FIRMS' INTERNAL NETWORKS AND LOCAL ECONOMIC SHOCKS

BY

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ONLINE APPENDIX

SECTION A: THEORY

1 Labor and Capital Input

This section presents a variant of the model in Section I in which regional firm units produce output using labor and capital input based on the Cobb-Douglas production function $f(\phi_i, L_i, K_i) = \phi_i L_i^{\alpha} K_i^{\beta}$, where $\alpha + \beta < 1$ indicates decreasing returns to scale. When transforming labor and capital input into output, each regional firm unit takes output prices p_i and factor prices w_i and r_i as given.

The firm solves

$$\max_{L_i, K_i, \lambda} \delta \sum\nolimits_i p_i \phi_i L_i^{\alpha} K_i^{\beta} - \sum\nolimits_i (w_i L_i + r_i K_i) + \lambda \left[\sum\nolimits_i C_i - \sum\nolimits_i (w_i L_i + r_i K_i) \right],$$

where λ denotes the Lagrange multiplier associated with the budget constraint.

The Kuhn-Tucker conditions are

$$\delta p_i \phi_i \alpha L_i^{\alpha-1} K_i^{\beta} = (1+\lambda)\, w_i \ \forall i, \tag{1}$$

$$\delta p_i \phi_i \beta L_i^{\alpha} K_i^{\beta-1} = (1+\lambda)\, r_i \ \forall i, \tag{2}$$

$$\sum\nolimits_i (w_i L_i + r_i K_i) \leq \sum\nolimits_i C_i, \tag{3}$$

and

$$\lambda \left[\sum\nolimits_i C_i - \sum\nolimits_i (w_i L_i + r_i K_i) \right] = 0; \ \lambda \geq 0.$$

From equations (1) and (2), it follows that for any two regional firm units i and j it must hold that

$$\begin{aligned} \frac{\delta p_i \phi_i}{w_i} \left(\frac{w_i}{r_i} \frac{\beta}{\alpha} \right)^{\beta} \alpha L_i^{\alpha+\beta-1} &= \frac{\delta p_i \phi_i}{r_i} \left(\frac{r_i}{w_i} \frac{\alpha}{\beta} \right)^{\alpha} \beta K_i^{\alpha+\beta-1} \\ &= \frac{\delta p_j \phi_j}{r_j} \left(\frac{r_j}{w_j} \frac{\alpha}{\beta} \right)^{\alpha} \beta K_j^{\alpha+\beta-1} \\ &= \frac{\delta p_j \phi_j}{w_j} \left(\frac{w_j}{r_j} \frac{\beta}{\alpha} \right)^{\beta} \alpha L_j^{\alpha+\beta-1}, \end{aligned} \tag{4}$$

implying that a marginal dollar of funds has the same value at each regional firm unit, regardless of whether the dollar is used for labor or capital input.

As a benchmark, suppose that the firm is financially unconstrained, so that the budget constraint (3) is slack ($\lambda = 0$). In that case, equation (4) implies that headquarters allocates labor (capital) input to each regional firm until the (discounted) marginal revenue product of labor (capital) equals the wage (rental rate of capital). Accordingly, labor and capital input at each regional firm unit are at the first-best optimum.

Suppose next that the firm is financially constrained, so that the budget constraint (3) binds ($\lambda > 0$). By equation (4), the marginal revenue product of labor (capital) at each regional firm unit strictly exceeds the wage (rental rate of capital). Consequently, labor and capital input at each regional firm unit are below the first-best optimum.

Consider now a negative cash-flow shock in region j. Analogous to the main model, differentiating equations (1), (2), and (3) with respect to C_j and solving yields

$$\frac{d\lambda}{dC_j} = \frac{\delta\left(\alpha+\beta-1\right)}{\sum_i \left(\frac{w_i^2}{p_i\phi_i}\frac{L_i^{2-\alpha-\beta}}{\alpha}\left(\frac{w_i}{r_i}\frac{\beta}{\alpha}\right)^{-\beta} + \frac{r_i^2}{p_i\phi_i}\frac{K_i^{2-\alpha-\beta}}{\beta}\left(\frac{r_i}{w_i}\frac{\alpha}{\beta}\right)^{-\alpha}\right)} < 0,$$

$$\frac{dL_i}{dC_j} = \frac{\frac{w_i}{p_i\phi_i}\frac{L_i^{2-\alpha-\beta}}{\alpha}\left(\frac{w_i}{r_i}\frac{\beta}{\alpha}\right)^{-\beta}}{\sum_i \left(\frac{w_i^2}{p_i\phi_i}\frac{L_i^{2-\alpha-\beta}}{\alpha}\left(\frac{w_i}{r_i}\frac{\beta}{\alpha}\right)^{-\beta} + \frac{r_i^2}{p_i\phi_i}\frac{K_i^{2-\alpha-\beta}}{\beta}\left(\frac{r_i}{w_i}\frac{\alpha}{\beta}\right)^{-\alpha}\right)} > 0 \ \forall i,$$

and

$$\frac{dK_i}{dC_j} = \frac{\frac{r_i}{p_i\phi_i}\frac{K_i^{2-\alpha-\beta}}{\beta}\left(\frac{r_i}{w_i}\frac{\alpha}{\beta}\right)^{-\alpha}}{\sum_i \left(\frac{w_i^2}{p_i\phi_i}\frac{L_i^{2-\alpha-\beta}}{\alpha}\left(\frac{w_i}{r_i}\frac{\beta}{\alpha}\right)^{-\beta} + \frac{r_i^2}{p_i\phi_i}\frac{K_i^{2-\alpha-\beta}}{\beta}\left(\frac{r_i}{w_i}\frac{\alpha}{\beta}\right)^{-\alpha}\right)} > 0 \ \forall i.$$

Lastly, as in the main model, we can compare the sensitivity of single-region firms and regional firm units that are part of multi-region firms to a local cash-flow shock. For a single-region firm, the sensitivity of labor and capital input to a local cash-flow shock in region j is given by

$$\frac{dL_j}{dC_j} = \frac{\alpha}{\alpha+\beta}\frac{1}{w_j}$$

and

$$\frac{dK_j}{dC_j} = \frac{\beta}{\alpha+\beta}\frac{1}{r_j},$$

respectively. By contrast, for a regional firm unit in region j that is part of a multi-region firm, the sensitivity of labor and capital input to a local cash-flow shock is given by

$$\frac{dL_j}{dC_j} = \frac{\alpha}{\alpha+\beta}\frac{1}{w_j}\frac{\frac{w_j^2}{p_j\phi_j}L_j^{2-\alpha-\beta}\left(\frac{w_j}{r_j}\right)^{-\beta}}{\sum_i\left(\frac{w_i^2}{p_i\phi_i}L_i^{2-\alpha-\beta}\left(\frac{w_i}{r_i}\right)^{-\beta}\right)}$$

and

$$\frac{dK_j}{dC_j} = \frac{\beta}{\alpha+\beta}\frac{1}{r_j}\frac{\frac{r_j^2}{p_j\phi_j}K_j^{2-\alpha-\beta}\left(\frac{r_j}{w_j}\right)^{-\alpha}}{\sum_i\left(\frac{r_i^2}{p_i\phi_i}K_i^{2-\alpha-\beta}\left(\frac{r_i}{w_i}\right)^{-\alpha}\right)},$$

respectively, which is strictly less than the sensitivity for single-region firms.

2 Regional Productivity Shocks

This section presents a variant of the model in Section I in which regional firm units produce output using labor input according to the production function $f_i(L_i) = \phi_i f(L_i)$, where ϕ_i is a region-specific productivity parameter.

The firm solves

$$\max_{L_i,\lambda} \delta\sum\nolimits_i p_i\phi_i f(L_i) - \sum\nolimits_i w_i L_i + \lambda\left[\sum\nolimits_i C_i - \sum\nolimits_i w_i L_i\right],$$

where λ denotes the Lagrange multiplier associated with the budget constraint.

The Kuhn-Tucker conditions are

$$\delta p_i\phi_i f\,'(L_i) = (1+\lambda)\,w_i \;\forall i, \tag{5}$$

$$\sum\nolimits_i w_i L_i \leq \sum\nolimits_i C_i, \tag{6}$$

and

$$\lambda\left[\sum\nolimits_i C_i - \sum\nolimits_i w_i L_i\right] = 0;\ \lambda \geq 0.$$

Consider now a negative productivity shock in region j. If the firm is financially un-

constrained, so that the budget constraint (6) is slack ($\lambda = 0$), (the first-best optimal) labor input in region j declines. There are no implications for regions $i \neq j$. Formally, setting $\lambda = 0$ and differentiating equation (5) with respect to ϕ_j, we obtain

$$\delta p_j \left[f\,'(L_j) + \phi_j f\,''(L_j) \frac{dL_j}{d\phi_j} \right] = 0,$$

implying that

$$\frac{dL_j}{d\phi_j} = \frac{-f\,'(L_j)}{\phi_j f\,''(L_j)} > 0,$$

and

$$\delta p_i \phi_i f\,''(L_i) \frac{dL_i}{d\phi_j} = 0 \ \forall i \neq j,$$

implying that

$$\frac{dL_i}{d\phi_j} = 0 \ \forall i \neq j.$$

Suppose next that the firm is financially constrained, so that the budget constraint (6) binds ($\lambda = 0$). There are two effects at work. First, as in the financially unconstrained case, labor input in region j declines. However, this frees up scarce funds, which can be used for labor inputs in regions $i \neq j$ given that labor input in those regions is below the first-best optimum. Consequently, labor input in regions $i \neq j$ *increases*. Formally, differentiating equations (5) and (6) with respect to ϕ_j and solving yields

$$\frac{d\lambda}{d\phi_j} = \frac{\frac{w_j f\,'(L_j)}{\phi_j f\,''(L_j)}}{\sum_i \frac{w_i^2}{\delta p_i \phi_i f\,''(L_i)}} > 0,$$

$$\frac{dL_j}{d\phi_j} = \frac{w_j f\,'(L_j)}{\phi_j f\,''(L_j)} \left[\frac{-\sum_{i \neq j} \frac{w_i}{\delta p_i \phi_i f\,''(L_i)}}{\sum_i \frac{w_i^2}{\delta p_i \phi_i f\,''(L_i)}} \right] > 0,$$

and

$$\frac{dL_i}{d\phi_j} = \frac{w_j f\,'(L_j)}{\phi_j f\,''(L_j)} \frac{\frac{w_i}{\delta p_i \phi_i f\,''(L_i)}}{\sum_i \frac{w_i^2}{\delta p_i \phi_i f\,''(L_i)}} < 0 \ \forall i \neq j.$$

Hence, if the firm is financially constrained, a negative productivity shock in region j leads to a decline in labor input in region j and an *increase* in labor input in regions $i \neq j$.

SECTION B: TABLES

Table B1
Excluding Outliers

This table presents variants of the specifications in columns 3 to 8 of Table 3 in which a five percent cutoff (in lieu of a ten percent cutoff) is used to account for outliers. All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$					
	Excluding outliers (top or bottom five percent)					
	Firms		ZIP codes			
	Largest	Smallest	Largest house price decline	Smallest house price decline	Largest employment decline	Smallest employment decline
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.023**	0.025***	0.025***	0.026***	0.026***	0.024***
	(0.009)	(0.006)	(0.008)	(0.006)	(0.006)	(0.006)
ZIP code × industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.47	0.28	0.29	0.29	0.28	0.27
Observations	105,700	382,500	365,100	364,900	383,300	383,200

Table B2
Firm Size Bins

This table presents variants of the specification in column 2 of Table 3 in which the sample is divided into terciles based on firm size (log number of employees in 2006). All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$		
	First Tercile	Second Tercile	Third Tercile
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.024***	0.026***	0.025***
	(0.009)	(0.010)	(0.009)
ZIP code × industry fixed effects	Yes	Yes	Yes
R-squared	0.43	0.41	0.47
Observations	128,000	128,200	128,800

Table B3
Selected Non-Tradable Industries

This table presents variants of the specification in column 2 of Table 3 in which the sample is restricted to selected non-tradable industries. In column 1, the sample is restricted to NAICS code industries 7221 (full-service restaurants) and 7222 (limited-service eating places). In column 2, the sample is restricted to NAICS code industries 7221, 7222, 7223 (special food services), and 7224 (drinking places). In column 3, the sample is restricted to NAICS code industries 7221, 7222, 7223, 7224, 4451 (grocery stores), and 4452 (specialty food stores). All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$		
	7221, 7222	7221, 7222, 7223, 7224	7221, 7222, 7223, 7224, 4451, 4452
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.026**	0.029**	0.027**
	(0.012)	(0.012)	(0.011)
ZIP code × industry fixed effects	Yes	Yes	Yes
R-squared	0.19	0.19	0.25
Observations	70,200	77,500	88,200

Table B4
Census Regions

This table presents variants of the specification in column 2 of Table 3 in which the sample is divided into Census regions. All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$			
	West	Northeast	Midwest	South
	(1)	(2)	(3)	(4)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.027***	0.025**	0.026**	0.021**
	(0.009)	(0.013)	(0.011)	(0.009)
ZIP code × industry fixed effects	Yes	Yes	Yes	Yes
R-squared	0.27	0.31	0.30	0.27
Observations	92,800	66,100	81,000	145,100

Table B5
Establishment-Level Controls

This table presents variants of the specification in column 2 of Table 3 with additional controls. Establishment size is the number of employees in 2006 (in logs). 10-year (20-year) employment volatility is the standard deviation of the annual percentage change in establishment-level employment using all available years from 1997 to 2006 (from 1987 to 2006). 10-year (20-year) employment beta is the coefficient from a regression of the annual percentage change in establishment-level employment on a constant and the annual percentage change in total LBD employment using all available years from 1997 to 2006 (from 1987 to 2006). All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$	
	(1)	(2)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.026***	0.026***
	(0.008)	(0.008)
10-year employment volatility	0.004	
	(0.003)	
10-year employment beta	0.001	
	(0.003)	
20-year employment volatility		0.003
		(0.003)
20-year employment beta		0.003
		(0.003)
Establishment size$_{06}$	-0.030***	-0.031***
	(0.010)	(0.010)
ZIP code × industry fixed effects	Yes	Yes
R-squared	0.35	0.35
Observations	356,500	356,500

Table B6
Alternative Weighting Schemes

This table presents variants of the specification in column 2 of Table 3 in which observations are weighted by either ZIP code, county, state, or 4-digit NAICS code industry employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$			
	ZIP code	County	State	Industry
	(1)	(2)	(3)	(4)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.029**	0.027***	0.027***	0.025***
	(0.013)	(0.009)	(0.008)	(0.005)
ZIP code × industry fixed effects	Yes	Yes	Yes	Yes
R-squared	0.07	0.22	0.24	0.19
Observations	385,000	385,000	385,000	385,000

Table B7
Distance-Adjusted Network Weights

This table presents a variant of the specification in column 2 of Table 3 in which the firm's non-tradable ZIP-code level employment in the formula describing the firm network weights ω in Section IIB is replaced with the product of the firm's non-tradable ZIP-code level employment and the geographical distance (in logs) between the given ZIP code and the establishment's ZIP code, thereby placing more weight on distant ZIP codes. The regression is weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$
	(1)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.022***
	(0.007)
ZIP code × industry fixed effects	Yes
R-squared	0.29
Observations	385,000

Table B8
Excluding Coastal States

This table presents a variant of the specification in column 2 of Table 3 in which coastal states are excluded from the sample. The regression is weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$
	(1)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.020**
	(0.008)
ZIP code × industry fixed effects	Yes
R-squared	0.31
Observations	312,200

Table B9
Changes in House Prices from March 2007 to March 2009

This table presents a variant of the specification in column 2 of Table 3 in which changes in ZIP-code level house prices are measured from March 2007 to March 2009 contemporaneous with changes in establishment-level employment. The regression is weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$
	(1)
Δ Log(HP)$_{07\text{-}09}$ (other)	0.022***
	(0.007)
ZIP code × industry fixed effects	Yes
R-squared	0.29
Observations	385,000

Table B10
Housing Boom

This table presents variants of the specifications in columns 1 and 2 of Table 2 and column 2 of Table 3 in which changes in ZIP-code level house prices and changes in establishment-level employment are measured from 2003 to 2006. All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{03\text{-}06}$		
	(1)	(2)	(3)
Δ Log(HP)$_{03\text{-}06}$	0.058***	0.050**	
	(0.017)	(0.020)	
Δ Log(HP)$_{03\text{-}06}$ (other)		0.016*	0.015*
		(0.009)	(0.009)
Industry fixed effects	Yes	Yes	–
ZIP code × industry fixed effects	–	–	Yes
R-squared	0.01	0.01	0.18
Observations	320,000	320,000	320,000

Table B11
Establishment-Level Wages

This table presents variants of the specifications in columns 1 and 2 of Table 2 and column 2 of Table 3 in which the dependent variable, Δ Log(Wages)$_{07\text{-}09}$, is the percentage change in non-tradable establishment-level wages from 2007 to 2009. Establishment-level wages are computed as the ratio of payroll to the number of employees. All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log (Wages)$_{07\text{-}09}$		
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$	0.022	0.012	
	(0.014)	(0.015)	
Δ Log(HP)$_{06\text{-}09}$ (other)		0.005	0.004
		(0.010)	(0.010)
Industry fixed effects	Yes	Yes	–
ZIP code × industry fixed effects	–	–	Yes
R-squared	0.01	0.01	0.28
Observations	385,000	385,000	385,000

Table B12
2001 Firm Networks

This table presents a variant of the specification in column 2 of Table 3 in which the firm network weights ω are based on firms' internal networks in 2001 instead of 2006. The regression is weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$
	(1)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.021***
	(0.007)
ZIP code × industry fixed effects	Yes
R-squared	0.29
Observations	385,000

Table B13
Population Density (I)

This table presents a variant of the specification in column 7 of Table 4 in which the demographic controls are interacted with population density. The regression is weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$
	(1)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.021***
	(0.006)
Income	0.003
	(0.003)
Education	0.003
	(0.006)
Age	-0.003
	(0.006)
Non-white	-0.001
	(0.005)
Male	0.001
	(0.004)
Population density	0.001
	(0.002)
Income × population density	0.001
	(0.003)
Education × population density	0.002
	(0.003)
Age × population density	0.001
	(0.003)
Non-white × population density	-0.001
	(0.004)
Male × population density	-0.002
	(0.003)
ZIP code × industry fixed effects	Yes
R-squared	0.29
Observations	385,000

Table B14
"Urban" Dummy (I)

This table presents variants of the specifications in columns 6 and 7 of Table 4 and column 1 of Table B13 using an "urban" dummy in lieu of population density. The urban dummy equals one if the ZIP code is part of a Metropolitan Statistical Area (MSA). All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$		
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.024***	0.024***	0.022***
	(0.006)	(0.006)	(0.007)
Income		0.004*	0.003*
		(0.002)	(0.002)
Education		0.004	0.004
		(0.004)	(0.006)
Age		-0.001	-0.002
		(0.004)	(0.005)
Non-white		-0.001	0.000
		(0.006)	(0.006)
Male		-0.001	0.001
		(0.003)	(0.004)
Urban	0.005	0.004	0.005
	(0.008)	(0.008)	(0.007)
Income × urban			0.001
			(0.004)
Education × urban			-0.001
			(0.005)
Age × urban			0.001
			(0.005)
Non-white × urban			-0.002
			(0.005)
Male × urban			-0.002
			(0.006)
ZIP code × industry fixed effects	Yes	Yes	Yes
R-squared	0.29	0.29	0.29
Observations	385,000	385,000	385,000

Table B15
Population Density (II)

This table presents variants of the specifications in columns 1 to 5 of Table 4 in which the demographic controls are interacted with population density. All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$				
	(1)	(2)	(3)	(4)	(5)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.024***	0.024***	0.025***	0.024***	0.025***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Income	0.003*				
	(0.002)				
Education		0.005			
		(0.004)			
Age			0.000		
			(0.004)		
Non-white				-0.002	
				(0.004)	
Male					0.001
					(0.002)
Income × population density	0.003				
	(0.003)				
Education × population density		0.002			
		(0.004)			
Age × population density			-0.000		
			(0.004)		
Non-white × population density				0.000	
				(0.004)	
Male × population density					-0.001
					(0.003)
Population density	0.001	0.002	0.002	0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
ZIP code × industry fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.29	0.29	0.29	0.29	0.29
Observations	385,000	385,000	385,000	385,000	385,000

Table B16
"Urban" Dummy (II)

This table presents variants of the specifications in columns 1 to 5 of Table 4 in which the demographic controls are interacted with an "urban" dummy. The urban dummy is described in Table B14. All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$				
	(1)	(2)	(3)	(4)	(5)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.023***	0.024***	0.024***	0.024***	0.024***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)
Income	0.004*				
	(0.002)				
Education		0.005			
		(0.004)			
Age			0.000		
			(0.005)		
Non-white				-0.001	
				(0.005)	
Male					0.001
					(0.002)
Income × urban	0.002				
	(0.003)				
Education × urban		0.000			
		(0.005)			
Age × urban			0.002		
			(0.004)		
Non-white × urban				0.001	
				(0.004)	
Male × urban					0.000
					(0.004)
Urban	0.004	0.005	0.005	0.005	0.005
	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)
ZIP code × industry fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.29	0.29	0.29	0.29	0.29
Observations	385,000	385,000	385,000	385,000	385,000

Table B17
Actual vs. Counterfactual Locations

This table shows summary statistics for firms' actual and counterfactual locations based on the Placebo tests in columns 1 and 8 of Table 5. Counterfactual locations are described in Table 5. Income, Education, Age, Non-white, Male, and Population density are measured in 2006 and described in Tables 1 and 4, respectively. The table reports means, standard deviations (in parentheses), and *p*-values from difference-in-means tests.

	Table 5, column 1			Table 5, column 8		
	Actual	Counterfactual	Diff-in-means (*p* -value)	Actual	Counterfactual	Diff-in-means (*p* -value)
Δ Log(HP)$_{06\text{-}09}$	-0.123	-0.120	0.877	-0.119	-0.127	0.508
	(0.154)	(0.143)		(0.162)	(0.189)	
Δ Log(Emp)$_{07\text{-}09}$	-0.038	-0.035	0.872	-0.022	-0.024	0.913
	(0.397)	(0.444)		(0.419)	(0.579)	
Income$_{06}$	72,514	72,732	0.982	72,185	72,617	0.421
	(1,560)	(1,689)		(3,207)	(3,016)	
Education$_{06}$	0.273	0.258	0.432	0.259	0.281	0.359
	(0.106)	(0.124)		(0.120)	(0.146)	
Age$_{06}$	37.0	36.8	0.601	36.7	36.9	0.712
	(10.2)	(9.9)		(13.7)	(13.4)	
Non-white$_{06}$	0.273	0.281	0.544	0.282	0.274	0.646
	(0.090)	(0.095)		(0.116)	(0.102)	
Male$_{06}$	0.492	0.491	0.896	0.490	0.493	0.921
	(0.028)	(0.030)		(0.034)	(0.036)	
Population density$_{06}$	0.0010	0.0016	0.560	0.0013	0.0014	0.789
	(0.0015)	(0.0019)		(0.0020)	(0.0024)	

Table B18
Banking and Social Networks

This table presents variants of the specification in column 1 of Table 8 with additional controls. Δ Log(HP)$_{06\text{-}09}$ (other, banking) is computed analogously to Δ Log(HP)$_{06\text{-}09}$ (other) using establishments of commercial banks (NAICS code 522110), which are aggregated at the firm-county level. Δ Log(HP)$_{06\text{-}09}$ (other, SCI) is similar to Δ Log(HP)$_{06\text{-}09}$ (other), except that the firm-county network weights are replaced with county-pair weights based on the Social Connectedness Index (SCI) of Bailey et al. (2018b). All regressions are weighted by firm-county employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$			
	(1)	(2)	(3)	(4)
Δ Log(HP)$_{06\text{-}09}$	0.090***	0.088***	0.104***	0.101***
	(0.016)	(0.017)	(0.015)	(0.015)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.026***	0.025**		
	(0.010)	(0.012)		
Δ Log(HP)$_{06\text{-}09}$ (other, banking)	0.004		0.006	
	(0.012)		(0.013)	
Δ Log(HP)$_{06\text{-}09}$ (other, SCI)		0.005		0.006
		(0.015)		(0.021)
Industry fixed effects	Yes	Yes	Yes	Yes
R-squared	0.01	0.01	0.01	0.01
Observations	110,300	110,300	110,300	110,300

Table B19
Single- vs. Multi-Region Firms (I)

This table presents summary statistics for establishments of single- and multi-region firms. Multi-region firms are described in Table 1. 10-year and 20-year employment volatility are described in Table B5. The table reports means, standard deviations (in parentheses), and *p*-values from difference-in-means tests.

	Single-region (N = 506,500)	Multi-region (N = 356,500)	Diff-in-means (*p* -value)
10-year employment volatility	0.301	0.287	0.000
	(0.228)	(0.212)	
20-year employment volatility	0.314	0.299	0.000
	(0.224)	(0.209)	

Table B20
Single- vs. Multi-Region Firms (II)

The dependent variable is either 10-year or 20-year employment volatility at the establishment level. Multi-region is a dummy variable indicating whether an establishment belongs to a multi-region firm. 10-year and 20-year employment volatility are described in Table B5. Multi-region firms are described in Table 1. Firm size is described in Table 11. All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	10-year employment volatility	20-year employment volatility
	(1)	(2)
Multi-region	-0.010***	-0.009***
	(0.003)	(0.002)
Firm size	-0.033***	-0.023***
	(0.008)	(0.005)
ZIP code × industry fixed effects	Yes	Yes
R-squared	0.28	0.27
Observations	863,000	863,000

Table B21
Proximity to Headquarters

This table presents variants of the specification in column 2 of Table 3 in which Δ Log(HP)$_{06\text{-}09}$ and Δ Log(HP)$_{06\text{-}09}$ (other) are interacted with measures of proximity to headquarters (HQ) in 2006. In columns 1 and 2, Proximity is a dummy variable indicating whether the establishment and HQ are located in the same ZIP code and county, respectively. In column 3, Proximity is one divided by the geographical distance between the establishment and HQ. All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$		
	Same ZIP code	Same county	Inverse distance
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$ × proximity	-0.022**	-0.020**	-0.019**
	(0.010)	(0.010)	(0.009)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.031***	0.032***	0.029***
	(0.008)	(0.008)	(0.010)
Δ Log(HP)$_{06\text{-}09}$ (other) × proximity	-0.013**	-0.011**	-0.013**
	(0.006)	(0.006)	(0.005)
Proximity	0.017***	0.014***	0.023***
	(0.003)	(0.003)	(0.002)
ZIP code × industry fixed effects	Yes	Yes	Yes
R-squared	0.29	0.29	0.29
Observations	385,000	385,000	385,000

Table B22
Financial Constraints, Geographic Dispersion, and Proximity to Headquarters

This table presents variants of the specifications in Table 10 with additional controls. GD is the number of ZIP codes in which the firm operates. Proximity is a dummy variable indicating whether the establishment and headquarters are located in the same ZIP code. FC is either firm leverage (column 1), the KZ-index (column 2), or the WW-index (column 3). All three FC variables are described in Table 10. All regressions are weighted by establishment-level employment. Standard errors (in parentheses) are double clustered at the firm and county level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$		
	Leverage	KZ-index	WW-index
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$ × GD	-0.008**	-0.010***	-0.010**
	(0.003)	(0.003)	(0.004)
Δ Log(HP)$_{06\text{-}09}$ × proximity	-0.028**	-0.024*	-0.025**
	(0.013)	(0.013)	(0.013)
Δ Log(HP)$_{06\text{-}09}$ × FC	0.114**	0.002*	0.043**
	(0.061)	(0.001)	(0.019)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.018	0.015	0.021
	(0.012)	(0.012)	(0.014)
Δ Log(HP)$_{06\text{-}09}$ (other) × FC	0.043**	0.002*	0.015**
	(0.020)	(0.001)	(0.008)
Δ Log(HP)$_{06\text{-}09}$ (other) × proximity	-0.015*	-0.016*	-0.016*
	(0.008)	(0.010)	(0.010)
FC	-0.030***	-0.002*	-0.006*
	(0.009)	(0.001)	(0.004)
GD	0.003**	0.004***	0.003**
	(0.001)	(0.001)	(0.002)
Proximity	0.015**	0.014*	0.019*
	(0.008)	(0.008)	(0.010)
ZIP code × industry fixed effects	Yes	Yes	Yes
R-squared	0.42	0.42	0.42
Observations	124,100	124,100	124,100

Table B23
County-Level Analysis: Excluding Regional Firms

This table presents variants of the specification in column 2 of Table 12. Column 1 is the county-level equivalent of column 4 of panel A of Table 7. Columns 2 and 3 are the county-level equivalents of columns 3 and 4, respectively, of panel B of Table 7. Columns 4 and 5 are the county-level equivalents of columns 3 and 4, respectively, of panel C of Table 7. All regressions are weighted by county-level employment. Standard errors (in parentheses) are clustered at the state level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$				
	All	$\geq$ 500 miles	Out-of-state	$\geq$ 20 states	All Census regions
	(1)	(2)	(3)	(4)	(5)
Δ Log(HP)$_{06\text{-}09}$	0.110***	0.116***	0.116***	0.116***	0.118***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.019***	0.015**	0.017**	0.020***	0.017**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Δ Log(HP)$_{06\text{-}09}$ (other, proximity)	0.012*				
	(0.007)				
Demographic controls	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes
R-squared	0.17	0.17	0.17	0.17	0.17
Observations	1,000	1,000	1,000	1,000	1,000

Table B24
County-Level Analysis: Wages

This table presents variants of the specification in column 2 of Table 12 in which the dependent variable, Δ Log(Wages)$_{07\text{-}09}$, is the percentage change in non-tradable county-level wages from 2007 to 2009. County-level wages are computed as the ratio of payroll to the number of employees. In column 1, county-level wages are based on all firms in a county. In columns 2 and 3, county-level wages are based on multi- and single-county firms, respectively. Multi-county firms are firms operating in multiple counties. All regressions are weighted by county-level employment. Standard errors (in parentheses) are clustered at the state level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Wages)$_{07\text{-}09}$		
	All	Multi-county	Single-county
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$	0.018	0.015	0.022
	(0.017)	(0.020)	(0.021)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.006	0.007	0.004
	(0.009)	(0.011)	(0.010)
Demographic controls	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes
R-squared	0.13	0.12	0.13
Observations	1,000	1,000	1,000

Table B25
County-Level Analysis: Local Spillover Effects

Column 1 is identical to column 2 of Table 12. Columns 2 and 3 present variants of this specification in which county-level employment is based on multi- and single-county firms, respectively. Multi-county firms are described in Table B24. All regressions are weighted by county-level employment. Standard errors (in parentheses) are clustered at the state level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$		
	All	Multi-county	Single-county
	(1)	(2)	(3)
Δ Log(HP)$_{06\text{-}09}$	0.115***	0.089***	0.161***
	(0.012)	(0.016)	(0.016)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.024***	0.031***	0.011
	(0.007)	(0.010)	(0.007)
Demographic controls	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes
R-squared	0.17	0.15	0.17
Observations	1,000	1,000	1,000

Table B26
County-Level Analysis: Counties in Which House Prices Did Not Fall

This table presents variants of the specifications in columns 1 and 2 of Table 12 in which the sample is restricted to counties in which house prices either increased (columns 1 and 2) or changed only little, defined as changes of less than ± 2.5 percent (columns 3 and 4). All regressions are weighted by county-level employment. Standard errors (in parentheses) are clustered at the state level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

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

Table B27
County-Level Analysis: Wages in Counties in Which House Prices Did Not Fall

This table presents variants of the specifications in Table B24 in which the sample is restricted to counties in which house prices either increased (columns 1 to 3) or changed only little, defined as changes of less than ± 2.5 percent (columns 4 to 6). All regressions are weighted by county-level employment. Standard errors (in parentheses) are clustered at the state level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Wages)$_{07\text{-}09}$					
	Δ Log(HP)$_{06\text{-}09} \geq 0$			Δ Log(HP)$_{06\text{-}09} \pm 0.025$		
	All	Multi-county	Single-county	All	Multi-county	Single-county
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Log(HP)$_{06\text{-}09}$	0.002	0.002	0.003	-0.000	-0.002	0.004
	(0.046)	(0.049)	(0.052)	(0.030)	(0.034)	(0.031)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.004	0.005	0.003	0.004	0.004	0.003
	(0.021)	(0.025)	(0.020)	(0.017)	(0.020)	(0.019)
Demographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.15	0.15	0.15	0.17	0.15	0.17
Observations	200	200	200	200	200	200

Table B28
County-Level Analysis: Trade Channel

This table presents variants of the specification in column 2 of Table 12. In column 1, the dependent variable is the percentage change in tradable county-level employment from 2007 to 2009. In column 2, Δ Log(HP)$_{06\text{-}09}$ (other, tradable network) is similar to Δ Log(HP)$_{06\text{-}09}$ (other), except that the county network weights are replaced with weights based on tradable firms' internal networks in 2006. All regressions are weighted by county-level employment. Standard errors (in parentheses) are clustered at the state level. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	Δ Log(Emp)$_{07\text{-}09}$	
	Tradable	Non-tradable
	(1)	(2)
Δ Log(HP)$_{06\text{-}09}$	0.011	0.120***
	(0.010)	(0.006)
Δ Log(HP)$_{06\text{-}09}$ (other)	0.003	
	(0.014)	
Δ Log(HP)$_{06\text{-}09}$ (other, tradable network)		0.004
		(0.010)
Demographic controls	Yes	Yes
Industry controls	Yes	Yes
R-squared	0.13	0.17
Observations	1,000	1,000