta^H x) - 1)/\beta^H$, $\Delta H^s(x) = \sigma^h(\exp(\beta^h x) - 1)/\beta^h$. The values of these parameters depend on the scenario as follows:

- Case 1: $\sigma^H = \sigma^L = 0$, $\sigma^h = 4.0$, $\beta^h = 0$
- Case 2: $\sigma^H = \sigma^L = 0$, $\sigma^h = 2.0$, $\beta^h = 4.0$
- Case 2: $\sigma^H = \sigma^L = -0.2$, $\beta^H = \beta^L = -100$, $\sigma^h = 4.0$, $\beta^h = 0$

A.4 A Simple Model of Durable Housing

This section outlines a model to provide simple microfoundations for a concave housing supply curve (i.e., housing supply elasticity that is larger for increases in housing demand than for decreases in housing demand). As in Section 2, the model here is a two period model, where a

[6] Formally, a sufficient condition for this result to hold is that $(1-s_t)+s_t\Psi > 0$ and $s_h < ((1-s_t)+s_t\Psi)(1+\sigma)$. In words, transfer payments provide partial wage insurance, and housing expenditure share cannot be so large so that negative shocks would cause net in-migration of low-skill labor.

single city is shocked out of a large number of cities. The model includes a labor market and a housing market. Production of a homogeneous tradable good is constant returns to scale and uses only (homogeneous) labor as an input. All workers have identical Cobb-Douglas preferences for housing and the tradable good, so that expenditure share on housing (s_h) is constant.

Housing is supplied by absentee landlords who live in other cities. The housing supply is homogeneous in terms of workers' willingness-to-pay but there are heterogeneous costs to supplying housing (arising, perhaps, from topographic features of the land). This is modeled by assuming that the maximum housing supply is $\bar{H}^S$ (where $\bar{H}^S$ is assumed to be large enough so that we are not close to a corner solution) and that the cost of supplying an infinitesimal unit of housing is distributed according to the following density function: $f(c) = \frac{\sigma^h}{\bar{c}} \left(c/\bar{c}\right)^{\sigma^h - 1}$, where c is drawn from the closed interval $[0, \bar{c}]$. This results in an aggregate housing supply curve of $H^s(p^h) = \int_0^{p^h} \bar{H}^S f(c) dc = \bar{H}^S \cdot \left(p^h/\bar{c}\right)^{\sigma^h}$. Thus the initial housing market equilibrium is given by the following supply-demand equilibrium condition: $\bar{H}^S \cdot \left(p^h_{it}/\bar{c}\right)^{\sigma^h} = \bar{H}^D s_h w_{it} n_{it}/p^h_{it}$.

Using a similar simplifying assumption as in Glaeser and Gyourko (2005), I assume that housing is occasionally (and randomly) destroyed, and that the cost of rebuilding is the same as the initial cost of building. Mathematically, I assume that just before the labor demand shock, a random fraction δ of the initial housing supply collapses and needs to be re-built. For increases in housing demand, all housing that collapsed is immediately rebuilt in between periods, and housing supply further expands according to the elasticity of housing supply (σ^h). For decreases in housing demand, however, the "effective" housing supply elasticity is now only $\delta \cdot \sigma^h$ because some of the housing that was previously built does not collapse and cannot be destroyed. Unless $\delta = 1$ (i.e., housing is not durable at all and completely collapses between periods), these assumptions imply that the housing supply curve is nonlinear, asymmetric, and concave.

The equilibrium changes in wages, population, and housing prices following an exogenous labor demand shock ($\Delta\theta_{it}$) are as follows. The wage change in the city receiving the shock is $\Delta w_{it} = \Delta\theta_{it}$. Perfect mobility of workers implies that $\Delta w_{it} = s_h \Delta p^h_{it}$. This implies that $\Delta p^h_{it} = \Delta\theta_{it}/s_h$. In other words, both wages and housing prices respond *symmetrically*. For positive labor demand shocks, population increases by $\Delta n_{it} = (1+\sigma^h)\Delta p^h_{it} - \Delta w_{it} = (1+\sigma^h - s_h)/s_h \cdot \Delta\theta_{it}$. For negative labor demand shocks, population decreases by $\Delta n_{it} = (1 + \delta \cdot \sigma^h - s_h)/s_h \cdot \Delta\theta_{it}$. Assuming $s_h > 0$, $\sigma^h > 0$ and $0 < \delta < 1$, then positive shocks increase population more than equal-sized negative shocks reduce population.

The key difference between this model and the model in Glaeser and Gyourko (2005) is that the marginal value and the average value of housing are equal in the simple model in this section, while in Glaeser and Gyourko (2005) housing units have heterogeneous, location-specific amenities, which causes average housing prices to respond asymmetrically due to compositional changes in the location-specific amenities in the housing stock. The empirical evidence in this paper suggests that housing prices respond symmetrically to exogenous labor demand shocks, which is more consistent with the model in this paper.

A.5 GMM Estimation

There are 30 empirical moments given by the following vector:

$$\mathbf{m} = (\mathbf{m}^1, \mathbf{m}^2, \mathbf{m}^3, \mathbf{m}^4, \mathbf{m}^5)'$$

where

$$\mathbf{m}^d = \begin{bmatrix} \Delta e^h (\Delta\theta)^d \\ \Delta e^{wH} (\Delta\theta)^d \\ \Delta e^{wL} (\Delta\theta)^d \\ \Delta e^H (\Delta\theta)^d \\ \Delta e^L (\Delta\theta)^d \\ \Delta e^t (\Delta\theta)^d \end{bmatrix}$$

The orthogonality conditions are summarized as $E[\mathbf{m}] = 0$. The parameters to estimate are given by the following vector:

$$\boldsymbol{\beta} = (\sigma^h, \beta^h, \sigma^H, \beta^H, \sigma^L, \beta^L, \Psi, \alpha)'$$

The two-step GMM estimator is implemented by first estimating $\hat{\boldsymbol{\beta}}^0$ as follows:

$$\hat{\boldsymbol{\beta}}^0 = \arg\min_{\beta} \mathbf{m}'\mathbf{m}$$

This estimate is then used to form the following:

$$\hat{\Phi}^0 = \frac{1}{N} \sum_{i=1}^{N} \mathbf{m}_i(\hat{\boldsymbol{\beta}}^0) \cdot \mathbf{m}_i'(\hat{\boldsymbol{\beta}}^0)$$

Next, $\hat{\beta}$ is re-estimated as follows:

$$\hat{\beta}^{GMM} = \arg\min \mathbf{m}'(\hat{\Phi}^0)^{-1}\mathbf{m}$$

Inference is done by computing the following variance-covariance matrix:

$$\hat{V} = \frac{1}{N} \left(\hat{G}'(\hat{\Phi}^1)^{-1}\hat{G} \right)^{-1}$$

where $\hat{\Phi}^1$ is re-estimated using $\hat{\boldsymbol{\beta}}^{GMM}$ instead of $\hat{\boldsymbol{\beta}}^0$, and $\hat{G}$ is given by the following:

$$\hat{G} = \frac{1}{N} \sum_{i=1}^{N} \begin{bmatrix} \partial m_i^1 / \partial \boldsymbol{\beta} \\ \partial m_i^2 / \partial \boldsymbol{\beta} \\ \vdots \\ \partial m_i^{30} / \partial \boldsymbol{\beta} \end{bmatrix}$$

Finally, the overidentification statistic is given by:

$$\mathbf{m}'(\hat{\boldsymbol{\beta}}^{GMM}) \cdot (\hat{\Phi}^0)^{-1} \cdot \mathbf{m}(\hat{\boldsymbol{\beta}}^{GMM}) \rightarrow \boldsymbol{\chi}^2(\mathrm{row}(\mathbf{m}) - \mathrm{row}(\boldsymbol{\beta}))$$

Appendix Table A1
Industry Categories (Top 20 List By Average National Employment Share)

Industry Name	Industry Code	Average National Empl. Share	National Employment Growth Rates Mean	Min	Max
Persistently Expanding Industries					
Eating and drinking places	641	3.99%	14.17%	1.39%	32.78%
Offices and clinics of physicians	812	0.93%	25.41%	1.28%	42.59%
Legal services	841	0.79%	32.33%	7.54%	63.76%
Computer and data processing services	732	0.75%	75.71%	20.01%	139.09%
Accounting, auditing, and bookkeeping services	890	0.47%	15.62%	4.93%	34.52%
Services incidental to transportation	432	0.45%	50.41%	1.48%	85.46%
Services to dwellings and other buildings	722	0.43%	30.51%	4.10%	73.12%
Offices and clinics of dentists	820	0.43%	26.94%	13.17%	54.00%
Personnel supply services	731	0.39%	35.46%	0.80%	62.28%
Landscape and horticultural services	20	0.34%	55.19%	5.36%	158.68%
Detective and protective services	740	0.30%	42.85%	17.52%	103.97%
Residential care facilities, without nursing	870	0.27%	86.39%	33.35%	168.29%
Drugs	181	0.27%	12.75%	3.79%	22.01%
Sporting goods, bicycles, and hobby stores	651	0.23%	17.37%	11.76%	24.11%
Veterinary services	12	0.16%	40.92%	26.99%	54.86%
Retail nurseries and garden stores	582	0.12%	61.71%	12.43%	152.46%
Museums, art galleries, and zoos	872	0.11%	56.61%	28.32%	110.27%
Offices and clinics of optometrists	822	0.05%	25.20%	18.55%	37.94%
Offices and clinics of chiropractors	821	0.05%	92.45%	14.21%	191.25%
Persistently Declining Industries					
Apparel and accessories, except knit	151	0.89%	-39.17%	-59.31%	-18.67%
Aircraft and parts	352	0.65%	-26.94%	-40.51%	-10.53%
Blast furnaces, steelworks, rolling and finishing mills	270	0.51%	-26.75%	-52.32%	-10.65%
Radio, TV, and communication equipment	341	0.48%	-35.55%	-42.74%	-27.94%
Railroads	400	0.48%	-28.70%	-51.27%	-6.72%
Yarn, thread, and fabric mills	142	0.44%	-33.50%	-55.91%	-11.45%
Newspaper publishing and printing	171	0.44%	-15.78%	-20.69%	-13.19%
Laundry, cleaning, and garment services	771	0.39%	-25.61%	-49.71%	-6.59%
Metalworking machinery	320	0.31%	-26.67%	-31.42%	-17.49%
Pulp, paper, and paperboard mills	160	0.31%	-18.36%	-32.41%	-2.25%
Motor vehicles and equipment	500	0.26%	-13.26%	-30.43%	-5.03%
Ship and boat building and repairing	360	0.26%	-21.82%	-33.81%	-6.93%
Beverage industries	120	0.20%	-15.67%	-31.90%	-1.72%
Air force	941	0.20%	-29.65%	-46.78%	-12.51%
Paperboard containers and boxes	162	0.18%	-21.47%	-33.70%	-7.28%
Variety stores	592	0.18%	-47.74%	-48.42%	-47.07%
Canned, frozen, and preserved fruits and vegetables	102	0.18%	-17.75%	-26.05%	-8.16%
Other rubber products, and plastics footwear and belting	211	0.18%	-33.14%	-61.17%	-16.64%
Navy	942	0.18%	-27.63%	-41.14%	-14.12%
Other primary metal industries	280	0.17%	-33.08%	-58.09%	-8.57%
Stable Industries					
Elementary and secondary schools	842	6.53%	3.25%	-3.59%	7.45%
All construction	60	5.94%	5.25%	1.61%	7.99%
Colleges and universities	850	2.21%	5.40%	-5.68%	16.30%
Grocery stores	601	2.06%	-0.70%	-18.49%	19.74%
Insurance	711	2.02%	-1.90%	-10.44%	2.60%
Department stores	591	1.78%	-8.54%	-19.40%	11.30%
Trucking service	410	1.54%	5.91%	1.36%	10.47%
Telephone communications	441	1.21%	-9.32%	-19.93%	3.16%
Motor vehicle dealers	612	0.95%	-1.76%	-8.87%	6.85%
Hotels and motels	762	0.95%	6.60%	-9.80%	19.21%
Groceries and related products	550	0.74%	-9.67%	-12.00%	-6.04%
Religious organizations	880	0.65%	10.21%	1.45%	19.39%
Administration of economic programs	931	0.50%	-11.06%	-15.69%	-4.20%
Beauty shops	772	0.44%	-5.35%	-16.45%	6.59%
Furniture and home furnishings stores	631	0.44%	-0.18%	-7.68%	5.36%
Sawmills, planing mills, and millwork	231	0.42%	0.28%	-13.17%	10.24%
Bus service and urban transit	401	0.40%	-8.17%	-18.13%	0.34%
Agricultural production, livestock	11	0.39%	-4.56%	-13.70%	10.29%
Public finance, taxation, and monetary policy	921	0.29%	-4.23%	-8.72%	-0.25%
Water supply and irrigation	470	0.18%	-1.98%	-4.71%	5.08%

Volatile Industries					
Justice, public order, and safety	910	2.08%	-2.02%	-42.53%	26.30%
Motor vehicles and motor vehicle equipment	351	1.31%	-9.15%	-21.15%	24.42%
National security and international affairs	932	1.02%	-14.28%	-69.36%	50.12%
Automotive repair and related services	751	0.68%	14.32%	-23.44%	30.71%
Apparel and accessory stores, except shoe	623	0.64%	-5.43%	-28.42%	30.70%
Administration of human resources programs	922	0.58%	-0.25%	-38.36%	29.24%
Management and public relations services	892	0.49%	17.01%	-31.54%	54.16%
Radio, tv, and computer stores	633	0.38%	17.95%	-32.45%	102.77%
Oil and gas extraction	42	0.38%	7.56%	-36.31%	55.97%
Computers and related equipment	322	0.37%	-5.86%	-39.46%	48.79%
Research, development, and testing services	891	0.36%	31.34%	-20.44%	106.12%
Guided missiles, space vehicles, and parts	362	0.27%	15.85%	-48.89%	62.69%
Iron and steel foundries	271	0.23%	-22.67%	-56.79%	62.60%
Scientific and controlling instruments	371	0.22%	3.56%	-22.68%	34.13%
Savings institutions, including credit unions	701	0.22%	8.96%	-32.44%	44.24%
Administration of environmental quality and housing programs	930	0.21%	1.66%	-50.06%	44.03%
Hardware, plumbing and heating supplies	521	0.20%	-2.08%	-45.76%	31.74%
Drugs, chemicals, and allied products	541	0.20%	0.38%	-26.71%	38.45%
Petroleum refining	200	0.19%	-15.09%	-32.74%	25.77%
Catalog and mail order houses	663	0.16%	11.19%	-23.37%	71.12%
Other Industries					
Hospitals	831	4.63%	5.56%	-8.14%	22.95%
Banking	700	1.76%	0.40%	-20.39%	18.42%
Real estate, including real estate-insurance offices	712	1.26%	11.18%	-14.27%	33.53%
Nursing and personal care facilities	832	1.18%	21.88%	-8.46%	74.03%
Printing, publishing, and allied industries, except newspapers	172	1.07%	-10.11%	-20.00%	10.63%
U.S. postal service	412	0.85%	-10.99%	-28.24%	1.17%
Agricultural production, crops	10	0.78%	-12.45%	-28.96%	9.86%
Engineering, architectural, and surveying services	882	0.72%	29.53%	-6.11%	67.63%
Machinery, equipment, and supplies	530	0.66%	-12.22%	-47.76%	19.83%
Child day care services	862	0.66%	39.53%	-6.98%	82.69%
Security, commodity brokerage, and investment companies	710	0.63%	29.48%	-18.73%	59.34%
Electric light and power	450	0.61%	-0.78%	-9.00%	21.04%
Air transportation	421	0.59%	-8.72%	-22.35%	13.89%
Furniture and fixtures	242	0.56%	-6.62%	-27.01%	4.43%
Drug stores	642	0.53%	4.73%	-13.18%	24.10%
Lumber and building material retailing	580	0.52%	15.50%	-4.47%	48.91%
Gasoline service stations	621	0.48%	-14.80%	-28.20%	9.14%
Fabricated structural metal products	282	0.44%	-13.01%	-27.63%	3.77%
Meat products	100	0.35%	-4.13%	-25.30%	16.68%
Radio and television broadcasting and cable	440	0.33%	21.23%	-5.68%	48.12%

Notes: All industry codes in the Census IPUMS data set are grouped into one of the five categories in this table based on employment growth during 1970-1980, 1980-1990, 1990-2000 and 2000-2007. The industries within each cataegory are then sorted based on average employment share of national population and the top 20 industries in each category are listed in this table. See Section 5 in main text for more details on the industry categories. Industries that are coded as "catch-all" industry codes are excluded from this table.

Appendix Table A2
Alternative Measures of Housing Values and Rental Prices

Dependent Variable:	(1) Residualized Rental Prices	(2) Residualized Housing Values	(3) Average Rental Prices	(4) Average Housing Values	(5) Residualized Rental Prices	(6) Residualized Housing Values	(7) (FHFA) Average Housing Values
% Change in predicted employment **(β)**	0.842	0.714	0.808	0.633	0.943	1.155	1.142
	(0.151)	(0.360)	(0.155)	(0.320)	(0.177)	(0.379)	(0.293)
	[0.000]	[0.048]	[0.000]	[0.049]	[0.000]	[0.003]	[0.000]
(% Change in predicted employment)^2 (δ)	-0.999	-2.765	-0.742	-2.653	-2.496	-8.769	2.804
	(2.758)	(6.310)	(2.889)	(5.647)	(3.593)	(7.043)	(4.944)
	[0.717]	[0.662]	[0.797]	[0.639]	[0.488]	[0.215]	[0.571]
Marginal effect at $-\sigma$ **(A)**	0.912	0.907	0.860	0.818	1.117	1.767	0.947
	(0.243)	(0.580)	(0.254)	(0.511)	(0.304)	(0.563)	(0.390)
	[0.000]	[0.119]	[0.001]	[0.111]	[0.000]	[0.002]	[0.016]
Marginal effect at $+\sigma$ **(B)**	0.773	0.521	0.757	0.448	0.769	0.544	1.338
	(0.247)	(0.558)	(0.255)	(0.504)	(0.309)	(0.673)	(0.507)
	[0.002]	[0.351]	[0.003]	[0.376]	[0.014]	[0.420]	[0.009]
p-value of test **(A)** = **(B)**	0.717	0.662	0.797	0.639	0.488	0.215	0.571
p-value of nonparametric specification test	0.596	0.295	0.545	0.271	0.486	0.346	0.300
R^2	0.099	0.144	0.182	0.201	0.121	0.172	0.777
N	430	430	430	430	364	364	364

Notes: All columns report OLS results from estimating equation (7). Data come from IPUMS 1980, 1990, and 2000 census extracts and the OFHEO housing price indexes. Final sample is a balanced panel of 215 MSAs in columns (1) through (4); in remaining columns the sample is a balanced panel of 182 MSAs with non-missing data from FHFA (formerly OFHEO). Columns (5) and (6) reproduce columns (1) and (2) on the FHFA sub-sample. Dependent variable is always the percentage change across periods. The % Change in predicted employment is formed by interacting cross-sectional differences in industrial composition with national changes in industry employment shares. See Table 2, main text, and Data Appendix for more details. All specifications include year fixed effects. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each metropolitan area over time, are in parenthesis and p-values are in brackets.

Table A3
Results for Various Measures of Public Assistance Expenditures

Dependent Variable:	(1) Food Stamps + Income Maint.	(2) Food Stamps	(3) Income Maint-enance Programs	(4) Medicare Benefits	(5) Public Medical Benefits (Medicaid)	(6) Retirement and Disability Benefits	(7) SSI Benefits	(8) UI Compen-sation	(9) Veterans Benefits	(10) Fraction of Population Disabled
% Change in predicted empl. **(β)**	-2.367	-1.966	-4.841	-1.738	-2.151	-1.140	-1.725	-0.379	-0.914	-0.099
	(0.615)	(0.613)	(0.863)	(0.631)	(1.130)	(0.428)	(0.639)	(0.739)	(0.344)	(0.023)
	[0.000]	[0.002]	[0.000]	[0.006]	[0.058]	[0.008]	[0.007]	[0.608]	[0.008]	[0.000]
(% Change in predicted empl.)^2 (δ)	-21.779	-18.727	-41.397	-22.477	-14.332	-15.732	-3.267	-31.143	1.725	0.428
	(12.139)	(11.690)	(17.540)	(12.828)	(19.521)	(8.953)	(11.771)	(11.194)	(7.372)	(0.361)
	[0.074]	[0.111]	[0.019]	[0.081]	[0.464]	[0.080]	[0.782]	[0.006]	[0.815]	[0.237]
Marginal effect at $-\sigma$ **(A)**	-0.847	-0.659	-1.953	-0.169	-1.150	-0.042	-1.497	1.794	-1.034	-0.129
	(1.030)	(1.009)	(1.394)	(1.199)	(1.802)	(0.841)	(1.215)	(0.971)	(0.723)	(0.030)
	[0.412]	[0.514]	[0.163]	[0.888]	[0.524]	[0.960]	[0.219]	[0.066]	[0.155]	[0.000]
Marginal effect at $+\sigma$ **(B)**	-3.887	-3.273	-7.730	-3.306	-3.151	-2.237	-1.953	-2.552	-0.793	-0.069
	(1.064)	(1.031)	(1.595)	(0.980)	(1.737)	(0.664)	(0.831)	(1.170)	(0.492)	(0.039)
	[0.000]	[0.002]	[0.000]	[0.001]	[0.071]	[0.001]	[0.020]	[0.030]	[0.108]	[0.076]
p-value of test **(A)** = **(B)**	0.074	0.111	0.019	0.081	0.464	0.080	0.782	0.006	0.815	0.237
p-value of nonparam. specification test	0.241	0.345	0.017	0.193	0.046	0.118	0.457	0.031	0.469	0.081
R^2	0.403	0.438	0.273	0.797	0.697	0.557	0.534	0.017	0.340	0.045
N	430	430	430	430	430	430	430	430	430	430

Notes: All columns report OLS results from estimating equation (7). Data for dependent variables come from the REIS, except for column (10) which uses Census data on disability in the adult population. Final sample is a balanced panel of 215 MSAs. Dependent variable is always the percentage change across periods except for column (10) which reports percentage point changes. The % Change in predicted employment is formed by interacting cross-sectional differences in industrial composition with national changes in industry employment shares. See Table 2, main text, and Data Appendix for more details. All specifications include year fixed effects. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each metropolitan area over time, are in parenthesis and p-values are in brackets.

Appendix Table A4
Robustness Dropping Each Region

	Dependent Variable: % Change in Population									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	All Regions	Drop New England	Drop Middle Atlantic	Drop East North Central	Drop West North Central	Drop South Atlantic	Drop East South Central	Drop West South Central	Drop Mountain	Drop Pacific
% Change in predicted employment **(β)**	1.802	1.659	2.142	1.654	1.743	1.706	1.847	1.797	1.870	1.764
	(0.445)	(0.447)	(0.545)	(0.539)	(0.475)	(0.380)	(0.451)	(0.467)	(0.455)	(0.504)
	[0.000]	[0.000]	[0.000]	[0.002]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.001]
(% Change in predicted employment)^2 (δ)	28.010	27.839	22.645	29.303	29.633	20.857	27.388	28.840	31.122	30.672
	(7.905)	(7.982)	(8.989)	(9.266)	(8.377)	(7.491)	(8.019)	(8.168)	(8.562)	(8.188)
	[0.000]	[0.001]	[0.013]	[0.002]	[0.001]	[0.006]	[0.001]	[0.001]	[0.000]	[0.000]
Marginal effect at $-\sigma$ **(A)**	-0.152	-0.284	0.562	-0.390	-0.325	0.251	-0.065	-0.216	-0.301	-0.376
	(0.847)	(0.879)	(1.044)	(1.033)	(0.915)	(0.664)	(0.864)	(0.884)	(0.875)	(0.892)
	[0.858]	[0.747]	[0.591]	[0.706]	[0.723]	[0.706]	[0.940]	[0.807]	[0.731]	[0.674]
Marginal effect at $+\sigma$ **(B)**	3.757	3.602	3.722	3.699	3.811	3.162	3.758	3.809	4.042	3.904
	(0.535)	(0.498)	(0.539)	(0.591)	(0.546)	(0.628)	(0.535)	(0.553)	(0.602)	(0.604)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
p-value of test **(A)** = **(B)**	0.000	0.001	0.013	0.002	0.001	0.006	0.001	0.001	0.000	0.000
p-value of nonparametric specification test	0.000	0.001	0.004	0.002	0.000	0.149	0.001	0.000	0.000	0.000
R^2	0.315	0.324	0.334	0.333	0.322	0.288	0.316	0.323	0.297	0.303
N	430	408	382	342	402	360	404	372	404	366

Notes: All columns report OLS results from estimating equation (7). Final sample is a balanced panel of 215 MSAs. Columns report results from dropping one of the nine Census regions. Dependent variable is always the percentage change in population across periods. The % Change in predicted employment is formed by interacting cross-sectional differences in industrial composition with national changes in industry employment shares. See Table 2, main text, and Data Appendix for more details. All specifications include year fixed effects. Standard errors, adjusted to allow for an arbitrary variance-covariance matrix for each metropolitan area over time, are in parenthesis and p-values are in brackets.