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Risk avoidance, offsetting community effects, and COVID-19: Evidence from an indoor political rally

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Abstract
The Centers for Disease Control and Prevention (CDC) deem large indoor gatherings without social distancing the "highest risk" activity for COVID-19 contagion. On June 20, 2020, President Donald J. Trump held his first mass campaign rally following the US coronavirus outbreak at the indoor Bank of Oklahoma arena. In the weeks following the event, numerous high-profile national news outlets reported that the Trump rally was "more than likely" the cause of a coronavirus surge in Tulsa County based on time series data. This study is the first to rigorously explore the impacts of this event on social distancing and COVID-19 spread. First, using data from SafeGraph Inc, we show that while non-resident visits to census block groups hosting the Trump event grew by approximately 25 percent, there was no decline in net stay-at-home behavior in Tulsa County, reflecting important offsetting behavioral effects. Then, using data on COVID-19 cases from the CDC and a synthetic control design, we find little evidence that COVID-19 grew more rapidly in Tulsa County, its border counties, or in the state of Oklahoma than each's estimated counterfactual during the five-week post-treatment period we observe. Difference-in-differences estimates further provide no evidence that COVID-19 rates grew faster in counties that drew relatively larger shares of residents to the event. We conclude that offsetting risk-related behavioral responses to the rally—including voluntary closures of restaurants and bars in downtown Tulsa, increases in stay-at-home behavior, displacement of usual activities of weekend inflows, and smaller-than-expected crowd attendance—may be important mechanisms.

Keywords COVID-19 · Social distancing · Indoor events · Offsetting behavioral effects · Risk avoidance · Trump

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1 Introduction

"Coronavirus surge in Tulsa 'more than likely' linked to Trump rally"
-*New York Times* headline, July 10, 2020[1]

"Large in-person gatherings where it is difficult for individuals to remain spaced at least six feet apart and attendees travel from outside the local area" are the "highest risk" category of event or gathering for the spread of COVID-19, according to Centers for Disease Control and Prevention (CDC) guidelines (Centers for Disease Control & Prevention 2020a). Indoor gatherings are viewed as problematic as indoor temperature, airflow and humidity are conducive to the spread of COVID-19 (Allen and Marr 2020; Contini and Costabile 2020; Mittal et al. 2020; Setti et al. 2020). Between March 15, 2020 and June 1, 2020, nearly all states and the District of Columbia banned large indoor gatherings such as sporting events and theatre performances (Dave et al. 2020b; Mervosh et al. 2020).[2]

Despite the high-risk categorization of indoor gatherings, some states chose to roll back bans on indoor events. For example, as of June 22, 2020 most counties in Nebraska were allowed to hold indoor events as long as attendance did not exceed the maximum of 50 percent of building capacity or 10,000 individuals (Treisman 2020). Studies of sporting events in March 2020 suggest that additional professional and college level basketball games and additional professional hockey games strongly contributed to the spread of COVID-19 (Ahammer et al. 2020; Carlin et al. 2021).[3] However, evidence from these events comes from a time period where COVID-19 was circulating less widely – for example, Tulsa County, Oklahoma, which will be a point of focus in the analyses to follow had 32 new recorded cases on April 1, 2020 and over four times as many new recorded cases on June 20, 2020 (our time period of interest), meaning that the large estimates from sporting events may be a lower bound for viral spread due to indoor events during time periods where the virus is circulating more widely.

In this study, we examine a special case of President Donald J. Trump's re-election campaign rally, held on June 20, 2020 at the Bank of Oklahoma (BOK) Center and

[1] For other similar headlines from around this date, see, for example, articles at Forbes (https://www.forbes.com/sites/tommybeer/2020/07/08/trump-rally-more-than-likely-led-to-coronavirus-spike-in-tulsa-health-official-says/#6495ca4924e0), the *Washington Post* (https://www.washingtonpost.com/nation/2020/07/09/trump-tulsa-rally-coronavirus/), and CNN (https://www.cnn.com/2020/07/08/us/tulsa-covid-trump-rally-contact-tracers-trnd/index.html).

[2] Many large indoor events were cancelled earlier than this. For example, on Thursday March 11, the National Basketball Association (NBA) cancelled a game between the Utah Jazz and Oklahoma City Thunder after a single player tested positive for COVID-19. The game had been scheduled to be played indoors at the Oklahoma City Chesapeake Energy Arena. Later that evening, the NBA suspended the remainder of the 2020 basketball season (Aschburner 2020).

[3] There are also studies demonstrating spread of COVID-19 at indoor events utilizing contact tracing; however it is difficult to discern what the counterfactual level of transmission would have been (James et al. 2020; Nishiura et al. 2020). Work by Dave et al. (2020b) studies the Black Lives Matter protests (large outdoor events) and estimates a population level effect which includes avoidance behavior by non-attendees.

nearby convention center in Tulsa, Oklahoma. While estimates leading up to the rally estimated that attendance would reach up to 100,000 — well over the capacity of the venue, forcing overflow to the nearby convention center (Murphy and Lauer 2020; Murphy 2020a) — attendance figures reported by Fire Marshalls ranged from 6000 to 7000 and attendance numbers reported by the re-election campaign reached 12,000 (Murphy and Lauer 2020; Wise 2020). Though the turnout of the event was disappointing politically, the crowd size that did materialize is comparable to that seen at many sporting events — including those held by the Women's National Basketball Association, the National Basketball Association (NBA), and the National Hockey League (NHL) — as well as numerous megachurch services.

However, in some ways, this indoor event was also quite different from usual sporting events or church-related gatherings, making the rally a potentially poor bellwether for gauging the dangers of indoor events and reopening policies but at the same time an excellent laboratory in which to observe population reactions to risk. The rally was accompanied by numerous media reports suggesting there could be violent clashes between the president's supporters and opponents (Baker and Haberman 2020; Bierman 2020; Cohen 2020; Karni 2020; Murphy 2020b; Singh 2020). The National Guard was deployed to maintain order (Murphy 2020c) and numerous businesses and roads closed (Fox23News Staff 2020; Holloway 2020) in anticipation of the event and its size. Thus, the event was coupled with both a local shutdown of many gathering places, including restaurants and bars, as well as signals to deter non-attendees from visiting the area near the event. These factors may have plausibly generated avoidance behavior in the non-attending population, which could have important offsetting effects on population level growth of COVID-19 cases, a point discussed recently in the context of Black Lives Matter protests (Dave et al. (2020b).[4]

In the days and weeks following the campaign event, numerous high-profile media reports anecdotally linked the Trump rally to a surge in new COVID-19 cases in Tulsa, drawing on notable attendees or Oklahomans who had tested positive or drawing on post-rally infection trends in the city.[5] This included coverage of high profile COVID-19 cases and deaths where the patient had attended the rally, most notably, former businessman and presidential candidate Herman Cain (Ortiz and Seelye 2020).

This study is the first to rigorously explore the impact of President Trump's 2020 presidential campaign kickoff rally on social distancing and COVID-19 related outcomes. To begin, we utilize anonymized smartphone data from SafeGraph Inc. to examine the impact of the Tulsa rally on travel into the Census block groups (CBGs) where the Tulsa rally took place. We document that the Tulsa event increased total cell phone "pings" in the treatment CBGs by 22.4 percent and the number of

[4] Attendees of the rally were also drawn from a part of the political distribution that have been found to be less responsive to public health policies aimed at mitigation, which could exacerbate the spread of COVID-19 (Painter and Qiu 2020).

[5] See for instance: Associated Press News (2020); Itkowitz (2020); Murphy (2020e); Jones and Ries (2020); Astor and Weiland (2020); Carlisle (2020); Oprysko (2020).

non-resident cell phone pings by 25.7 percent. Foot traffic at hotels, restaurants, and entertainment venues in the treatment CBGs also increased, consistent with this influx of visitors. However, using synthetic control methods, we find that net stay-at-home behavior in Tulsa County, which drew over half of rally attendees (according to cell phone data), did not change. Moreover, foot traffic at restaurants and bars, and at retail and entertainment venues, in Tulsa County declined on the day of the rally and the preceding day, consistent with avoidance behavior of other residents and displacement of some of their usual weekend activities that would have taken place in the absence of the rally. Such individuals may have chosen to increase stay-at-home behavior to avoid congestion at the rally, owing to road and business closures, or in response to predictions of violent clashes between protesters and rally attendees which precipitated the National Guard being called out on June 19 and 20.

Then, turning to data from the Centers for disease control and prevention (CDC), we explore whether the Trump rally ignited COVID-19 growth, examining (i) Tulsa County, (ii) Tulsa County and its border counties, and (iii) the state of Oklahoma. Synthetic control estimates provide no evidence that the Tulsa rally precipitated COVID-19 case growth in any of these jurisdictions during the five weeks following the event. Moreover, a dose–response difference-in-differences approach, which utilizes SafeGraph data on higher "donor" counties to the rally, find no evidence that COVID-19 cases grew more quickly in counties that sent more attendees into the rally census block group and who returned home. An examination of COVID-19 deaths up to eight weeks following the rally similarly produced no evidence of significant increases in the COVID-19 death rate.

These findings have important implications for policymakers considering mass gathering bans and reopening policies. Our findings show that this indoor event was likely not as dangerous to public health as sporting events in the earliest days of the pandemic (Ahammer et al. 2020; Carlin et al. 2021). The reasons for this may be twofold, including a) effects from any risk mitigating behavior of attendees and organizers: such as the event being accompanied by substantial publicity surrounding the importance of mitigating behaviors (i.e., mask-wearing), and attendees having their temperature taken upon entry (Murphy 2020d), as well as b) any offsetting community effects in response to perceived risk from the large gathering. To the extent that the Tulsa event displaced mobility that otherwise would have taken place, such as by reducing gatherings of non-household members at restaurants and bars downtown, such compensatory avoidance behavior may have played a vital dampening role in community spread.[6] As not all future indoor events are likely to generate such avoidance behavior, reopening policies should not dismiss the possibility of disease spread under different circumstances. When assessing the risk of an event, both individual and population level risk mitigating behavior need to be considered.

[6] It should be noted that in this case, risk avoidance behavior does not necessarily require individuals to be risk averse. Individuals could be risk neutral or risk loving and still act to avoid potential infection so long as their utility function has a lower value when infected.

2 Background

2.1 COVID-19 and health policy response

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes COVID-19, primarily transmits from one person to another via droplets expelled from an infected individual — from speaking, breathing, coughing, or sneezing— that are absorbed into the nose, mouth, or eyes of an uninfected individual (Centers for Disease Control & Prevention 2020b; Fineberg 2020). To reduce transmission, a variety of public health recommendations and mandates have been issued by the government, including (i) recommendations for frequent handwashing (Centers for Disease Control 2020b), (ii) mandating mask wearing in public (Angell and Newsom 2020; Cuomo 2020), and (iii) policies requiring social distancing, such as shelter-in-place orders, non-essential business closures, school shutdowns, mandates for non-household members to remain six feet apart, and limits on the number of individuals that may gather in a group (Angell and Newsom 2020; Centers for Disease Control & Prevention 2020b; Cuomo 2020; Mervosh et al. 2020). Social distancing among the general population may be particularly important to the extent that infectious individuals are asymptomatic (Bai et al. 2020; Pan et al. 2020; Rothe et al. 2020). There is a growing body of evidence to suggest that public policies mandating social distancing and mask wearing played an important role in fighting the spread of COVID-19 (Courtemanche et al. 2020a, b; Dave et al. 2020a, 2021a, b; Friedson et al. 2021; Lyu and Wehby 2020; Sears et al. 2020).

One of the most common policies designed to enforce social distancing is the prohibition of large indoor gatherings, particularly at indoor arenas. By June 1, 2020, nearly all states and the District of Columbia had banned large indoor gatherings such as sporting events and theatre performances (Dave et al. 2021a; Mervosh et al. 2020). Indoor gatherings are viewed as sites with a high potential for that spread of COVID-19 due to airflows, temperatures, and humidity levels that are helpful for virus transmission (Allen and Marr 2020; Contini and Costabile 2020; Mittal et al. 2020; Setti et al. 2020). There have also been high profile reports of larger outbreaks in indoor facilities that maintained operations during state COVID-19 shutdowns, such as prisons and meatpacking plants (Mosk et al. 2020; Schlosser 2020; Williams et al. 2020).

2.2 President Trump's 2020 campaign kickoff rally

On June 10, 2020, the president's re-election campaign organization, Donald J. Trump for President, Inc., announced that the president would hold an indoor campaign rally on June 19 at the Bank of Oklahoma (BOK) Center in Tulsa, Oklahoma. The BOK Center has a capacity of approximately 19,000 individuals, and the campaign announced that overflow seating was permissible in the nearby outdoor Tulsa Convention Center (Bierman 2020; Karni 2020; Singh 2020). This event was the first large indoor arena event permitted in the United States since the start of the coronavirus outbreak in March 2020 (Bierman 2020; Karni 2020; Singh 2020).

On June 13, President Trump announced that the campaign rally was postponed one day, to June 20, to avoid coinciding with Juneteenth celebrations of the realized emancipation of enslaved peoples in the United States in 1865.[7] The date change was also related to concerns regarding potential conflicts between the president's supporters and critics (Baker and Haberman 2020; Cohen 2020).

Despite the change of date, event organizers expected to fill both the BOK Center and the nearby Convention Center, with a total estimated attendance of up to 100,000 (Murphy and Lauer 2020; Murphy 2020a). Attendees began lining up for the event the night prior and gathered throughout the day (Christopher 2020; Hinton 2020; Sgana 2020). At 3:00 PM local time on June 20, 2020, the BOK Center opened its doors to attendees. Each attendee had his or her temperature checked and only those with normal temperatures were permitted to enter. While mask-wearing was encouraged by public health officials (Centers for Disease Control 2020b), it was not required, and video footage of the event suggests that social distancing (i.e., six-foot distancing requirements among non-household members) did not occur inside or outside the event center and only a small fraction of attendees wore masks (Christopher 2020; Wise 2020).

The rally itself ran from about 7:00 PM to 10:30 PM and attendance did not reach the BOK Center's capacity. Attendance estimates range from approximately 6000 to 7000, according the Fire Marshalls, to over 12,000, from the president's election campaign (Murphy and Lauer 2020a; Wise 2020).[8]

While it was not immediately clear why attendance fell so far below expectations, speculation from the Trump campaign and the national news media suggested that potential attendees' concerns over COVID-19 or, perhaps, fears over violent confrontations with protesters may have induced some Trump supporters to remain at home (Murphy 2020a, b, c, d, e).[9] Indeed, substantial news coverage leading up to the event included alarming information about infection risk of attendance and potential violent confrontations between passionate admirers and critics of the president (Baker and Haberman 2020; Bierman 2020; Cohen 2020; Karni 2020; Murphy 2020a, b, c, d, e; Singh 2020). The presence of National Guard and local police around the BOK Center during the day prior to and the day of the rally may have reinforced concerns over possible confrontations (Murphy2020a, b, c, d, e).

2.3 Comparability to other indoor events and potential for infection

Though the attendance numbers for the campaign rally were well below the pre-event estimates, the re-election rally's actual size makes it representative of many types of events that could occur once indoor event bans are lifted. For example,

[7] A Juneteenth rally took place in the Greenwood District of the city and included Reverend Al Sharpton as a keynote speaker. The gatherings also attracted a large crowd, numbering in the thousands, were outdoors on the streets and sidewalks, and Rev. Sharpton delivered his address in an open field on the campus of Oklahoma State University-Tulsa.

[8] It is unclear whether protesters directly prevented anyone from entering the BOK Center (Murphy, 2020a).

[9] The *New York Times* reported one possibility of inflated expectations related to an elaborate prank by teenagers who were part of "TikTok Teens" and "K-Pop Stans" (Lorenz and Frenkel 2020).

many sporting events and concerts also occur in arenas such as the BOK Center in Tulsa, and one may reasonably expect attendance of events at such large venues to fall short of capacity during the COVID-19 pandemic. Prior to its cancellation, the 2019–2020 NBA season had an average attendance of 17,750 people per game (ESPN 2020), and the average NCAA Division I men's basketball game had an attendance of 4601 people per game (NCAA 2021). Ahammer et al. (2020) estimate the impact of NBA and NHL games during the first 2 weeks of March 2020 on the prevalence of COVID-19 at the end of April 2020 (roughly seven weeks later), they find that an additional sporting event increased the detected prevalence of COVID-19 within seven weeks later by 8.3 percent. Carlin et al. (2021) conduct a similar analysis, and estimate that an additional professional sporting event during any part of 2020 would increase cases in the host metro area by 3.8 percent, and an additional event in March 2020 would increase cases in the host metro area by 14.5 percent.

These studies suggest that it is reasonable to expect a similar effect from the political rally: several weeks later there would be several hundred additional cases that otherwise would not have occurred. However, the underlying population risk of infection (i.e., the local prevalence of the virus) was higher during the dates of the political rally than during the March 2020 NBA and NHL games. Tulsa County, Oklahoma had 32 new recorded cases on April 1, 2020 and 136 new recorded cases on June 20, 2020, meaning that the estimates from the sporting events are likely a lower bound for viral spread due to indoor events during later time periods with higher case rates. This is before accounting for any offsetting behavioral changes, a topic we will return to shortly.

Another way to predict the potential infections due to the rally is to estimate the number of expected cases under an epidemiological model of infectious disease spread over the time frame of our study. This type of calculation relies heavily on modeling assumptions and should only be taken as a ballpark estimate for how widespread cases could grow under one of the fastest plausible growth paths. Assuming a 1.5 percent infection prevalence applied to the low end of the estimated rally attendance (6000 attendees), a conservative viral reproductive rate (R_0) of 2.0 to 2.5, and a median incubation period of 5–6 days, the baseline number of infections at the rally could lead to as many as 9921 to 15,829 additional cases in Tulsa County and between 13,076 and 20,862 additional cases in the larger Tulsa metro area within 35 days.[10] A higher R_0 would serve to magnify these estimates.

[10] There were 333,216 newly confirmed COVID-19 cases, between June 6 and June 20 (a period that envelopes 14 days prior to the rally till the day of the rally), representing approximately 0.15 percent of the adult population in the U.S. These reported confirmed cases are almost certainly an undercount of the true infection rate (Kniesner and Sullivan 2020), with a study by researchers at the CDC and state health departments finding that confirmed cases undercounted true infections by a factor of 6 to 24 times (Havers et al. 2020) in the period up to May 12, 2020. We assume an undercount of 10 times, which implies that about 1.5 percent of rally attendees would have likely been infected at the time. A wide range of estimates exists for the basic reproductive rate, with the CDC utilizing a range from 2.0 to 4.0 (https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html), with their "best estimate" in their pandemic planning scenario being 2.5; under an R_0 of 2.5, the Tulsa rally could potentially generate an additional 15,829 and 20,862 cases within Tulsa County and the larger Tulsa cluster under ideal viral spread conditions.

From this starting point of having a large indoor event with the potential to accelerate spread of COVID-19 there are two types of behavioral responses that could have mitigated spread of the virus. The first is individual mitigation behavior on the part of attendees. This includes behavior such as mask wearing, and social distancing within the venue, self-quarantining post-event, and stringently avoiding others. As attendees of the rally are a selected sample, drawn from a part of the population distribution that is on average older and less responsive to public health policies aimed at mitigation (Barrios and Hochberg 2020; Painter and Qiu 2020) we believe that this source of mitigation was likely relatively small in magnitude (although also likely non-zero).

The second form mitigation could happen within the population of non-attendees. To the extent that this portion of the population changes behavior, and that behavior change lowers transmission, any increase in population case levels of COVID-19 due to the rally could be offset, yielding a net null population effect. In this respect, the Tulsa campaign rally differs from other indoor events such as sporting events dramatically. Several businesses, city buildings, and roads and streets in downtown Tulsa were closed in anticipation of the large influx of people attending the event (Fox23News Staff 2020; Holloway 2020). Due to concerns over potential clashes and violence, as a precautionary measure, some businesses in the downtown area and just outside the vicinity were boarded up (Hutchins 2020; Morgan 2020). Soldiers from the Oklahoma Army National Guard were activated to help provide security in the event of such clashes. These considerations may have increased stay-at-home behaviors among residents who were not planning on attending the campaign rally, and displaced inflows of non-residents who otherwise would be coming into the downtown area in the absence of the campaign event and anticipated disruptions.

Any population level changes in COVID-19 due to the rally will thus be the net effect of (a) changes in disease transmission due to the event, which is itself impacted by individual risk mitigation behavior, as well as (b) changes in disease transmission due to changes in behavior in the non-attending population due to the event. Population risks and population responses to events with large potential for health spillovers are driven by individual behavior of the groups making up the overall population. Only by understanding how all of the groups will likely respond can an appropriate prediction be made for the population.

3 Data

3.1 Anonymized smartphone data

Measures of social distancing and mobility patterns are constructed using data available from SafeGraph Inc.[11] This firm provides census-block-group-level data from 45+ million anonymized smartphone devices. These data are useful for measuring stay-at-home behavior and travel away from home, and have been used by the

[11] These data are available at: https://www.safegraph.com/covid-19-data-consortium.

Centers for Disease Control and Prevention to study social distancing behavior during the time of the COVID-19 epidemic in the United States. In addition, researchers analyzing social distancing policies in the United States have also used these data to study the impact of mitigation policies and large outdoor social gatherings on social distancing behaviors (Abouk and Heydari 2020; Andersen et al. 2020; Dave et al. 2020a, b, 2021a, b; Friedson et al. 2021). The time period of analysis for social distancing ranges from June 5, 2020 to June 27, 2020, a period including two weeks leading up to the Tulsa rally and 7 days following the event.

In the Safe Graph data, a person's "home" is defined as the 153-by-153-m area receiving the largest number of GPS "pings" from 6PM to 7AM. We can measure "movement" in the SafeGraph data when we observe a smartphone appearing outside of its home. We use these data in three key ways. First, we measure the number of non-resident visitors in a given census block group. *Non-Resident Ping Rate* measures the number of non-resident pings per 1000 square meters of size of a Census block group (CBG).[12] Our particular interest is to measure the non-resident ping rate in the census block groups where the Trump rally took place, that is, the CBG where the Bank of Oklahoma (BOK) Center and the Convention Center are located.

Between Saturday, June 13 and Saturday, June 20, the date of the Trump event, the rate of non-resident pings at the CBG which housed the BOK increased by 22.4 percent, reflecting a substantial increase in the number of non-residents in this key treatment CBG.[13] Generally, non-resident pings are highest from Monday through Friday, and decline considerably on Saturdays and Sundays, consistent with these CBGs comprising the central downtown business district. However, during the weekend of the Tulsa campaign event, inflows of non-resident pings were substantially lower on that Friday (relative to prior Fridays), reflecting displacement from early business closures and road closures (some of which had commenced Thursday evening),[14] and expectedly peaked on Saturday, the day of the event.

In addition, we measure *Total Ping Rate,* the total number of pings per 1,000 square meters. The total number of pings recorded in the BOK Arena CBG increased by 20.6 percent over the period between June 13 and June 20. Coupled with our findings for non-resident pings, this does suggest some degree of displacement of residents in a key treatment CBG in response to the rally.[15] This could reflect one dimension of avoidance behavior by local residents.

Importantly, we are able to measure the home counties of those non-residents (those who did not record a "home residence" in the CBG) who appeared in the treatment CBGs.[16] The national map in panel (a) of Fig. 1 documents the counties

[12] Alternately, normalizing by the population of the CBG, as a proxy for its size and economic activity, yields virtually identical results in relative terms.

[13] For the CBG housing the Convention Center, the increase was more than twofold.

[14] See Fox23News Staff (2020).

[15] For both treatment CBGs combined, the percent increase in non-resident pings was 52.6 percent, while the total number of pings rose by 46.7 percent, again reflective of displacement.

[16] We are unable to precisely detect whether residents of the treatment CBG attended the rally.

that drew the most residents into the rally.[17] As shown, the rally was largely an Oklahoma event and, more precisely, a Tulsa County event. About half (43 percent) of the total of non-resident pings in the Trump rally CBGs were recorded from individuals whose homes were recorded in Tulsa County. Another 38 percent of the pings came from other counties in the state of Oklahoma outside of Tulsa County. Finally, 18 percent of pings came from outside of the state of Oklahoma, largely in the border counties of Texas (including Clay and Grayson counties), Missouri (including McDonald and Newton counties), and Arkansas (including Benton and Washington counties). Panels (b) and (c) of Fig. 1 further isolate the state of Oklahoma and Oklahoma along with its border states to highlight jurisdictions that drew the most residents to the rally.[18]

Second, we use four measures of net social distancing behavior at the county-level. These include *Median Hours at Home*, which measures the median number of hours respondents spend at their home (mean for Oklahoma = 11.5 and mean for Tulsa County = 11.7), *Mean Hours at Home*, which captures the mean of the same measure (mean for Oklahoma = 11.3 and mean for Tulsa County = 11.5), *Percent of Time at Home*, which measures the percent of total time that the phone was turned on that was pinged at home (mean for Oklahoma = 78.8 percent and mean for Tulsa County = 81.6 percent), and *Percent at Home-Full Time*, which measures the mean percent of individuals who spent the full day at home (mean for Oklahoma = 24.3 percent and mean for Tulsa County = 26.7 percent).

Finally, we use foot traffic data, also available from SafeGraph, to capture external mobility and activity patterns at various venues. These data track hourly-aggregated foot traffic to millions of points of interest across the United States, which are classified based on the industry-specific National American Industry Classification System (NAICS) codes. We use the NAICS codes to categorize movements at bars and restaurants, retail establishments, entertainment venues, hotels, and business service establishments. Foot traffic for each of these categories of industry is then aggregated to the day-by-census block group (or County) level.

3.2 COVID-19 cases and deaths

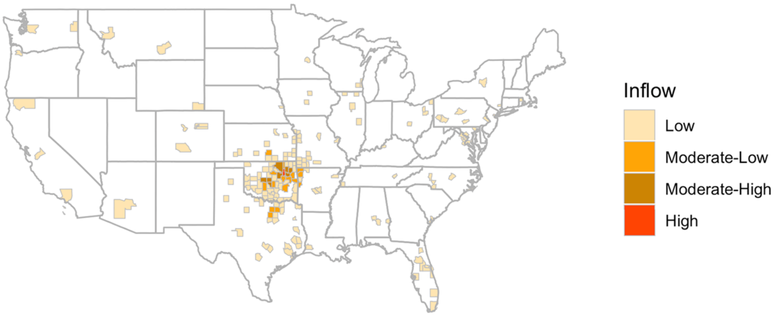
We measure County-level confirmed COVID-19 cases and deaths using state- and County-level data provided by the Centers for disease control and prevention (CDC), and made available via the Kaiser Family Foundation and the *New York Times*.[19] Our main COVID-19 analyses are conducted over the period from June 6, 2020 through July 24, 2020. During this period, the mean COVID-19 case rate

[17] We define a *High Inflow* as a County (Tulsa County) that contributed more than 9.5 percent of visitors to the treatment CBGs on June 20, *Moderate-High Inflow* as a County contributing 2.9 to 9.4 percent of visitors, *Moderate-Low Inflow* as a County contributing 1 to 2.8 percent of visitors, and *Low Inflow* as a County contributing 0.1 to 1 percent of visitors.

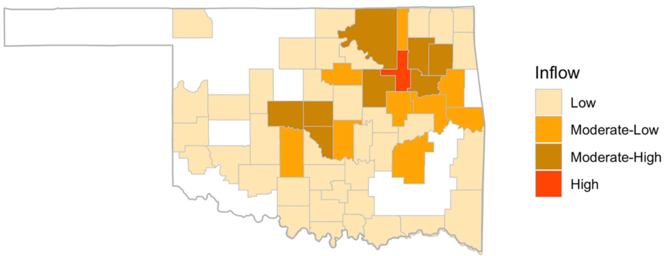
[18] For comparison, Appendix Fig. 1 shows jurisdictions with pings in treatment CBGs for Saturday, June 6.

[19] These data are available at: https://github.com/nytimes/covid-19-data

*Panel **(a)**: Distribution of Home Counties of Those Who Traveled to Trump Event CBGs*



*Panel **(b)**: Distribution of Home Counties of Oklahomans Who Traveled to Trump Event CBGs*



*Panel **(c)**: Distribution of Home Counties of Oklahomans and Border State Residents Who Traveled to Trump Event CBGs*

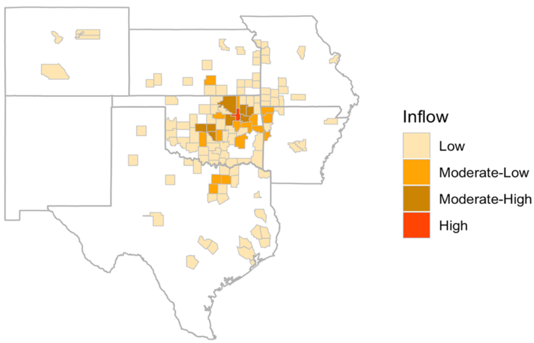


Fig. 1 Distribution of Home Counties for absolute inflows to treatment Census block groups (CBGs) on June 20, 2020

per 100,000 population in the state of Oklahoma was 382.6 and the death rate was 10.0. For Tulsa County, the mean case (mortality) rate was 554.2 (10.9) per 100,000 population. Finally, an examination of Tulsa County and its border counties (Creek, Okmulgee, Osage, Pawnee, Rogers, Wagoner, and Washington counties) revealed a mean COVID-19 case (mortality) rate of 478.6 (14.5) per 100,000 population.

An examination of trends in COVID-19 cases in the state of Oklahoma, in Tulsa County, and in Tulsa County and its surrounding border counties ("Tulsa County Cluster") shows that though Tulsa County starts off at a similar rate of COVID-19 cases as the state of Oklahoma, the rate of COVID-19 growth is faster in Tulsa County. By July 24, there were nearly 400 more COVID-19 cases per 100,000 in Tulsa County as compared to the state of Oklahoma. We also find that the death rate is low in Tulsa County as compared to its surrounding border counties. Similar to cases, we find that Tulsa County has a similar rate of COVID-19 death growth as the state of Oklahoma at the start, but then experiences faster growth over the latter part of the sample period.

4 Empirical approach

4.1 Non-resident travel

We begin by estimating the effect of the Trump rally on non-resident and total pings in the CBGs where Trump rally events were organized (the BOK Center and the adjacent Convention Center). We pool a panel of 2965 CBGs in the state of Oklahoma across 22 days and estimate a difference-in-differences model of the following form:

$$Non-Resident\ Ping\ Rate_{gct} = \beta_0 + \beta_1 Trump_{gt} + \beta_2 Temp_{ct} + \beta_3 precip_{ct} + \beta_4 BLM_{ct} + \alpha_g + \tau_t + \varepsilon_{gct} \quad (1)$$

Here *Non-Resident Ping Rate*$_{gct}$ is the non-resident GPS ping rate in census block group g in County c on day t, $Trump_{gt}$ is the interaction of an indicator for June 20th and whether the CBG is one of the two in which primary Trump rally events took place, $Temp_{ct}$ is a measure of the average temperature (in degrees Celsius) in County c on day t, $Precip_{ct}$ is a dichotomous variable capturing whether measurable precipitation fell that day,[20] and BLM_{ct} is a County-level indicator for whether a Black Lives Matter (BLM) protest took place in a metropolitan area with a municipal population greater than 100,000.[21] Finally, α_g is a time-invariant census block group effect and τ_t is a CBG-invariant day effect that captures intra-day cyclicality in travel behavior in addition to secular trends. All regressions are weighted by the census block group population.

Following Buchmueller et al. (2011) and Cunningham and Shah (2018), statistical inference is conducted by re-estimating β_1 from Eq. (1) $G-2$ times for each untreated census block group. We then compare the main estimate to the distribution of placebo estimates by ranking them. If the estimate of the true treatment effect is in the top five percent of all (treatment plus placebo) estimates, then we judge it statistically distinguishable from zero at the five percent level.

[20] Weather data are available at: https://www.ncdc.noaa.gov.

[21] These data are described in Dave et al. (2020b).

Our estimate of β_1 will be unbiased only if the common trends assumption is satisfied. We take a number of tacks to ensure that will be true. First, our analysis takes place entirely within Oklahoma, where major policy changes regarding reopening were conducted at the state-level and hence are captured by the common day fixed effect. Second, we explore the robustness of our findings to including County-specific linear time trends, to capture unmeasured time shocks that could be correlated with social distancing and the Trump event. Finally, we also utilize event study analyses, which capture social distancing trends in the weeks leading up to the Trump event.

4.2 COVID-19 cases

The previous analyses on the scale of non-resident travel, in conjunction with the inflow patterns across counties that contributed the largest numbers of rally attendees, highlight areas of focus for studying potential effects on COVID-19 cases as attendees travel back home. In order to evaluate the impact of the Trump rally on confirmed COVID-19 cases, we first turn to a synthetic control approach (Abadie et al. 2010). This approach has been used by several recent studies exploring how COVID-19 mitigation policies have affected coronavirus spread (Dave et al. 2021b; Friedson et al. 2021). Motivated by findings in Fig. 1, we begin by examining three treatment jurisdictions: (i) Tulsa County, the county that included the rally, (ii) Tulsa County and its surrounding border counties ("Tulsa cluster"), and (iii) the state of Oklahoma.

We use several approaches to generate our synthetic treatment units to ensure that our estimates are not influenced by researcher-driven matching characteristics. First, in all cases, we exclude border states from the donor pool given that some border counties of these states contributed travelers to the Trump rally (see Fig. 1). In addition, for our Tulsa County-based analysis, we (i) exclude other counties within the state of Oklahoma as potential donors, (ii) exclude donor counties that contributed positive number of cell phone pings in the treatment CBGs on June 20, and (iii) focus on donor counties (and their border counties) with urbanization that approximates Tulsa County. Specifically, we restrict the donor pool to counties with urbanicity rates between 93 and 98 percent, a band that narrowly envelopes Tulsa County's urbanicity of 95.2 percent, or counties with population-weighted density similar to Tulsa County.[22] Population-weighted density captures the density where the average person lives; based on this measure, Tulsa has a weighted population density of 3,250 per square mile, and we restrict the donor pool to a band of $\pm$ 1000 enveloping Tulsa.[23] Given the vital role of social interactions and crowding in

[22] Urbanicity rates are the proportion of individuals living in an urban area instead of a rural area, calculated using 2010 Census data available from https://www.census.gov/data/datasets/2010/dec/stateside-pums.html. The state of Oklahoma has an urbanicity rate of 66.2 percent.

[23] We compute the weighted population density for each County by combining population density at the census block group level weighted by the population of each CBG. See: https://www.census.gov/programs-surveys/metro-micro/data/tools/metro-micro-help/variables.html.

contributing to community spread of the coronavirus, drawing on a donor pool of urbanized, densely populated counties similar to Tulsa improves the quality of synthetic counterfactual.[24]

Second, to ensure that the synthetic control was similar to the treatment jurisdiction on pre-rally COVID-19 cases, we match on (i) cumulative COVID-19 cases on each day for the two weeks prior to the rally (June 5, 2020 to July 18, 2020, allowing June 19, a travel day for some arriving in Tulsa, to have different COVID-19 case levels), or (ii) cumulative COVID-19 cases on six pre-rally days (June 6, June 8, June 10, June 14, June 16 and June 18) when we choose to match on other observable characteristics of jurisdictions that may influence COVID-19 case growth.

We focus on several observable traits that have been found to influence COVID-19 case growth in the selection of our synthetic control, including *median hours spent at home* during the pre-rally period (11.6 h in Oklahoma and 11.4 h in Tulsa County), *COVID-19 testing rate* per 100,000 population (6841.6 per 100,000 in the state of Oklahoma), *state reopening policies* (number of days that the state has permitted reopening of restaurants/bars, retail, personal care services and gyms and entertainment),[25] and whether the state issued a *mask-wearing mandate*.

We estimate the unobserved counterfactual COVID-19 case rate for Tulsa County, the Tulsa cluster (Tulsa County and its border counties), or the state of Oklahoma on pre-treatment day t by $\sum_j w_j * COVID_{jt}$, where w_j is the weight assigned to donor jurisdiction j. The estimated weights w_j are chosen to minimize the absolute difference between $COVID_{i=Tulsa,t}$ and $\sum_j w_j * COVID_{jt}$ and for all pre-treatment days. Then, the per-day treatment effect α_t is estimated as $\alpha_t = COVID_{i=Tulsa,t} - \sum_j w_j * COVID_{jt}$ for t ∈ [June 20,[26] July 24]. The average treatment effect is then the average over the post-treatment window.

In addition to the above COVID-19 analysis, we also use the above synthetic control methods for examining net stay-at-home behavior, using the four stay-at-home measures described above, and foot traffic at various points of interest in Tulsa County and the Tulsa cluster. These analyses are motivated by recent work showing that increased social mobility to attend an event may be countered by behavior of non-attendees who may choose to avoid congestion or due to fear of violence from political clashes (Dave et al. 2020b).

The above analyses focused on Tulsa County and its surrounding areas since the campaign rally was largely a greater Tulsa event, with the Tulsa cluster supplying the majority (57.2 percent) of attendees. Nevertheless, rally-goers from other parts of the state (notably counties comprising Oklahoma City), and to a smaller extent from other states, were also observed in the treated CBGs on the day of the campaign event. We therefore also broaden our focus to outside the greater Tulsa area,

[24] Widening this constraint to include donor counties with urbanicity rates greater than 90 percent does not materially alter our results.

[25] Hence, if the state rolls back its reopening or suspends it for any or all of these sectors, this will be reflected in the separate duration measure of days for each sector that the state has remained reopened over the sample period.

[26] In our main specification, we also include June 19 as a posttreatment day given travel to the event that day. Using June 20 as the first post-treatment day yields a qualitatively similar pattern of results.

in order to assess whether there were any discernible changes in COVID-19 cases in these other areas that contributed attendees at the rally. Specifically, we explore a dose–response difference-in-differences model by taking advantage of the variation in non-resident pings to the treatment CBGs, as shown in Fig. 1. That is, we pool a panel of counties and days from Oklahoma and its bordering states (Arkansas, Colorado, Kansas, Missouri, New Mexico, and Texas) and estimate the following specification:

$$\log\,(\text{COVID}-19)_{cst} = \beta_0 + \mathit{Inflow}_{\text{c}} * \mathit{PostRally}_{\text{t}} * \beta_1 + X_{\text{st}} * \beta_2 + Z_{\text{ct}} * \beta_3 + \alpha_{\text{c}} + \tau_{\text{t}} + \alpha_{\text{c}} * t + \mu_{\text{cst}} \quad (2)$$

where $\mathbf{Inflow}_{\text{c}}$ is a vector measuring inflows of home counties that contributed to non-resident pings in the treatment CBGs on the day of the Trump rally, June 20, (*High Inflow, Moderate-High Inflow, Moderate-Low Inflow, Low Inflow*) as measured by SafeGraph using data on smartphone home locations and destinations (see Fig. 1 and footnote 17). For COVID-19 confirmed cases, we utilize a log transformation, while for our supplementary analyses of deaths, we utilize an inverse hyperbolic sine transformation. The latter approximates the natural log, is interpreted in a similar manner, but has the advantage of retaining areas with zero death counts (Bellemare and Wichman 2020).[27]

In alternate specifications, we also define relative inflow measures that account for the population of the County that contributed residents to the treatment CBG, in order to capture heterogeneity arising from differential risk of exposure from potential population mixing.[28] For instance, 100 returning residents from the rally to their home County would have different implications for community spread if the home County has a relatively smaller population (than if the home County was more populated). On the one hand, this implies a larger share of the County's population being potentially treated by attending the rally; on the other hand, interactions between the returning attendees and non-attendees may be more limited if the home County is relatively sparsely populated, ceteris paribus.

Turning back to Eq. (2), $\mathbf{PostRally}_{\text{t}}$ measures post-Trump rally windows capturing the incubation period (up to 5 days following the rally), the aftermath of the incubation period (6–14 days), 15–29 days, and 30–34 days after the rally. This post-treatment window (up to 34 days after treatment) captures a period well after the median incubation period for COVID-19 (5.1 days) and exceeds the time after which 97 percent of infected individuals would have exhibited symptoms (Lauer

27 Approximately 44 percent of County-day observations had zero death counts, mainly representing rural counties. Our estimates are not sensitive to utilizing a log transformation, and dropping these County-days with zero deaths, or utilizing a log transformation after adding one to the death count in all counties.

28 Based on the relative share measure, we define high inflow as a County that contributed more than 10 percent of its observed residents (as measured by resident pings) to the treatment CBGs on June 20, moderate-high inflow as a County contributing 6 to 10 percent of its observed residents, moderate- low inflow as a County contributing 1 to 6 percent of its residents, and low inflow as a County contributing 0.1 to 1 percent of its residents.

et al., 2020). In addition, $\boldsymbol{X}_{st}$ is a vector of state characteristics including separate indicators of state reopening policies for each of the following sectors including restaurants/bars, retail, personal care services, and gyms and entertainment activity, the presence of a state shelter-in-place order (SIPO), the COVID-19 testing rate per 100,000 population, and whether the state had issued a mask-wearing mandate; and $\mathbf{Z}_{\mathbf{ct}}$ is a vector for the average temperature in the County, whether measurable precipitation fell in the County, and the onset of Black Lives Matter protests in major urban centers in the County (Dave et al. 2020b). In addition, we include a set of County fixed effects, α_c, day fixed effects, τ_t, and a County-specific linear time trend (α_c*t). This last control may account for differential growth trends of COVID-19 across states and counties.[29] To evaluate the common trends assumption, we conduct event-study analyses for counties that contributed large shares of residents to the Trump rally CBGs.[30]

5 Results

Our difference-in-differences and synthetic control estimates of the effect of the indoor political rally on non-resident travel and foot traffic are reported in Tables 1, 2, 3; the corresponding event-study analysis is shown in Figs. 2, 3, 4. Our main findings on COVID-19 are shown in Figs. 5, 6 and Tables 4, 5.

5.1 Non-resident travel and social distancing

We first assess the effects of the Tulsa rally on the scope of non-resident travel behavior into the census block groups containing the planned venues, based on Eq. (1). Estimated effects of the rally on the non-resident ping rate (Panel I) and the total ping rate (Panel II) in the treatment CBGs are shown in Table 1. Column (1) includes day and CBG fixed effects, column (2) adds controls for temperature and weather, column (3) adds controls for the onset of Black Lives Matter protests in large cities in the County (see Dave et al. 2020b), and column (4) adds controls for County-specific linear time trends. While our preferred estimates are from the saturated models that include predictors of social distancing and trend controls, it is reassuring that the estimates are robust across all of these specifications.

[29] One concern with the inclusion of a control for a County-specific linear time trend is that its inclusion may bias estimated treatment effects downward in the presence of dynamic impacts (Dave et al. 2020a; Goodman-Bacon 2018). We experiment with alternate specifications, including difference-in-differences models that (i) excluded a County-specific time trend or (ii) included a treatment County-specific linear pre-treatment trend. Event study analyses of these specifications provided no evidence that the Tulsa rally increased COVID-19 cases in counties that drew larger numbers of residents to the June 20 events. Moreover, an examination of pre-treatment trends across each of our specifications suggested that models including County-specific linear time trends produced findings most consistent with the common trends assumption.

[30] Statistical inference is conducted via permutation-based placebo tests in which the estimate of β1 from Eq. (2) is compared to the distribution of β_1 generated from randomly assigning treatment to counties that did not contribute inflows to the Tulsa event.

Table 1 Difference-in-differences estimates of the effect of Tulsa rally on pings per 1000 m squared in treatment census block groups

	(1)	(2)	(3)	(4)
	Panel I: Non-resident pings			
Trump Rally	0.097**	0.097**	0.098**	0.097**
P-value	[.017]	[.017]	[.017]	[.017]
N	68,148	68,148	68,148	68,148
Mean of DV	0.377	0.377	0.377	0.377
	Panel II: Total pings			
Trump Rally	0.092**	0.091**	0.091**	0.092**
P-value	[.018]	[.018]	[.018]	[.018]
N	68,148	68,148	68,148	68,148
Mean of DV	0.410	0.410	0.410	0.410
Day and Census block group FE	Yes	Yes	Yes	Yes
COVID-19 policy and weather controls	No	Yes	Yes	Yes
BLM protest controls	No	No	Yes	Yes
County linear time trend	No	No	No	Yes

Estimates are generated using weighted least squares. All estimates include county and day fixed effects as well as county specific linear time trends. State policy controls include COVID-19 testing, an indicator for whether a state reopened restaurant or bars, an indicator for whether a state reopened retail services beyond curbside pickup, an indicator for whether a state reopened personal or pet care services, an indicator for whether a state reopened entertainment business, an indicator for whether a state reopened gyms or parks, and an indicator for whether a state paused reopening. County weather controls include average temperature and an indicator for whether any measurable precipitation fell. BLM Controls include whether a county had a city with at least 100,000 population with a protest. Permutation based *p*-values are reported inside the brackets.

*Significant at the 10% level, **Significant at the 5% level, ***Significant at the 1%

Estimates in Panel I indicate that the Trump campaign event resulted in a significant increase in non-residents traveling into the treated CBGs, reflecting an increase of 0.10 additional non-resident pings (per 1000 m squared). While actual turnout at the rally was far lower than anticipated, the influx on Saturday still amounts to a 25.7 percent increase over inflows into the area that would normally occur on average prior to the rally. Panel II presents commensurate estimates based on total pings (resident and non-resident) observed in the CBGs. As evident from the means, virtually all (92 percent) of the total pings observed in the treated CBGs are from non-residents; this reflects the fact that the CBGs containing the BOK Center and the Convention Center comprise the central business districts of Tulsa and are primarily non-residential. Hence, it is not surprising that we find highly similar estimates of the rally-induced inflows in Panel II, reflecting an increase in the total ping rate of 0.09 or 22.4 percent relative to the pre-treatment mean. This is virtually identical to the unadjusted difference in inflows between the Saturday of the rally (June 20) and the previous Saturday (June 13).

Figure 2 visually presents the event study analyses for non-resident and total pings observed in the treated CBGs. They underscore the dynamics in travel

Table 2 Difference-in-differences estimates of the effect of Tulsa rally on pings per 1000 m squared in treatment census block groups, Tulsa County

	(1)	(2)	(3)
	Panel I: Entertainment		
Trump Rally	0.0934***	0.0934***	0.0932***
P-value	[0.006]	[0.006]	[0.006]
Mean of DV	0.0273	0.0273	0.0273
	Panel II: Hotel		
Trump Rally	0.0336***	0.0336***	0.0335***
P-value	[0.006]	[0.006]	[0.006]
Mean of DV	0.0251	0.0251	0.0251
	Panel III: Restaurants		
Trump Rally	0.0279*	0.0278*	0.0280*
P-value	[0.060]	[0.060]	[0.060]
Mean of DV	0.0682	0.0682	0.0682
	Panel IV: Bar		
Trump Rally	− 0.0006***	− 0.0006***	− 0.0006***
P-value	[0.008]	[0.008]	[0.008]
Mean of DV	0.0031	0.0031	0.0031
	Panel V: Business services		
Trump Rally	− 0.0021**	− 0.0021**	− 0.0022**
P-value	[0.291]	[0.291]	[0.315]
Mean of DV	0.0100	0.0100	0.0100
	Panel VI: Retail		
Trump Rally	0.0257	0.0256	0.0260
P-value	[0.109]	[0.108]	[0.108]
Mean of DV	0.0727	0.0727	0.0727
N	60,501	60,501	60,501
Day and Census block group FE	Yes	Yes	Yes
Weather controls	No	Yes	Yes
County linear time trend	No	No	Yes

Estimates are generated using weighted least squares. All estimates include county and day fixed effects as well as county specific linear time trends. State policy controls include COVID-19 testing, an indicator for whether a state reopened restaurant or bars, an indicator for whether a state reopened retail services beyond curbside pickup, an indicator for whether a state reopened personal or pet care services, an indicator for whether a state reopened entertainment business, an indicator for whether a state reopened gyms or parks, and an indicator for whether a state paused reopening. County weather controls include average temperature and an indicator for whether any measurable precipitation fell. BLM Controls include whether a county had a city with at least 100,000 population with a protest. Permutation based *p*-values are reported inside the brackets

*Significant at the 10% level, **Significant at the 5% level, ***Significant at the 1%

behavior surrounding the campaign rally. First, inflows into the treated and non-treated CBGs trend quite similarly prior to the event. Second, there is a substantial and significant spike in pings, reflecting an influx of non-residents into the area, on the day of the rally, relative to the control groups. Third, immediately following the

Table 3 Synthetic control estimates of Tulsa rally on foot traffic per 100,000 population

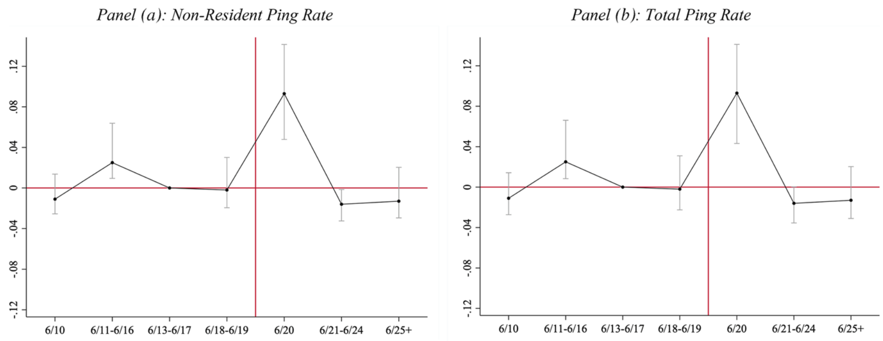
	Bars/Restaurant (1)	Bars (2)	Restaurant (3)	Retail (4)	Hotel (5)	Entertainment (6)
			Panel I: Tulsa county			
6/19 and 6/20	– 357.05	0.582	– 356.482	– 254.474*	– 54.747	– 156.958
P-value	[0.272]	[0.621]	[0.286]	[0.058]	[0.947]	[0.660]
1 Sided *P*-value	[0.171]	[0.214]	[0.189]	[0.044]	[0.529]	[0.437]
6/21 and onwards	98.145	1.863	97.406	– 98.528	4.999	– 689.227
P-value	[0.811]	[0.519]	[0.831]	[0.501]	[0.995]	[0.184]
1 Sided *P*-value	[0.369]	[0.248]	[0.374]	[0.223]	[0.485]	[0.155]
Pre-treatment mean of DV	3788.759	20.698	3768.061	5369.27	337.621	1681.813
			Panel II: Tulsa cluster			
6/19 and 6/20	– 190.689	0.491	– 196.329	– 275.156***	– 51.578	– 199.657
P-value	[0.286]	[0.617]	[0.267]	[0.0010]	[0.841]	[0.180]
1 Sided *P*-value	[0.228]	[0.262]	[0.214]	[0.005]	[0.481]	[0.131]
6/21 and onwards	2.506	1.397	– 6.833	– 58.954	– 19.637	– 409.45**
P-value	[0.675]	[0.432]	[0.709]	[0.485]	[0.996]	[0.049]
1 Sided *P*-value	[0.296]	[0.223]	[0.417]	[0.277]	[0.481]	[0.049]
Pre-treatment mean of DV	3107.877	13.663	3094.213	4666.514	246.688	2179.864

Estimates are generated using synthetic control methods. Matching was based on six days of pre-treatment COVID-19 case rates, pre-treatment stay-at-home behavior, COVID-19 testing rate, COVID-19 reopening policy, and mask wearing policy. Donor pool is restricted to counties/states with similar weighted population density or urbanicity as Tulsa/Oklahoma

event, the treated CBGs experience a commensurate and equally rapid decrease in non-resident pings, consistent with rally-goers returning home, with inflows thereafter reverting to baseline.

While the estimates in Table 1 reveal an increase in inflows into the treated CBGs of 22 to 26 percent, it is important to note that this is a *net increase* above and over what would have occurred on a typical Saturday in the absence of the rally. As noted earlier, individuals who otherwise would have visited downtown Tulsa on the weekend may have reduced their travel behavior due to business and road closures, anticipated crowding, and/or safety concerns arising from potential clashes between protesters and rally attendees. Thus, not only did the Trump campaign rally lead to an increase in the level of inflows but would also be expected to shift the composition of visitors into the treated CBGs, as rally attendees displace typical Saturday visitors and their activities.

Such displacement and avoidance behaviors are somewhat more evident in Figs. 3 and 4, when we turn to stay-at-home measures of social distancing. Here we present trends in the extensive and intensive measures of staying at home (Panels a through d) for the larger Tulsa County cluster (Fig. 3) and for just Tulsa County (Fig. 4) along with their respective synthetically-generated counterfactuals. The



Note: Estimate is generated using weighted least squares estimate. All estimates include county and day fixed effects as well as county linear time trend.. State policy controls include COVID-19 testing, an indicator for whether a state reopened restaurant or bars, an indicator for whether a state reopened retail services beyond curbside pickup, an indicator for whether a state reopened personal or pet care services, an indicator for whether a state reopened entertainment business, an indicator for whether a state reopened gyms or parks, and an indicator for whether a state paused reopening. County weather controls include average temperature and an indicator for whether any measurable precipitation fell.

Fig. 2 Event-study analyses of effect of Tulsa rally on non-resident ping rate in affected census block groups

synthetic controls, constructed through matches on outcomes in all pre-treatment periods, track Tulsa lock-step in all periods prior to the rally. For both the broader Tulsa cluster and just Tulsa County, there is a short-term increase in the percent of residents staying at home full-time (Panel a), on the day of the rally and the preceding Friday, relative to the control group. These effects are statistically significant (two-tailed permutation-based p-value = 0.029). Given that the greater Tulsa area is responsible for the majority of visitors into the treated CBGs for the Trump rally, the *increase* in the percent of residents staying at home full-time reflects counteracting compensatory behavior on the part of residents who chose not to the attend the rally or leave their homes. That this is consistent with a rally-induced displacement is supported by the short-term duration of the increase in stay-at-home behaviors over that Friday and Saturday, and a rapid return to their baseline trends thereafter. Turning to the intensive measures of time spent at home (Panels c through d), we find no significant or substantial change. Given that attendees from Tulsa and surrounding counties are known to have travelled to the treatment CBGs, thereby reducing their time spent at home, a null effect at this margin also implies countering increase in the time spent at home among other non-traveling sub-populations.[31]

To shed further light on displacement and offsetting behaviors, we turn to an analysis of how the Tulsa event impacted activity patterns at various venues immediately within the treatment CBGs, and within the County and larger Tulsa metro area. Estimates from difference-in-differences models (similar to Eq. 1) of

[31] It is more difficult to detect changes in time spent at home at the intensive margin, and thus separate out increases driven by the avoidance behavior of non-attendees from decreases due to attendees traveling to the venue CBGs with these measures of stay-at-home behaviors.

Fig. 3 Synthetic control estimates of effects of Tulsa rally on stay-at-home behavior in Tulsa County cluster

shifts in activity patterns, presented in Table 2, indicate that the Tulsa rally significantly increased foot traffic at entertainment venues, hotels, and restaurants in the census block groups hosting the rally, which is consistent with the influx of visitors; usual foot traffic at business service establishments that would have occurred in this area was displaced. There is also a small (on the order of five percent relative to the mean), but significant, decrease in foot traffic at bars, which further suggests a displacement effect that was large enough to counter that from the rally visitors. In contrast, foot traffic within the larger Tulsa County and Tulsa cluster, at bars and restaurants, retail and entertainment venues, and at hotels on the day of the rally and on the preceding day, *declined* relative to their respective synthetic controls (see Table 3; and the corresponding Appendix Figs 2 and 3). The decline in foot traffic across these establishments ranged from 4.7 to 16.2 percent for Tulsa County and from 5.9 to 20.9 percent for the broader cluster. While we qualify our discussion by noting that many of these latter estimates are imprecise, these results are consistent with avoidance behaviors as the rally would have deterred usual visitors into Tulsa and displaced the usual retail and dining activities that may have taken place in the city on the weekend in the absence of the rally.

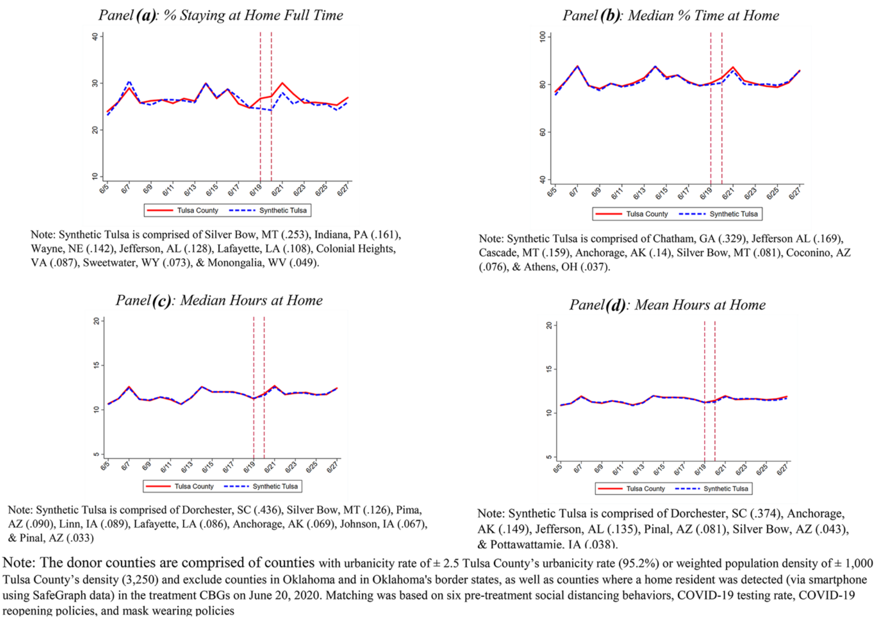


Fig. 4 Synthetic control estimates of effects of Tulsa rally on stay-at-home behavior in Tulsa County

5.2 COVID-19 results

In light of the evidence from Table 1 and the mobility patterns documented in Fig. 1, it is clear that, while attendance at the Trump campaign event fell short of expectations, the event nevertheless did attract a significant inflow of visitors into the treated CBGs. Moreover, the visitors primarily hailed from instate (81.6 percent) and mainly from Tulsa County (43.4 percent) and the broader Tulsa cluster (57.2 percent). In assessing the impact of the large indoor gathering on COVID-19 case rates, as attendees returned home, we therefore aim our spotlight on these areas that contributed the largest shares of visitors to the rally.

Figure 5 presents a synthetic control counterfactual evolution of realized COVID-19 cases for Tulsa County (Panels a and b). Given that Tulsa County is highly urbanized, and the central role played by social interactions and crowding in community spread, we constrain the donor pool to counties that a priori approximate Tulsa in their degree of urbanization as proxied by urbanicity and weighted population density.[32] We draw on this donor pool of similar counties, and construct the counterfactual in Panel (a) by matching on predictors of confirmed infections including social

[32] Given differential risk of exposure, population mixing, and other unobservable dynamics in infection spread, it would not be appropriate to include sparsely populated, rural and less urban counties as part of the potential donors.

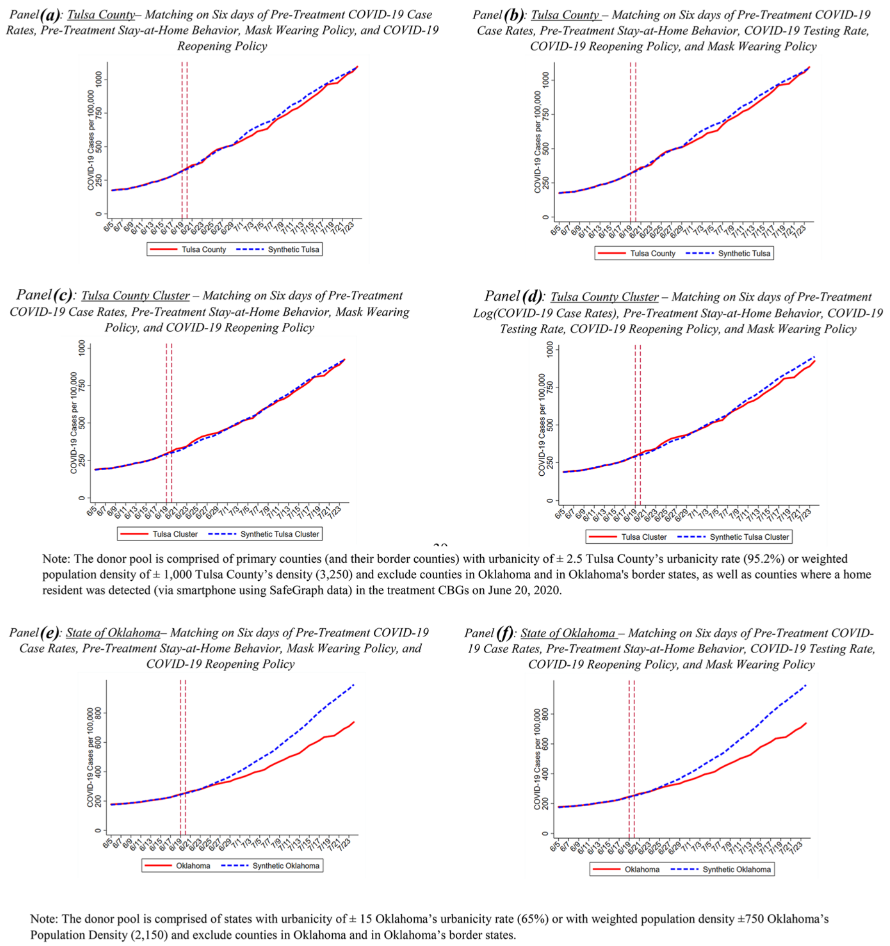
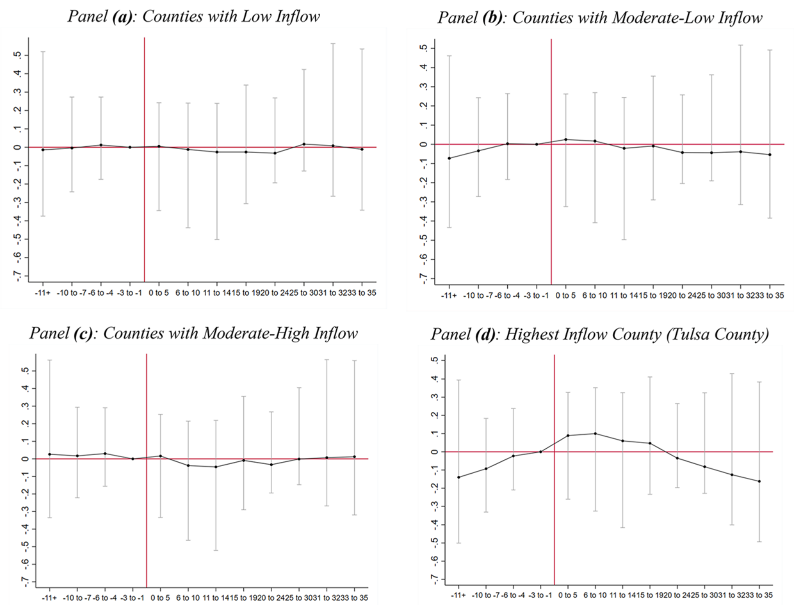


Fig. 5 Synthetic control estimates of effect of Tulsa rally on COVID-19 cases

distancing (median hours spent at home) and COVID-19 testing rates and matching on the outcome at six points in time (June 6, 8, 10, 14, 16, and 18) during the pre-treatment period. Panel (b) further matches on states' reopening policies and policies mandating public use of face masks.[33]

These analyses underscore two points. First, despite not forcing matches on the outcome across all pre-treatment days, synthetic Tulsa County trends virtually identically to actual Tulsa County with respect to confirmed cases and deaths prior to the campaign event. Second, there is little indication that the rally had any meaningful

[33] Appendix Table 1 shows the principal counties (or states, in the case of Oklahoma) that received positive weights from our donor pool in our various matching strategies.



Note: Estimate is generated using weighted least squares estimate. All estimates include county and day fixed effects as well as county specific linear time trend. State policy controls include COVID-19 testing, an indicator for whether a state reopened restaurant or bars, an indicator for whether a state reopened retail services beyond curbside pickup, an indicator for whether a state reopened personal or pet care services, an indicator for whether a state reopened entertainment business, an indicator for whether a state reopened gyms or parks, and an indicator for whether a state paused reopening. County weather controls include average temperature and an indicator for whether any measurable precipitation fell.

Fig. 6 Event-Study analyses of effect of Tulsa rally on covid-19 cases per 100,000 population in Oklahoma and Border States, by Dose (Absolute Inflow)

effects on confirmed infection rates in Tulsa County relative to the control set, within 35 days of the event. These results provide little support for any sustained or persistent increase in COVID-19 infections, as measured by confirmed cases in Tulsa County following the campaign event.

In the remaining panels of Fig. 5, we widen the spatial unit of analysis to incorporate the cluster of surrounding counties (Tulsa County and its neighboring counties in Panels c and d) and the entire state (Panels e and f). These continue to show no signs of any discernible increase in COVID-19 cases in Tulsa cluster and the state of Oklahoma, relative to their synthetic controls.[34]

The corresponding point estimates and their permutation-based inferential statistics for our main analyses are reported in Table 4 for confirmed cases. In columns (1) and (2), we match on observable predictors of COVID-19 infection spread in conjunction with cumulative COVID-19 cases for a subset of the pre-treatment period (six of the 14 pre-rally days), and in column (3) we match directly on cumulative

[34] Confirmed cases in the state of Oklahoma are somewhat lower than their respective estimated counterfactuals, though the difference is not statistically significant (Fig. 5, Panels e and f).

Table 4 Synthetic control estimates of effect of Tulsa rally on COVID-19 cases

	(1)	(2)	(3)
	Panel I: Tulsa county		
Trump Rally	− 20.290	− 20.747	− 36.902
P-value	[0.580]	[0.541]	[0.502]
Pre-treatment mean of DV[a]	230.099	230.099	230.099
	Panel II: Tulsa county cluster		
Trump Rally	− 2.017	− 13.288	− 14.833
P-value	[0.888]	[0.766]	[0.829]
Pre-treatment mean of DV[a]	227.892	227.892	227.892
	Panel III: State of Oklahoma		
Trump Rally	− 106.378	− 106.41	− 104.474
P-value	[0.174]	[0.174]	[0.304]
Pre-treatment mean of DV[a]	203.002	203.002	203.002
Observable used to construct the weights			
Number of pre-treatment days	6	6	14
Matching on median hours at home	Yes	Yes	No
Matching on reopening policy?	Yes	Yes	No
Matching on mask wearing policy?	Yes	Yes	No
Matching COVID-testing?	No	Yes	No

Estimates are generated using synthetic control methods. Matching was conducted using the pre-treatment COVID-19 case rate and variables listed under each column. The permutation-based *p*-values are included in brackets below each point estimate (Abadie et al. 2010)

*Significant at the 10% level, **Significant at the 5% level, ***Significant at the 1% level

[a]Pre-treatment mean of the Dependent variable (DV) is calculated using the treated unit

COVID-19 cases over the entire pre-treatment period. These estimates indicate no consistent or systematic patterns reflective of an increase in COVID-19 cases following the Tulsa rally, and none of the estimates are statistically distinguishable from zero. It is validating that these results are robust across alternate donor pools, matching algorithms, and variation in the donors and weights used to form the counterfactual set.[35]

[35] Our main analyses (Fig. 5 and Table 4) had constrained the donor pool to include jurisdictions with a similar level of urbanization to Tulsa County and to Oklahoma, based on proximity to the treated area's urbanicity rate or weighted population density. Appendix Table 7 presents estimates where we restrict the donor pool alternately based on urbanicity rates alone or weighted population density alone. The results are largely similar. We also generated synthetic control estimates based on the natural log of the outcome (COVID-19 confirmed cases) in order to assess sensitivity to functional form. Relative changes, that is changes in the log of confirmed cases or deaths, may provide a better counterfactual tracking for Tulsa for infections that are growing at a non-linear exponential rate. These results also do not show any consistent, persistent, or significant increase within five weeks following the campaign event.

Table 5 Dose–response difference-in-differences estimates of the effect of Tulsa rally on log (COVID-19 cases)

	Absolute inflow		*Relative inflow*	
	(1)	(2)	(3)	(4)
Counties with low inflow				
June 20-June 25 (0–5 days after rally)	– 0.017	– 0.018	– 0.022	– 0.024
P-value	[0.510]	[0.538]	[0.712]	[0.375]
June 26-July 4 (6–14 days after rally)	– 0.059	– 0.062	– 0.063	– 0.067
P-value	[0.529]	[0.577]	[0.817]	[0.452]
June 5-July 19 (15–29 days after rally)	– 0.032	– 0.034	– 0.022	– 0.027
P-value	[0.519]	[0.644]	[0.250]	[0.529]
July 20 onward (30+ days after rally)	– 0.035	– 0.036	– 0.020	– 0.025
P-value	[0.577]	[0.904]	[0.337]	[0.615]
Counties with moderate- low inflow				
June 20-June 25 (0–5 days after rally)	– 0.011	– 0.015	– 0.001	– 0.001
P-value	[0.288]	[0.317]	[0.654]	[0.596]
June 26-July 4 (6–14 days after rally)	– 0.035	– 0.043	– 0.036	– 0.039
P-value	[0.365]	[0.365]	[0.779]	[0.731]
June 5-July 19 (15–29 days after rally)	– 0.075	– 0.078	– 0.045	– 0.043
P-value	[0.481]	[0.558]	[0.760]	[0.779]
July 20 onward (30+ days after rally)	– 0.101	– 0.101	– 0.068	– 0.064
P-value	[0.519]	[0.817]	[0.375]	[0.865]
Counties with moderate- high inflow				
June 20-June 25 (0–5 days after rally)	– 0.024	– 0.018	– 0.003	0.001
P-value	[0.385]	[0.394]	[0.663]	[0.702]
June 26-July 4 (6–14 days after rally)	– 0.036	– 0.039	– 0.056	– 0.054
P-value	[0.250]	[0.221]	[0.192]	[0.298]
June 5-July 19 (15–29 days after rally)	– 0.067	– 0.059	– 0.053	– 0.042
P-value	[0.404]	[0.375]	[0.769]	[0.385]
July 20 onward (30+ days after rally)	– 0.064	– 0.048	0.005	0.028
P-value	[0.587]	[0.923]	[0.346]	[0.385]
Highest inflow county (Tulsa County)				
June 20-June 25 (0–5 days after rally)	– 0.006	0.001	– 0.0002	– 0.002
P-value	[0.144]	[0.173]	[0.644]	[0.250]
June 26-July 4 (6–14 days after rally)	– 0.029	– 0.030	0.011	0.007
P-value	[0.260]	[0.212]	[0.202]	[0.308]
June 5-July 19 (15–29 days after rally)	– 0.047	– 0.038	– 0.047	– 0.046
P-value	[0.413]	[0.365]	[0.779]	[0.375]
July 20 onward (30+ days after rally)	– 0.057	– 0.038	– 0.064	– 0.059
P-value	[0.596]	[0.913]	[0.356]	[0.375]
N	34,709	34,709	34,709	34,709
Observable controls?	No	Yes	No	Yes

Estimates are generated using weighted least squares. All estimates include county and day fixed effects as well as county specific linear time trends. State policy controls include log COVID-19 testing, an indi-

Table 5 (continued)

cator for whether a state reopened restaurant or bars, an indicator for whether a state reopened retail services beyond curbside pickup, an indicator for whether a state reopened personal or pet care services, an indicator for whether a state reopened entertainment business, an indicator for whether a state reopened gyms, and an indicator for whether a state paused reopening. County weather controls include average temperature and an indicator for whether any measurable precipitation fell. BLM Protest control include an indicator for whether a County had a city with 100,000 or more population with a Black Lives Matter protest. Permutation based *p*-values are included inside the brackets below each point estimate (Buchmueller et al. 2011; Cunningham and Shah 2018)

*Significant at the 10% level, **Significant at the 5% level, ***Significant at the 1% level

Appendix Table 6 presents alternate analyses, following Courtemanche et al. (2020a, b) and Dave et al. (2021b), based on a three-day moving average of growth rate in cases, which is defined as the difference in the natural log of cumulative COVID-19 cases between day t and day t-1. While growth in cumulative cases tends to be noisier, this measure captures dynamics in new confirmed cases from day to day (that is the rate of change or the derivative of cumulative cases over time) and may magnify effects that might otherwise be masked by looking at changes in total confirmed cases. The synthetic control estimates of the effects of the Trump campaign rally on the growth in cases continue to confirm our prior results, and do not indicate any substantial or significant shift.[36]

One concern is that the lack of any discernible increase in COVID-19 cases in Tulsa (and Oklahoma) may reflect reduced availability of testing rather than a reduction in infections per se. Note that in order for this to explain our findings, however, the availability of testing must be differentially affected in the treated areas relative to the control areas post-rally. One limitation, which is not specific to just our study, is that local County-level data on tests are not publicly available. Nevertheless, since the Tulsa Rally drew visitors largely from instate (82 percent of visitors were from within OK), we incorporated state testing availability in various flexible ways in our models (presented in Appendix Figs. 4, 5, 6) to ensure that our results were not driven by the reduced availability of testing across the state. While we are constrained by the lack of granular testing data, in alternate models that match on levels and trends in testing availability at the state level before and after the rally, we continue to find no significant or meaningful increase in confirmed cases across Tulsa County, cluster, or the statewide over the post-event window.

Given that we do not find any significant effects on COVID-19 cases, it is not plausible to expect any effects on mortality. Nevertheless, assessing effects on deaths permits an additional validation check; death counts represent an alternate objective measure of COVID-19 infections that bypasses any issues with the measurement of

[36] Our synthetic approach matches on COVID-19 case growth on each pretreatment day until June 19, and June 19 is included as part of the three-day moving average.

confirmed case counts potentially conflating selection into testing. As with cases, we find no significant or systematic increase in deaths in Tulsa County, within the larger Tulsa cluster, or across the state of Oklahoma over our five-week post-event window (Appendix Table 2 and Appendix Fig. 7). It might be that the five-week post-event window, while sufficient for tracking changes in confirmed COVID cases, may not be sufficiently long enough to detect an increase in deaths from secondary infections. We therefore extend our window of analysis, and continue to find no economically or statistically significant effects on COVID-19 related deaths, within a period of eight weeks following the rally (Appendix Table 4).

5.3 Dose -response results

While the Trump campaign rally was largely a Tulsa event drawing almost half of its attending audience from within the County, it did also pull some – though notably a smaller share – of its attendees from more distant parts, including Oklahoma City (more than 100 miles from Tulsa) and from bordering states (see Fig. 1). Next, we therefore assess whether the Tulsa event led to any increase in COVID-19 cases across any of the counties that contributed attendees, nearby or far, from within the state or from its neighbors. We exploit variation in non-resident pings into the treated CBGs to assess whether there are any changes in confirmed cases across counties that contributed fewer as compared to more visitors to the rally, and if so, whether effects are larger for home counties that supplied more attendees.

Table 5 reports these County-level dose–response difference-in-differences estimates of the association between pings in the rally CBGs and COVID-19 case counts, based on Eq. (2). We group counties whose resident cell phones were detected in the treated CBGs on the day of the rally into four categories (*Low Inflow; Moderate-Low Inflow, Moderate-High Inflow, High Inflow*) that monotonically capture the absolute share of visitors in the treated CBG from the source County. For instance, for the *High Inflow* county (Tulsa County), more than 9.5 percent of observed visitors in the venue CBGs came from this County, compared to the *Low Inflow* counties, where less than one percent of visitors traveled from any of these counties. These estimates are reported in the first two columns, which alternately exclude and include extended controls. Counties with low inflows saw slight decreases in infections following the rally (6.8 percent 15–29 days after and 7.0 percent 30 or more days after) in the saturated model (column 2). Point estimates for counties with high inflows indicate a 1.6 percent increase within 15–29 days, and an 8.3 percent decrease 30 or more days after.[37] None of these estimates are statistically significant or show any consistent patterns reflective of any substantial increase in confirmed cases following the campaign event. That is, we do not find

[37] For convenience of presentation, we present estimates for four lag windows: 0–5 days, 6–14 days, 15–29 days, and 30 or more days. When we further disaggregate the post-treatment days, the pattern of results is similar.

stronger positive effects on cases in counties that drew relatively more attendees to the treated CBGs, especially at the end of three weeks following the event.[38]

Arguably, it is not just the number of visitors returning back to their home County, but also the resident population of the home County, that together may impact the dynamics of population mixing and community transmission. In columns (3) and (4), we report dose–response estimates based on an alternate relative measure of inflow, which considers the share of residents traveling to the rally CBGs relative to the population of the home County, as measured by home resident pings in the Safegraph data. If there are any increases in COVID-19 cases, they would be expected for counties with the most residents pinging in the rally CBGs. Regardless of how we define the inflows, we do not find this to be the case, and estimates continue to suggest no significant changes across the high inflow counties or across any of the other County groupings from which residents visited the treatment CBGs on the day of the rally.

Figure 6 visually presents the event study analyses for the sets of counties alternating from low to high inflows, for realized cases. Differential trends in confirmed cases are fairly flat across each of the treated groups and the controls prior to the rally, and there is little evidence of a significant, substantial or persistent increase in cases for any of these treated groups following the rally.[39]

One concern regarding our finding on the lack of any strong effects for COVID-19 cases is that the post-rally sample period might not be sufficiently protracted to detect an increase in transmission rates. While we acknowledge this possibility, we also note that our sample includes 35 days of data in the post-treatment period, 34 days following the day of the campaign event. This combined with the median incubation period for COVID-19 being 5.1 days, with 75 percent of all infected individuals experiencing symptoms within 6.7 days and 97.5 percent within 11.5 days (Lauer et al. 2020), suggests that our post-event window is long enough to be able capture any substantial increase in confirmed cases if there are any meaningful changes. Moreover, prior work has uncovered strong effects of shelter-in-place orders on confirmed cases within ten days following the adoption of the policy (Dave et al. 2020a, 2021a, b; Courtemanche et al. 2020a, b; Friedson et al. 2021), and other work in economics has detected secondary spread of COVID-19 from travel due to spring break at a 2-week time horizon (Mangrum and Niekamp 2020). Finally, in supplemental analyses available upon request, our dose response estimates provide no evidence of significant or meaningful increases in COVID-19 case or death rates in a period extending to eight weeks following the rally.

[38] Appendix Tables 3 and 5 report the corollary county-level dose–response difference-in-differences estimates for mortality, using the 5-week and 8-week post-treatment windows respectively. As with cases, estimates indicate no significant or systematic increase in deaths across counties that experience the highest inflows of rally attendees. Appendix Fig. 8 visually presents the event study analyses for the counties sourcing from the lowest to the highest inflows of visitors to the rally.

[39] A weakly positive (though statistically insignificant) differential trend in the case rate for Tulsa County (relative to the control counties) prior to campaign event is evident (Fig. 6 Panel d). The event study however shows little indication of a break in this trend or any sustained increase in cases following the event.

6 Conclusion

The Trump Campaign's Tulsa rally on June 20, 2020 was at the time the largest indoor event in the United States since March 2020. In the weeks following the event, numerous high-profile news outlets, including the *Washington Post*, *Time*, *CBS News*, and *CNN* linked the Tulsa rally to a spike in COVID-19 case growth. Commenting on Tulsa's COVID-19 case growth in the weeks following June 20, Tulsa Health Department Executive Director Bruce Dart suggested "we just connect the dots" (Astor and Weiland 2020). However, no study has rigorously examined the impact of the Trump rally on COVID-19. Further, evidence from indoor sporting events in early 2020 and standard epidemiological models of infectious disease spread suggests that the rally had a large potential for increased viral spread in the overall population (Ahammer et al. 2020; Carlin et al. 2021).

This study is the first to empirically examine the link between this event and changes in confirmed COVID-19 case rates, drawing focus on areas that drew the most attendees to the census block groups containing the rally venues and to which the attendees traveled back home following the event. During the five weeks of our post-treatment period, we do not find any significant or substantial changes in the trajectory of COVID-19 cases in Tulsa County, which was home to the Trump rally, or from counties that drew attendees to the event.[40] While the data do not allow us to pinpoint all of the mechanisms underlying our findings, we hypothesize several possible explanations.

First, the results are consistent with avoidance behaviors among those who did not attend to the rally. Given the business and road closures along with the anticipation of large crowds and potential for violence, visitors into the venue CBGs likely displaced typical travellers into the area. These visitors who were displaced would likely have engaged in a number of 'risky' COVID-related behaviors in the treatment CBGs, including bar, restaurant, and entertainment-related activities. Moreover, deployment of the National Guard, which stood ready to assist with crowd control and security, along with police and Secret Service efforts, likely deterred many individuals from the area. In other words, individuals who otherwise typically would have travelled into the downtown area on the weekend may have chosen to stay home that weekend or travel elsewhere, and their activities were displaced. There is some indication of a net increase in stay-at-home behaviors coinciding with the rally, as many non-attendees opted not to travel to the area or leave their homes. Dave et al. (2020b) find similar effects, specifically a net increase in stay-at-home behaviors, in communities following the onset of Black Lives Matter protests. Such avoidance behaviors on the part of other segments of the population can change the level and composition of population mixing, and may also serve to isolate individuals of varying risk profiles.

Second, mitigating factors specific to the rally may also have played a role. These included temperature checks prior to entry, a crowd size that filled the arena to only

[40] Moreover, our confidence intervals reject the large potential increases projected from epidemiological disease modeling described in Sect. 2.3.

about a third of its capacity, and self-protection behaviors (face masks, social distancing) among some of the attendees. Countering these are other considerations; for instance, individuals attending the Trump campaign rally are a selected sample, on average older and less likely to engage in risk mitigation efforts (Barrios and Hochberg 2020). If these individuals are also less likely to get tested, then they may not be reflected in the official case numbers.[41] However, given that turnout was far lower than anticipated, possibly in response to concerns over COVID-19 risk, individuals who are more risk-averse, or perceived themselves to be at a higher risk of exposure or complications may have opted to bypass the event. Thus, the risk of infection among attendees may not be representative of the population risk.

While our findings suggest that the first large indoor gathering in the United States since the COVID-19 shutdowns was not associated with a significant rise in confirmed cases, the complexities of the potential mechanisms at play should not be taken to imply that all indoor gatherings of a similar scale are necessarily low-risk. Our work highlights the importance of understanding the behavior of all parts of the population when trying to evaluate population level outcomes. An increase in risky behavior by one subset of a population is not necessarily enough to change overall population outcomes if other parts of the population behave in a compensatory manner.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11166-021-09359-4.

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[41] We also note that it is possible that due to the selected nature of the rally attendees, the activities forgone to attend the rally may have had a similar infection risk.

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