What's Across the Border? Re-Evaluating the Cross-Border Evidence on Minimum Wage Effects

Appendix — For Online Publication

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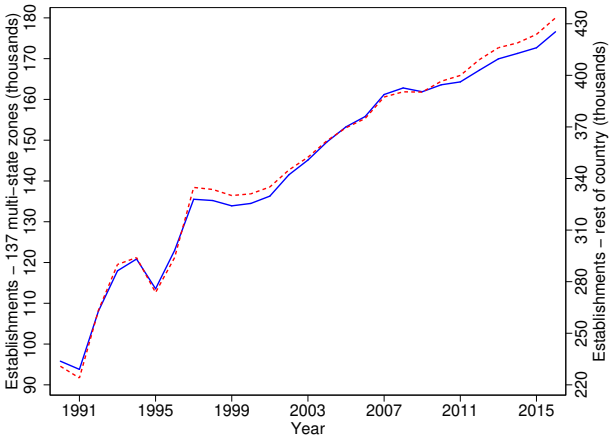
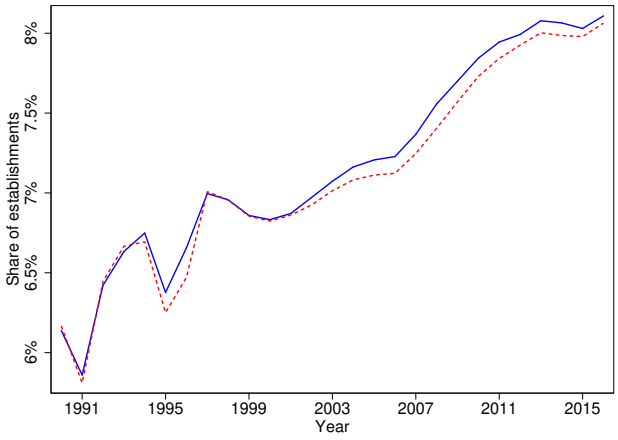
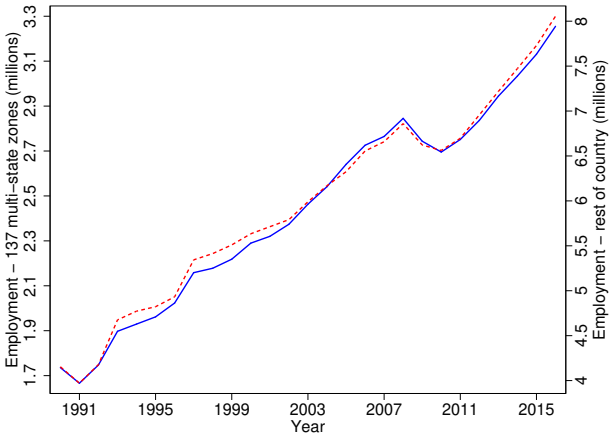
A Supporting Figures and Tables



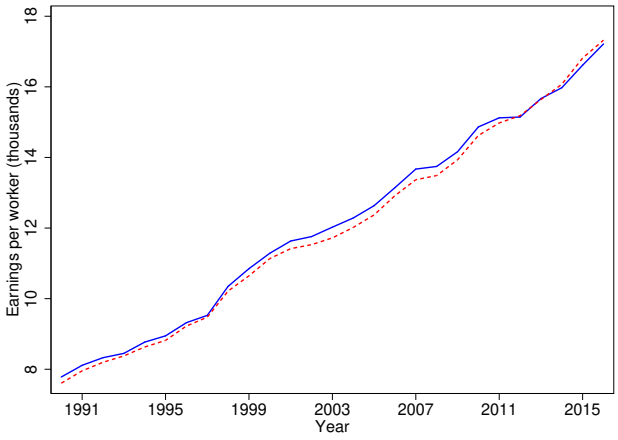
(a) Number of establishments



(b) Fraction of total establishments



(c) Employment



(d) Earnings per worker (U.S. dollars)

Figure A-1: Comparison between commuting-zone groups for restaurant industry: 137 multi-state commuting zones (solid blue) and rest of the country (dashed red)

Notes: This figure shows that in both groups, the restaurant industry accounted for 6.1 percent of all establishments in 1990 and that this share increased to about 8.1 percent by 2016. From Figure A-1d, note that nominal earnings per worker increased from $7.6-$7.8 thousand in 1990 to $17.2-$17.4 thousand in 2016. The annual payroll variable (from the CBP database) that we use to calculate earnings per worker includes reported tips.

Table A-1: Employment shares and earnings ranking of industries, 1990 and 2016

	1990			2016		
Industry	*Employment share*	*Worker earnings (thousands US$)*	*Earnings ranking (lowest=1)*	*Employment share*	*Worker earnings (thousands US$)*	*Earnings ranking (lowest=1)*
Eating and drinking places	7.21%	7.68	1	9.37%	17.36	1
Retail trade	13.94%	13.47	2	12.81%	27.08	2
Services	16.40%	14.06	3	22.92%	33.02	3
Textiles/apparel	1.99%	15.92	4	0.31%	36.20	4
Wood/furniture	1.36%	19.73	5	0.68%	41.76	5
Other manufacturing	0.44%	21.36	6	0.19%	47.40	7
Food/tobacco	1.62%	23.98	7	1.31%	45.28	6
Health services	9.83%	24.27	8	12.78%	53.87	10
Plastics, clay, stone	1.57%	24.72	9	0.91%	49.80	8
Agriculture, forestry, fishing, and mining	1.29%	25.10	10	1.52%	52.35	9
Construction	5.94%	25.22	11	5.13%	58.69	12
Paper/printing	2.44%	26.94	12	1.04%	63.76	14
Wholesale trade	6.69%	27.97	13	5.50%	66.68	16
Finance, insurance, and real estate	7.60%	28.00	14	7.05%	86.09	19
Metals	2.46%	28.31	15	1.36%	54.19	11
Transp., comm., elec., gas, and sanitary	5.88%	28.98	16	5.50%	60.16	13
Equipment	4.94%	30.33	17	2.21%	66.18	15
Legal, consulting, and computing services	5.27%	34.43	18	7.67%	91.09	20
Transportation manufacturing	2.03%	35.02	19	1.04%	69.44	17
Chemicals/petroleum	1.11%	35.94	20	0.70%	84.35	18

Table A-2: Pair-approach minimum wage elasticities of employment and earnings using multi-state commuting zones: Unweighted/log weighted estimation with different end years

	Employment			**Earnings**		
Period	(1)	(2)	(3)	(4)	(5)	(6)
1990–2006	-0.291***	-0.282***	-0.279***	0.275***	0.238***	0.252***
	(0.095)	(0.093)	(0.094)	(0.088)	(0.071)	(0.078)
1990–2007	-0.301***	-0.303***	-0.294***	0.243***	0.214***	0.224***
	(0.092)	(0.087)	(0.089)	(0.071)	(0.058)	(0.064)
1990–2008	-0.327***	-0.325***	-0.316***	0.239***	0.213***	0.221***
	(0.093)	(0.085)	(0.089)	(0.069)	(0.056)	(0.061)
1990–2009	-0.337***	-0.334***	-0.326***	0.243***	0.217***	0.225***
	(0.092)	(0.084)	(0.088)	(0.069)	(0.055)	(0.061)
1990–2010	-0.338***	-0.333***	-0.327***	0.244***	0.219***	0.227***
	(0.094)	(0.085)	(0.090)	(0.069)	(0.054)	(0.060)
1990–2011	-0.333***	-0.329***	-0.323***	0.238***	0.218***	0.224***
	(0.094)	(0.085)	(0.090)	(0.069)	(0.054)	(0.060)
1990–2012	-0.341***	-0.334***	-0.330***	0.228***	0.217***	0.218***
	(0.095)	(0.085)	(0.090)	(0.068)	(0.053)	(0.059)
1990–2013	-0.323***	-0.325***	-0.317***	0.212***	0.214***	0.208***
	(0.099)	(0.086)	(0.092)	(0.070)	(0.053)	(0.060)
1990–2014	-0.275**	-0.291***	-0.277***	0.176***	0.194***	0.181***
	(0.112)	(0.091)	(0.100)	(0.065)	(0.047)	(0.055)
1990–2015	-0.258**	-0.264***	-0.259**	0.185***	0.190***	0.186***
	(0.117)	(0.096)	(0.103)	(0.063)	(0.042)	(0.051)
1990–2016	-0.242**	-0.242**	-0.241**	0.163***	0.168***	0.165***
	(0.120)	(0.098)	(0.105)	(0.055)	(0.039)	(0.047)
Zone-state effects	Y	Y	Y	Y	Y	Y
Pair–period effects	Y	Y	Y	Y	Y	Y
Number of pairs	151	151	151	151	151	151
Weighted by log		emp	pop		emp	pop

Notes: This table reports $\hat{\beta}$ from the unweighted and weighted estimation of specification (3) for the restaurant industry using CBP yearly data for different end-year periods. All regressions in the table use the 151 multi-state commuting zone pairs. The dependent variable in columns 1-3 is log employment, whereas in columns 4-6 it is log earnings per worker. The main regressor is the log minimum wage, and the controls (not reported) are log employment in the rest of the industries in columns 1-3, log earnings per worker in the rest of the industries in columns 4-6, and log working age population. Columns 1 and 4 show the unweighted estimation results, columns 2 and 5 use initial log employment weights, and columns 3 and 6 use initial log working age population weights. Standard errors (in parentheses) are two-way clustered at the state and border segment levels. The coefficients are statistically significant at the *10%, **5%, or ***1% level.

Table A-3: Long-term minimum wage responses with DLR's QCEW 1990-2006 data

	CBCP sample	**MCZP sample**
$\hat{\beta}_{-8}$	-0.038	-0.122*
	(0.050)	(0.073)
$\hat{\beta}_{-6}$	-0.041	-0.106
	(0.069)	(0.080)
$\hat{\beta}_{-4}$	0.012	-0.061
	(0.100)	(0.093)
$\hat{\beta}_{-2}$	0.088	0.008
	(0.128)	(0.121)
$\hat{\beta}_{0}$	0.053	-0.121
	(0.116)	(0.140)
$\hat{\beta}_{2}$	0.027	-0.130
	(0.132)	(0.123)
$\hat{\beta}_{4}$	0.015	-0.144
	(0.116)	(0.101)
$\hat{\beta}_{6}$	-0.074	-0.253
	(0.107)	(0.154)
$\hat{\beta}_{8}$	-0.017	-0.220
	(0.112)	(0.143)
$\hat{\beta}_{10}$	0.011	-0.206
	(0.128)	(0.139)
$\hat{\beta}_{12}$	0.009	-0.211**
	(0.122)	(0.104)
$\hat{\beta}_{14}$	-0.013	-0.293***
	(0.149)	(0.086)
$\hat{\beta}_{16}$	-0.007	-0.305**
	(0.156)	(0.137)
ln(priv. employment)	0.384***	0.354***
	(0.091)	(0.125)
ln(population)	0.727***	0.717
	(0.199)	(0.478)
Pair–period effects	Y	Y
Total private sector	Y	Y
Number of pairs	316	73
Observations	40,416	9,342

Notes: This table reports $\hat{\beta}_k$, for $k \in \{-8, -6, -4, -2, 0, 2, 4, 6, 8, 12, 16\}$, from the estimation of specification (5) using either the CBCP sample or the MCZP sample. Standard errors (in parentheses) are two-way clustered at the state and border segment levels. The coefficients are statistically significant at the *10%, **5%, or ***1% level.

Table A-4: Long-term minimum wage responses with CBP 1990-2016 data

	County-level sample			**Multi-state zones sample**		
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}_{-2}$	-0.118	0.062	0.031	-0.082	-0.087	-0.029
	(0.070)	(0.065)	(0.045)	(0.052)	(0.087)	(0.046)
$\hat{\beta}_{-1}$	-0.160**	0.119*	0.073	-0.163***	-0.148	-0.029
	(0.072)	(0.063)	(0.044)	(0.061)	(0.111)	(0.049)
$\hat{\beta}_0$	-0.215**	0.160*	0.072	-0.178**	-0.172*	-0.113*
	(0.086)	(0.084)	(0.061)	(0.074)	(0.099)	(0.066)
$\hat{\beta}_1$	-0.287***	0.042	-0.004	-0.260***	-0.334**	-0.248***
	(0.104)	(0.097)	(0.078)	(0.089)	(0.125)	(0.081)
$\hat{\beta}_2$	-0.378***	0.017	-0.072	-0.357***	-0.524***	-0.419***
	(0.124)	(0.096)	(0.084)	(0.100)	(0.154)	(0.109)
$\hat{\beta}_3$	-0.468***	-0.044	-0.072	-0.412***	-0.547***	-0.406***
	(0.138)	(0.091)	(0.093)	(0.114)	(0.159)	(0.124)
$\hat{\beta}_4$	-0.593***	-0.025	-0.094	-0.559***	-0.689***	-0.512***
	(0.186)	(0.106)	(0.103)	(0.139)	(0.183)	(0.149)
ln(employment$^-$)	0.163***	0.204***	0.115**	0.019	0.079	0.067
	(0.039)	(0.055)	(0.044)	(0.073)	(0.090)	(0.088)
ln(population)	1.007***	0.929***	1.015***	1.065***	0.806***	1.128***
	(0.072)	(0.121)	(0.079)	(0.091)	(0.182)	(0.212)
Zone-state effects				Y	Y	Y
County effects	Y	Y	Y			
Year effects	Y			Y		
Pair–period effects		Y	Y		Y	Y
DLR data pairs			Y			Y
Number of pairs	–	1,157	309	–	151	71
Observations	64,064	47,268	12,866	18,109	6,262	2,954

Notes: This table reports $\hat{\beta}_k$, for $k \in \{-2, -1, 0, 1, 2, 3, 4\}$, $\hat{\gamma}$, and $\hat{\delta}$ from the estimation of specification (6) using either the CBP county-level sample or the CBP multi-state commuting zones sample. Columns 3 and 6 restrict the sample to complete pairs in DLR's data. Although column 1 in Table 3 uses 1,165 complete pairs, the leads and lags in specification (6) make us lose eight pairs. We do not lose any pairs in the estimation with multi-state commuting zones. For the sample that uses DLR's complete pairs, recall that we have 309 out of 316 of DLR's complete pairs, and 71 out of 73 for the multi-state zones estimation. Standard errors (in parentheses) are clustered at the state level in columns 1 and 4, and are two-way clustered at the state and border segment levels in columns 2-3 and 5-6. The coefficients are statistically significant at the *10%, **5%, or ***1% level.

Table A-5: Conventional TWFE estimation of minimum wage responses at the county level using CBP 1990-2016 data

	(1)	(2)
A. ln(employment)		
ln(minimum wage)	-0.362***	-0.309***
	(0.118)	(0.104)
ln(employment^{-})	0.150***	0.090
	(0.044)	(0.055)
ln(population)	1.024***	1.047***
	(0.070)	(0.091)
B. ln(earnings)		
ln(minimum wage)	0.216***	0.226***
	(0.037)	(0.051)
ln(earnings^{-})	0.141***	0.183***
	(0.035)	(0.065)
ln(population)	0.021	0.043
	(0.026)	(0.036)
County effects	Y	Y
Year effects	Y	Y
All counties	Y	
Only border counties		Y
Number of counties	3,103	1,129
Observations	83,160	30,287

Notes: This table reports $\hat{\beta}$, $\hat{\gamma}$, and $\hat{\delta}$ from the estimation of specification (2) for the restaurant industry using yearly county-level data from 1990 to 2016. In panel A, the dependent variable is log employment. Panel B uses instead log earnings per worker. Each column uses a different county-level sample. Standard errors (in parentheses) are clustered at the state level. The coefficients are statistically significant at the *10%, **5%, or ***1% level.

B Quotes on DLR's Relevance in the Minimum Wage Literature

DLR is the source of many claims that newer, more credible evidence shows that minimum wages do not reduce employment. In addition to those mentioned in footnote 1, here are other examples:

"... [V]ariation over the past two decades in minimum wages has been highly selective spatially, and employment trends for low-wage workers vary substantially across states... This has tended to produce a spurious negative relationship between the minimum wage and employment for low wage workers..." (Dube, 2011, p. 763)

"Careful causal studies of the restaurant industry also suggest that a 10 percent increase in the minimum wage affects restaurant employment somewhere between -0.5 percent and zero." [citing DLR] (Reich, 2021)

Moreover, the reliance on the DLR estimates has been used in work advocating for higher minimum wages and criticizing claims that higher minimum wages can lead to job loss. Here are some examples:

"In summary, the best research on minimum wage effects does not find negative employment effects on low-wage workers" [citing DLR extensively] (Reich, 2012, p. 9, arguing for a higher minimum wage in San Jose)

"Dube, Lester, and Reich (2010 and forthcoming) ... find no statistically significant effects of minimum wage increases on either employment or hours worked in restaurants ..." (Jacobs et al., 2015, p. 14, arguing for a higher minimum wage in Contra Costa County)

And the conclusion in the original paper says the same: "The estimates suggest no detectable employment losses from the kind of minimum wage increases we have seen in the United States." (Dube, Lester, and Reich, 2010, p. 962)

C Heterogeneous (or Not) Minimum Wage Effects

This section shows that a larger fraction of the population lives in counties where the employment effects of minimum wages are negative, and then explores if the differential results in different subsamples can be explained by varying degrees of monopsony power, as captured by employment concentration.

The 843 pairs of subsample 1, whose contiguous counties in each pair belong to different commuting zones, are formed from 929 counties, whereas the 986 cross-border pairs of subsample 3 span from the 742 counties (excluding DC) within the 137 multi-state commuting zones. In total population size, subsample 3 is between 19.5% and 24.3% larger than subsample 1: the 929 counties

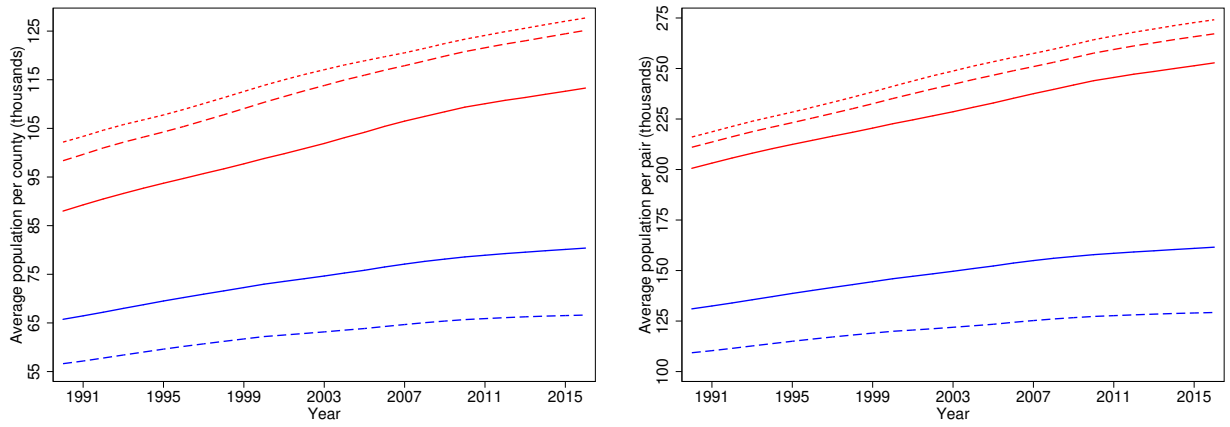


Figure C-1: Average population per subsample: 1 (blue-solid), 2 (red-solid), 3 (red-dash), 4 (red-short dash), 5 (blue-dash)

of subsample 1 had a population of 61.1 million in 1990 and of 74.7 million in 2016, while the 742 counties of subsample 3 had 73 million in 1990 and 92.9 million in 2016. Although these differences may not seem too large, it is important to note that 343 of the 742 MSCZ counties in subsample 3 also appear in subsample 1, and account for about 40% of the population of its 929 counties.

For a rural versus urban comparison, it is more relevant to look at each sample's average population per county and average population per county pair. To obtain a better contrast between MSCZs and non-MSCZs, we create a new subsample—which we refer to as *subsample 5*—which contains the 395 pairs of subsample 1 where each pair is formed by two counties from *single-state* commuting zones (463 counties span these 395 pairs). Figure C-1 shows the evolution of the average population per county (left) and the average population per county pair (right) during the 1990-2016 period for each of our subsamples. Focusing on subsample 3 and subsample 5 (the red and blue dashed lines, respectively), note that the gap between them increases over time for both average population measures: whereas MSCZ counties were on average 73.7% larger than non-MSCZ counties in 1990, they were 87.9% larger by 2016—for county-pairs the average is 93% larger in 1990 and 106.7% larger in 2016. Therefore, MSCZ areas have a much larger population density at the county level than non-MSCZ cross-border areas, and the density difference has only increased over time. As a consequence, one might view the results in panel B of Table 9 as capturing the heterogeneous effects of minimum wages in urban and rural areas, with employment effects being negative in urban areas (where most people live, as captured by multi-state commuting zones) and near zero in rural areas (as captured by low population density county pairs not in MSCZs).

Along the lines of the recent literature on monopsony power and wages (see, for example, Azar,

Marinescu, and Steinbaum, 2022), a natural exercise is to explore how employment concentration in the restaurant industry affects minimum wage elasticities. In particular, we can verify if more employment concentration—thought to be associated with more monopsony power in the labor market—is related to higher (less negative) minimum wage elasticities of employment.

To calculate employment concentration at the county level, we use the National Establishment Time Series (NETS) data.[42] NETS includes yearly data on employment for the universe of establishments in the U.S., including detailed location information, so we can calculate a Herfindahl–Hirschman index (HHI) for each county's restaurant industry using firm-level employment. Given that HHI is likely to be endogenous, our employment concentration measure is the HHI of 1992, which is the first year of reliable NETS data. Thus, if county i had three restaurants in 1992 with employment shares of 0.25, 0.4, and 0.35, then HHI_i is given by $0.25^2 + 0.4^2 + 0.35^2 = 0.345$.[43]

For each of our subsamples, Table C-1 presents the estimation of a version of equation (3) that includes the interaction term $\ln MW_{it} \times (HHI_i - \overline{HHI})$, where $\overline{HHI}$ is the average HHI across all counties in that subsample. Given that our HHI measure is from 1992, we restrict our CBP data to the 1992-2016 period. The monopsony argument is that more employment concentration (a higher HHI) implies less adverse effects of minimum wages on employment, so that the estimated coefficient of the interaction term should be positive. In contrast, all columns show a negative (though not significant) interaction coefficient—this result appears even when using the most rural subsample 5, which only includes cross-border pairs of counties from single-state commuting zones.[44] Therefore, monopsony power—to the extent that it is captured by employment concentration—does not seem to be a cause of heterogeneity in our estimated minimum wage elasticities of employment.

[42] See Neumark, Zhang, and Wall (2007) and Neumark, Wall, and Zhang (2011) for a detailed description of the NETS database.

[43] Although the HHI is usually presented in a $(0, 10,000]$ range, here we use a $(0, 1]$ normalization. A market is considered moderately concentrated if $HHI \in (0.15, 0.25]$, and highly concentrated if $HHI > 0.25$ (see section 5.3 in the *Horizontal Merger Guidelines* of the U.S. Department of Justice & FTC).

[44] The HHI statistics in the bottom of Table C-1 show similar standard deviations, minimums, and maximums across counties used in each subsample, with the mean being higher for the counties of subsample 5. The last result is expected, as rural counties should be more concentrated than urban counties. Note that HHI averages are below 0.15 in all subsamples, which indicates that concentration in the restaurant industry is low on average.

Table C-1: Monopsony power in the pair-approach estimation of minimum wage responses for different cross-border county-pair samples

	Pairs formed by contiguous counties not in same CZ	*Pairs formed by contiguous counties in same MSCZ*	*Pairs formed by contig. and non-contig. counties in same MSCZ*	*Pairs formed by non-contig. counties in same MSCZ*	*Pairs formed by contiguous counties not in any MSCZ*
	Subsample 1	**Subsample 2**	**Subsample 3**	**Subsample 4**	**Subsample 5**
ln(minimum wage)	-0.021	-0.162	-0.231**	-0.263*	0.101
	(0.077)	(0.100)	(0.110)	(0.137)	(0.142)
ln(MW) × $(HHI - \overline{HHI})$	-0.605	-0.558	-0.823	-0.904	-0.463
	(0.456)	(0.673)	(0.540)	(0.559)	(0.641)
ln(employment^{-})	0.237***	0.174**	0.192***	0.201***	0.288***
	(0.062)	(0.070)	(0.050)	(0.052)	(0.075)
ln(population)	0.938***	0.894***	0.889***	0.890***	0.855***
	(0.128)	(0.151)	(0.107)	(0.127)	(0.153)
County effects	Y	Y	Y	Y	Y
Pair–period effects	Y	Y	Y	Y	Y
Number of pairs	843	322	986	664	395
Observations	41,496	15,940	48,912	32,972	19,354
Summary statistics for 1992 HHI $\in (0, 1]$***:***					
Mean ($\overline{HHI}$)	0.109	0.094	0.097	0.097	0.122
Standard deviation	0.130	0.123	0.130	0.131	0.142
Minimum	0.002	0.003	0.001	0.001	0.003
Maximum	1	1	1	1	1
Number of counties	927	456	740	557	462

Notes: Using yearly county-pair data from 1992 to 2016, this table reports the estimation from an extension of specification (3) that includes the interaction term $\ln MW_{it} \times (HHI_i - \overline{HHI})$. The dependent variable is log employment in the restaurant industry. HHI_i is calculated at the firm level for each county i in 1992. Each column indicates the subsample used. Standard errors (in parentheses) are two-way clustered at the state and border segment levels. The coefficients are statistically significant at the *10%, **5%, or ***1% level.

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