Minimum Wages and Labor Markets in the Twin Cities

Loukas Karabarbounis
University of Minnesota

Jeremy Lise
University of Minnesota

Anusha Nath
FRB of Minneapolis

July 2022

What are the labor market effects of a min wage increase?

- (Mostly) statistical analysis of min wage increases in Twin Cities.

	Introduced	Implemented	Δ Min Wage 2020
Minneapolis	2017	2018	38%
Saint Paul	2018	2020	19%

- Why Twin Cities? Large min wage increase and recession.

Our approach

1. Time series across cities.
    - Synthetic diff-in-diff using (i) MN cities, (ii) other US cities.
2. Cross sections of establishments and workers within cities.
    - Differential exposure to min wage increase.
3. Model of establishment dynamics.
    - Reconcile time series with cross section.
    - Map estimates to deeper determinants of labor demand.

Our findings

1. Time series.
    - Reasonable wage gains in most low-wage sectors.
    - Large employment losses for restaurants.
    - Plausible upper bound: post 2018 attributed to min wage.
2. Cross section.
    - Employment losses 1/2 of time series.
    - Employment elasticity with respect to wage -1.
    - Plausible lower bound: entry is missing.

Data

Minimum wage policy in the Twin Cities

details MN policy

	Minneapolis		Saint Paul			
Firms	Small	Large	Micro	Small	Large	Macro
(Employees)	(< 100)	(≥ 100)	(≤ 5)	(6-100)	(101-10,000)	($> 10,000$)
2018 (Jan)		10.00				
2018 (Jul)	10.25	11.25				
2019 (Jul)	11.00	12.25				
2020 (Jan)						12.50
2020 (Jul)	11.75	13.25	9.25	10.00	11.50	
2021 (Jul)	12.50	14.25	10.00	11.00	12.50	
2022 (Jul)	13.50	15.00	10.75	12.00	13.50	15.00
2023 (Jul)	14.50	PCE	11.50	13.00	15.00	PCE
2024 (Jul)	large		12.25	14.00	macro	
2025 (Jul)			13.25	15.00		
2026 (Jul)			14.25	macro		
2027 (Jul)			15.00			
2028 (Jul)			macro			

Administrative datasets

▸ details ▸ industry shares

1. Unemployment Insurance (UI) wage detail reports.
    - Workers' quarterly earnings and hours at their establishment.
2. Quarterly Census of Employment and Wages (QCEW).
    - Establishments' location, 6-digit NAICS code, and firm.

Merged DEED dataset between 2001(1)-2020(4):

- workers' hours and wages,
- establishments of employment by industry, zip code, city.

Comparison of data with previous studies

Our measurements improve upon previous studies:

- Hours worked (in addition to jobs).
- Firms with multiple establishments (50% of jobs).
- Unit of analysis is zip code within a city.

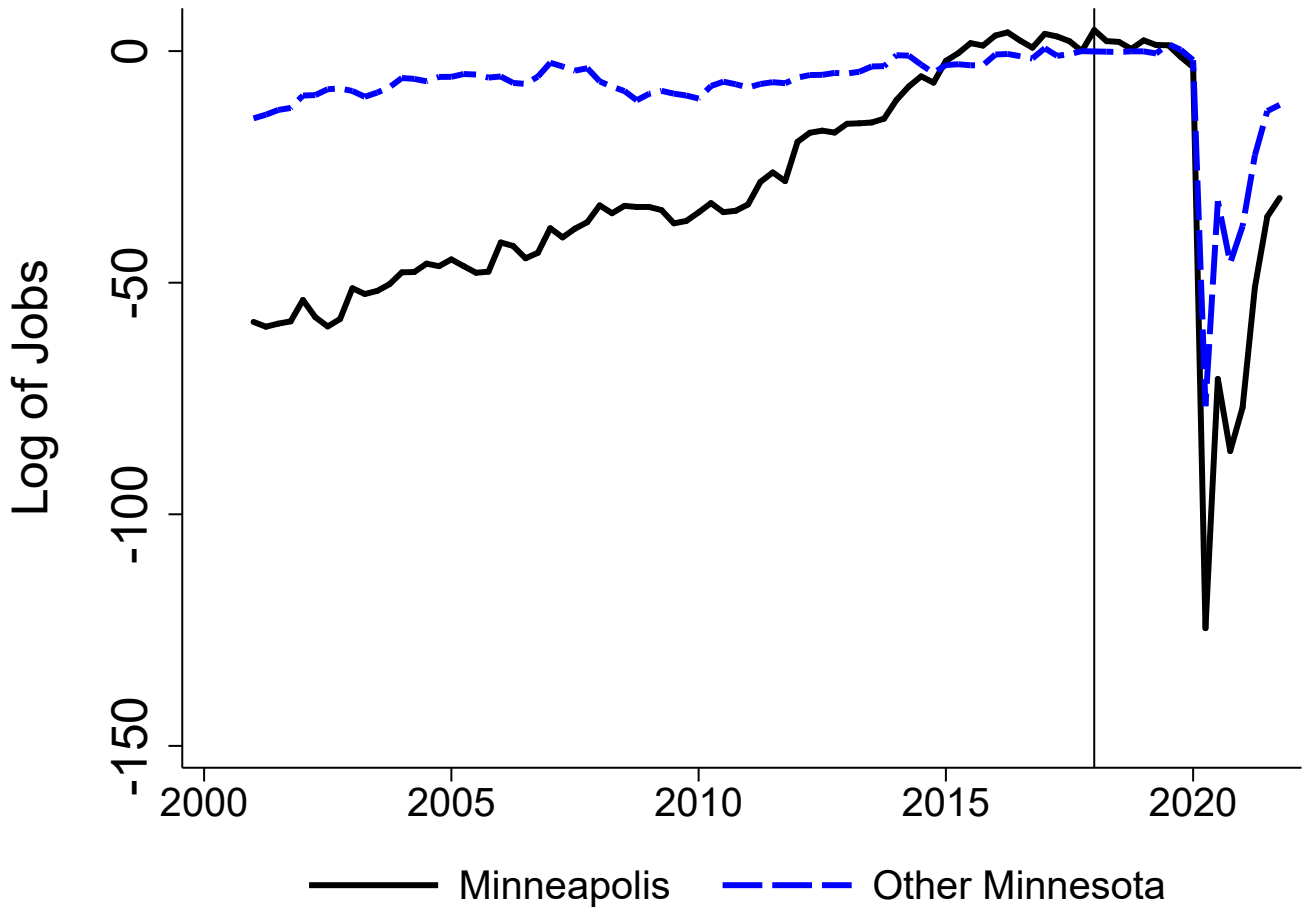
Evidence from the Time Series

Setup

- Treat Minneapolis with a min wage increase after 2018.
- Treat Saint Paul with a min wage increase after 2018.
  - Saint Paul committed to policy when Minneapolis ordinance passed.
  - Saint Paul effects before 2020 reflect advance notice.
  - Consistent with effects on jobs but less on wages.

Full-Service Restaurants jobs in Minneapolis

more



Econometric methodology

[Based on Abadie, Diamond, Hainmueller (2015) and Arkhangelsky, Athey, Hirshberg, Imbens, Wager (2021).]

- $W_{it} \in \{0, 1\}$ exposure to the min wage increase.
- Average treatment effect:

$$\tau_t = \frac{1}{N_{\text{tr}}} \sum_{N_{\text{co}}+1}^{N} (Y_{it}^1 - Y_{it}^0) \quad \text{and} \quad \tau = \frac{1}{T - T_{\text{pre}}} \sum_{T_{\text{pre}}+1}^{T} \tau_t,$$

Y_{it}^1: observed outcome; Y_{it}^0: counterfactual outcome.

Econometric methodology

[Based on Abadie, Diamond, Hainmueller (2015) and Arkhangelsky, Athey, Hirshberg, Imbens, Wager (2021).]

- $W_{it} \in \{0, 1\}$ exposure to the min wage increase.
- Average treatment effect:

$$\tau_t = \frac{1}{N_{\text{tr}}} \sum_{N_{\text{co}}+1}^{N} (Y_{it}^1 - Y_{it}^0) \quad \text{and} \quad \tau = \frac{1}{T - T_{\text{pre}}} \sum_{T_{\text{pre}}+1}^{T} \tau_t,$$

  Y_{it}^1: observed outcome; Y_{it}^0: counterfactual outcome.

- Synthetic difference-in-differences estimator:

$$\left(\hat{\tau}, \hat{\alpha}, \hat{\beta}\right) = \arg\min_{\tau,\alpha,\beta} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - \alpha_i - \beta_t - \tau W_{it})^2 \hat{\omega}_i \right\}.$$

  weights such that $\sum_{i=1}^{N_{\text{co}}} \hat{\omega}_i Y_{it} \approx N_{\text{tr}}^{-1} \sum_{i=N_{\text{co}}+1}^{N} Y_{it}$.

Growth specification of synthetic difference-in-differences

▸ weighting

- Use year-to-year differences in level of time series y_{it}:

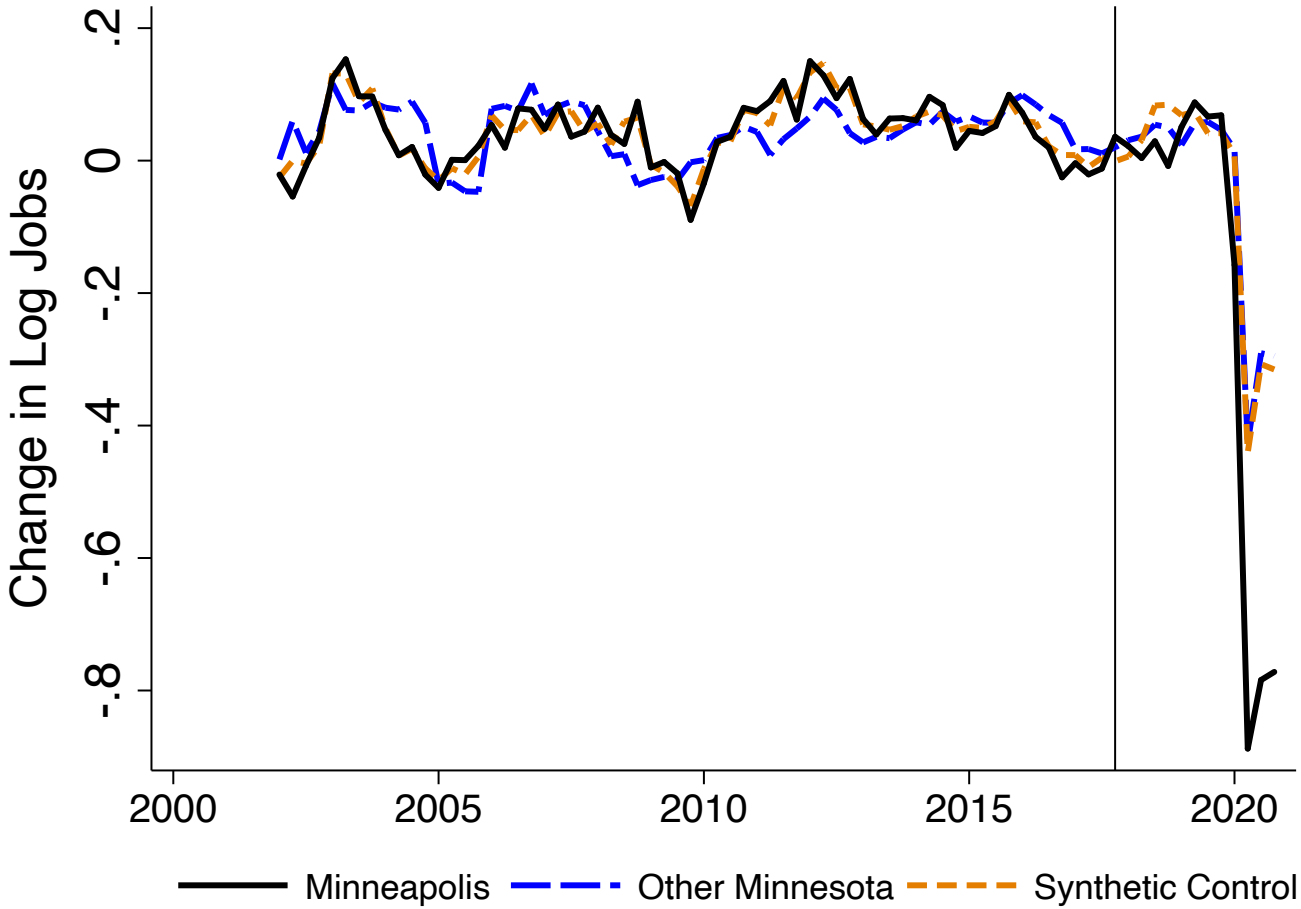
$$Y_{it} \equiv \log y_{it} - \log y_{i,t-4}.$$

  - Remove quarterly seasonal variation.
  - α_i allows average growth to be correlated with min wage.

- Transform growth effect τ into cumulative effect up to period T:

$$g_T \equiv \mathbb{E}\big(\log y^1_{i,T} - \log y^0_{i,T}\big) = \frac{(T - T_{\text{pre}})\tau}{4}.$$

Full-Service Restaurants growth rate of jobs in Minneapolis



▸ fit

Results for Minneapolis

[Coefficients are $100 \cdot g_{2020(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	8.8			
	(0.0)			
Admin and Support (56)	8.8			
	(0.0)			
Health Care and Social Asst (62)	−3.3			
	(1.8)			
Arts, Entmt, and Recreation (71)	3.9			
	(63.1)			
Accomm and Food Services (72)	0.3			
	(98.1)			
Other Services (81)	10.7			
	(0.0)			
Full-Service Restaurants (722511)	4.0			
	(0.0)			
Ltd-Service Restaurants (722513)	13.4			
	(0.0)			

Note: p-values in parentheses constructed with the placebo method.

Results for Minneapolis

[Coefficients are $100 \cdot g_{2020(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	8.8	−9.4	−7.6	0.9
	(0.0)	(12.8)	(13.4)	(80.9)
Admin and Support (56)	8.8	−1.9	0.1	12.2
	(0.0)	(92.7)	(82.5)	(27.8)
Health Care and Social Asst (62)	−3.3	3.5	3.2	−1.2
	(1.8)	(47.8)	(67.7)	(65.1)
Arts, Entmt, and Recreation (71)	3.9	−13.4	3.6	16.7
	(63.1)	(17.0)	(77.1)	(37.6)
Accomm and Food Services (72)	0.3	−31.4	−46.5	−36.9
	(98.1)	(0.0)	(0.0)	(0.0)
Other Services (81)	10.7	−1.2	−6.2	9.0
	(0.0)	(91.7)	(33.0)	(9.6)
Full-Service Restaurants (722511)	4.0	−41.4	−44.5	−42.1
	(0.0)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	13.4	−32.0	−29.7	−28.4
	(0.0)	(0.6)	(2.2)	(2.0)

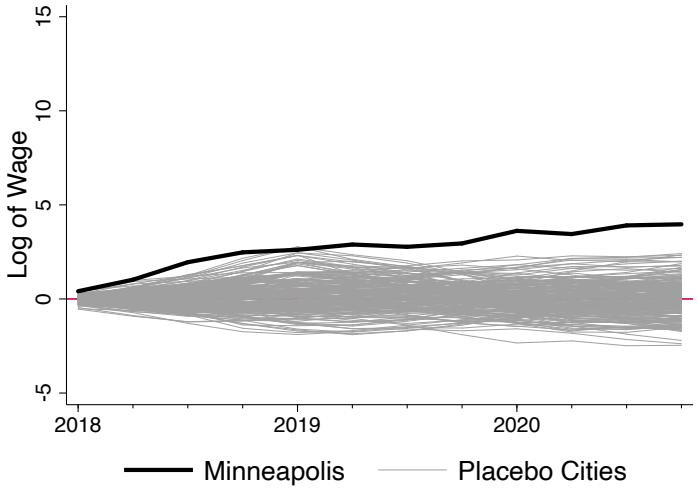
Note: p-values in parentheses constructed with the placebo method.

Results for Saint Paul

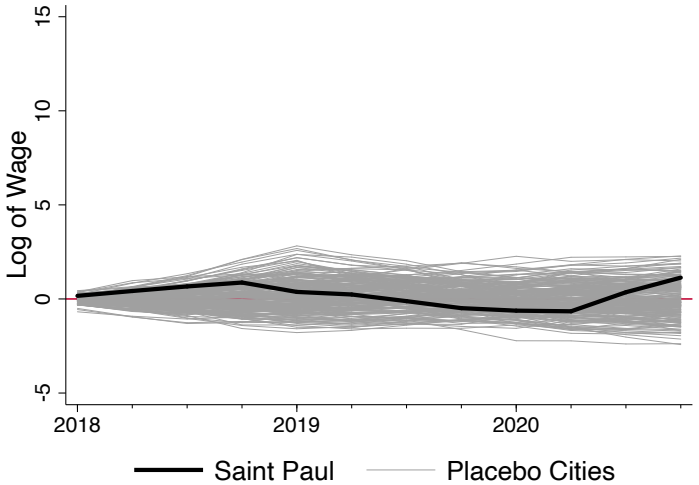
[Coefficients are $100 \cdot g_{2020(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	4.6	−2.0	−35.0	−11.5
	(0.0)	(72.7)	(0.0)	(8.2)
Admin and Support (56)	0.7	−7.3	−9.3	−69.7
	(92.1)	(60.3)	(32.6)	(0.0)
Health Care and Social Asst (62)	−4.2	4.3	3.7	−1.9
	(0.2)	(39.2)	(60.9)	(58.5)
Arts, Entmt, and Recreation (71)	−0.0	−18.1	−6.4	−16.6
	(57.1)	(6.2)	(50.5)	(4.0)
Accomm and Food Services (72)	7.9	−47.0	−64.8	−33.0
	(0.0)	(0.0)	(0.0)	(0.0)
Other Services (81)	2.0	15.0	1.3	11.6
	(35.4)	(0.2)	(70.7)	(3.2)
Full-Service Restaurants (722511)	1.1	−38.8	−38.4	−44.1
	(21.6)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	4.6	−57.2	−75.2	−85.7
	(0.0)	(0.0)	(0.0)	(0.0)

Note: p-values in parentheses constructed with the placebo method.

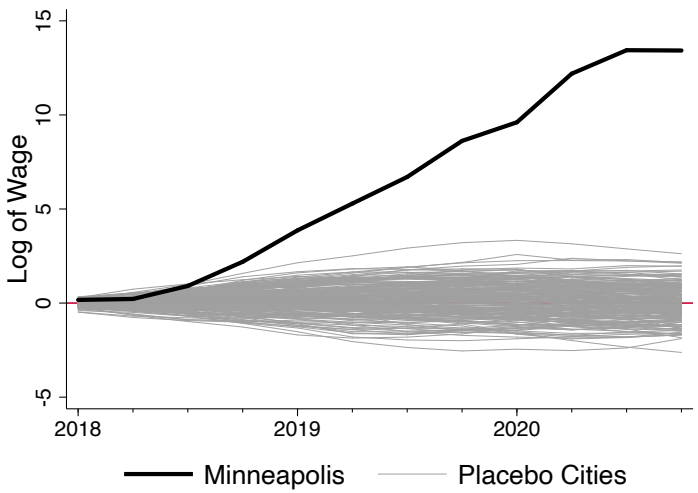
Time-varying wage effects for restaurants



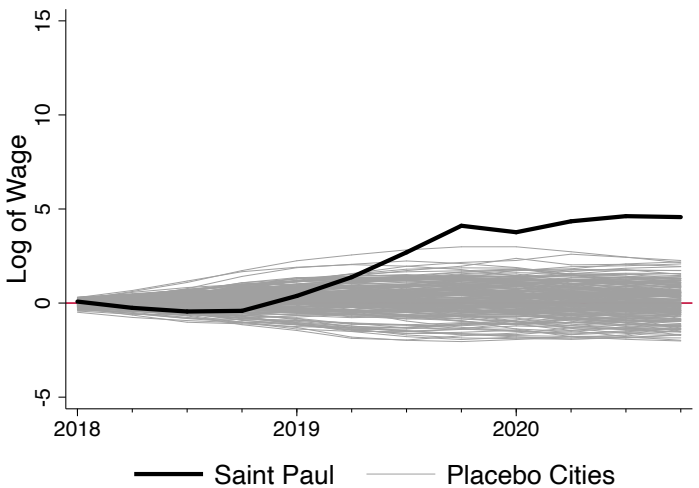
(a) Full-Service Restaurants, MPLS



(b) Full-Service Restaurants, SP



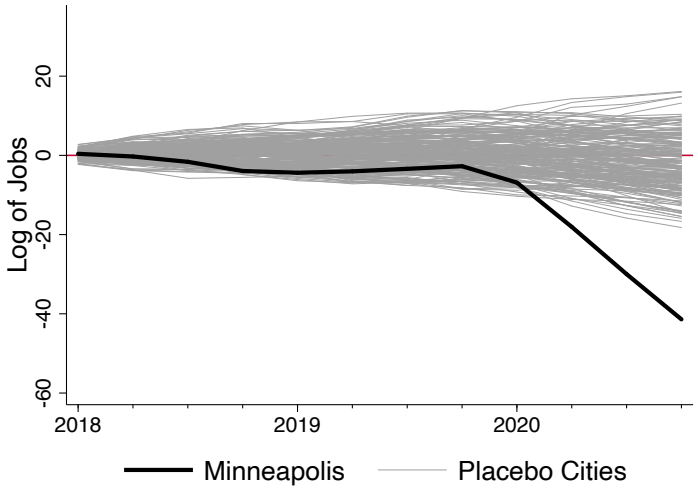
(c) Ltd-Service Restaurants, MPLS



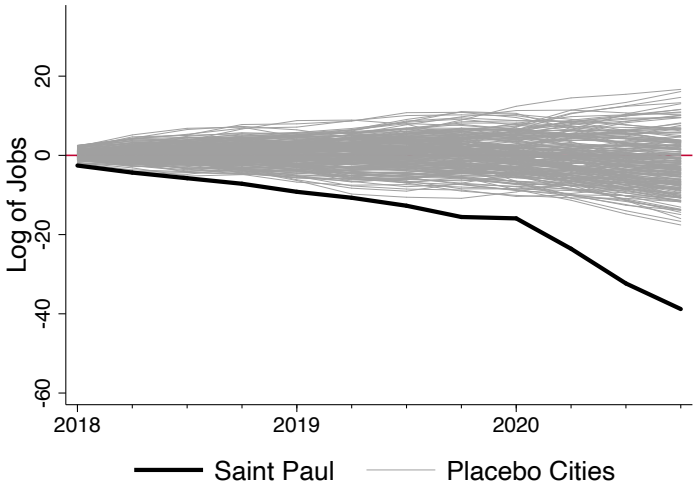
(d) Ltd-Service Restaurants, SP

Time-varying job effects for restaurants

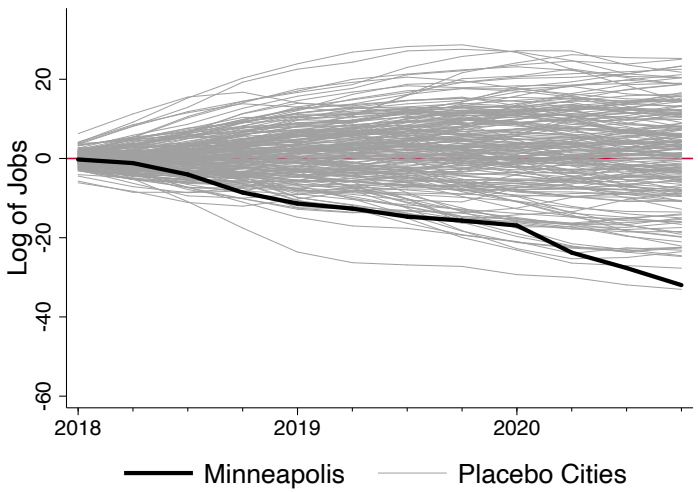
more



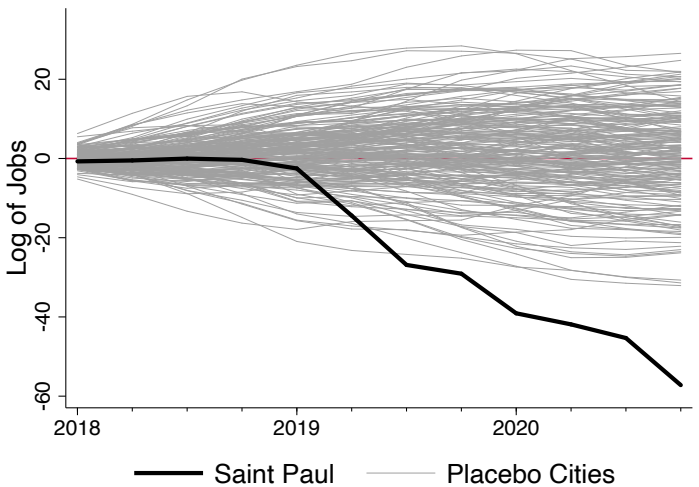
(a) Full-Service Restaurants, MPLS



(b) Full-Service Restaurants, SP



(c) Ltd-Service Restaurants, MPLS



(d) Ltd-Service Restaurants, SP

Challenges in interpreting time series results from MN

- Pandemic may be atypical relative to previous recessions.
  - Did sensitivity to aggregate shocks change relative to control?
  - Eg: lockdowns affect more densely populated cities.
- Use other U.S. cities of similar size as a control group.
  - Also densely populated, also subject to prolonged lockdowns.
  - Control for national-wide changes that affect larger cities.
  - Eg: demand away from services; rise of gig work; labor shortages.

Results using U.S. cities of similar size

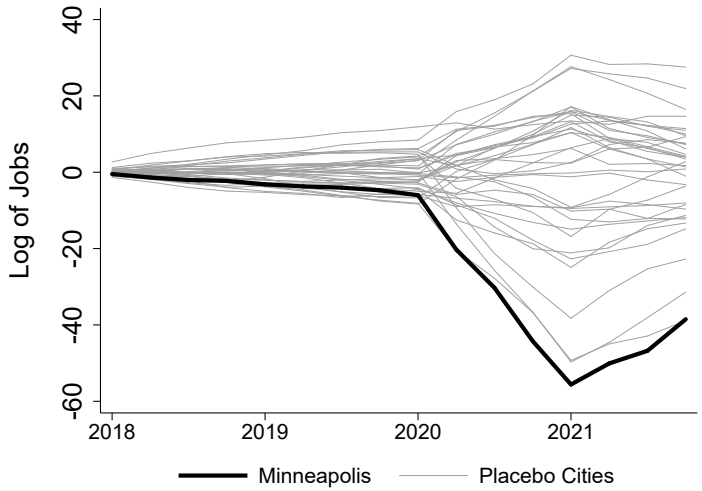
▸ λ_t ▸ bias ▸ all cities ▸ MN

[Coefficients are $100 \cdot g_{2021(4)}$]	Jobs in Minneapolis	Jobs in Saint Paul
Retail Trade (44)	−3.2	−11.4
	(64.9)	(0.0)
Admin and Support (56)	2.5	−9.8
	(97.3)	(38.1)
Health Care and Social Asst (62)	−2.5	−4.5
	(64.9)	(41.9)
Arts, Entmt, and Recreation (71)	−12.4	−21.6
	(32.4)	(18.6)
Accomm and Food Services (72)	−25.2	−21.9
	(5.4)	(9.3)
Other Services (81)	−9.6	−1.9
	(34.5)	(61.1)
Full-Service Restaurants (722511)	−38.5	−22.1
	(5.4)	(9.3)
Ltd-Service Restaurants (722513)	−19.0	−12.3
	(5.4)	(4.8)

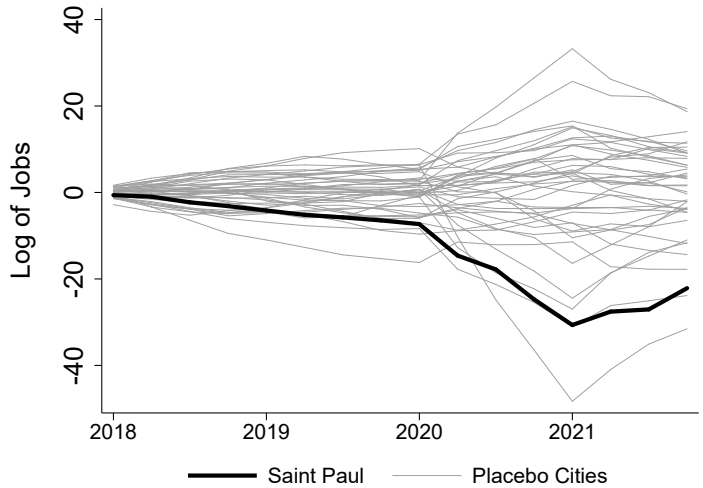
Note: p-values in parentheses constructed with the placebo method.

Time-varying effects using U.S. cities of similar size

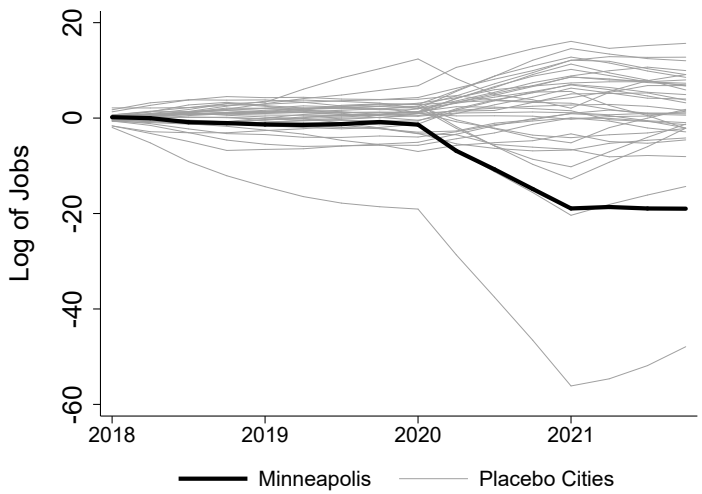
more



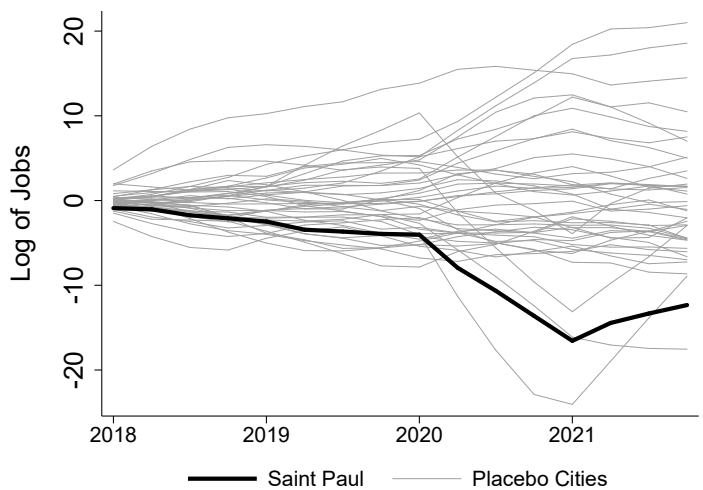
(a) Full-Service Restaurants, MPLS



(b) Full-Service Restaurants, SP



(c) Ltd-Service Restaurants, MPLS



(d) Ltd-Service Restaurants, SP

Evidence from the Cross Section

Challenge in interpreting the time series results

- Idiosyncratic shocks or idiosyncratic loading on aggregate shocks.
  - Eg: social unrest in 2020.
- Use variation across establishments in exposure to min wage.
  - Agnostic about intercept that absorbs all zip code time effects.
  - Eg: all establishments exposed to same civil unrest within zip code.

Econometric methodology: cross section of establishments

Notation: j: establishment, s: industry, z: zip code in city, t: period, i: worker.

Regression model:

$$Y_{jszt} = \gamma_{szt} + \sum_{t=2018}^{2020} \tau_t \left(\text{GAP}_{jszt-3} \cdot d_t\right) + u_{jszt},$$

arc percent change over 3 years:

$$Y_{jszt} = \frac{y_{jszt} - y_{jszt-3}}{(1/2)(y_{jszt} + y_{jszt-3})},$$

gap in labor cost over 3 years:

$$\text{GAP}_{jszt} = \frac{\sum_{i \in j} \max(15/(1+\pi_{t,2017}) - w_{ijszt}, 0) h_{ijszt}}{\sum_{i \in j} w_{ijszt} h_{ijszt}}.$$

Controlling for typical establishment dynamics

- Dynamics generate $\tau_t < 0$ for jobs and $\tau_t > 0$ for wage.
  - Smaller establishments pay lower wages and, thus, have larger gaps.
  - Smaller establishments exit at faster rate.
  - If survive, smaller establishments experience higher wage growth.

- Augment model with one more diff:

$$Y_{jszt} = \gamma_{szt} + \sum_{t=2018}^{2020} \tau_t \left(\text{GAP}_{jszt-3} \cdot d_t\right) + \tau_0 \text{GAP}_{jszt-3} + u_{jszt}.$$

  in a sample including 3 years prior to treatment.

Cross-establishment estimates for Minneapolis

▸ lags ▸ more years

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	11.5	−10.9	−12.7	−7.9
	(0.0)	(1.3)	(0.5)	(13.1)
2019	13.7	−15.7	−16.2	−11.4
	(0.0)	(0.5)	(0.4)	(8.0)
2020	15.2	−14.3	−13.1	−12.8
	(0.0)	(1.5)	(2.6)	(6.3)

Note: p-values in parentheses from standard errors clustered at the establishment level.

- Cannot reject τ_0's constant for all $t < 2018$.

Cross-establishment estimates for Saint Paul

▸ lags ▸ more years

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	4.9	−11.8	−12.9	−13.4
	(15.4)	(6.0)	(4.2)	(6.0)
2019	5.7	−24.2	−22.4	−25.1
	(21.4)	(0.1)	(0.4)	(0.4)
2020	4.7	−24.4	−23.8	−23.3
	(32.2)	(0.1)	(0.2)	(0.8)

Note: p-values in parentheses from standard errors clustered at the establishment level.

- Cannot reject τ_0's constant for all $t < 2018$.

Challenge in interpreting the establishment results

demo

- Spillovers, workers moving from high to low GAP establishments.
  - Eg: Target hiring all retail workers.
  - Eg: workers finding jobs outside Twin Cities.
- Use variation in wage gaps across workers.
  - Tracks workers over time.
  - Again agnostic about intercept that absorbs all time effects.

Econometric methodology: cross section of workers

Notation: i: worker, s: industry, t: period.

$$Y_{it} = \sum_{s} \gamma_{st} X_{ist} + \sum_{t=2018}^{2020} \tau_t \left(\text{GAP}_{it-3} \cdot d_t \right) + \tau_0 \text{GAP}_{it-3} + \rho Y_{it-1} + u_{it},$$

arc percent change over 3 years:

$$Y_{it} = \frac{y_{it} - y_{it-3}}{(1/2)(y_{it} + y_{it-3})},$$

gap in wage over 3 years:

$$\text{GAP}_{it} = \frac{\max(15/(1 + \pi_{t,2017}) - w_{it}, 0)}{w_{it}},$$

X_{ist} share of i's employment in s.

Cross-worker estimates for Twin Cities using GAP_{it}

	Minneapolis			Saint Paul		
[Entries are $100 \cdot \tau_t$]	Wage	Hours	Earnings	Wage	Hours	Earnings
2018	3.6	0.2	1.8	1.6	−9.1	−7.3
	(0.0)	(89.3)	(23.8)	(2.2)	(0.0)	(0.0)
2019	11.4	−5.0	−2.6	4.5	−10.4	−7.6
	(0.0)	(0.2)	(11.8)	(0.0)	(0.0)	(0.0)
2020	14.2	−15.1	−10.5	7.3	−16.4	−12.1
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)

Note: p-values in parentheses from standard errors clustered at the worker level.

Treating workers with their establishments' gaps

Notation: i: worker, j: establishment, s: industry, t: period.

$$Y_{it} = \sum_{s} \gamma_{st} X_{ist} + \sum_{t=2018}^{2020} \tau_t \left(\overline{\text{GAP}}_{it-3} \cdot d_t \right) + \tau_0 \overline{\text{GAP}}_{it-3} + \rho Y_{it-1} + u_{it},$$

gap in wage over 3 years:

$$\overline{\text{GAP}}_{it} = \frac{1}{\#J_t(i)} \sum_{j \in J_t(i)} \text{GAP}_{jt}.$$

Cross-worker estimates for Twin Cities using $\overline{GAP}_{it}$

	Minneapolis			Saint Paul		
[Entries are $100 \cdot \tau_t$]	Wage	Hours	Earnings	Wage	Hours	Earnings
2018	−1.4	−0.8	−2.7	−0.7	−8.8	−8.0
	(18.7)	(76.9)	(30.4)	(53.1)	(0.7)	(1.8)
2019	7.0	−15.2	−12.4	−2.1	−13.0	−11.9
	(0.0)	(0.0)	(0.0)	(15.2)	(0.0)	(0.1)
2020	7.9	−14.5	−8.8	3.7	−14.6	−9.2
	(0.0)	(0.0)	(0.4)	(1.3)	(0.0)	(1.5)

Note: p-values in parentheses from standard errors clustered at the worker level.

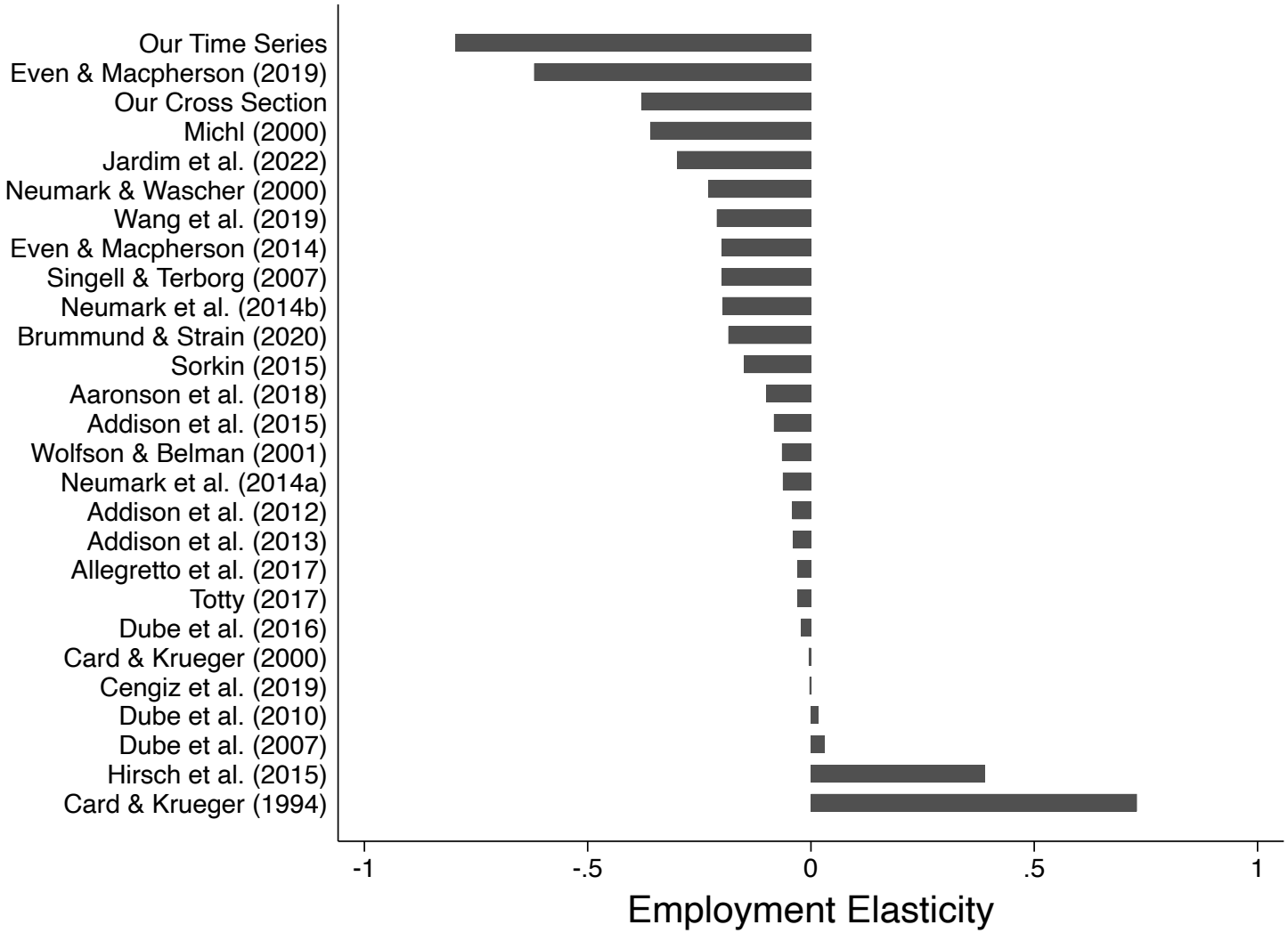
Summing Up the Estimates

Summary of estimates

details

Jobs (2020, percent)	Time Series	Cross Section	Ratio
Minneapolis Average	−2.1	−0.7	0.33
Minneapolis Most Negative	−30.1	−13.9	0.46
Saint Paul Average	−3.3	−1.4	0.42
Saint Paul Most Negative	−27.6	−19.2	0.70
Average			**0.48**

Comparison of restaurants estimates with other studies



Rationalizing our larger elasticities

1. Size of minimum wage change.
    - Clemens and Strain (2021): elasticity -0.5 in "large increases."
    - MPLS 38% min wage increase $>$ "large increases" with 20%.
2. Interaction of minimum wage with the recession.
    - Seattle min wage increase in 2015 during a significant boom.
    - Clemens and Wither (2019): elasticity -1 during Great Recession.
3. Labor demand elasticity.
    - Hamermesh (1993): plant elasticity -1.
    - Beaudry, Green, and Sand (2018): city-industry elasticity -1.

Reconciling Time Series with Cross Section

Why do results from time series differ from cross section?

Time series estimates include:

1. Potentially other shocks contemporaneous with min wage.
2. Entry of new units, potentially more sensitive to min wage.
3. Industry equilibrium affecting the average unit (eg. wage spillover).

Cross Section: has none of these.

Period before the minimum wage increase

- Establishment is $(z, \phi, \bar{w}, \kappa)$.
- Conditional on entry:

$$\max_{p_0, \ell_0, m_0} \pi_0 = \max\{p(y_0) \cdot y_0(m_0, \ell_0) - w_0 \ell_0 - m_0 - f, 0\},$$

$$y_0 = z\left(\phi m_0^{\frac{\sigma-1}{\sigma}} + (1-\phi)\ell_0^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}, \qquad p_0 = y_0^{-\frac{1}{\varepsilon}}.$$

- Entry if:

$$\mathbb{E}\pi_0 \geq \kappa.$$

Period after the minimum wage increase

labor demand

- Fraction δ of establishments destroyed exogenously.
- Continuing establishments:

$$\max_{p_1,\ell_1,m_1} \pi_1^c = \max\{p(y_1)\cdot y_1(m_1,\ell_1) - \max\{w_1, w_{\min}\}\ell_1 - m_1 - f, 0\}.$$

- New establishments:

$$\max_{p_1,\ell_1,m_1} \pi_1^n = \max\{p(y_1)\cdot y_1(m_1,\ell_1) - \max\{w_1, w_{\min}\}\ell_1 - m_1 - f, 0\}.$$

$$\mathbb{E}\pi_1^n \geq \kappa.$$

Effects of minimum wage

parameters

		$\Delta Z < 0$	
	Baseline	$\kappa = 0$	$\kappa = 0$
Cross-Sectional Elasticity, τ_ℓ / τ_w	-1.01		
GAP	0.14		
Labor Share of Costs	0.30		
Operating Cost to Profit	0.59		
Entry Cost to Profit	0.36		
Labor Demand Elasticity, $\eta = \alpha\varepsilon + (1-\alpha)\sigma$	-1.07		
Aggregate Wage Change	0.09		
Aggregate Employment Change	-0.25		
Ratio of Entry	2.28		

Effects of minimum wage

			$\Delta Z < 0$
	Baseline	$\kappa = 0$	$\kappa = 0$
Cross-Sectional Elasticity, τ_ℓ / τ_w	-1.01	-1.01	
GAP	0.14	0.14	
Labor Share of Costs	0.30	0.30	
Operating Cost to Profit	0.59	0.59	
Entry Cost to Profit	0.36	0.00	
Labor Demand Elasticity, $\eta = \alpha\varepsilon + (1-\alpha)\sigma$	-1.07	-1.07	
Aggregate Wage Change	0.09	0.09	
Aggregate Employment Change	-0.25	-0.08	
Ratio of Entry	2.28	–	

Effects of minimum wage

more

			$\Delta Z < 0$
	Baseline	$\kappa = 0$	$\kappa = 0$
Cross-Sectional Elasticity, τ_ℓ / τ_w	-1.01	-1.01	-1.01
GAP	0.14	0.14	0.14
Labor Share of Costs	0.30	0.30	0.30
Operating Cost to Profit	0.59	0.59	0.59
Entry Cost to Profit	0.36	0.00	0.00
Labor Demand Elasticity, $\eta = \alpha\varepsilon + (1-\alpha)\sigma$	-1.07	-1.07	-1.26
Aggregate Wage Change	0.09	0.09	0.09
Aggregate Employment Change	-0.25	-0.08	-0.25
Ratio of Entry	2.28	–	–

Extra Slides

Minimum wage policy details

back

- MN min wage applied before tips.
- Minneapolis and Saint Paul also exclude tips from min wage.
- Size threshold is total employment across all establishments.
- Franchises with more than 10 franchises nationally are large firms.
- For full-service restaurants with fewer than 10 locations nationally, each restaurant counts separately for determining size.

Minimum wage policy in Minnesota

back

(Annual Revenue in Dollars)	Youth	Small Firms ($< 500,000$)	Large Firms ($\geq 500,000$)
2000-2005	4.25	4.90	5.15
2006-2013	4.90	5.25	6.15
2014	6.50	6.50	8.00
2015	7.25	7.25	9.00
2016	7.75	7.75	9.50
2017	7.75	7.75	9.50
2018	7.87	7.87	9.65
2019	8.04	8.04	9.86
2020	8.15	8.15	10.00
2021	8.21	8.21	10.08
2022	PCE	PCE	PCE

Dropped observations in merged DEED dataset

back

- Multi-establishment-city firms reporting a single UI account (3-5%).
- Establishments without physical location information (4%).
- Contradictions between city and zip code ($< 1\%$).
- For wages, exclude 5% of observations with zero hours worked.

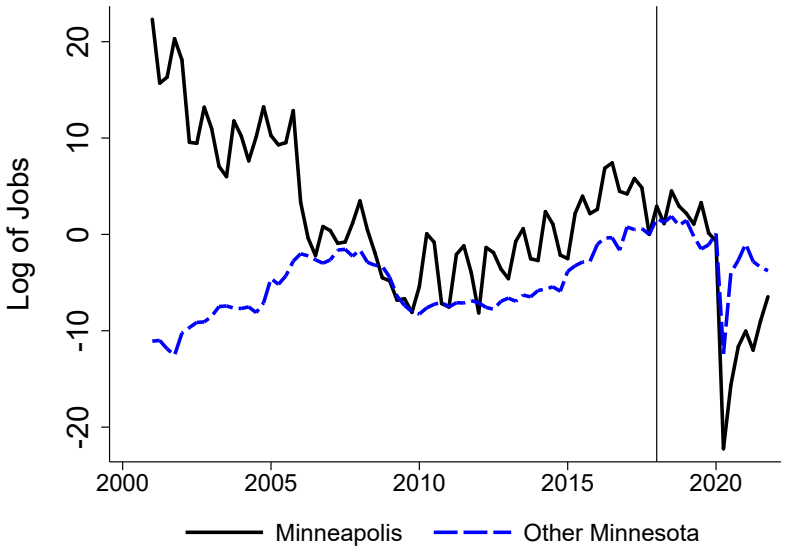
Employment and workers below 15 dollars

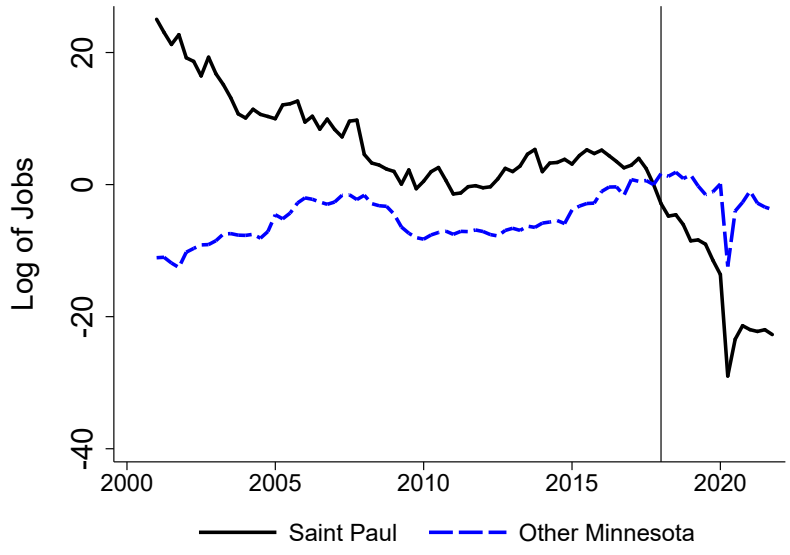
back

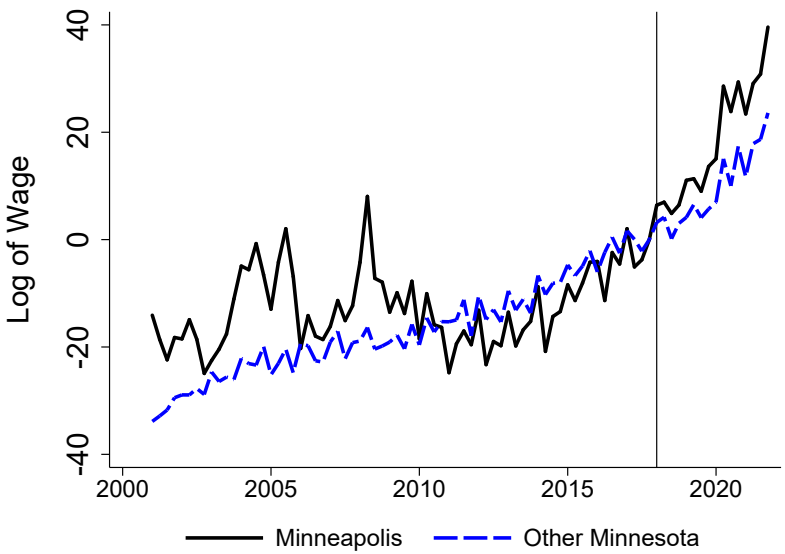
(2017, percent)	Employment Share			Worker Share $<$ 15$		
	MPLS	SP	OtherMN	MPLS	SP	OtherMN
Retail Trade (44)	5	7	12	59	63	65
Admin and Support (56)	6	6	5	58	66	48
Health Care and Social Asst (62)	17	18	17	30	42	34
Arts, Entmt, and Recreation (71)	2	2	2	42	45	61
Accomm and Food (72)	8	10	9	54	63	71
Other Services (81)	3	4	3	40	34	49
Full-Service Restaurants (722511)	4	4	3	46	51	56
Ltd-Service Restaurants (722513)	2	4	3	80	82	90

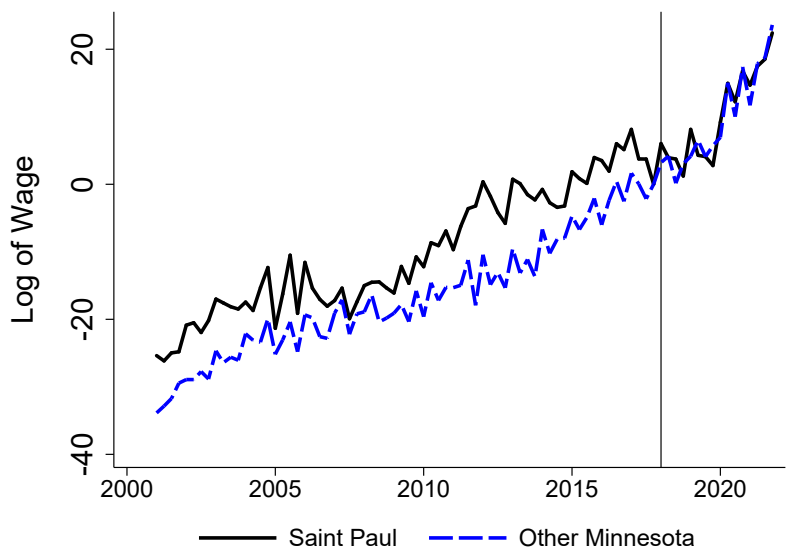
Retail time series

back



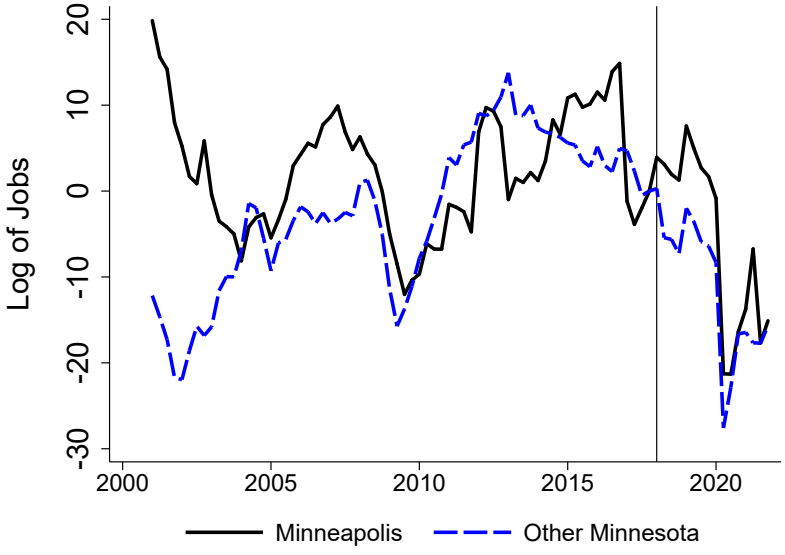


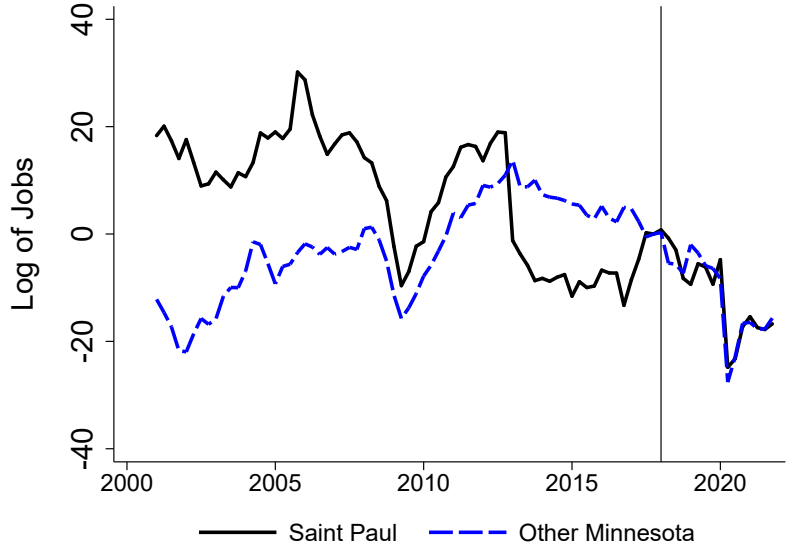


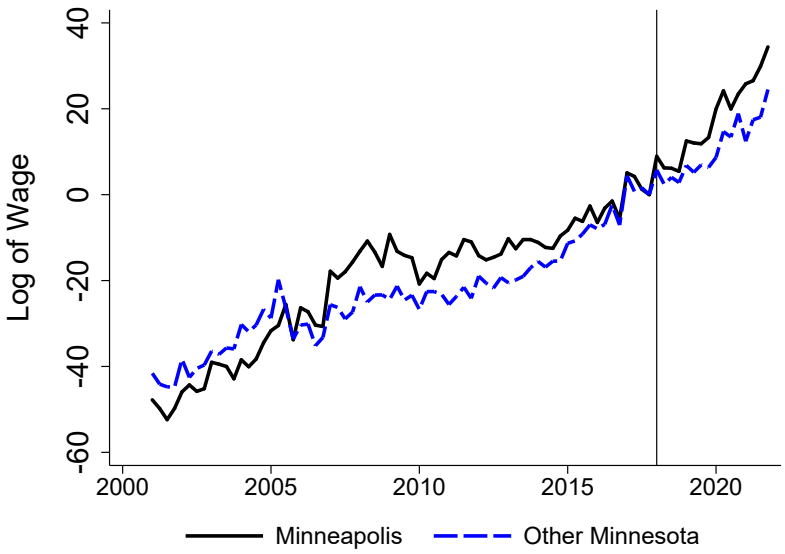


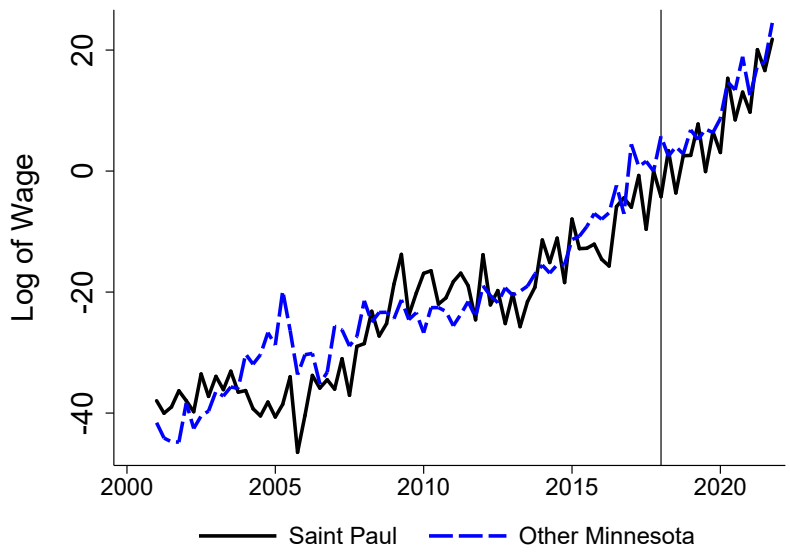
Administration and Support time series

back



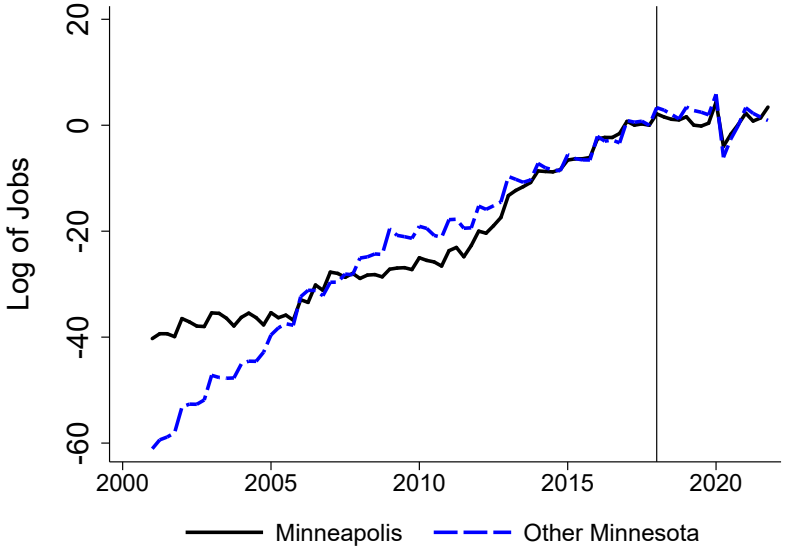


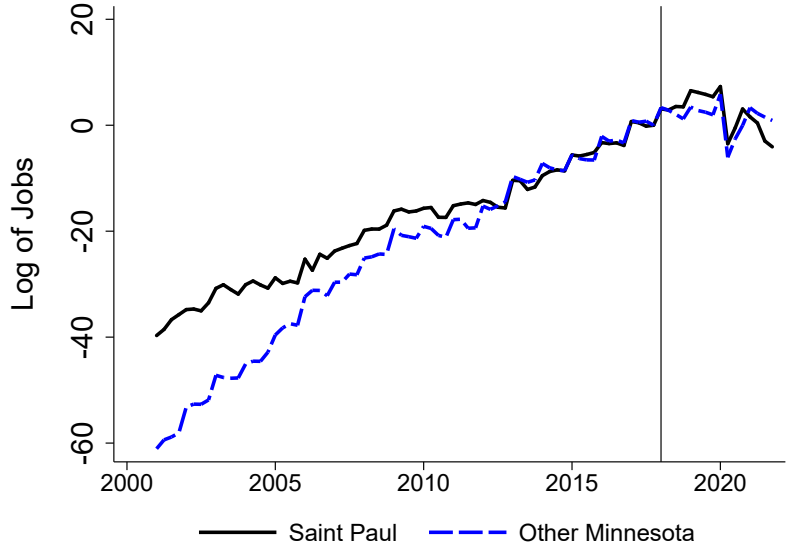


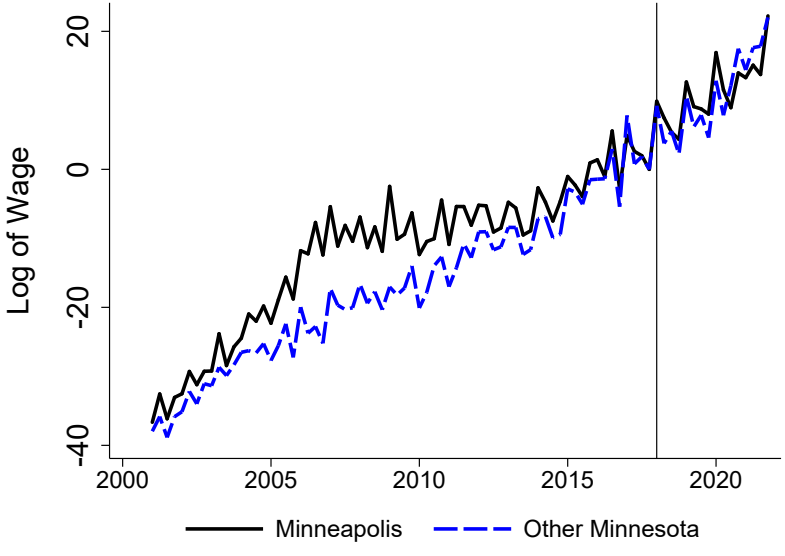


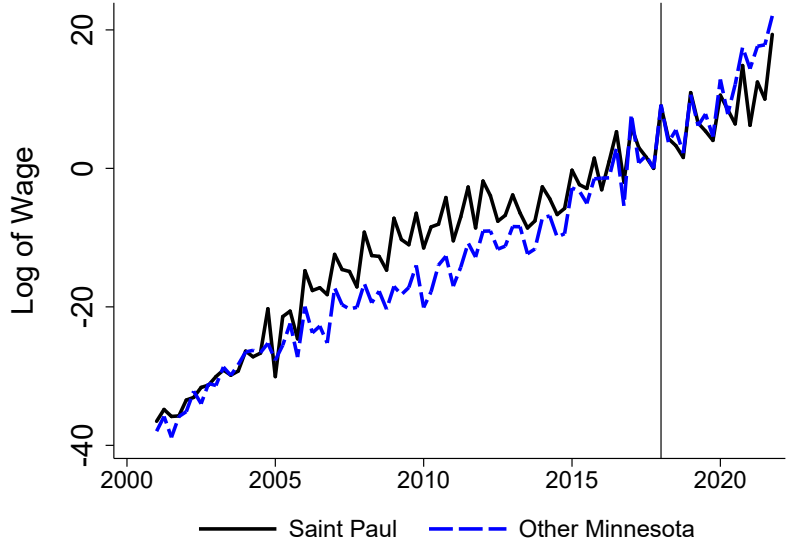
Health Care and Social Assistance time series

back



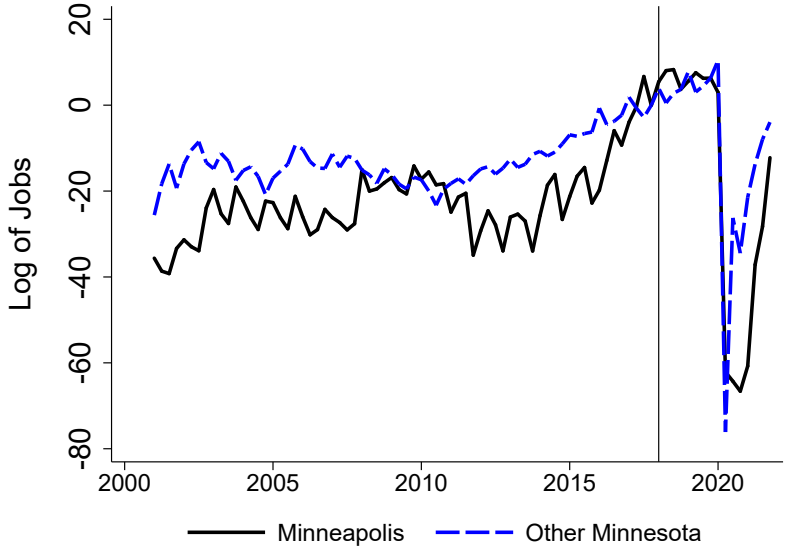


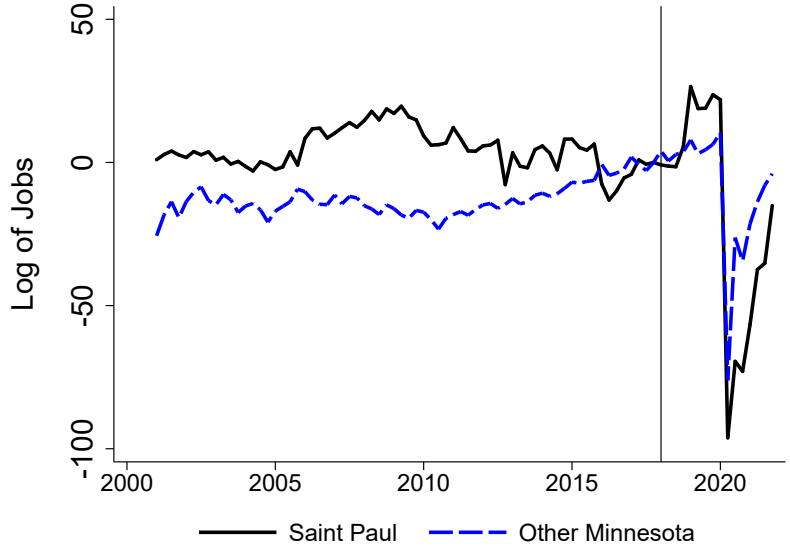


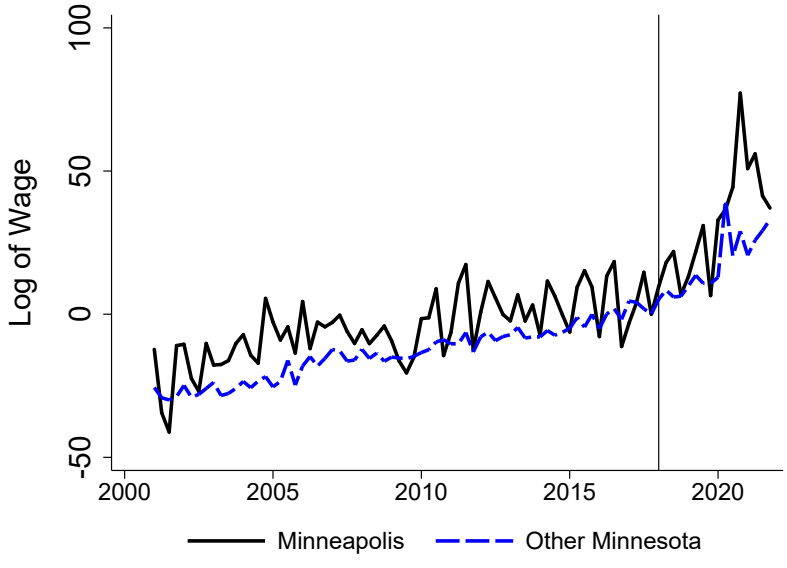


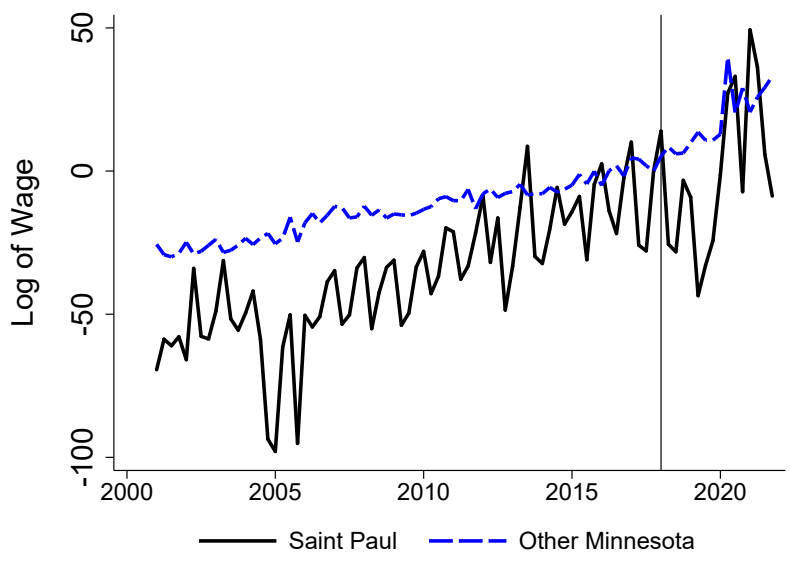
Arts, Entertainment, and Recreation time series

back



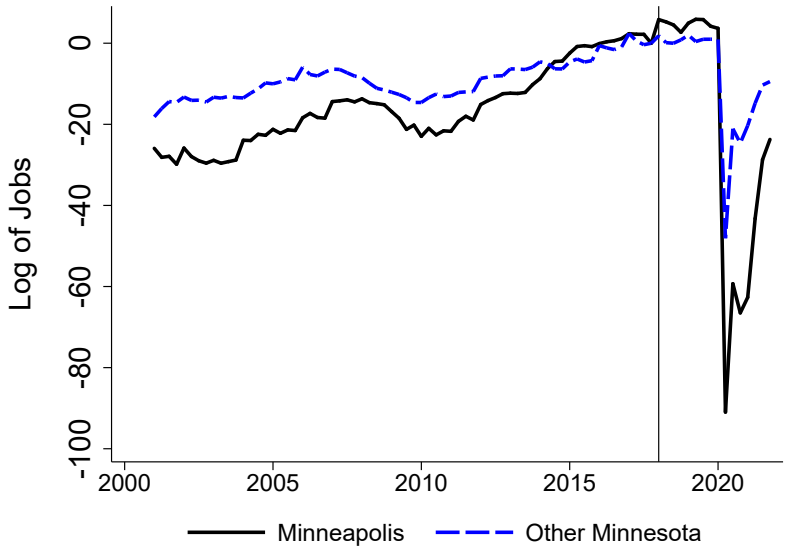


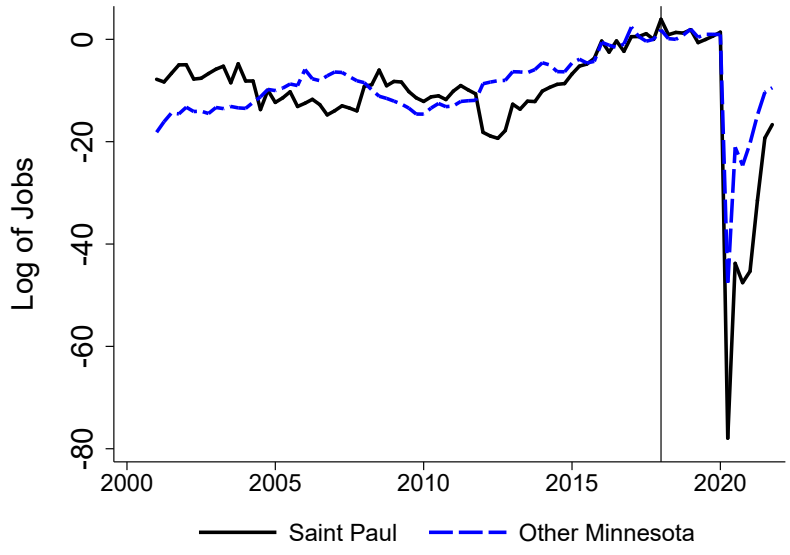


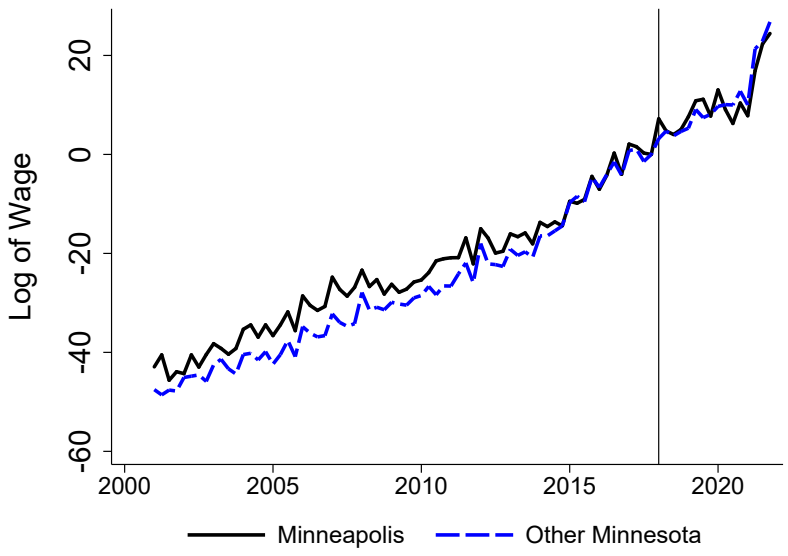


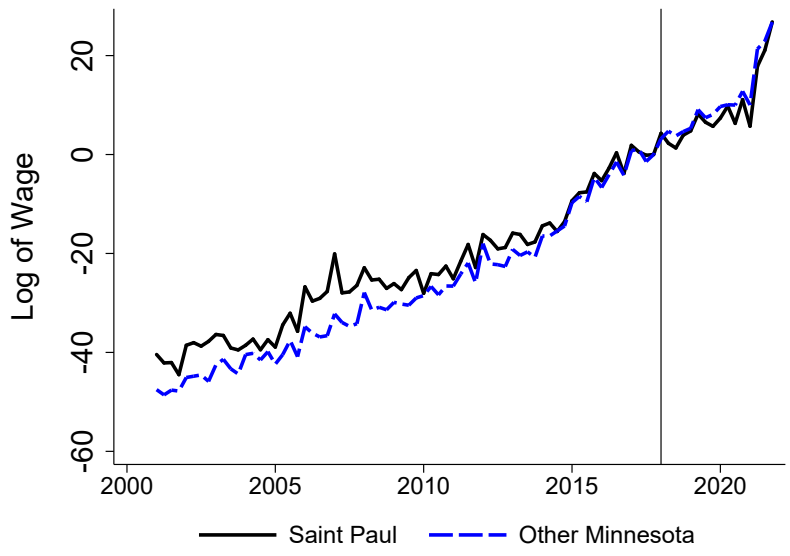
Accommodation and food time series

back



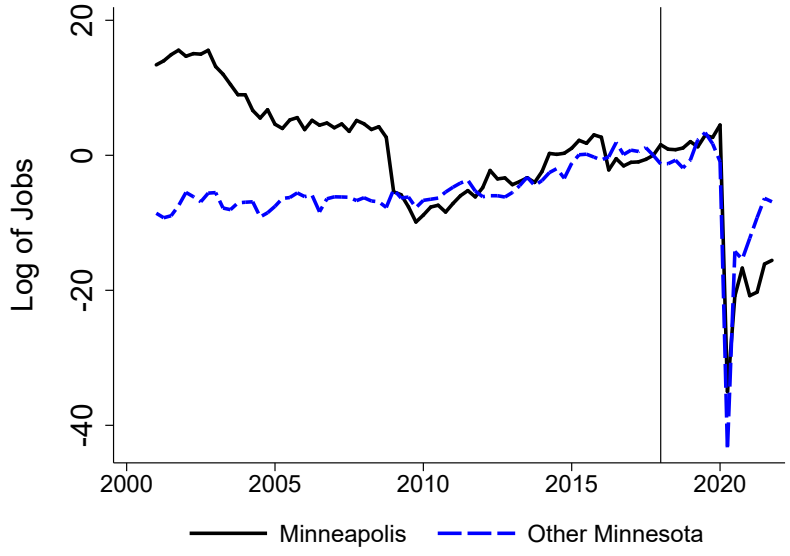


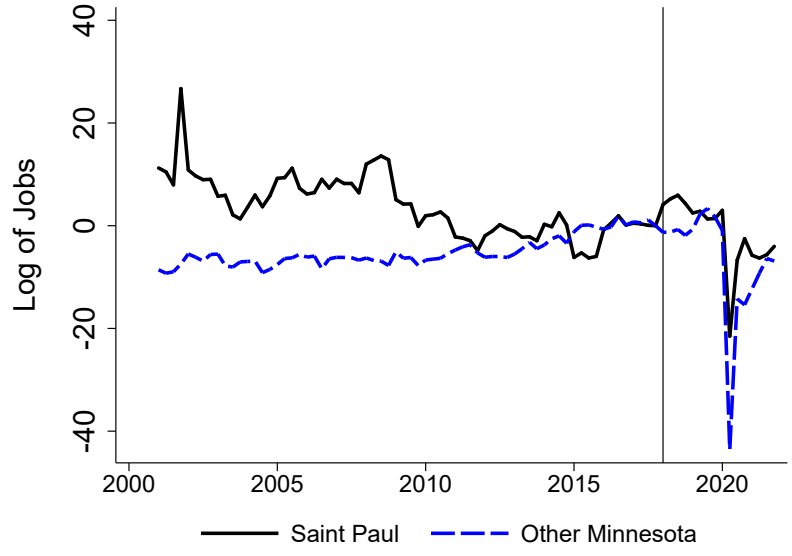


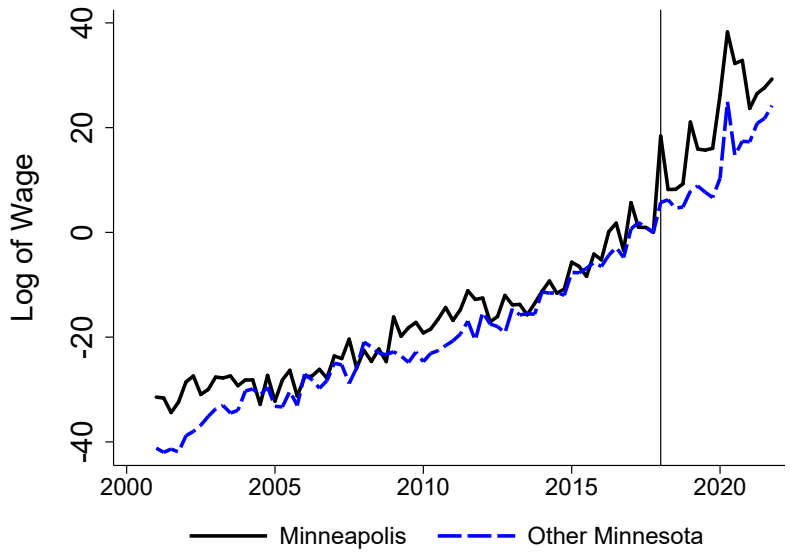


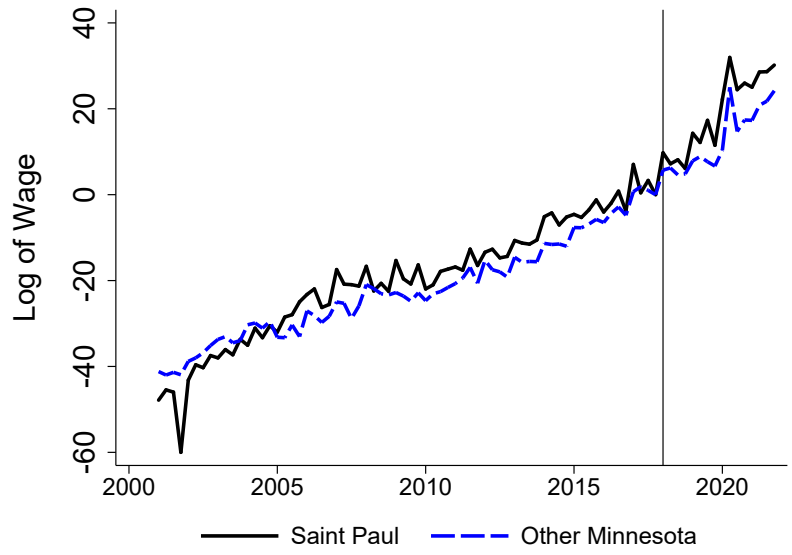
Other Services time series

back



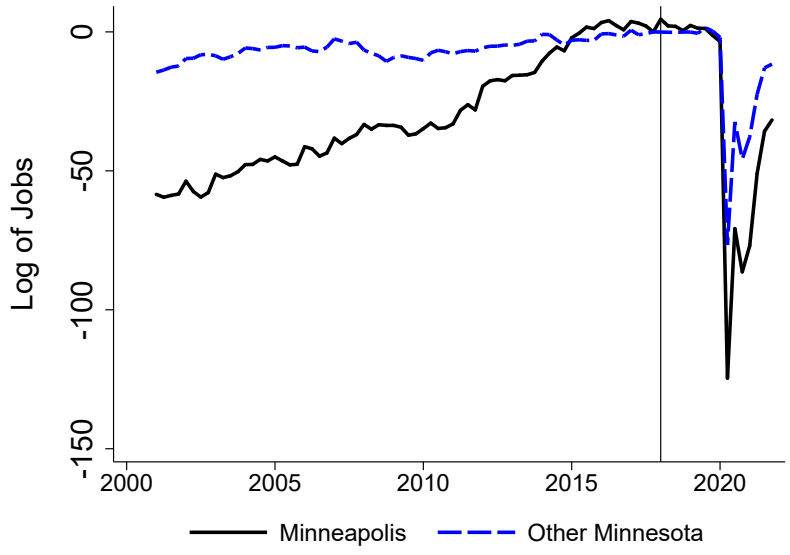


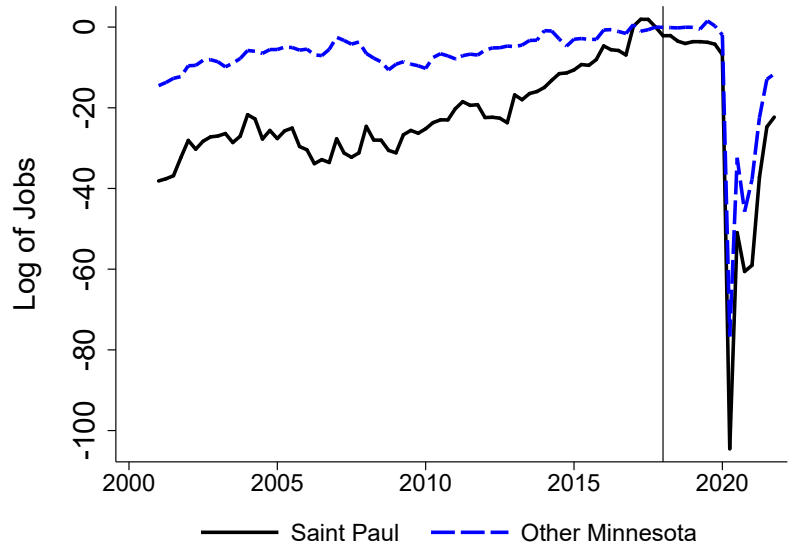


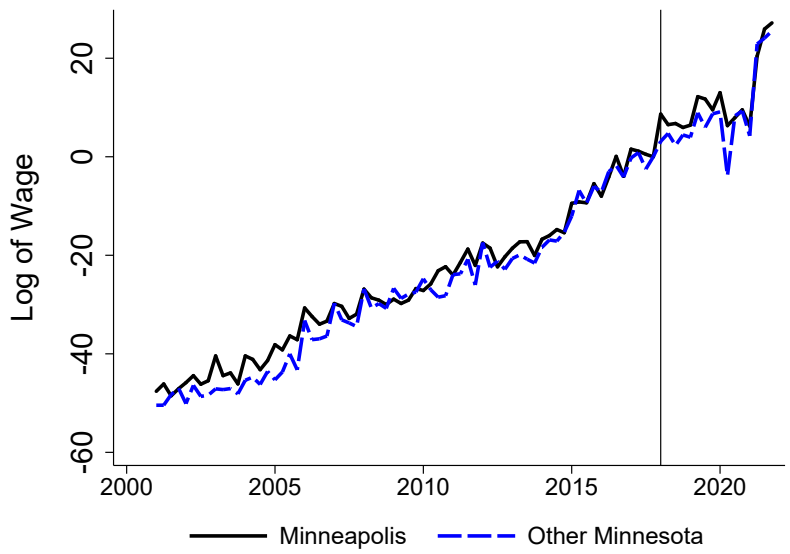


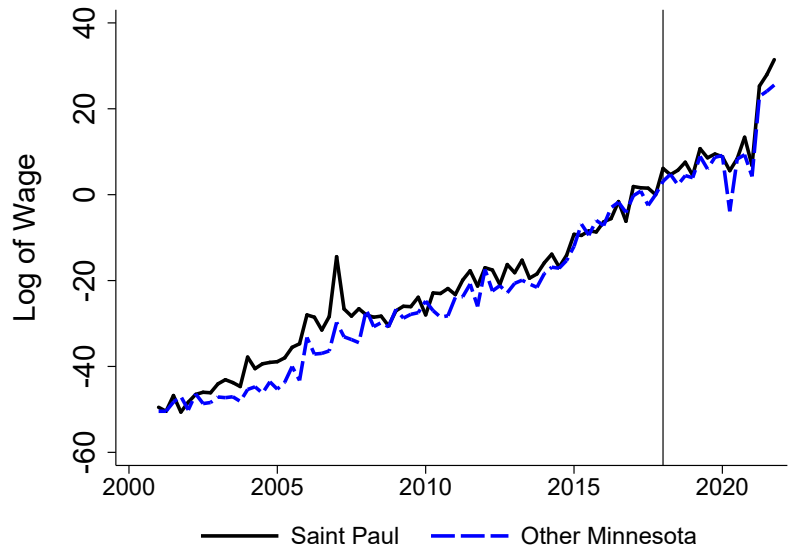
Full-Service Restaurants time series

back



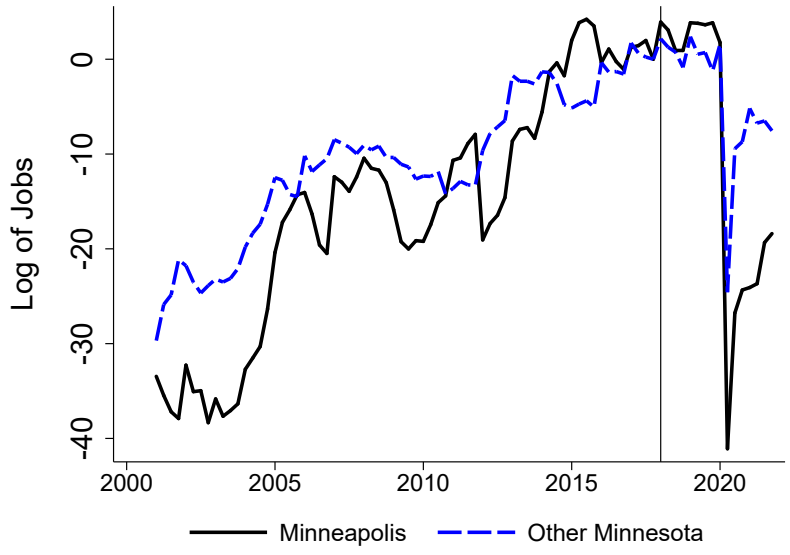


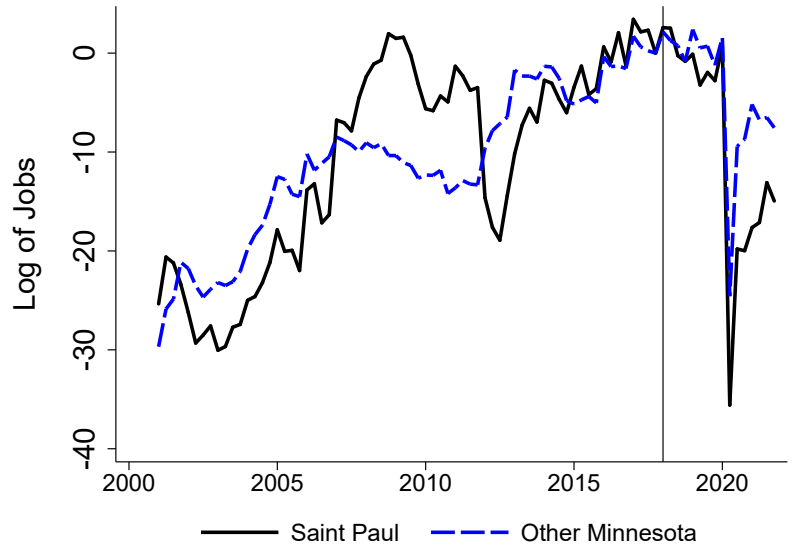


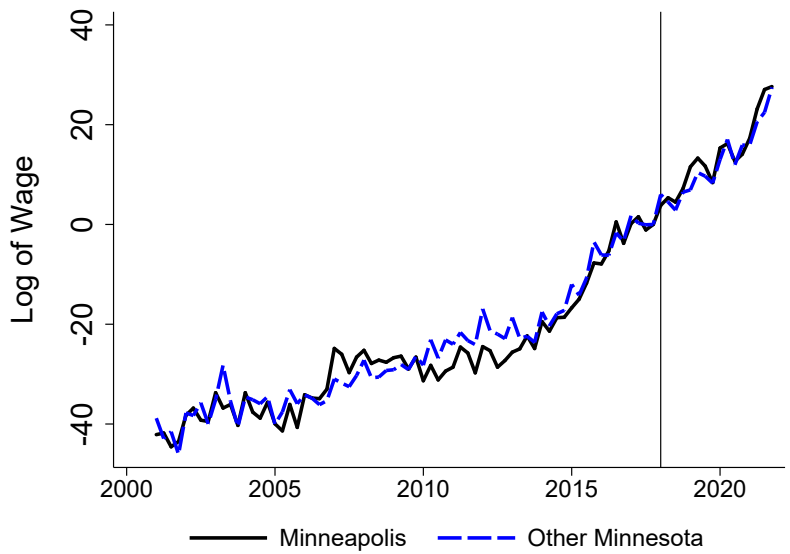


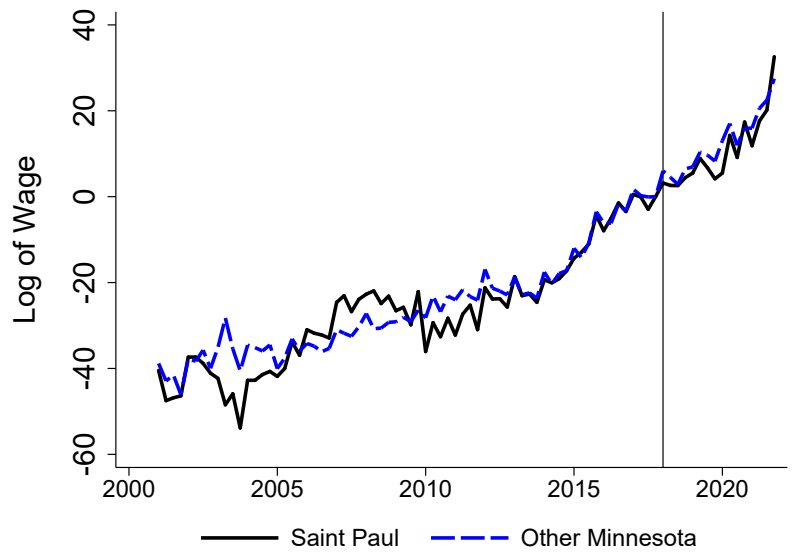
Limited-Service Restaurants time series

back









Adding time weights

back

[Based on Arkhangelsky, Athey, Hirshberg, Imbens, Wager (2021).]

Synthetic difference-in-differences estimator:

$$\left(\hat{\tau}, \hat{\alpha}, \hat{\beta}\right) = \arg\min_{\tau,\alpha,\beta} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} \left(Y_{it} - \alpha_i - \beta_t - \tau W_{it}\right)^2 \hat{\omega}_i \hat{\lambda}_t \right\},$$

$$(\hat{\omega}_0, \hat{\omega}_i) = \arg\min_{\omega} \sum_{t=1}^{T_{\text{pre}}} \left(\omega_0 + \sum_{i=1}^{N_{\text{co}}} \omega_i Y_{it} - N_{\text{tr}}^{-1} \sum_{i=N_{\text{co}}+1}^{N} Y_{it} \right)^2 + \text{reg.},$$

$$(\hat{\lambda}_0, \hat{\lambda}_t) = \arg\min_{\lambda} \sum_{i=1}^{N_{\text{co}}} \left(\lambda_0 + \sum_{t=1}^{T_{\text{pre}}} \lambda_t Y_{it} - T_{\text{post}}^{-1} \sum_{t=T_{\text{pre}}+1}^{T} Y_{it} \right)^2.$$

Consistency of synthetic control

back

[Based on Abadie, Diamond, Hainmueller (2010).]

- Factor model ("true model"):

$$Y_{it} = \underbrace{\beta_t + Z_i\theta_t + \mu_i\gamma_t + u_{it}}_{=\tilde{Y}_{it}} + \sum_{s=T_{\text{pre}}+1}^{T} \tau_s W_{is}.$$

- Synthetic control $\hat{\tau}_s = Y_{Ns} - \sum_{i=1}^{N_{\text{co}}} \omega_i Y_{is}, \forall s = T_{\text{pre}}, ..., T$, is unbiased estimator of τ_s if:

1. Perfect fit. There exist $\omega_1, ..., \omega_{N_{\text{co}}}$ such that:

$$\sum_{i=1}^{N_{\text{co}}} \omega_i [Y_{it}, Z_i]' = [Y_{Nt}, Z_i]', \quad \forall t = 1, ..., T_{\text{pre}}.$$

2. Small "scale" of u_{it} relative to pre-intervention periods T_{pre}.

Assessing the bias I

back

- Data generating process:

$$Y_{it} = \alpha_i + \beta_t + \sum_{k=1}^{4} \mu_i^k \gamma_t^k + u_{it} + \sum_{s=T_{\text{pre}}+1}^{T} \tau_s W_{is},$$

- $\alpha_i = (1/T) \cdot \sum_{t=1}^{T} Y_{it}$, for all $i = 1, ..., N_{\text{co}}$.
- $\alpha_N = (1/T_{\text{pre}}) \cdot \sum_{t=1}^{T_{\text{pre}}} Y_{Nt}$.
- $\beta_t = (1/N_{\text{co}}) \cdot \sum_{i=1}^{N_{\text{co}}} Y_{it}$, for all $t = 1, ..., T$.
- Residualized $\bar{Y}_{it} = Y_{it} - \alpha_i - \beta_t$ for $i = 1, ..., N$.

Assessing the bias II

back

- Estimate γ_t^k and μ_i^k using $\bar{Y}_{it}$ for units $i = 1, ..., N_{\text{co}}$ and time $t = 1, ..., T$.
- Treated units has the β_t and γ_t^k of the control group and we are missing an estimate of its μ_N^k.
- Estimate μ_N^k by using the interactive fixed effects model on all units' $\bar{Y}_{it}$ including the treated units for the pre-treatment period $t = 1, ..., T_{\text{pre}}$.
- Obtain residuals u_{it} for all i and t using the estimates of the α_i, β_t, μ_i^k, γ_t^k.

Weighting of zip codes

back

- For jobs, hours, and earnings, in *treated* zip codes, we define:

$$Y_{it} \equiv (\log y_{it} - \log y_{i,t-4})\,\bar{\nu}_i,$$

  $\nu_{i,t}$ is zip code i share in 2015-2017.

- Weighted growth of zip codes equals growth of treated city, as if treated city had the same composition prior to treatment.

- We do not employment-weight zip codes of *control* because they are absorbed by synthetic control weight ω_i.

Pre-treatment fit in Minneapolis

back

	Wage		Jobs		Hours		Earnings	
(R-squared, percent)	SDD	DD	SDD	DD	SDD	DD	SDD	DD
Retail Trade (44)	84	25	84	0	77	5	72	3
Admin and Support (56)	53	3	87	12	72	13	80	19
Health Care and Social Asst (62)	94	27	92	7	79	15	91	7
Arts, Entmt, and Recreation (71)	30	5	46	5	45	14	21	5
Accomm and Food (72)	82	41	94	45	93	36	95	58
Other Services (81)	61	0	79	2	78	2	85	12
Full-Service Restaurants (722511)	65	33	86	25	84	38	84	26
Ltd-Service Restaurants (722513)	64	29	62	13	59	4	55	5

SDD: synthetic difference-in-differences; DD: difference-in-differences.

Pre-treatment fit in Saint Paul

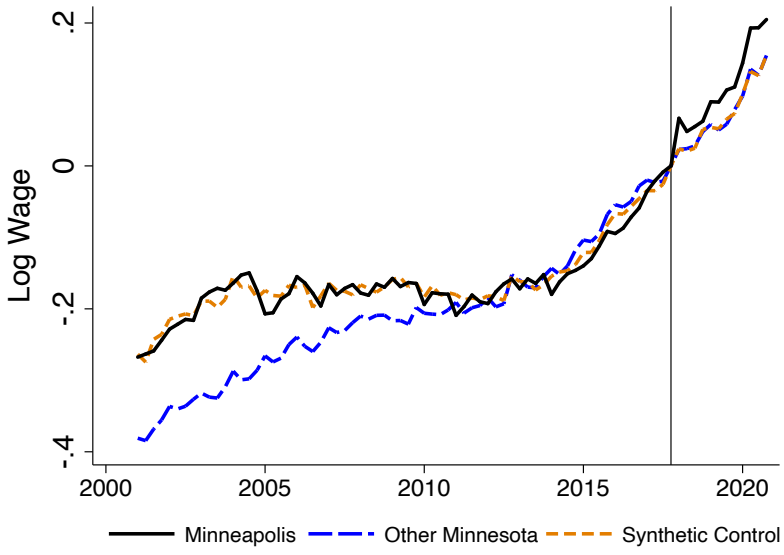
back

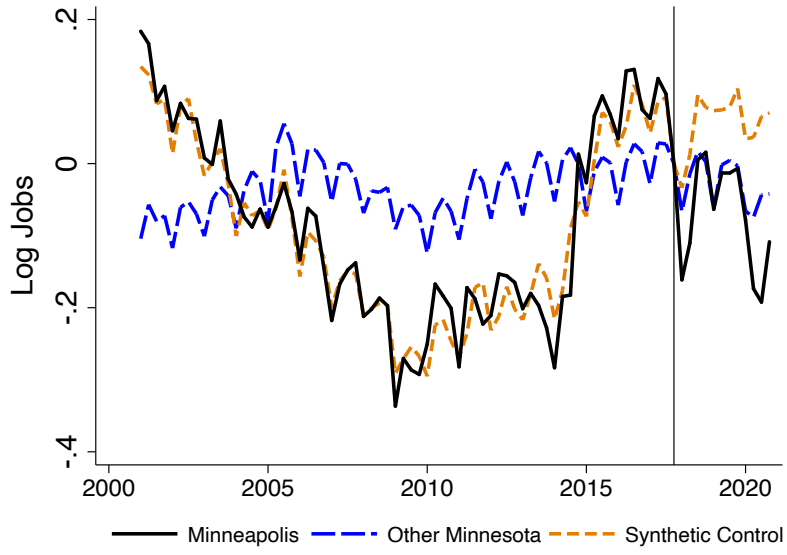
	Wage		Jobs		Hours		Earnings	
(R-squared, percent)	SDD	DD	SDD	DD	SDD	DD	SDD	DD
Retail Trade (44)	70	2	65	1	60	0	67	3
Admin and Support (56)	47	0	69	5	80	12	75	3
Health Care and Social Asst (62)	90	14	91	1	95	15	97	34
Arts, Entmt, and Recreation (71)	35	9	32	2	53	3	31	0
Accomm and Food (72)	77	40	70	6	57	0	68	13
Other Services (81)	84	38	85	28	87	14	92	19
Full-Service Restaurants (722511)	79	51	73	2	65	3	67	5
Ltd-Service Restaurants (722513)	66	47	53	3	47	0	59	2

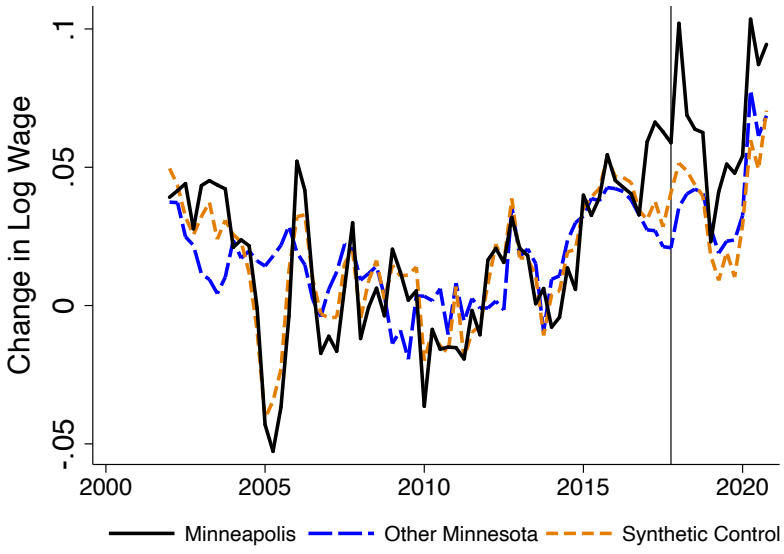
SDD: synthetic difference-in-differences; DD: difference-in-differences.

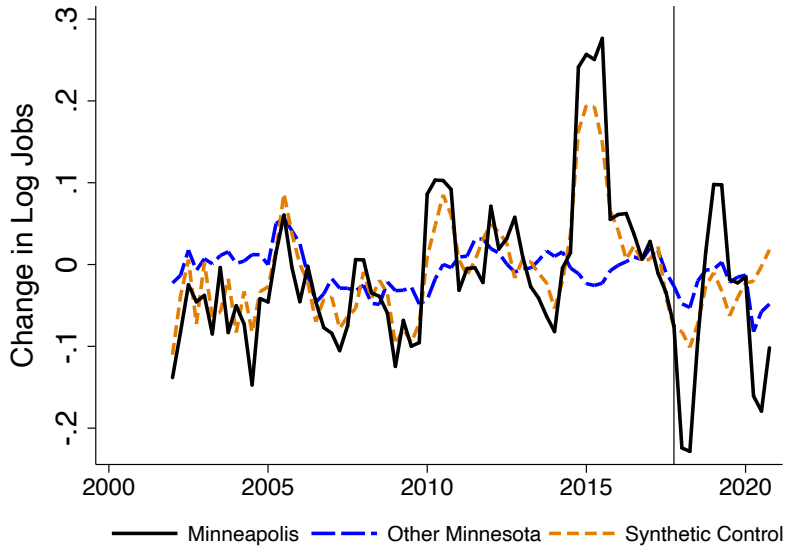
Retail fit in Minneapolis

back



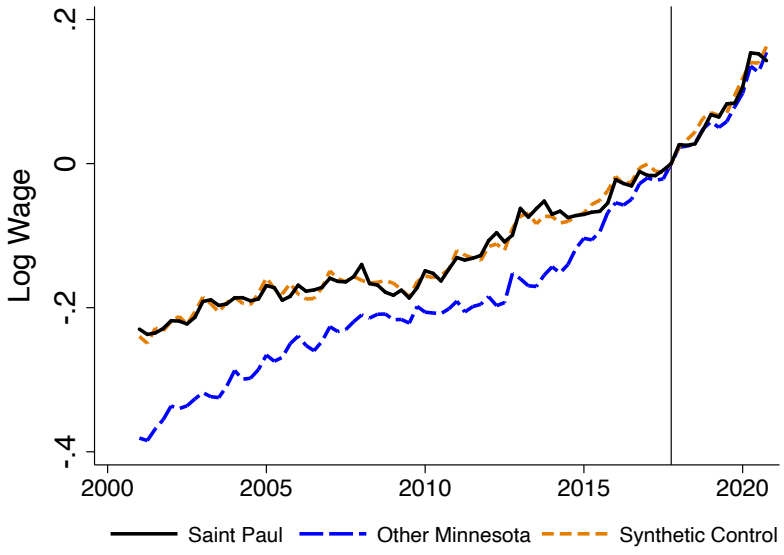


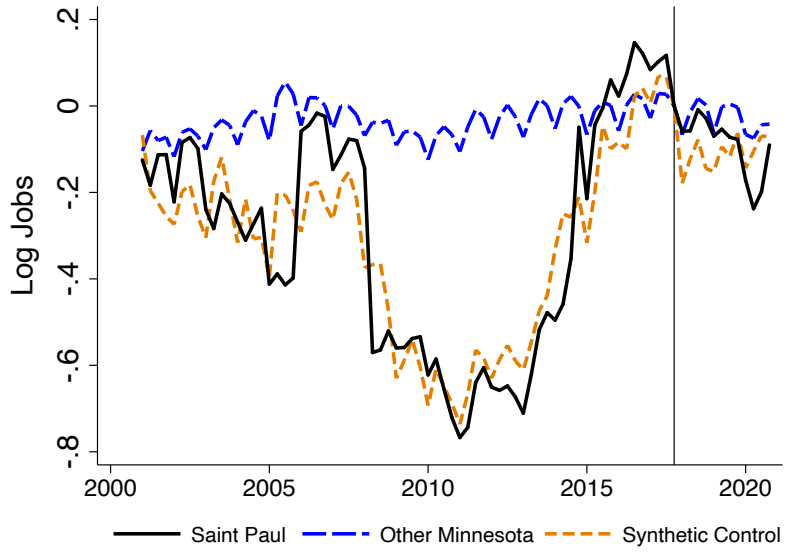


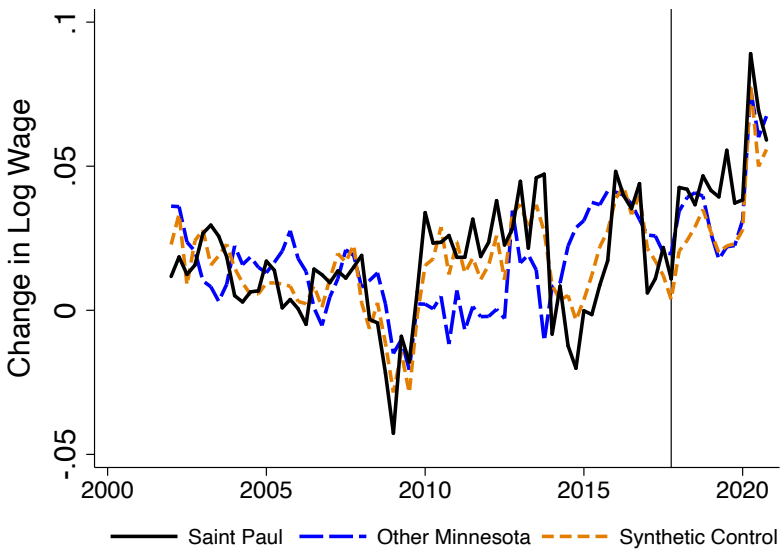


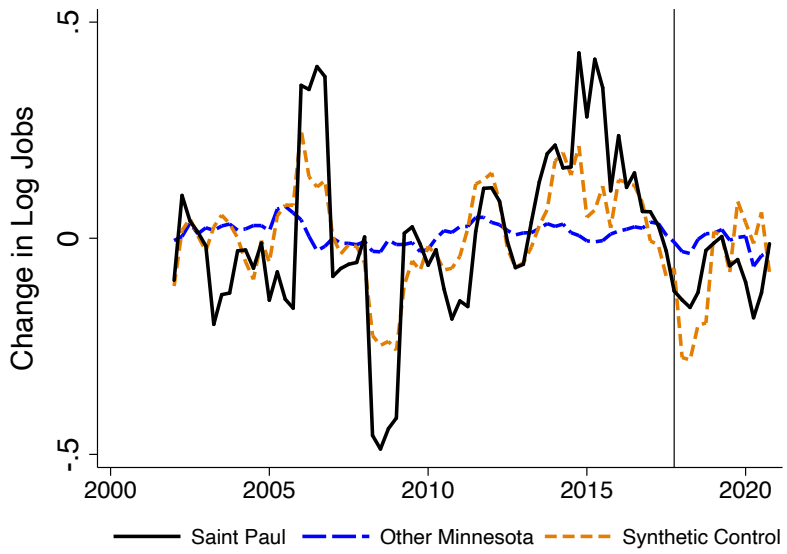
Retail fit in Saint Paul

back



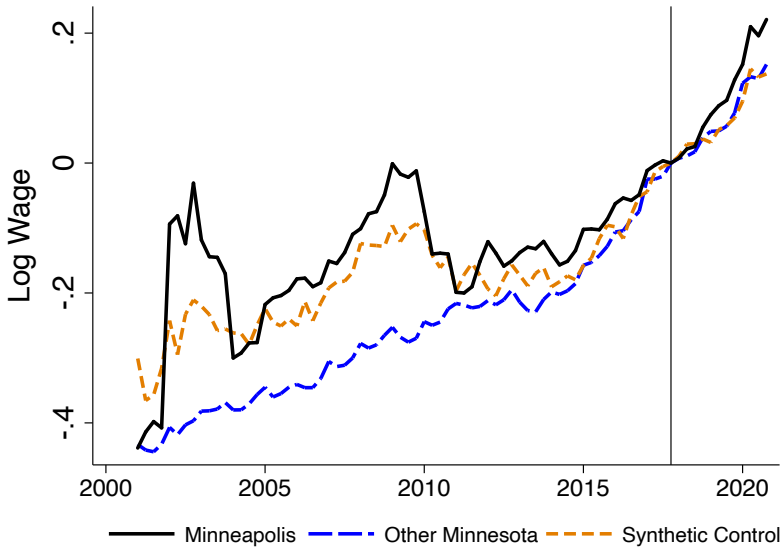


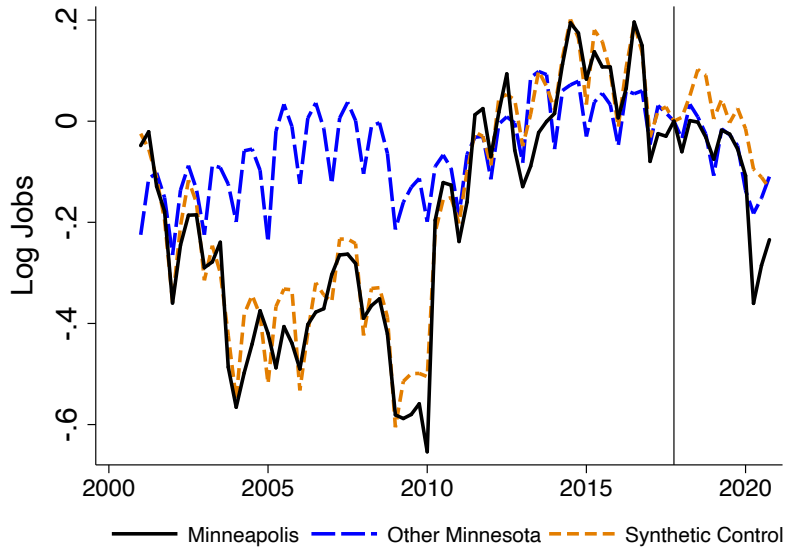


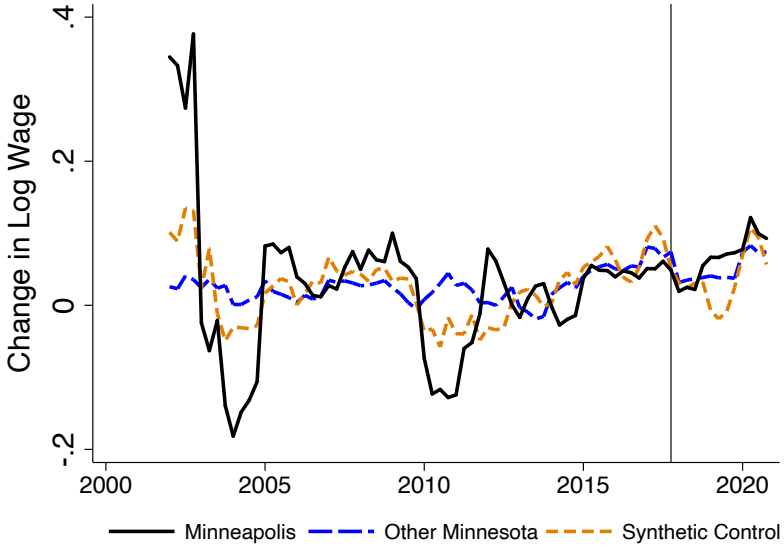


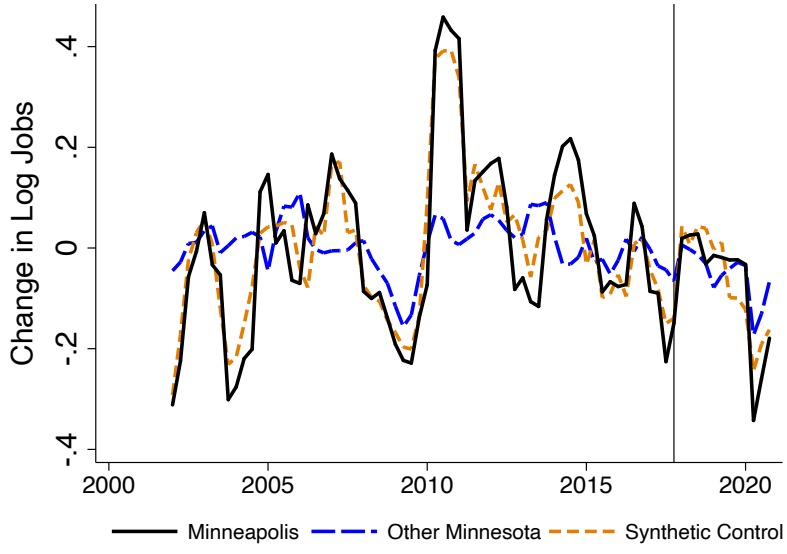
Administration and Support fit in Minneapolis

back



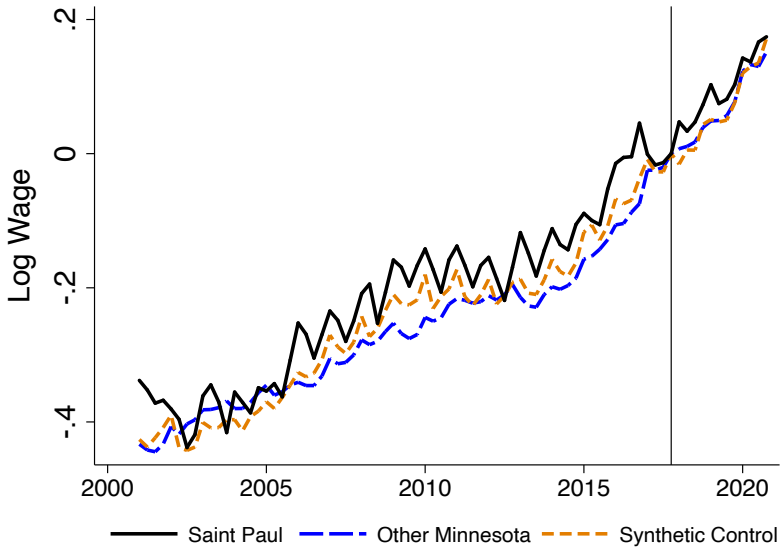


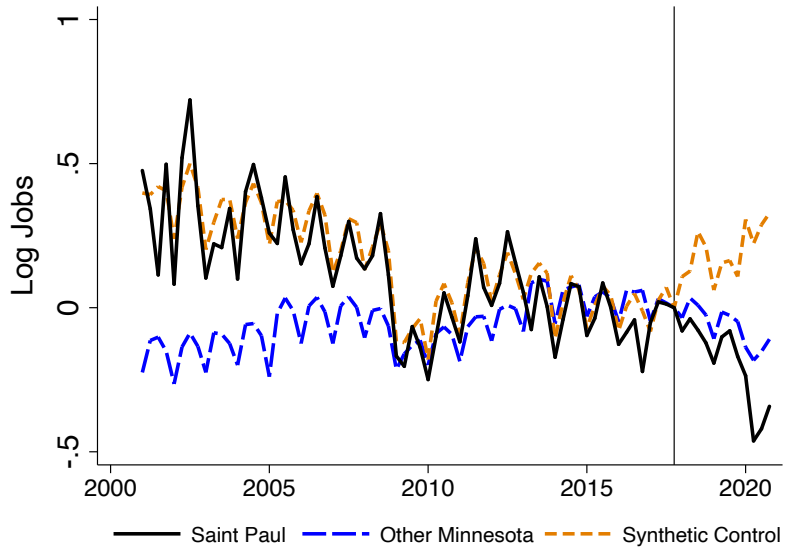


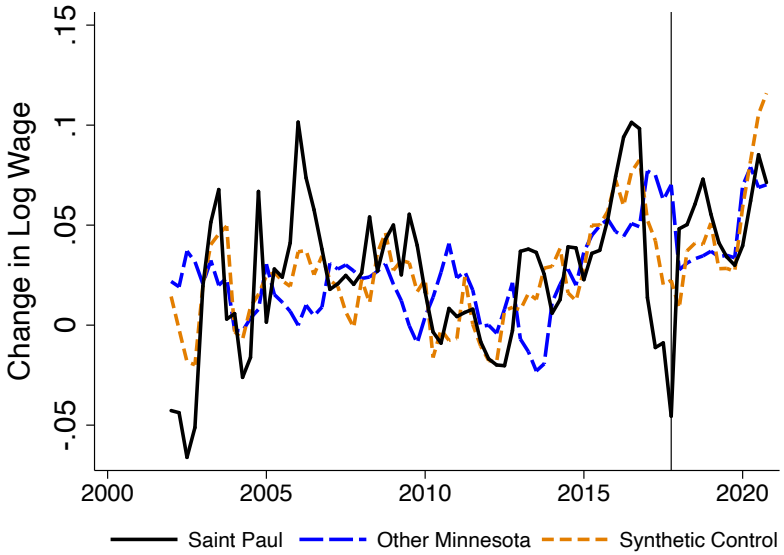


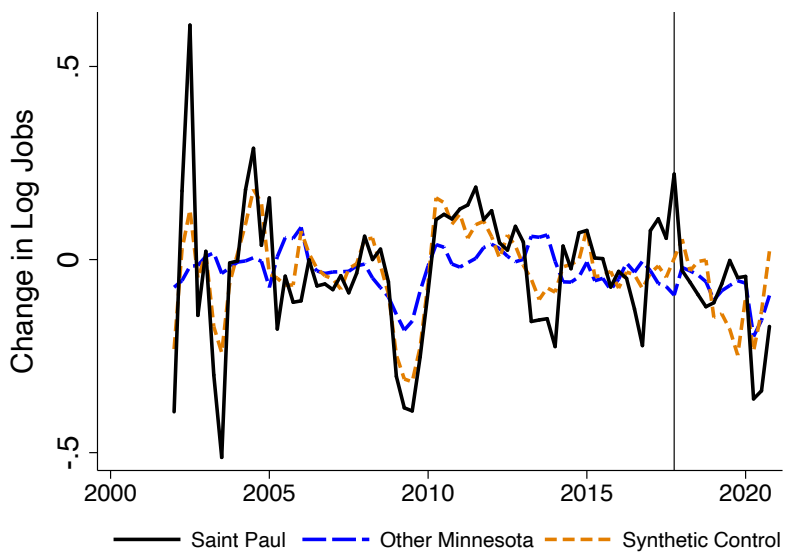
Administration and Support fit in Saint Paul

back



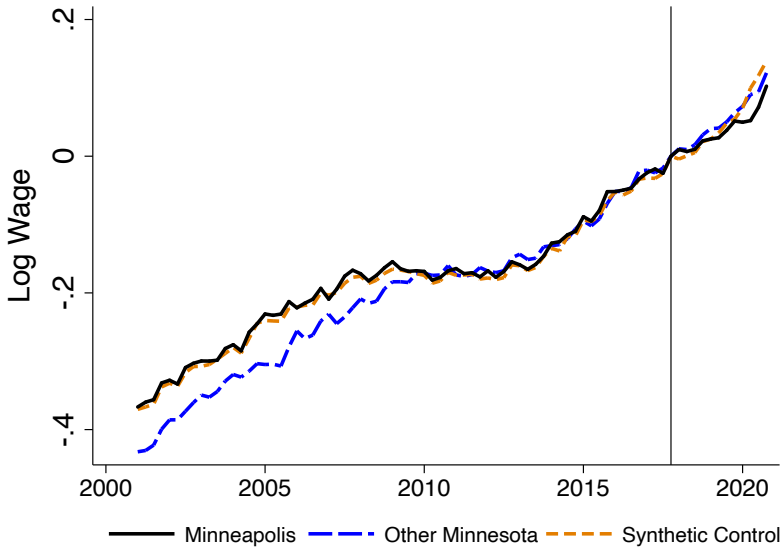


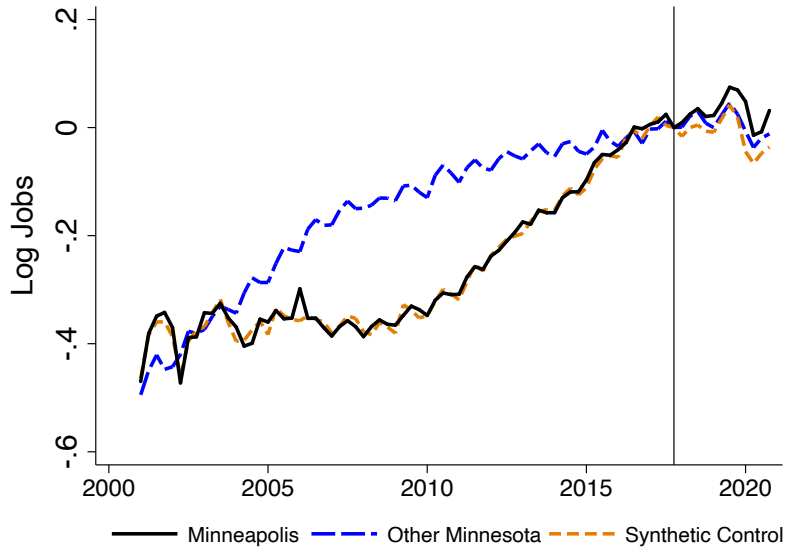


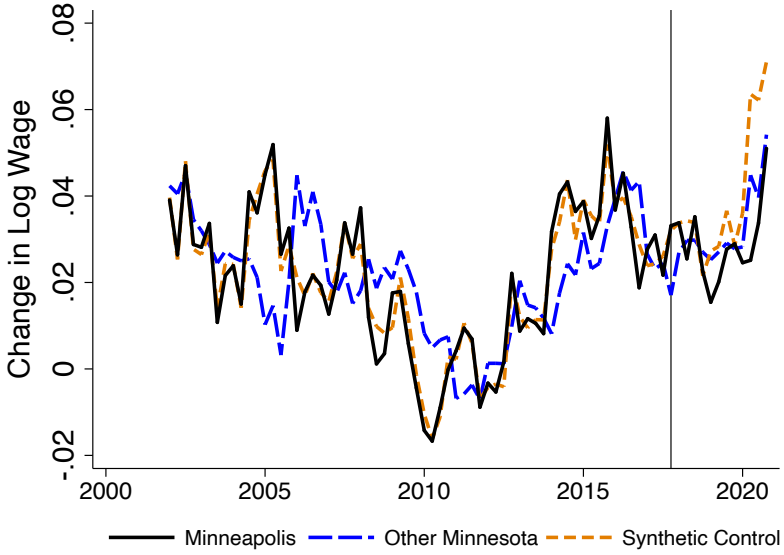


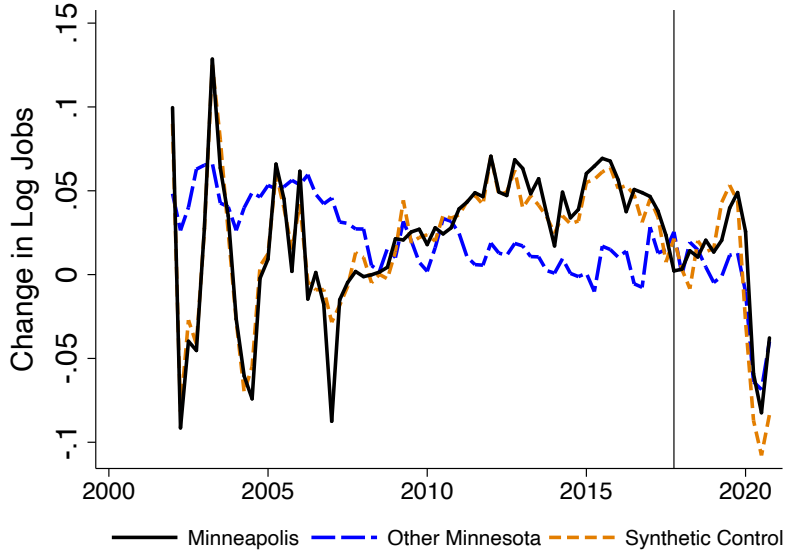
Health Care and Social Assistance fit in Minneapolis

back



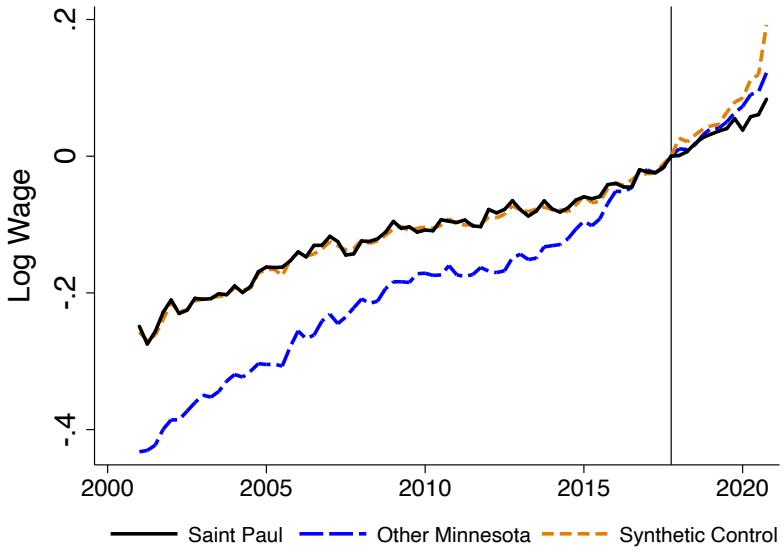


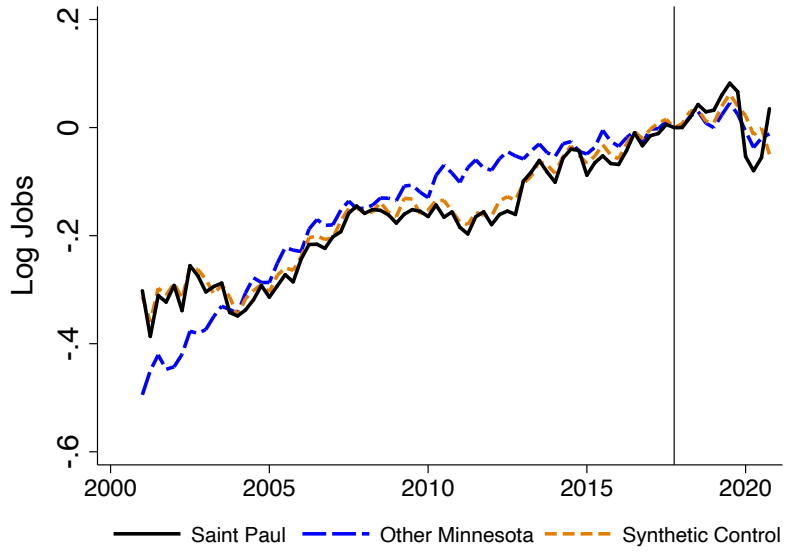


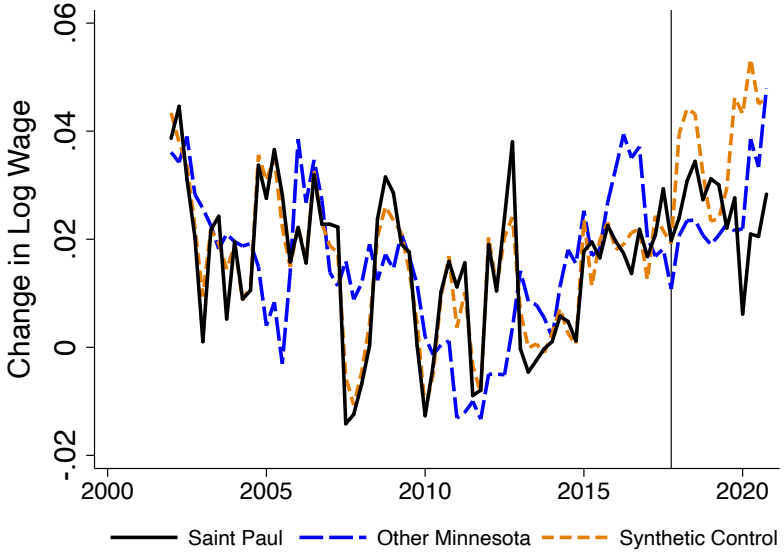


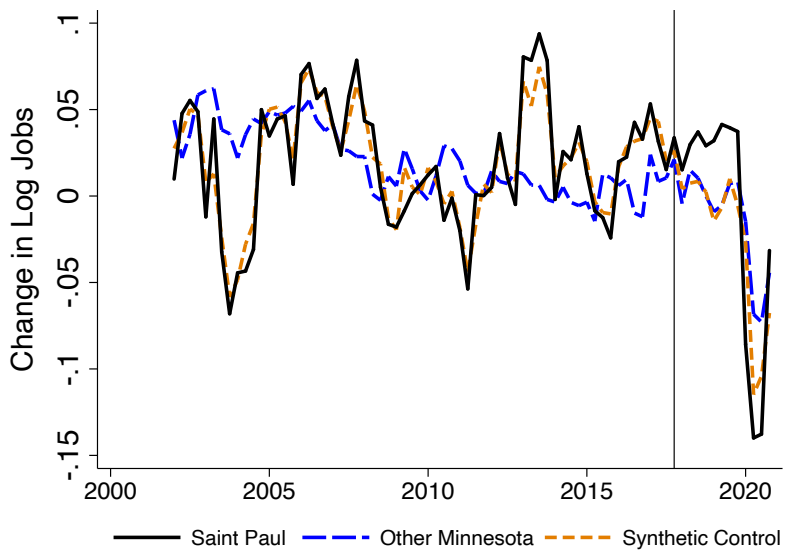
Health Care and Social Assistance fit in Saint Paul

back



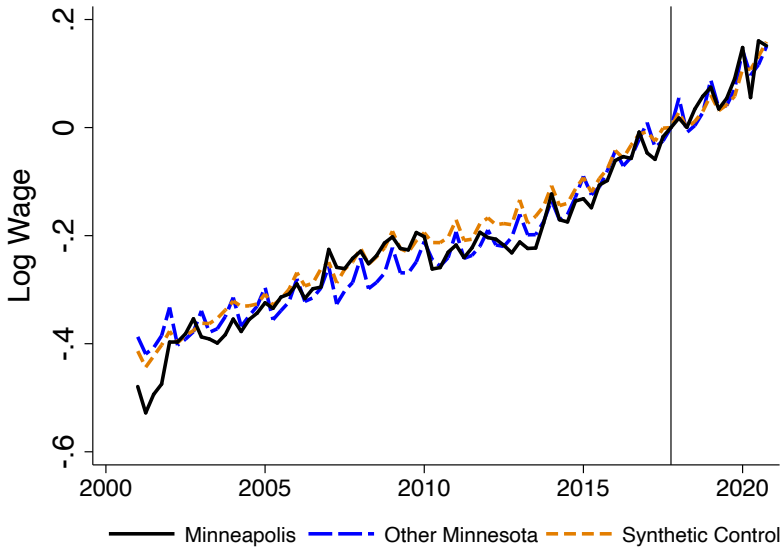


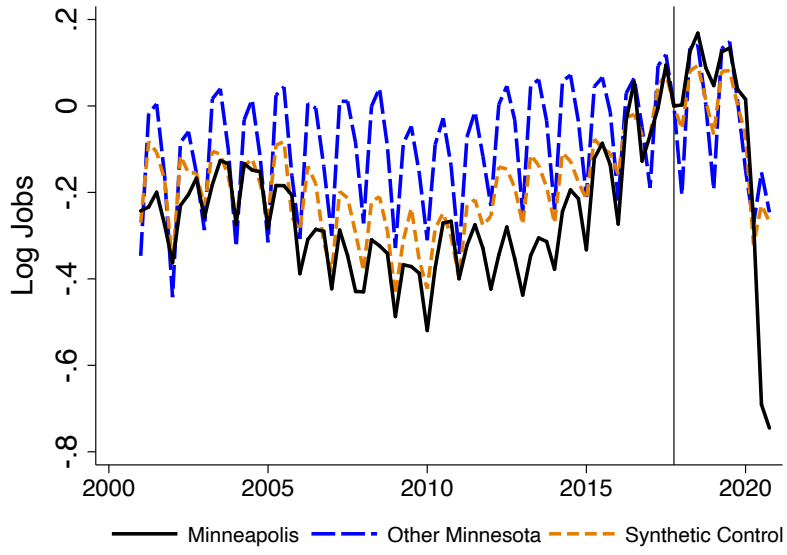


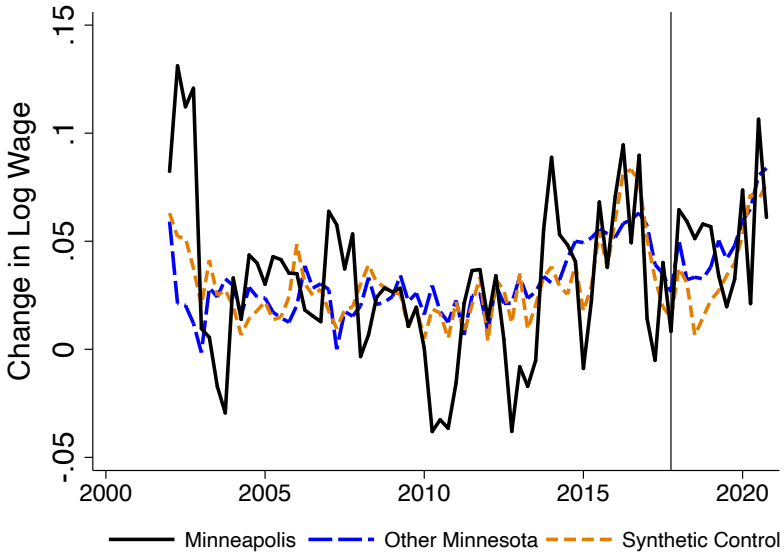


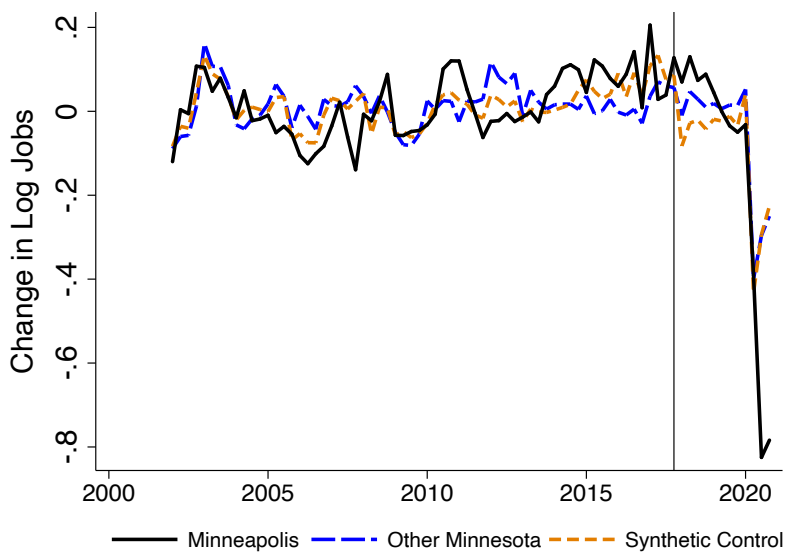
Arts, Entertainment, and Recreation fit in Minneapolis

back



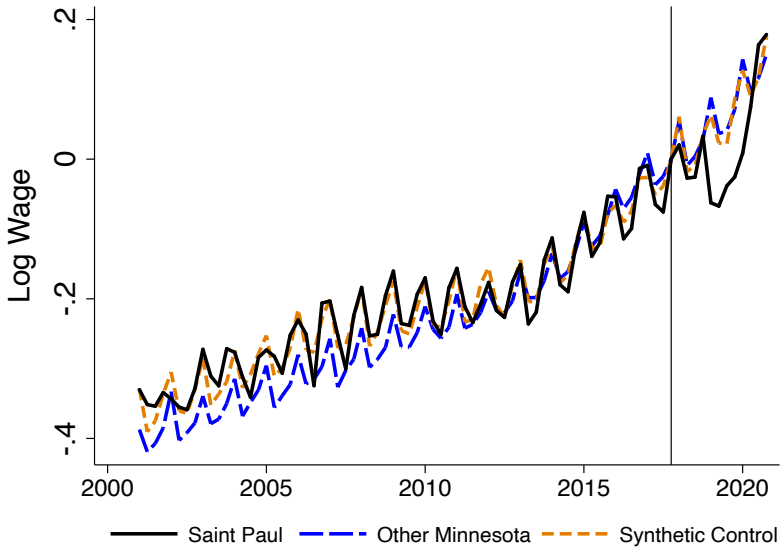


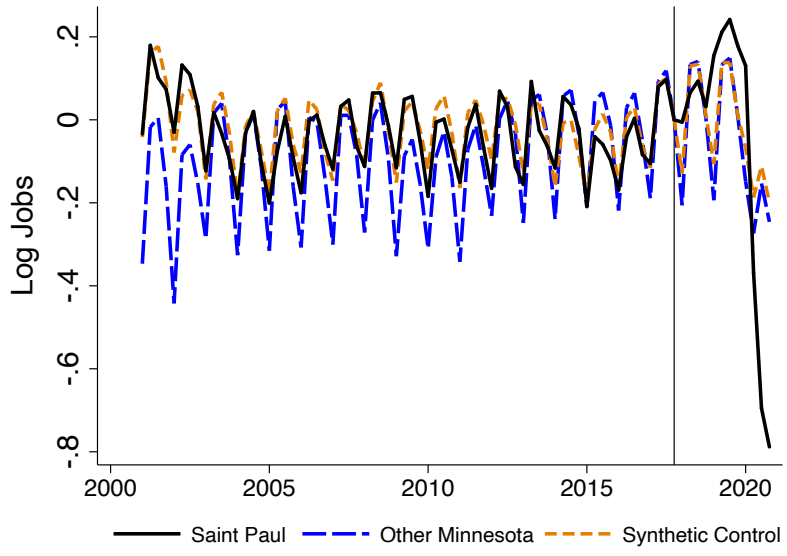


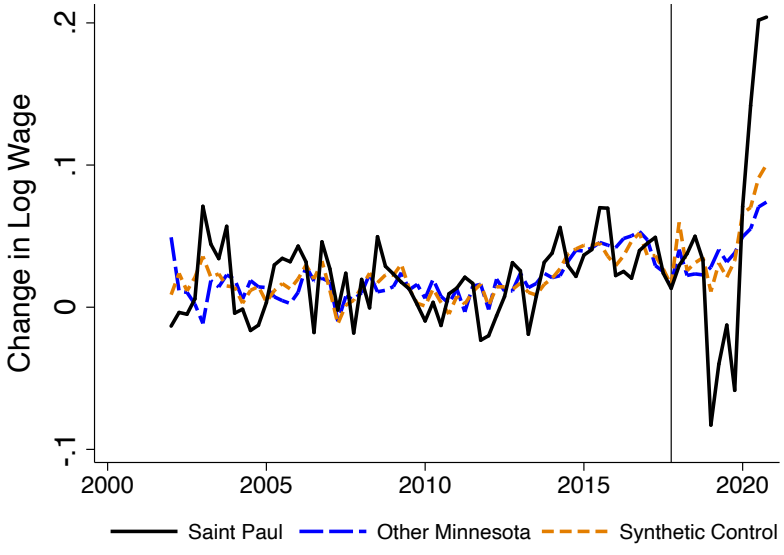


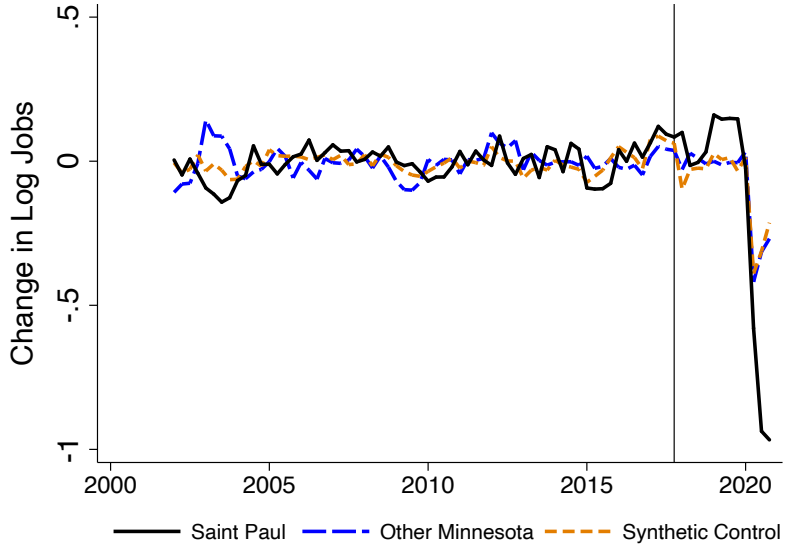
Arts, Entertainment, and Recreation fit in Saint Paul

back



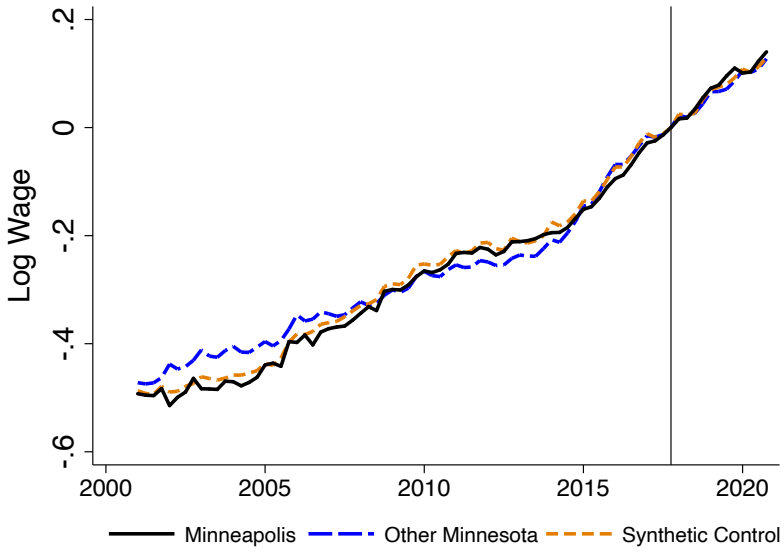


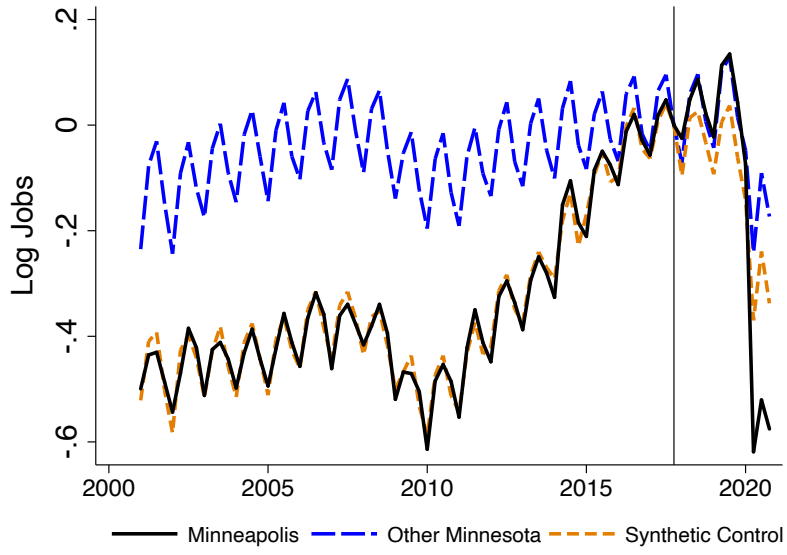


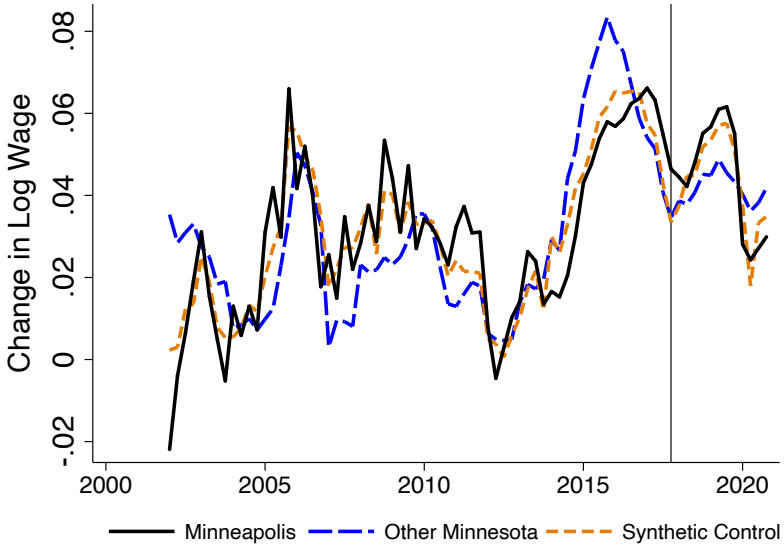


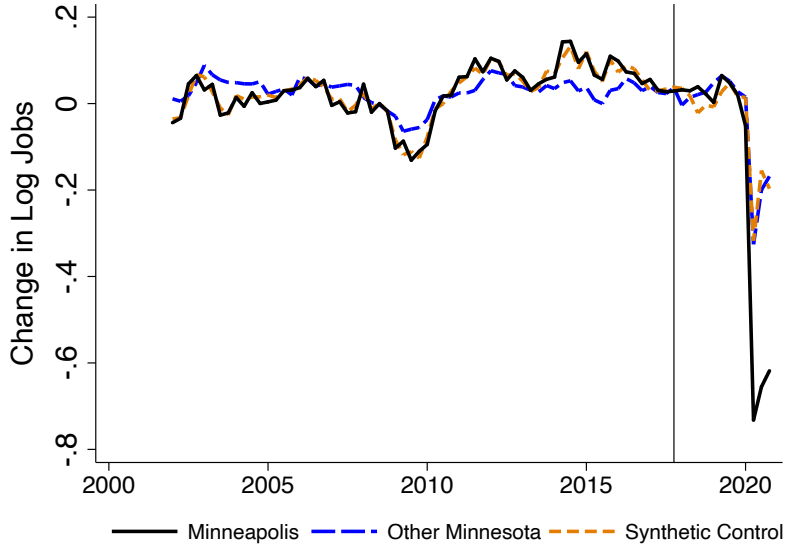
Accommodation and Food Services fit in Minneapolis

back



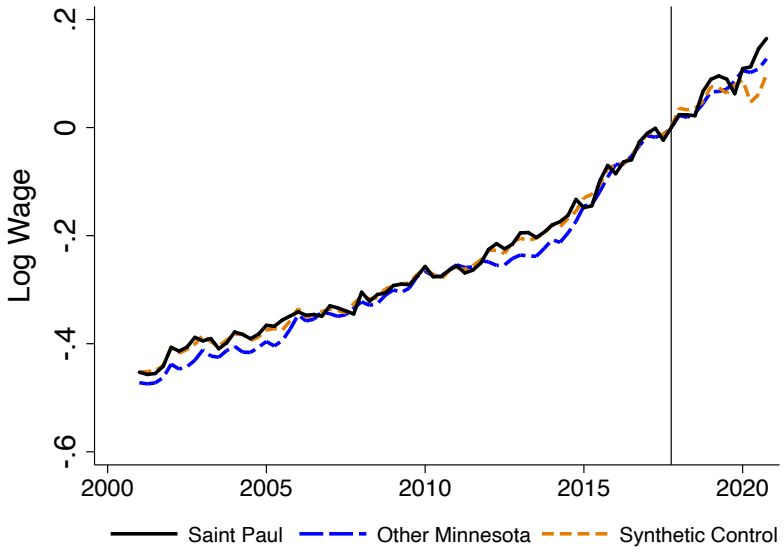


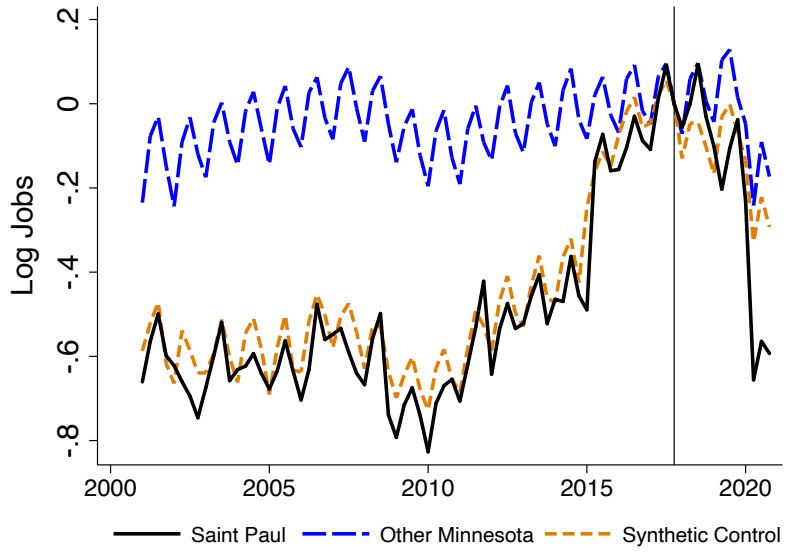


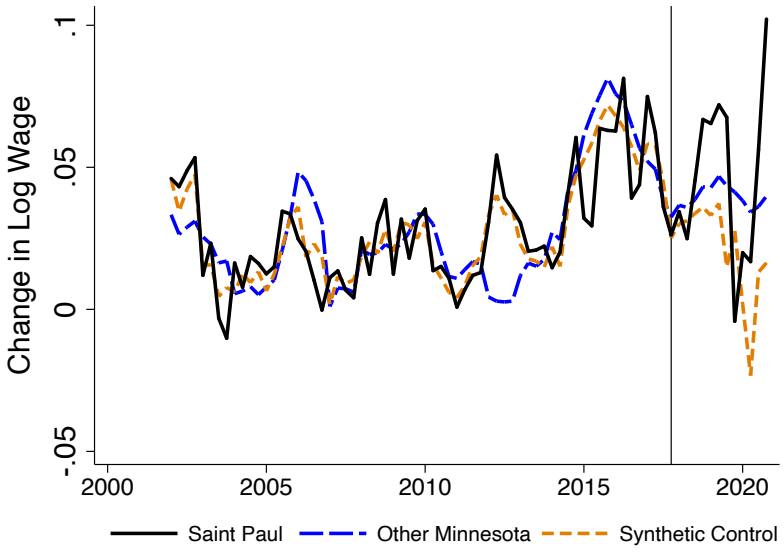


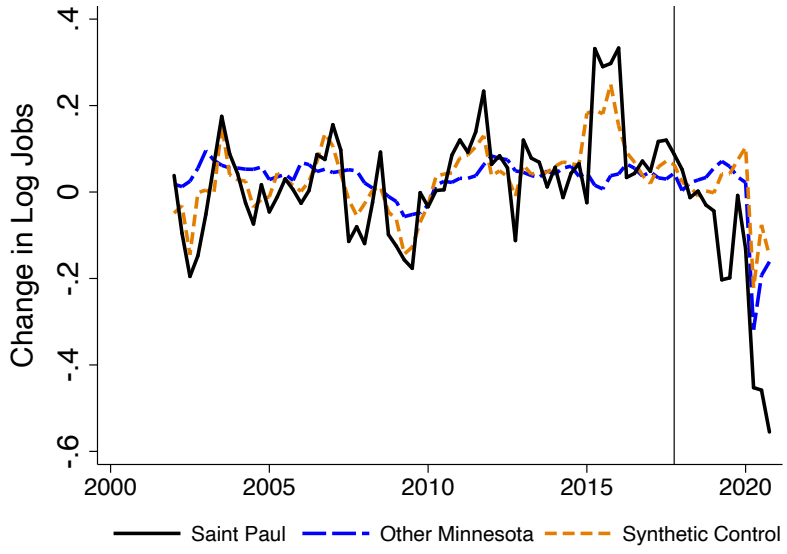
Accommodation and Food Services fit in Saint Paul

back



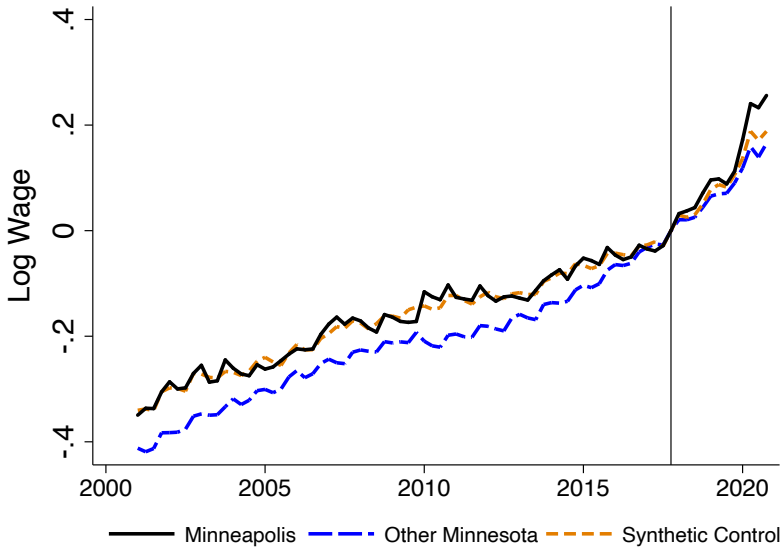


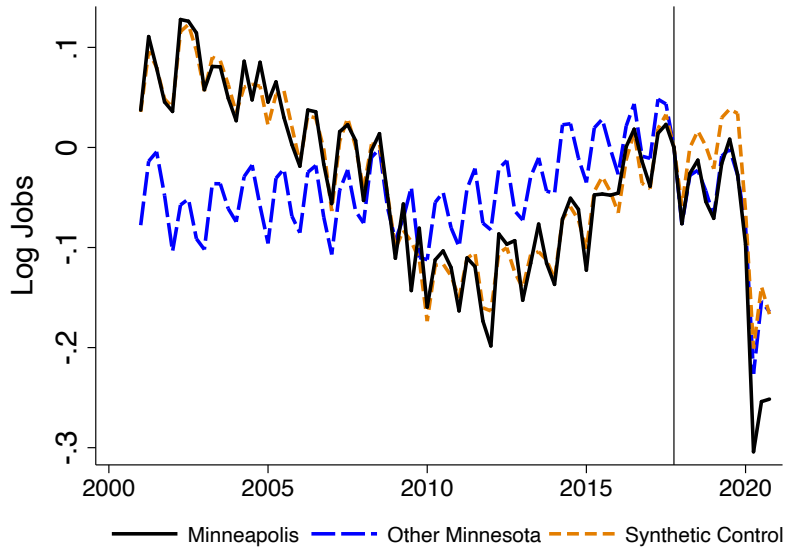


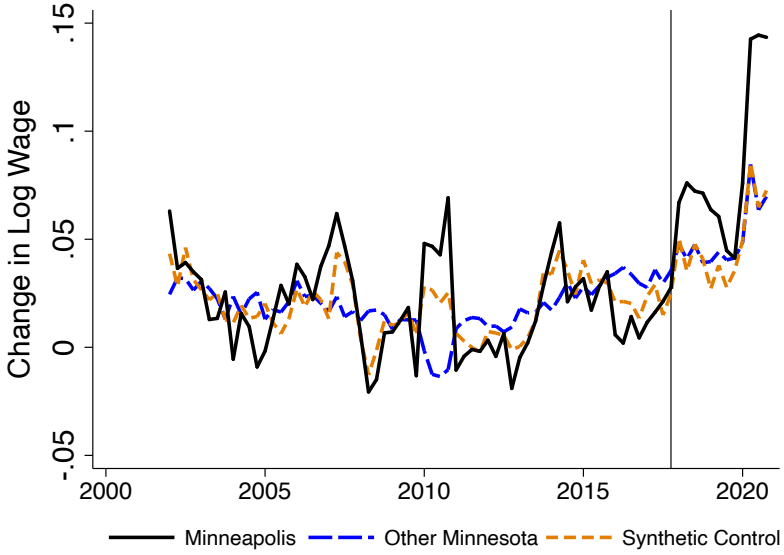


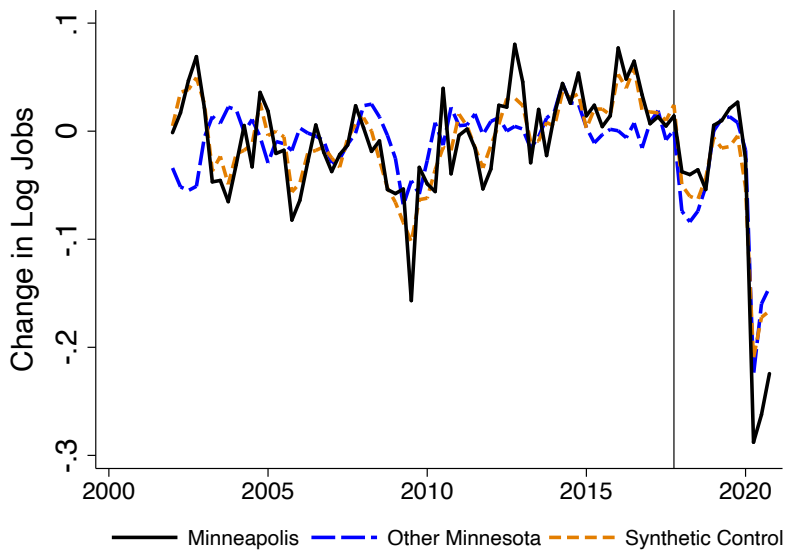
Other Services fit in Minneapolis

back



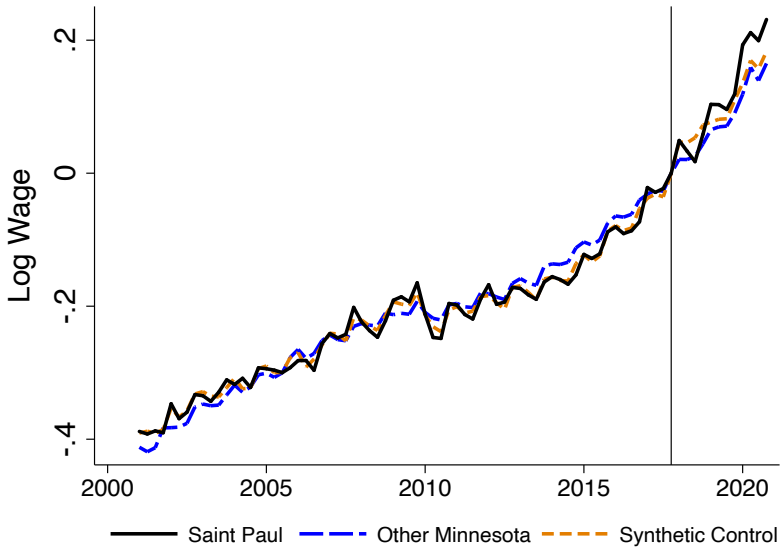


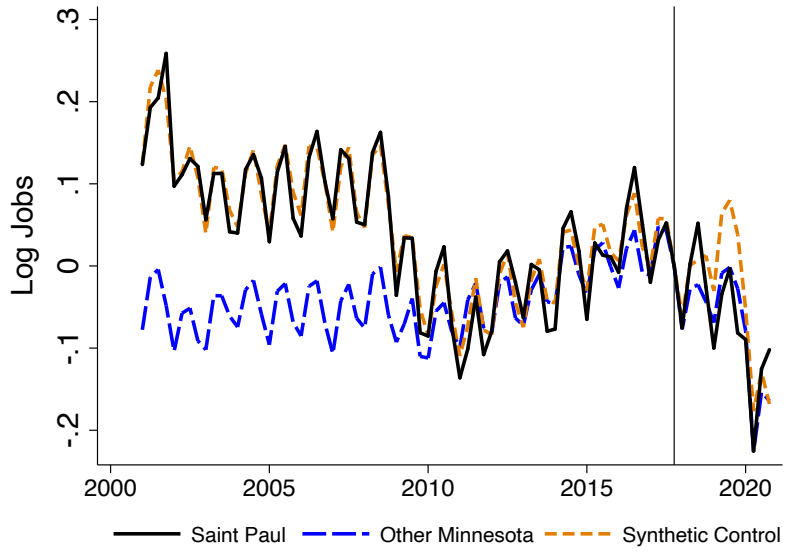


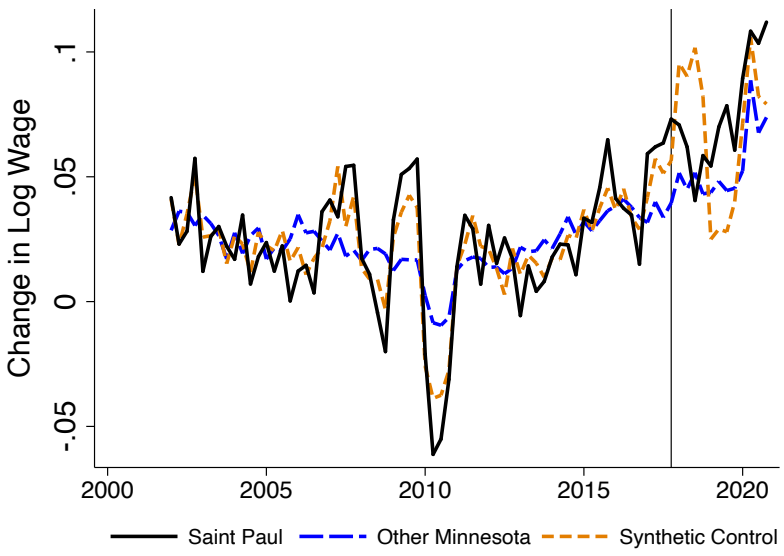


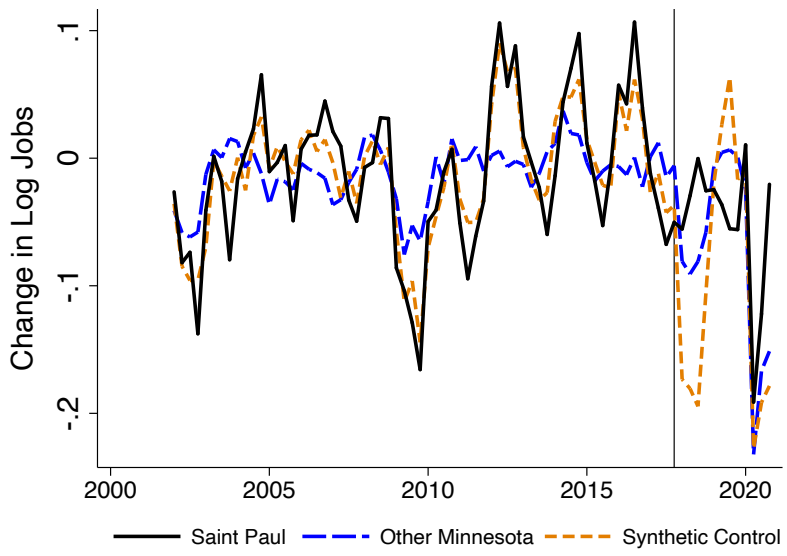
Other Services fit in Saint Paul

back



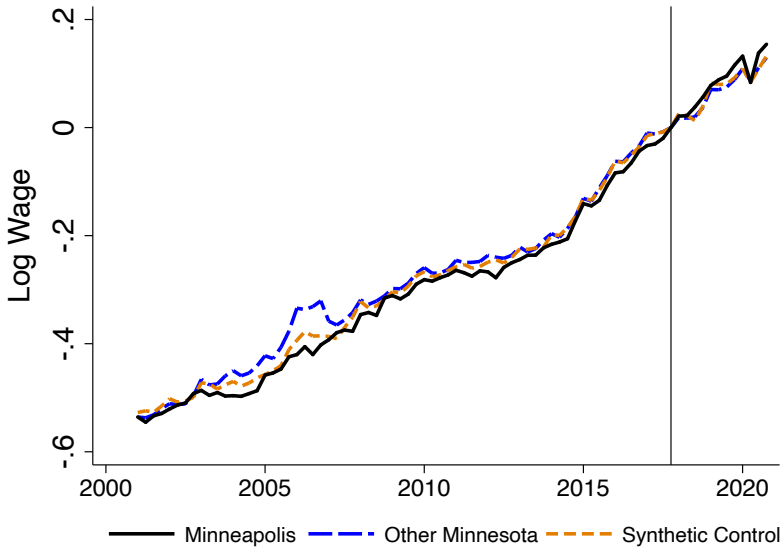


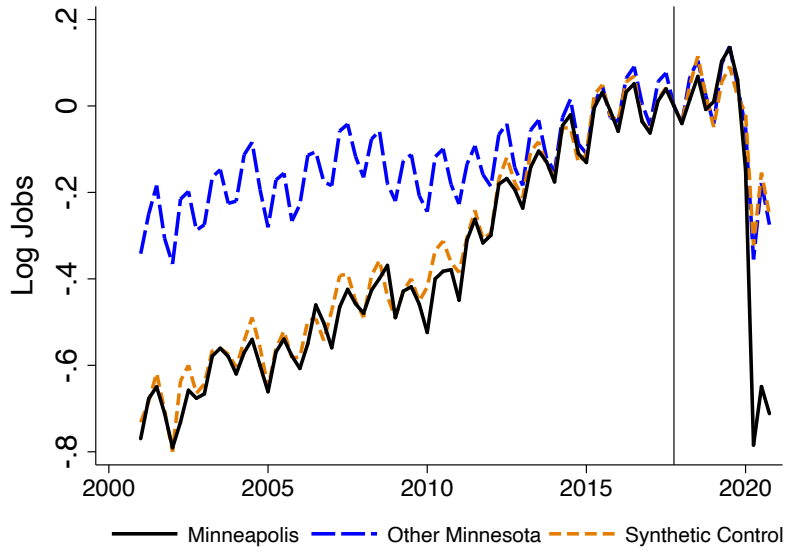


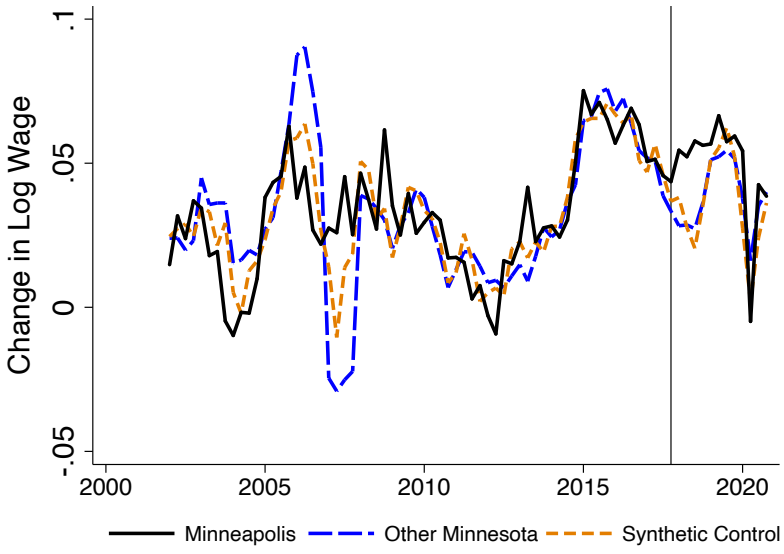


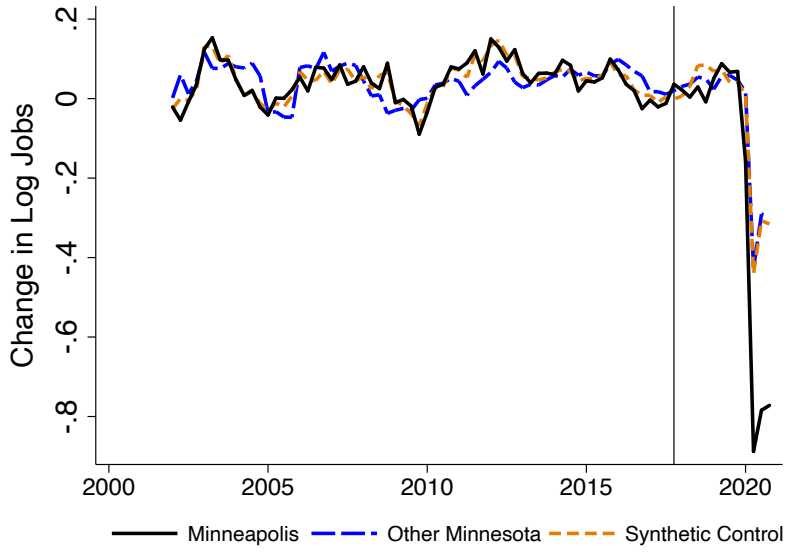
Full-Service Restaurants fit in Minneapolis

back



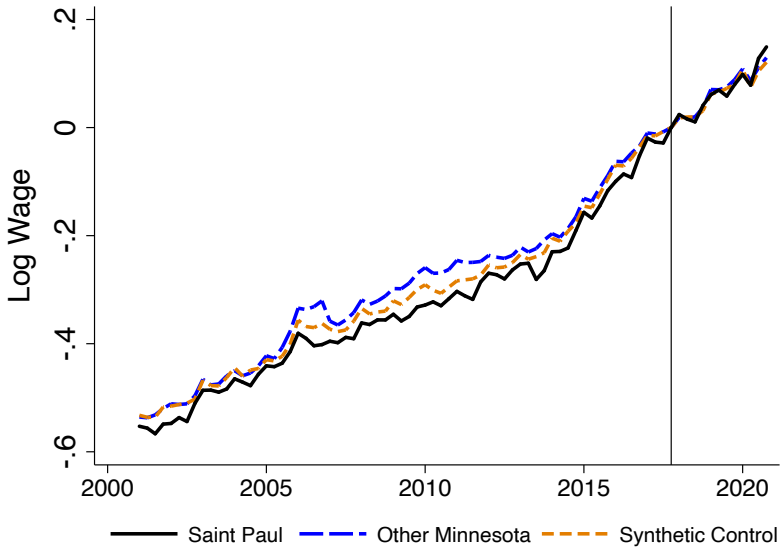


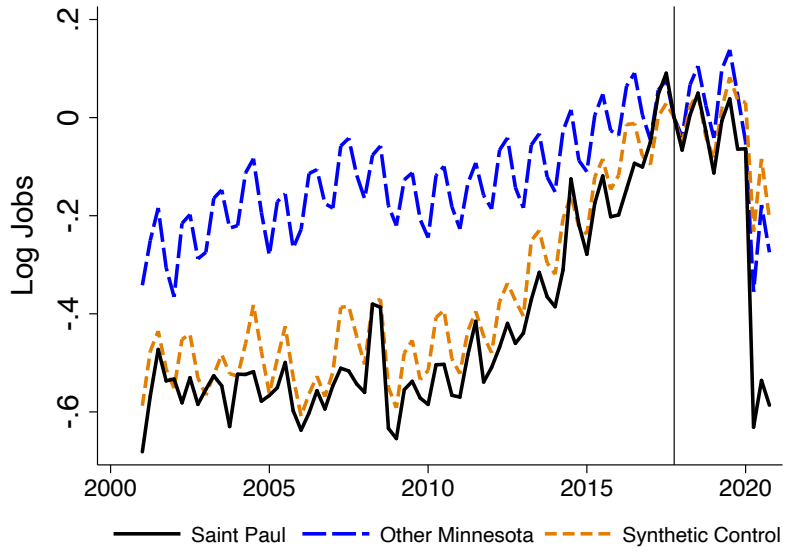


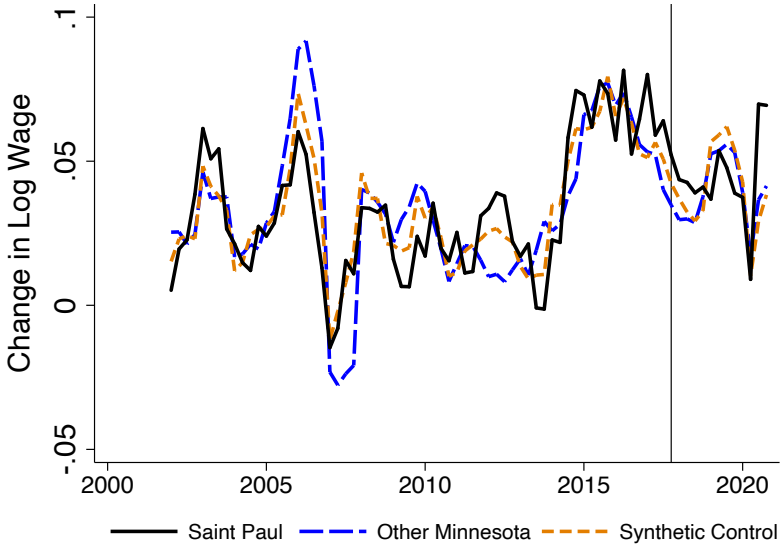


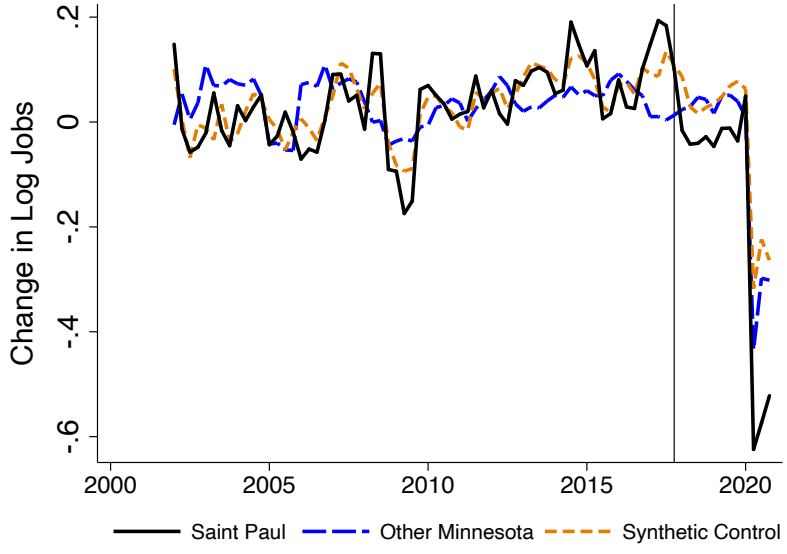
Full-Service Restaurants fit in Saint Paul

back



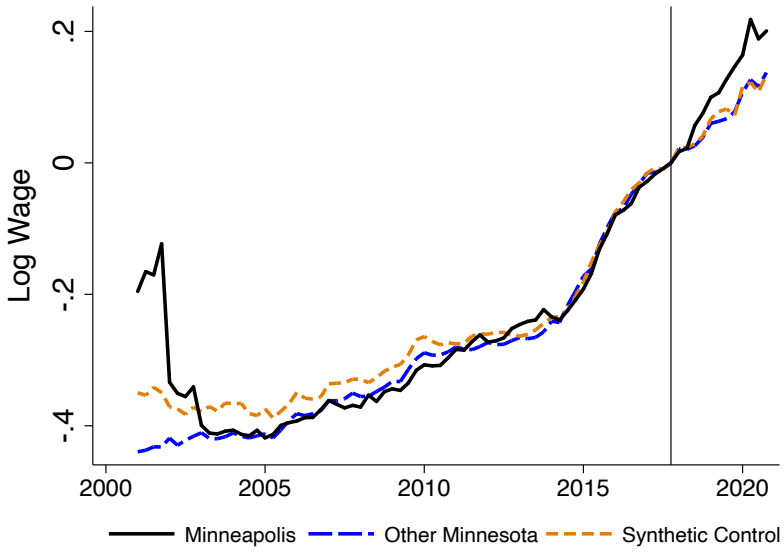


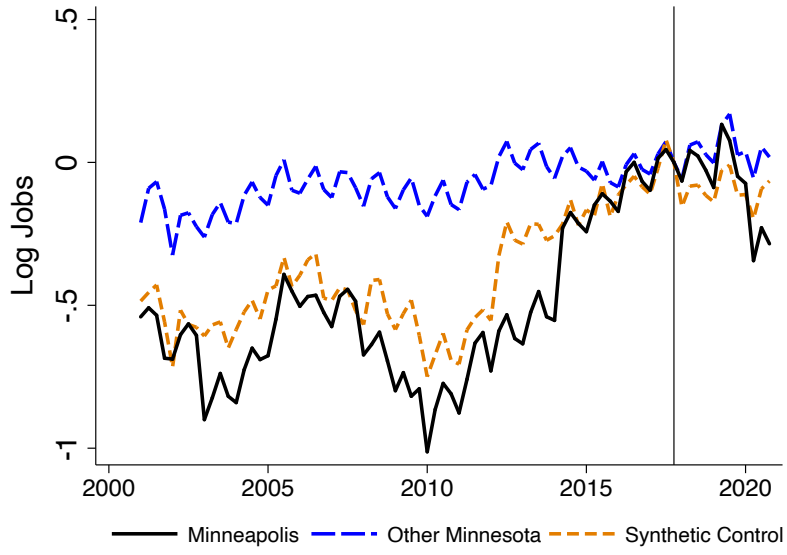


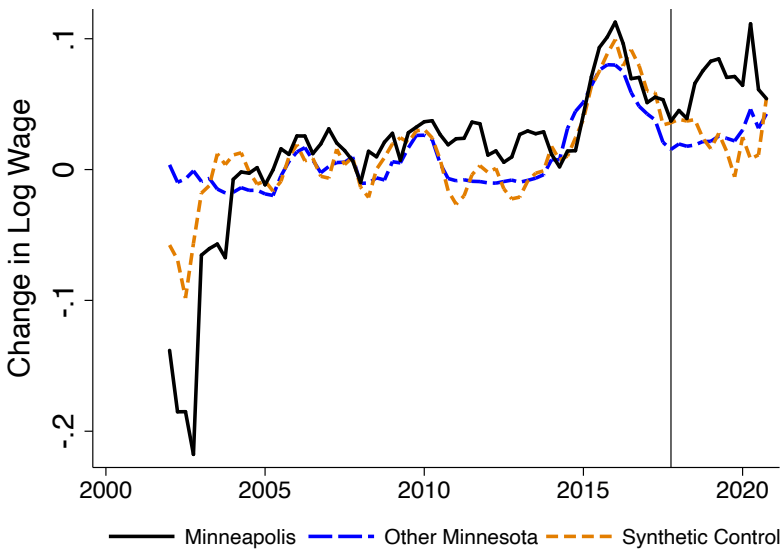


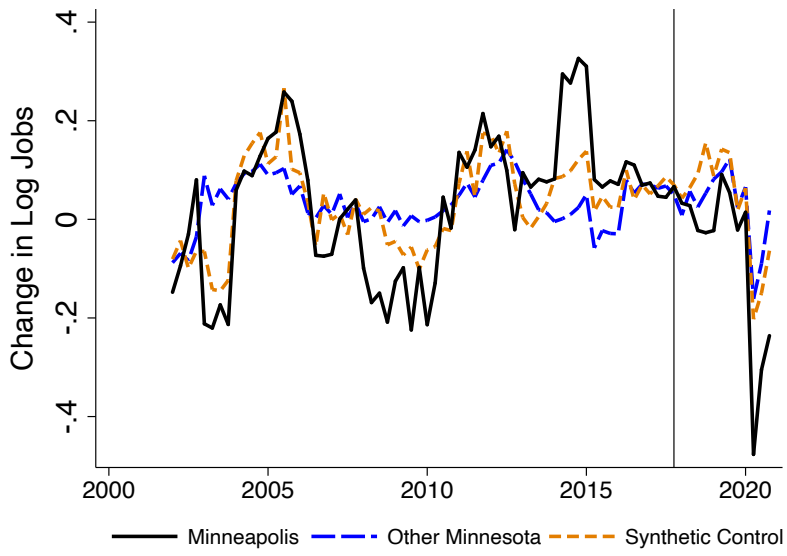
Limited-Service Restaurants fit in Minneapolis

back



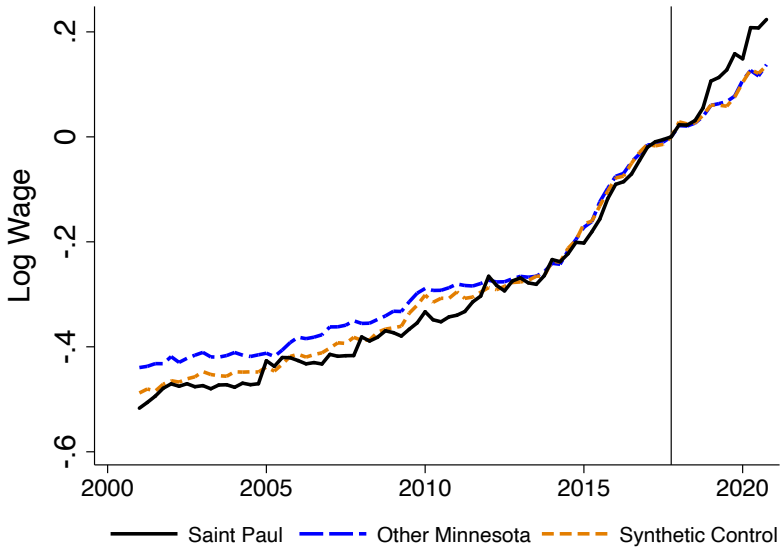


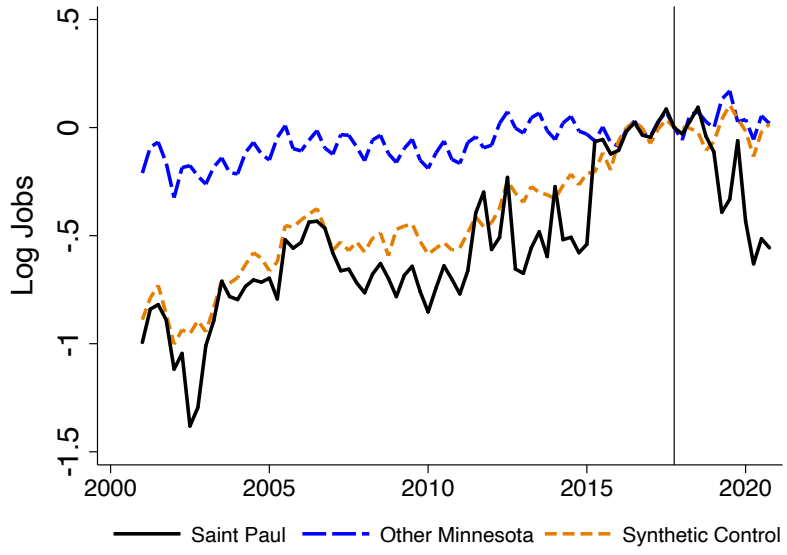


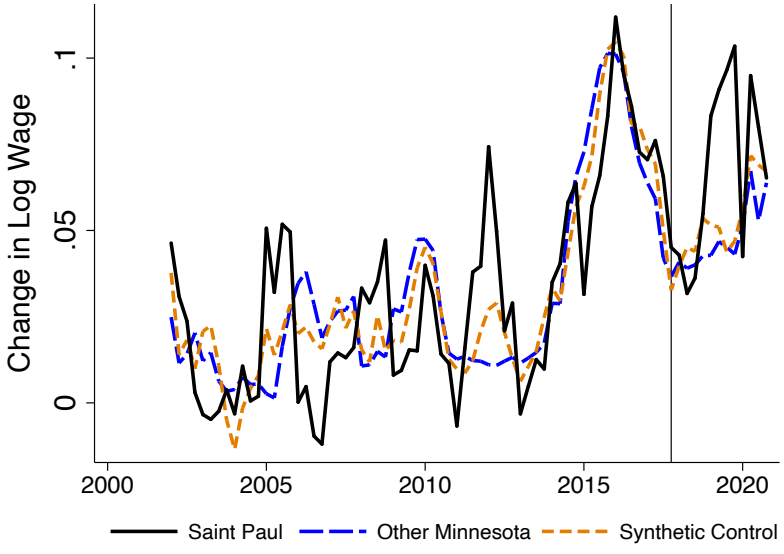


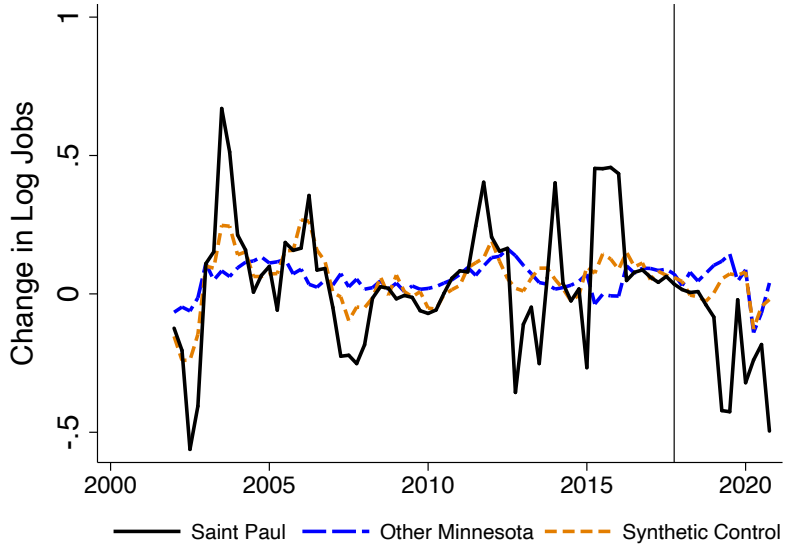
Limited-Service Restaurants fit in Saint Paul

back









Inference using the placebo method

back

- Assign treatment status to 999 random subsamples of zip codes.
- Each subsample of equal size to number of treated zip codes.
- p_H: fraction of placebo samples with higher point estimates.
- p_L: fraction of placebo samples with lower point estimates.
- $p = 2\min(p_H, p_L)$ for null hypothesis of no treatment effect.

Excluding Minneapolis bordering cities

back

[Coefficients are $100 \cdot g_{2020(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	9.0	−9.6	−6.1	0.5
	(0.0)	(13.6)	(18.0)	(83.1)
Admin and Support (56)	8.8	4.6	2.0	7.2
	(0.2)	(63.7)	(99.1)	(58.9)
Health Care and Social Asst (62)	−4.0	3.1	0.8	−0.0
	(0.4)	(54.9)	(94.9)	(78.3)
Arts, Entmt, and Recreation (71)	3.6	−15.1	5.2	27.8
	(69.9)	(13.2)	(53.3)	(4.4)
Accomm and Food Services (72)	1.3	−31.4	−32.5	−40.0
	(43.0)	(0.0)	(0.0)	(0.0)
Other Services (81)	10.7	0.7	−5.6	10.0
	(0.0)	(70.3)	(35.6)	(8.2)
Full-Service Restaurants (722511)	4.0	−41.4	−43.4	−42.7
	(0.0)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	13.4	−28.9	−28.9	−27.6
	(0.0)	(1.0)	(3.0)	(3.8)

Note: p-values in parentheses constructed with the placebo method.

Minneapolis results using time weights

back

[Coefficients are $100 \cdot g_{2020(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	7.3	−12.0	−11.9	−5.0
	(0.0)	(2.8)	(1.8)	(59.3)
Admin and Support (56)	8.9	0.6	−1.9	12.1
	(0.0)	(89.7)	(70.1)	(30.8)
Health Care and Social Asst (62)	−1.7	5.9	−0.1	2.3
	(9.8)	(22.0)	(86.3)	(99.7)
Arts, Entmt, and Recreation (71)	5.2	−17.3	1.6	21.5
	(38.6)	(5.6)	(96.5)	(31.2)
Accomm and Food Services (72)	0.8	−31.0	−38.9	−41.8
	(64.9)	(0.0)	(0.0)	(0.0)
Other Services (81)	9.6	−1.4	−5.2	−0.5
	(0.0)	(96.1)	(43.6)	(83.9)
Full-Service Restaurants (722511)	3.5	−42.1	−44.8	−40.1
	(0.0)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	14.2	−26.2	−26.7	−21.2
	(0.0)	(2.6)	(6.6)	(11.4)

Note: p-values in parentheses constructed with the placebo method.

Excluding Saint Paul bordering cities

back

[Coefficients are $100 \cdot g_{2020(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	4.5	−2.0	−34.7	−11.4
	(0.0)	(78.5)	(0.0)	(9.0)
Admin and Support (56)	0.7	−8.4	−9.5	−73.3
	(99.3)	(57.9)	(36.2)	(0.0)
Health Care and Social Asst (62)	−3.8	4.0	2.1	−2.1
	(1.0)	(43.8)	(82.3)	(55.1)
Arts, Entmt, and Recreation (71)	−0.1	−18.3	−6.4	−16.6
	(61.7)	(3.8)	(46.2)	(5.0)
Accomm and Food Services (72)	8.0	−43.4	−64.8	−34.2
	(0.0)	(0.0)	(0.0)	(0.0)
Other Services (81)	1.9	14.6	3.1	11.1
	(29.8)	(0.4)	(51.5)	(3.8)
Full-Service Restaurants (722511)	1.1	−37.3	−39.5	−45.6
	(32.4)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	3.6	−57.2	−75.2	−85.8
	(0.0)	(0.0)	(0.0)	(0.0)

Note: p-values in parentheses constructed with the placebo method.

Saint Paul results using time weights

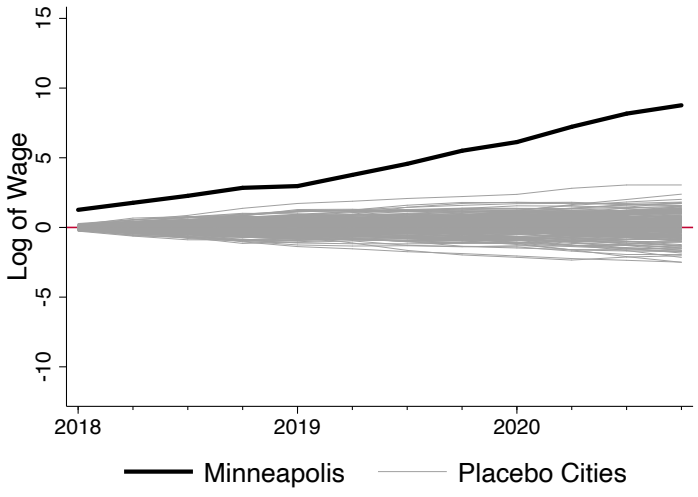
back

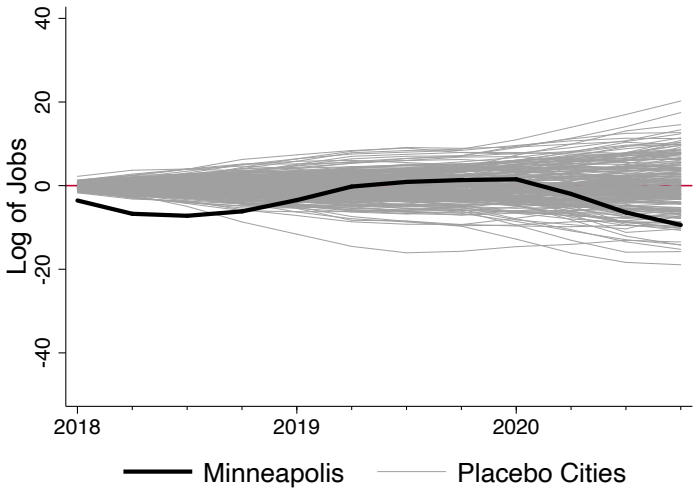
[Coefficients are $100 \cdot g_{2020(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	4.8	−8.1	−32.6	−13.7
	(0.0)	(17.4)	(0.0)	(3.4)
Admin and Support (56)	−1.9	−35.1	−13.4	−76.8
	(37.0)	(1.8)	(23.8)	(0.0)
Health Care and Social Asst (62)	−3.5	4.3	−0.0	−4.4
	(0.0)	(39.4)	(88.1)	(27.0)
Arts, Entmt, and Recreation (71)	−0.7	−15.7	−4.6	−28.6
	(53.1)	(6.8)	(64.5)	(0.0)
Accomm and Food Services (72)	5.8	−48.6	−60.1	−41.0
	(0.0)	(0.0)	(0.0)	(0.0)
Other Services (81)	1.7	14.7	5.3	11.4
	(34.4)	(0.2)	(26.4)	(2.0)
Full-Service Restaurants (722511)	1.7	−41.7	−41.7	−38.0
	(6.8)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	2.2	−33.4	−41.4	−55.0
	(1.6)	(0.2)	(0.4)	(0.0)

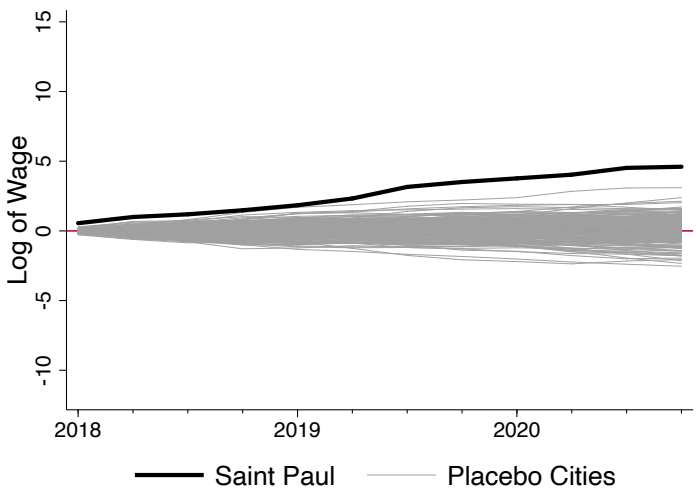
Note: p-values in parentheses constructed with the placebo method.

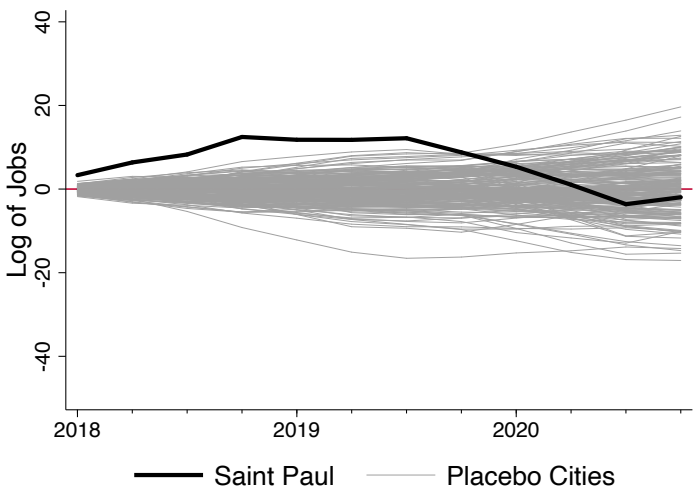
Retail: time-varying effects

back



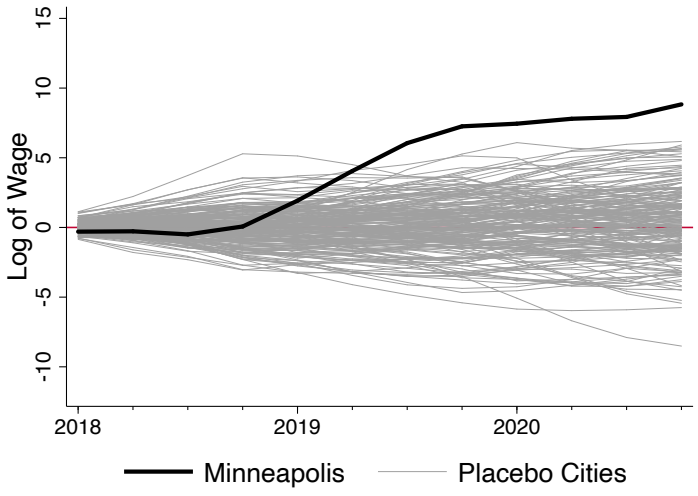


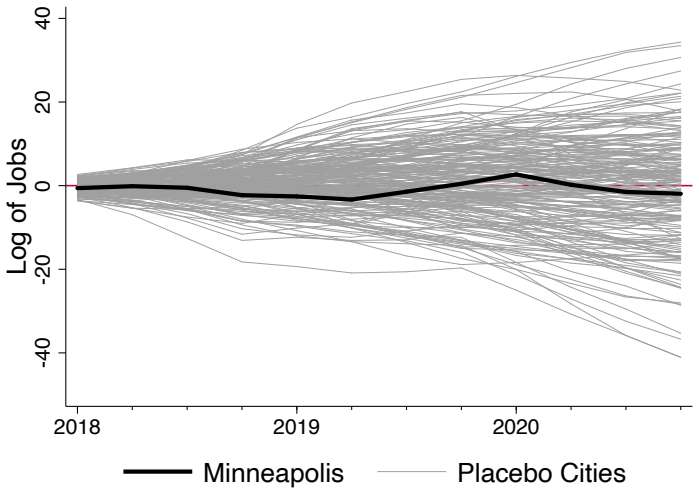


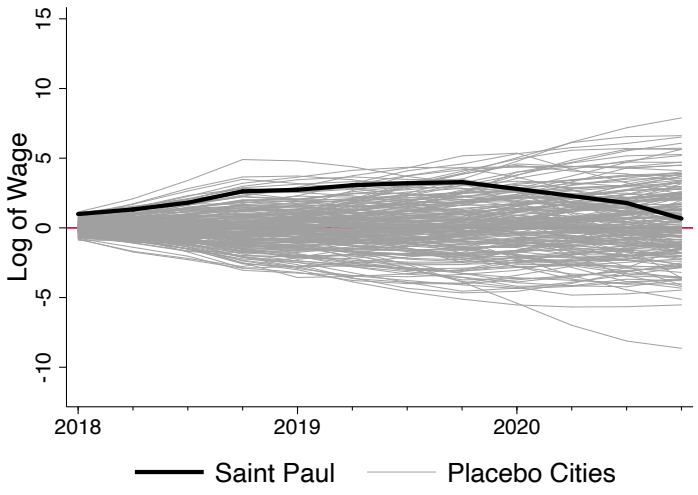


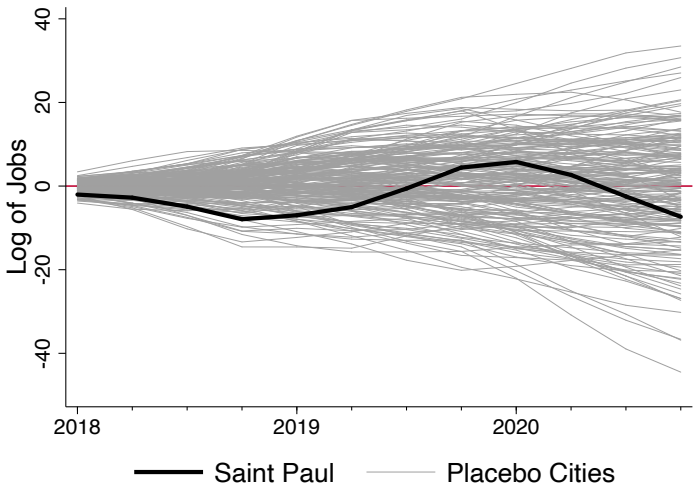
Administration and Support: time-varying effects

back



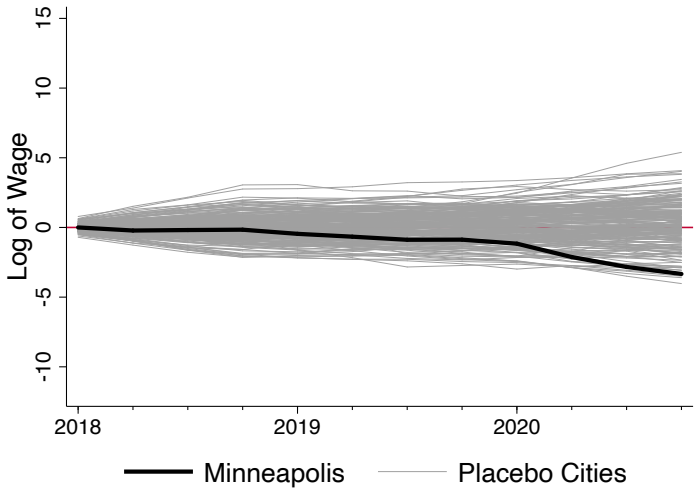


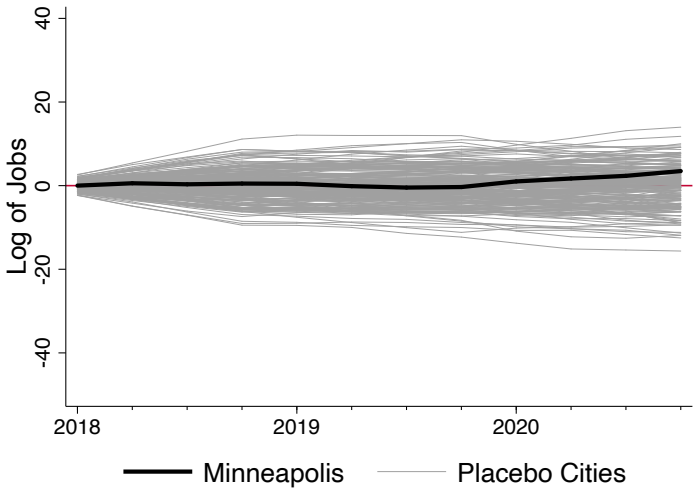


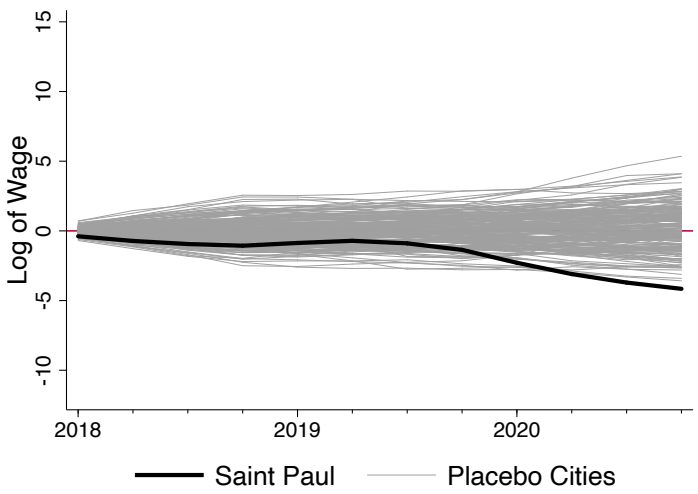


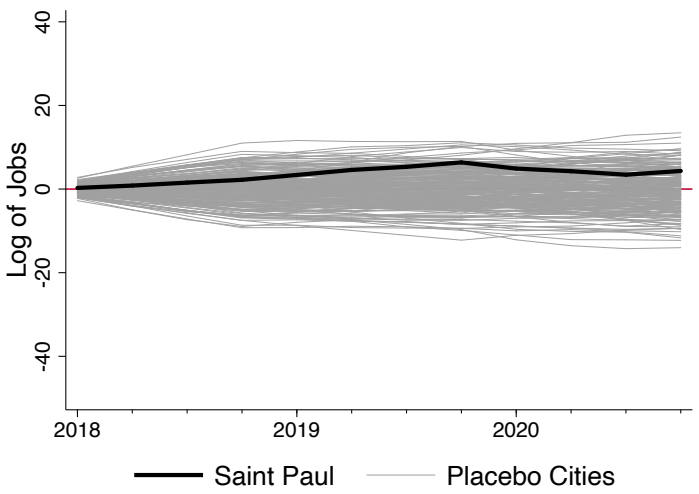
Health and Social Assistance: time-varying effects

back



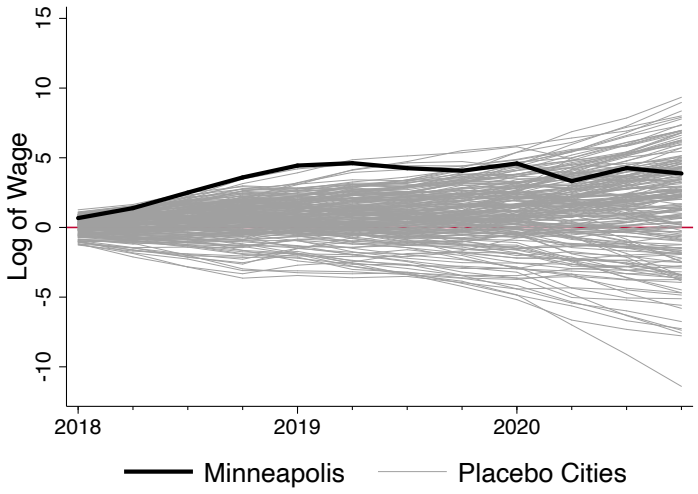


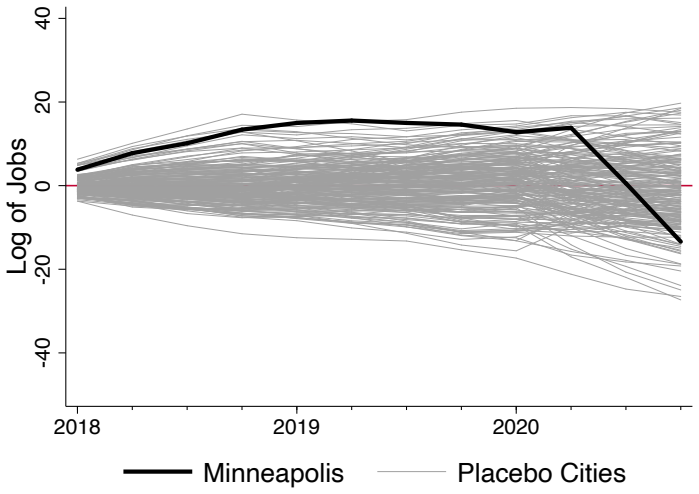


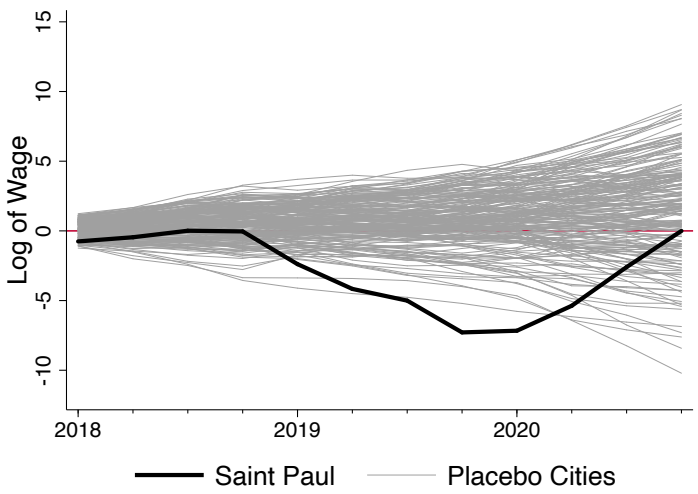


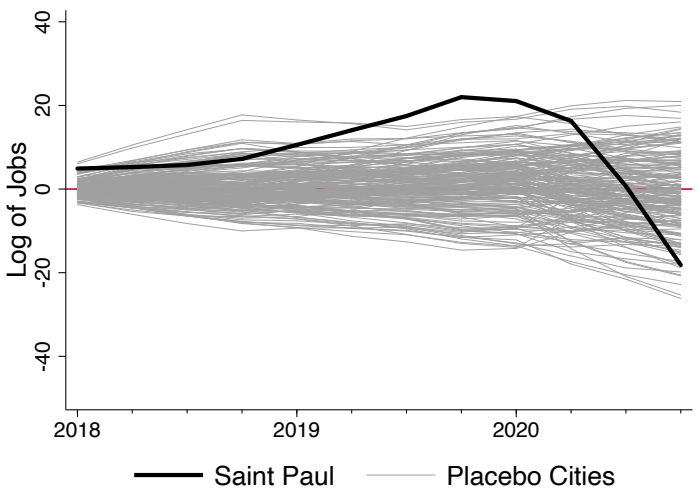
Arts, Entertainment, Recreation: time-varying effects

back



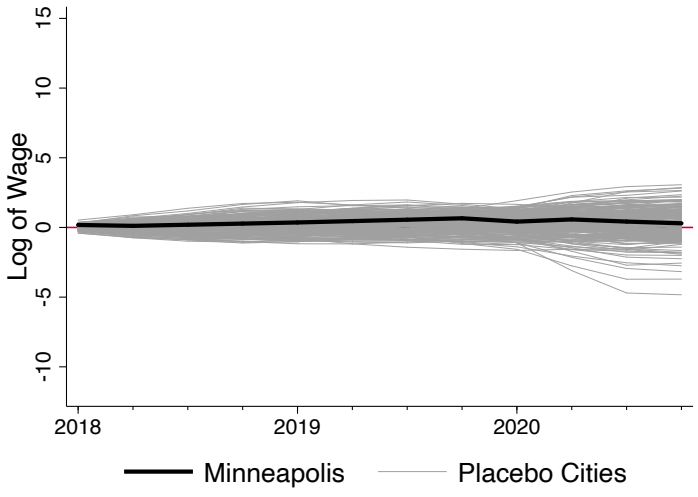


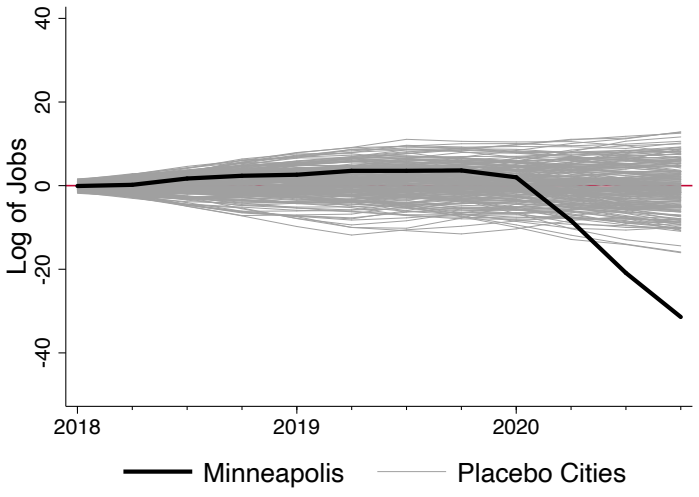


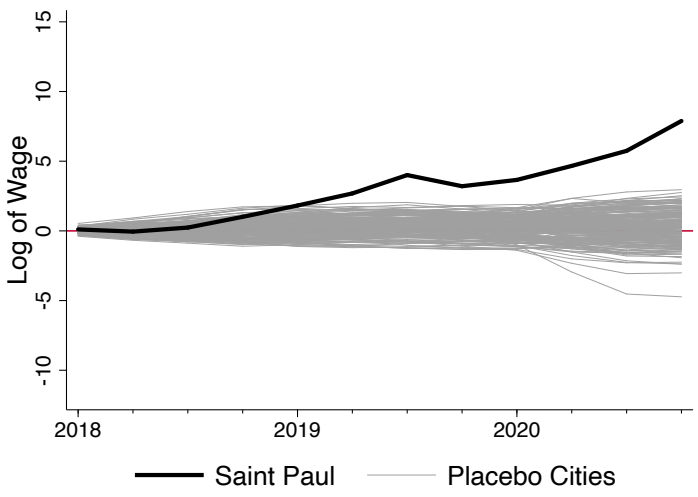


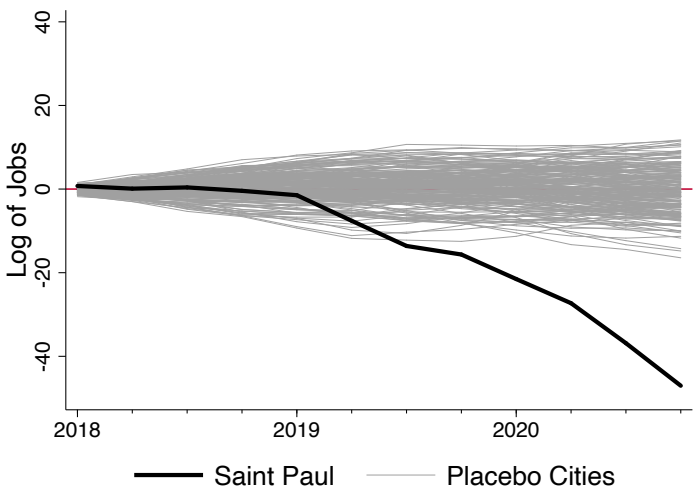
Accommodation and Food: time-varying effects

back



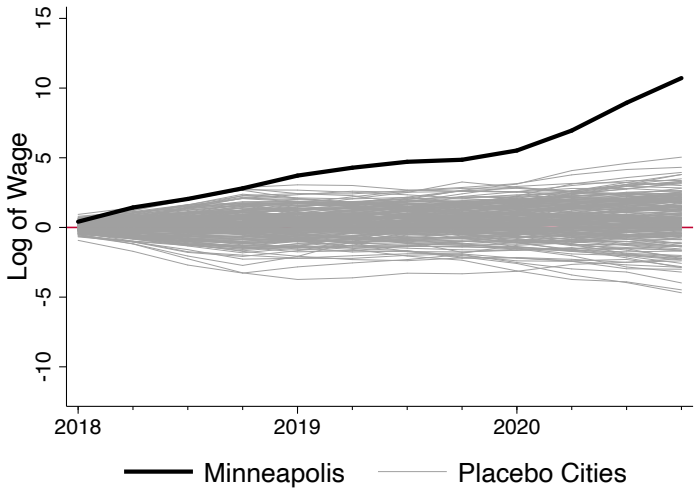


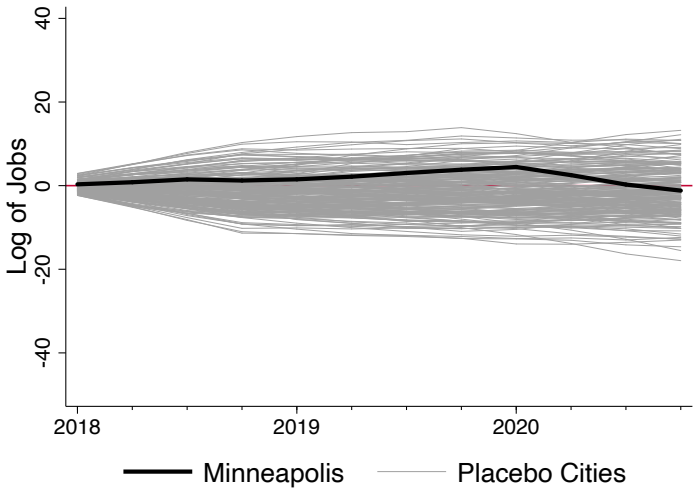


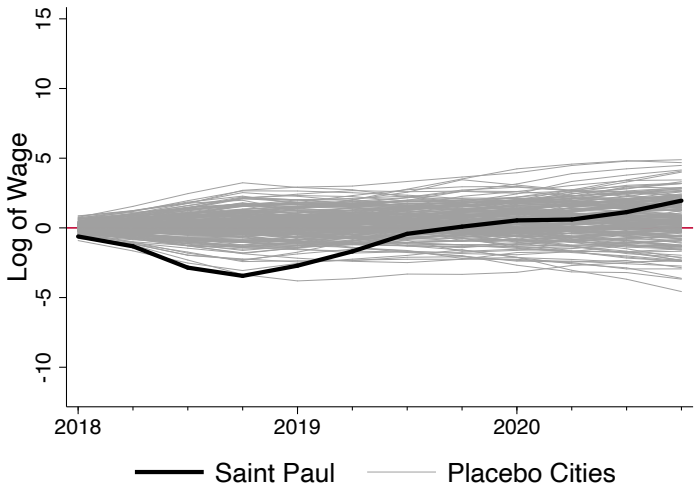


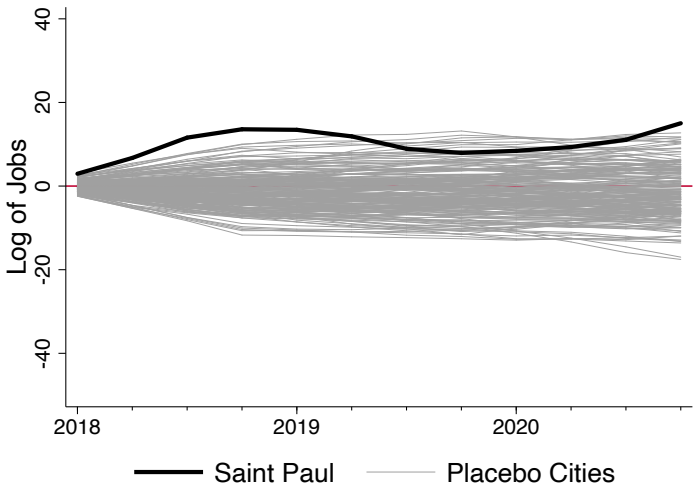
Other Services: time-varying effects

back









Other U.S. cities of similar size to Minneapolis

back

City	Jobs (000's)	City	Jobs (000's)
Washington, DC	533	Baltimore, MD	276
Indianapolis, IN	527	Albuquerque, NM	264
Jacksonville, FL	461	Greensboro, NC	251
Denver, CO	444	El Paso, TX	236
Nashville, TN	440	Prince George's County, MD	232
Memphis, TN	438	Colorado Springs, CO	225
Milwaukee, WI	434	Baton Rouge, LA	222
Portland, OR	433	Wichita, KS	220
Louisville, KY	425	Little Rock, AR	201
Montgomery County, MD	380	St. Louis, MO	197
Honolulu, HI	380	Reno, NV	193
Oklahoma City, OK	374	New Orleans, LA	170
Tulsa, OK	322	Fort Wayne, IN	169
Kansas City, MO	314	Winston-Salem, NC	167
Fresno, CA	310	Lexington, KY	159
Omaha, NE	301	Huntsville, AL	155
Tucson, AZ	299	Virginia Beach, VA	149
Aurora, CO	295	Springfield, MO	147
Minneapolis, MN	280		

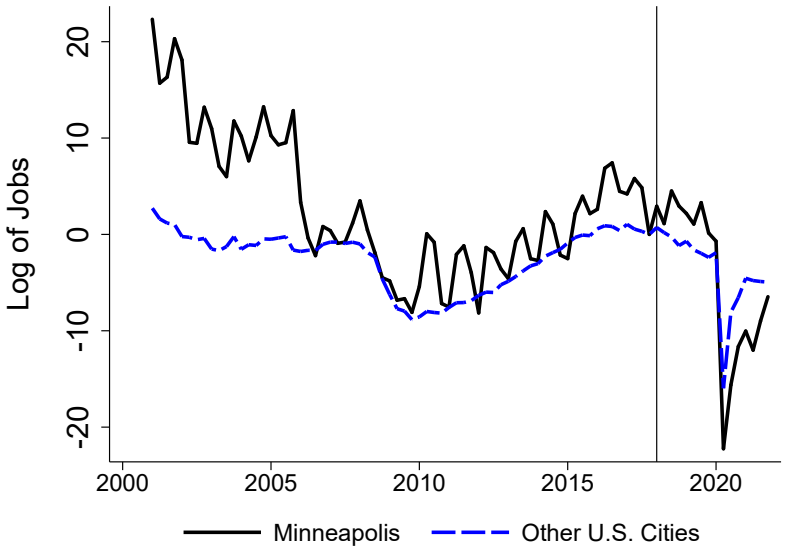
Other U.S. cities of similar size to Saint Paul

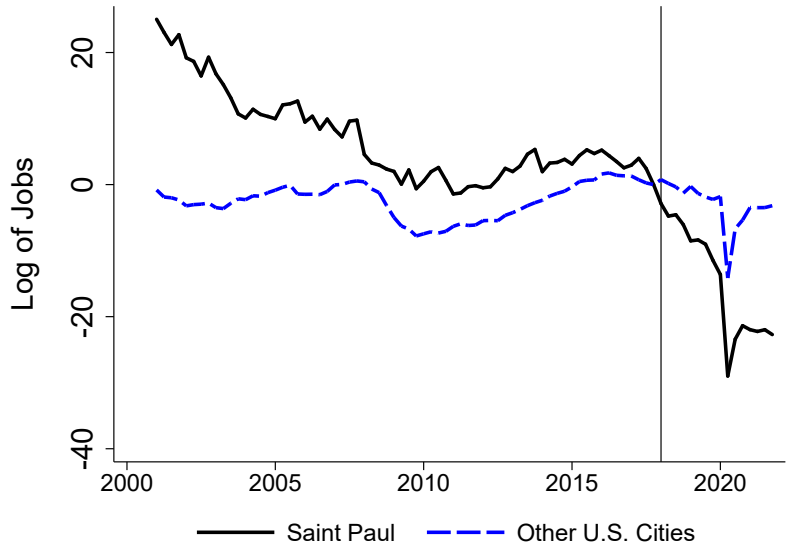
back

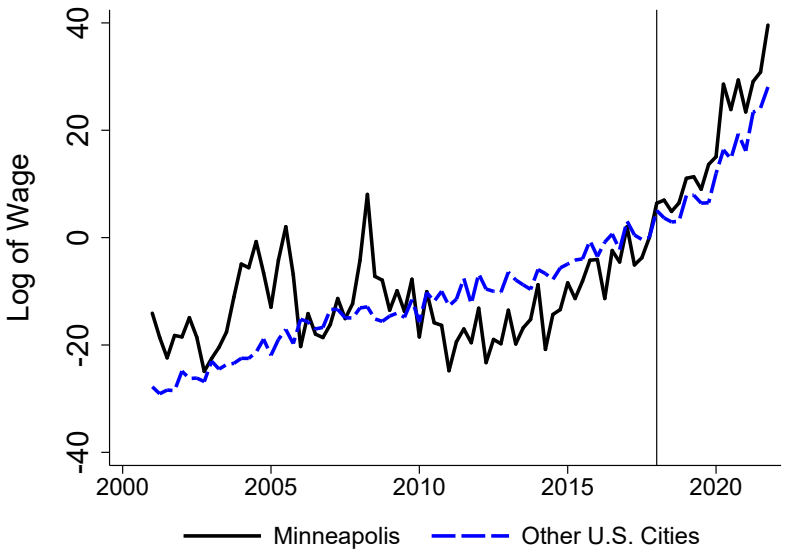
City	Jobs (000's)	City	Jobs (000's)
Aurora, CO	295	Corpus Christi, TX	135
Baltimore, MD	276	Salem, OR	132
Albuquerque, NM	264	Anchorage, AK	120
Greensboro, NC	251	Sioux Falls, SD	115
El Paso, TX	236	Rockford, IL	114
Prince George's County, MD	232	Richmond, VA	114
Colorado Springs, CO	225	Lubbock, TX	111
Baton Rouge, LA	222	Norfolk, VA	104
Wichita, KS	220	Tallahassee, FL	102
Little Rock, AR	201	Montgomery, AL	97
St. Louis, MO	197	Shreveport, LA	95
Reno, NV	193	Amarillo, TX	90
New Orleans, LA	170	Jackson, MS	86
Fort Wayne, IN	169	Midland, TX	85
Winston-Salem, NC	167	Chesapeake, VA	85
Lexington, KY	159	Newport News, VA	83
Huntsville, AL	155	Fayetteville, NC	83
Saint Paul, MN	149	Augusta, GA	81
Virginia Beach, VA	149	Laredo, TX	79
Springfield, MO	147	Kansas City, KS	78
Lincoln, NE	137	Birmingham, AL	77
Savannah, GA	136		

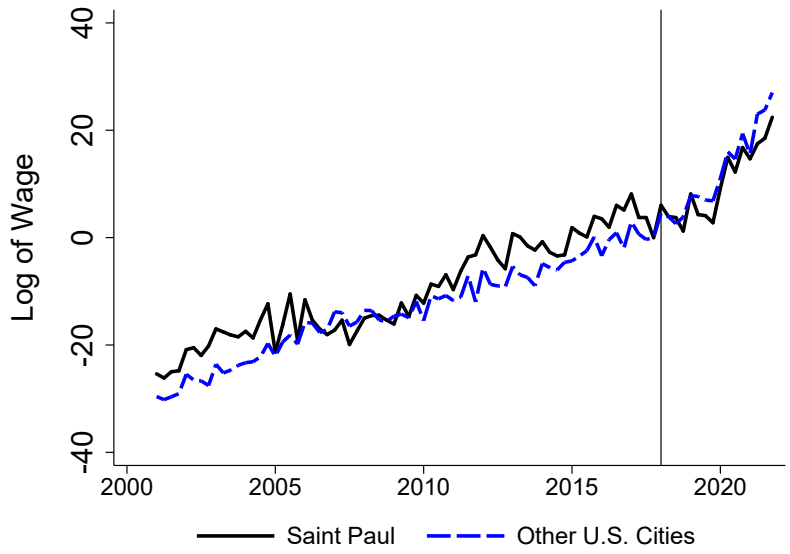
Retail time series

back



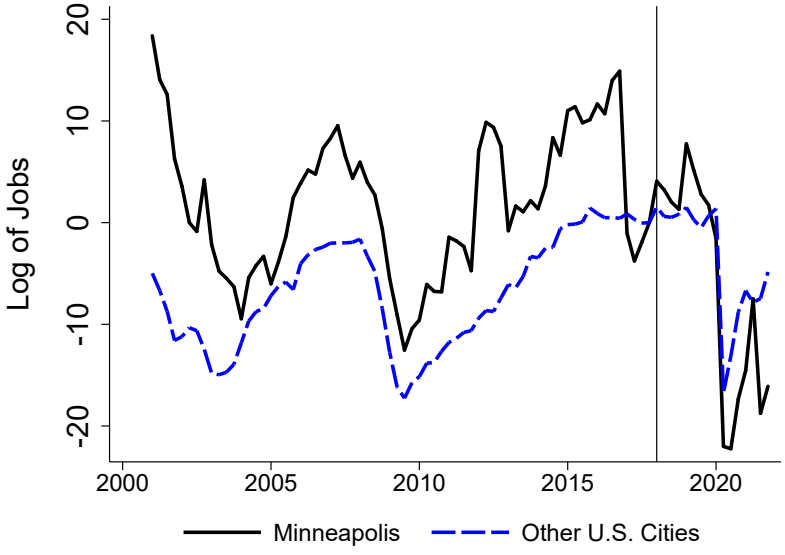


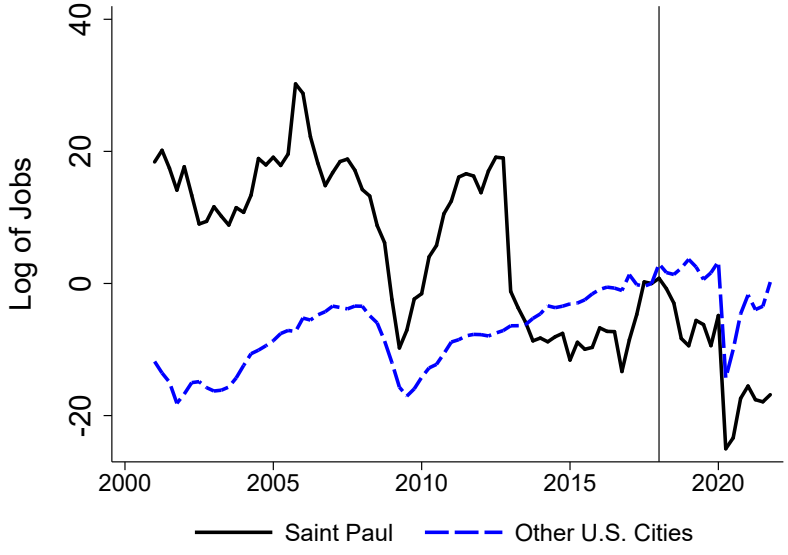


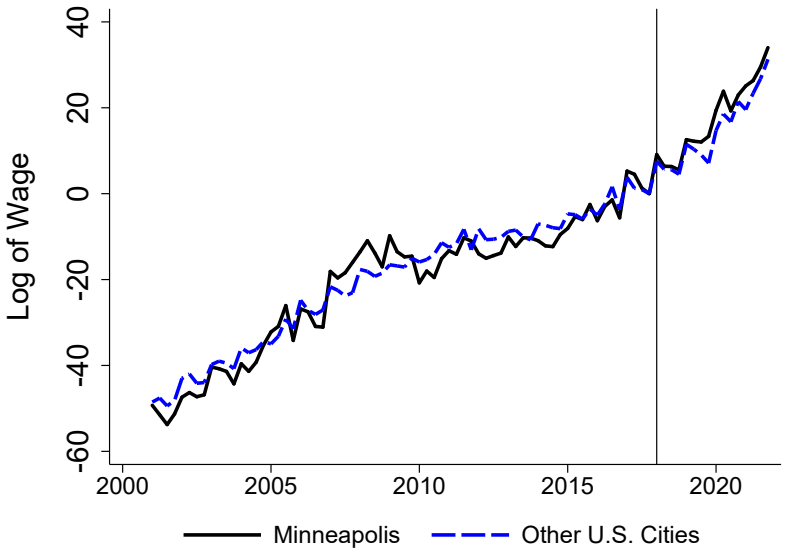


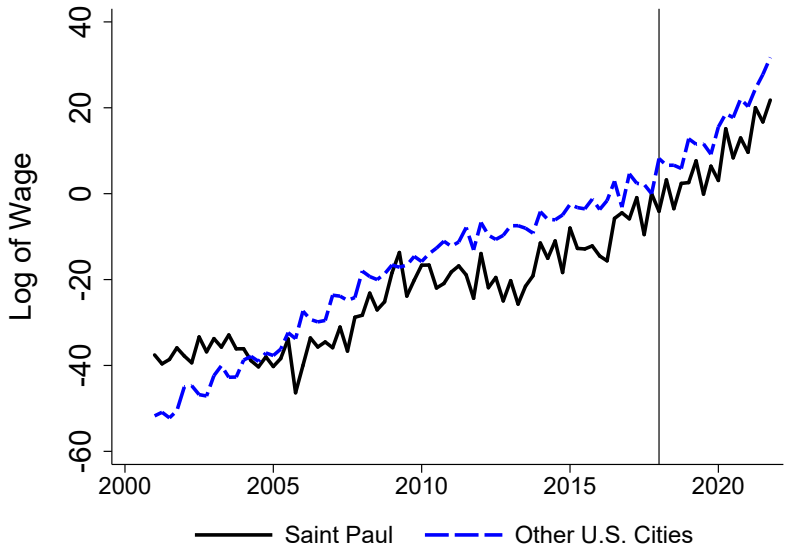
Administration and Support time series

back



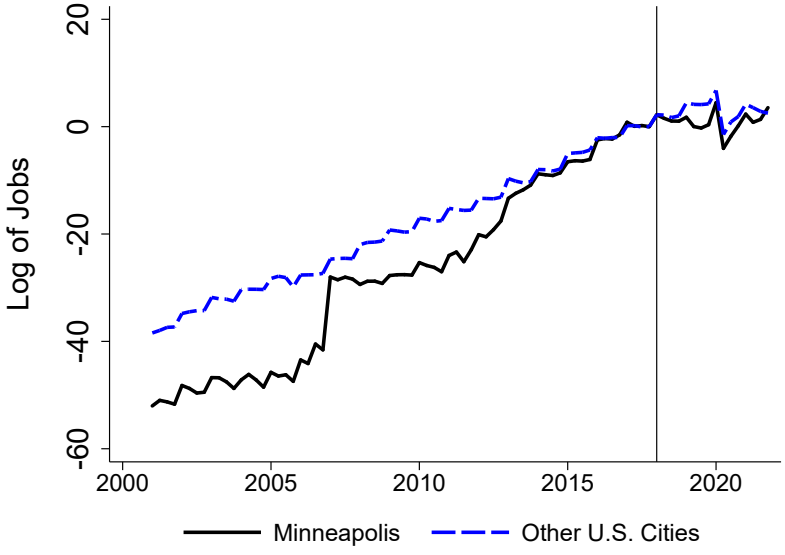


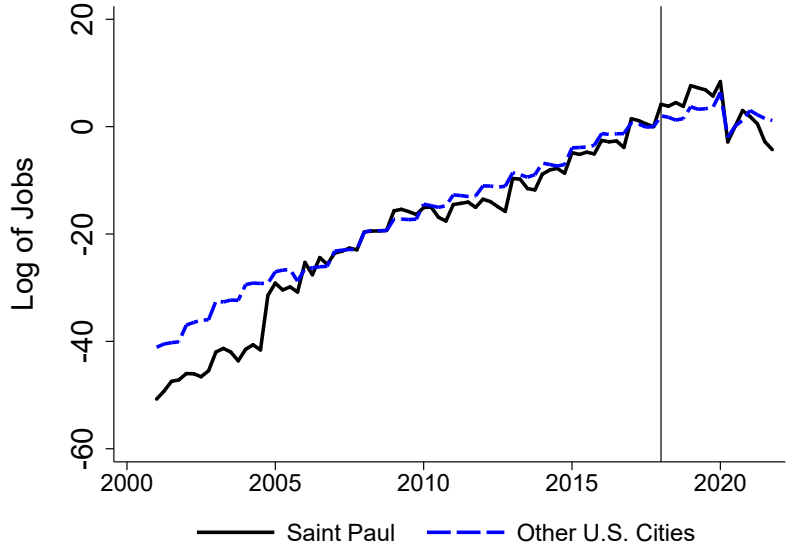


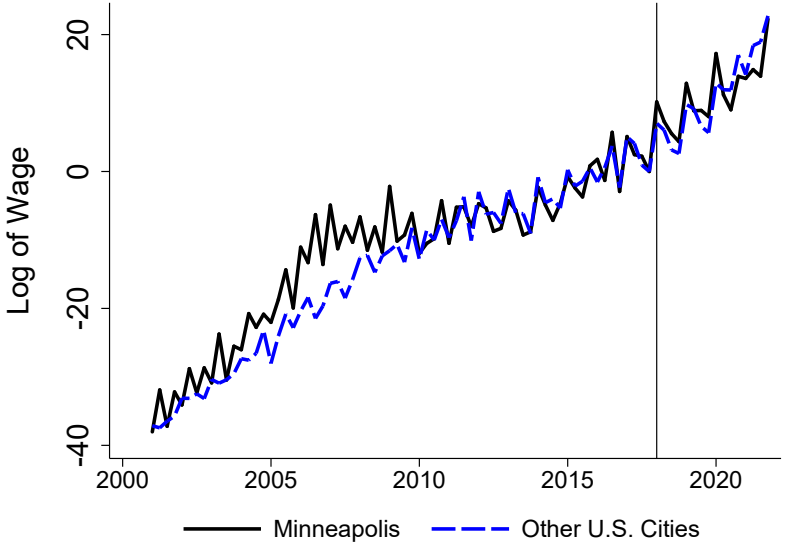


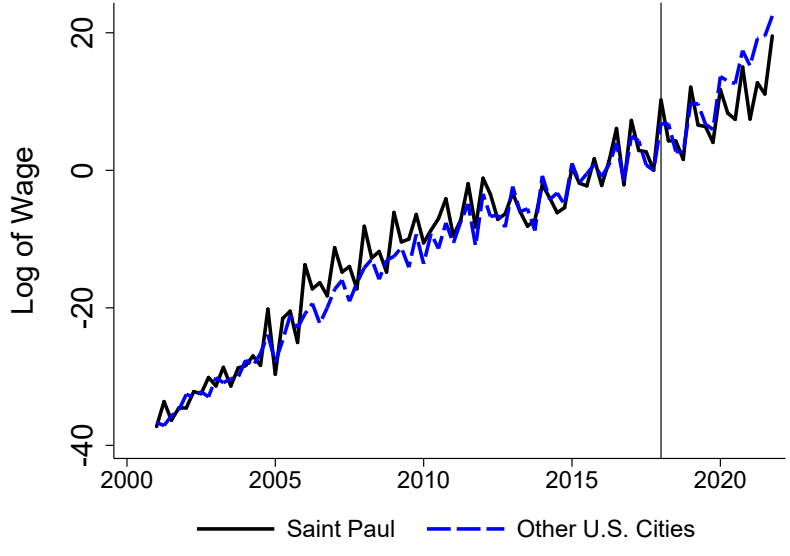
Health Care and Social Assistance time series

back



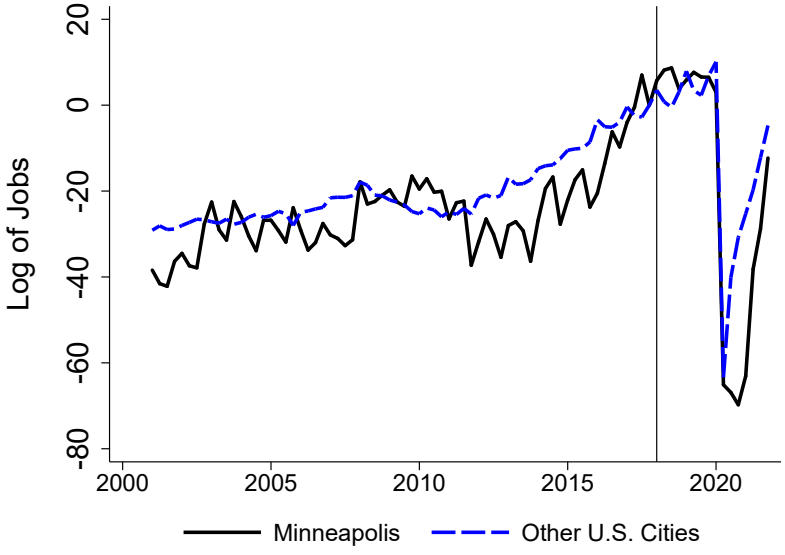


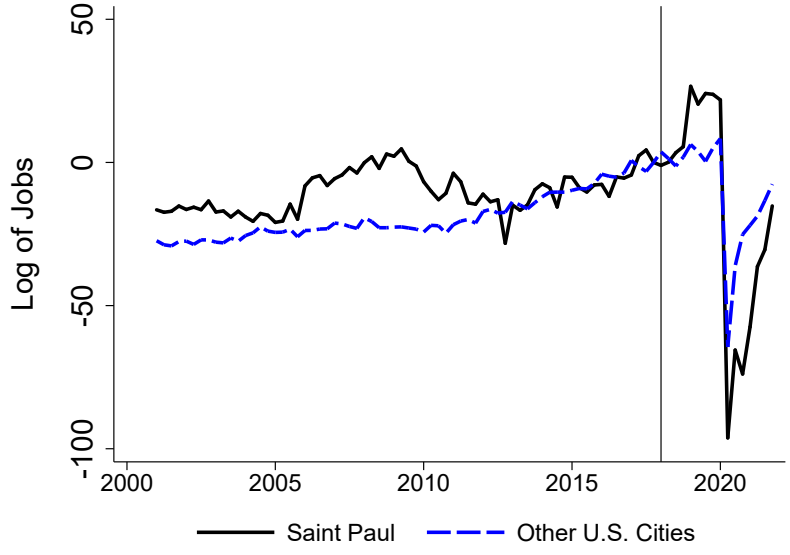


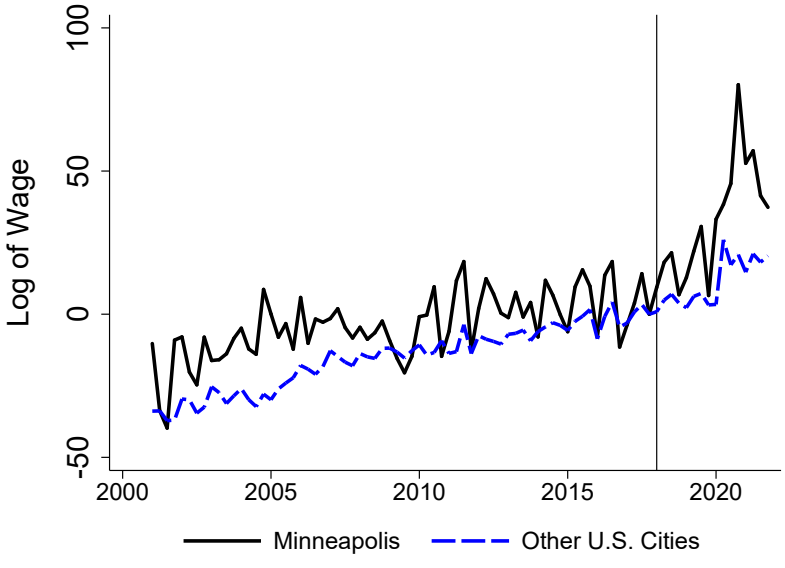


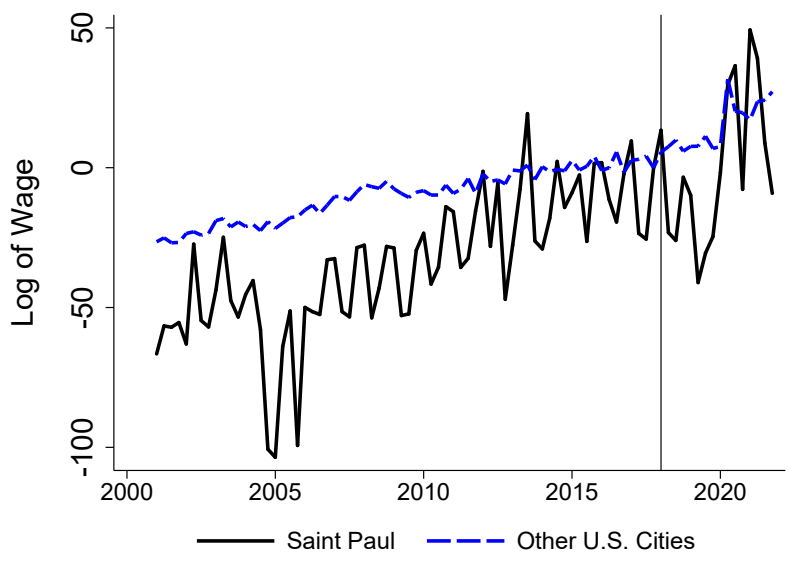
Arts, Entertainment, and Recreation time series

back



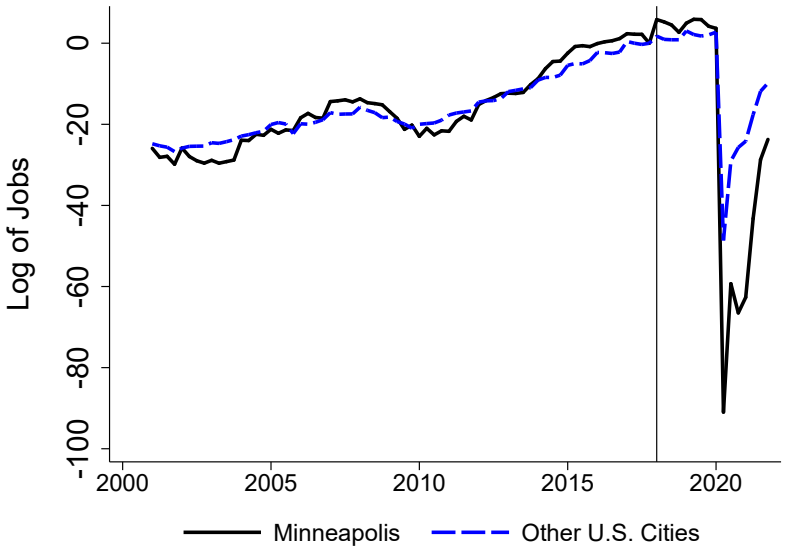


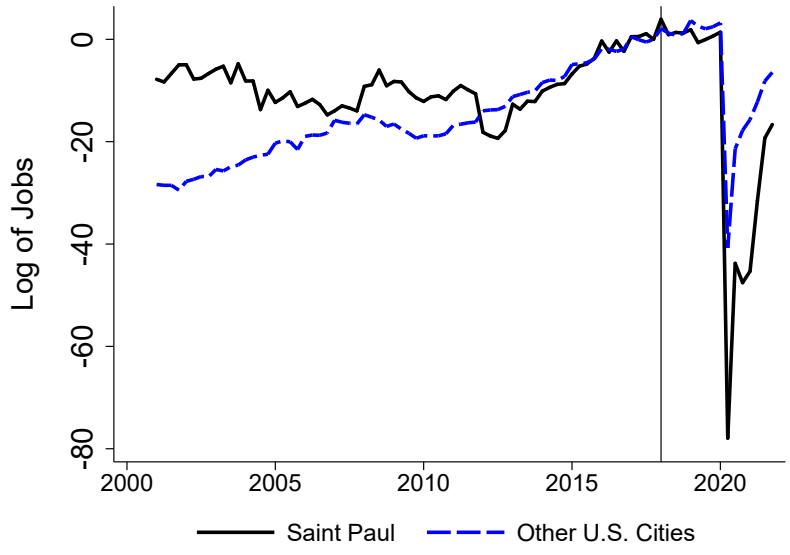


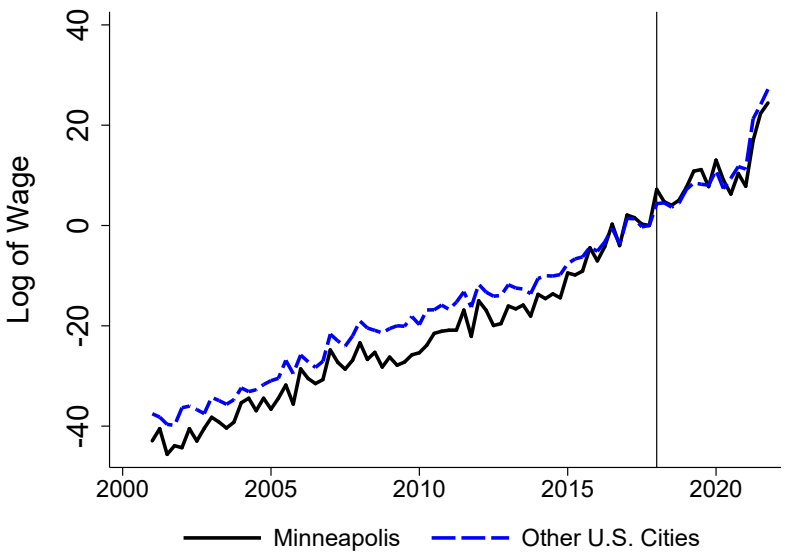


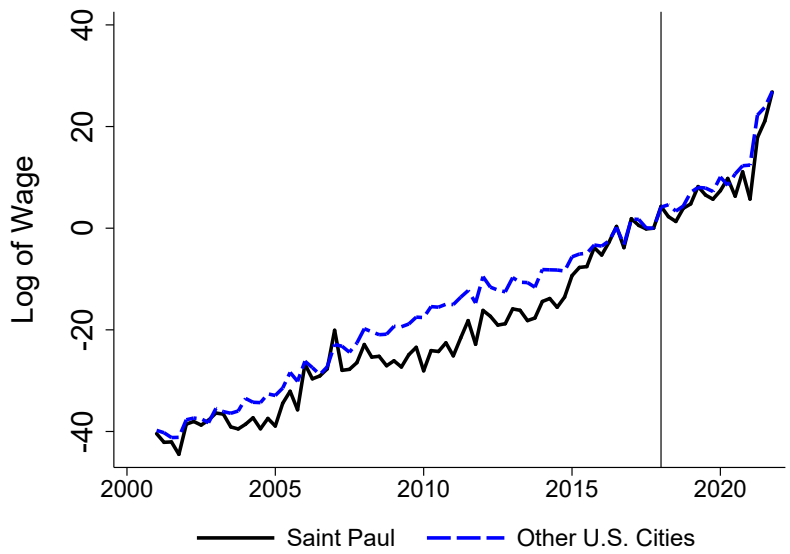
Accommodation and Food time series

back



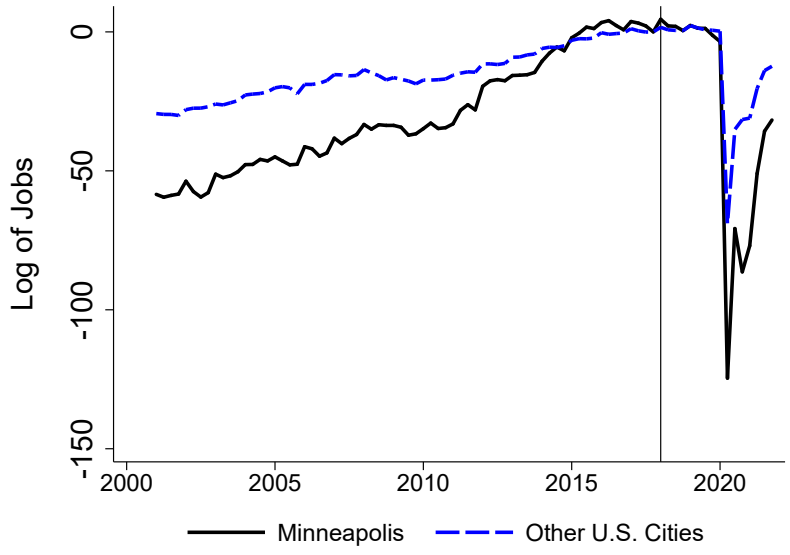


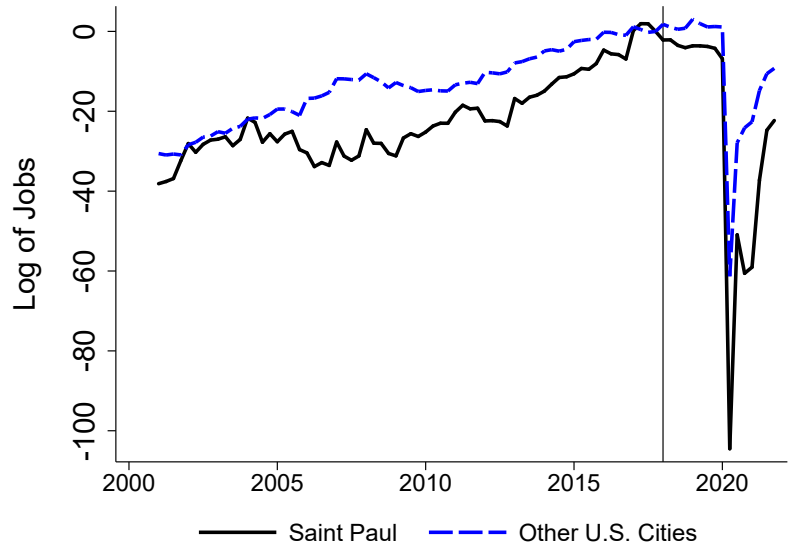


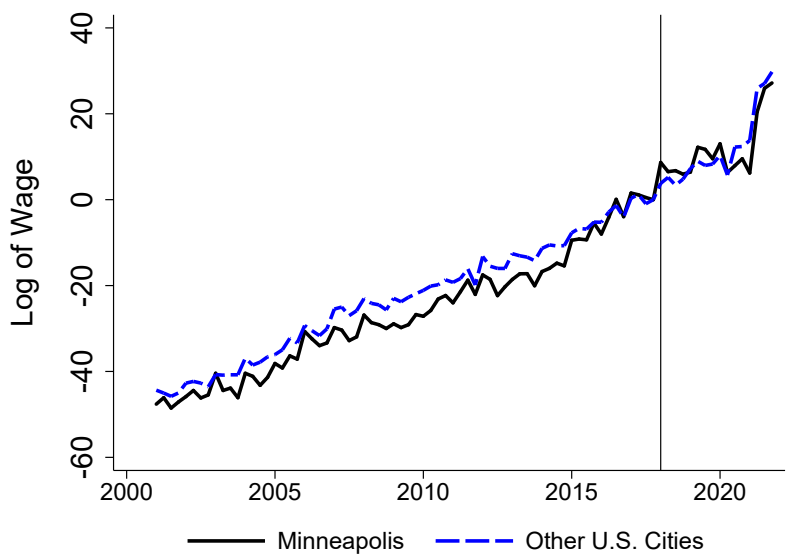


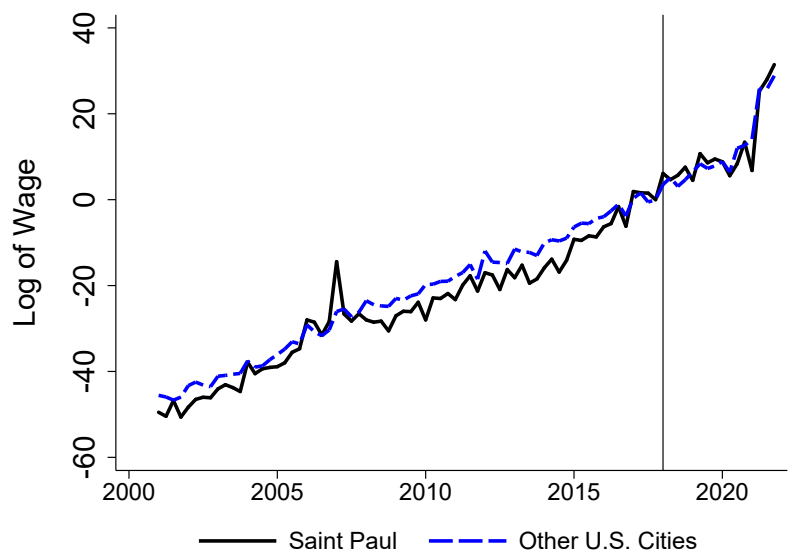
Full-Service Restaurants time series

back



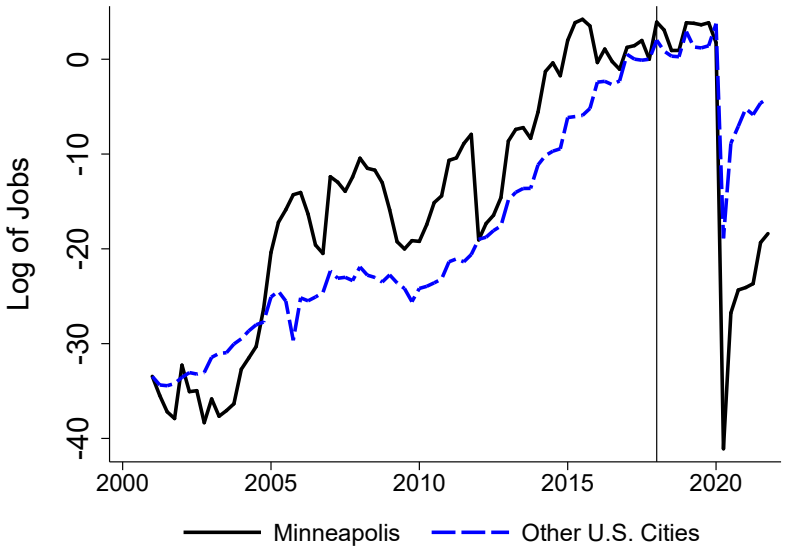


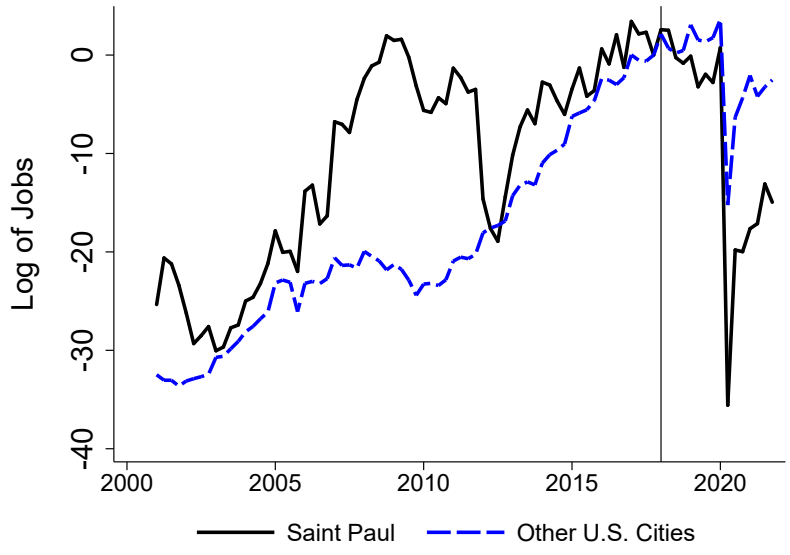


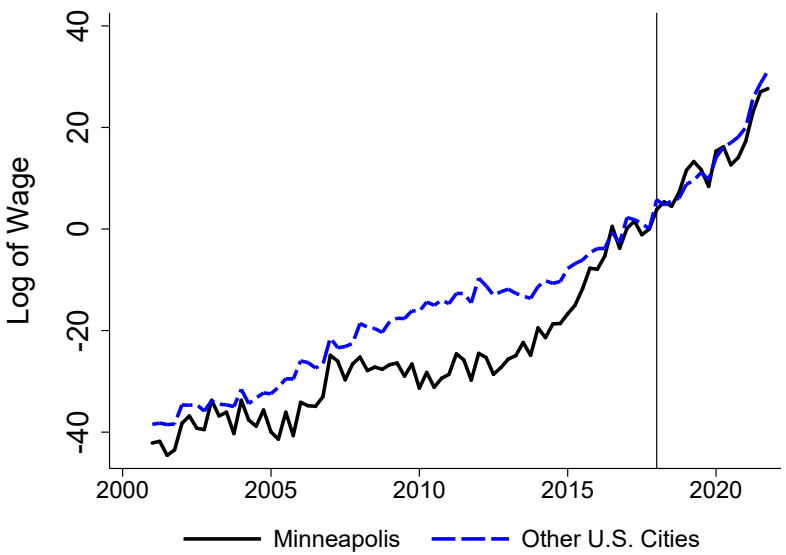


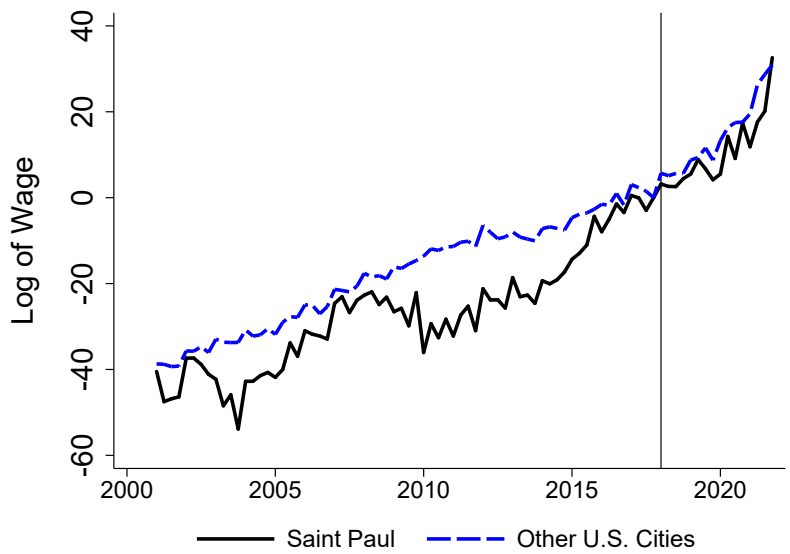
Limited-Service Restaurants time series

back









Results using time weights

back

[Coefficients are $100 \cdot g_{2021(4)}$]	Jobs in Minneapolis	Jobs in Saint Paul
Retail Trade (44)	−4.1	−10.6
	(48.6)	(9.5)
Admin and Support (56)	5.6	−25.2
	(75.7)	(14.3)
Health Care and Social Asst (62)	−1.0	−7.3
	(70.3)	(41.9)
Arts, Entmt, and Recreation (71)	−19.0	−26.4
	(32.4)	(18.6)
Accomm and Food Services (72)	−23.6	−23.0
	(16.2)	(4.7)
Other Services (81)	−10.2	2.8
	(34.5)	(77.8)
Full-Service Restaurants (722511)	−32.7	−17.6
	(5.4)	(9.3)
Ltd-Service Restaurants (722513)	−7.9	−18.4
	(16.2)	(4.8)

Note: p-values in parentheses constructed with the placebo method.

Assessment of bias in Minneapolis

back

[Coefficients are $100 \cdot g_{2021(4)}$]	Jobs Effect	Bias μ	Bias u	Bias Total
Retail Trade (44)	−3	−2	0	−2
Admin and Support (56)	2	0	0	0
Health Care and Social Asst (62)	−2	0	0	0
Arts, Entmt, and Recreation (71)	−12	7	−3	4
Accomm and Food Services (72)	−25	3	−6	−3
Other Services (81)	−10	1	−1	0
Full-Service Restaurants (722511)	−39	0	−6	−6
Ltd-Service Restaurants (722513)	−19	22	−7	15

Bias μ: assume $u_{Nt} = \sum_{i=1}^{N_{co}} \omega_i u_{it}, \forall t = 1, ..., T$. Bias u: assume $\sum_{i=1}^{N_{co}} \omega_i \mu_i^k = \mu_N^k$.

Assessment of bias in Saint Paul

back

[Coefficients are $100 \cdot g_{2021(4)}$]	Jobs Effect	Bias μ	Bias u	Bias Total
Retail Trade (44)	−11	0	−2	−2
Admin and Support (56)	−10	−1	−1	−2
Health Care and Social Asst (62)	−4	−1	−1	−2
Arts, Entmt, and Recreation (71)	−22	2	−4	−2
Accomm and Food Services (72)	−22	1	−4	−3
Other Services (81)	−2	−4	0	−4
Full-Service Restaurants (722511)	−22	1	−5	−4
Ltd-Service Restaurants (722513)	−12	−7	−1	−8

Bias μ: assume $u_{Nt} = \sum_{i=1}^{N_{co}} \omega_i u_{it}, \forall t = 1, ..., T$. Bias u: assume $\sum_{i=1}^{N_{co}} \omega_i \mu_i^k = \mu_N^k$.

Results using all U.S. cities as control

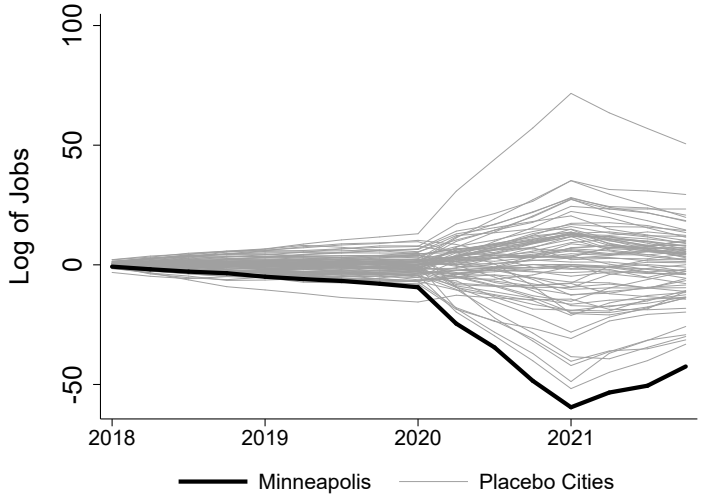
back

[Coefficients are $100 \cdot g_{2021(4)}$]	Jobs in Minneapolis	Jobs in Saint Paul
Retail Trade (44)	−5.6	−12.5
	(26.0)	(7.8)
Admin and Support (56)	−5.6	−10.1
	(59.7)	(31.2)
Health Care and Social Asst (62)	0.9	−4.5
	(97.4)	(43.6)
Arts, Entmt, and Recreation (71)	−17.4	−21.1
	(35.9)	(30.8)
Accomm and Food Services (72)	−28.9	−21.9
	(0.0)	(2.6)
Other Services (81)	−9.0	−2.2
	(37.5)	(81.3)
Full-Service Restaurants (722511)	−42.5	−23.8
	(0.0)	(12.8)
Ltd-Service Restaurants (722513)	−18.5	−18.6
	(10.5)	(10.5)

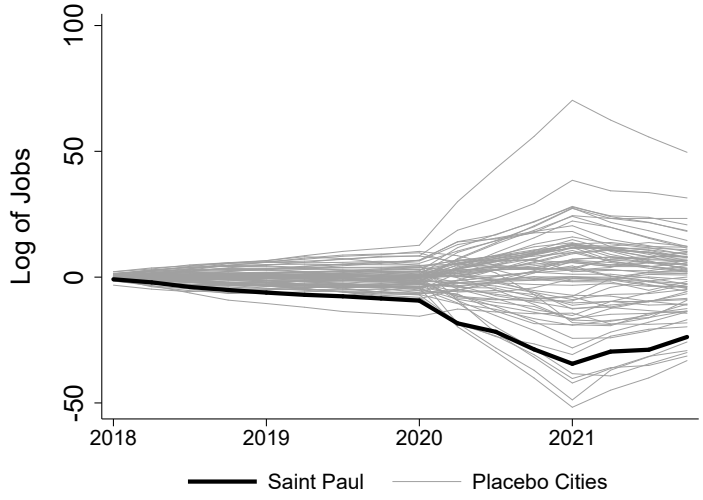
Note: p-values in parentheses constructed with the placebo method.

Time-varying effects using all other U.S. cities

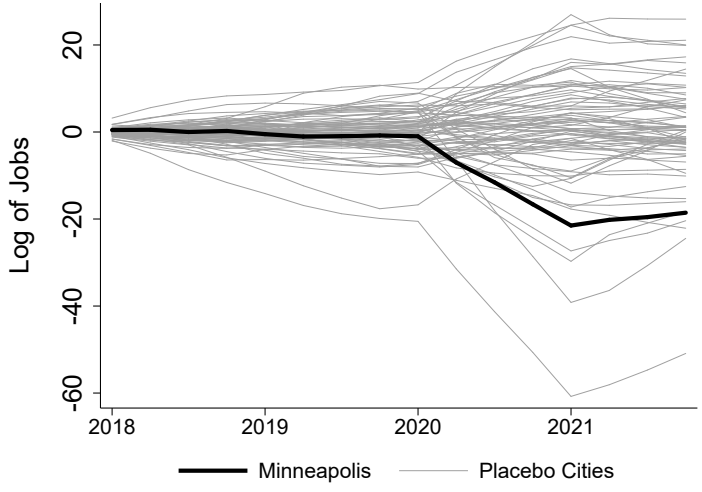
back



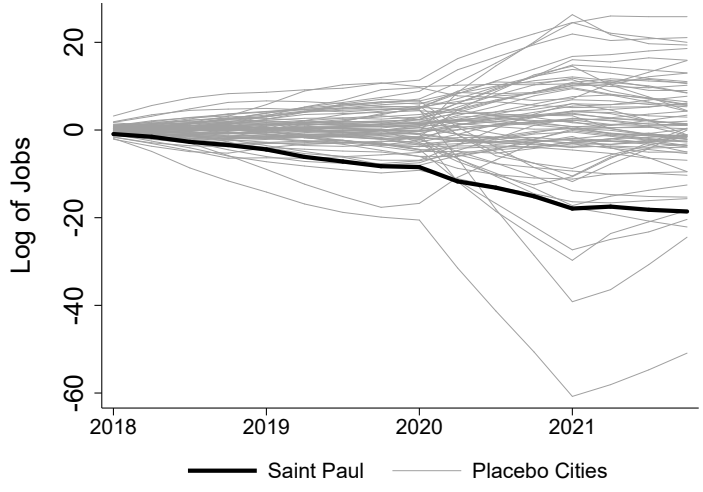
(a) Full-Service Restaurants, MPLS



(b) Full-Service Restaurants, SP



(c) Ltd-Service Restaurants, MPLS



(d) Ltd-Service Restaurants, SP

Results using MN Public QCEW Data

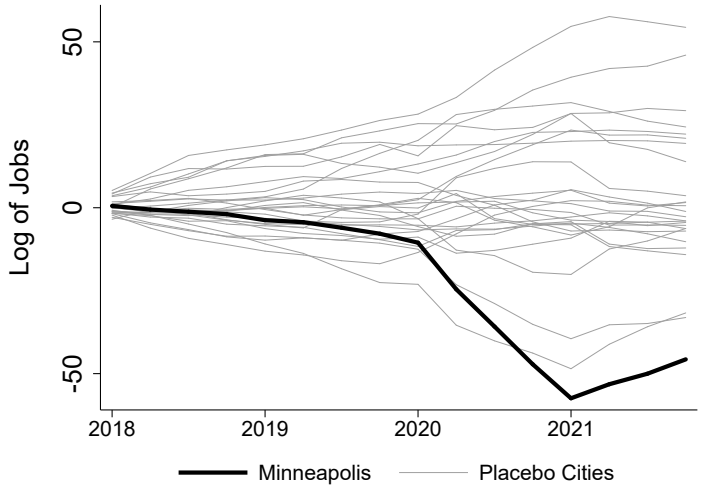
back

[Coefficients are $100 \cdot g_{2021(4)}$]	Jobs in Minneapolis	Jobs in Saint Paul
Retail Trade (44)	2.7	−8.2
	(97.5)	(35.0)
Admin and Support (56)	14.8	18.1
	(76.5)	(64.7)
Health Care and Social Asst (62)	3.9	−0.3
	(82.4)	(76.5)
Arts, Entmt, and Recreation (71)	−10.7	−17.2
	(73.5)	(61.2)
Accomm and Food Services (72)	−26.0	−16.3
	(10.7)	(21.4)
Other Services (81)	−9.1	3.4
	(57.1)	(92.9)
Full-Service Restaurants (722511)	−45.7	−18.3
	(0.0)	(14.8)
Ltd-Service Restaurants (722513)	−8.5	−9.4
	(48.0)	(56.0)

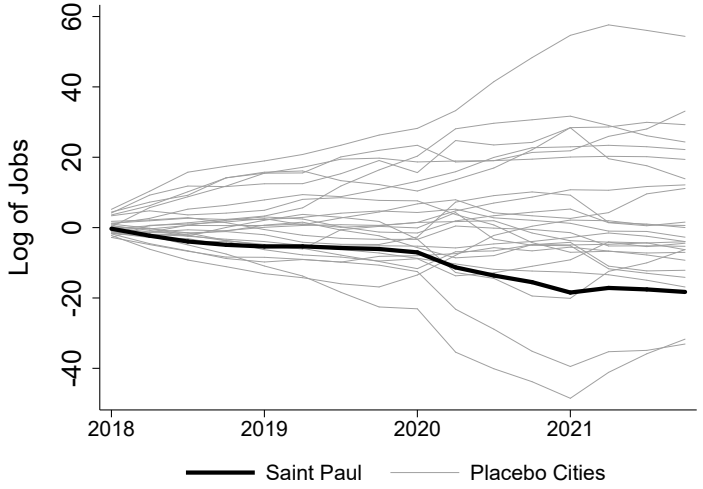
Note: p-values in parentheses constructed with the placebo method.

Time-varying effects using MN Public QCEW Data

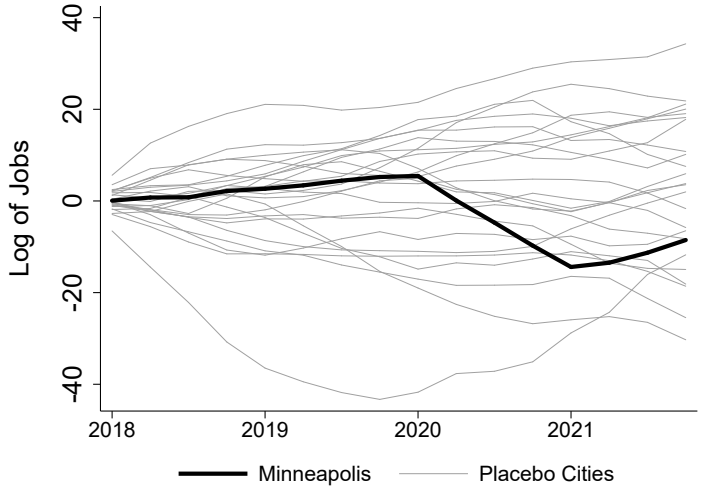
back



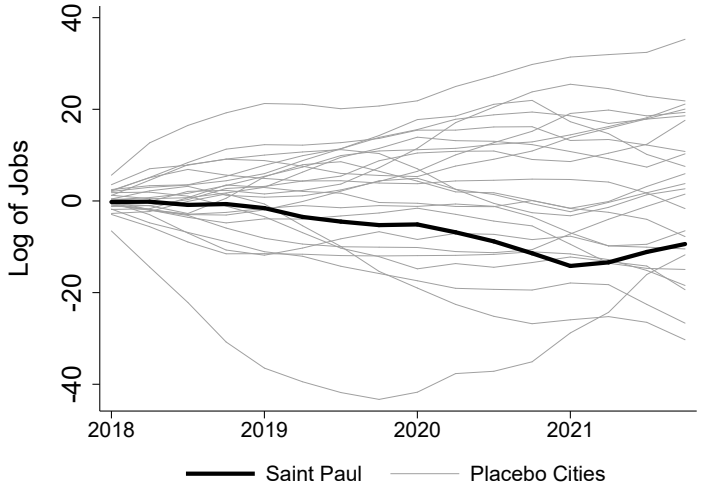
(a) Full-Service Restaurants, MPLS



(b) Full-Service Restaurants, SP



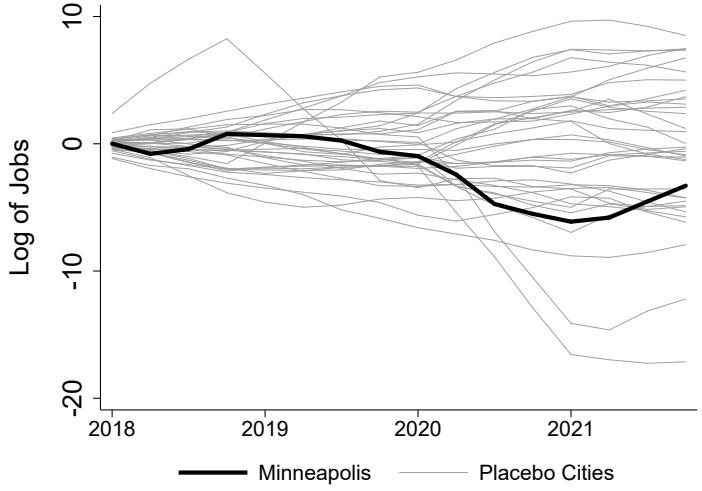
(c) Ltd-Service Restaurants, MPLS



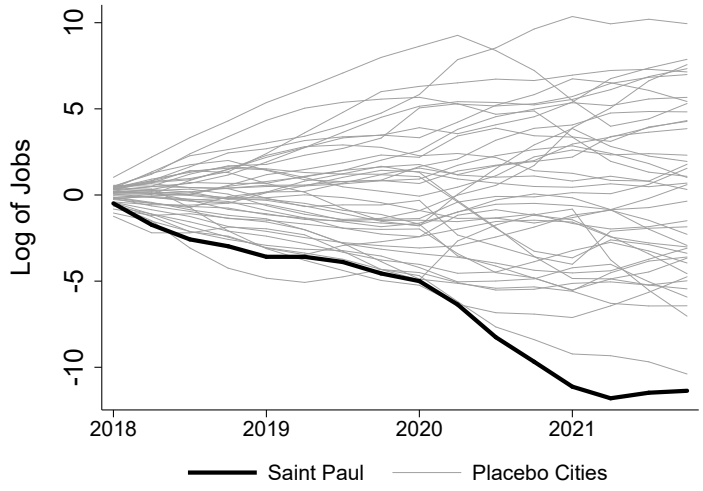
(d) Ltd-Service Restaurants, SP

Time-varying effects using U.S. cities of similar size

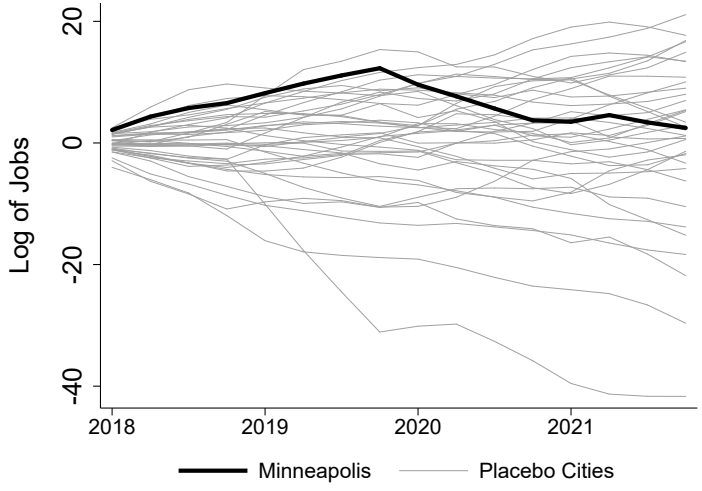
back



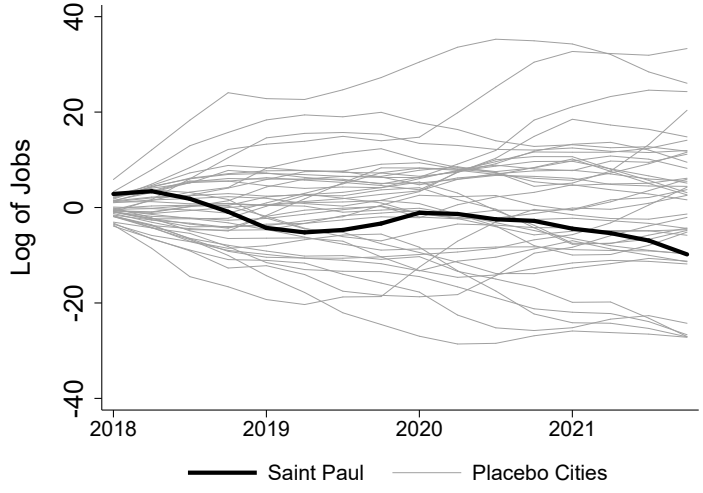
(a) Retail, MPLS



(b) Retail, SP



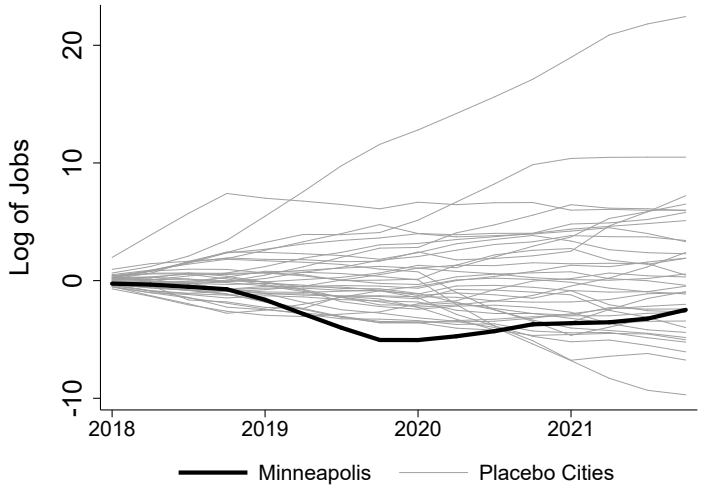
(c) Admin and Support, MPLS



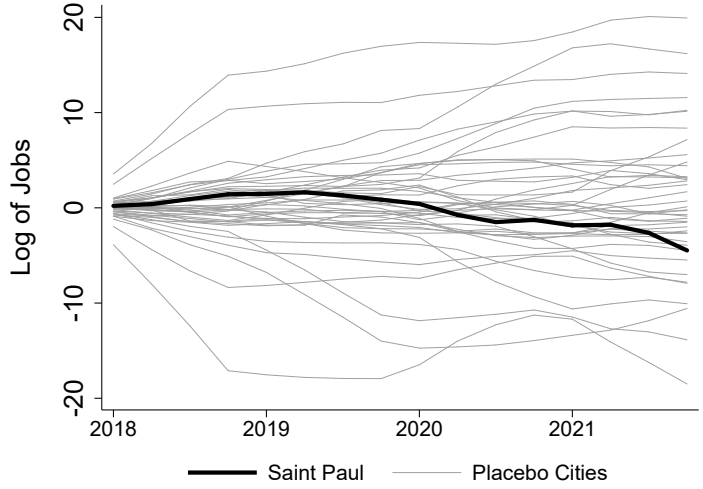
(d) Admin and Support, SP

Time-varying effects using U.S. cities of similar size

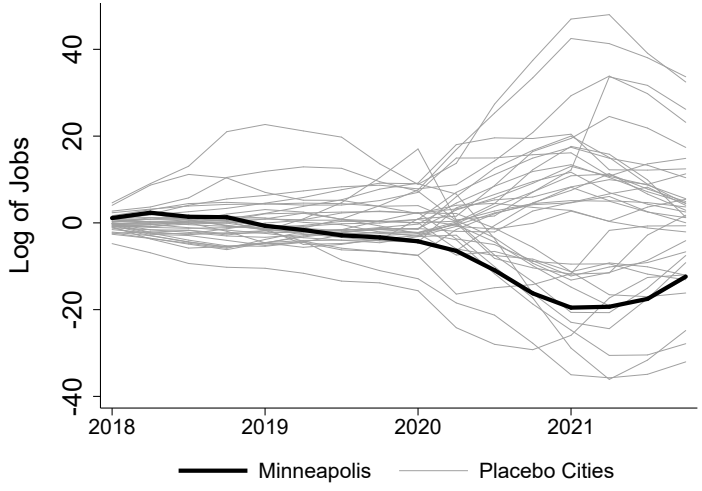
back



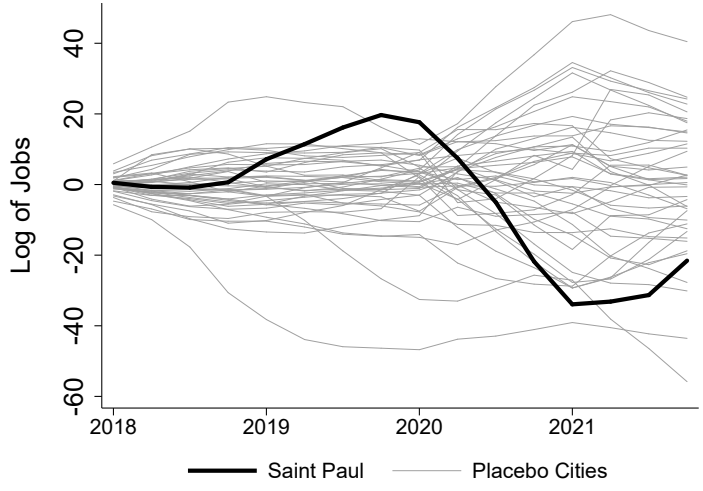
(a) Health and Social, MPLS



(b) Health and Social, SP



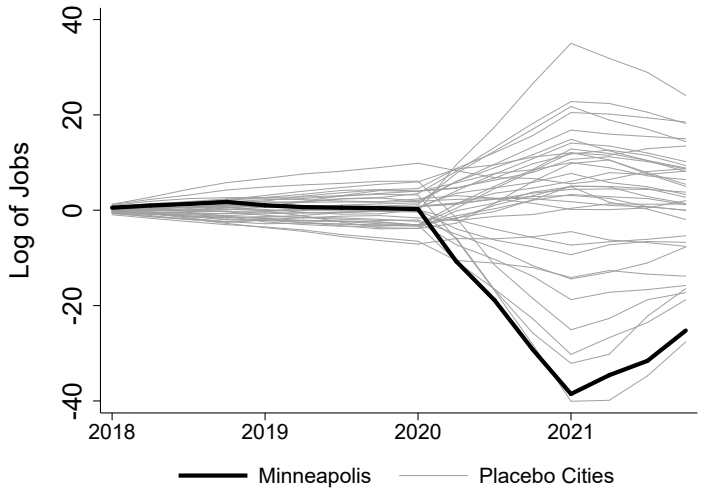
(c) Arts, Entmt, and Rec, MPLS



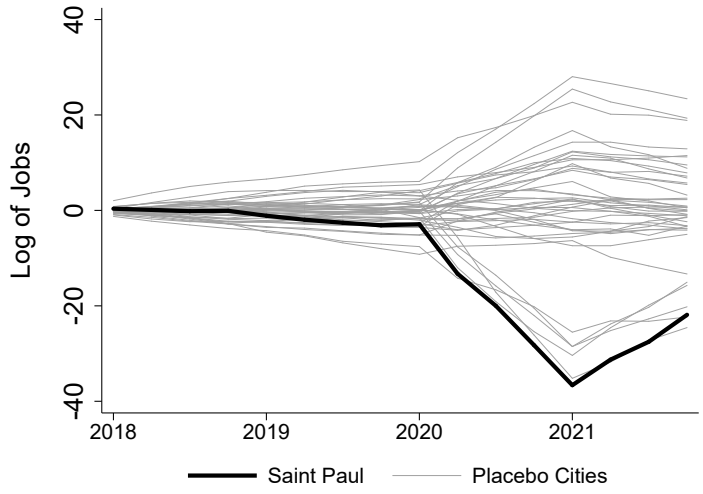
(d) Arts, Entmt, and Rec, SP

Time-varying effects using U.S. cities of similar size

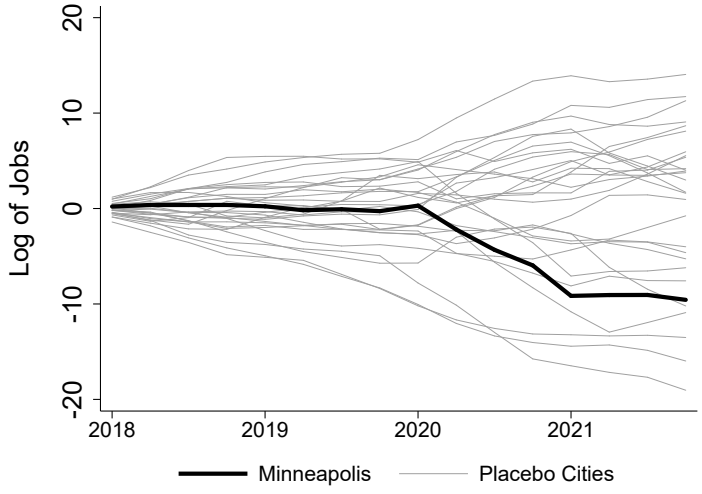
back



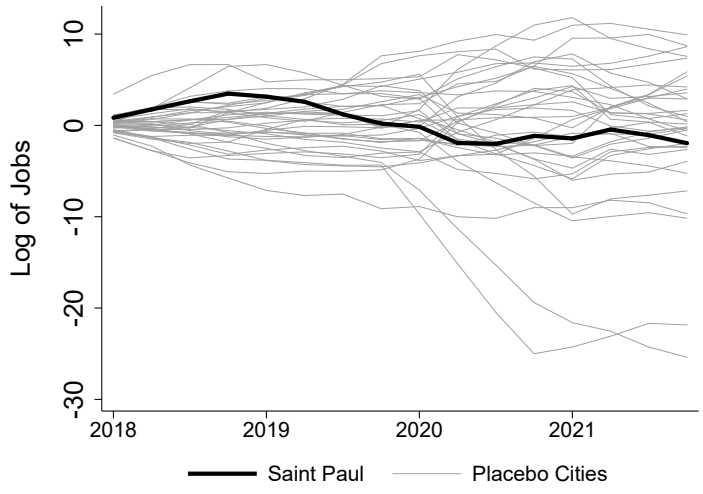
(a) Accomm and Food, MPLS



(b) Accomm and Food, SP



(c) Other Services, MPLS



(d) Other Services, SP

Adding lags of growth for Minneapolis

back

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	7.5	−10.7	−12.5	−8.0
	(1.1)	(1.6)	(0.6)	(11.9)
2019	8.6	−15.1	−16.0	−11.3
	(1.8)	(0.7)	(0.4)	(7.7)
2020	6.4	−14.1	−13.1	−13.3
	(9.3)	(1.7)	(2.7)	(5.1)

Note: p-values in parentheses from standard errors clustered at the establishment level.

Expanding the sample to 6 years for Minneapolis

back

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	10.0	−9.0	−10.8	−8.0
	(0.1)	(5.3)	(2.3)	(13.8)
2019	12.1	−13.7	−14.3	−11.6
	(0.0)	(1.3)	(1.0)	(7.0)
2020	13.7	−12.3	−11.2	−12.9
	(0.0)	(3.1)	(4.8)	(5.0)

Note: *p*-values in parentheses from standard errors clustered at the establishment level.

Expanding the sample to all years for Minneapolis

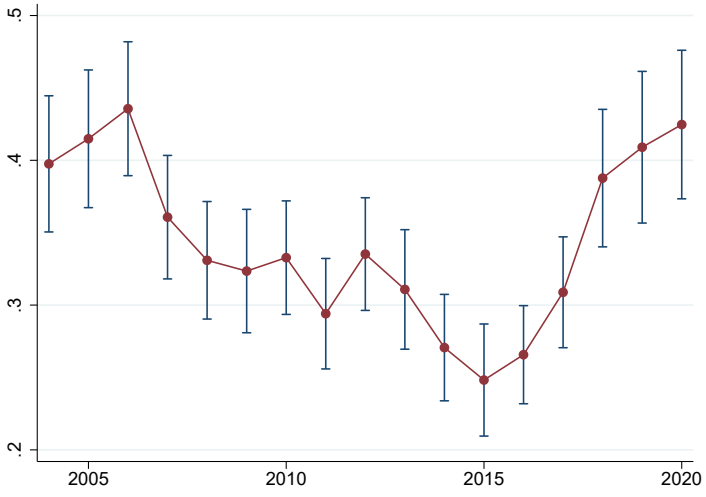
back

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	6.1	−6.7	−8.9	−12.6
	(3.3)	(15.2)	(4.2)	(2.0)
2019	8.3	−11.4	−12.4	−16.2
	(1.0)	(3.4)	(2.2)	(1.0)
2020	9.8	−10.0	−9.4	−17.6
	(0.2)	(6.7)	(8.6)	(0.6)

Note: p-values in parentheses from standard errors clustered at the establishment level.

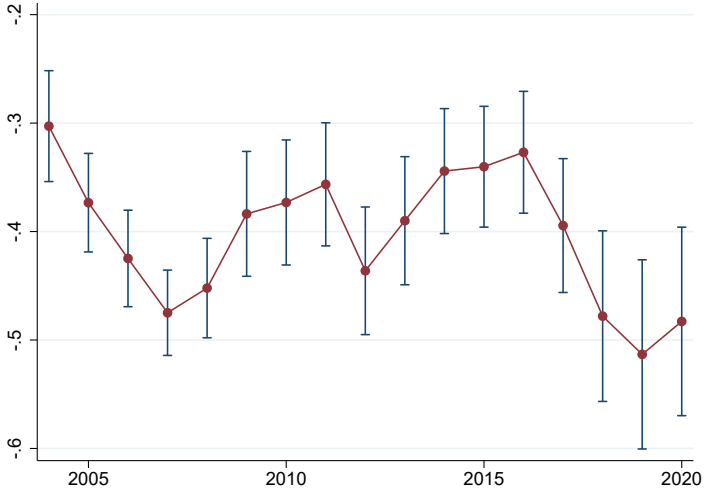
Establishment coefficients for Minneapolis

back



(a) Wage

(b) Jobs



(c) Hours

(d) Earnings

Adding lags of growth for Saint Paul

back

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	5.5	−10.8	−12.3	−12.7
	(14.0)	(8.5)	(5.3)	(7.2)
2019	3.3	−23.6	−22.0	−23.4
	(53.3)	(0.2)	(0.4)	(0.7)
2020	2.3	−24.5	−23.7	−22.8
	(67.3)	(0.1)	(0.2)	(0.9)

Note: p-values in parentheses from standard errors clustered at the establishment level.

Expanding the sample to 6 years for Saint Paul

back

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	4.4	−11.8	−13.3	−12.3
	(23.3)	(6.3)	(4.0)	(9.1)
2019	5.2	−24.2	−22.8	−24.0
	(26.1)	(0.1)	(0.2)	(0.4)
2020	4.3	−24.4	−24.2	−22.2
	(36.7)	(0.1)	(0.1)	(0.8)

Note: p-values in parentheses from standard errors clustered at the establishment level.

Expanding the sample to all years for Saint Paul

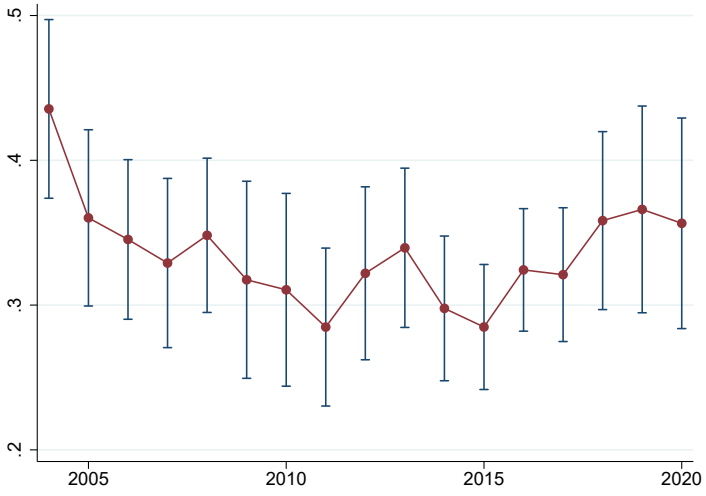
back

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	3.1	−5.2	−8.3	−9.2
	(39.6)	(41.3)	(25.8)	(20.6)
2019	3.9	−17.7	−16.8	−20.9
	(39.0)	(1.3)	(2.1)	(1.0)
2020	3.0	−17.8	−18.3	−19.0
	(52.3)	(0.9)	(0.8)	(1.7)

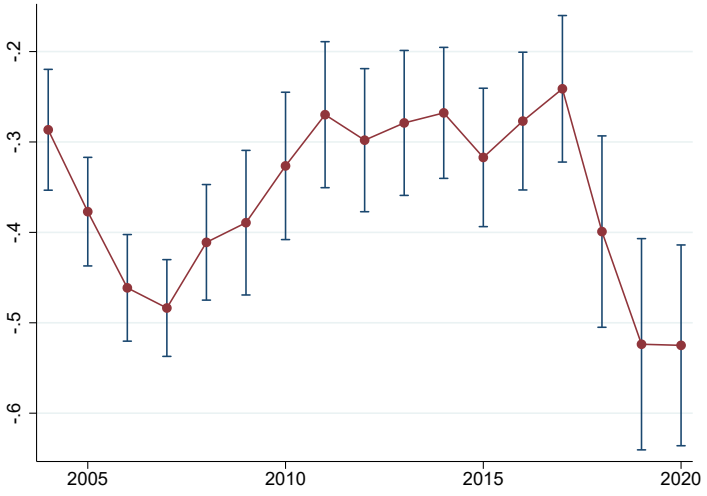
Note: *p*-values in parentheses from standard errors clustered at the establishment level.

Establishment coefficients for Saint Paul

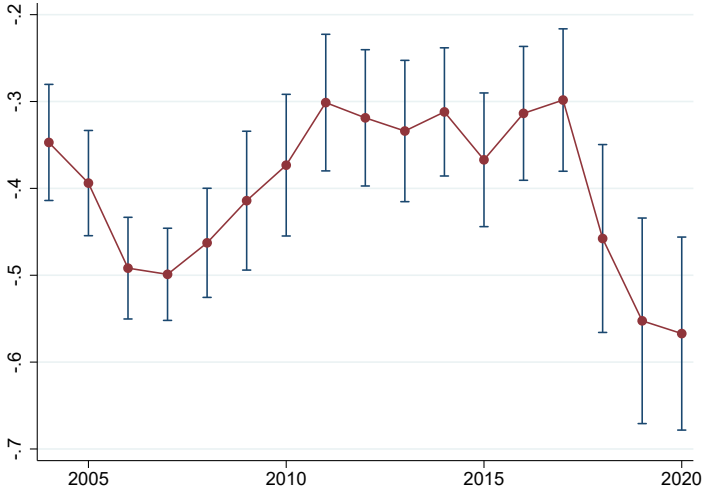
back



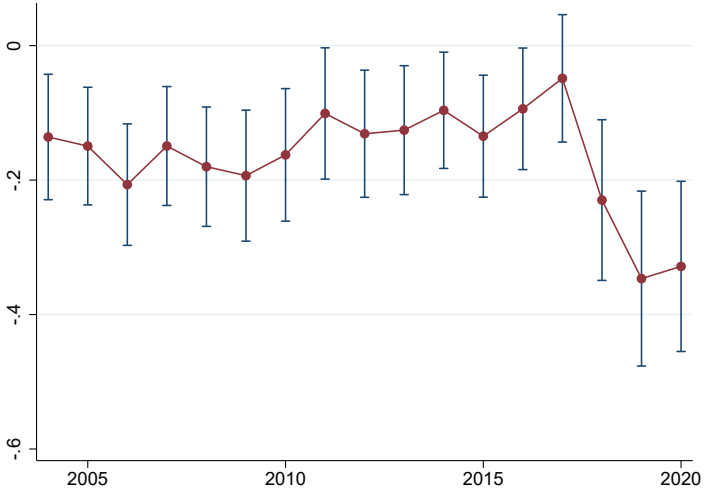
(a) Wage



(b) Jobs



(c) Hours



(d) Earnings

Exposure statistics by demographic group

back

(Twin Cities, 2017)	Mean GAP	Share in Q4 GAP
Female	7	25
Male	7	28
Black	11	44
Hispanic	9	35
Other	8	31
White	5	19
Less than High School	15	61
High School	7	29
Some College	9	37
College or More	5	20
Age 16-19	15	63
Age 20-29	8	30
Age 30-39	4	15
Age 40+	4	13

Detailed calculations

back

1. Time Series.
   - Average: $\sum_s \tau_s \nu_s$ for significant τ_s.
   - Most Negative: $\sum_{\text{rest.}} \tau_{\text{rest.}} \nu_{\text{rest.}} / \sum_{\text{rest.}} \nu_{\text{rest.}}$.
2. Cross Section.
   - Average: $(\tau^e + \tau^w)(\text{Mean GAP})/2$.
   - Most Negative: $(\tau^e + \tau^w)(\text{Max GAP})/2$.

Minimum wage effects on establishment labor demand

back

Note: $\mu_w = (\theta + 1)/\theta$ and $\mu_p = \varepsilon/(\varepsilon - 1)$.

- Labor demand without minimum wage:

$$\ell = (1-\phi)^{\varepsilon} z^{\varepsilon-1} \left(\phi \left(\frac{\phi \mu_w w}{1-\phi} \right)^{\sigma-1} + (1-\phi) \right)^{\frac{\varepsilon-\sigma}{\sigma-1}} (\mu_p \mu_w w)^{-\varepsilon}.$$

- Labor demand if minimum wage binds $w_{\min} > w$:

$$\ell = (1-\phi)^{\varepsilon} z^{\varepsilon-1} \left(\phi \left(\frac{\phi w_{\min}}{1-\phi} \right)^{\sigma-1} + (1-\phi) \right)^{\frac{\varepsilon-\sigma}{\sigma-1}} (\mu_p w_{\min})^{-\varepsilon}.$$

- Effect depends on $\mu_w w$ vs $w_{\min}$.

Parameters

back

$$\varepsilon = 2, \delta = 0.28, \sigma_w = \sigma_z = 0.46, \sigma_\phi = .1\mu_\phi, \sigma_\kappa = .1\mu_\kappa.$$

Parameter	Value	Data Moments	Value
Elasticity of Factor Substitution, σ	0.19	Cross-Sectional Elasticity, τ_ℓ/τ_w	-1.01
Mean Intensity of Other Inputs, μ_ϕ	0.52	Labor Share of Costs, Mean	0.30
Share of Affected Establishments, q	0.23	GAP, Employment-Weighted	0.14
Mean Entry Cost, μ_κ	0.06	Entry Cost to Profit, Median	0.36
Fixed Operating Cost, f	0.08	Operating Cost to Profit, Median	0.59

Model experiments

back

	τ_ℓ/τ_w	η	W_1/W_0-1	L_1/L_0-1	Ratio of Entry
Baseline	-1.01	-1.07	0.09	-0.25	2.28
$\delta = 0$	-1.01	-1.07	0.09	-0.08	∞
$f = 0.08$	-0.98	-1.07	0.09	-0.21	1.75
$f = \bar{f} w^{1/2}$	-0.95	-1.04	0.08	-0.29	3.50
$\mu_\phi = 0.80$	-0.88	-0.96	0.08	-0.16	1.40
$\sigma = 1$	-1.57	-1.48	0.14	-0.36	2.37
$\text{corr}(\log z, \log w) = 0.50$	-1.46	-1.10	0.07	-0.29	3.43
$\text{corr}(\phi, \log w) = 0.50$	-1.03	-1.07	0.09	-0.26	2.35
$\theta = 5$	-0.77	-1.12	0.07	-0.20	2.33
$\theta = 2$	-0.45	-1.19	0.06	-0.12	2.46