Minimum Wages and Labor Markets in the Twin Cities

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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 2021
Minneapolis	2017	2018	46%
Saint Paul	2018	2020	26%

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Saint Paul	2018	2020	26%

- Why Twin Cities? What is new?

1. *Data*: administrative, improved measurements.
2. *Context*: local policy, large change, and recession.
3. *Methods*: time series; cross section; model.
4. *Timing lag*: evidence of anticipation effects.

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)-2021(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.

Econometric methodology

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

- 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:

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

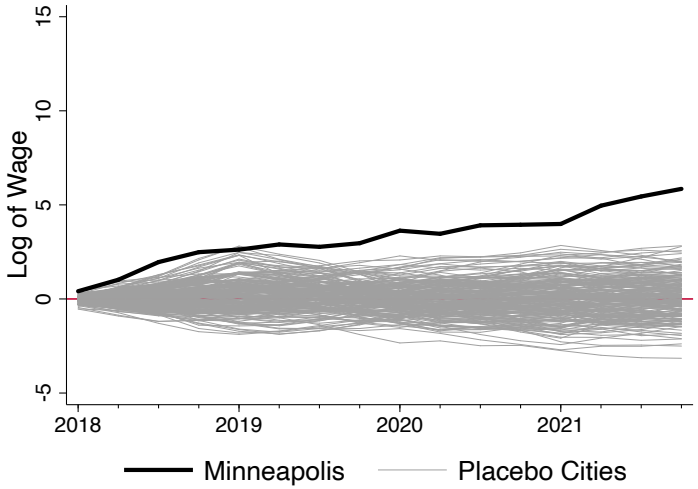
with weights $\sum_{i=1}^{N_{\text{co}}} \hat{\omega}_i Y_{it} \approx N_{\text{tr}}^{-1} \sum_{i=N_{\text{co}}+1}^{N} Y_{it}$ during pre-treatment.

Appropriateness of synthetic difference-in-differences

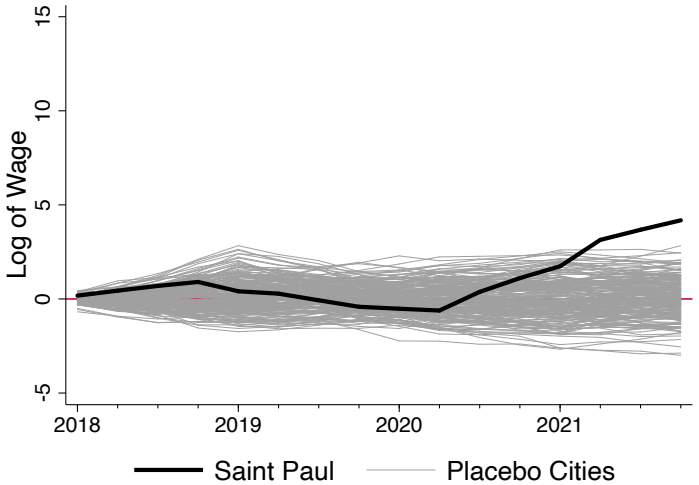
- Synthetic control substantial fraction of pre-treatment variation.
- Bias with imperfect pre-treatment fit?
  - Growth spec.: no overfitting; correlation of treatment with growth.
  - Time weights: balance pre- and post-treatment growth for control.
  - Monte Carlo simulations: small bias relative to factor model.

Wage effects for restaurants

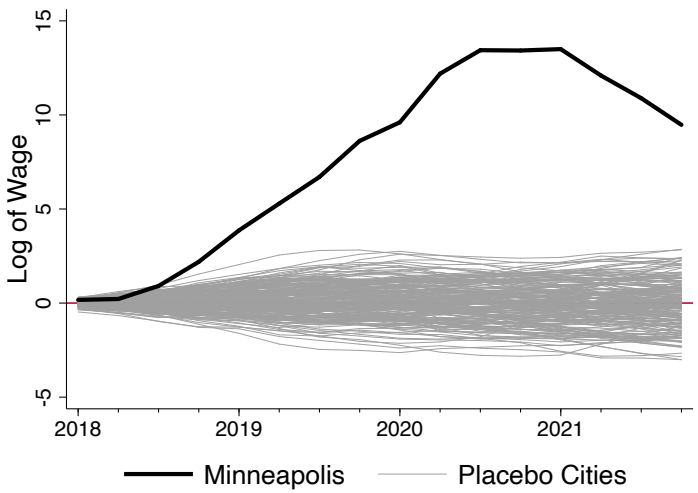
▸ details ▸ placebo



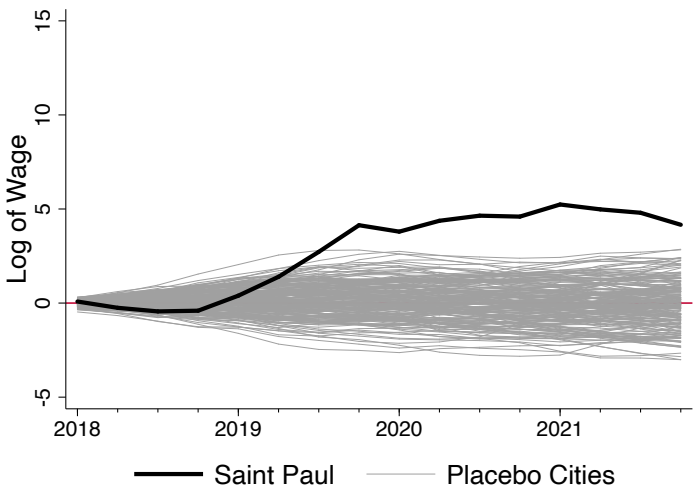
(a) Full-Service Restaurants, MPLS



(b) Full-Service Restaurants, SP



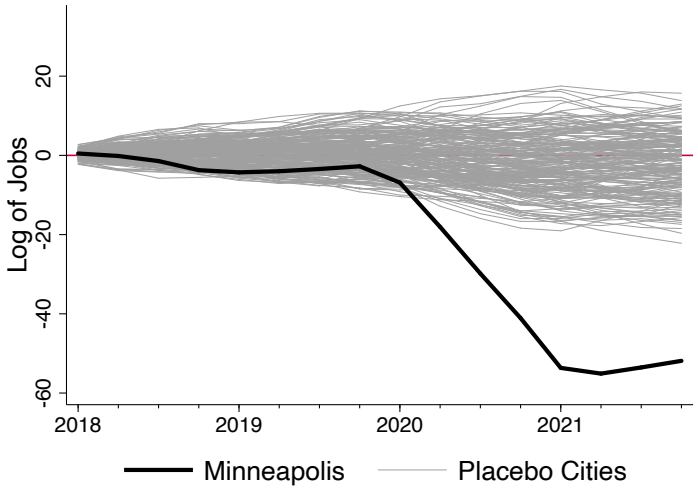
(c) Ltd-Service Restaurants, MPLS



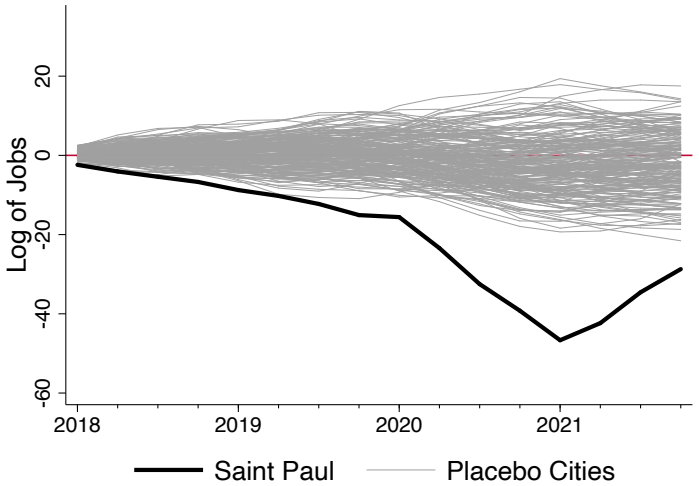
(d) Ltd-Service Restaurants, SP

Jobs effects for restaurants

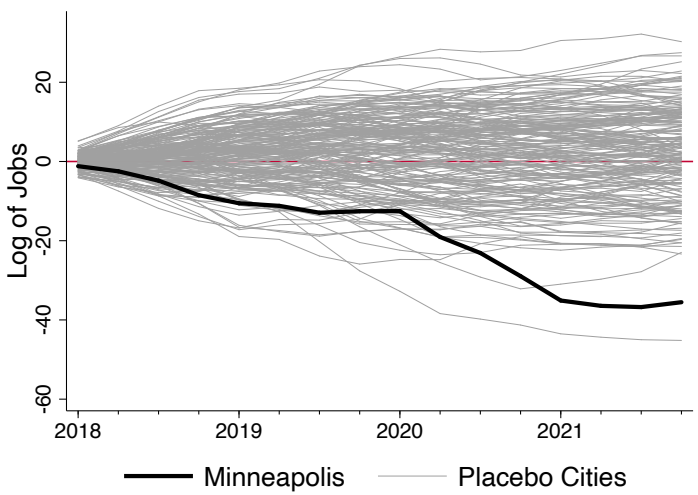
▸ border ▸ λ_t



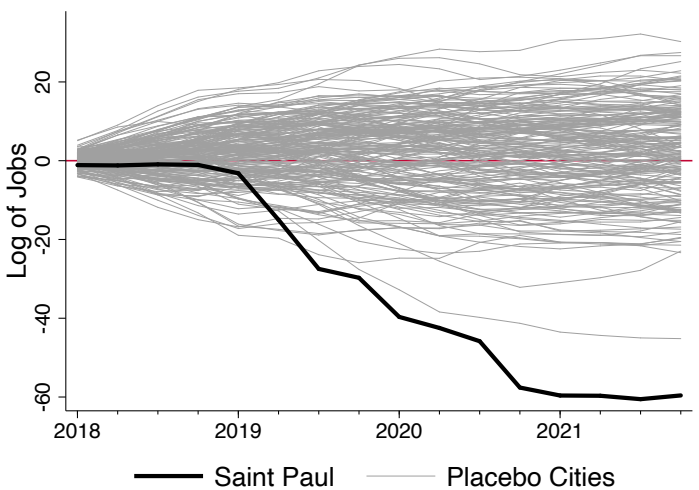
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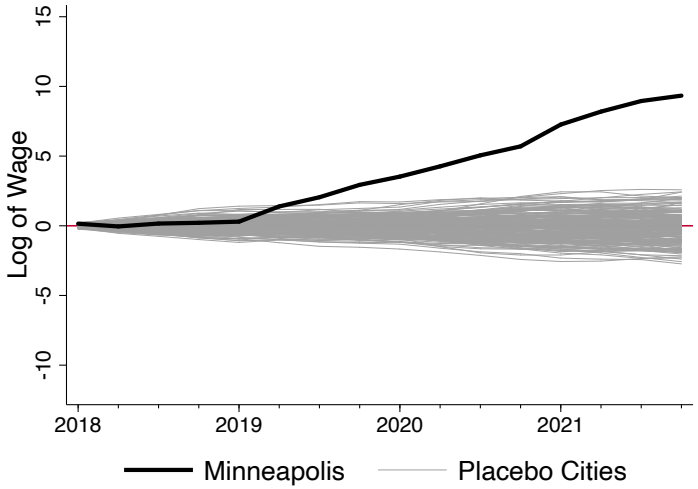
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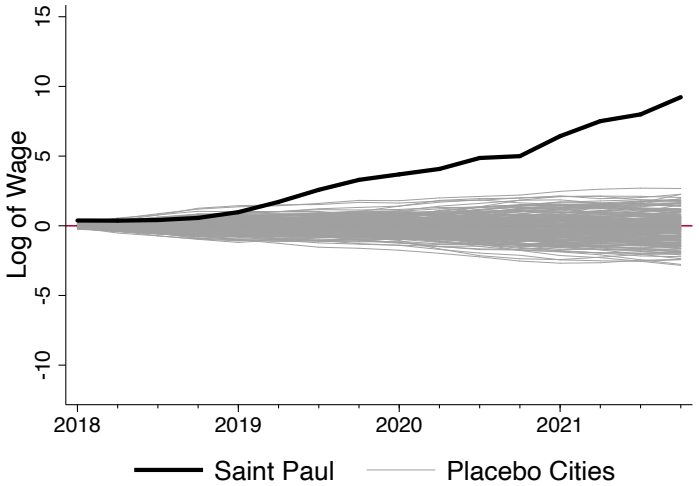
(d) Ltd-Service Restaurants, SP

Effects for retail

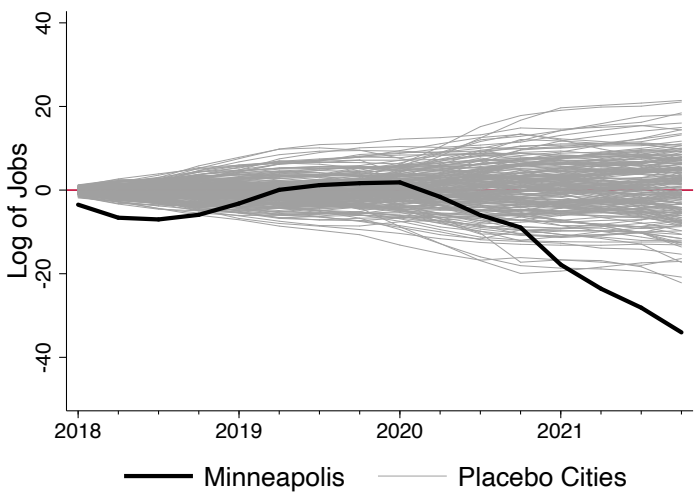
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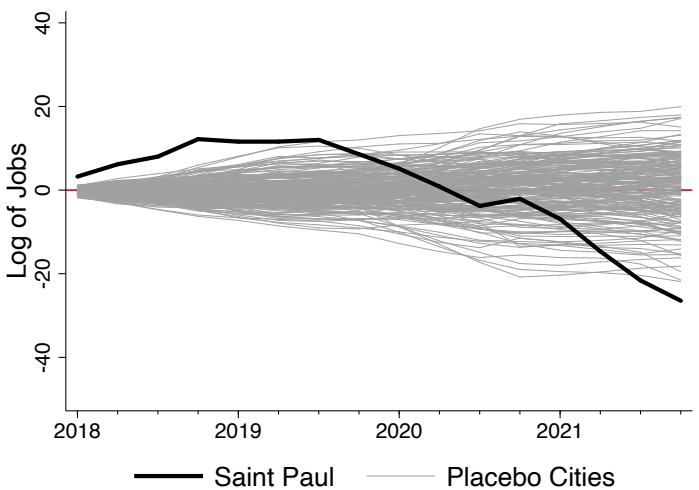
(a) Wages, MPLS



(b) Wages, SP



(c) Jobs, MPLS



(d) Jobs, SP

Challenges in interpreting time series results from MN

1. Idiosyncratic loading on aggregate shocks.
    - Eg: pandemic lockdowns affect more densely populated cities.
2. Idiosyncratic shocks.
    - Eg: social unrest in 2020(2).

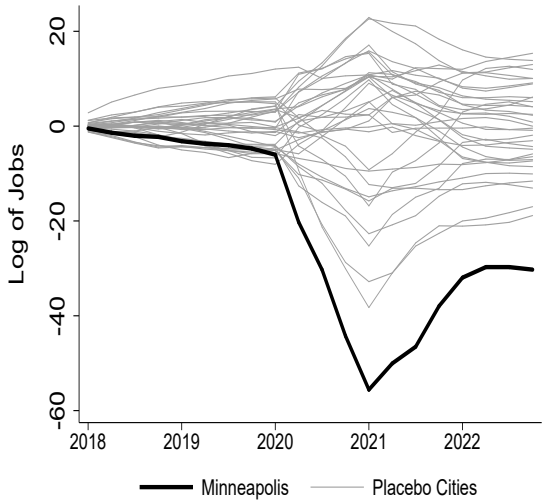
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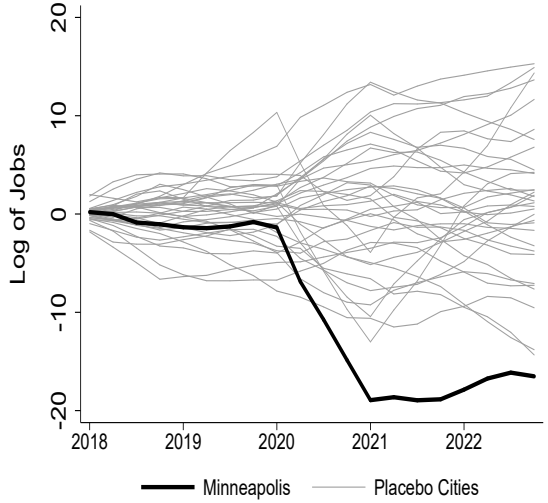
Use other U.S. cities of similar size as a control group.

- Also dense, also facing lockdowns, unrest, national-wide changes.
- Adjust for differences in pandemic conditions and civil unrest.

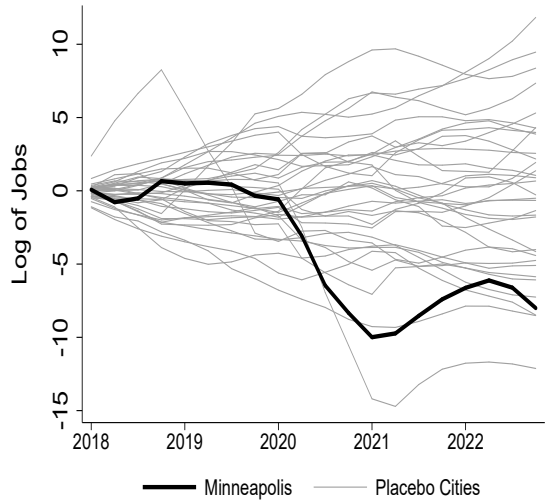
Results using U.S. cities of similar size



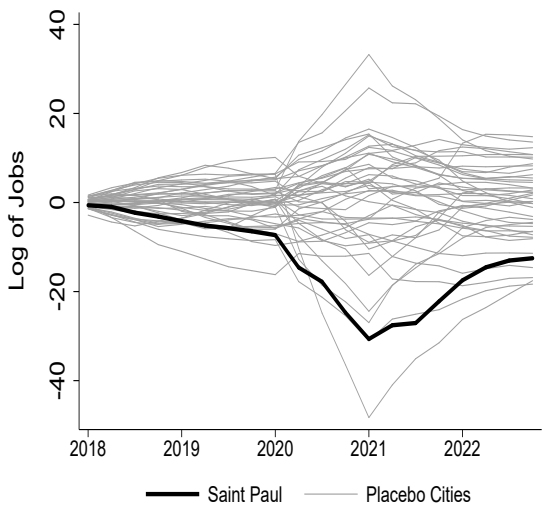
(a) FS Restaurants, MPLS



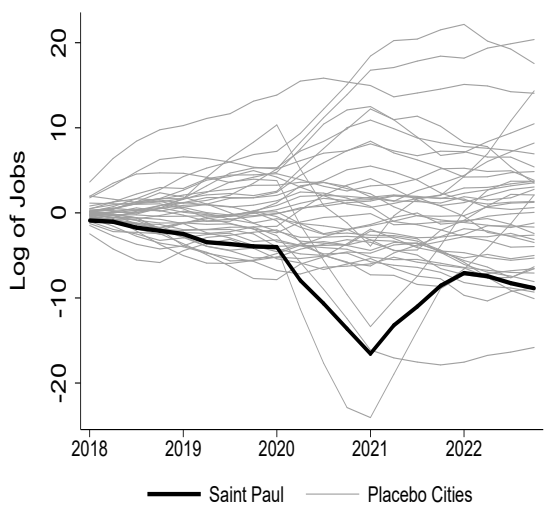
(b) LS Restaurants, MPLS



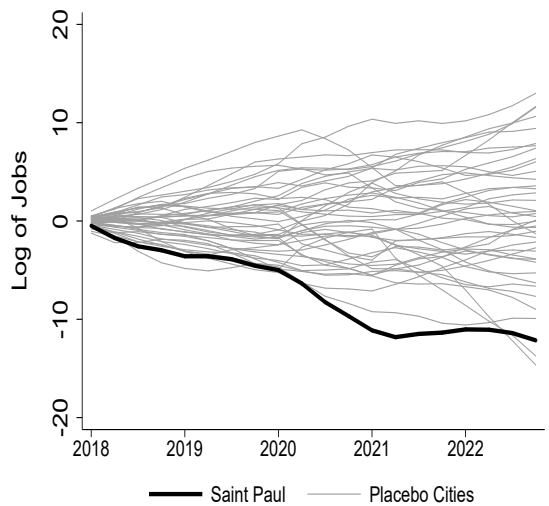
(c) Retail, MPLS



(d) FS Restaurants, SP



(e) LS Restaurants, SP



(f) Retail, SP

Pandemic and civil unrest controls Z_{it}

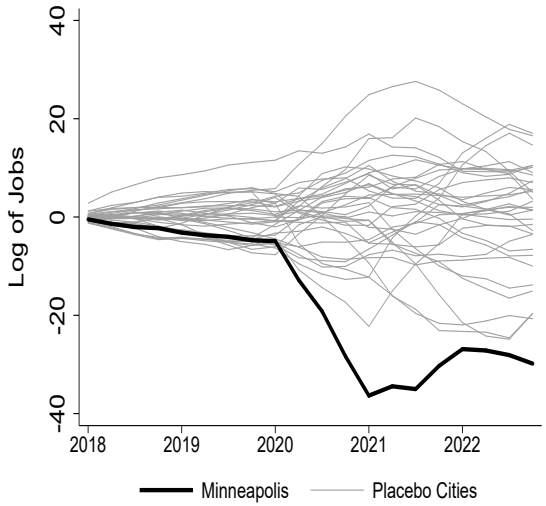
- Methodology.
  - Project Y_{it} on Z_{it} in $i = 1, ..., N_{co}, t = 2020, ...$ (by industry, city).
  - Residualize all outcome variables: $\hat{Y}_{it} = Y_{it} - \hat{\beta}_Z Z_{it}$.

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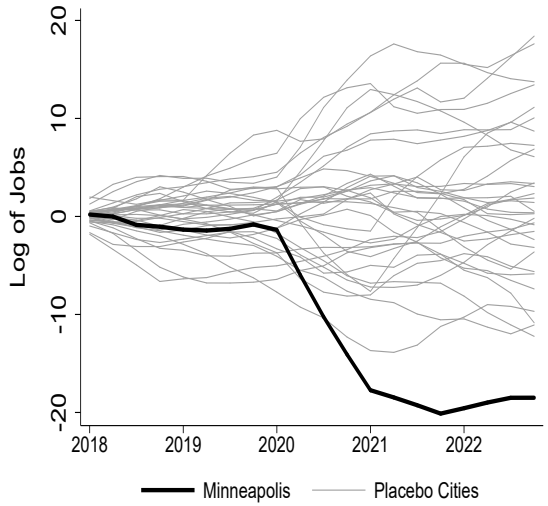
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  - Residualize all outcome variables: $\hat{Y}_{it} = Y_{it} - \hat{\beta}_Z Z_{it}$.
- Controls Z_{it}.
  - Retail & recreation mobility (Google and Chetty et al, 2023).
  - Workplace mobility (Google and Chetty et al, 2023).
  - Violent protests (Armed Conflict Location & Event Data Project).
  - Total protests (Armed Conflict Location & Event Data Project).

Results adjusting for retail and recreation mobility

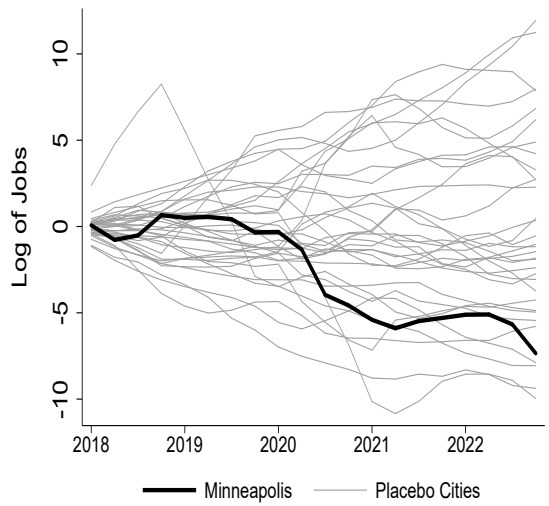
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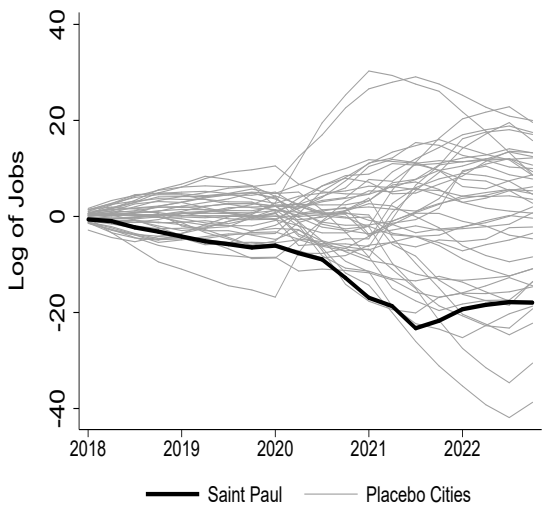
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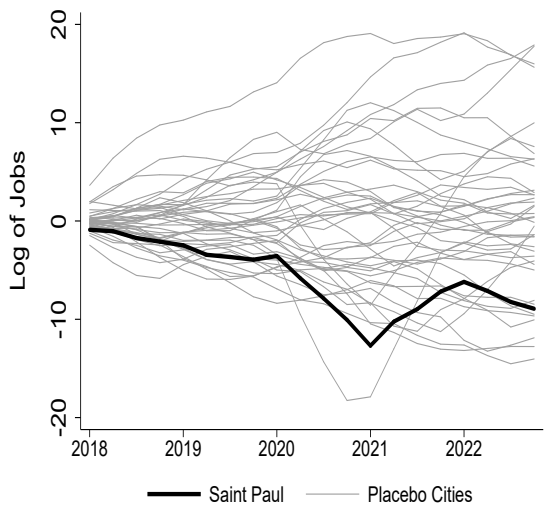
(b) LS Restaurants, MPLS



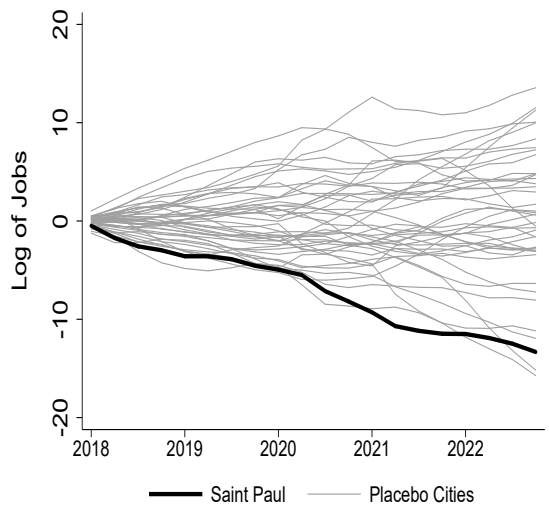
(c) Retail, MPLS



(d) FS Restaurants, SP



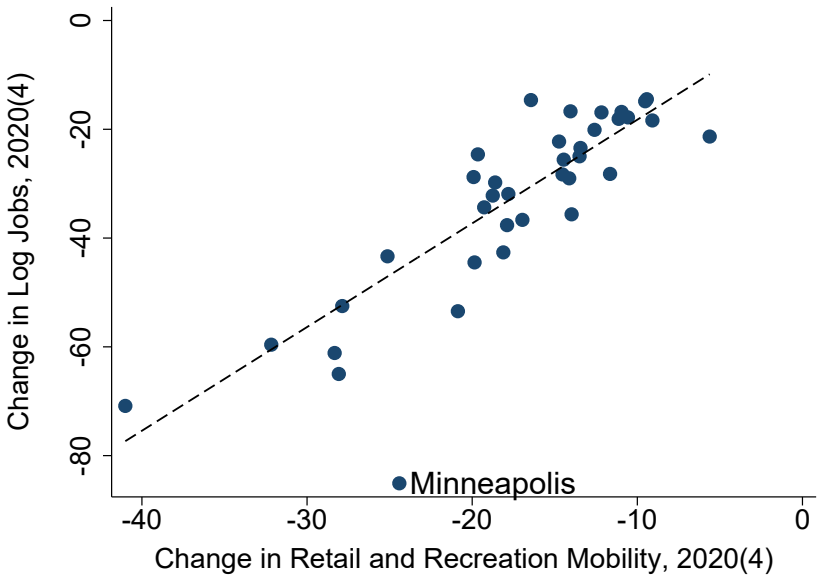
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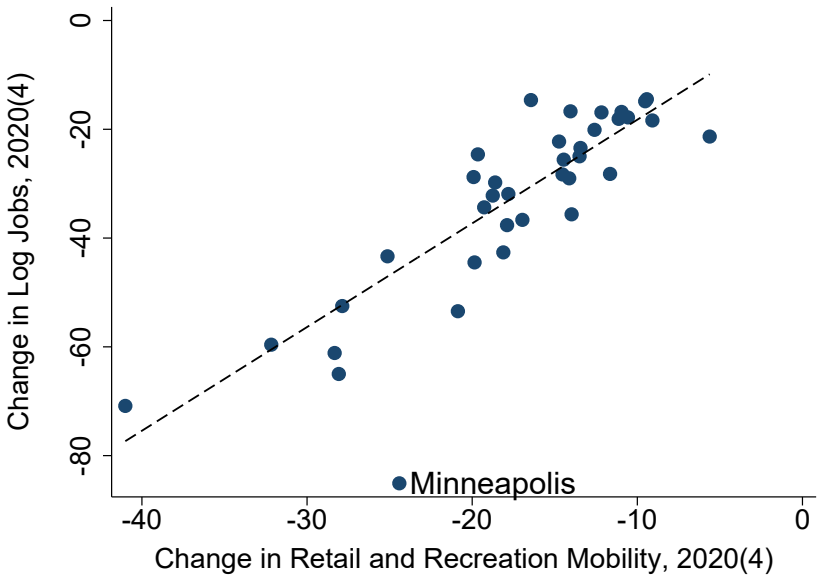
Why is pandemic mobility adjustment not significant?

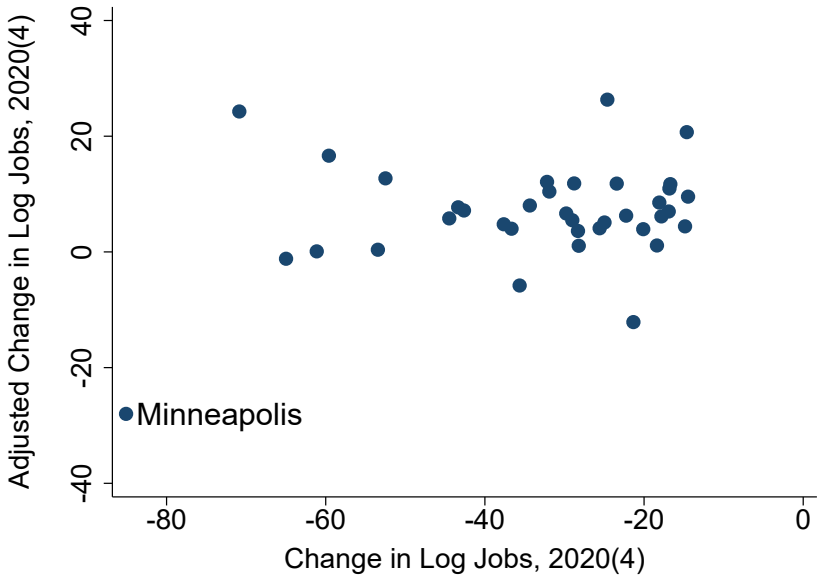
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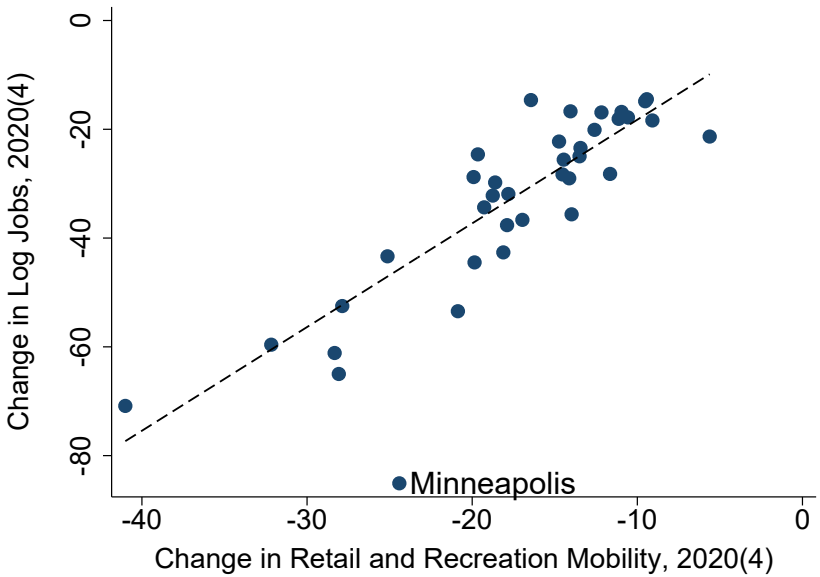
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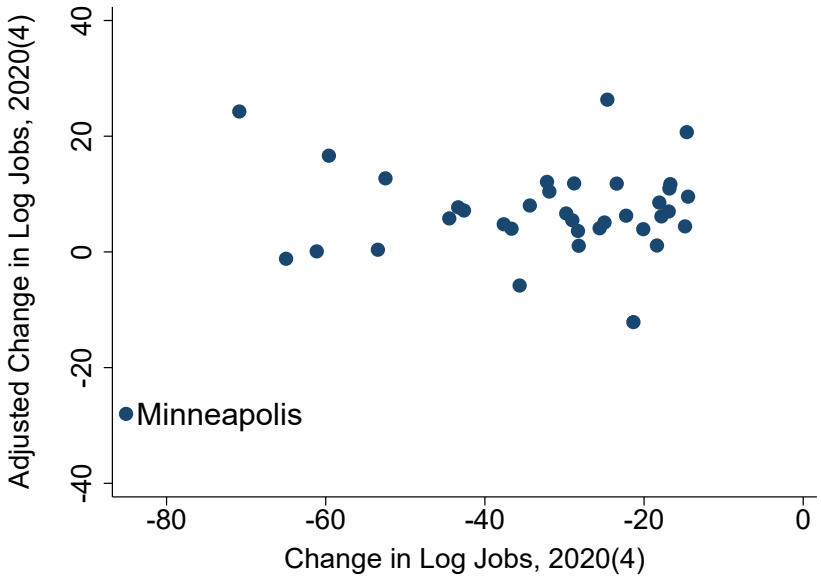


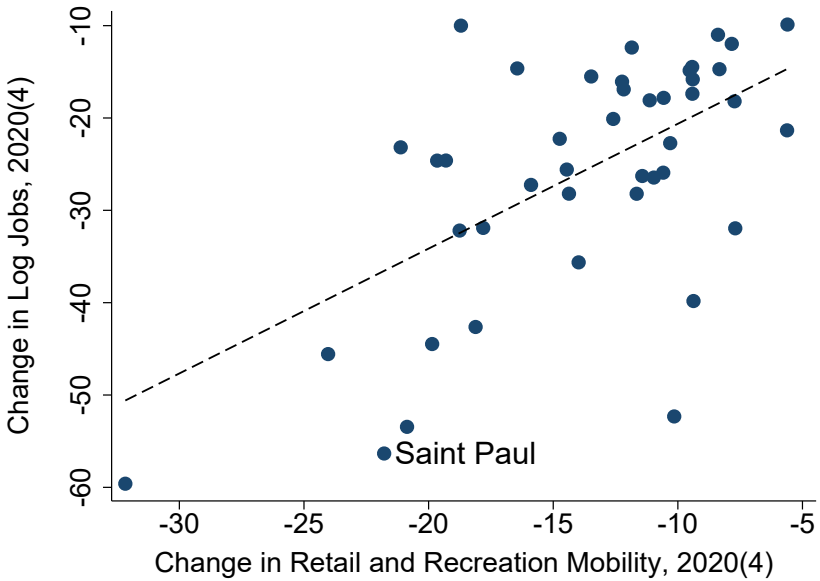


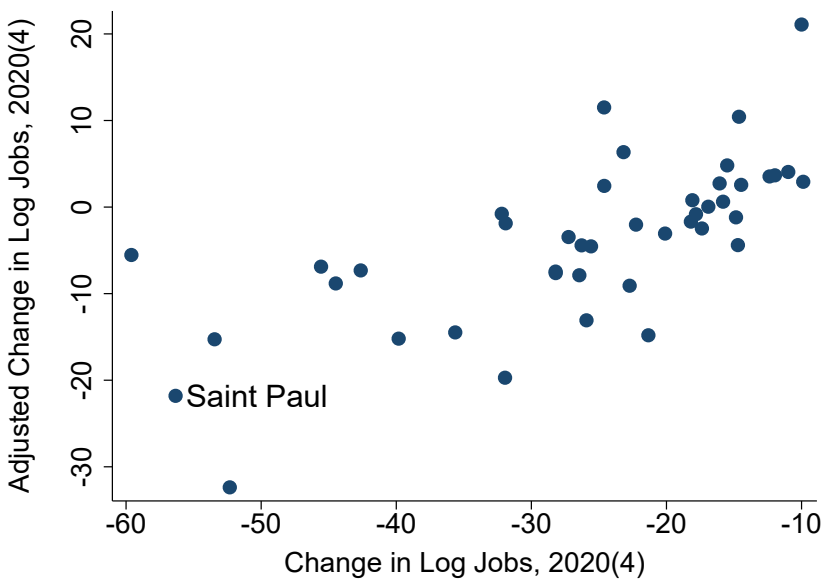
Why is pandemic mobility adjustment not significant?

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Evidence from the Cross Section

Econometric methodology: cross section of establishments

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

Regression model:

$$Y_{jszt} = \gamma_{szt} + \sum_{t=2018}^{2021} \tau_t \left(\text{GAP}_{jszt-3} \cdot d_t\right) + u_{jszt},$$

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:

$$Y_{jszt} = \gamma_{szt} + \sum_{t=2018}^{2021} \tau_t \left(\text{GAP}_{jszt-3} \cdot d_t\right) + \tau_0 \text{GAP}_{jszt-3} + u_{jszt}.$$

  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	−11.1	−12.8	−8.0
	(0.0)	(1.2)	(0.4)	(12.5)
2019	13.5	−15.8	−16.3	−11.6
	(0.0)	(0.4)	(0.4)	(7.5)
2020	15.1	−14.6	−13.3	−13.1
	(0.0)	(1.3)	(2.4)	(5.7)
2021	14.7	−14.6	−15.8	−16.1
	(0.0)	(1.9)	(1.2)	(2.7)

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

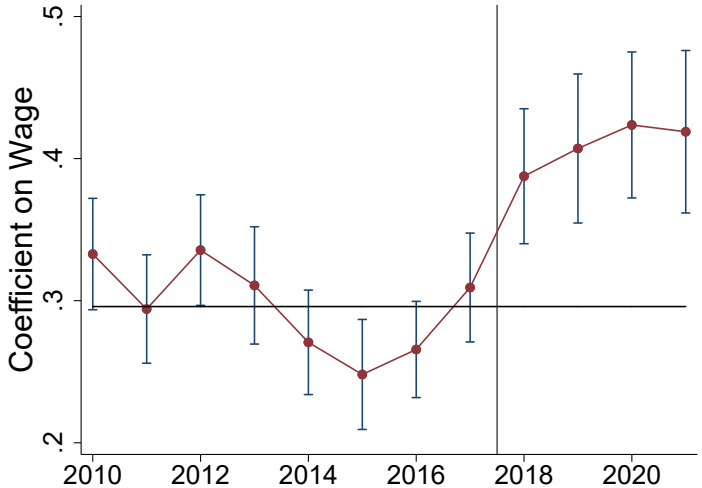
Cross-establishment estimates for Saint Paul

lags more years

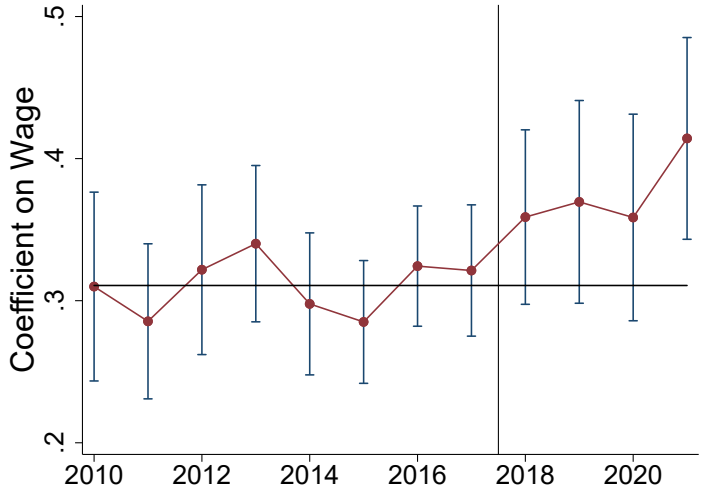
[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	4.9	−11.8	−12.9	−13.4
	(15.1)	(6.0)	(4.3)	(6.0)
2019	6.0	−24.1	−22.4	−24.9
	(18.7)	(0.1)	(0.4)	(0.4)
2020	4.9	−24.7	−24.1	−23.6
	(30.3)	(0.1)	(0.2)	(0.7)
2021	10.5	−13.2	−14.8	−14.8
	(3.1)	(9.5)	(7.1)	(11.5)

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

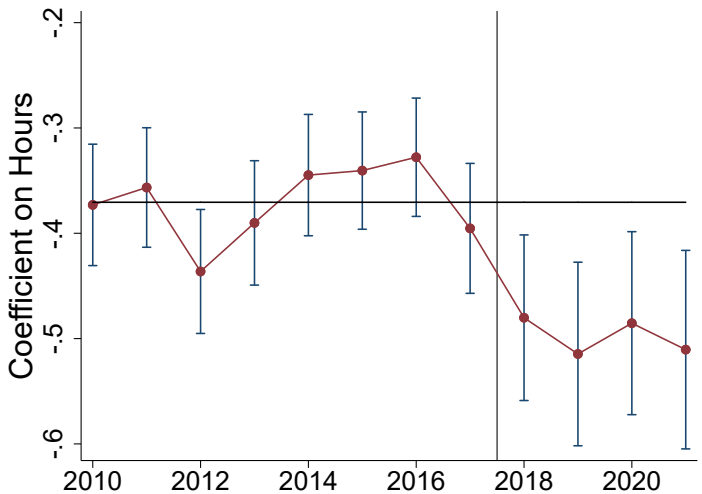
No pre-trends in τ coefficients



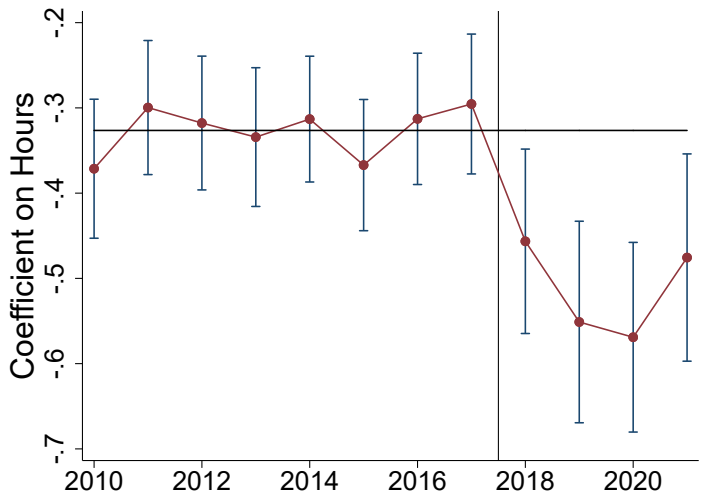
(a) Minneapolis



(b) Saint Paul



(c) Minneapolis



(d) Saint Paul

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.

Cross-worker estimates for Twin Cities

more

	Minneapolis			Saint Paul		
[Entries are $100 \cdot \tau_t$]	Wage	Hours	Earnings	Wage	Hours	Earnings
2018	−4.0	−1.2	−6.1	−3.4	−10.4	−10.2
	(0.1)	(67.1)	(3.3)	(0.9)	(0.3)	(0.5)
2019	5.7	−14.7	−12.1	−2.8	−15.7	−14.0
	(0.0)	(0.0)	(0.0)	(7.5)	(0.0)	(0.0)
2020	4.9	−12.7	−9.5	1.4	−11.9	−5.8
	(0.1)	(0.0)	(0.4)	(39.4)	(0.2)	(14.2)
2021	13.6	−14.1	−8.1	6.5	−13.1	−9.9
	(0.0)	(0.0)	(1.8)	(0.0)	(0.1)	(1.4)

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

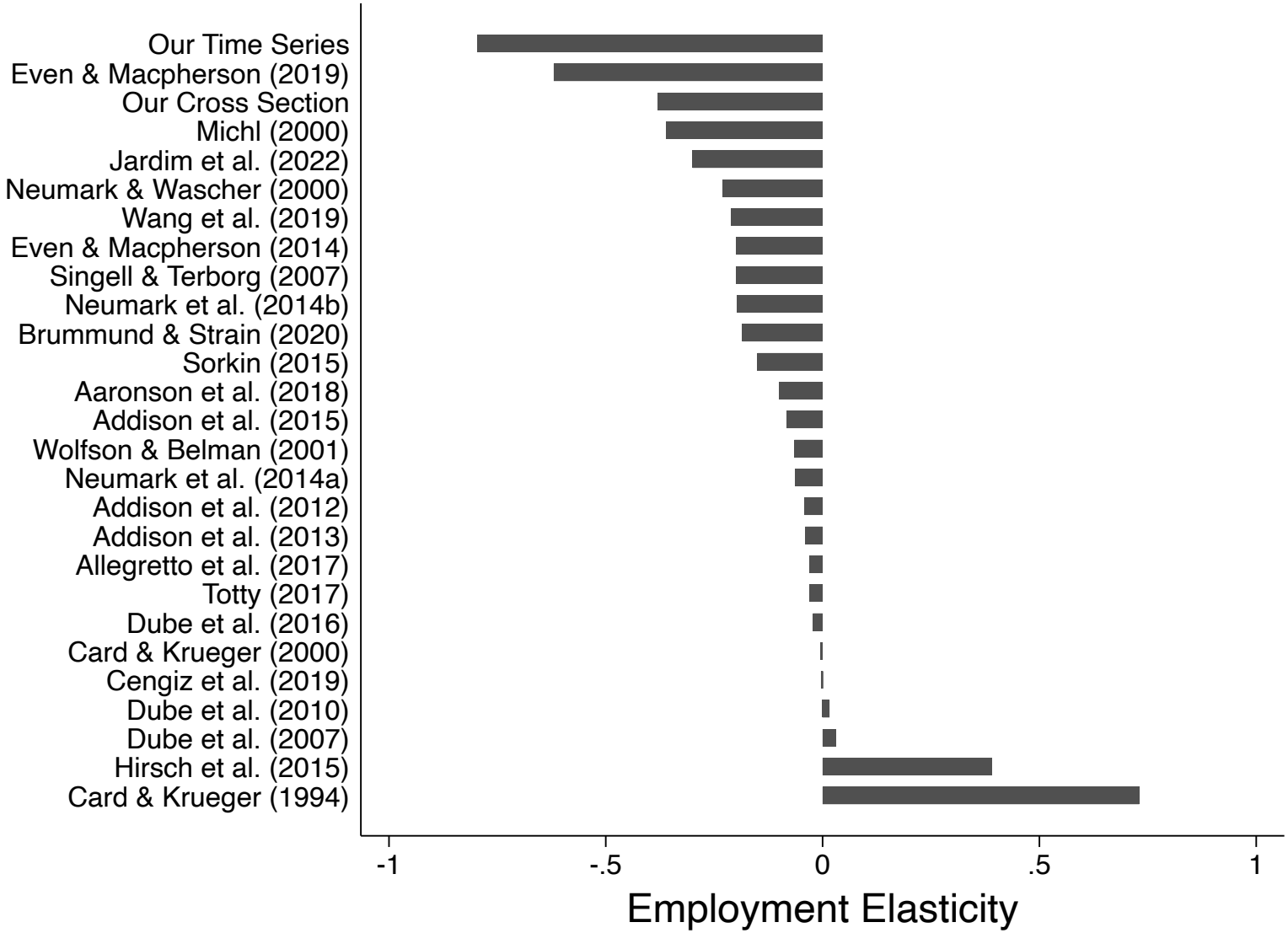
Summing Up the Estimates

Summary of estimates

details

Jobs (2021, percent)	Time Series	Cross Section	Ratio
Minneapolis Average	−2.7	−0.7	0.26
Minneapolis Most Negative	−31.9	−14.3	0.45
Saint Paul Average	−3.5	−1.3	0.37
Saint Paul Most Negative	−22.4	−18.7	0.83
Average			**0.48**

Comparison of restaurants estimates with other studies



Rationalizing our larger elasticities

1. Product substitution elasticities are larger at the local level.
2. Size of minimum wage change.
    - Clemens and Strain (2021): elasticity -0.5 in "large increases."
    - MPLS 46% min wage increase $>$ "large increases" with 20%.
3. 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.

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.

The exercise

▸ model details

- Write model of heterogeneous establishments.
  - heterogeneity: productivity, factor shares, wages, entry costs.
  - choices: entry, exit, prices, inputs.
- Model parameterized to account for cross-section.
- Introduce min wage and ask: does model match the time series?

Discipline: entry cost calibrated externally (Aguirregabiria and Mira, 2007).

Effects of minimum wage

			Aggregate Shock
	Baseline	No Entry Cost	No Entry Cost
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			
Aggregate Wage Change			
Aggregate Employment Change			
Ratio of Entry (Pre/Post)			

Effects of minimum wage

			Aggregate Shock
	Baseline	No Entry Cost	No Entry Cost
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	-1.07		
Aggregate Wage Change	0.09		
Aggregate Employment Change	-0.25		
Ratio of Entry (Pre/Post)	2.28		

Effects of minimum wage

			Aggregate Shock
	Baseline	No Entry Cost	No Entry Cost
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	-1.07	-1.07	
Aggregate Wage Change	0.09	0.09	
Aggregate Employment Change	-0.25	-0.08	
Ratio of Entry (Pre/Post)	2.28	1.00	

Effects of minimum wage

other experiments

			Aggregate Shock
	Baseline	No Entry Cost	No Entry Cost
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	−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 (Pre/Post)	2.28	1.00	1.00

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	8.42	8.42	10.33
2023	8.63	8.63	10.59
2024	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.

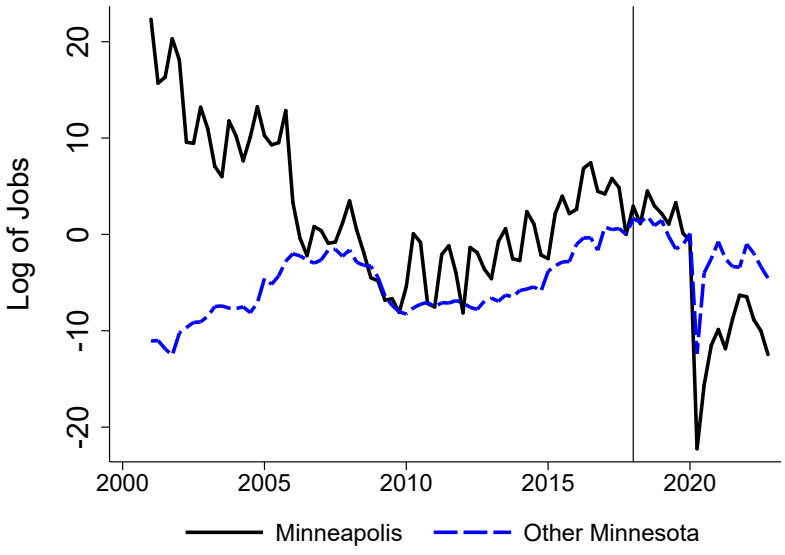
Employment and workers below 15 dollars

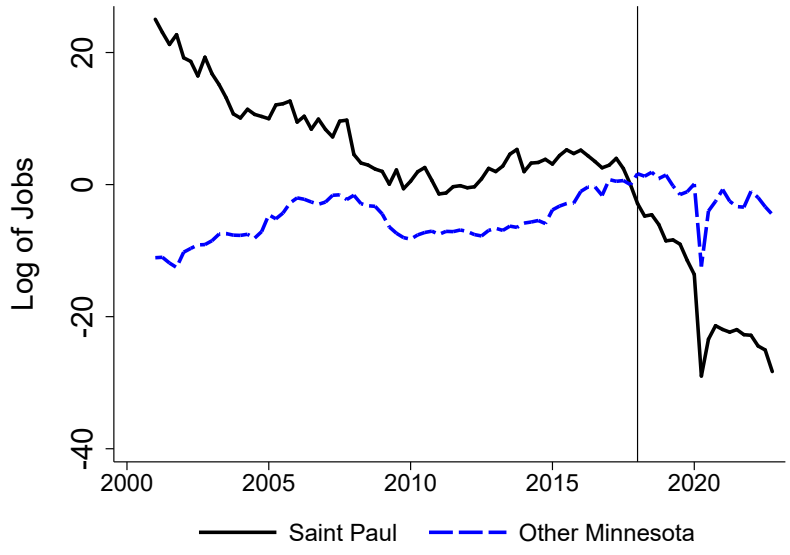
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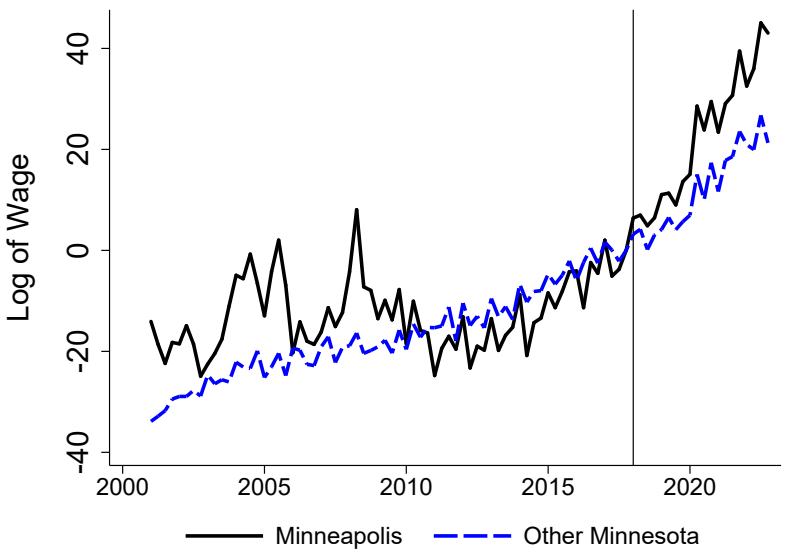
(2017, percent)	Employment Share			Worker Share $<$ 15$		
	MPLS	SP	OtherMN	MPLS	SP	OtherMN
Retail Trade (44)	5	7	12	59	63	65
Admin and Support (56)	6	6	5	58	66	48
Health Care and Social Asst (62)	17	18	17	30	42	34
Arts, Entmt, and Recreation (71)	2	2	2	42	45	61
Accomm and Food (72)	8	10	9	54	63	71
Other 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

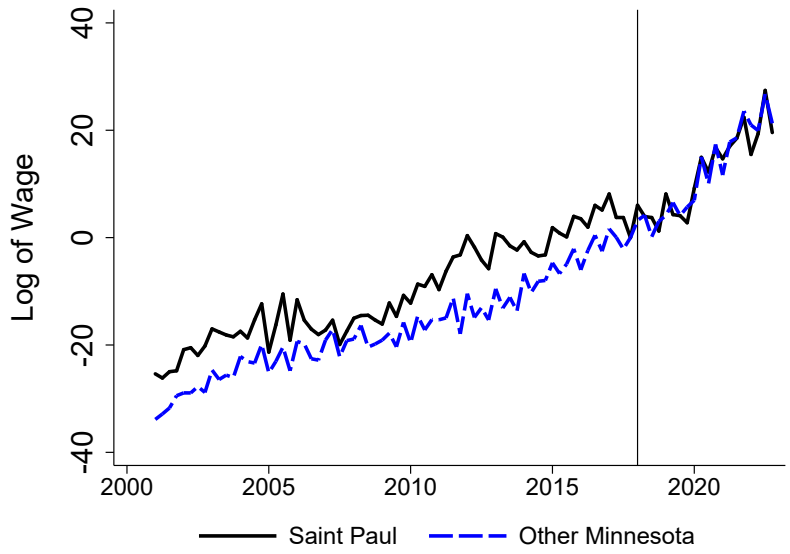
Retail time series

back



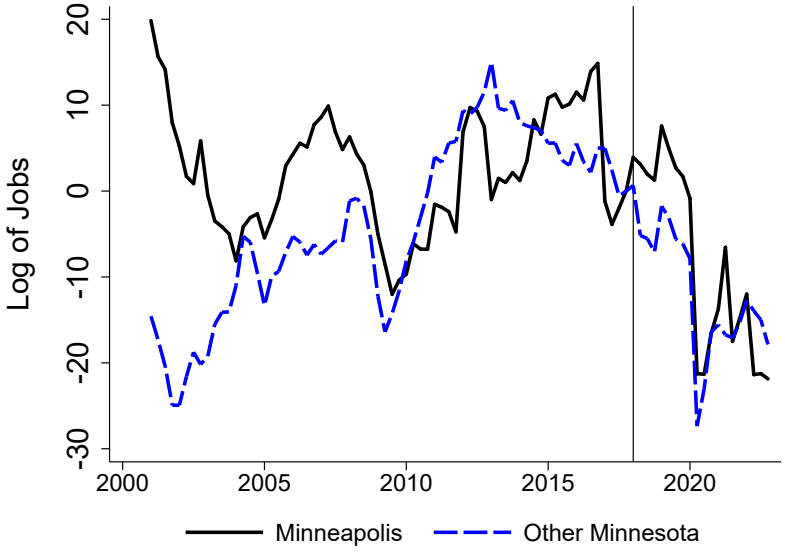


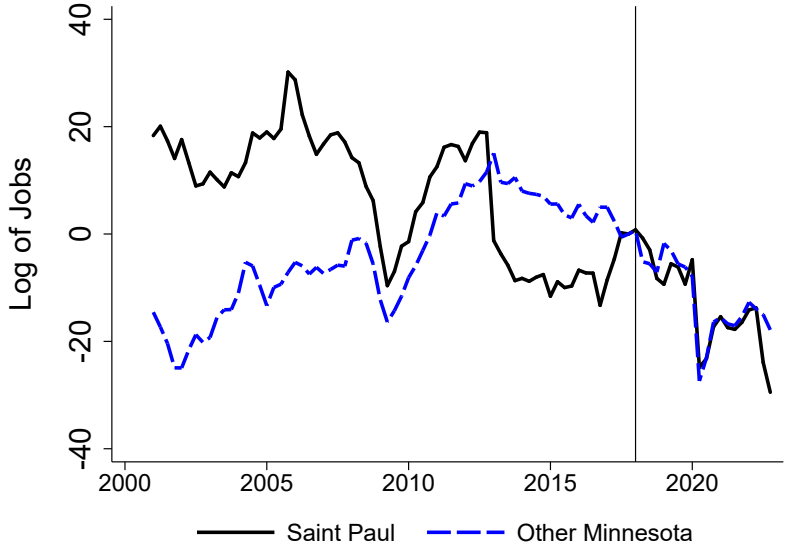


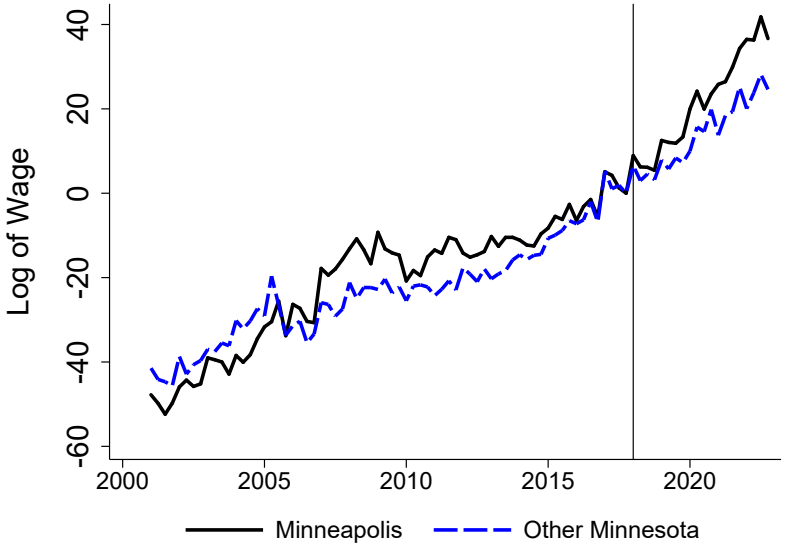


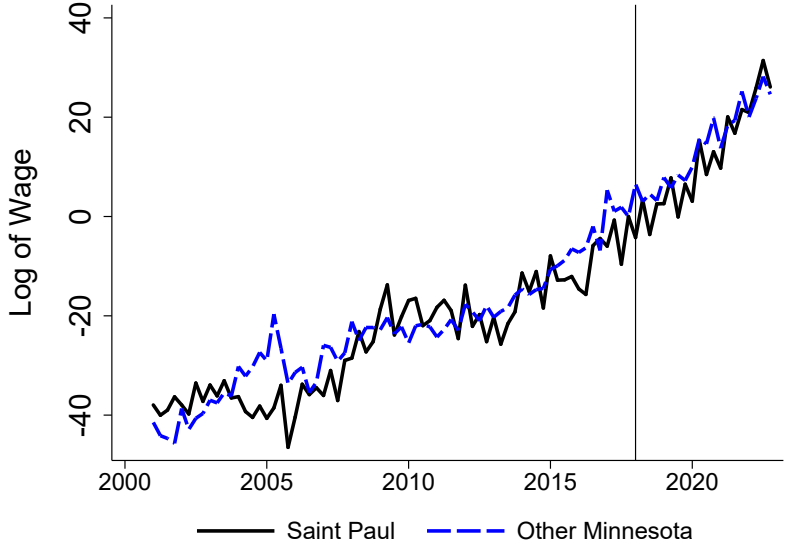
Administration and Support time series

back



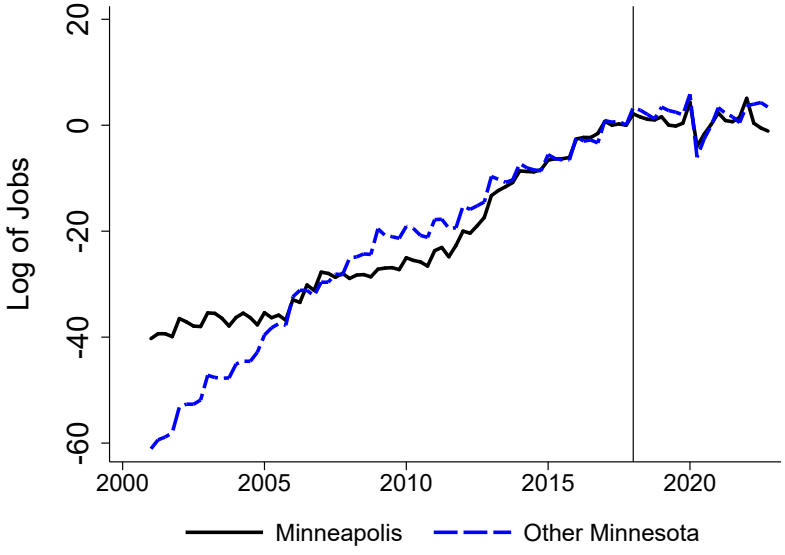


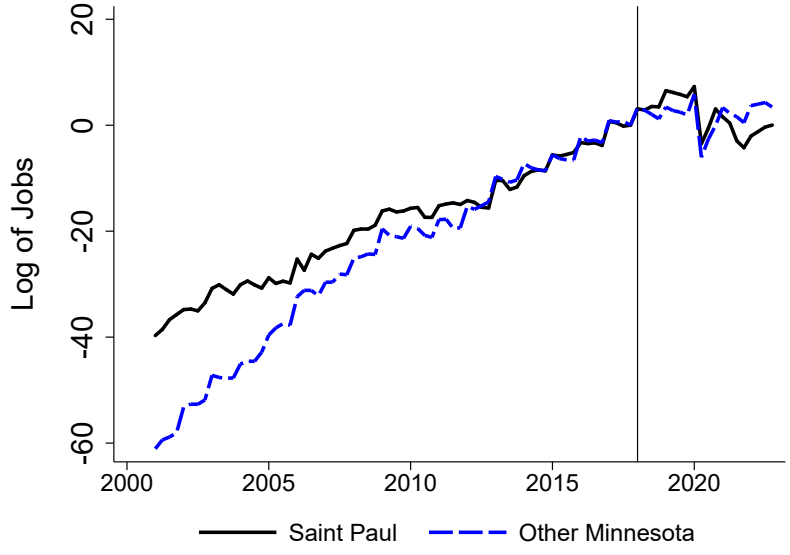


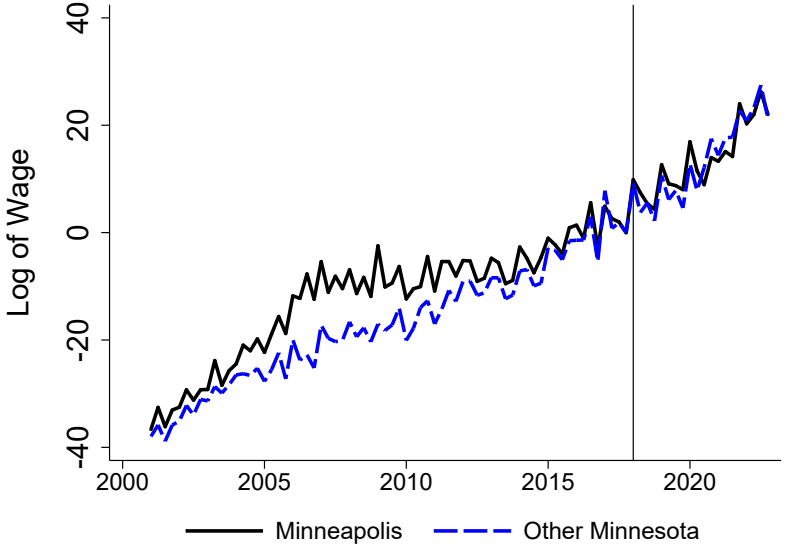


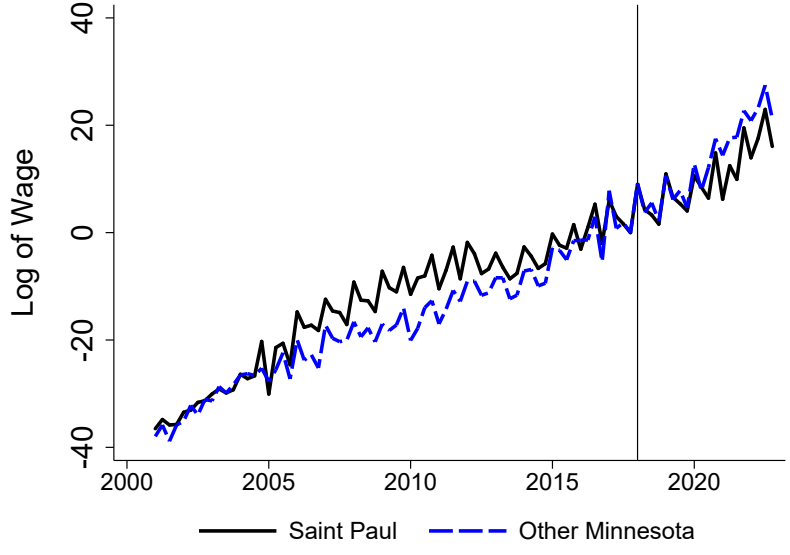
Health Care and Social Assistance time series

back



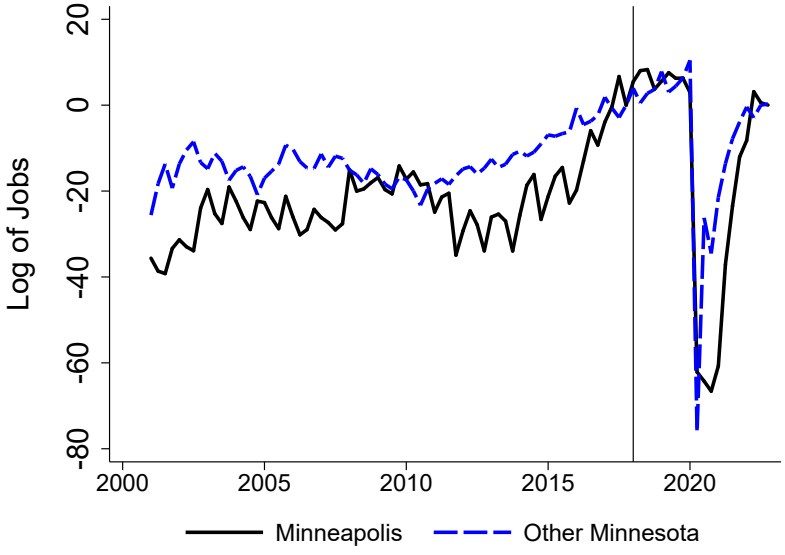


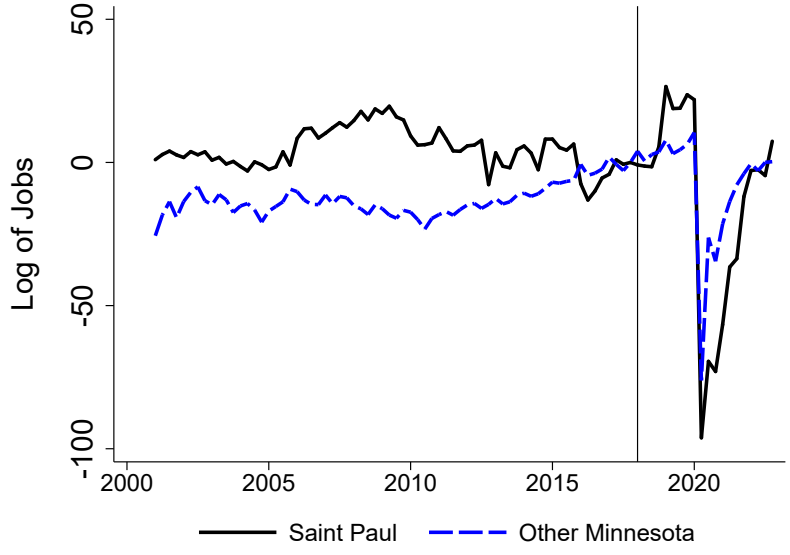


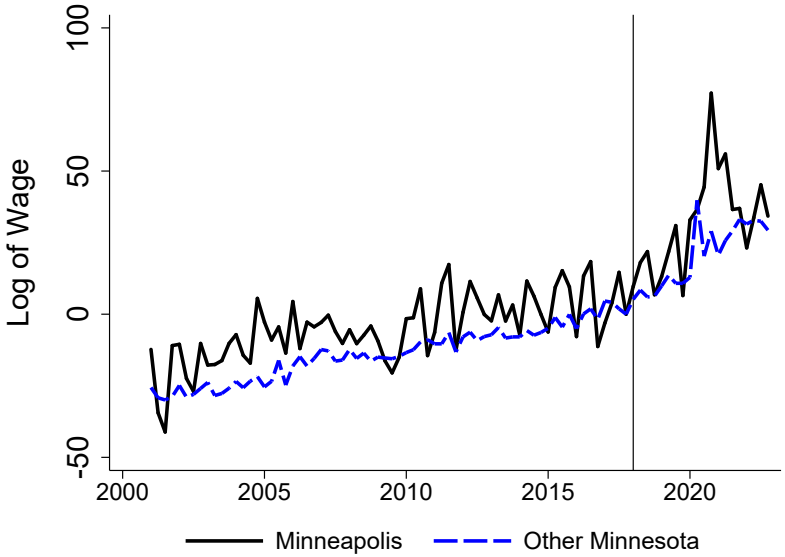


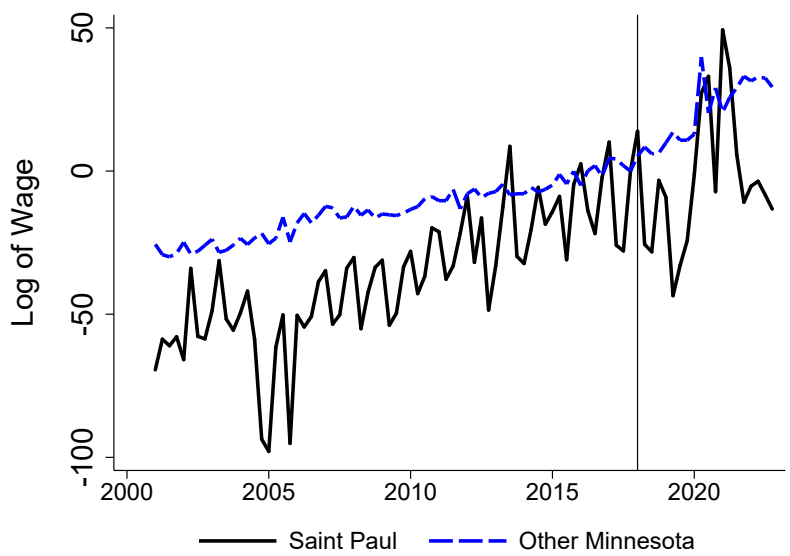
Arts, Entertainment, and Recreation time series

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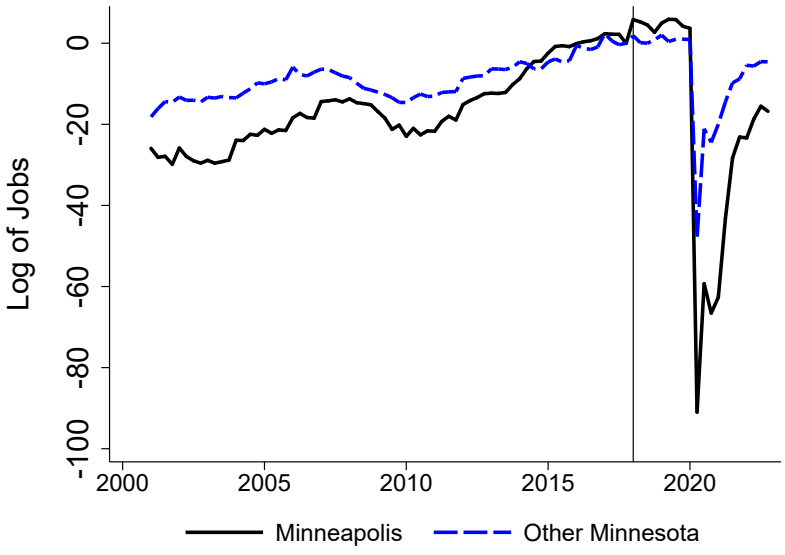


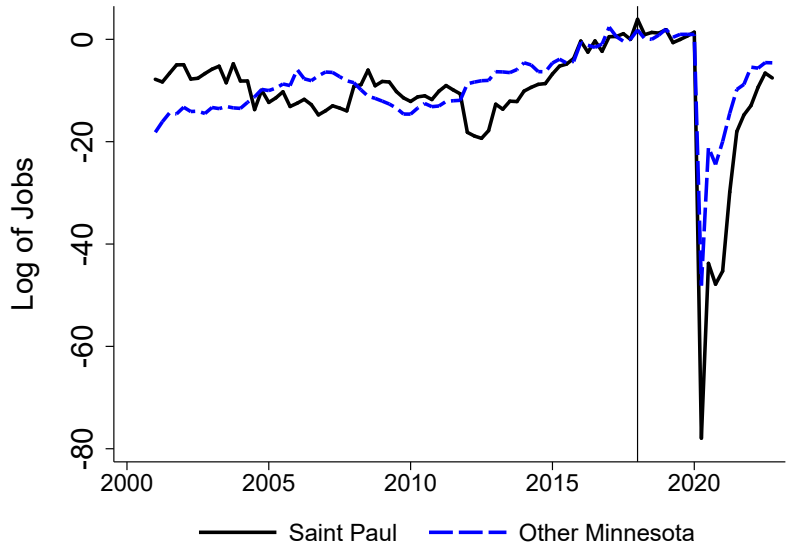


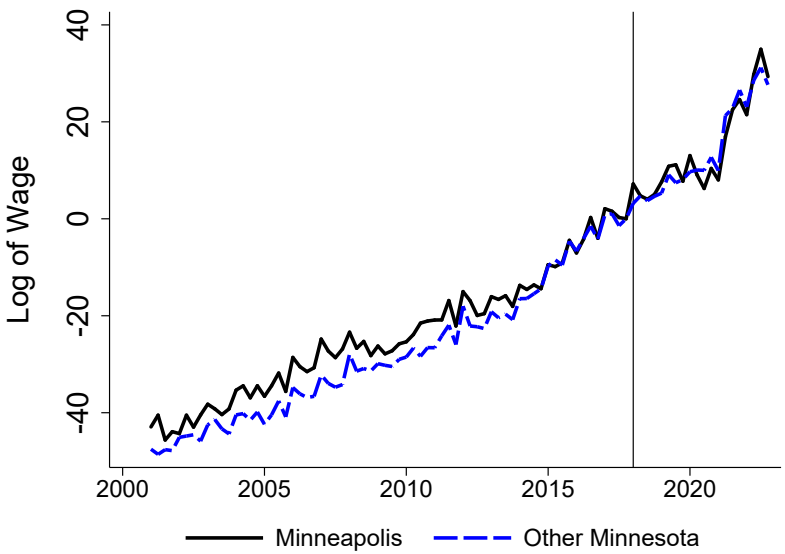


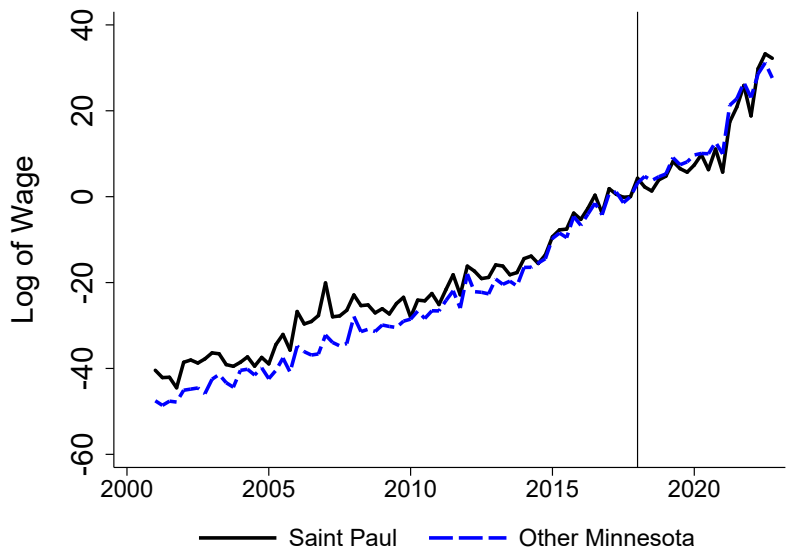
Accommodation and food time series

back



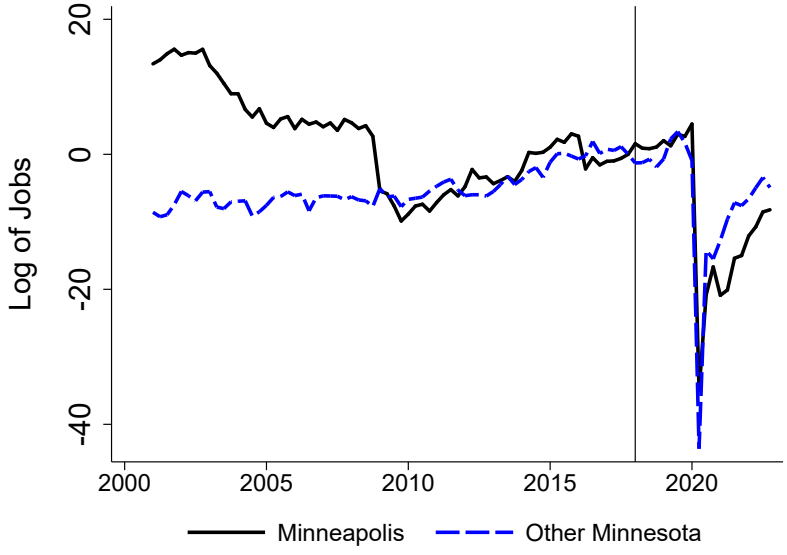


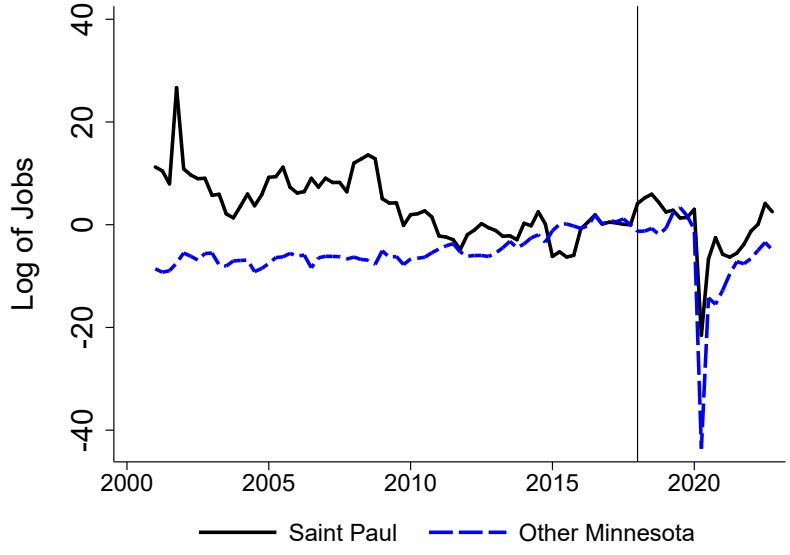


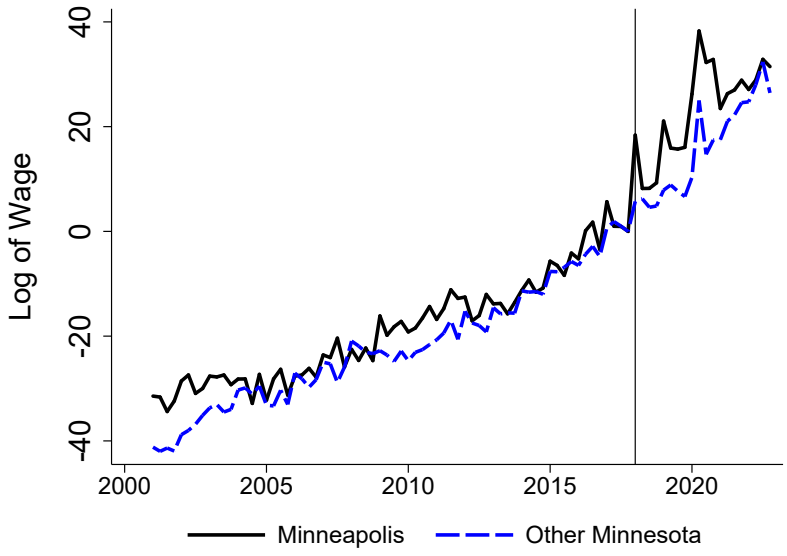


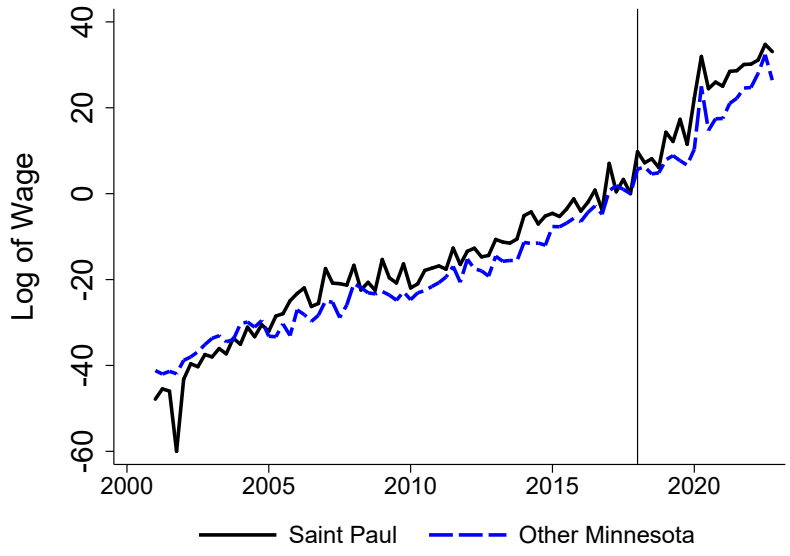
Other Services time series

back



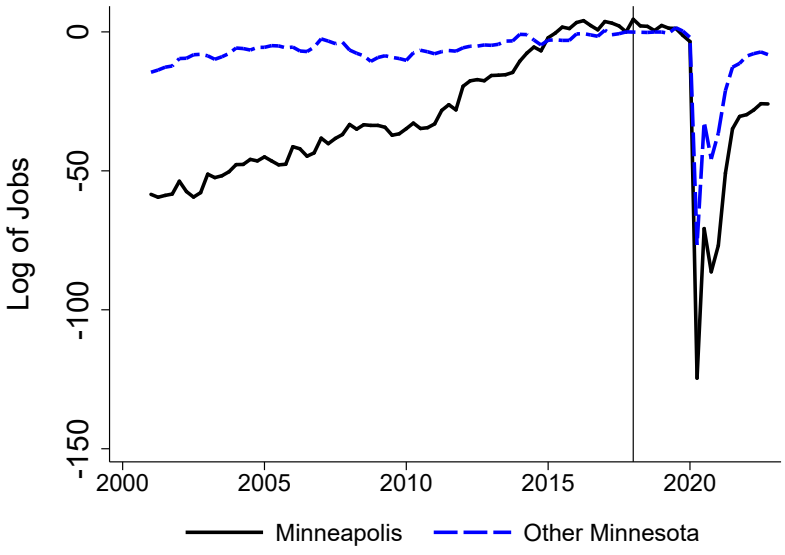


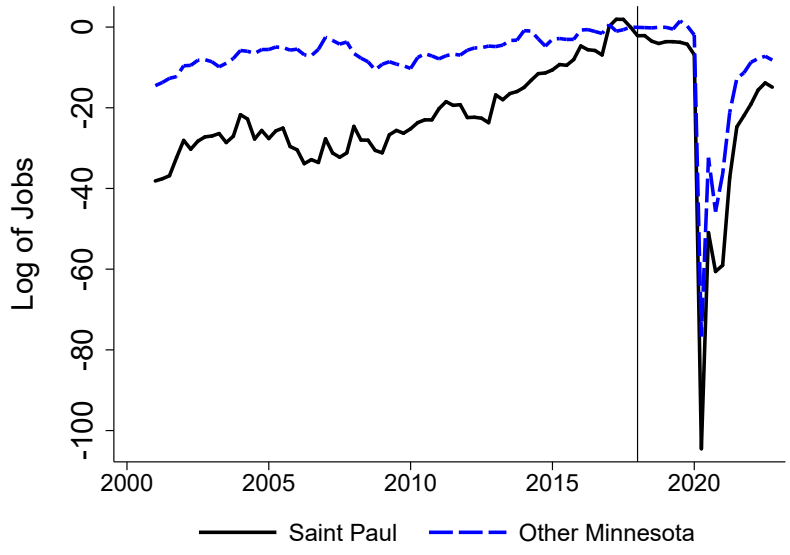


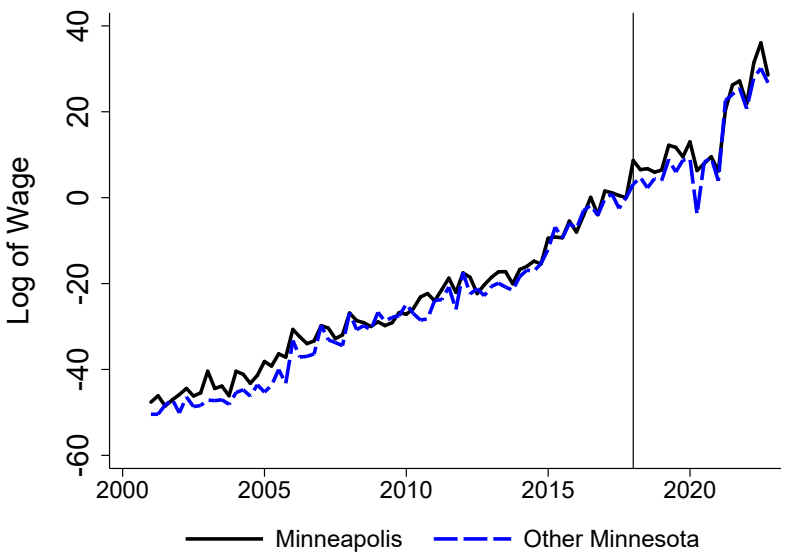


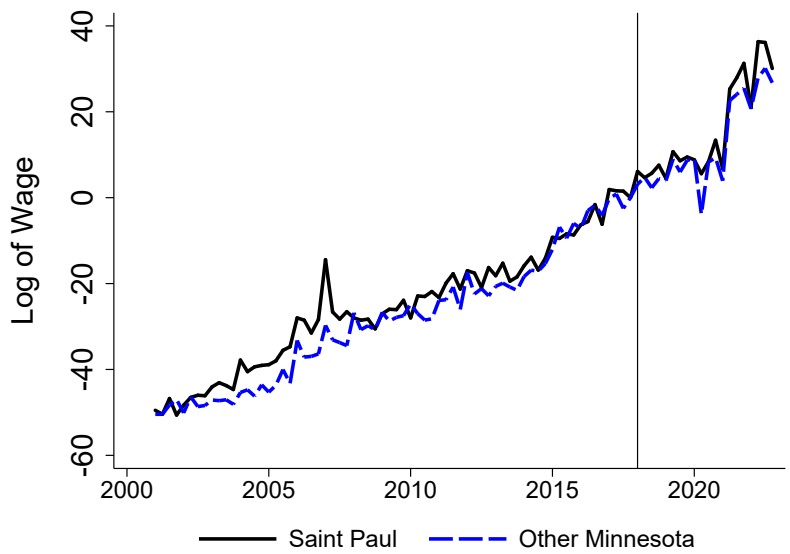
Full-Service Restaurants time series

back



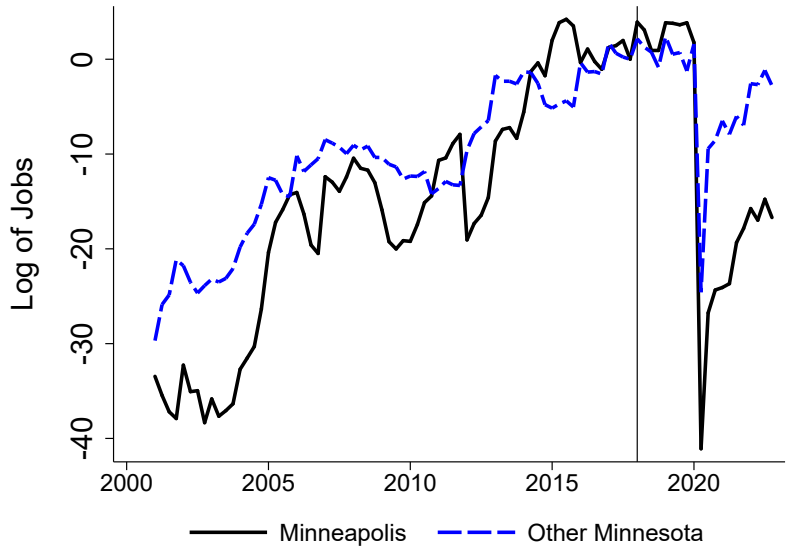


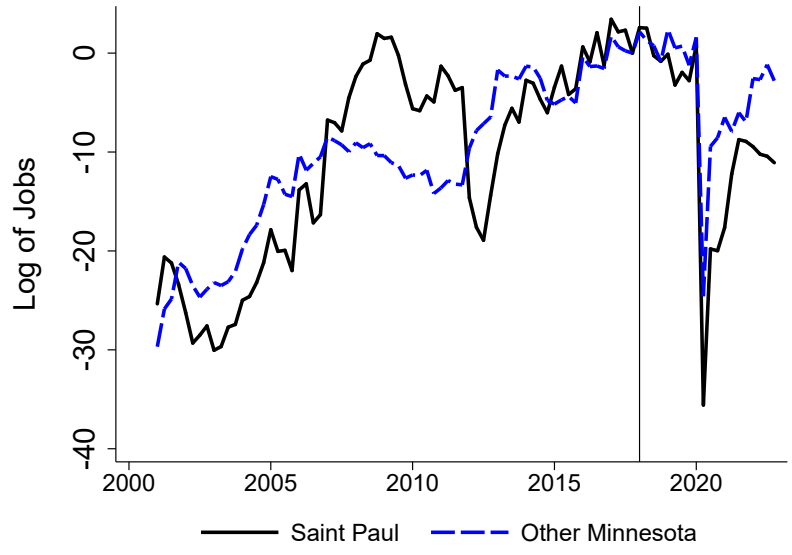


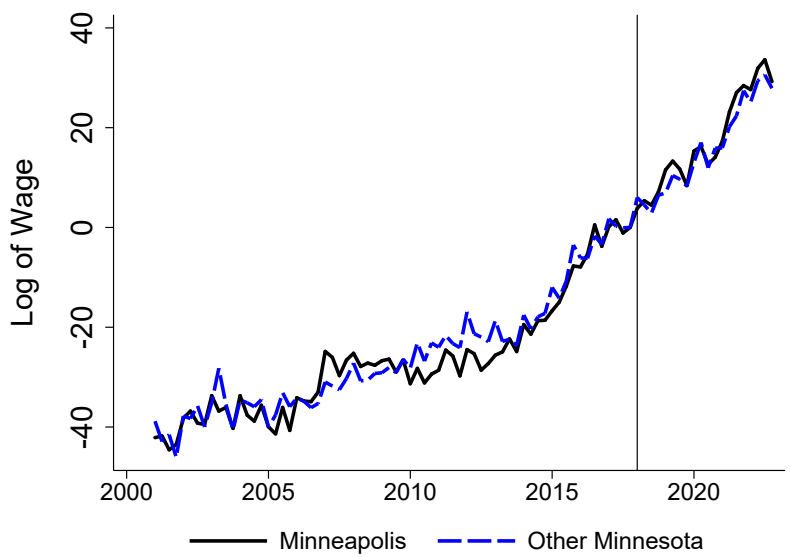


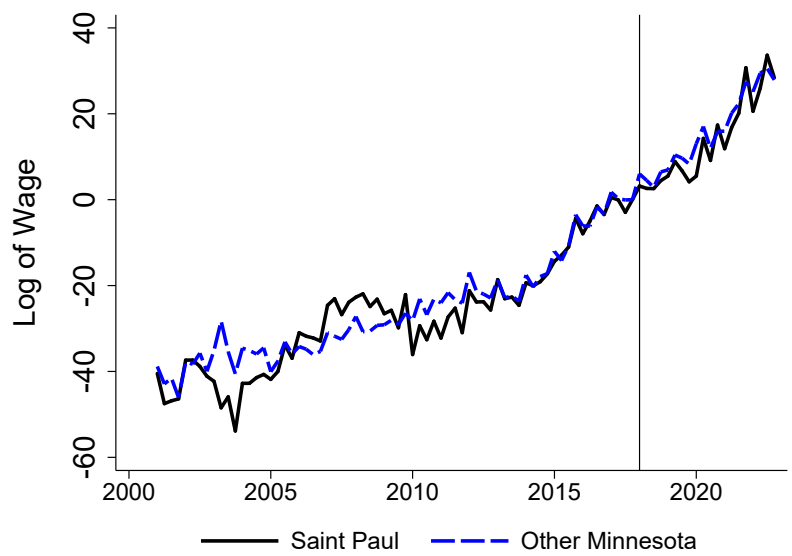
Limited-Service Restaurants time series

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.

Growth specification

back

- 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:

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

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, holding composition constant to pre-treatment levels.

- 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)	85	32	84	0	77	4	72	3
Admin and Support (56)	57	5	87	12	71	13	80	18
Health Care and Social Asst (62)	94	32	92	7	79	15	92	7
Arts, Entmt, and Recreation (71)	29	9	46	5	45	14	21	5
Accomm and Food (72)	85	57	94	46	92	36	94	58
Other Services (81)	64	0	79	4	82	2	87	13
Full-Service Restaurants (722511)	65	33	87	25	84	38	84	25
Ltd-Service Restaurants (722513)	64	29	58	10	56	3	50	4

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

Pre-treatment fit in Saint Paul

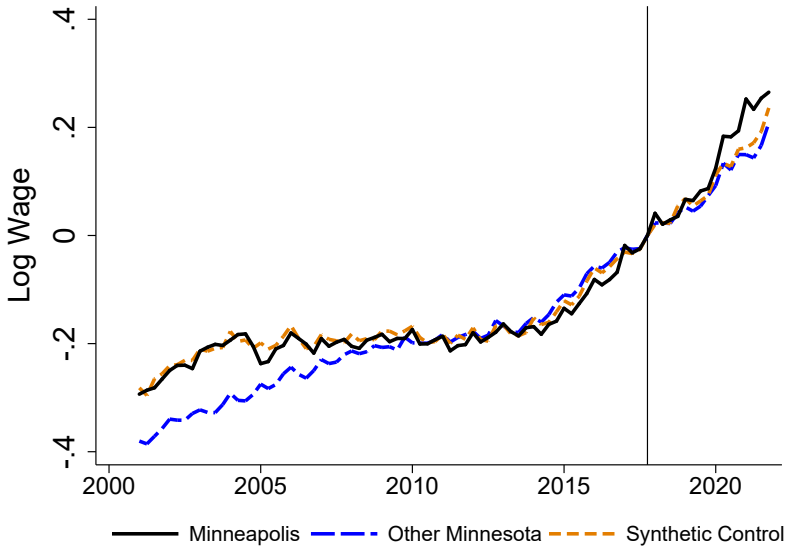
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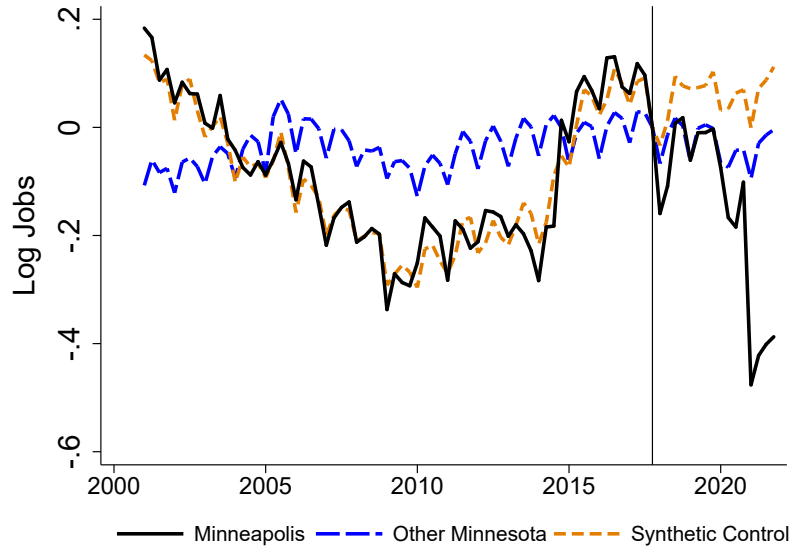
	Wage		Jobs		Hours		Earnings	
(R-squared, percent)	SDD	DD	SDD	DD	SDD	DD	SDD	DD
Retail Trade (44)	69	0	65	1	60	0	68	3
Admin and Support (56)	61	4	65	3	74	4	73	3
Health Care and Social Asst (62)	95	17	92	1	95	15	96	34
Arts, Entmt, and Recreation (71)	39	16	33	2	53	3	31	0
Accomm and Food (72)	77	39	70	6	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	48	53	4	46	0	58	4

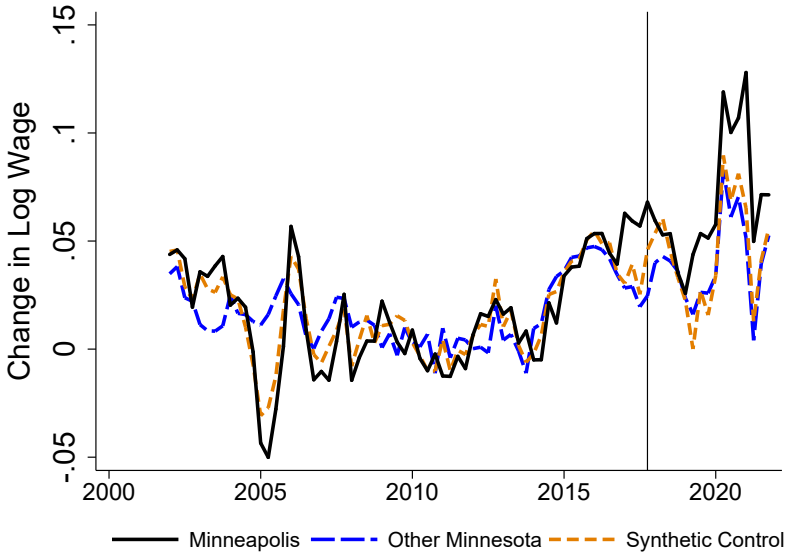
SDD: synthetic difference-in-differences; DD: difference-in-differences.

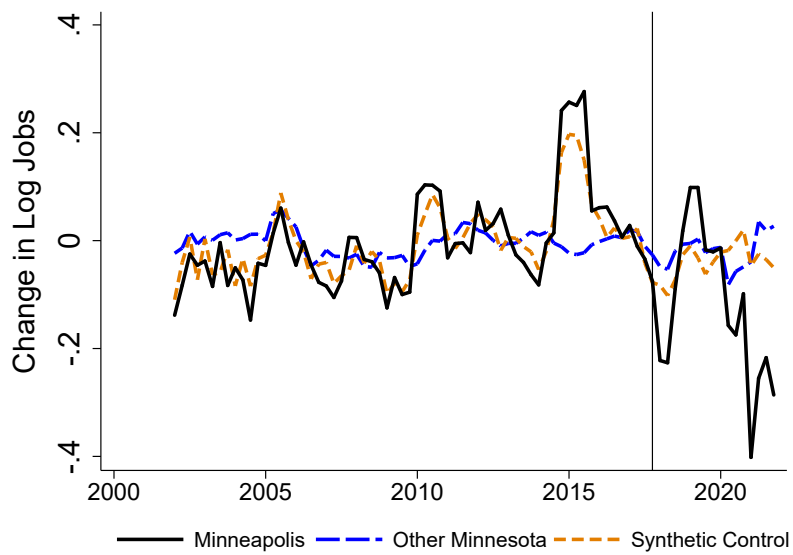
Retail fit in Minneapolis

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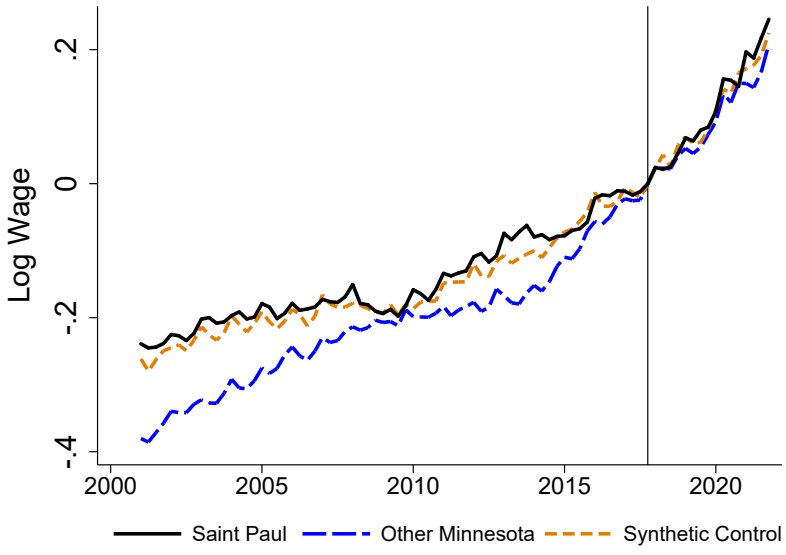


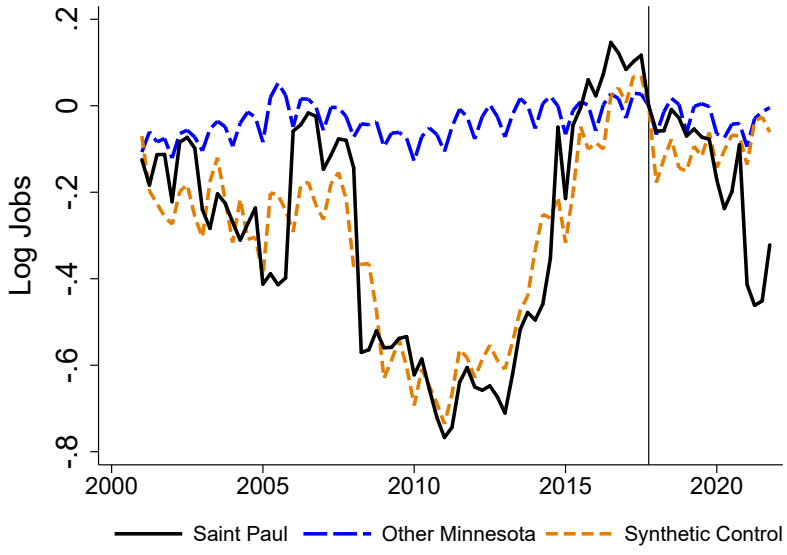


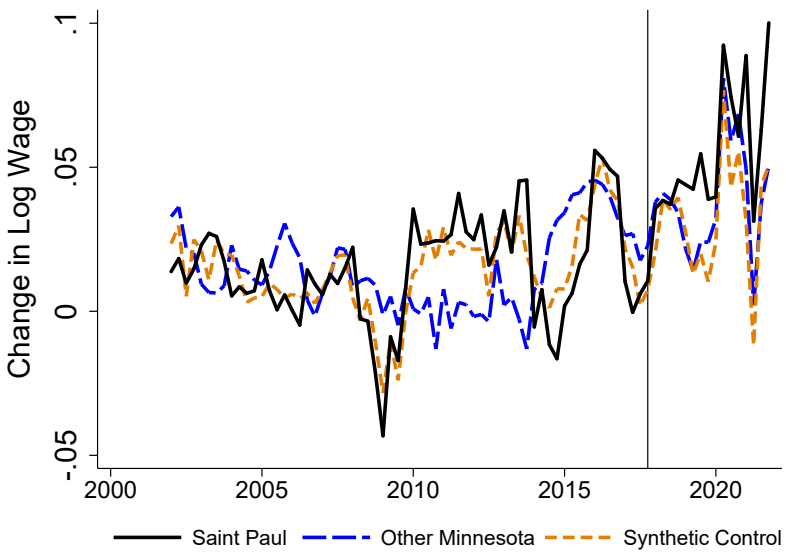


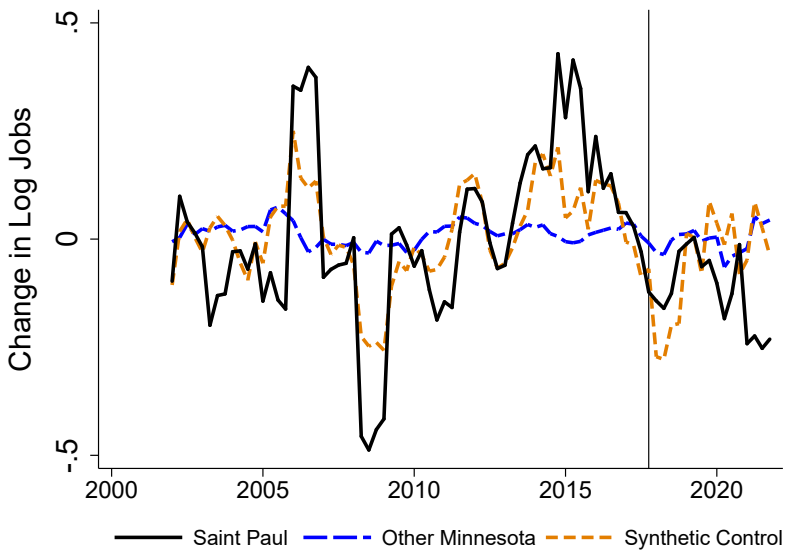
Retail fit in Saint Paul

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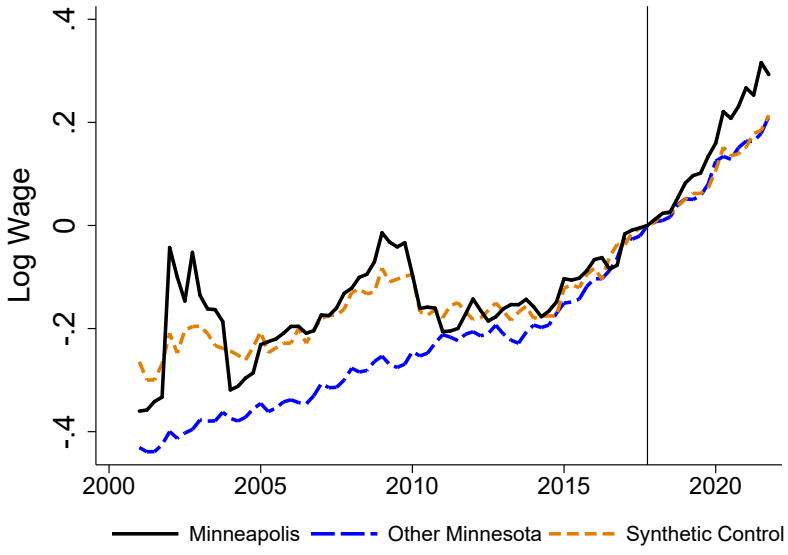


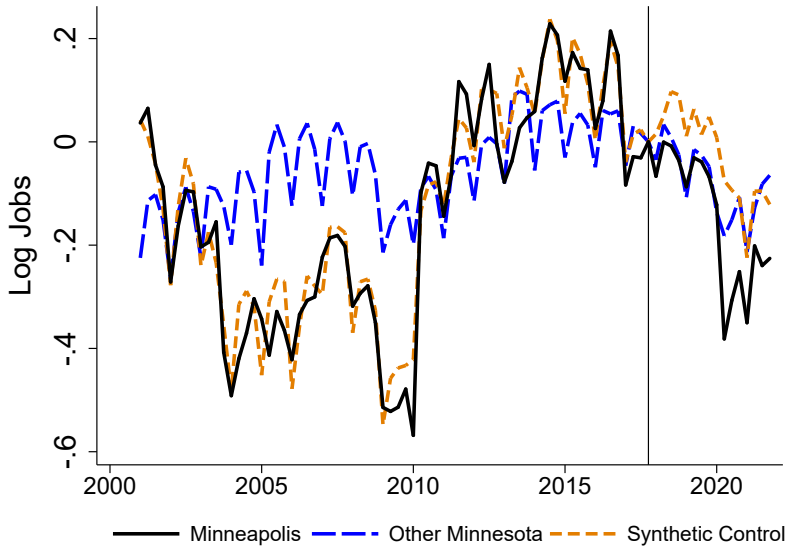


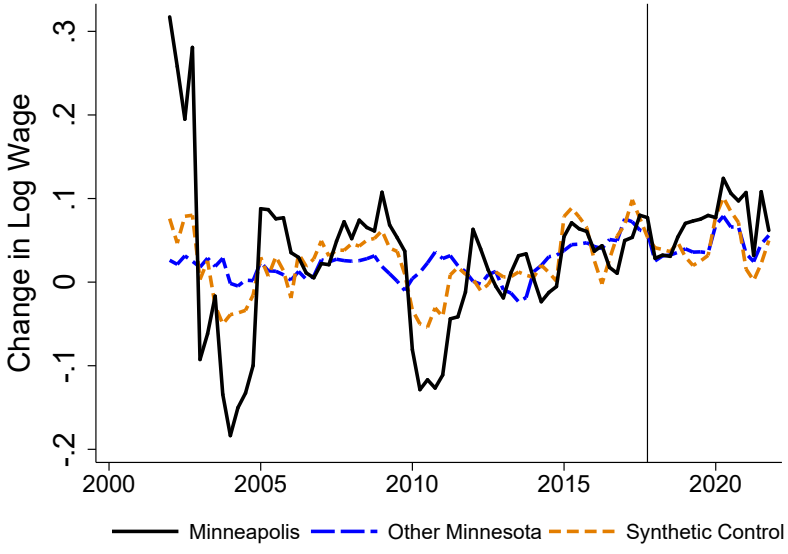


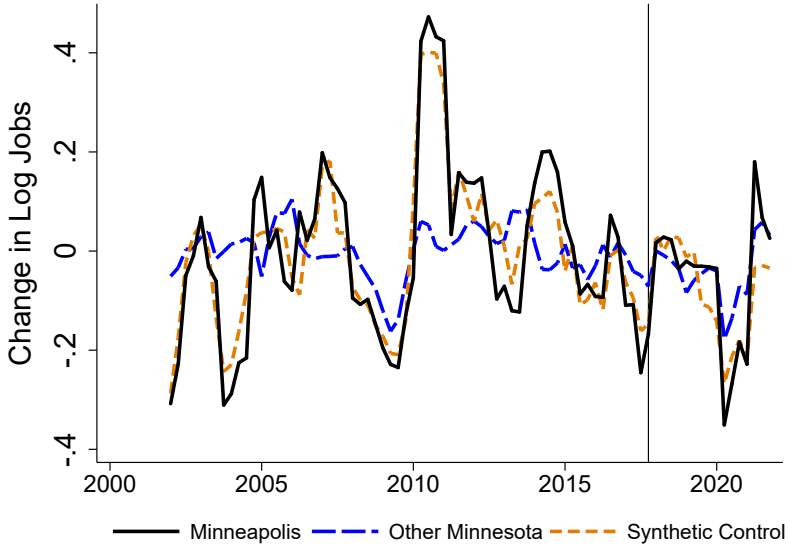
Administration and Support fit in Minneapolis

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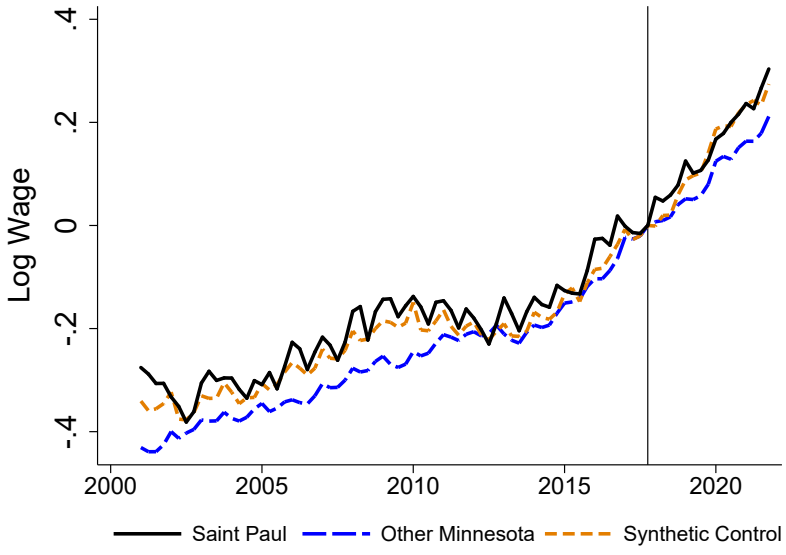


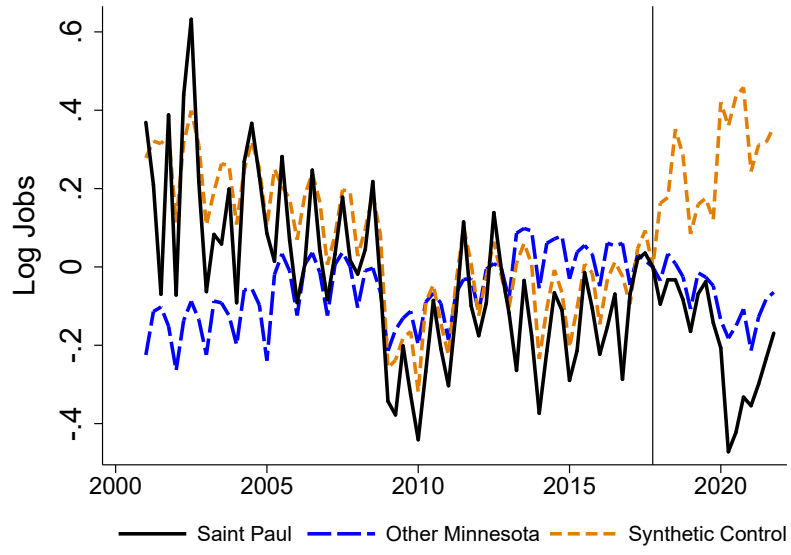


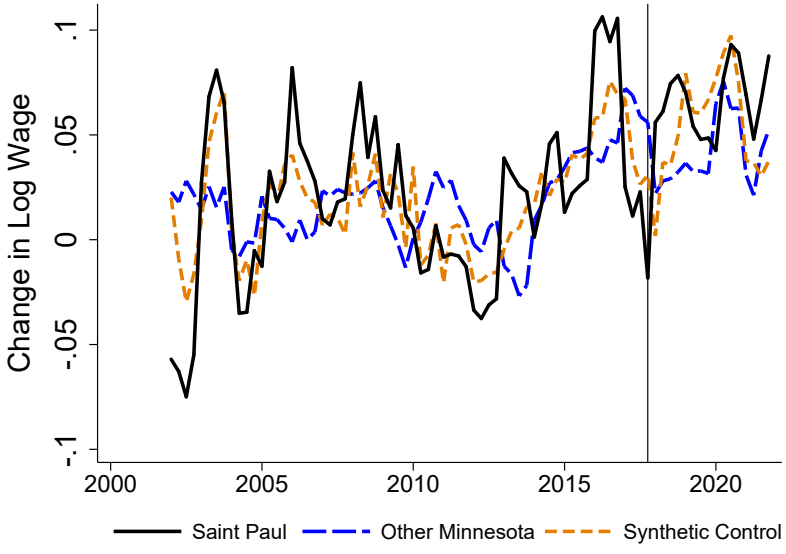


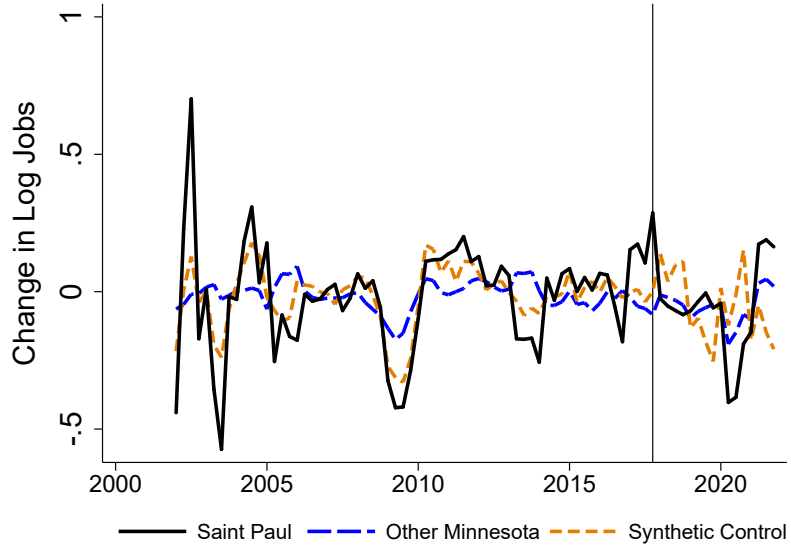
Administration and Support fit in Saint Paul

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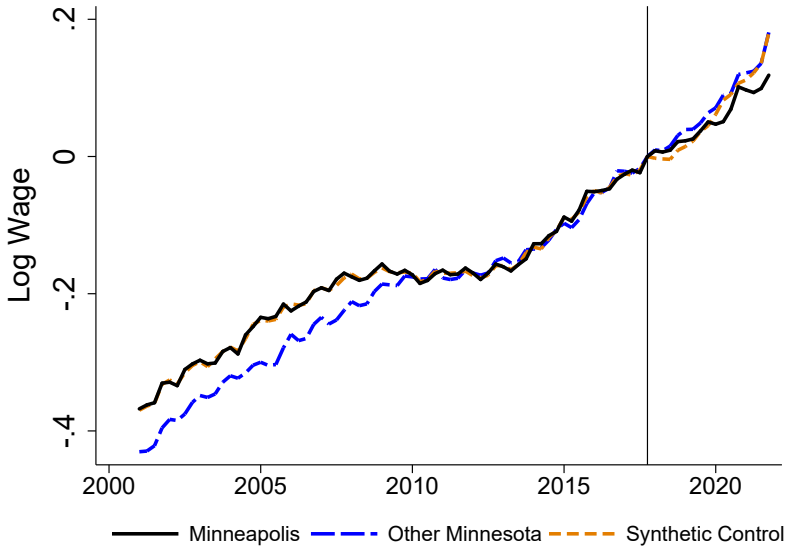


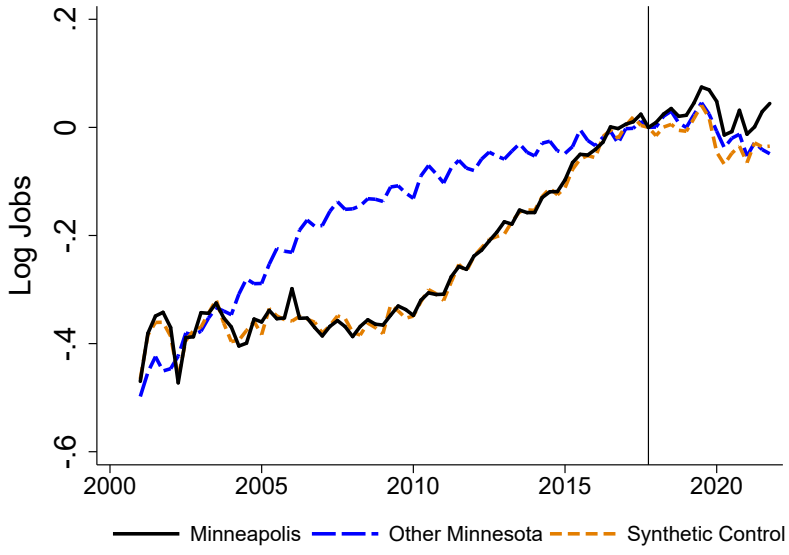


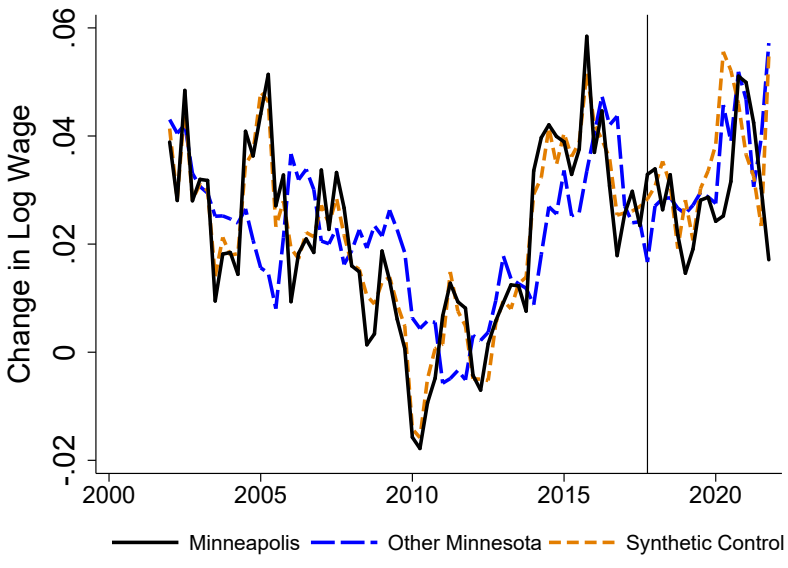


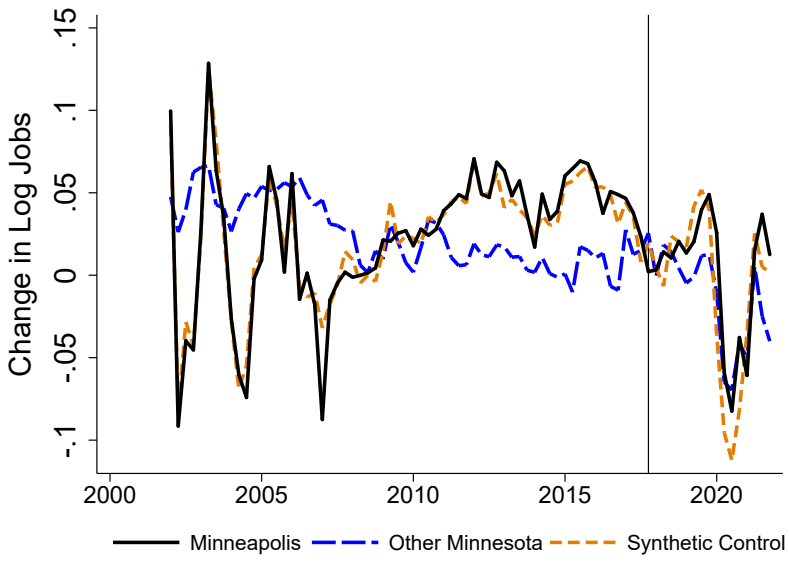
Health Care and Social Assistance fit in Minneapolis

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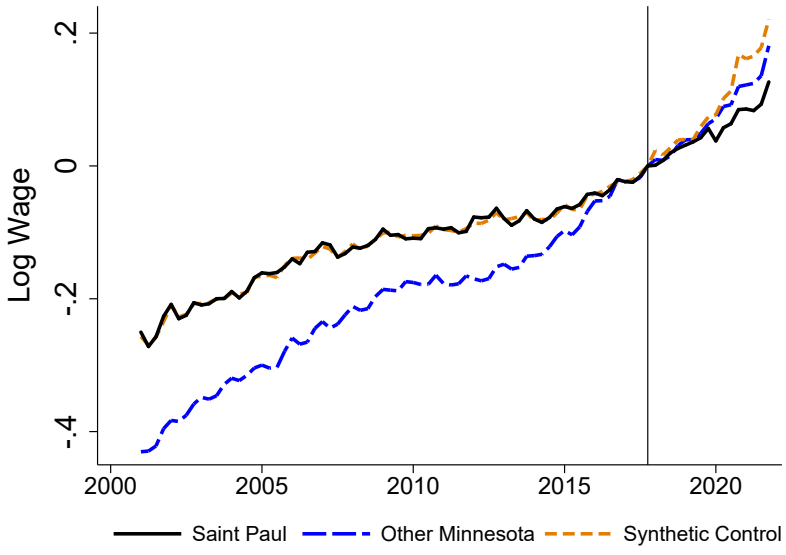


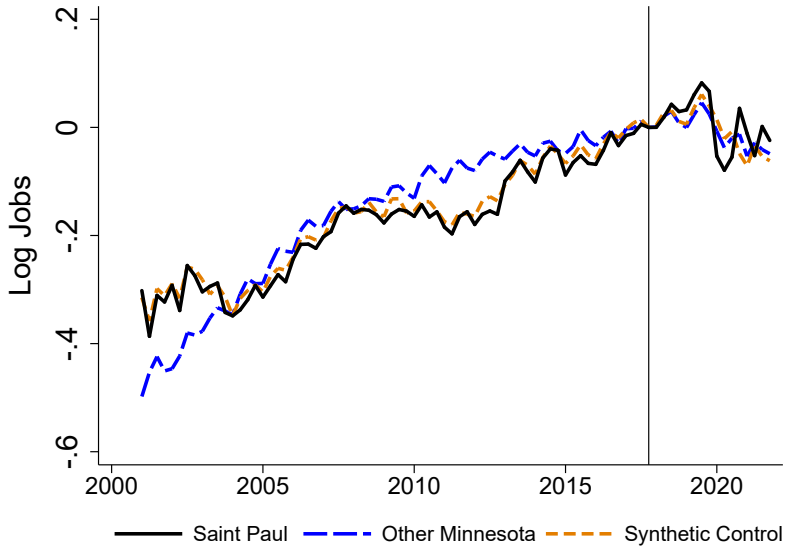


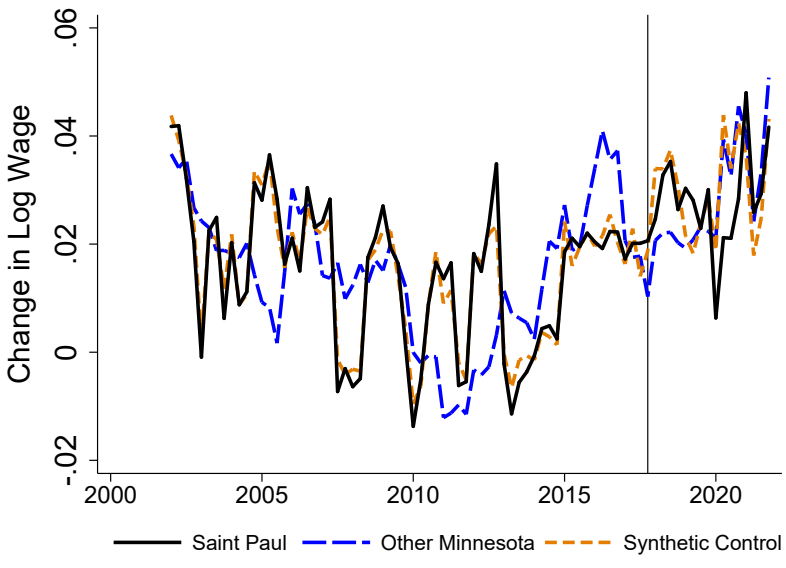


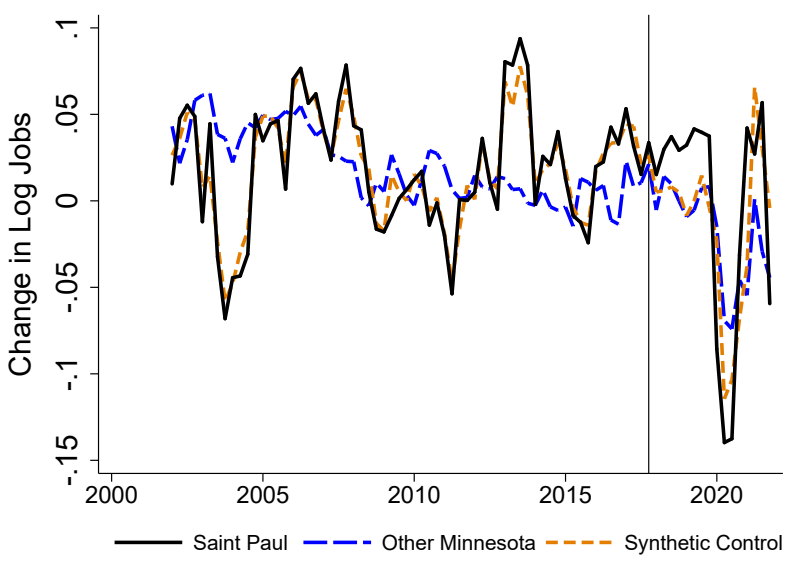
Health Care and Social Assistance fit in Saint Paul

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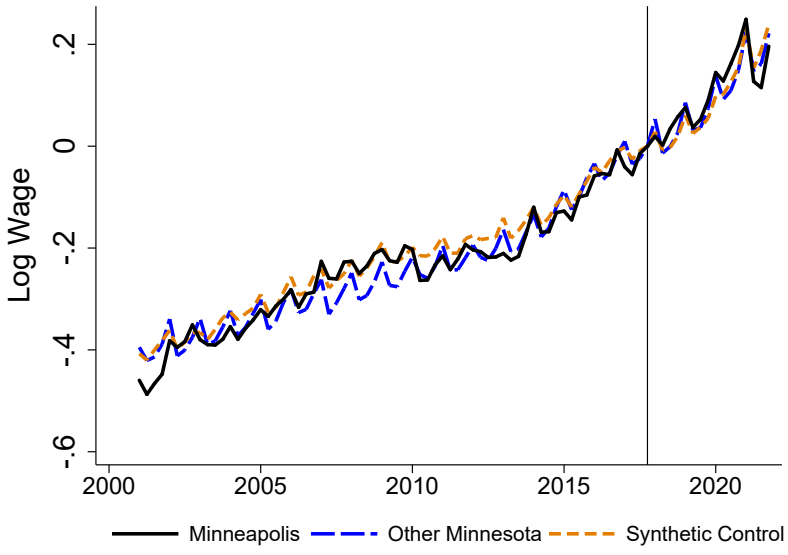


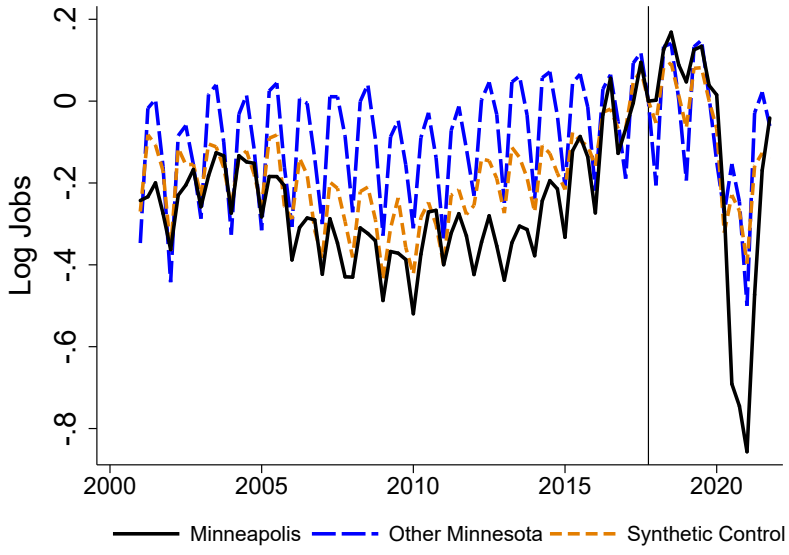


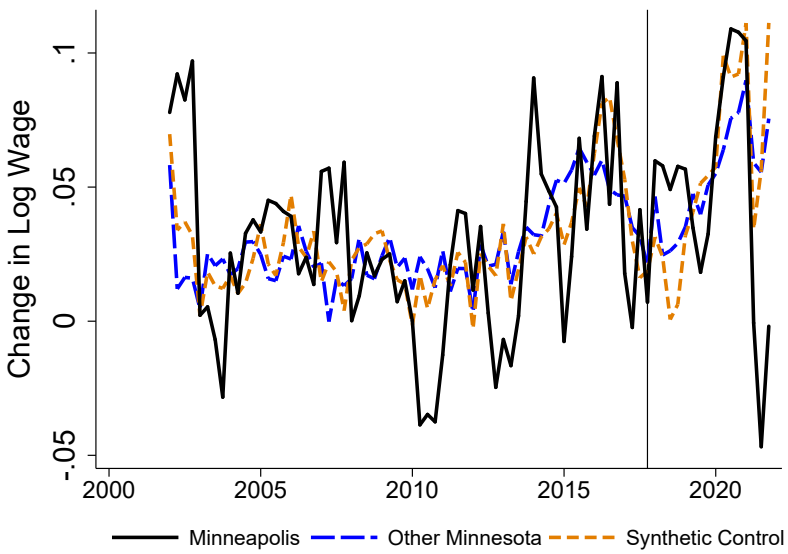


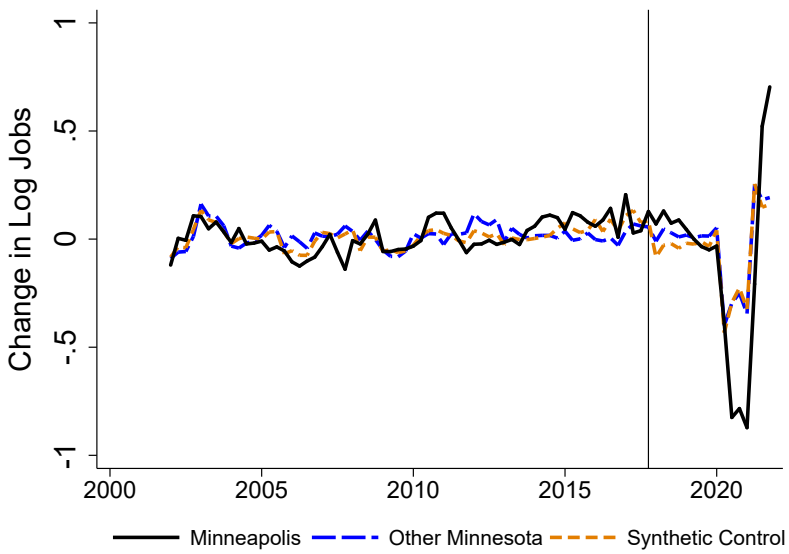
Arts, Entertainment, and Recreation fit in Minneapolis

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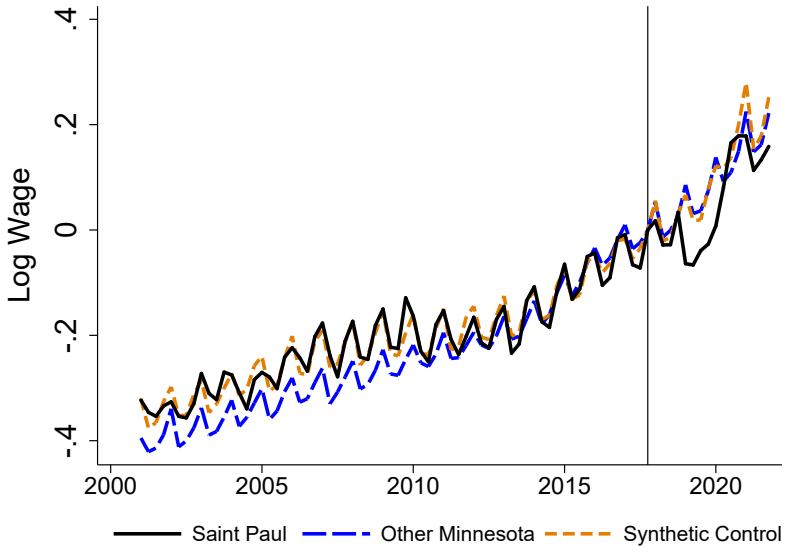


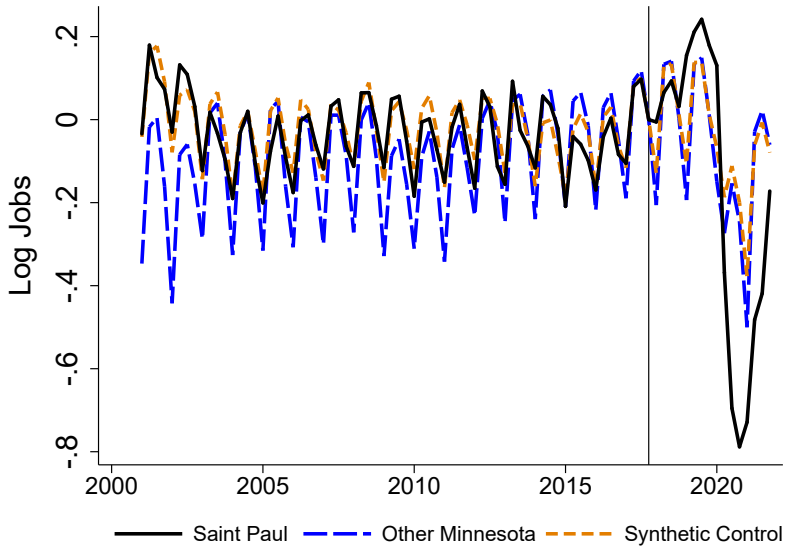


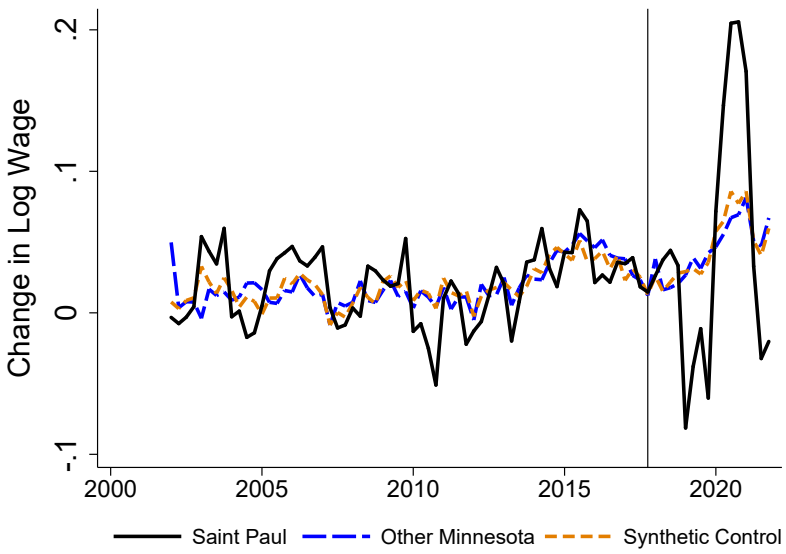


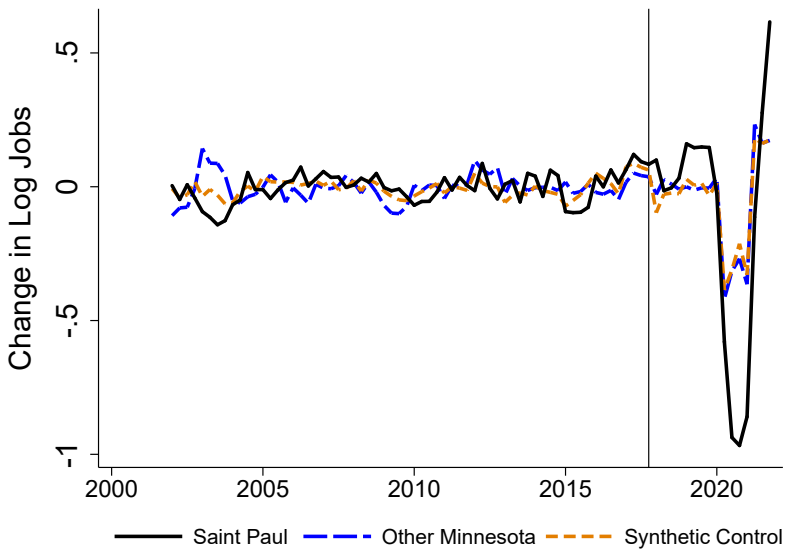
Arts, Entertainment, and Recreation fit in Saint Paul

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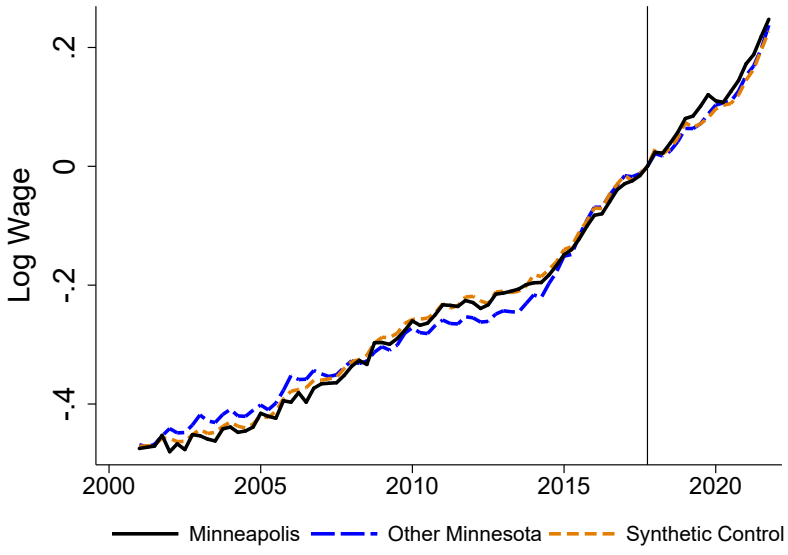


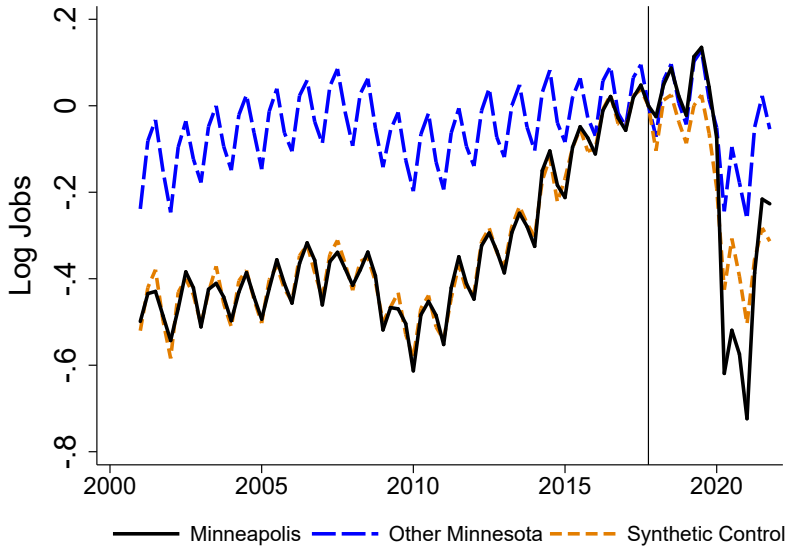


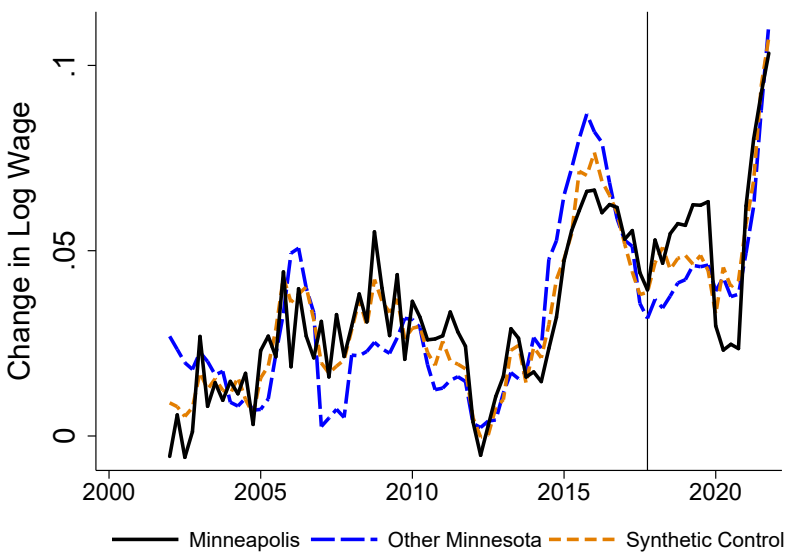


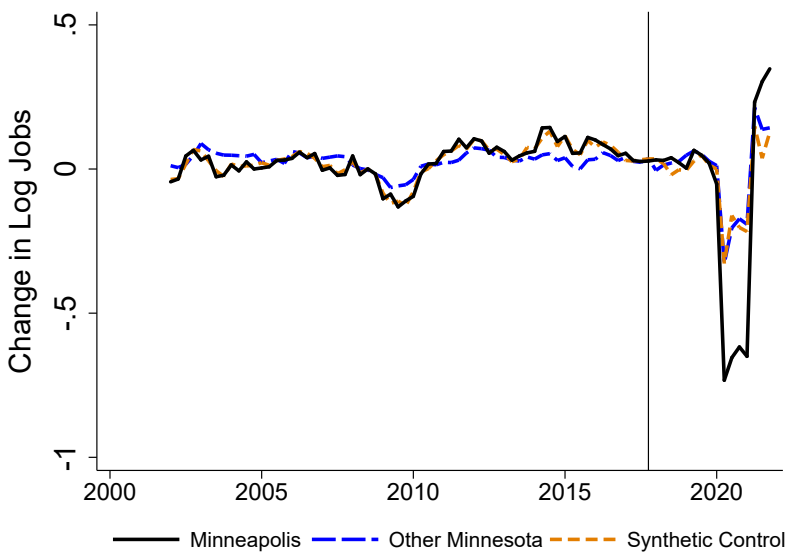
Accommodation and Food Services fit in Minneapolis

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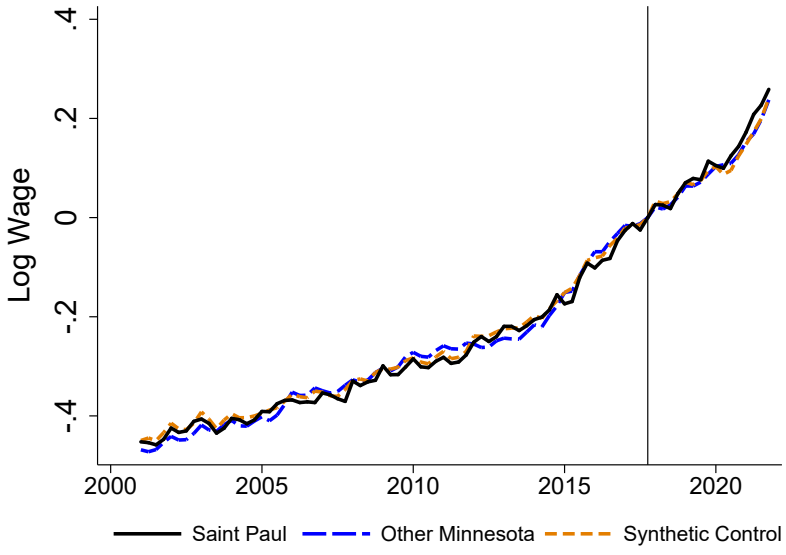


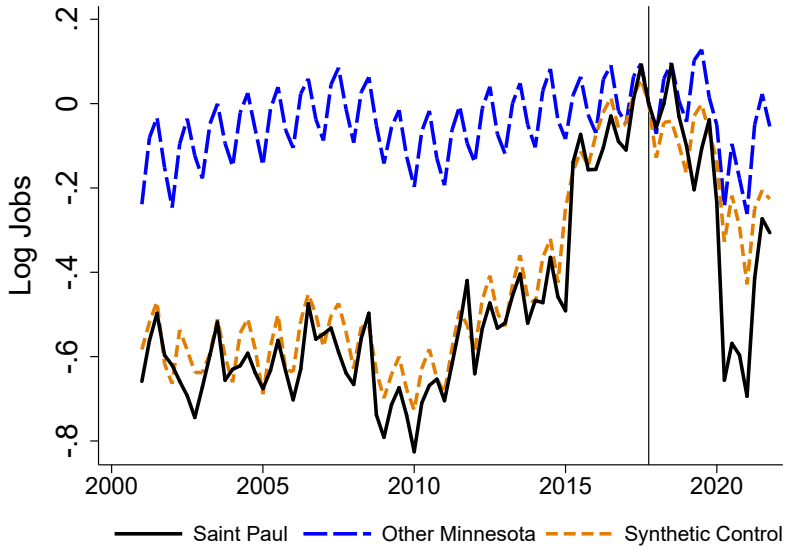


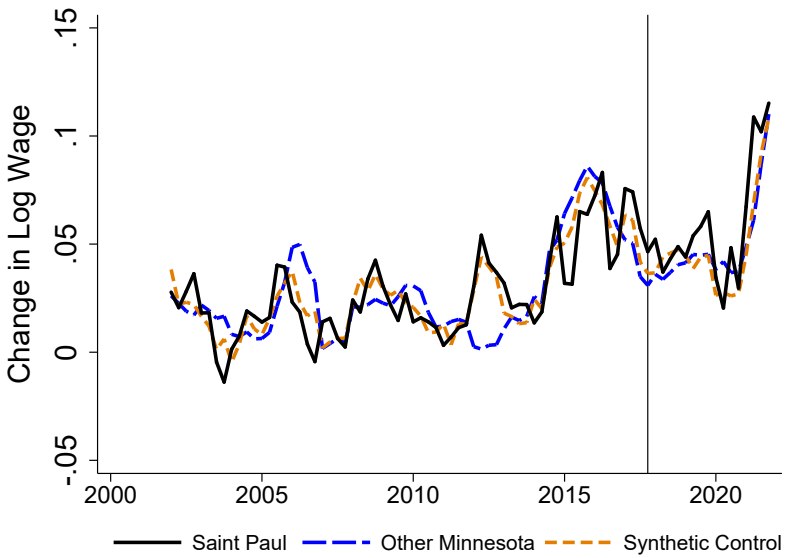


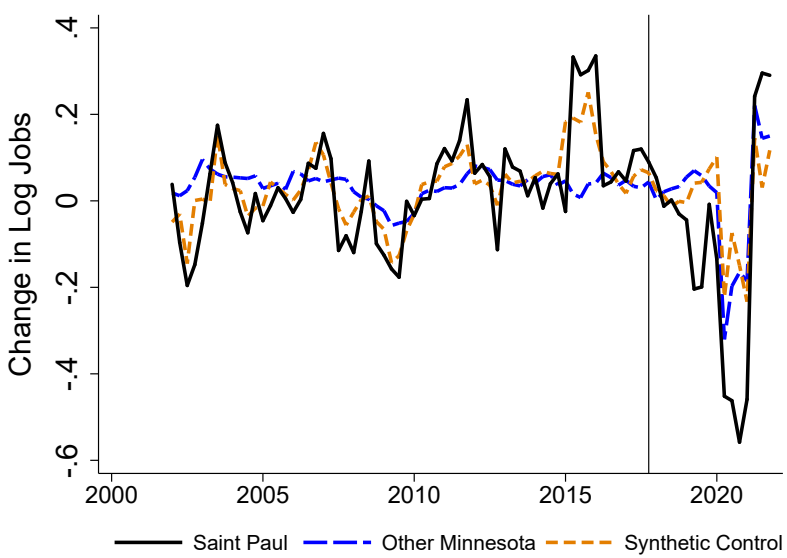
Accommodation and Food Services fit in Saint Paul

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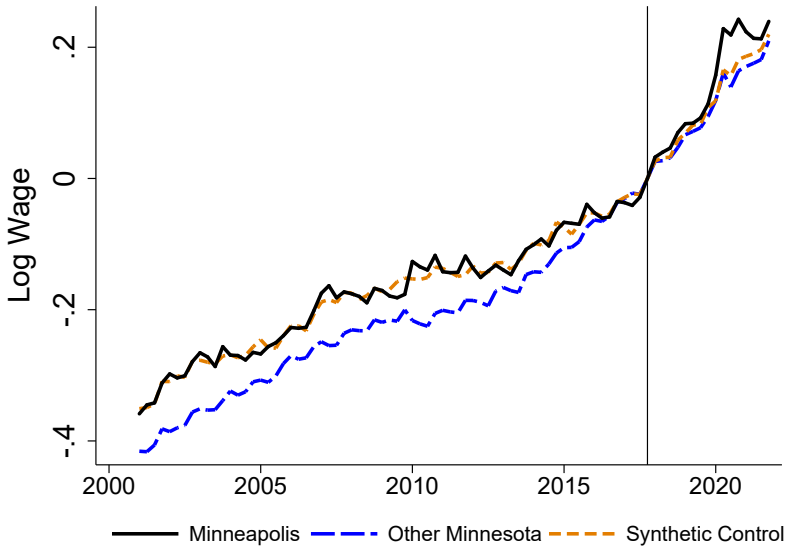


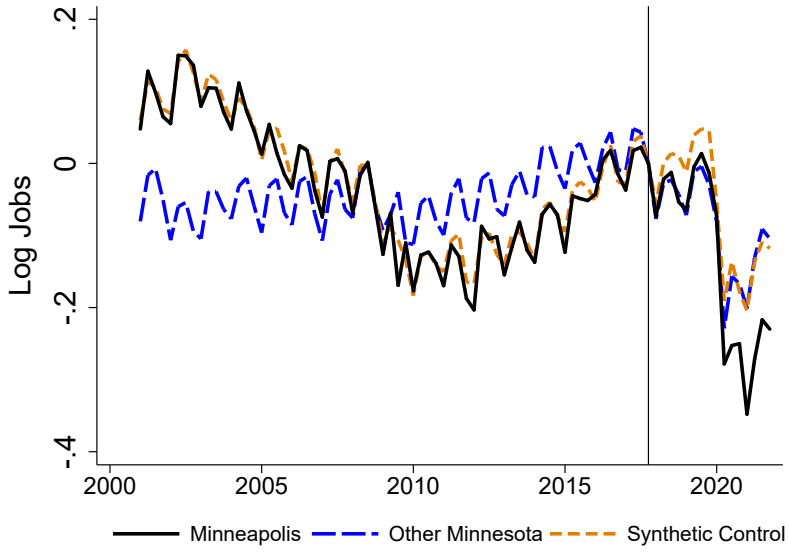


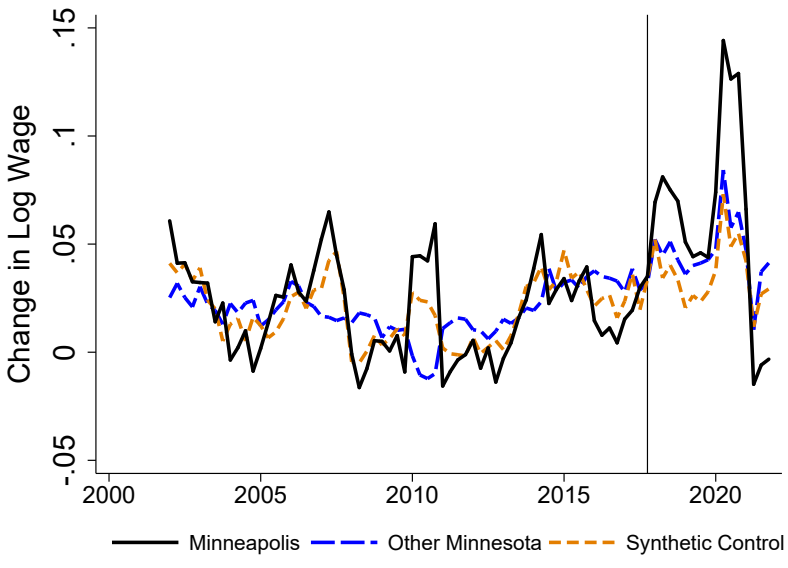


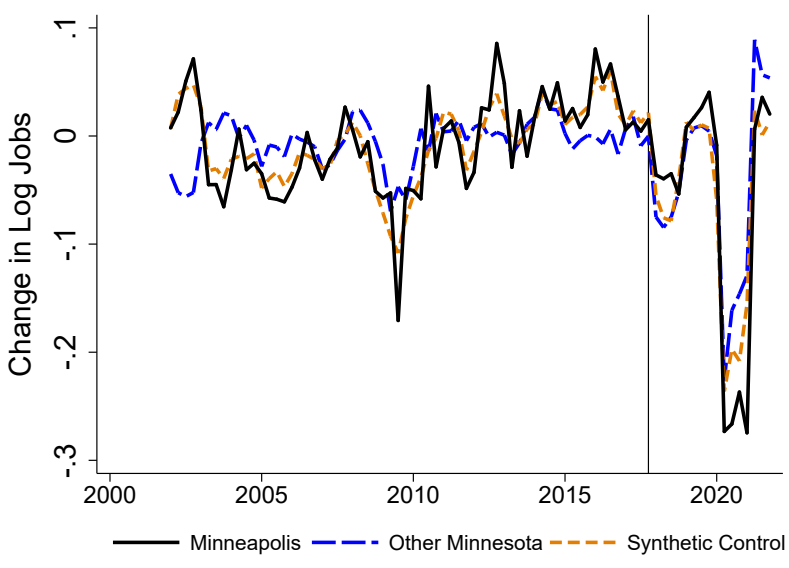
Other Services fit in Minneapolis

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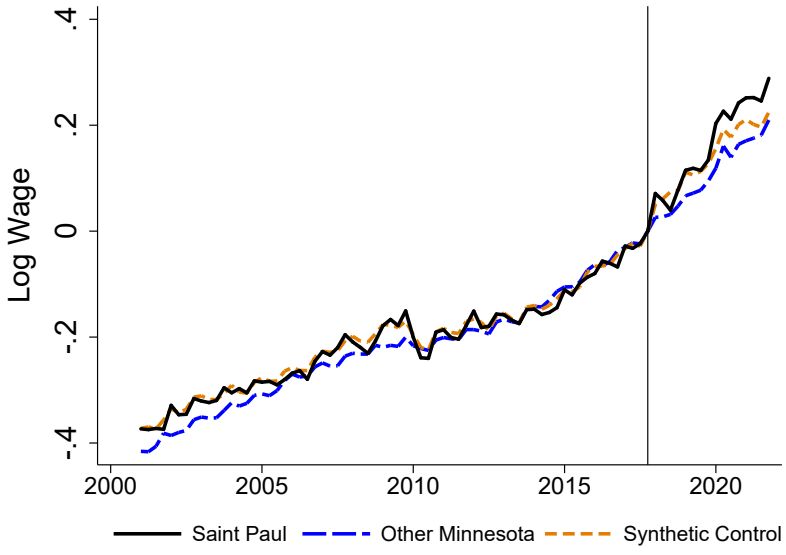


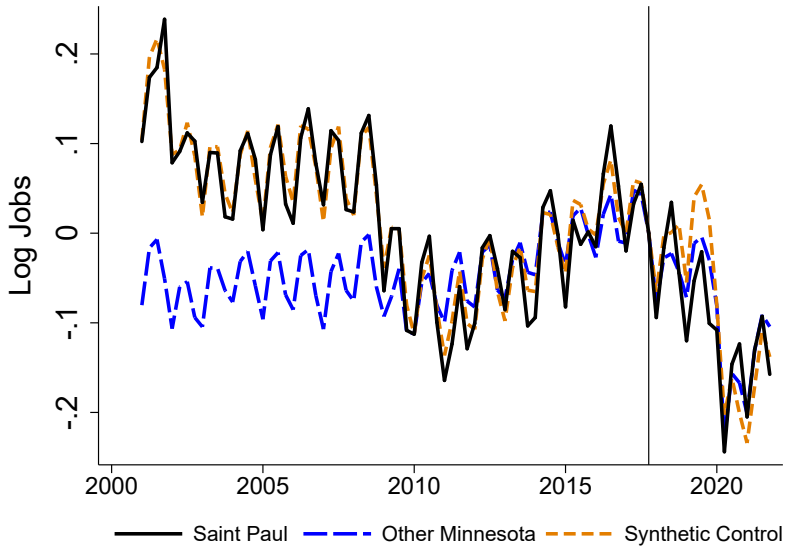


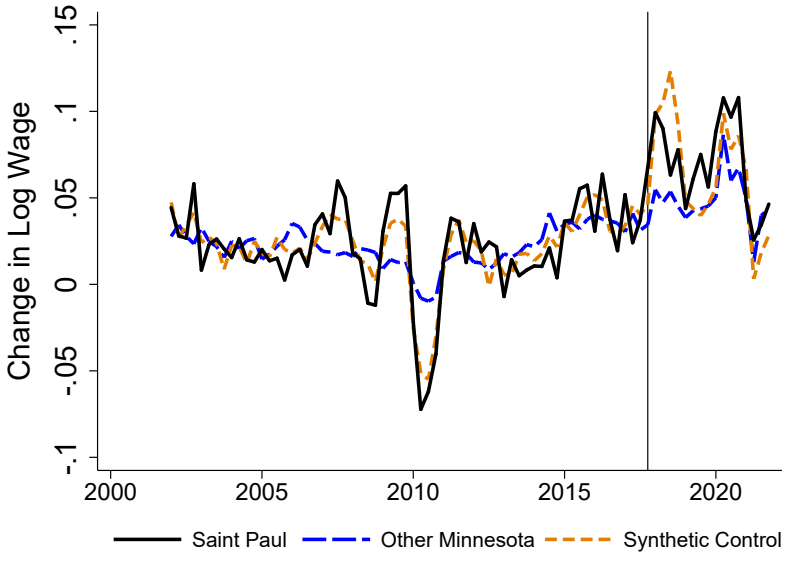


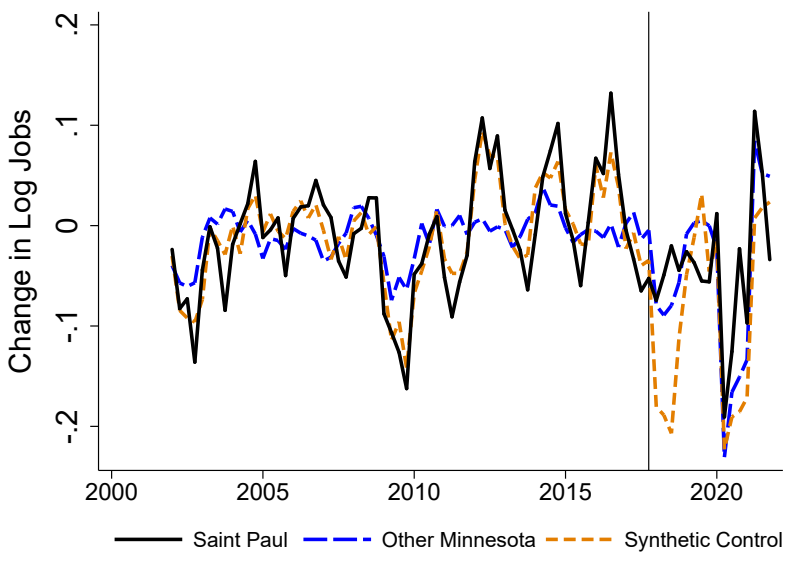
Other Services fit in Saint Paul

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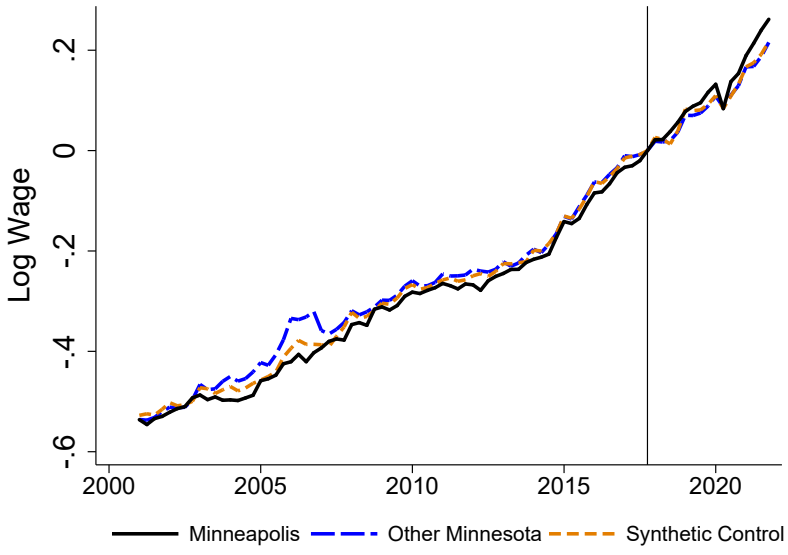


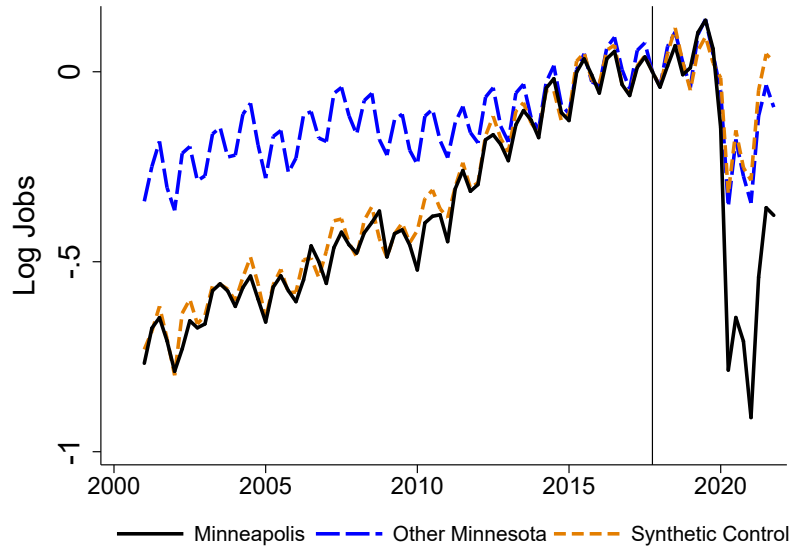


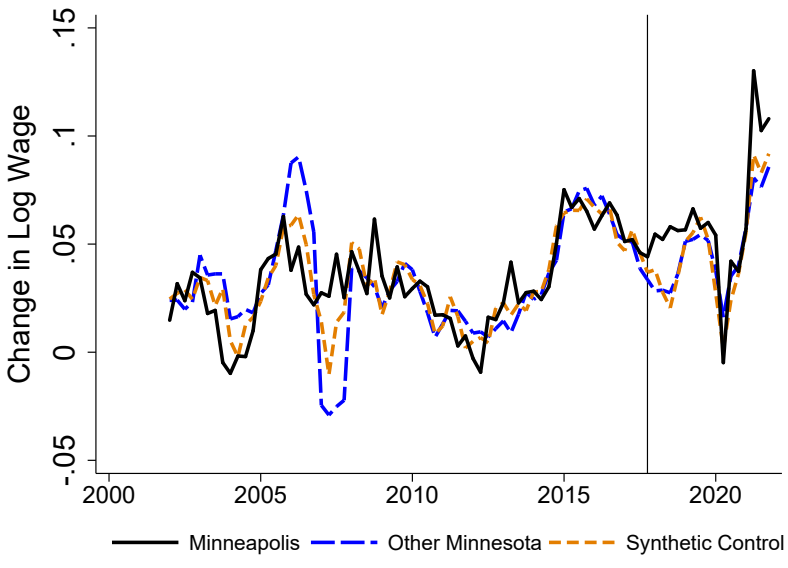


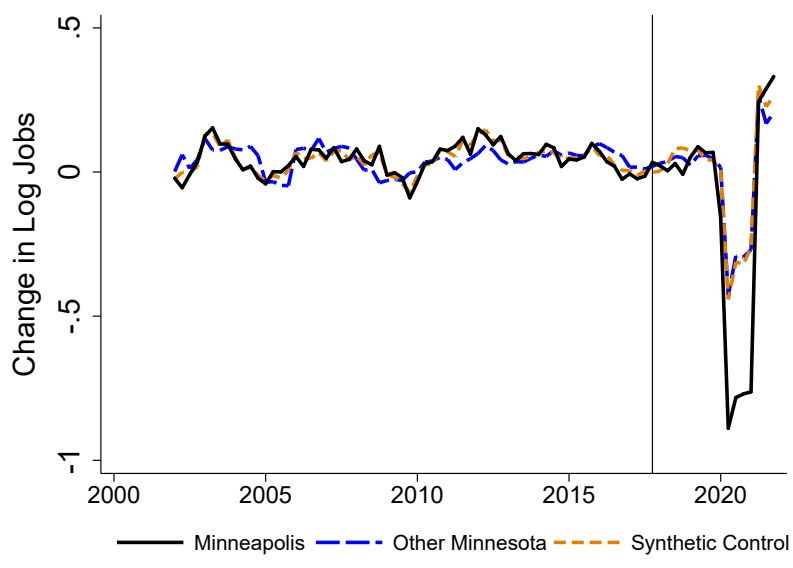
Full-Service Restaurants fit in Minneapolis

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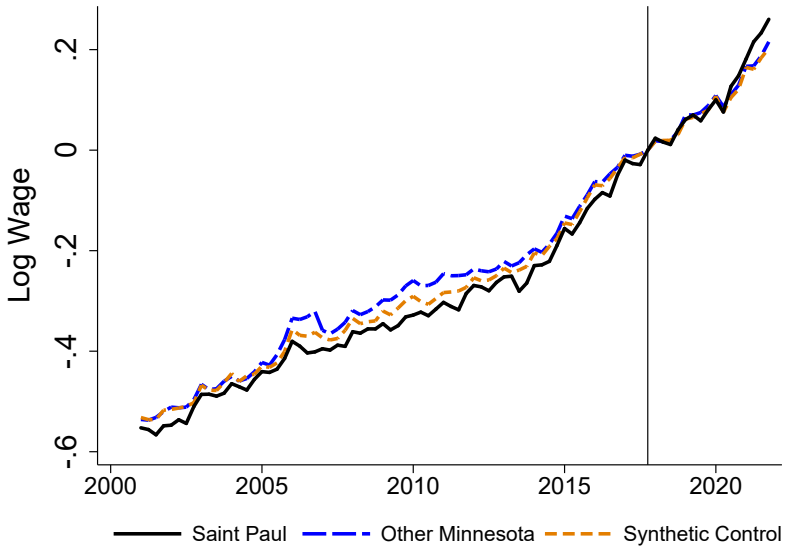


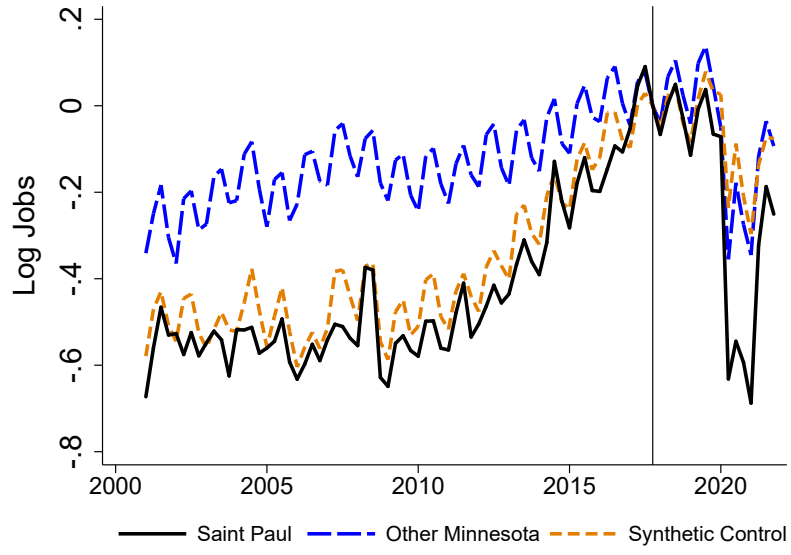


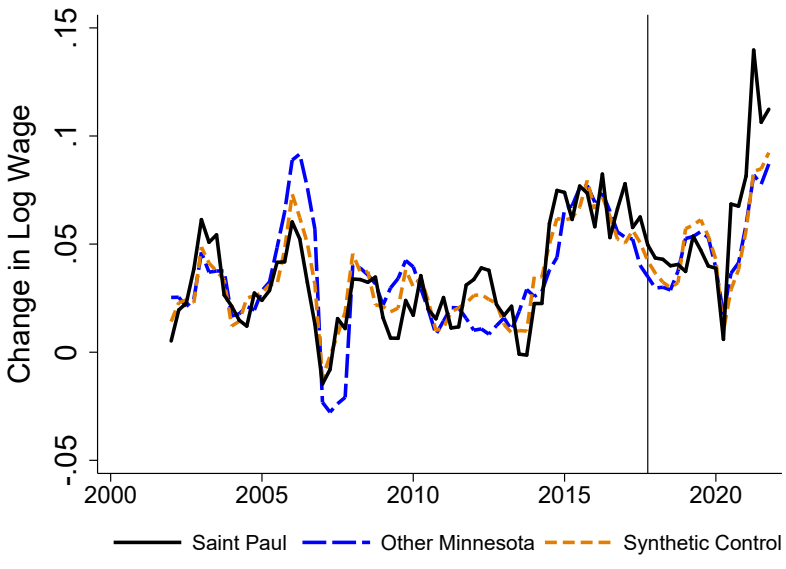


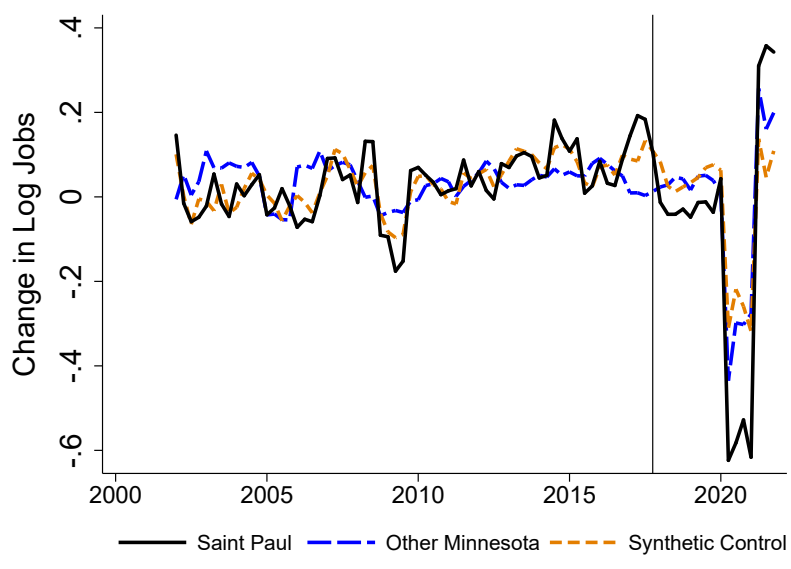
Full-Service Restaurants fit in Saint Paul

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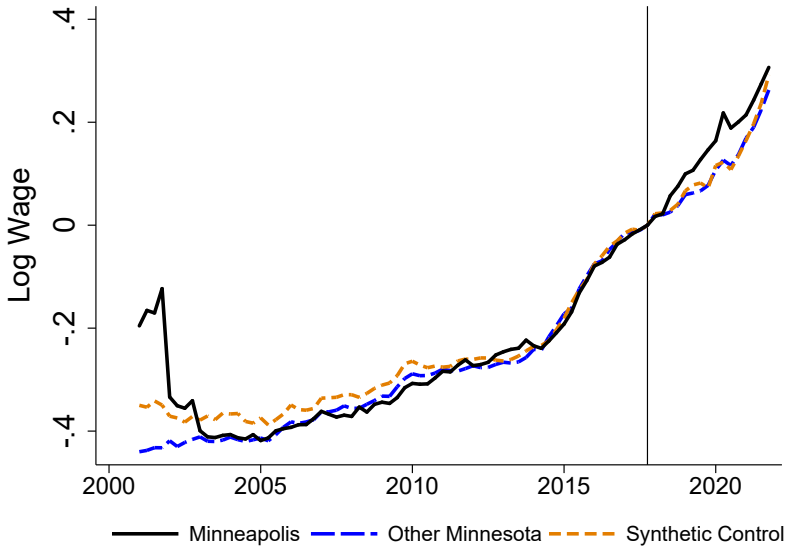


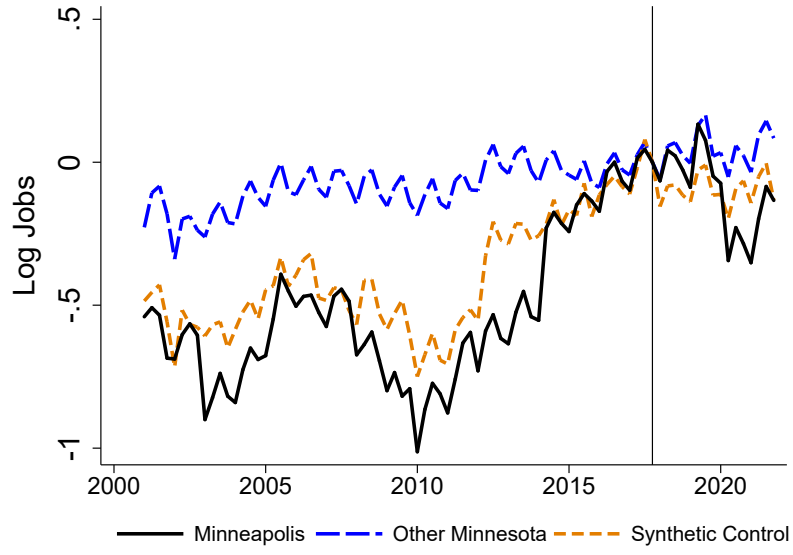


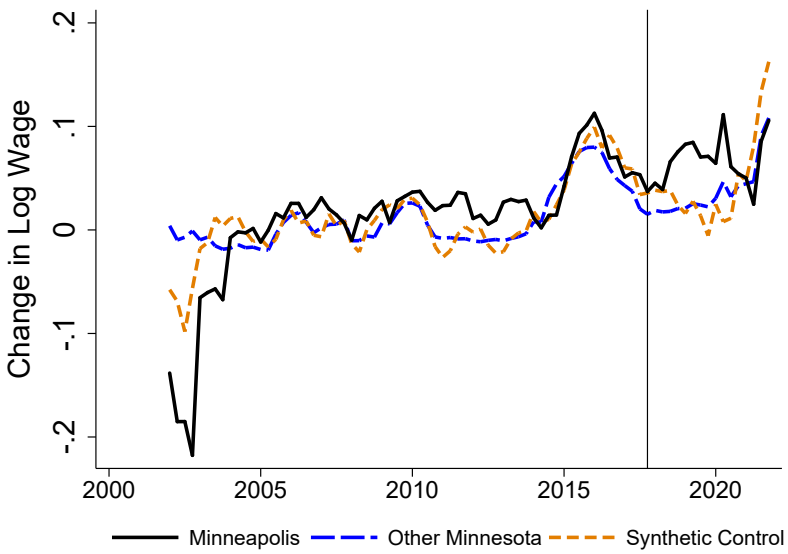


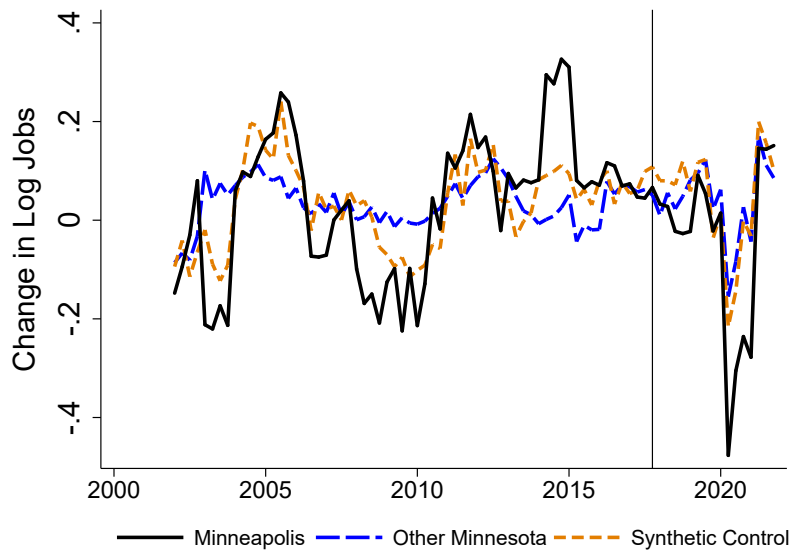
Limited-Service Restaurants fit in Minneapolis

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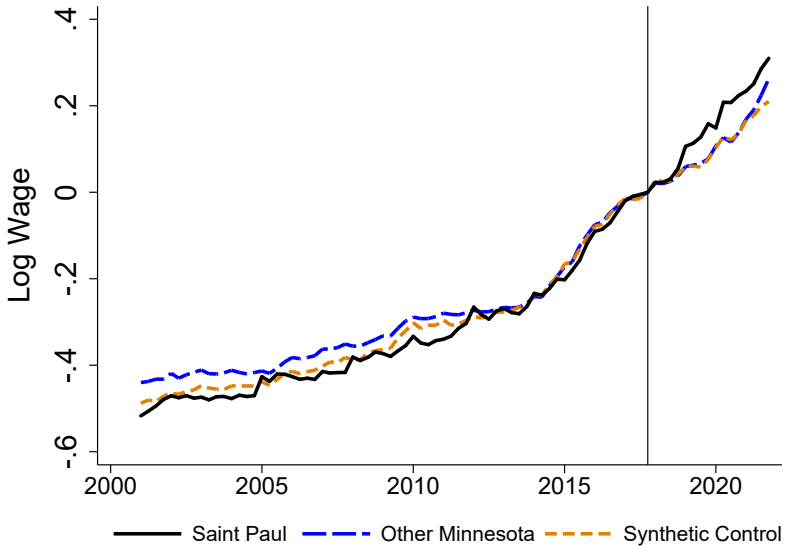


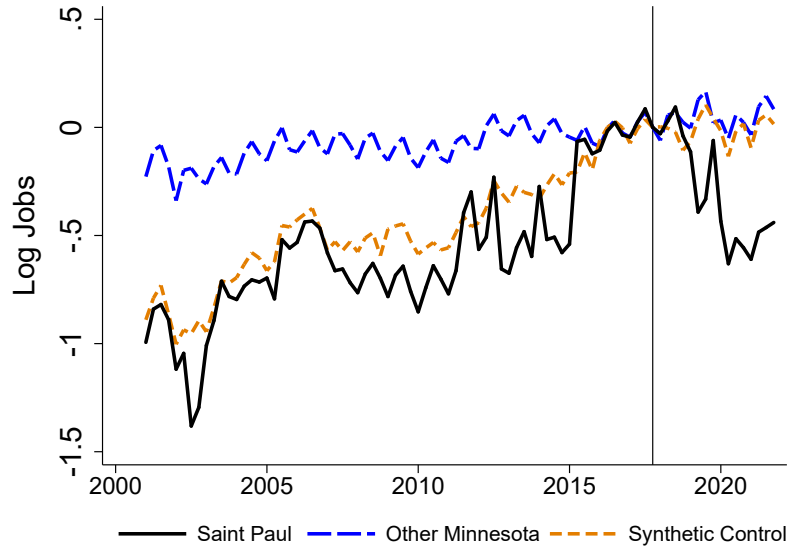


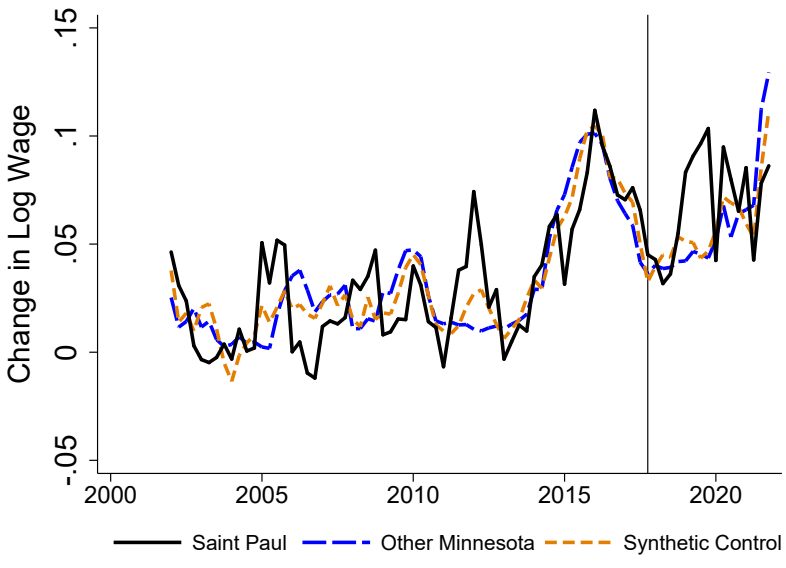


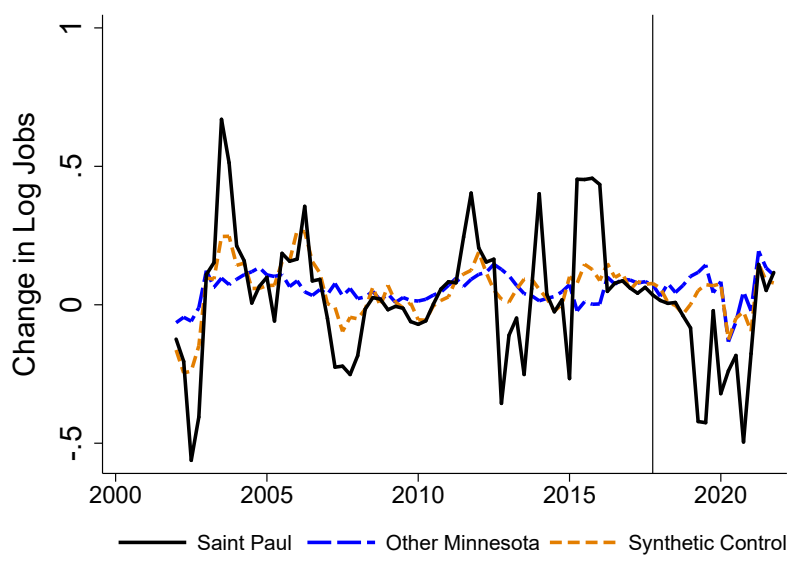
Limited-Service Restaurants fit in Saint Paul

back









Results for Minneapolis

back

[Coefficients are $100 \cdot g_{2021(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	9.3	−34.0	−23.4	−14.8
	(0.0)	(0.0)	(0.8)	(7.4)
Admin and Support (56)	11.5	9.6	11.3	17.7
	(0.0)	(46.8)	(49.6)	(18.6)
Health Care and Social Asst (62)	−2.3	3.9	6.9	2.8
	(13.8)	(52.7)	(34.0)	(86.3)
Arts, Entmt, and Recreation (71)	−2.4	−15.7	−7.9	7.0
	(38.4)	(3.6)	(28.4)	(89.3)
Accomm and Food Services (72)	0.7	−27.1	−45.7	−40.1
	(70.7)	(0.0)	(0.0)	(0.0)
Other Services (81)	10.3	−0.9	−15.2	−0.4
	(0.0)	(81.7)	(4.8)	(87.3)
Full-Service Restaurants (722511)	5.9	−51.9	−49.3	−50.0
	(0.0)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	9.5	−35.5	−26.9	−25.5
	(0.0)	(0.6)	(2.6)	(5.8)

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

Results for Saint Paul

back

[Coefficients are $100 \cdot g_{2021(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	9.2	−26.5	−53.6	−28.8
	(0.0)	(0.4)	(0.0)	(0.4)
Admin and Support (56)	4.8	−5.2	21.1	−60.5
	(9.4)	(69.7)	(12.4)	(0.0)
Health Care and Social Asst (62)	−0.9	4.1	7.1	−3.3
	(50.9)	(54.3)	(31.0)	(59.9)
Arts, Entmt, and Recreation (71)	−0.2	−25.1	−17.4	−4.1
	(83.3)	(0.0)	(2.8)	(30.6)
Accomm and Food Services (72)	4.0	−39.2	−58.8	−30.0
	(0.0)	(0.0)	(0.0)	(0.0)
Other Services (81)	2.3	21.2	−2.1	11.1
	(32.2)	(0.2)	(85.3)	(11.6)
Full-Service Restaurants (722511)	4.2	−28.7	−26.6	−29.4
	(0.0)	(0.0)	(0.2)	(0.0)
Ltd-Service Restaurants (722513)	4.2	−59.6	−76.0	−88.3
	(0.0)	(0.0)	(0.0)	(0.0)

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

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 $100 \cdot g_{2021(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	9.9	−34.7	−21.5	−13.8
	(0.0)	(0.0)	(0.2)	(5.2)
Admin and Support (56)	11.6	18.1	15.0	15.8
	(0.0)	(15.8)	(34.6)	(27.2)
Health Care and Social Asst (62)	−3.0	2.0	5.4	2.7
	(7.2)	(85.7)	(53.9)	(96.7)
Arts, Entmt, and Recreation (71)	−2.4	−16.4	−7.1	14.4
	(32.2)	(5.0)	(49.8)	(38.4)
Accomm and Food Services (72)	0.7	−27.2	−33.3	−42.3
	(73.7)	(0.0)	(0.0)	(0.0)
Other Services (81)	10.3	4.1	−11.7	−0.8
	(0.0)	(43.6)	(9.0)	(92.3)
Full-Service Restaurants (722511)	5.8	−50.0	−47.5	−50.4
	(0.0)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	9.5	−35.5	−26.8	−25.7
	(0.0)	(0.6)	(4.0)	(5.4)

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

Excluding Saint Paul bordering cities

back

[Coefficients are $100 \cdot g_{2021(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	9.2	−26.2	−53.6	−28.6
	(0.0)	(0.2)	(0.0)	(0.0)
Admin and Support (56)	4.8	−4.6	20.5	−62.1
	(10.4)	(72.7)	(15.2)	(0.2)
Health Care and Social Asst (62)	−1.0	4.8	6.2	−2.5
	(44.0)	(53.7)	(48.6)	(55.3)
Arts, Entmt, and Recreation (71)	−0.2	−25.1	−17.4	−4.1
	(89.7)	(0.0)	(3.6)	(34.6)
Accomm and Food Services (72)	4.2	−38.2	−59.2	−30.0
	(0.0)	(0.0)	(0.0)	(0.0)
Other Services (81)	2.3	21.2	−0.9	11.0
	(25.0)	(0.2)	(99.9)	(9.8)
Full-Service Restaurants (722511)	4.2	−31.9	−31.0	−35.8
	(0.0)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	2.0	−59.6	−76.0	−88.5
	(11.4)	(0.0)	(0.0)	(0.0)

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

Minneapolis results using time weights

back

[Coefficients are $100 \cdot g_{2021(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	9.6	−39.5	−34.9	−19.9
	(0.0)	(0.0)	(0.0)	(1.2)
Admin and Support (56)	11.4	13.1	16.4	23.4
	(0.0)	(32.4)	(26.0)	(7.0)
Health Care and Social Asst (62)	−2.3	9.5	4.0	6.8
	(7.6)	(11.0)	(58.9)	(53.3)
Arts, Entmt, and Recreation (71)	−0.4	−12.9	−10.5	7.9
	(84.7)	(6.0)	(25.4)	(99.5)
Accomm and Food Services (72)	2.1	−29.2	−38.0	−43.8
	(4.8)	(0.0)	(0.0)	(0.0)
Other Services (81)	7.9	−5.2	−10.2	−7.7
	(0.0)	(58.3)	(16.2)	(40.2)
Full-Service Restaurants (722511)	4.7	−54.2	−50.8	−46.1
	(0.0)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	7.8	−26.3	−18.7	−17.1
	(0.0)	(3.2)	(13.0)	(22.4)

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

Saint Paul results using time weights

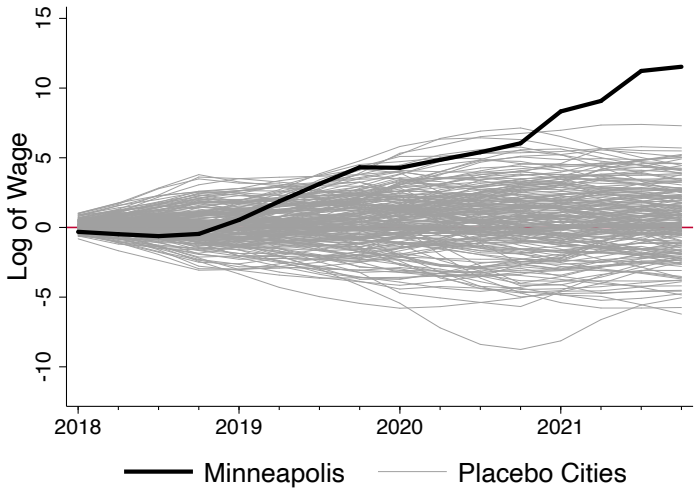
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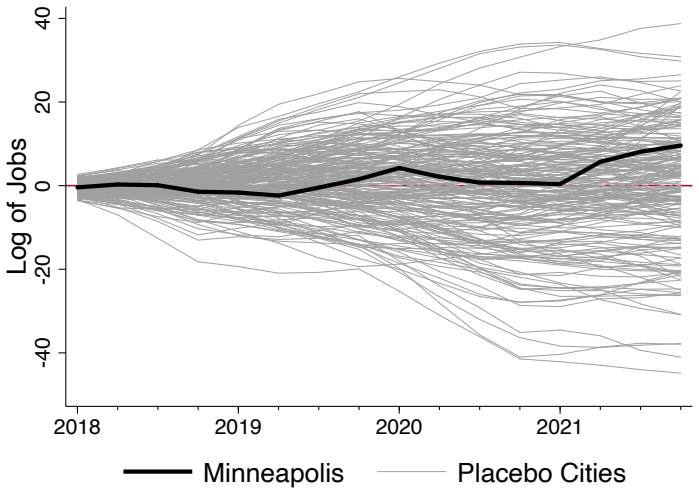
[Coefficients are $100 \cdot g_{2021(4)}$]	Wage	Jobs	Hours	Earnings
Retail Trade (44)	9.0	−21.7	−56.1	−27.0
	(0.0)	(0.0)	(0.0)	(0.0)
Admin and Support (56)	4.7	−7.4	6.3	−74.5
	(9.0)	(59.1)	(79.3)	(0.0)
Health Care and Social Asst (62)	−3.0	13.1	5.7	−3.5
	(2.8)	(3.8)	(40.8)	(45.0)
Arts, Entmt, and Recreation (71)	−3.4	−20.4	−14.8	−8.4
	(36.8)	(0.0)	(14.6)	(21.4)
Accomm and Food Services (72)	6.0	−41.6	−58.9	−37.0
	(0.0)	(0.0)	(0.0)	(0.0)
Other Services (81)	1.8	14.3	0.5	8.2
	(40.4)	(2.6)	(85.9)	(18.2)
Full-Service Restaurants (722511)	4.2	−34.1	−32.2	−28.2
	(0.0)	(0.0)	(0.0)	(0.0)
Ltd-Service Restaurants (722513)	3.6	−34.1	−32.0	−55.7
	(0.2)	(1.0)	(1.8)	(0.0)

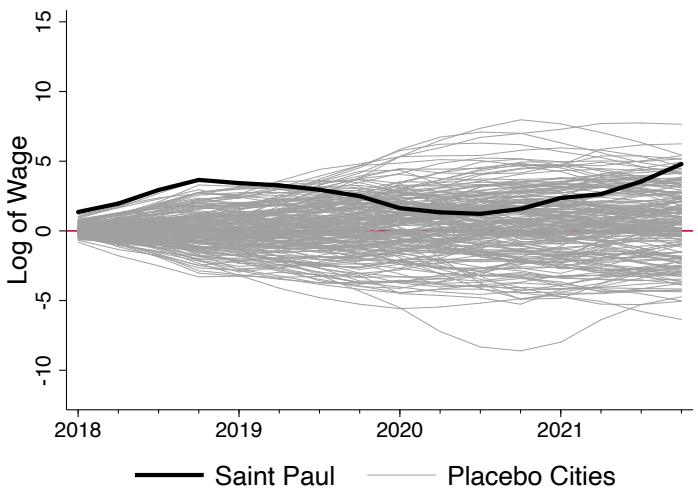
Note: p-values in parentheses constructed with the placebo method.

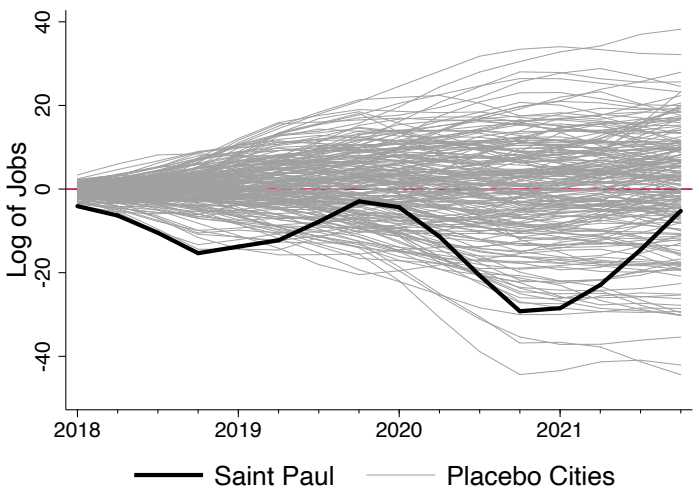
Effects for Administration and Support

back



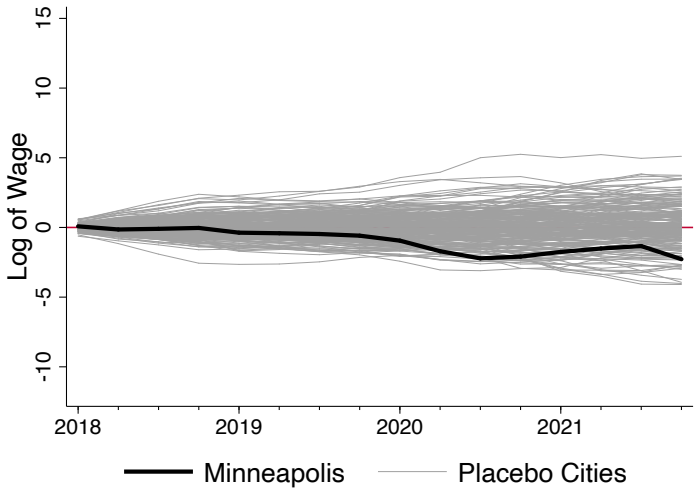


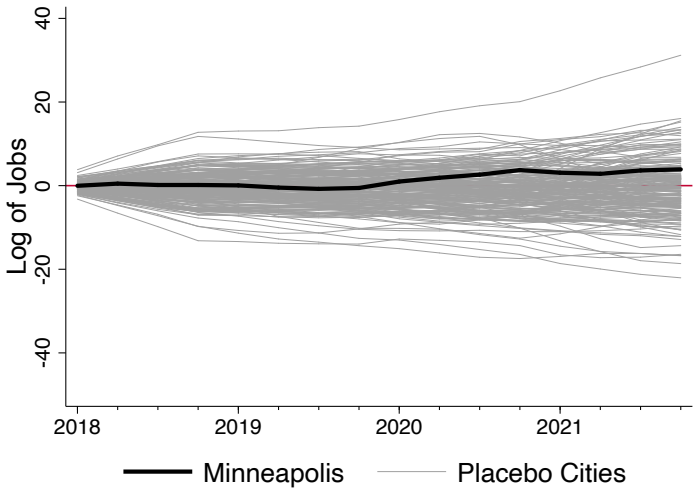


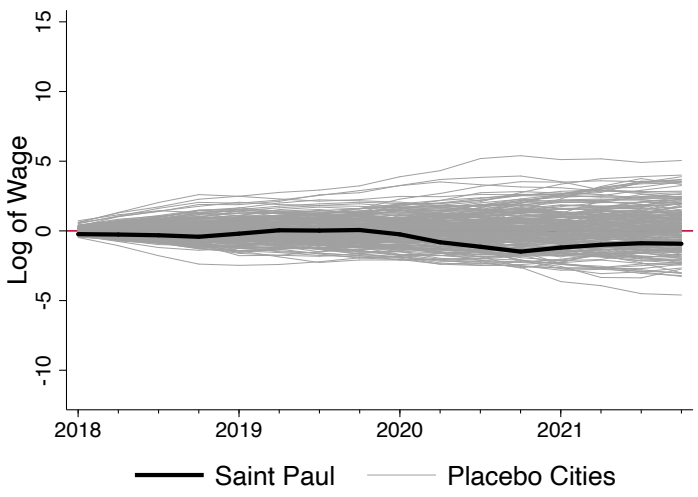


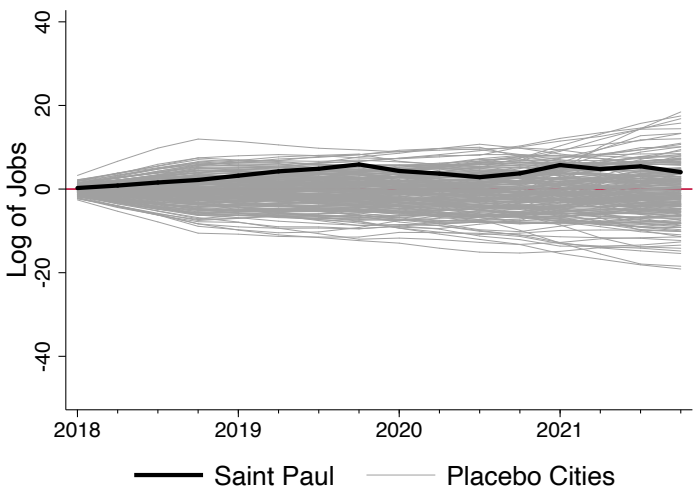
Effects for Health and Social Assistance

back



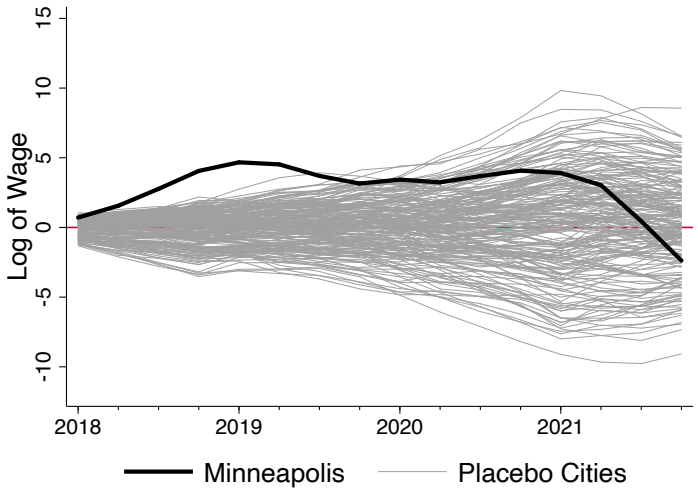


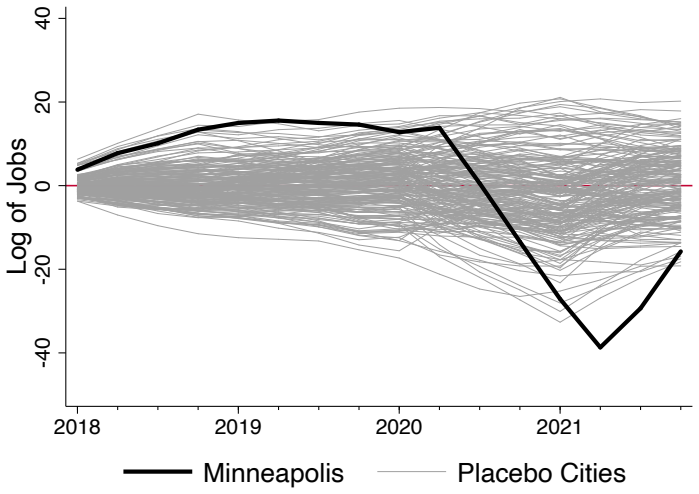


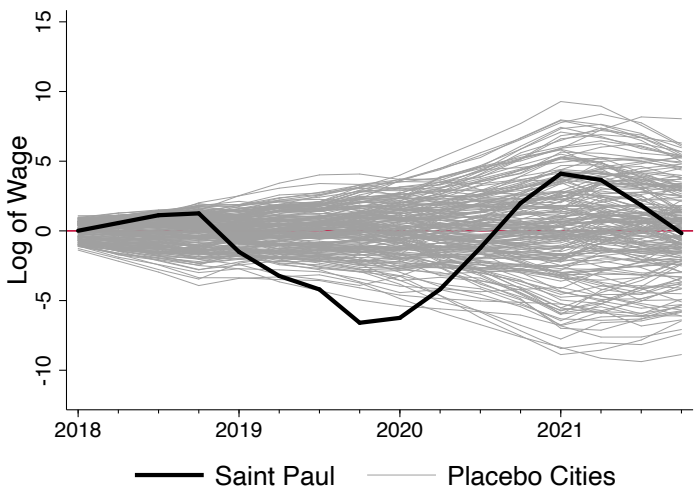


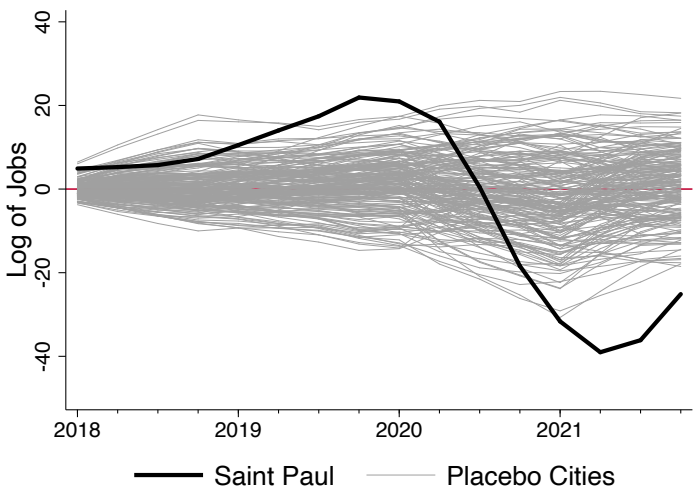
Effects for Arts, Entertainment, Recreation

back



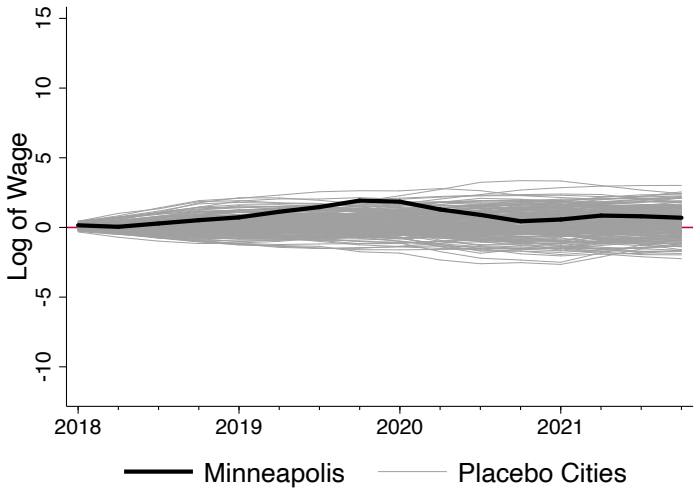


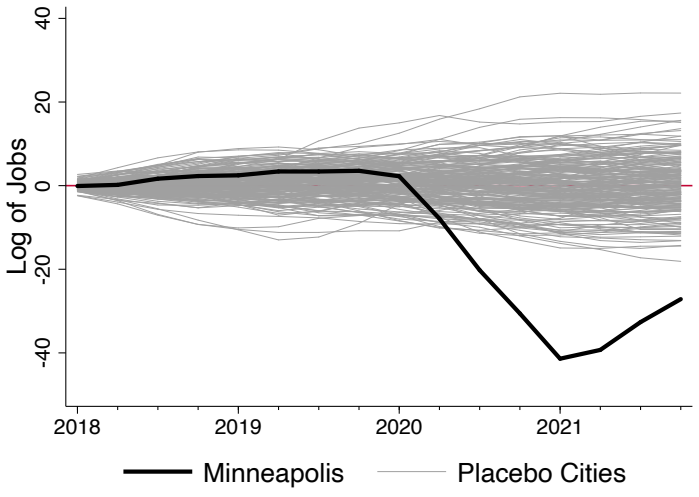


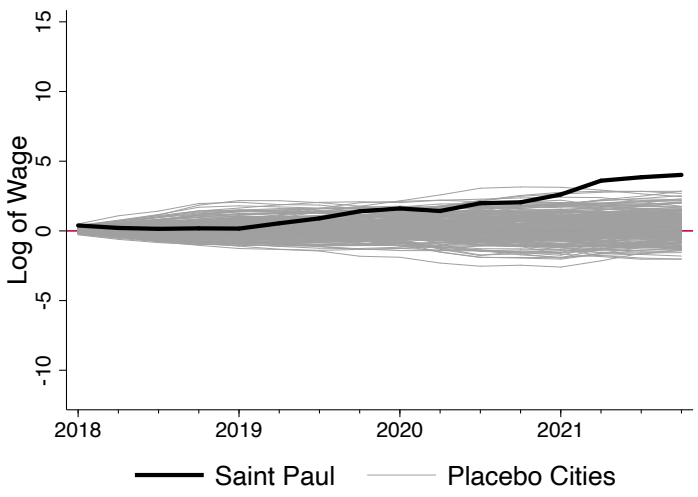


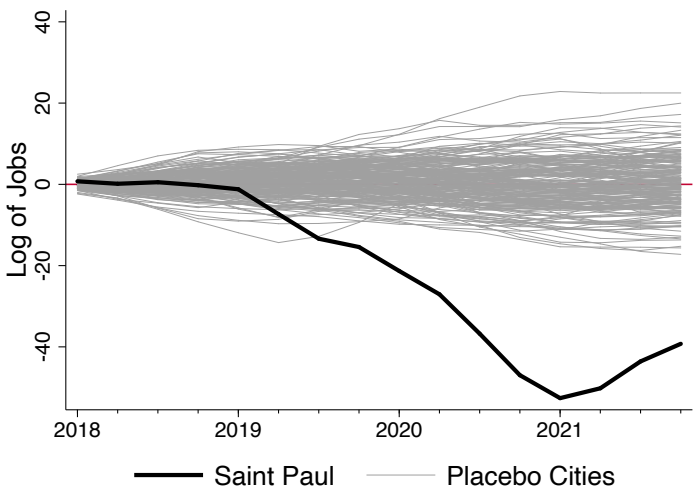
Effects for Accommodation and Food

back



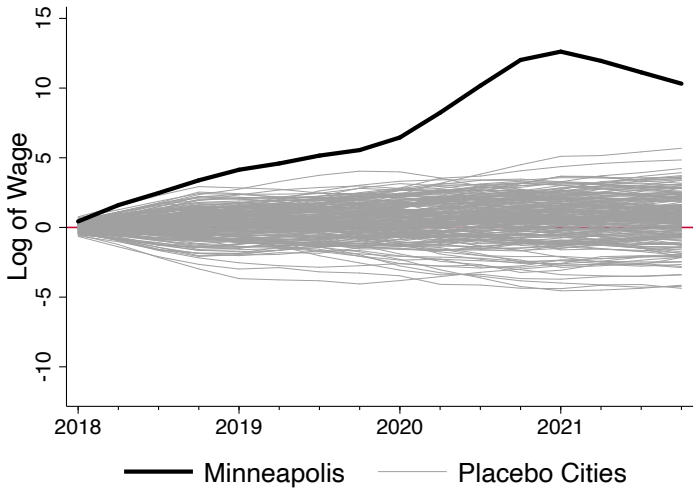


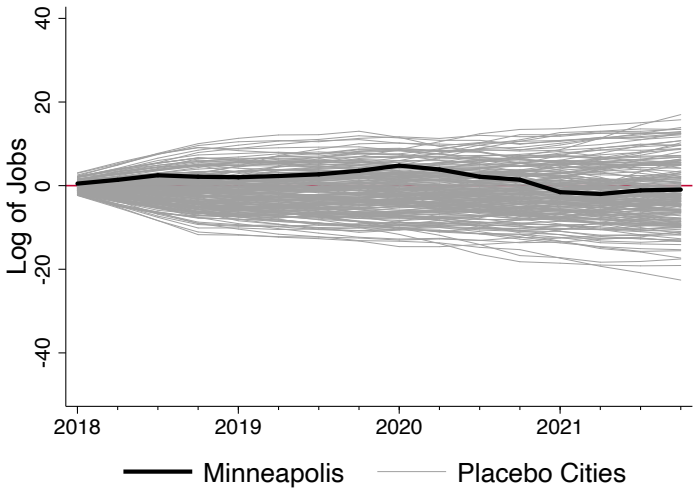


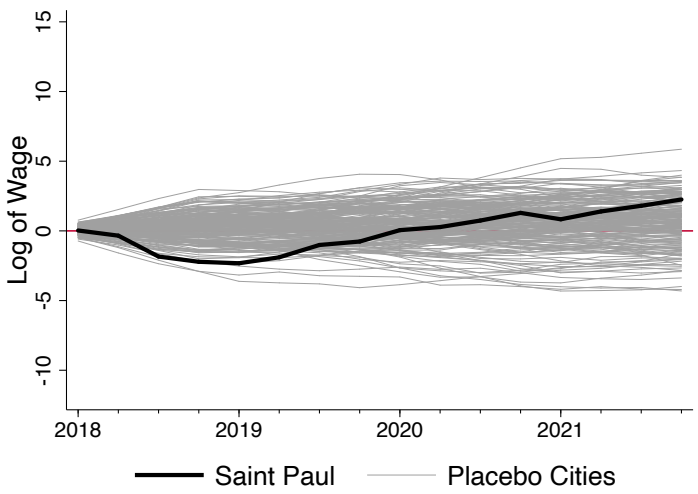


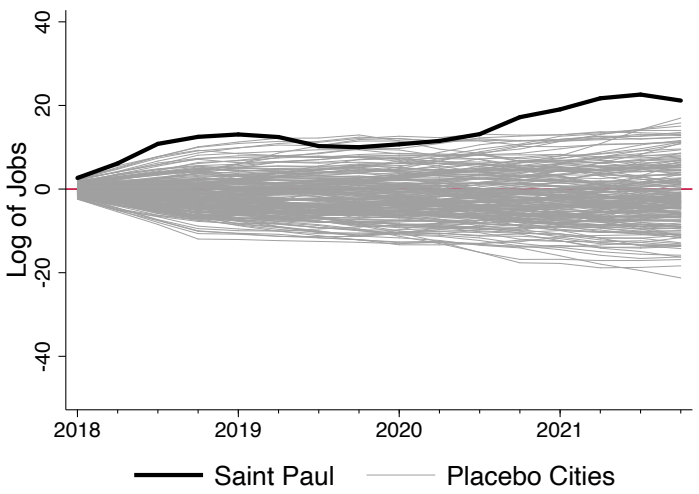
Effects for Other Services

back









Other U.S. cities of similar size to Minneapolis

back

City	Jobs (000's)	City	Jobs (000's)
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
Louisville, KY	425	Wichita, KS	220
Honolulu, HI	380	Little Rock, AR	201
Oklahoma City, OK	374	St. Louis, MO	197
Tulsa, OK	322	Reno, NV	193
Kansas City, MO	314	New Orleans, LA	170
Fresno, CA	310	Fort Wayne, IN	169
Omaha, NE	301	Winston-Salem, NC	167
Tucson, AZ	299	Lexington, KY	159
Aurora, CO	295	Huntsville, AL	155
Minneapolis, MN	280	Virginia Beach, VA	149
Baltimore, MD	276	Springfield, MO	147

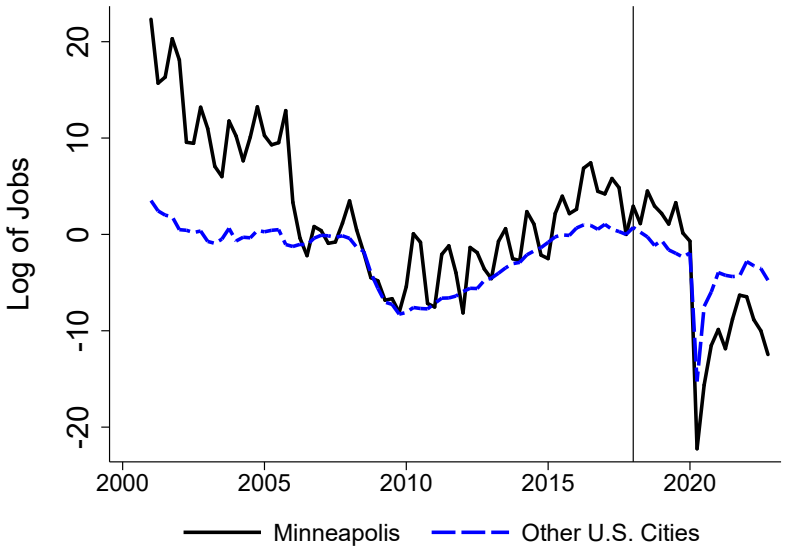
Other U.S. cities of similar size to Saint Paul

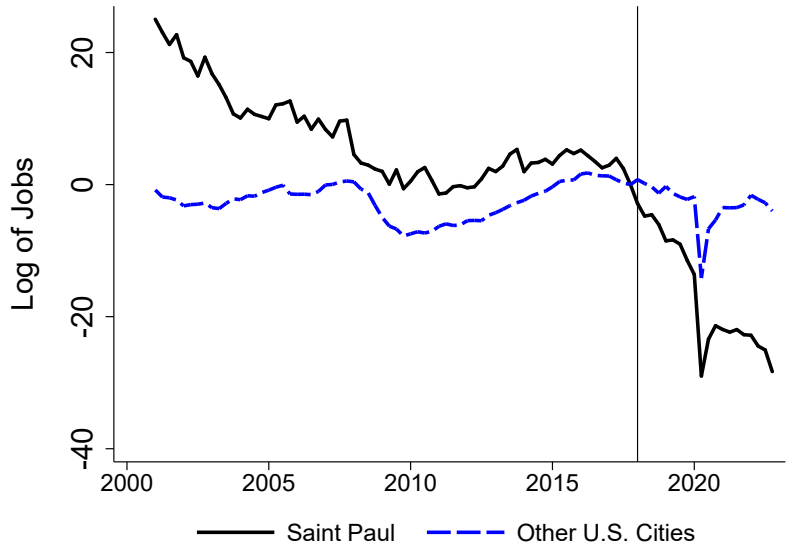
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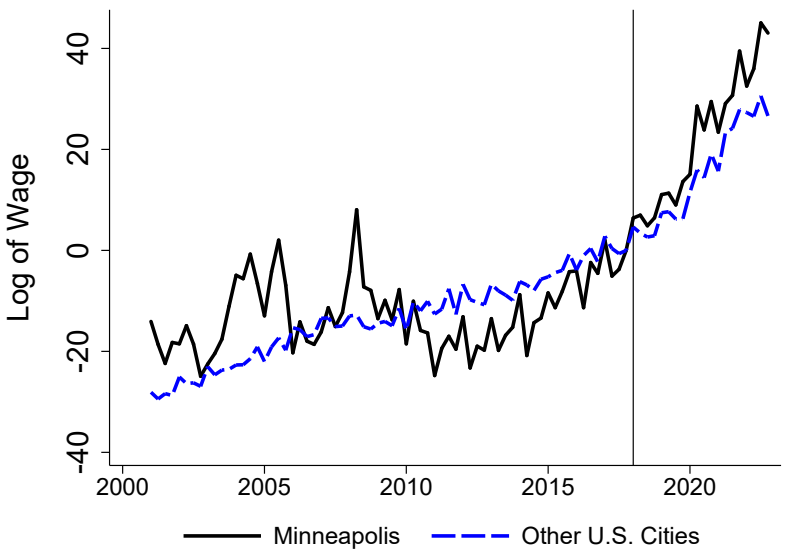
City	Jobs (000's)	City	Jobs (000's)
Aurora, CO	295	Corpus Christi, TX	135
Baltimore, MD	276	Salem, OR	132
Albuquerque, NM	264	Anchorage, AK	120
Greensboro, NC	251	Sioux Falls, SD	115
El Paso, TX	236	Rockford, IL	114
Prince George's County, MD	232	Richmond, VA	114
Colorado Springs, CO	225	Lubbock, TX	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	Chesapeake, VA	85
Winston-Salem, NC	167	Midland, TX	85
Lexington, KY	159	Fayetteville, NC	83
Huntsville, AL	155	Newport News, VA	83
Virginia Beach, VA	149	Augusta, GA	81
Saint Paul, MN	149	Laredo, TX	79
Springfield, MO	147	Kansas City, KS	78
Lincoln, NE	137	Birmingham, AL	77
Savannah, GA	136		

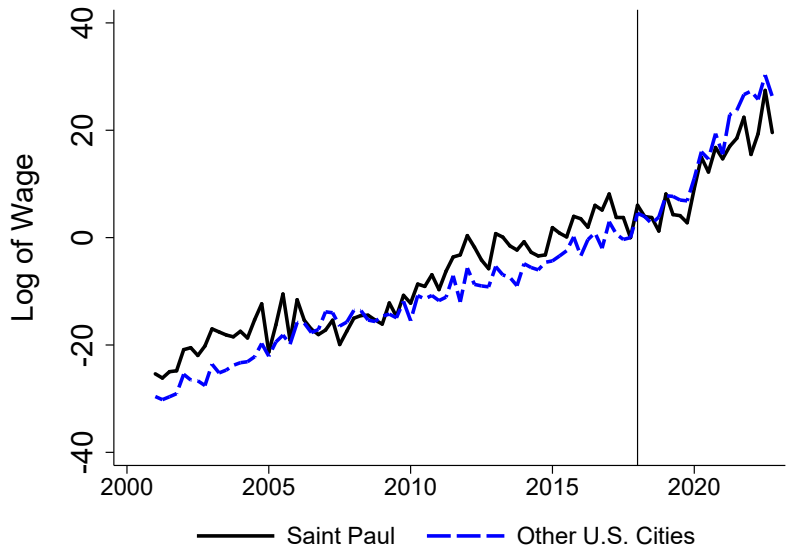
Retail time series

back



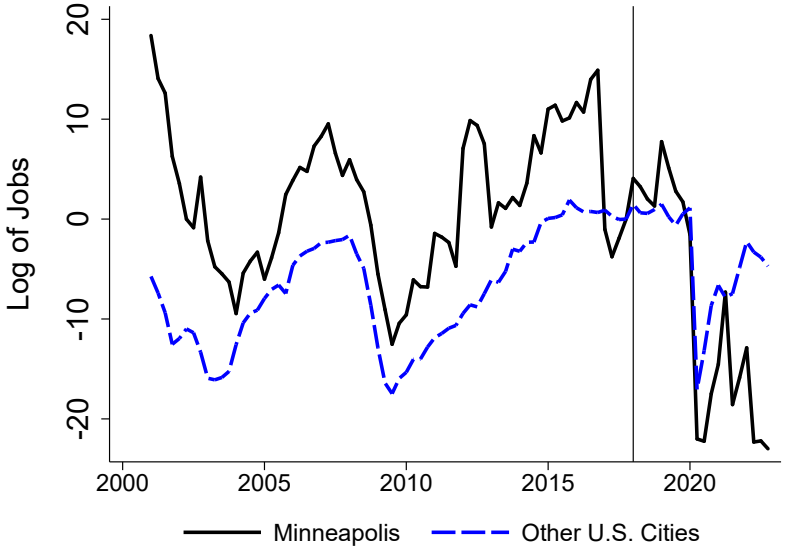


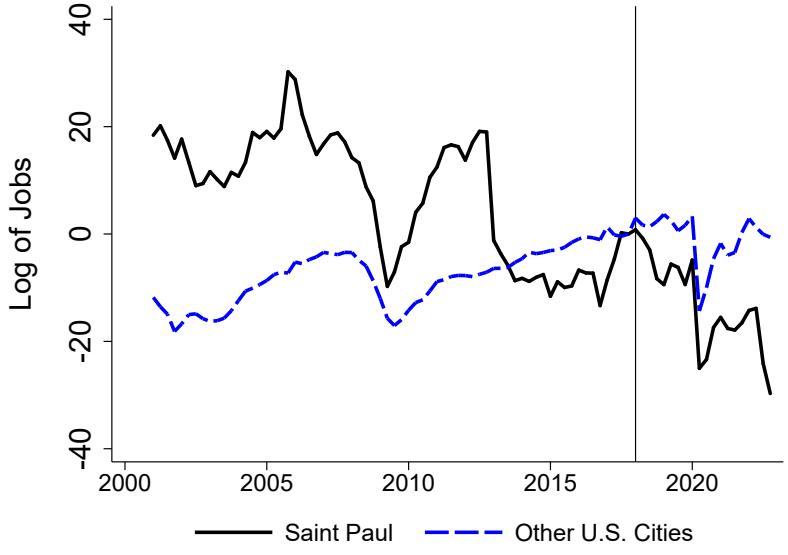


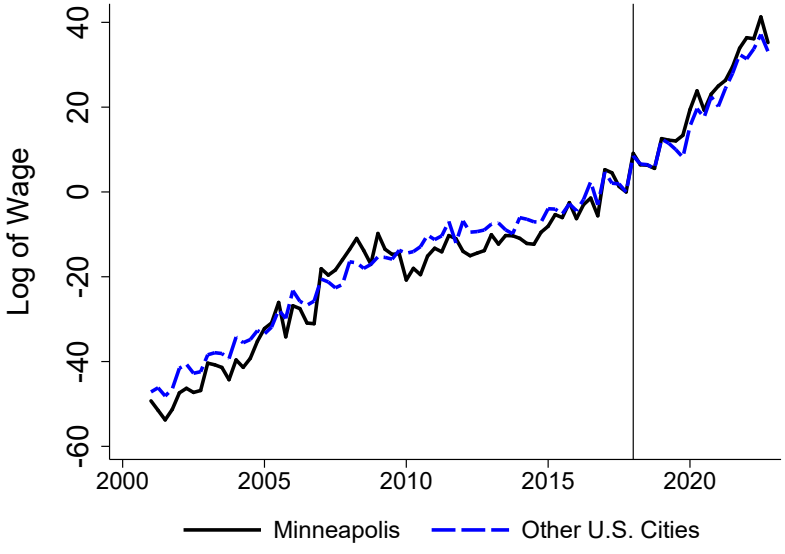


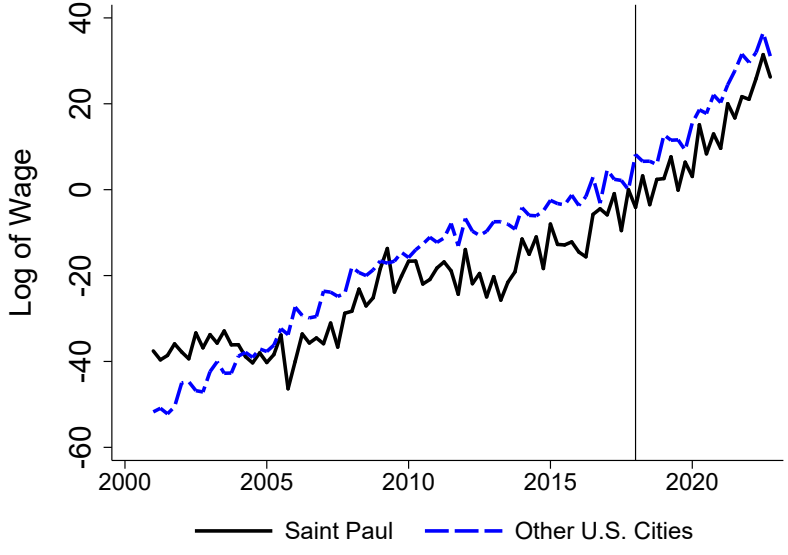
Administration and Support time series

back



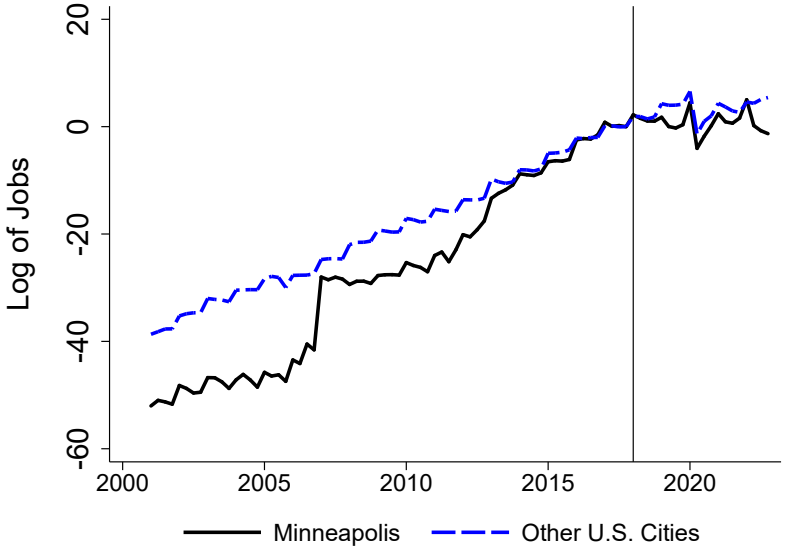


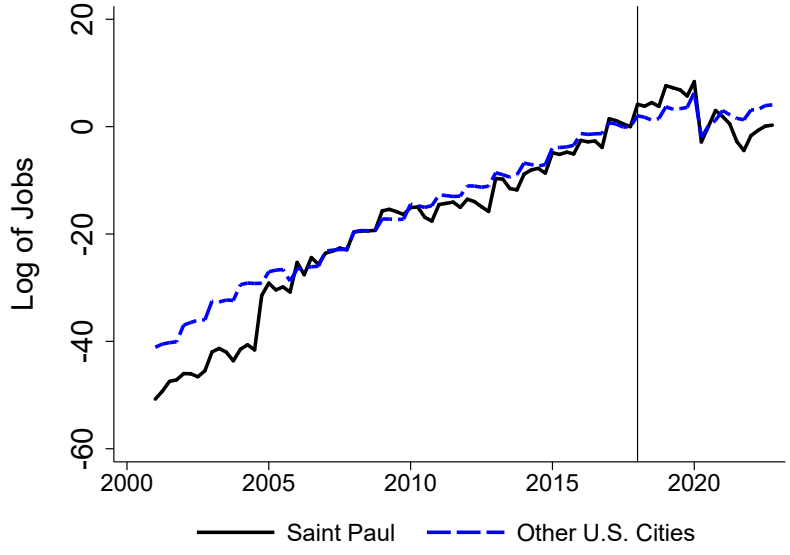


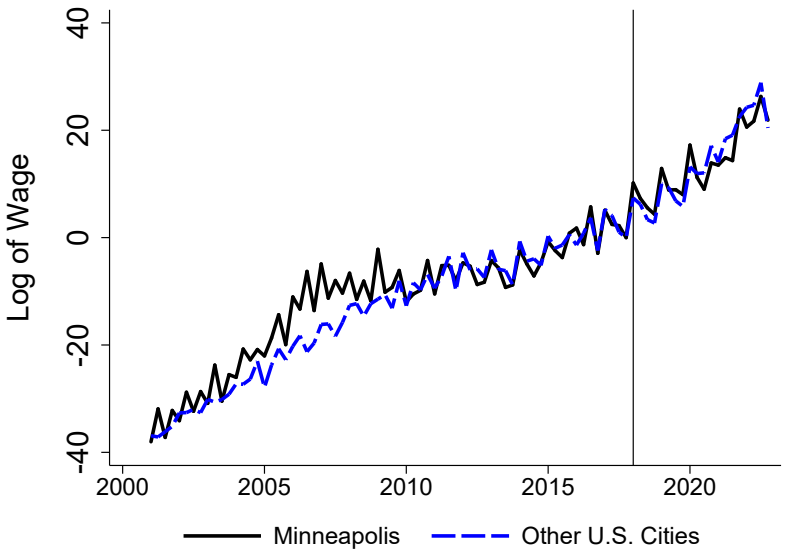


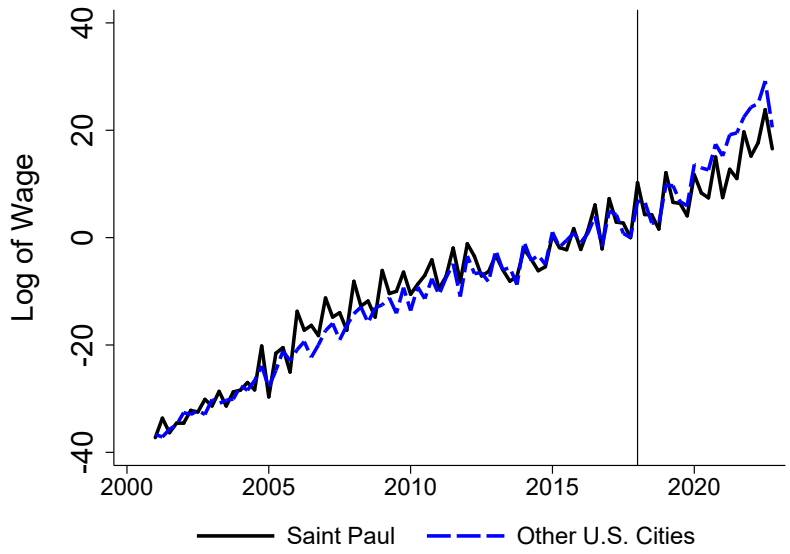
Health Care and Social Assistance time series

back



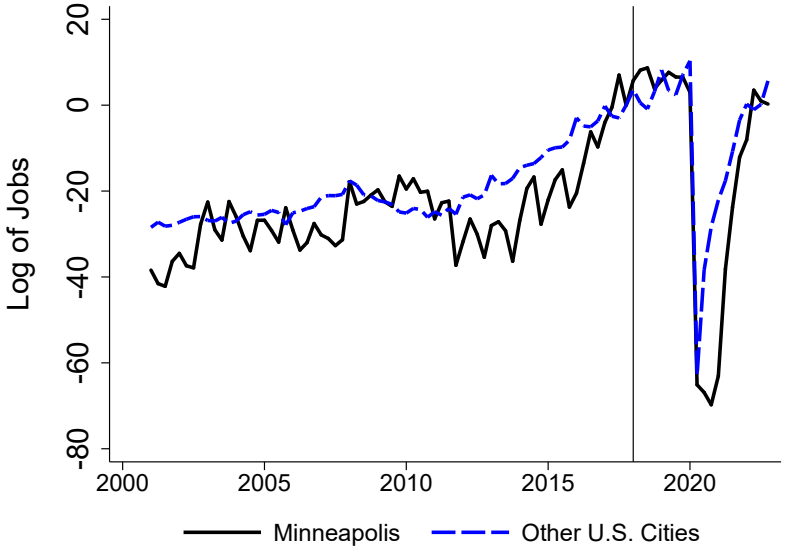


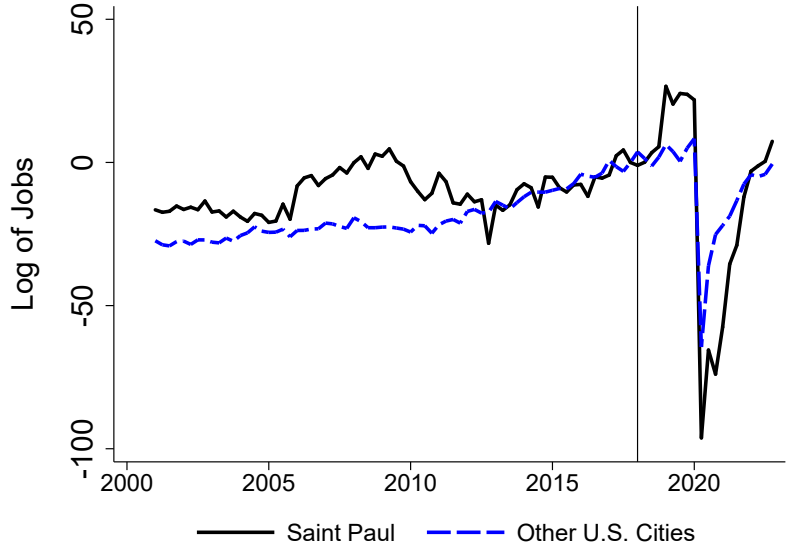


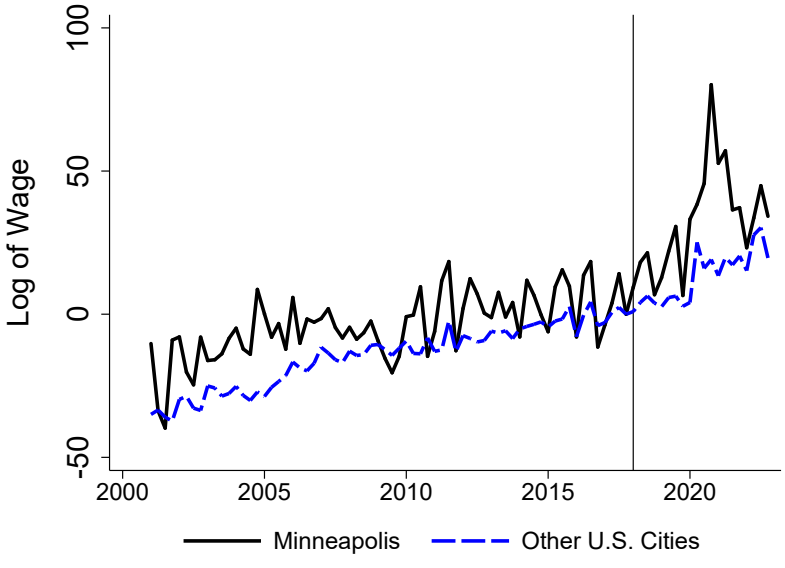


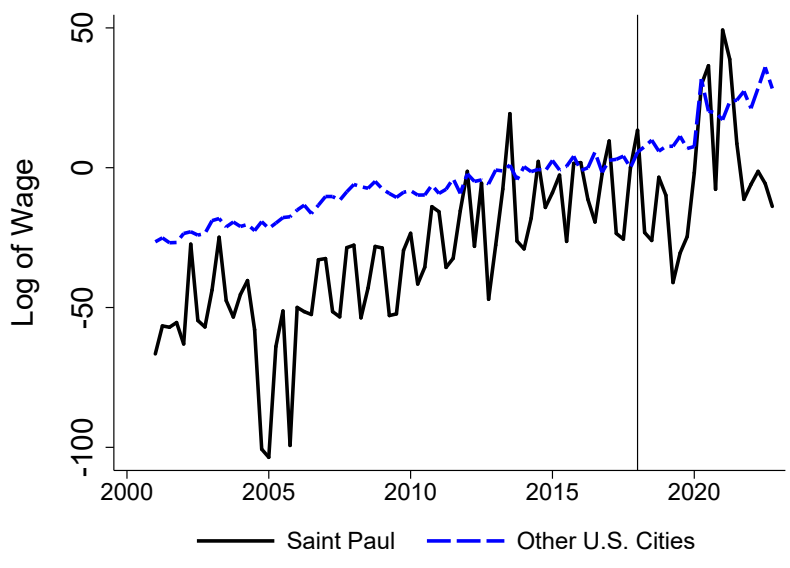
Arts, Entertainment, and Recreation time series

back



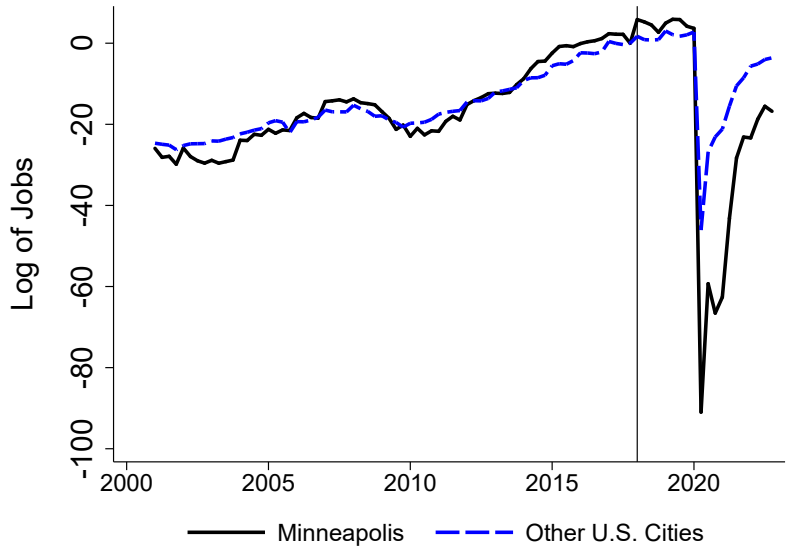


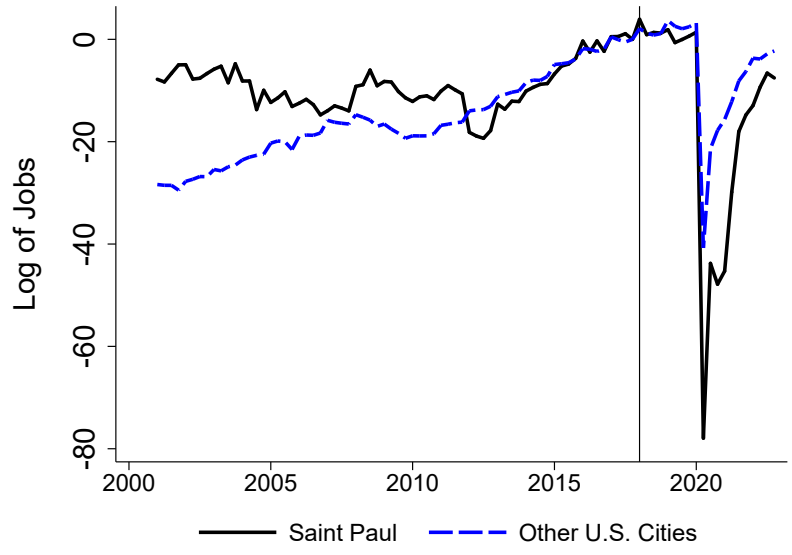


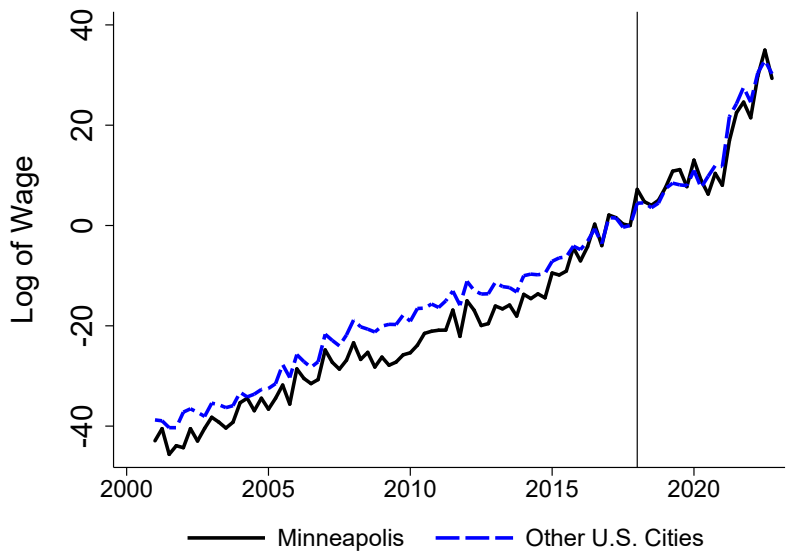


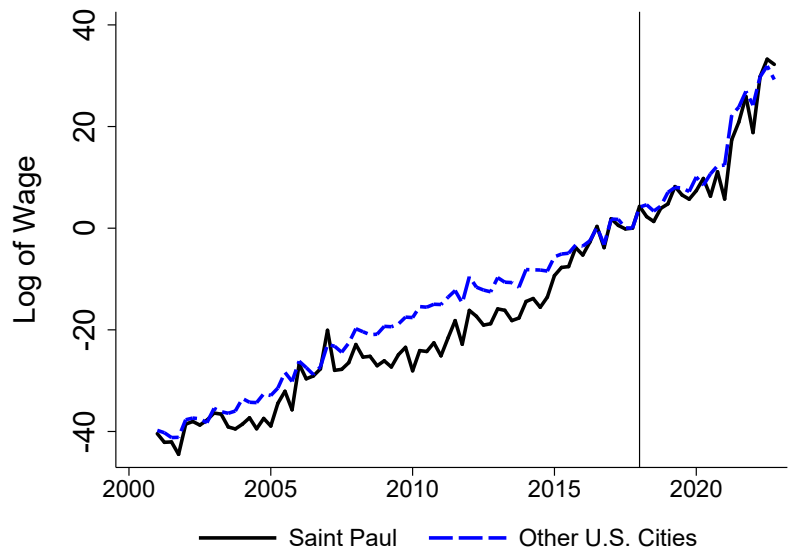
Accommodation and Food time series

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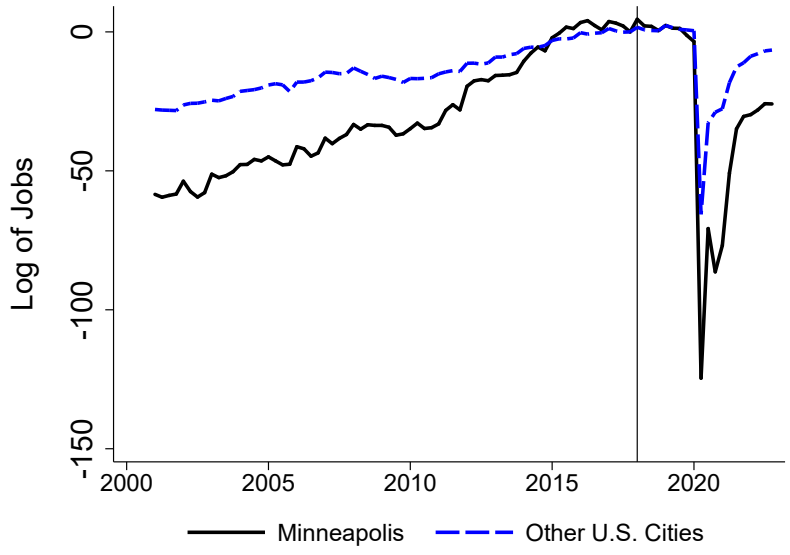


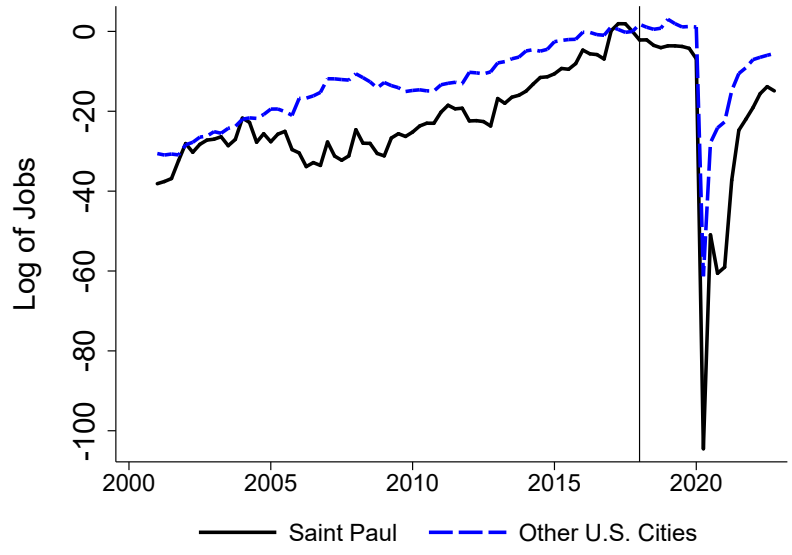


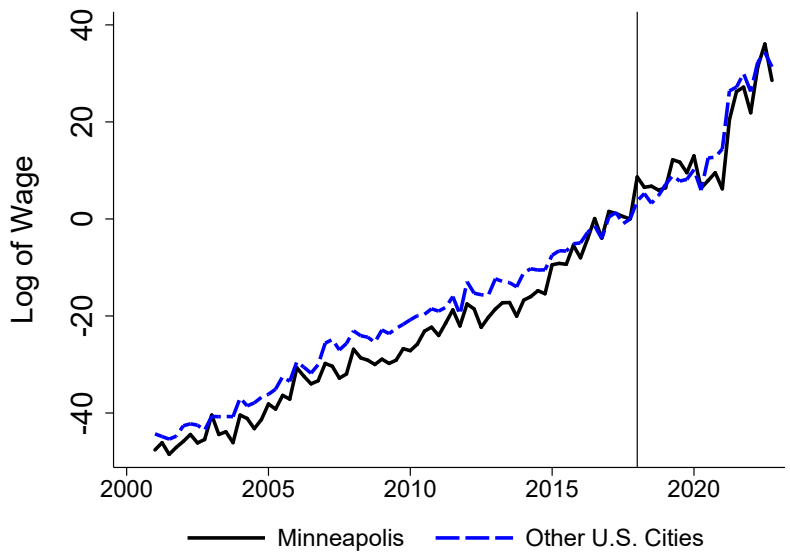


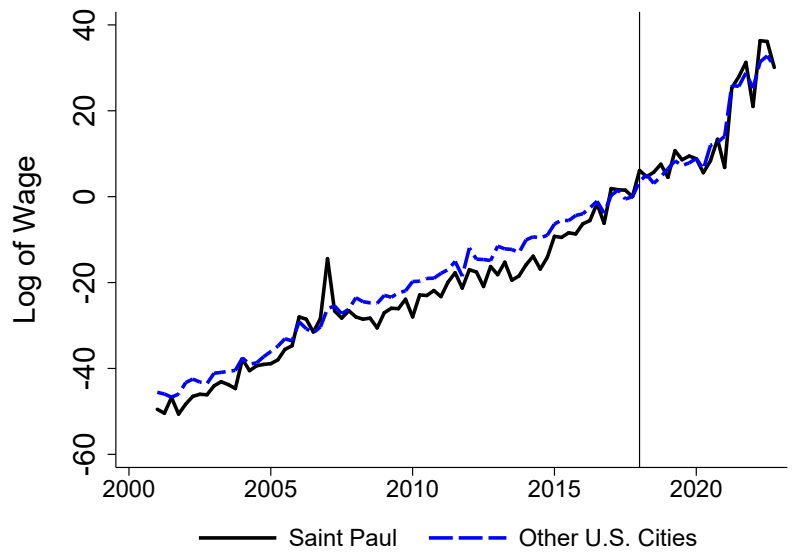
Full-Service Restaurants time series

back



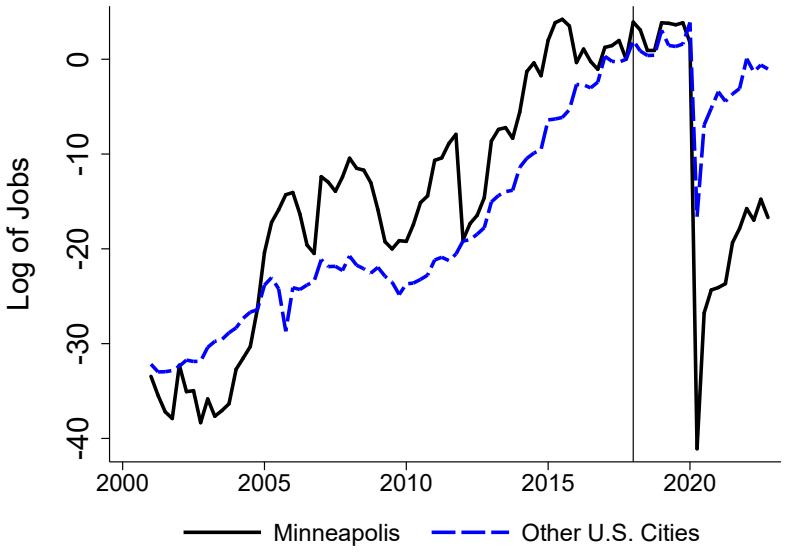


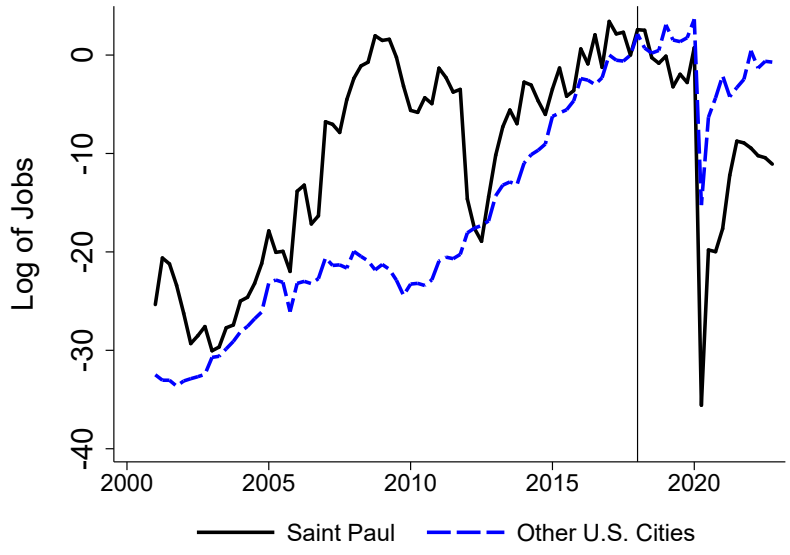


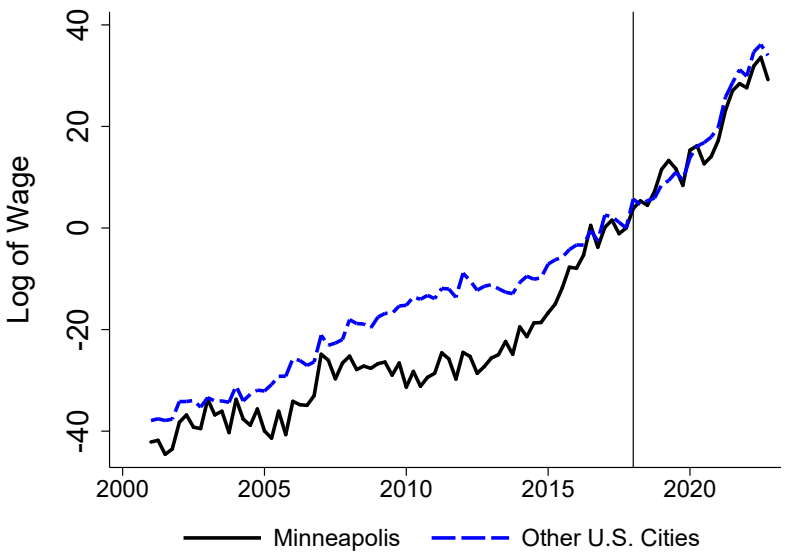


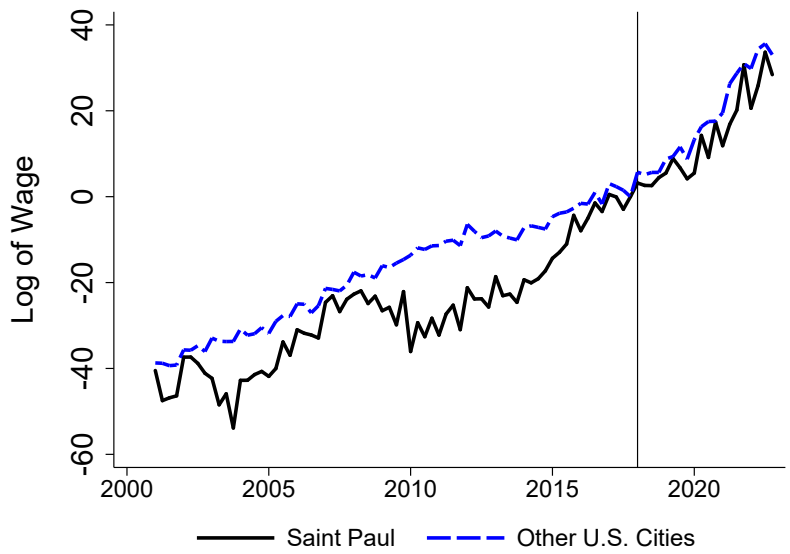
Limited-Service Restaurants time series

back



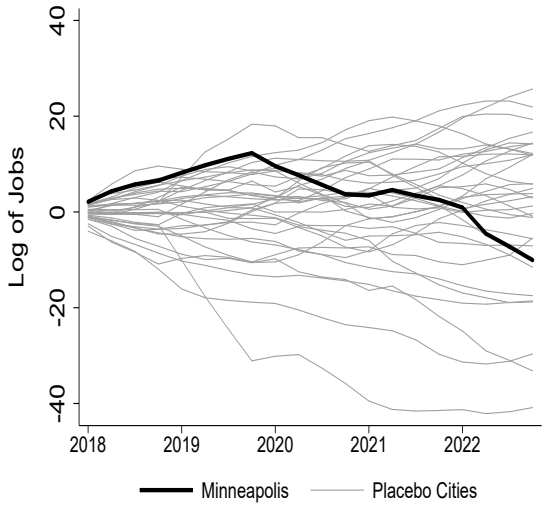




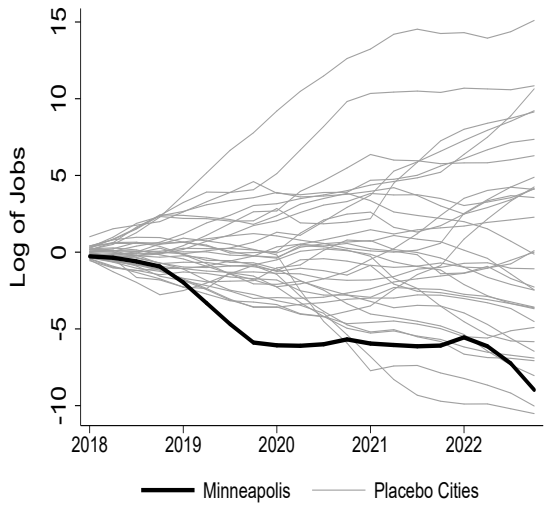


Results for other industries

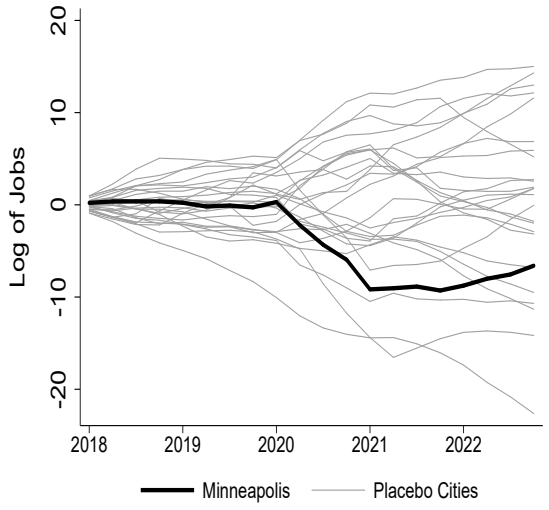
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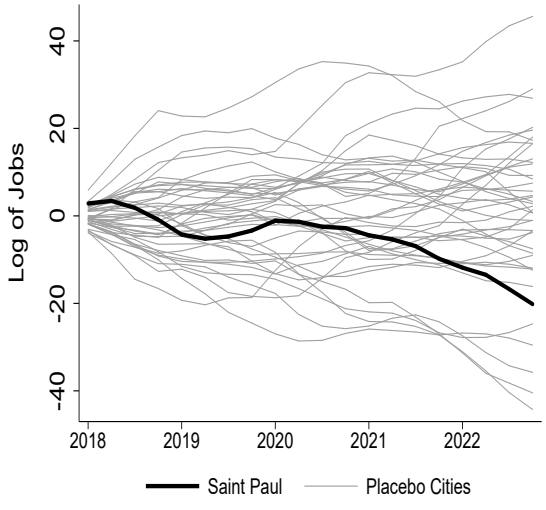
(a) Admin, MPLS



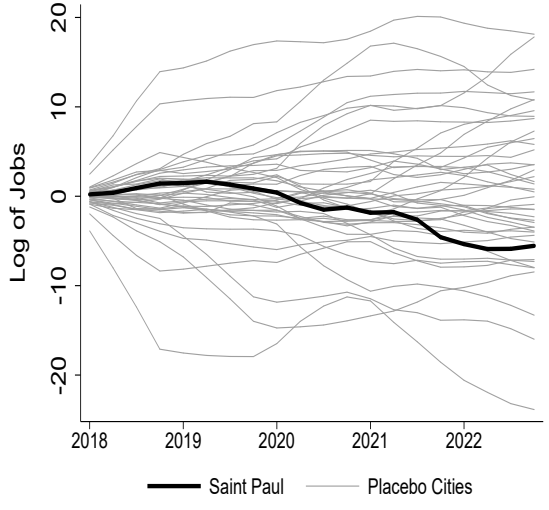
(b) Health, MPLS



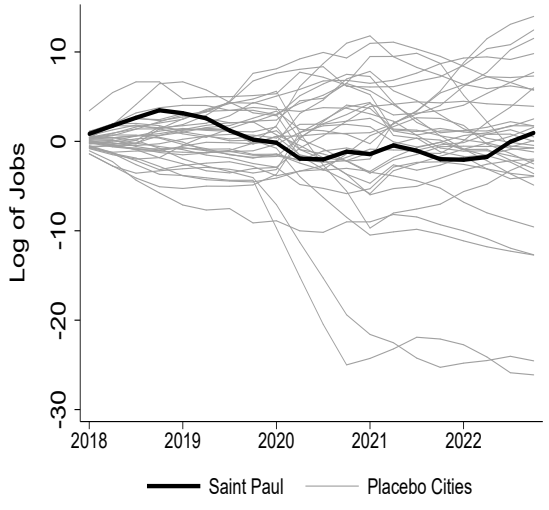
(c) Other Services, MPLS



(d) Admin, SP



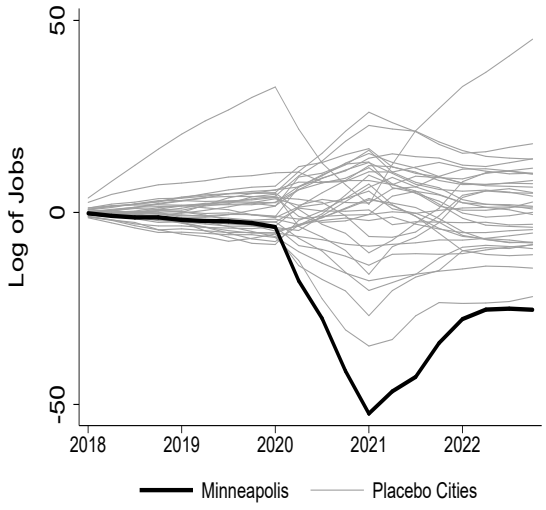
(e) Health, SP



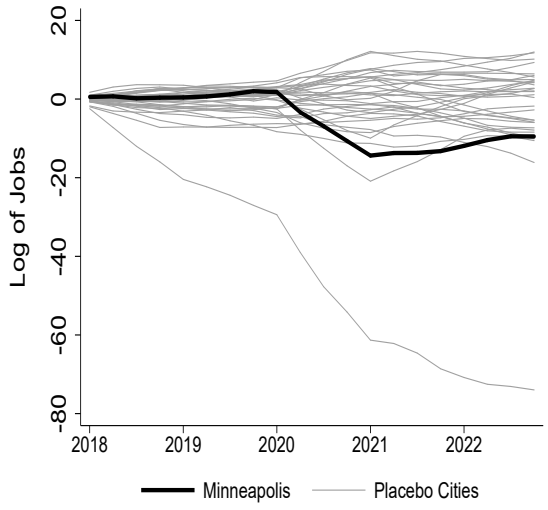
(f) Other Services, SP

Results using time weights

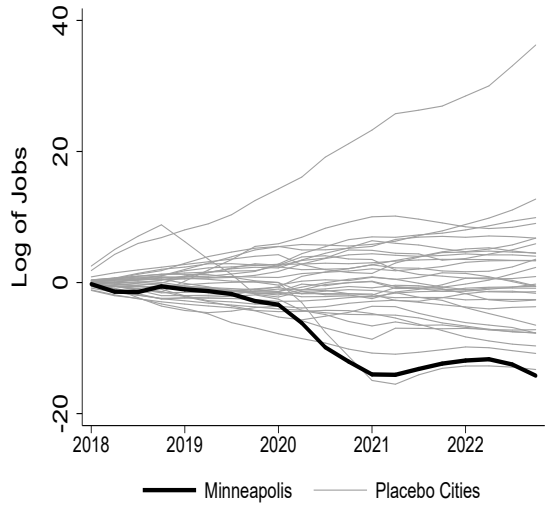
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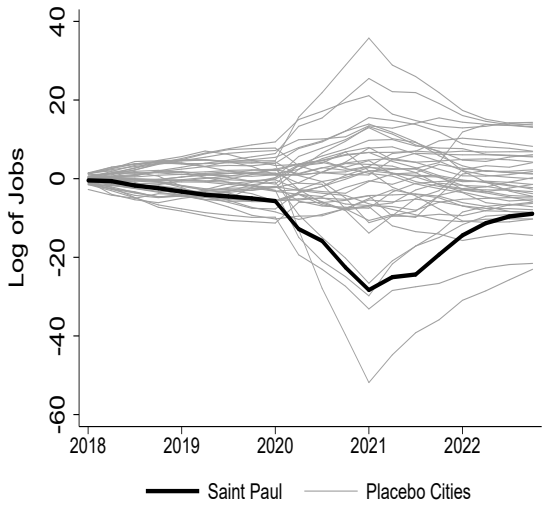
(a) FS Restaurants, MPLS



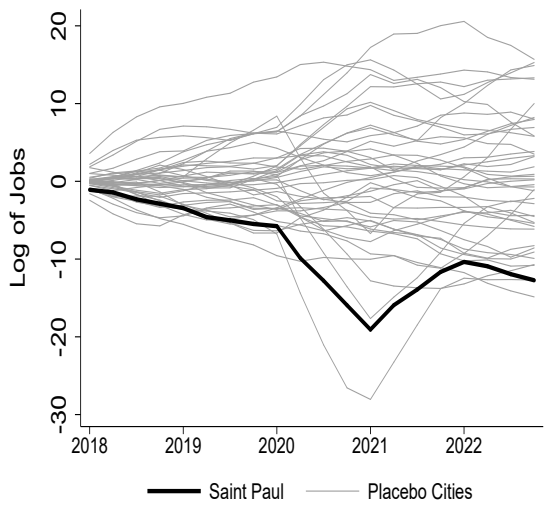
(b) LS Restaurants, MPLS



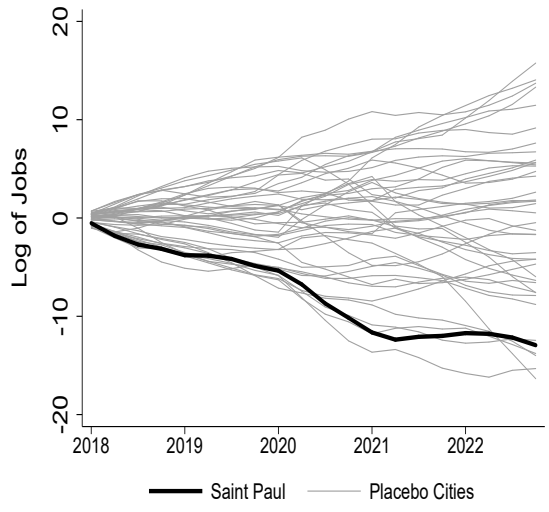
(c) Retail, MPLS



(d) FS Restaurants, SP



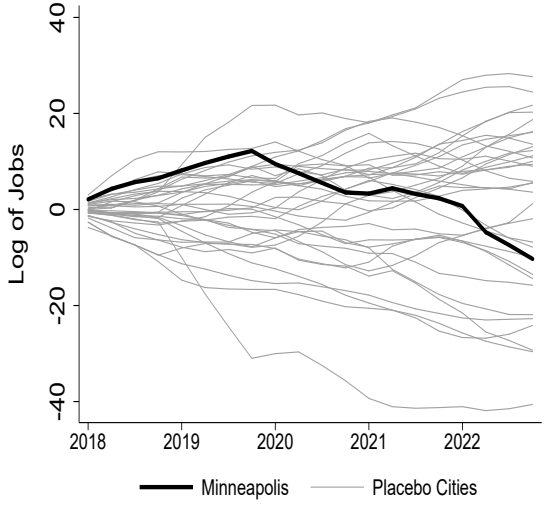
(e) LS Restaurants, SP



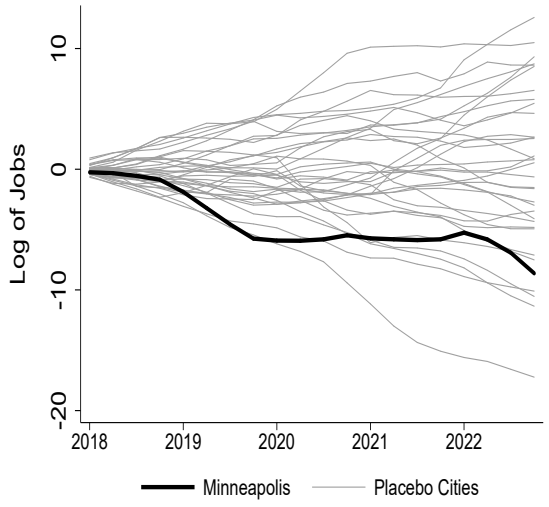
(f) Retail, SP

Results using time weights

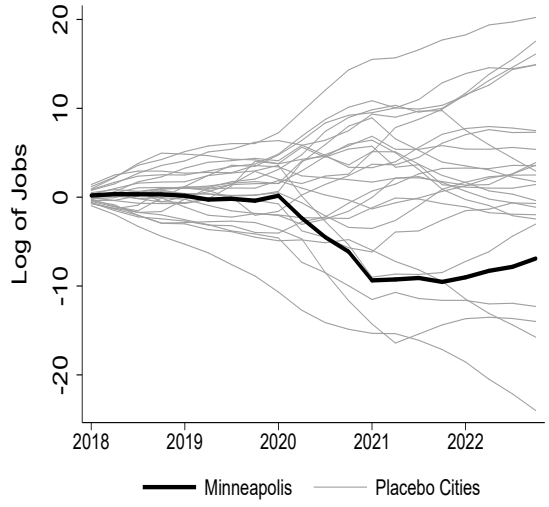
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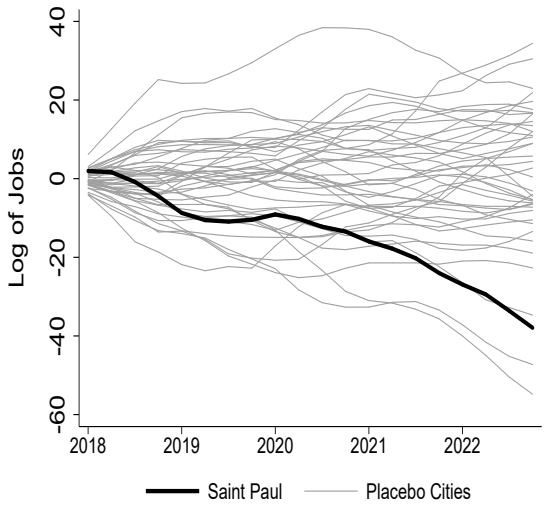
(a) Admin, MPLS



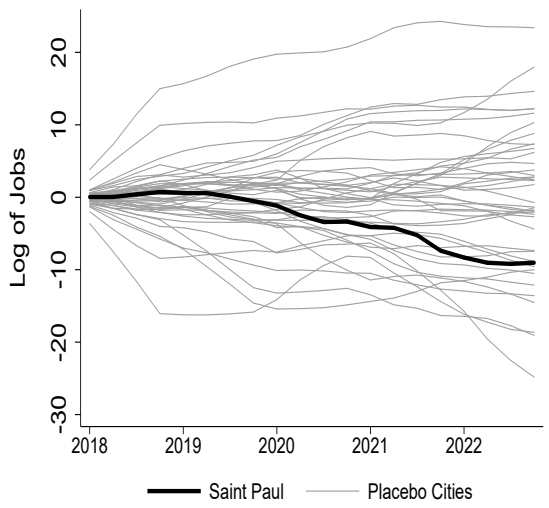
(b) Health, MPLS



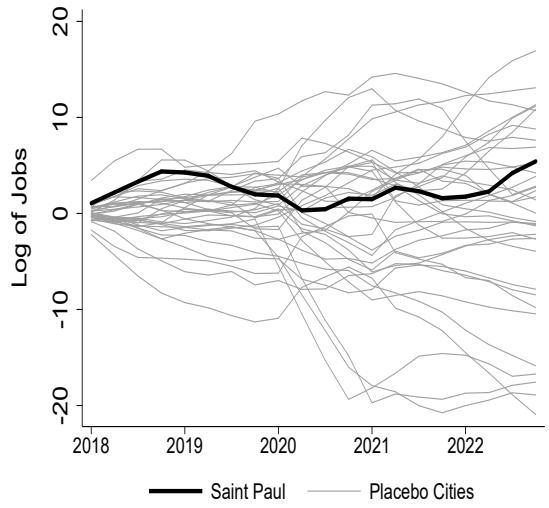
(c) Other Services, MPLS



(d) Admin, SP



(e) Health, SP



(f) Other Services, SP

Assessment of bias in Minneapolis

back

[Coefficients are $100 \cdot g_{2022(4)}$]	Jobs Effect	Bias μ	Bias u	Bias Total
Retail Trade (44)	−8	1	−2	−1
Admin and Support (56)	−10	−1	−2	−3
Health Care and Social Asst (62)	−9	−1	−2	−3
Arts, Entmt, and Recreation (71)	−12	3	−4	−1
Accomm and Food Services (72)	−19	0	−4	−4
Other Services (81)	−7	−4	0	−4
Full-Service Restaurants (722511)	−30	2	−7	−5
Ltd-Service Restaurants (722513)	−17	−3	−3	−6

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

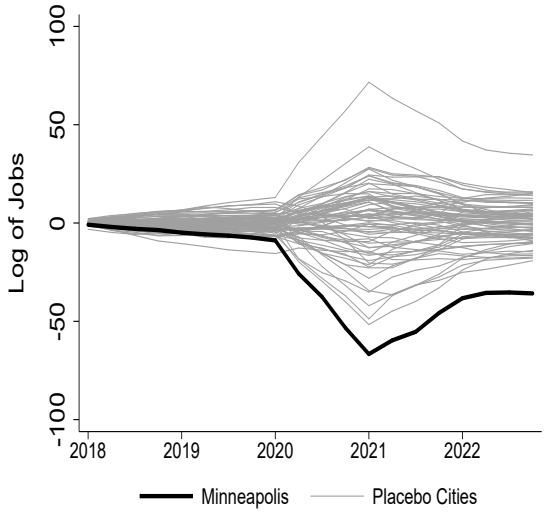
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[Coefficients are $100 \cdot g_{2022(4)}$]	Jobs Effect	Bias μ	Bias u	Bias Total
Retail Trade (44)	−12	0	−3	−3
Admin and Support (56)	−20	4	−6	−2
Health Care and Social Asst (62)	−6	−1	−1	−2
Arts, Entmt, and Recreation (71)	8	−3	2	−1
Accomm and Food Services (72)	−7	−7	0	−7
Other Services (81)	1	4	−1	3
Full-Service Restaurants (722511)	−13	1	−3	−2
Ltd-Service Restaurants (722513)	−9	−5	−1	−6

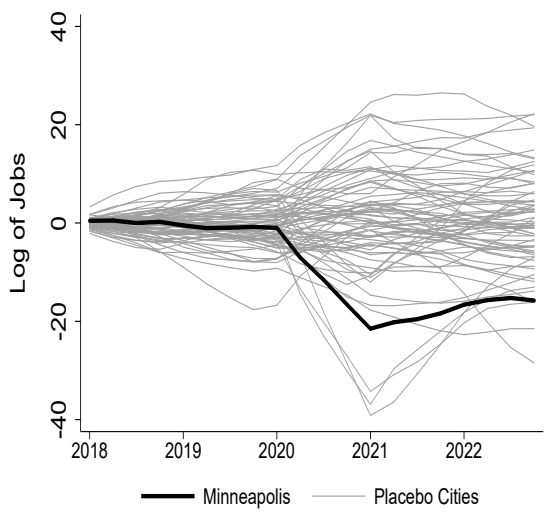
Bias μ: assume $u_{Nt} = \sum_{i=1}^{N_{co}} \omega_i u_{it}, \forall t = 1, ..., T$. Bias u: assume $\sum_{i=1}^{N_{co}} \omega_i \mu_i^k = \mu_N^k$.

Results using all U.S. cities as control

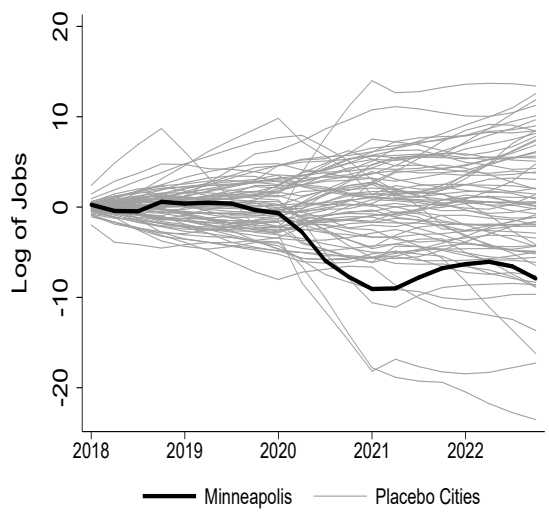
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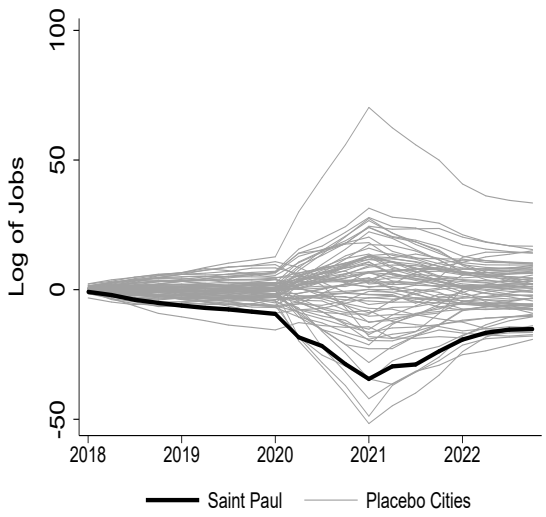
(a) FS Restaurants, MPLS



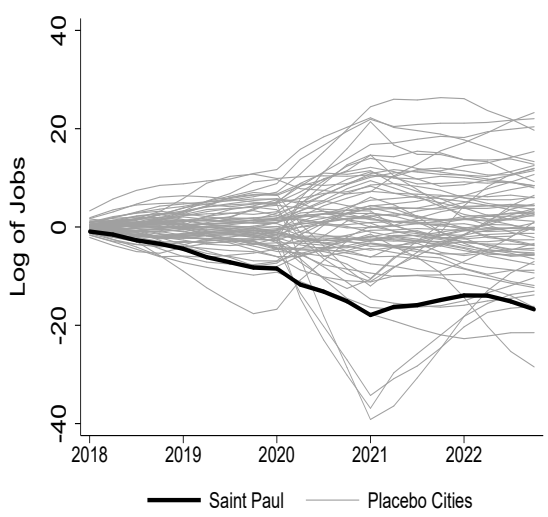
(b) LS Restaurants, MPLS



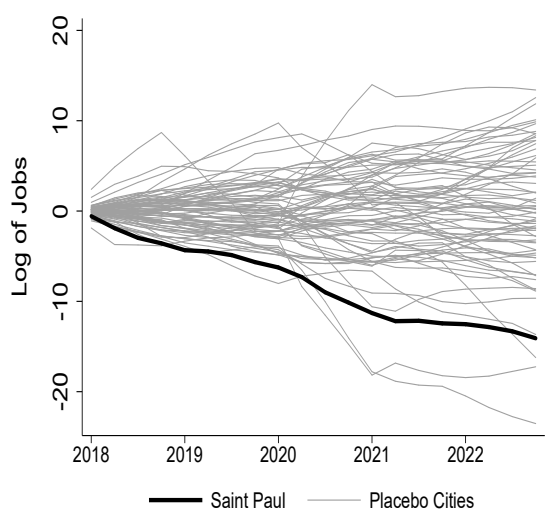
(c) Retail, MPLS



(d) FS Restaurants, SP



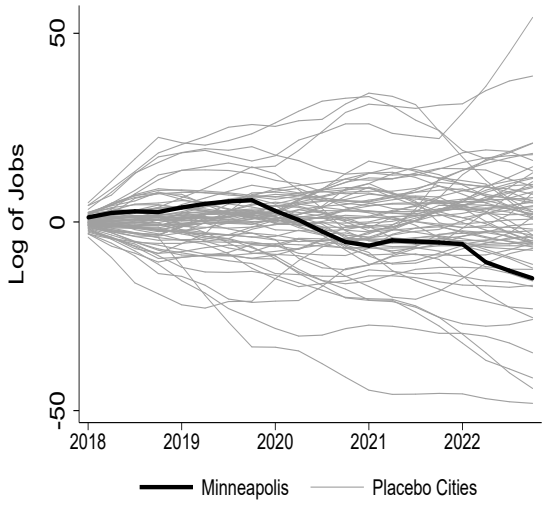
(e) LS Restaurants, SP



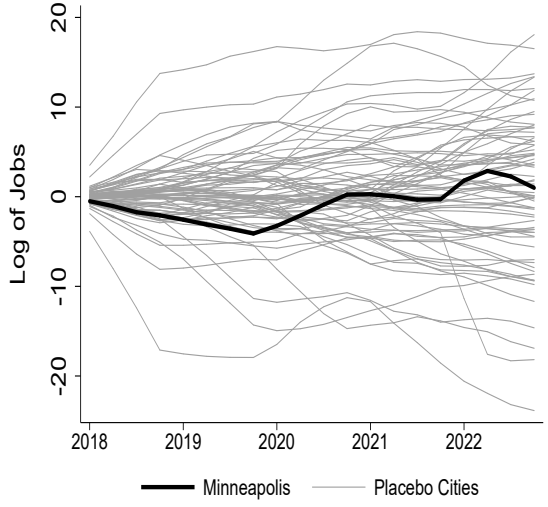
(f) Retail, SP

Results using all U.S. cities as control

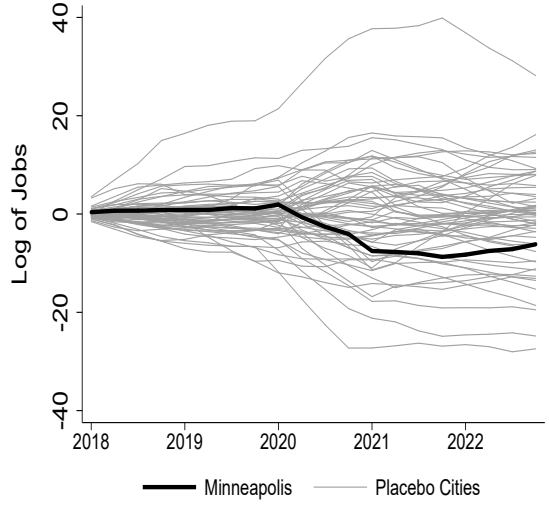
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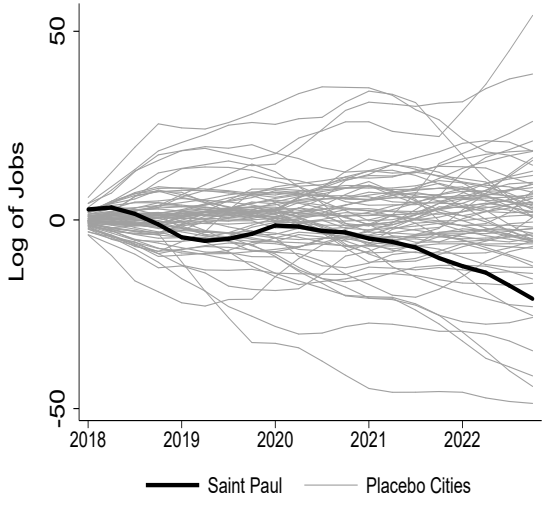
(a) Admin, MPLS



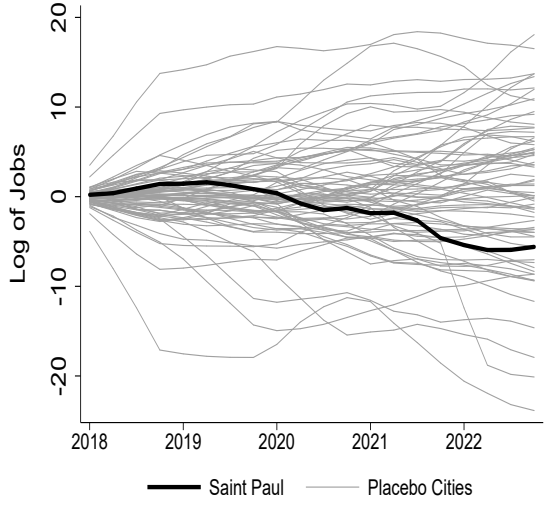
(b) Health, MPLS



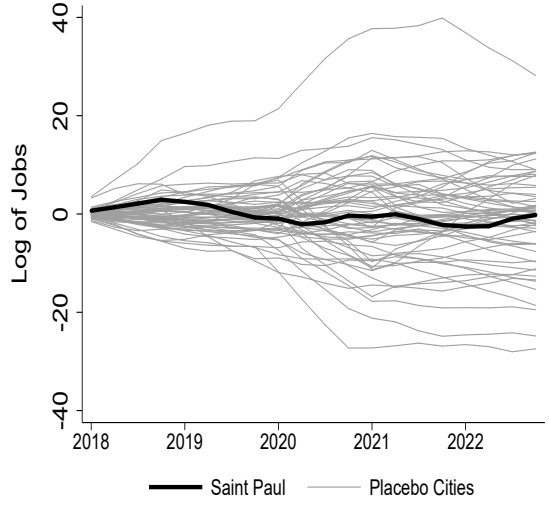
(c) Other Services, MPLS



(d) Admin, SP



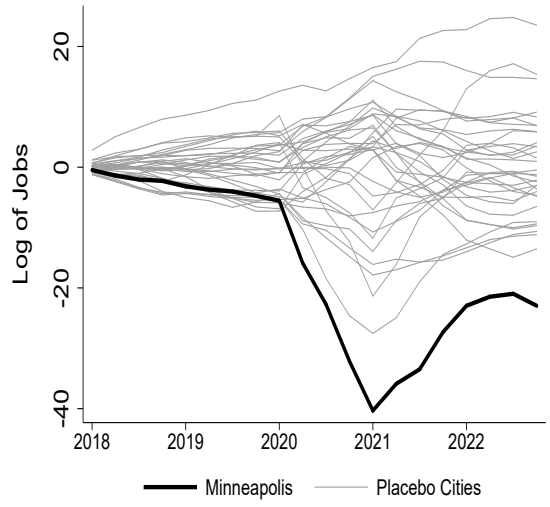
(e) Health, SP



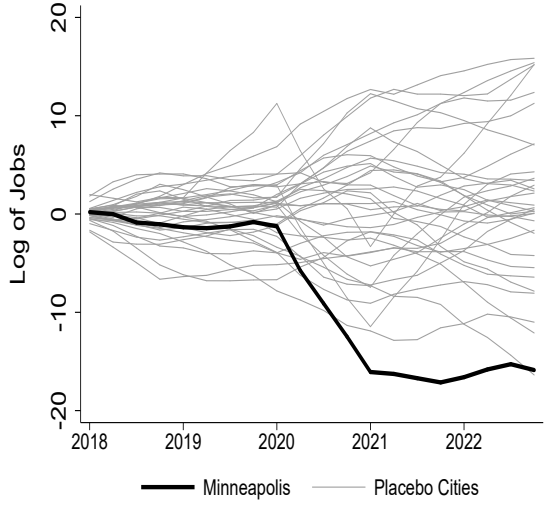
(f) Other Services, SP

Results adjusting for workplace mobility

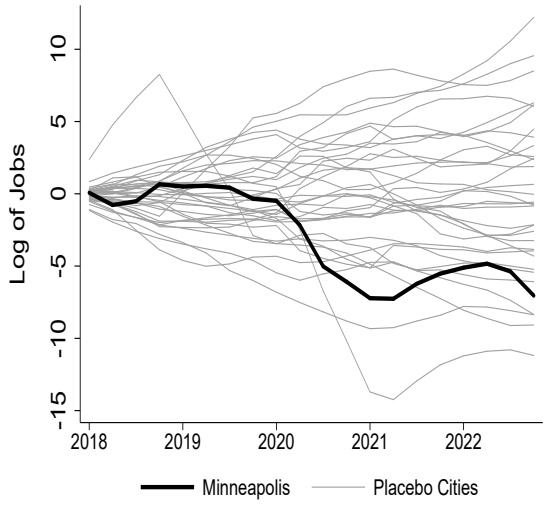
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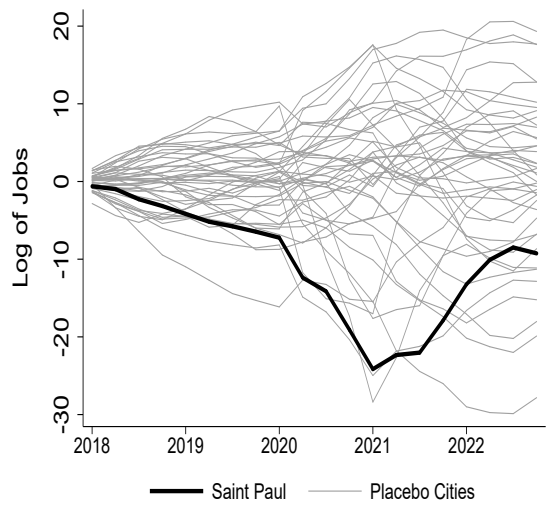
(a) FS Restaurants, MPLS



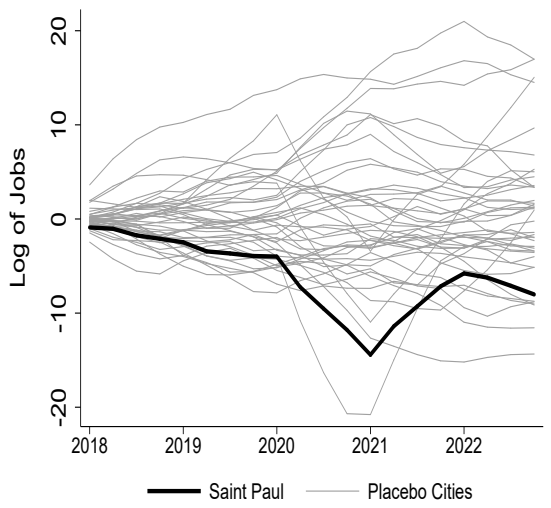
(b) LS Restaurants, MPLS



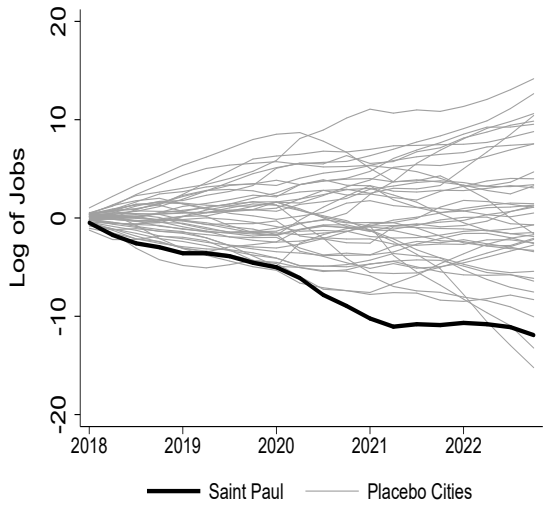
(c) Retail, MPLS



(d) FS Restaurants, SP



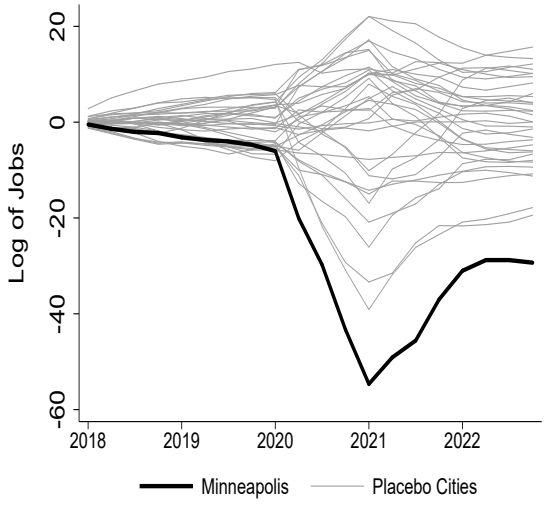
(e) LS Restaurants, SP



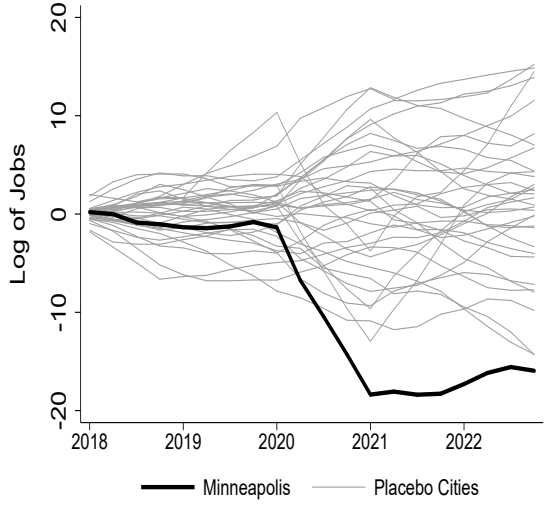
(f) Retail, SP

Results adjusting for violent protests

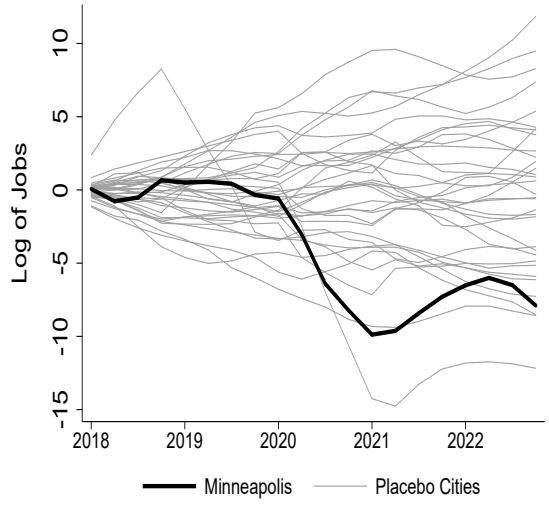
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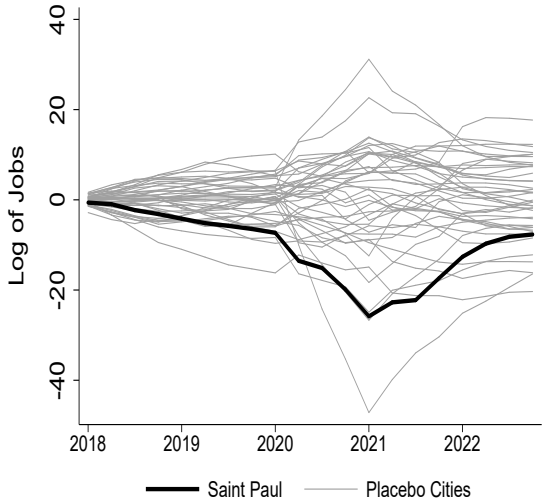
(a) FS Restaurants, MPLS



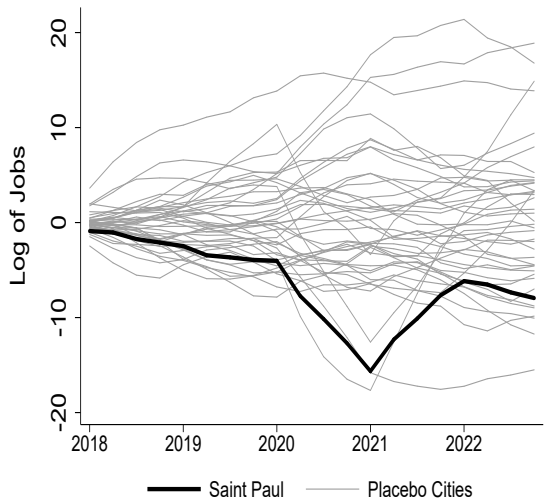
(b) LS Restaurants, MPLS



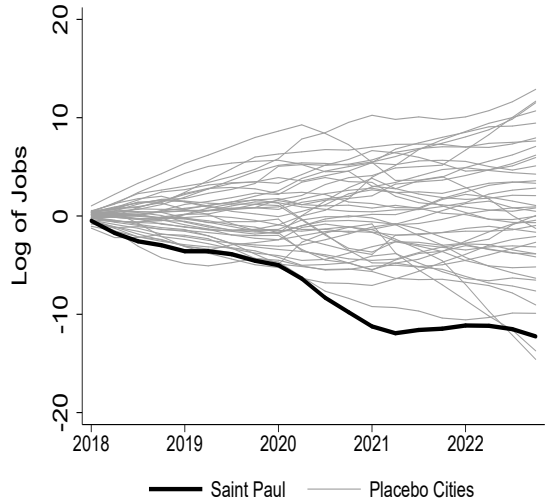
(c) Retail, MPLS



(d) FS Restaurants, SP



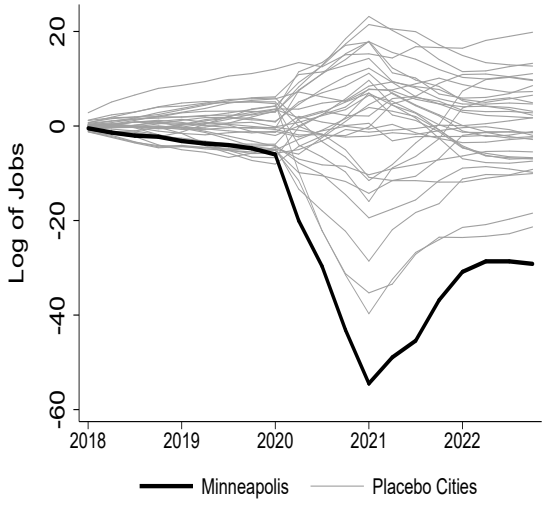
(e) LS Restaurants, SP



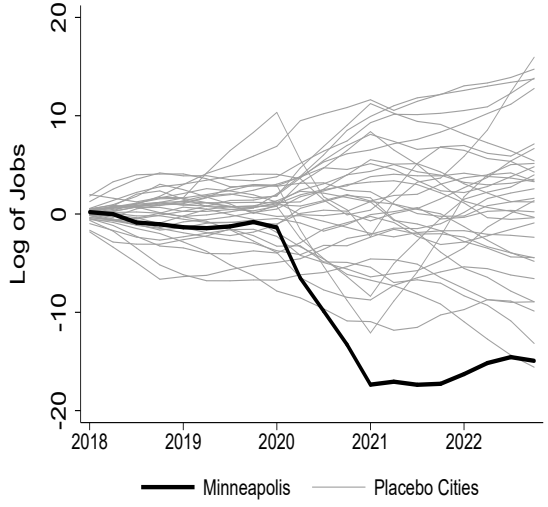
(f) Retail, SP

Results adjusting for total protests

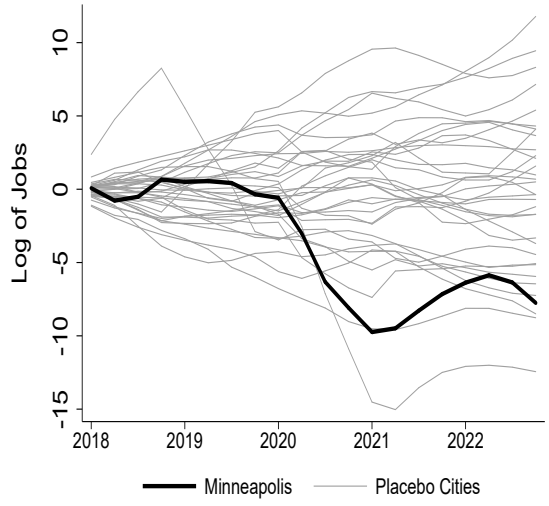
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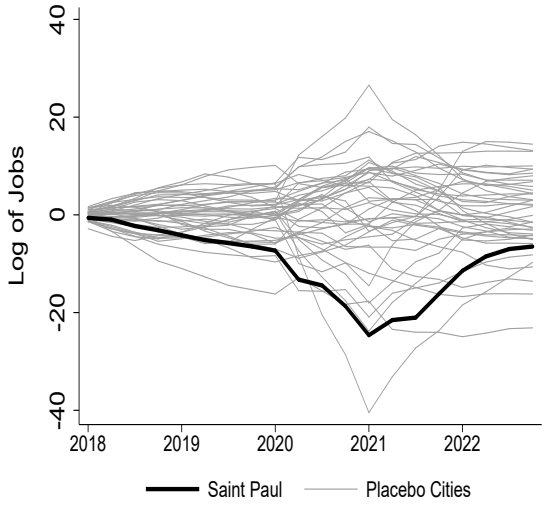
(a) FS Restaurants, MPLS



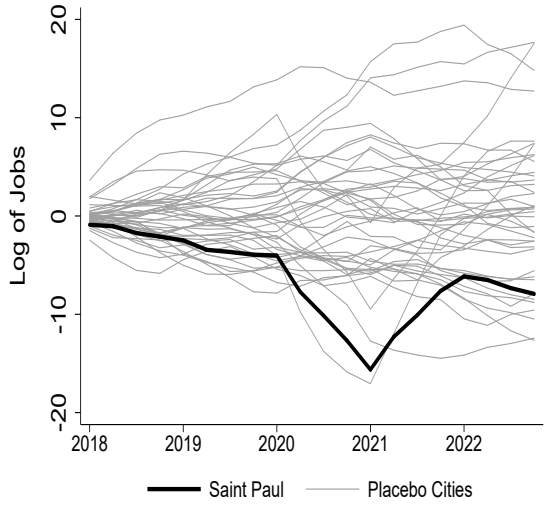
(b) LS Restaurants, MPLS



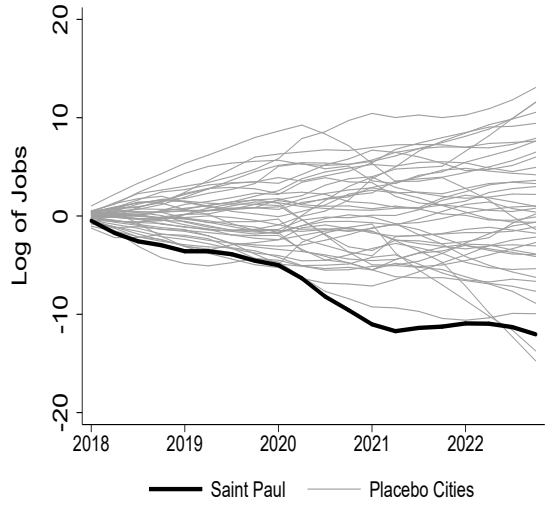
(c) Retail, MPLS



(d) FS Restaurants, SP



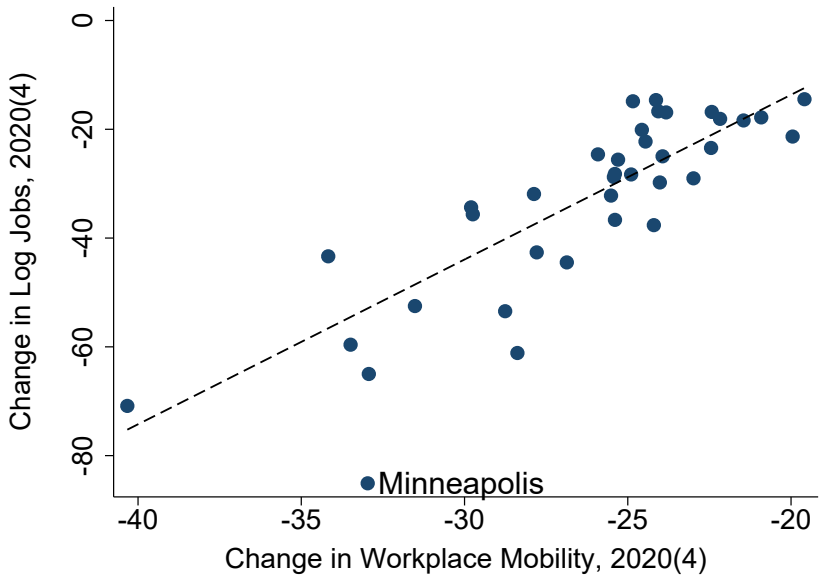
(e) LS Restaurants, SP

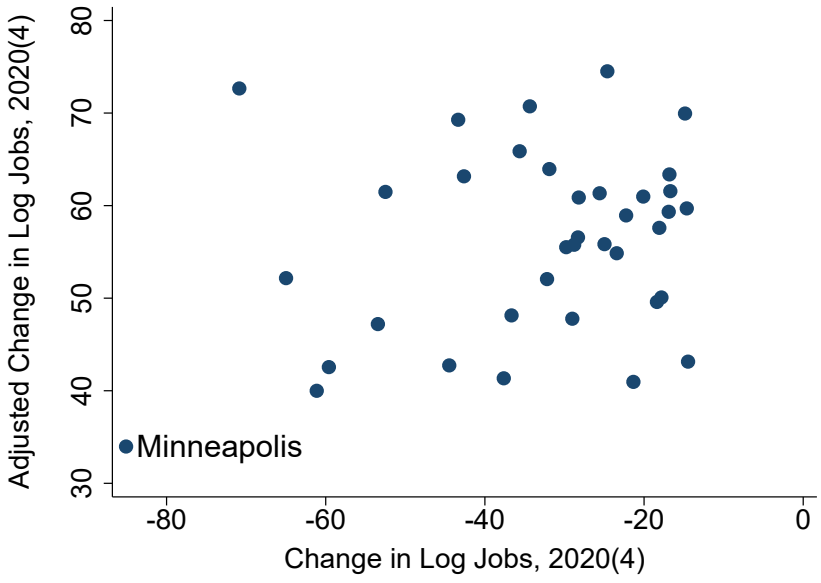


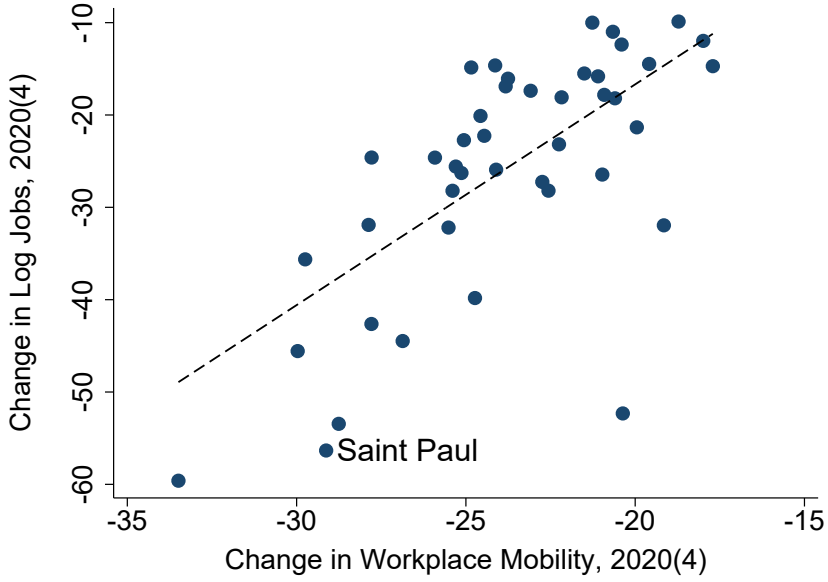
(f) Retail, SP

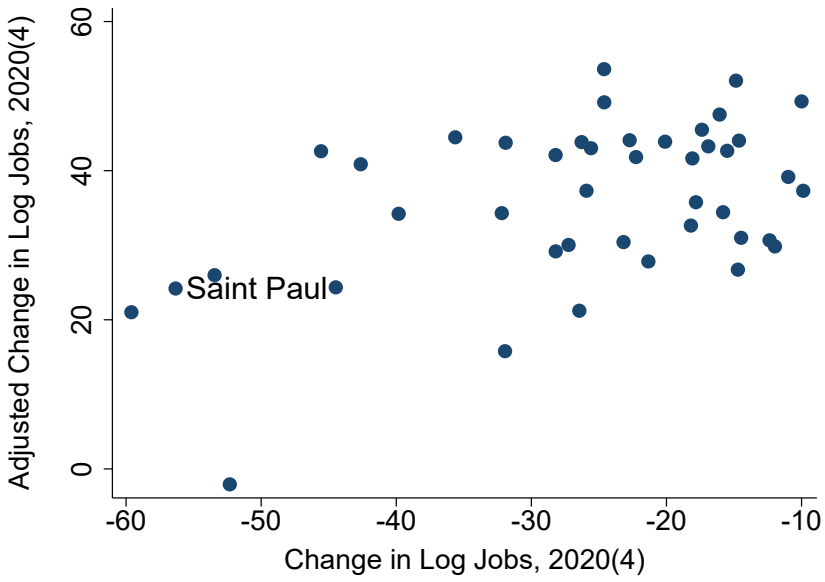
Adjustment for workplace mobility not significant

back



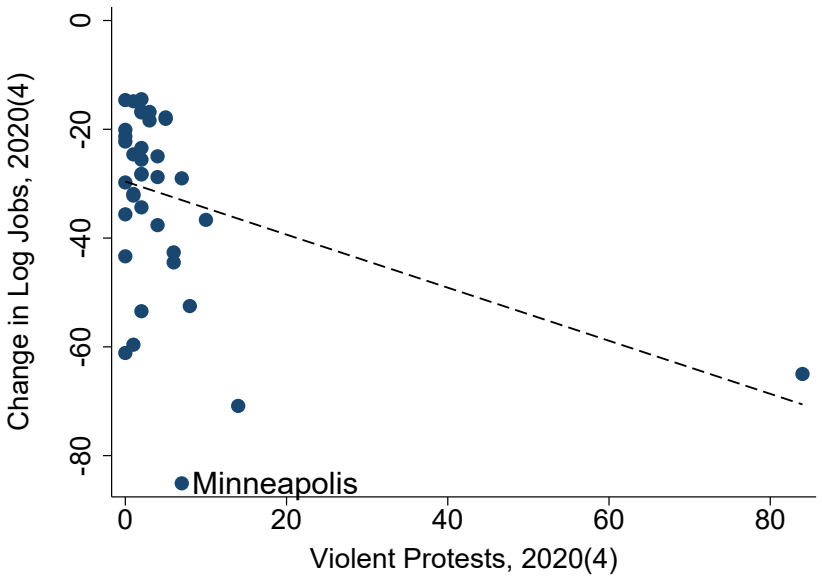


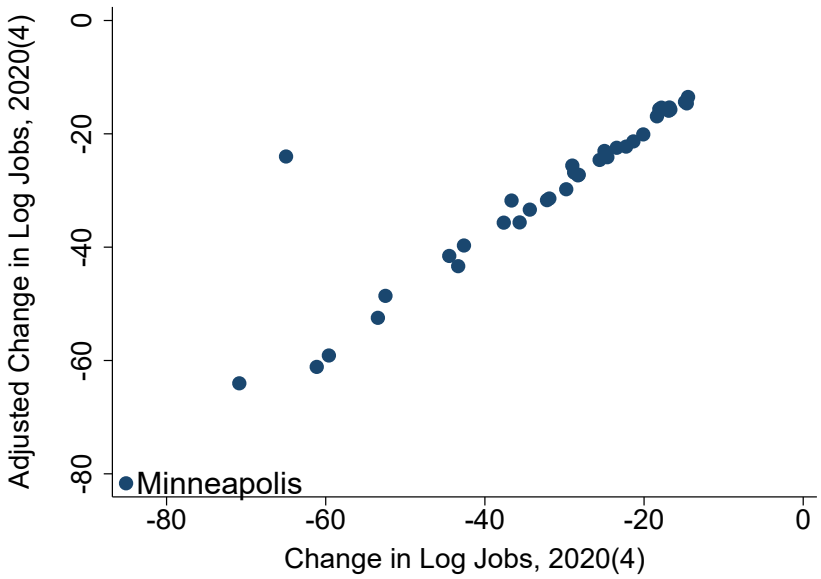


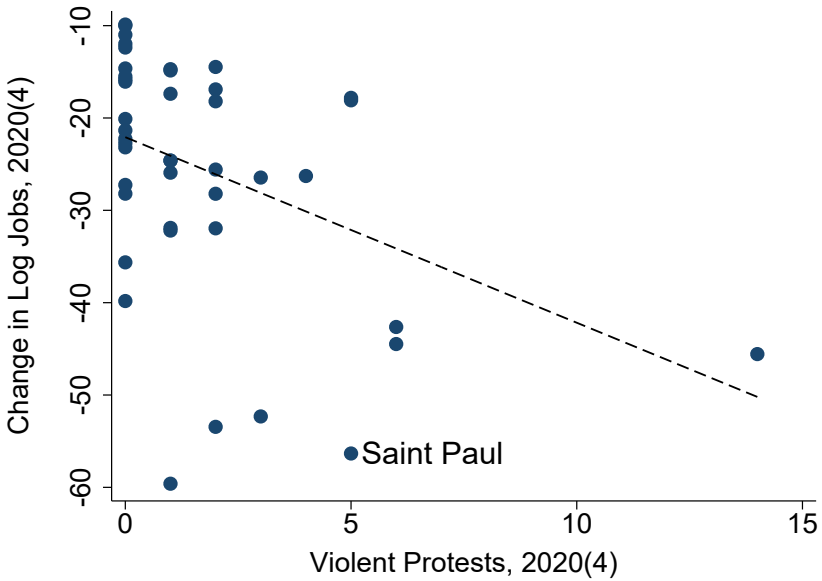


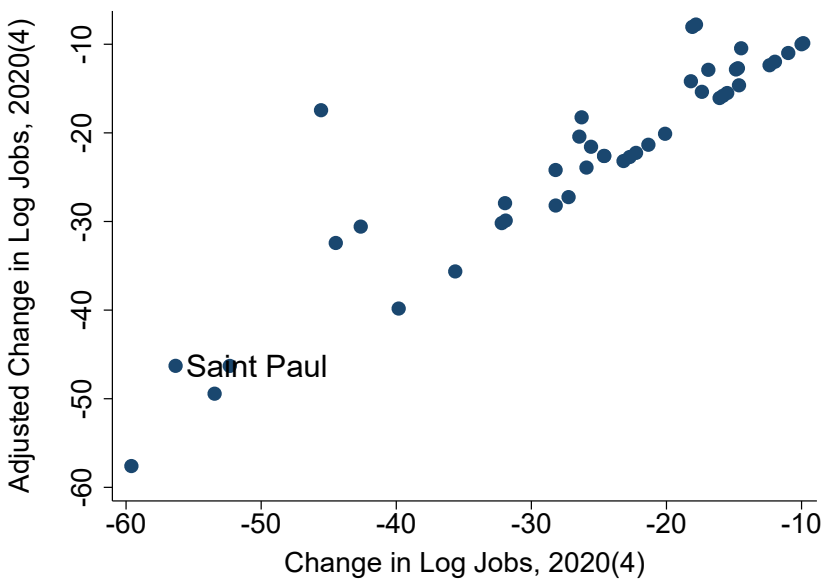
Adjustment for violent protests not significant

back



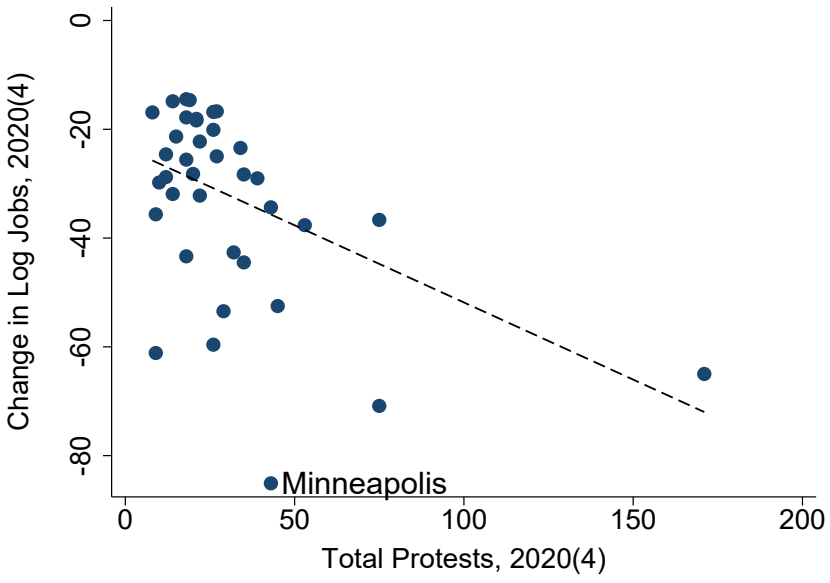


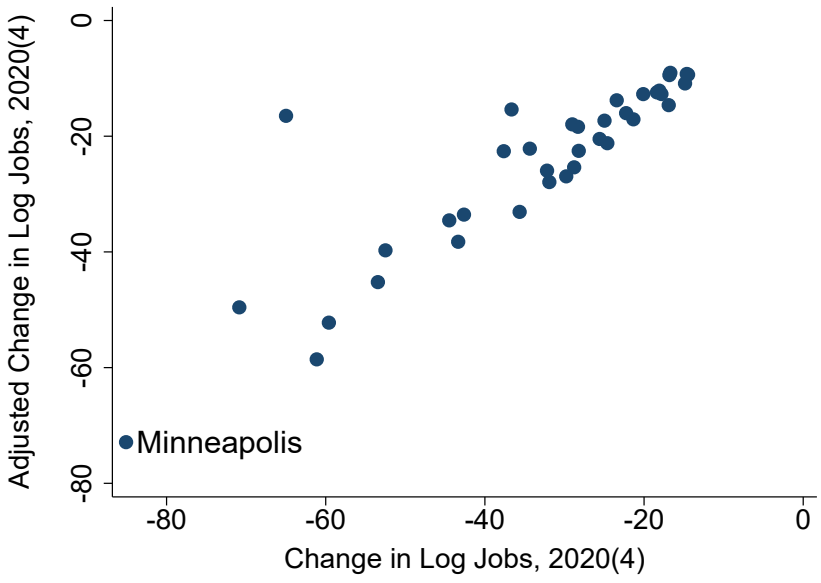


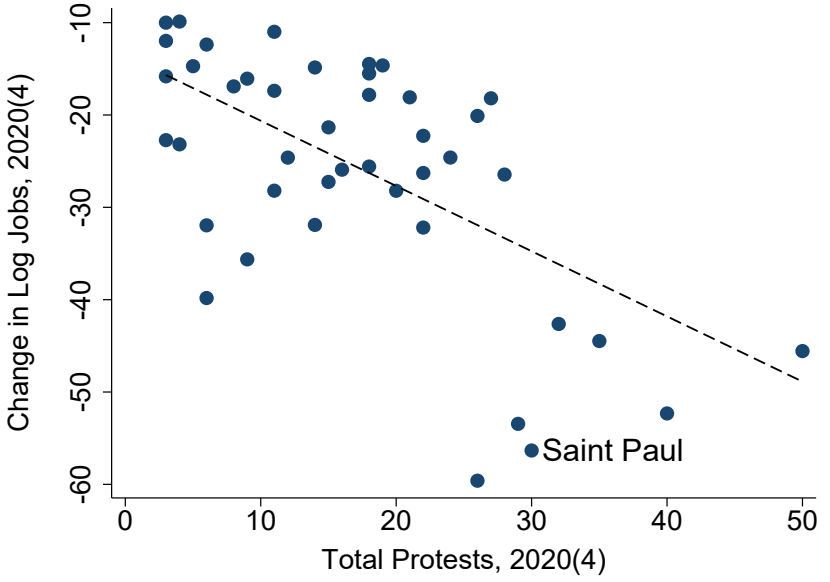


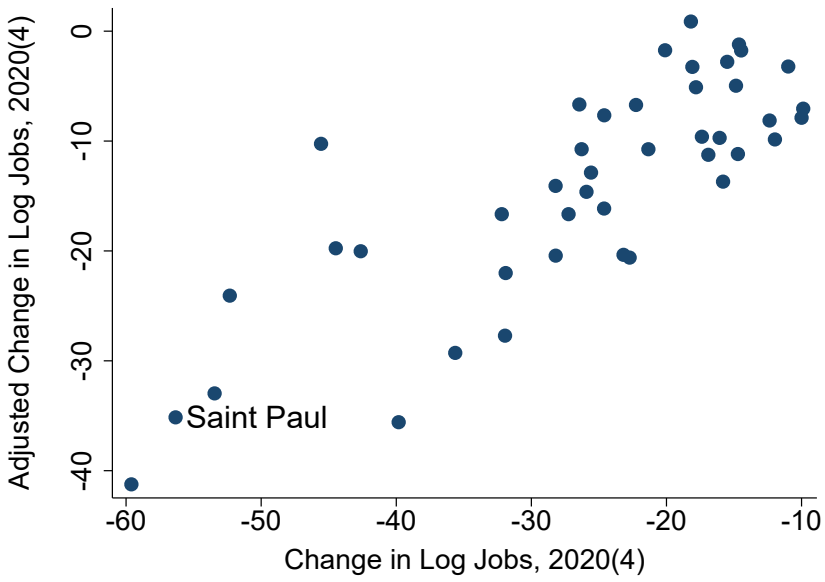
Adjustment for total protests not significant

back









Adding lags of growth for Minneapolis

back

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	7.5	−10.8	−12.7	−8.1
	(1.1)	(1.4)	(0.5)	(11.3)
2019	8.4	−15.3	−16.1	−11.5
	(2.0)	(0.6)	(0.4)	(7.1)
2020	6.0	−14.4	−13.3	−13.6
	(11.7)	(1.5)	(2.5)	(4.6)
2021	8.5	−14.7	−15.8	−15.6
	(4.8)	(1.8)	(1.2)	(3.1)

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

Expanding the sample to 6 years for Minneapolis

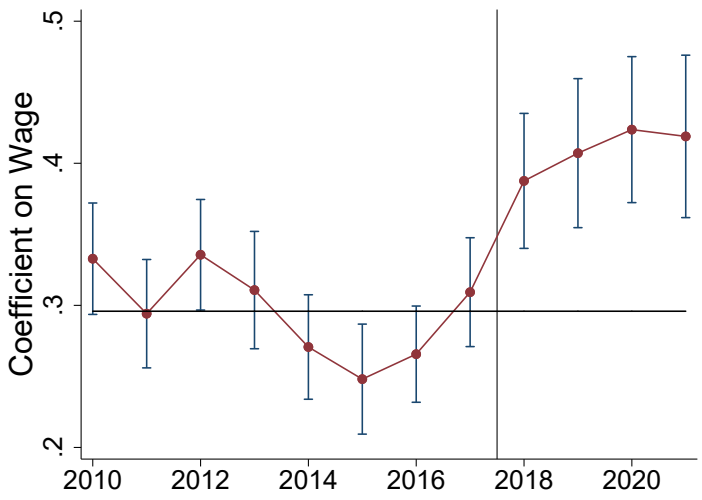
back

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	9.9	−9.1	−10.9	−8.2
	(0.1)	(4.9)	(2.1)	(13.0)
2019	11.9	−13.8	−14.4	−11.8
	(0.0)	(1.2)	(1.0)	(6.4)
2020	13.6	−12.6	−11.4	−13.3
	(0.0)	(2.7)	(4.4)	(4.4)
2021	13.1	−12.7	−14.0	−16.3
	(0.0)	(3.5)	(2.3)	(2.0)

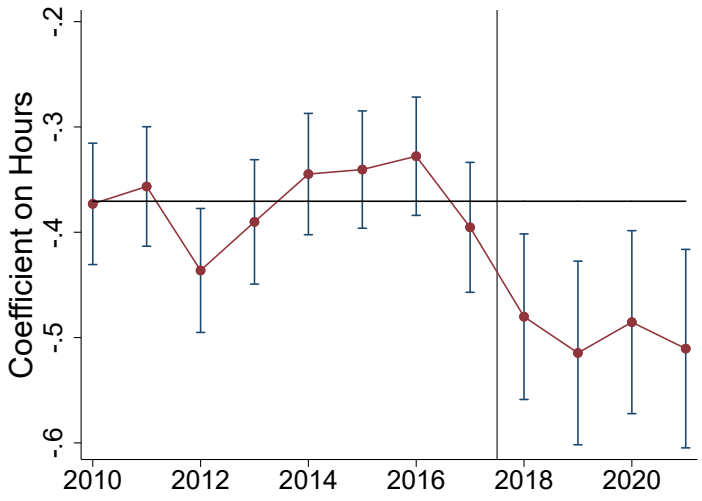
Note: p-values in parentheses from standard errors clustered at the establishment level.

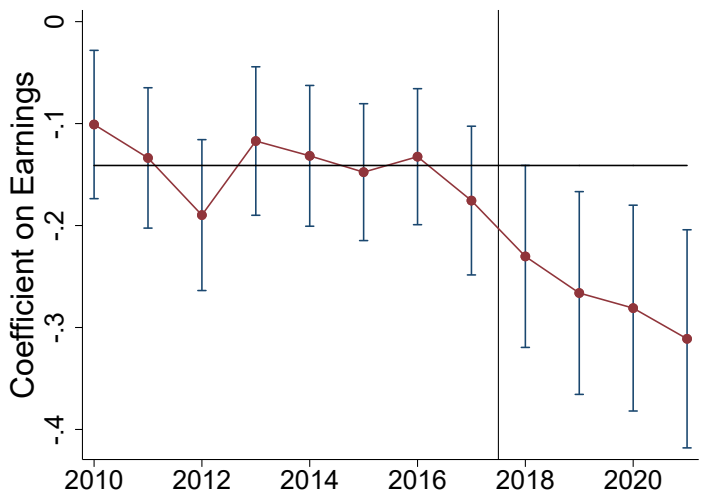
Establishment coefficients for Minneapolis

back









Adding lags of growth for Saint Paul

back

[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	5.6	−10.9	−12.4	−12.8
	(13.4)	(8.3)	(5.2)	(7.1)
2019	3.4	−23.5	−22.0	−23.3
	(52.3)	(0.2)	(0.4)	(0.7)
2020	2.5	−24.9	−24.1	−23.1
	(65.5)	(0.1)	(0.2)	(0.9)
2021	10.8	−13.2	−14.5	−15.7
	(7.0)	(9.4)	(7.7)	(9.1)

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

Expanding the sample to 6 years for Saint Paul

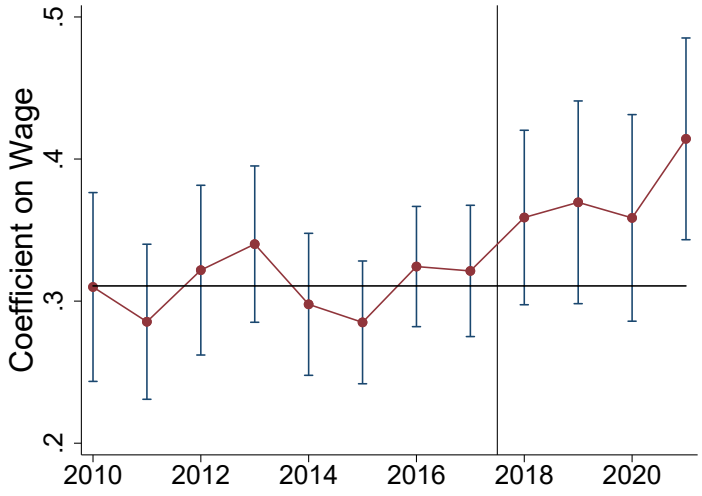
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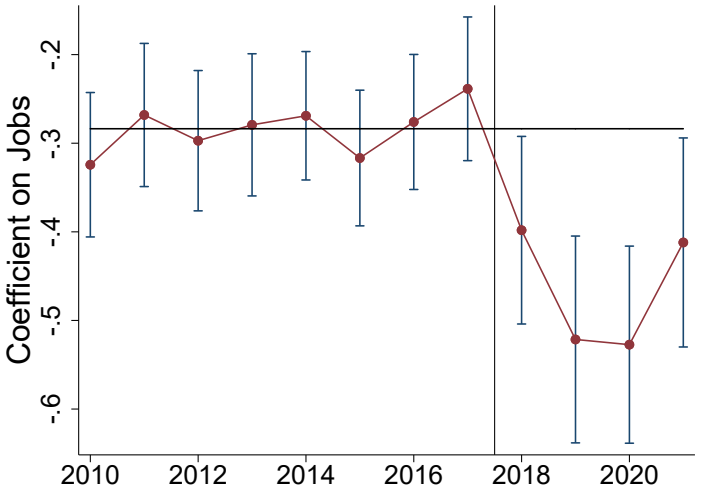
[Entries are $100 \cdot \tau_t$]	Wage	Jobs	Hours	Earnings
2018	4.5	−11.7	−13.2	−12.3
	(22.9)	(6.4)	(4.1)	(9.3)
2019	5.5	−24.1	−22.7	−23.8
	(23.2)	(0.1)	(0.2)	(0.4)
2020	4.4	−24.6	−24.5	−22.4
	(34.5)	(0.1)	(0.1)	(0.7)
2021	10.0	−13.1	−15.1	−13.6
	(3.8)	(8.2)	(5.5)	(12.9)

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

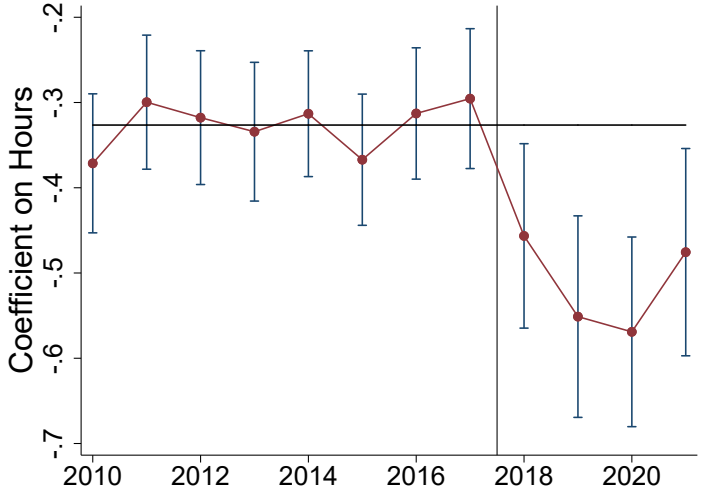
Establishment coefficients for Saint Paul

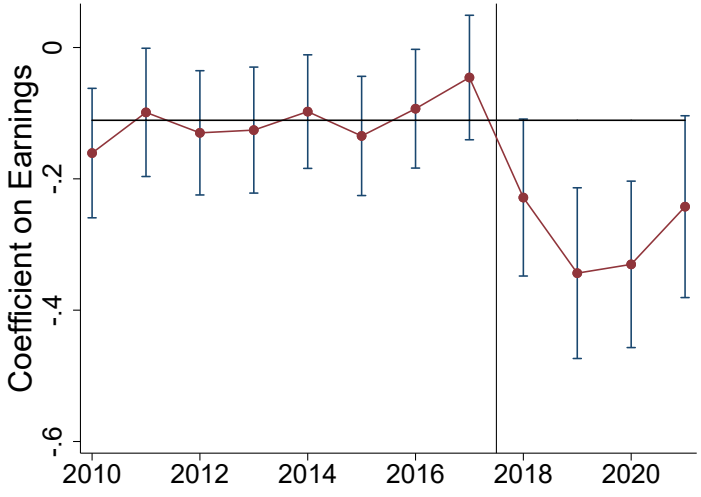
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Exposure statistics by demographic group

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

Econometric methodology: cross section of workers

back

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

$$Y_{it} = \sum_{s} \gamma_{st} X_{ist} + \sum_{t=2018}^{2021} \tau_t \left(\overline{\text{GAP}}_{it-3} \cdot d_t \right) + \tau_0 \overline{\text{GAP}}_{it-3} + \rho Y_{it-1} + u_{it},$$

arc percent change over 3 years:

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

gap is workers' establishment gap in wages over 3 years:

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

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

Alternative methodology: cross section of workers

back

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

$$Y_{it} = \sum_{s} \gamma_{st} X_{ist} + \sum_{t=2018}^{2021} \tau_t \left(\text{GAP}_{it-3} \cdot d_t \right) + \tau_0 \text{GAP}_{it-3} + \rho Y_{it-1} + u_{it},$$

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}

back

	Minneapolis			Saint Paul		
[Entries are $100 \cdot \tau_t$]	Wage	Hours	Earnings	Wage	Hours	Earnings
2018	0.3	−1.0	−2.1	−0.4	−8.0	−6.8
	(67.9)	(58.1)	(25.1)	(66.6)	(0.0)	(0.3)
2019	10.2	−6.5	−4.8	3.0	−11.4	−8.2
	(0.0)	(0.0)	(1.0)	(0.2)	(0.0)	(0.0)
2020	12.5	−15.5	−14.5	5.7	−16.2	−12.2
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
2021	8.8	3.7	−2.7	10.9	−9.2	−4.7
	(0.0)	(5.7)	(19.4)	(0.0)	(0.0)	(6.2)

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

Detailed calculations

back

1. Time Series.
   - Average: $\sum_s \tau_s \nu_s$ for significant τ_s in 2021.
   - Most Negative: $\sum_{\text{rest.}} \tau_{\text{rest.}} \nu_{\text{rest.}} / \sum_{\text{rest.}} \nu_{\text{rest.}}$ in 2021.
2. Cross Section (establishments).
   - Average: $\tau^e \times$ Mean GAP across all years.
   - Most Negative: $\tau^e \times$ Max GAP across all years.

Period before the minimum wage increase

back

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

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

$$y_0 = z\left(\phi m_0^{\frac{\sigma-1}{\sigma}} + (1-\phi)\ell_0^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}, \quad p_0 = y_0^{-\frac{1}{\varepsilon}}, \quad w_0 = \bar{w}\ell_0^{\frac{1}{\theta}}.$$

- Entry if:

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

Period after the minimum wage increase

back

- 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:

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

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

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:

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

$$\partial \log \ell / \partial \log w = -\left[\alpha(\phi, .)\varepsilon + (1 - \alpha(\phi, .))\sigma \right].$$

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:

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

$$\partial \log \ell / \partial \log w = -\left[\alpha(\phi,.)\varepsilon + (1-\alpha(\phi,.))\sigma \right].$$

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

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

Baseline parameters

back

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

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

Labor market power

back

	τ_ℓ/τ_w	$\frac{\partial \log \ell}{\partial \log w}$	$W_1/W_0 - 1$	$L_1/L_0 - 1$	Ratio of Entry
Baseline	-1.01	-1.07	0.09	-0.25	2.28
$\theta = 5$	-0.77	-1.12	0.07	-0.20	2.33
$\theta = 2$	-0.45	-1.19	0.06	-0.12	2.46

- With $\theta < \infty$, τ_ℓ/τ_w less informative about $\frac{\partial \log \ell}{\partial \log w}$.
- Reject imperfect labor markets & min wage increase small enough.

Other model experiments

back

	τ_ℓ/τ_w	$\frac{\partial \log \ell}{\partial \log w}$	$W_1/W_0 - 1$	$L_1/L_0 - 1$	Ratio of Entry
Baseline	-1.01	-1.07	0.09	-0.25	2.28
$\delta = 0$	-1.01	-1.07	0.09	-0.08	∞
$f = 0.07$	-0.96	-1.07	0.09	-0.15	1.26
$f = \bar{f} w^{1/2}$	-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