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ABSTRACT

Mandated shutdowns of nonessential businesses during the COVID-19 crisis brought into sharp relief the tradeoff between public health and a healthy economy. This paper documents the short-run effects of shutdowns during the Spanish flu pandemic of 1918, which provides a useful counterpoint to choices made in 2020. The 1918 closures were shorter and less sweeping, in part because the US was at war and the Wilson administration was unwilling to let public safety jeopardize the war's prosecution. The result was widespread sickness, which pushed some businesses to shutdown voluntarily; others operated shorthanded. Using hand-coded, high-frequency data (mostly weekly) this study reports three principal results. First, retail sales declined during the three waves of the pandemic; manufacturing activity slowed, but by less than retail. Second, worker absenteeism due to either sickness or fear of contracting the flu reduced output in several key sectors and industries that were not ordered closed by as much as 10 to 20% in weeks of high excess mortality. Output declines were the result of labor-supply rather than demand shocks. And, third, mandated closures are not associated with increases in the number or aggregate dollar value of business failures, but the number and aggregate dollar value of business failures increased modestly in weeks of high excess mortality. The results highlight that the tradeoff between mandated closures and economic activity is not the only relevant tradeoff facing public health authorities. Economic activity also declines, sometimes sharply, during periods of unusually high influenza-related illness and excess mortality even absent mandated business closures.

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> "Business led me out sometimes to the other end of the town … [and] it was a most surprising thing to see those streets, which were usually thronged now grown desolate…I might sometimes have gone the length of the whole street, I mean of the by-streets, and seen nobody." --Daniel Defoe, *A Journal of the Plague Year* ([1722]/1904, 19).

1. Introduction

One of the principal debates during the height of the COVID-19 crisis in May 2020 concerned the tradeoff between the public health and economic consequences of keeping non-essential businesses closed and people indoors. Between February and April, after several weeks of lockdown and shelter-in-place orders, the unemployment rate in the United States increased from a near-historic low of 3.5% to 14.7%, or one not witnessed since the Great Depression (BLS 2020). In April 2020 alone, nonfarm payrolls fell by 20.5 million – the leisure and hospitality (7.7 million) and retail (2.1 million) sectors suffered the largest declines. Retail sales fell 16.4% and manufacturing output declined 13.7%, each of which was the largest single monthly decline on record (Torry 2020). In the first five months of 2020, more than 100,000 Americans died from influenza-related complications (CDC 2020). The counterfactual is hard to know, but in early January some epidemiological models predicted, absent mandatory closings and social distancing measures, as many as 2.5 million excess deaths. Economists talk about tradeoffs. The decision to lock down retail and manufacturing establishments in order to "flatten the curve" was a tradeoff of enormous consequence.

In 1918 government officials at all levels also struggled with the tradeoff between public health and a healthy economy. Woodrow Wilson's administration was concerned with a different tradeoff. It could wage total war

in Europe or it could quarantine army bases to stop the spread of the Spanish flu. It chose to prosecute the war. The administration made the decision knowing that either large numbers of young men would die of complications from influenza in American military installations and on troop ships bound for France, or more of them would die in trenches (Barry 2018). At the same time, Philadelphia's inept, corrupt, and much-maligned public health officials delayed issuing quarantine orders and Philadelphians died at the highest rate of any large US city. Wirth (2006, 322) recognizes, however, that the decisions of the director of the city's Department of Public Health, Dr. Wilmer Krusen, were driven by his sense of balance between "public health with the city's desire for a robust economy." Krusen's choices now seem wrongheaded, but in October 1918 the city's leaders were under such intense pressure from federal Liberty Loan administrators to meet the city's sales quota and the war department to keep the city's shipyards open that his decision to lean toward the robust economy may not have been as negligent as it appears in retrospect.

When the virus started to spread in autumn 1918, local public health authorities responded with a number of traditional measures adopted during previous polio and cholera epidemics: isolation of infected individuals, quarantine of those having contact with infected individuals, surveillance of at-risk populations (school students), disinfection and hygiene, targeted closings, and public service announcements (Rosner 2010, 45). Municipal and state public health officials closed schools, churches, theaters, restaurants, bars and saloons; they shut down streetcars; they asked people to refrain from nonessential travel of all kinds; they asked doctors who treated suspected cases to report affected individuals and families to local officials; they limited business hours. All of these measures took a toll on local businesses of all kinds. Retail sales fell, sometimes precipitously (Garrett 2007). With public transport shut down, employees' commutes became more difficult. Worker absenteeism increased. Manufacturing productivity declined.

People, of course, responded endogenously to the risk of venturing out.[1] Even those not afflicted refused to go out. In early October, prior to peak mortality in Philadelphia, people were already avoiding each other; they were isolating themselves. Barry (2018, 332) quotes one survivor: "We didn't work. Couldn't go to work. Nobody came into work … they were all afraid." Some business owners did likewise. Grocers and dealers in all kinds of goods simply closed up their stores, either because they were already ill or afraid that, if they kept their stores open, they would become so. Thus, the virus created both supply-side and demand-side effects. Worker absenteeism, whether among the healthy or the sick, reduced production capabilities. As people refused to venture out, sales of consumer goods declined. Sorting out the independent supply- and demand-side effects is an empirical challenge.

This study assembles a wide variety of high-frequency qualitative and quantitative data to shed light on the supply- and demand-side effects. Instead of trying to identify the effects statistically through the use of exogenous demand or supply shifters, the underlying hypothesis is that the federal administration's semi-nationalization of wartime production pushed much of the US manufacturing sector to maintain operations in order to meet the military's needs. The production and sale of strictly civilian consumer goods were not a federal priority. As a result, manufacturing and mining, especially in war-related activities, were more likely to be affected by supply-side effects; that is, declining manufacturing productivity and output were more likely to be influenced by voluntary (fear) and involuntary (sickness) worker absenteeism than from endogenous declines in demand. In the very short term, however, civilian-oriented retail was more likely to be affected by endogenous

[1] Economists have adapted standard epidemiological models of infectious disease spread to include behavioral responses to the risk of contracting the disease. A critical parameter in a standard SIRD (susceptible-infected-recovered-died) model of new infections, β, effectively accounts for the number of contacts an infected person has per day. Government mandates (shelter-in-place or closure orders) or individual decisions to self-isolate slow the rate of spread of the disease. A sufficiently large response will lead to the diseases dying out as the rate of new infections per infected person falls below one. Kermack and McKendrick (1927) develop the original SIR model as a system of differential equations; Fernandez-Villaverde and Jones (2020) provide a tractable extension that includes a time-varying β response parameter and a feedback effect that reduces the spread as people choose to avoid close contact with others.

demand shocks due to consumer illness or self-isolation than supply shocks resulting from worker absenteeism.

Using hand-coded, high-frequency (mostly weekly) qualitative and quantitative information, supplemented by narrative evidence, from a variety of trade publications, this study documents the effects of the influenza pandemic and mandated shutdowns, or nonpharmaceutical interventions, on economic activity in several important economic sectors in the U.S. South. The South is an informative case for several reasons: (1) the virus appeared early, before officials were aware of its virulence and the salutary effects of mandated closures; (2) the incidence of the flu varied across the region, from a maximum weekly excess mortality rate of 200 per 100,000 population in Baltimore to 75 in Atlanta; (3) the South was home to several critical war-related industries, including coal, cotton textiles, and lumber; and (4) the region's business sector was particularly hard hit by the virus, in that between 1915 and 1920 more businesses failed in the South than in any other region and the failure rate on a per capita basis exceeded the country's other regions.[2]

The first set of results point to declines in both retail and manufacturing activity in the weeks of unusually high influenza related deaths that are attributable to both mandated closings and the sickness itself. The independent effect of the influenza epidemic is evident during the two non-peak waves of mortality that occurred after closing orders were lifted. Second, quantitative evidence from the coal mining industry reveal almost pure supply-side effects due to workers incapacitated by the disease through illness or a reluctance to report to work for fear of catching it. Production in the South's principal coal fields in Kentucky and West Virginia declined by upwards of 15% at the height of the epidemic despite pressure from the US Fuel Administration and War Department to meet the industry's government-established weekly output quotas. Third, narrative evidence from the region's textile- and lumber-producing regions points to equally large short-term

[2] It is impossible at the moment to construct regional business failure rates because the principal sources of business failures did not provide estimates of the total number of businesses at risk at the regional level. See the discussion in Section 6 for further details concerning business failures.

declines of output. Declines in textile output are, like coal, almost purely labor-supply driven, as the army needed uniforms and tent canvas. Declines in lumber output, however, were due to a host of supply and demand-driven factors. Finally, weekly reports of the number of business failures in the South and elsewhere provide evidence that a rise in influenza-related mortality during the pandemic was associated with an increased number of business failures. The implementation of nonpharmaceutical interventions, as well as the Armistice and immediate peace-time adjustments are, however, associated with modest declines in the number of failures.

The evidence brings into sharp relief one feature of the tradeoff between public health and a healthy economy. The COVID-19 debate focuses on the economic costs of mandatory lockdowns and shelter-in-place orders. Less discussion has focused on the economic costs of the counterfactual of not locking down and not sheltering. History offers an object lesson. Any comparison between 1918 and 2020 must be drawn carefully given advances in medical practice, changes in the structure of the economy, and the inherent differences between countries at war and peace. But wartime demands militated against mandatory lockdowns and sheltering orders. One consequence was that the Spanish flu virus was passed among workers and several industries experienced epidemic outbreaks in their workplaces. Productivity declined. Some of the South's principal industries witnessed 25 to 50% worker absenteeism rates that reduced output by 10 to 20% for periods between one and four weeks. Had it not been for federal administrators pressuring these industries to maintain production in support of the war effort, it is likely that the output declines would have been even larger. America's experience with the Spanish flu shows that any debate about health benefits and economic costs of lockdowns and shelter-in-place orders must be compared to a reasonable counterfactual in which more people die and the economy still contracts. In short, the question is: how do we compare a 15% unemployment rate and 100,000 deaths at the end of May 2020 to a "full-employment" economy with a 7% sickness-induced absenteeism rate and,

perhaps, several multiples of the number of recorded deaths? The American experience with the Spanish flu offers insights not answers.

2. The pandemic in the South

In late January 1918, Loring Miner, a country doctor in Haskell County, Kansas, was called to treat several patients with what appeared to be an unusual strain of seasonal influenza. The symptoms included a violent headache and body aches, high fever, and a nonproductive cough, but he had never before witnessed a flu that struck with such intensity. Its progress through the body was rapid, and it killed, usually in short order. Within a couple weeks, Miner lost dozens of patients. What was most distressing was that those dying were the strongest, the heathiest, and the most robust young men among those who came down with the flu. He contacted the U.S. Public Health Service, but they offered him neither advice nor assistance (Barry 2018, 91-94).

At about the time Miner was confronted with an apparently new strain of the influenza virus, several young men from Haskell County reported for army basic training at Camp Funston in eastern Kansas. The weather that winter was unusually cold and the quickly-constructed base did not provide adequate shelter, heat, or outerwear. To keep the fresh recruits warm, as many beds as possible were placed in each of the barracks and men huddled around stoves. The first report of a flu-like sickness was reported on March 4. Within weeks 1,100 men were admitted to the base hospital and thousands more were treated in the infirmaries. Eventually, 237 men contracted pneumonia; 38 died. Wartime exigencies and the need for men meant that Camp Funston supplied a stream of potentially exposed or infected soldiers to the front lines in Europe, where a particularly virulent and deadly strain of the influenza broke out, spread, and was carried back to the US beginning in late summer 1918.

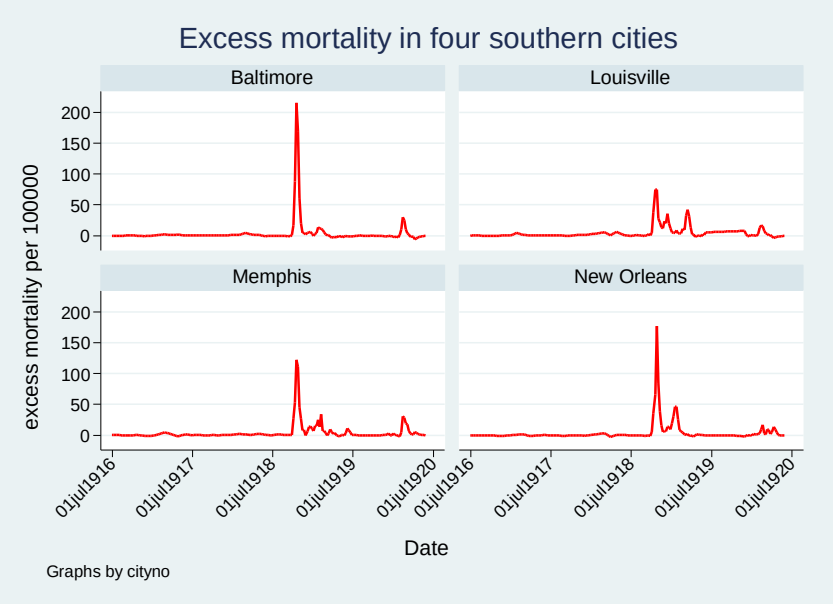
No one is sure whether the 'Spanish flu' originated in western Kansas – some epidemiologists contend that it originated in China, Vietnam, or even in the trenches in France – but at least one Nobel laureate who spent his life studying influenza was convinced of its Kansas origins (Barry 2018, 98). When

it came back to the US, by way of troops returning from Europe through Boston, it spread rapidly and killed at unprecedented rates. By mid-October 1918, when the typical influenza-pneumonia mortality rate would normally have been about 2 per 100,000 per week, it rose above 94 in the 35 largest US cities.[3] Mortality rates remained above 10 through February 1919, or about twice the median weekly mortality rate (Collins et al 1930, 2281 [Table 3]). A second wave appeared in February 1920 when mortality rates briefly rose above 28.

Figure 1 presents excess mortality rates in four representative southern cities reported in Collins et al (1930), which mirror the experiences of other major metropolitan areas, though there is substantial variation across cities. Among southern cities, Baltimore experienced the highest excess mortality rates, with a weekly peak of nearly 200 per 100,000 population. Southern cities also reveal a range of experiences that accords with Collins et al's (1930, 2301) assertion that, while most people think of the pandemic as a singular, shared event occurring in October and November 1918, the epidemic persisted, by their accounting, for 31 weeks with a peak mortality on 19 October 1918. Unusually high excess mortality rates continued, however, into March 1919. While many cities experienced a second (some label it a third) peak in winter 1920, which on its own would qualify as an epidemic, it is dwarfed by the 1918 peak.

[3] Epidemiological studies of the era combine influenza and pneumonia deaths because it was common for physicians to report influenza-related deaths as pneumonia.

Figure 1
Weekly excess mortality in four southern cities
Source: Collins et al (1930)



Southern officials responded to the appearance of the virus in much the same way elected officials and health authorities elsewhere. Despite published reports from Boston and New York about the seriousness of the virus, when the first cases were reported in Wilmington, North Carolina, on 19 September 2018 the city's public health commissioner assured residents that it was probably a common flu and there was no call for unusual measures or precautions (Cockrell 1996).[4] Within a week, the city's hospitals were inundated with sick and dying patients. The virus radiated out from the port city along the railroad lines. Within weeks, Kannapolis, a cotton mill town that was home of Cannon Mills, located 30 miles north of Charlotte and with a population of about 6,500 was thought to have had 2,000 cases of the flu. Kannapolis's three doctors, exhausted from overwork, begged for assistance. Similar stories appear across the South. At Mississippi A&M College (now

[4] Arkansas' United States Public Health Service officer, James C. Geiger, is similarly quoted as having observed, on September 7, even after receiving reports of its virulence in Boston, that the obviously novel strain of the virus was a "simple, plain old-fashioned la grippe." (Scott 1988, 320).

Mississippi State University) in Starkville, nearly all 1,800 students were inducted into the army. More than half contracted the virus. By the time 36 died, the region's US public health official noted that locals were near panic (Barry 2018, 342-345).

Once southern municipal health authorities appreciated the seriousness of the flu, they responded with a variety of measures aimed at limiting the spread and mortality of the virus. Epidemiologists label them nonpharmaceutical interventions (NPIs), which, when faced with a virus without treatments or vaccines, are considered the most effective public health responses. Schools, churches, dance halls, pool halls, saloons, and theatres were closed. Retail store hours were shortened, usually to daylight hours to limit after-work crowding when people shopped as they made their way home (Woolley 1963). Even public funerals were suspended so that only immediate family could mourn and still keep their distance from others.

< table 1 about here >

Table 1 reports the date of the first reported appearance of an influenza case in select southern cities, the date the first NPI closure order was issued, and the number of days any NPI was in effect. Markel et al (2007 and supplementary online materials) report that although school and business closure orders may have been issued on different dates, the orders were sufficiently close in time that they cannot be studied separately using standard statistical methods. That is, there were sometimes only a day or two between an order to close schools and one to close certain businesses, so that it is impossible to discern the independent effects of each with weekly or monthly mortality data. There was about a two-week lag between the first reported influenza case and the issuance of a closure order. The average length of

southern cities' NPIs was 52 days. Louisville's lockdown was the longest among the city's reported here; Memphis's was likely the shortest.[5]

There is a general consensus in the epidemiological literature that earlier and more comprehensive shutdown orders delayed peak mortality and reduced peak and overall mortality, though the effects of non-pharmaceutical interventions on overall mortality are smaller. Hatchett et al (2007) find that cities with earlier and more interventions experienced peak mortality approximately 50% lower than cities that did not intervene, but cumulative excess mortality was reduced by about 20%. Bootsma and Ferguson (2007) run simulations using a standard epidemiological transmission model and find that short-term interventions, like those implemented in 1918, reduced total mortality by 10 to 30%, but cities with longer more comprehensive NPIs witnessed transmission rates 30 to 50% lower than other cities. Markel et al (2007) and Barro (2020) use a larger sample of cities and find that cities with earlier and broader bans on public gatherings experienced delayed peak mortality, lower peak mortality rates, and lower total mortality. These studies demonstrate a strong correlation between early and comprehensive closings. They do not, however, address the potential tradeoff between economic losses due to closings and the losses attributable to reduced economic activity incidental to increased morbidity and mortality during a pandemic.

3. Economic consequences of the pandemic

Relying on narrative and anecdotal accounts, a number of histories of the pandemic discuss its economic consequences at the macroeconomic and the microeconomic levels. At the macro level is an account of Philadelphia's experience, which cites a contemporary Pennsylvania State Health Commission report that estimated Philadelphia's economic losses from the pandemic in October 1918 alone to be $55 million, or about $27.50 per capita

[5] Finger (2006) does not report the exact date of Memphis' shutdown. He reports that by October 12, the city's schools had been closed for a few days. I imputed Thursday, October 10 as the shutdown date, but it may have happened as early as Monday, October 7.

(Wirth 2006, 335).[6] Although Philadelphia's pandemic mortality experience was worse than that experienced in any southern city, mortality rates were of the same order of magnitude in Baltimore and New Orleans. Slosson (1930, 45) estimates that the total economic cost to the US of the 1918/19 pandemic was $3 billion, or about 3.9% of gross domestic product (cited in McLaurin 1982).

At a less disaggregated level, a history of the epidemic in Paducah, Kentucky finds that a local clothing manufacturer was forced to close for 10 days due to the high absenteeism rate among sick employees; a local newspaper stopped publishing for more than a week for the same reason (Maupin 1975). Local coal mines, too, suspended operations when worker absenteeism rose, but the dollar value of any losses are not reported or estimated.

Whereas some businesses closed voluntarily as an endogenous response to the outbreak, others were ordered closed by various municipal, county, or state authorities. In the second week of October, North Carolina's state health commissioner imposed a ban on almost all social interactions that, if strictly interpreted, would have closed nearly every business in the state. The commissioner found it difficult to enforce his order, especially against small businesses. When the board tried to enforce it against larger businesses, they pushed back. Several large tobacco manufacturers appealed the closings to the governor, but the governor refused to overturn the health officials' orders. Henry Pope, the federal Food and Drug Administration's North Carolina representative also protested the closing of a cottonseed oil mill because oil was vital war materiel. Not every business resisted. When Shreveport's health authorities restricted business hours the president of the city's Retail Merchants' Association asked businesses to comply. "The loss of a few dollars," he said, "is as nothing compared to the health of the people" (McLaurin 1982, 7).

[6] Wirth (2006) cites a newspaper clipping found in an archive as the source (Philadelphia *Evening Bulletin*, 31 October 1918), but I have not been able to locate any such report among the online records of the Pennsylvania Health Commission. The $27.50 estimate is equivalent to between $500 and $1,000 in constant 2020 dollars, depending on the conversion factor included at the Measuring Worth website (Williamson 2020).

Despite the reluctance of many businesses to shutter their doors, Cockrell (1996, 314) writes that among those enterprises not forced to close due to worker absenteeism, "many enterprises shut their doors voluntarily" for a few weeks, at least, in response to the perceived danger. Following an outbreak at a nearby military cantonment in early October, Shreveport Louisiana's theaters closed voluntarily rather than risk contributing to the virus's spread (McLaurin 1982). A study of Little Rock, Arkansas' documents the city's quarantine order that closed schools, churches, and theaters, and restricted retailers' hours of operation, features Little Rock shared with other cities. But the city's health officials went farther when they prohibited "bargain" sales to discourage crowds (Scott 1988, 331). While this last restriction appears trifling at first blush, any late fall retail restriction threatened the Christmas sales season, which was as important to some retailers then as now.[7]

The COVID-19 outbreak has encouraged economists and economic historians to document the consequences of epidemics and public health responses to them. At a theoretical level, Eichenbaum et al (2020) extend a standard epidemiological model of contagious disease to include the interaction between economic choices and epidemic. Their results suggest that people's choices to reduce consumption and work to avoid contracting the virus reduces the severity of the epidemic. It also necessarily reduces economic activity by a nontrivial amount.

An early effort by an economist to document the costs of the pandemic adds some quantitative analysis to the newspaper reports relied on by historians. Garrett (2007) uses hand-collected reports from Little Rock and Memphis and finds that retail businesses experienced substantial reductions in sales during the pandemic. Smaller retailers in Little Rock reported sales declines of 40 to 70 percent, and a department store reported a 50 percent

[7] *Dun's Reports*, which surveyed local business conditions in the pandemic era, repeatedly discussed holiday sales, especially at large department stores, as an indicator of the retail sector's health. On 7 December 1918, for example, *Dun's* published the following concerning Philadelphia's retail sector: "With very great improvement in public health conditions, retail trade has assumed seasonable activity, the larger stores are crowded with holiday shoppers."

decline. On October 19, near the epidemic's peak, the reporter estimated that Little Rock's businesses were losing about $10,000 per day ($170,000 in 2019 dollars, or $2.60 per capita), mostly in spoilage of unsold goods, that would not be realized when the quarantine was lifted. In Memphis, the city transit authority reported that than 25 percent of their workers were out sick, and the local phone company asked the public not to make unnecessary calls because most of its operators were out sick.[8]

Most economic studies of the pandemic focus on its medium- to long-term consequences. Brainerd and Siegler (2003) find a positive correlation between states with high influenza mortality in 1918 and income growth over the subsequent decade, which is consistent with the predictions of a standard growth model in which the labor-capital ratio declines sharply. Barro et al (2020) estimates suggest that US gross domestic product declined by 6% and per capita consumption by 8%, which makes the pandemic the fourth costliest event of the twentieth century behind the two world wars and the Great Depression. Using a difference-in-differences approach Correia et al (2020) find that the epidemic led to an average decrease in state-level manufacturing output of 18% and an increase in bank loan charge-offs through 1923. They also report that the adoption of more aggressive closings and social distancing measures had a modest positive effect on economic activity in the years after the epidemic. Lilley et al (2020), however, argue that once they control for pre-existing trends the effect of non-pharmaceutical interventions studied by Correia et al (2020) is "a noisy zero." Finally, Almond (2006) finds that men and women observed in 1960, 1970 and 1980 who were exposed to the virus in utero exhibit lesser later-life attainments. They were 15% less likely to graduate from high school, men's wages were 5 to 9% lower, occupational

[8] Back-of-the-envelope extrapolations from modern studies, assuming a 33% incidence rate for the Spanish flu rather than an average of 2.5% of a typical flu season, suggest per capita losses from lost work days during the pandemic between $6.75 and $13.10 in 1918, or about 0.9% to 1.8% of gross domestic product, which are of the same order of magnitude as contemporary estimates of retail sales losses (Akazawa et al 2003). The calculation does not account for changes in composition of the workforce over the twentieth century. Other studies suggest smaller losses in typical influenza years. See Thanner, et al (2011).

statuses were lower, poverty rates were higher, and they were more likely to receive public support.

An exception of economists' focus on medium- to long-term consequences of the epidemic is Velde (2020). He looks at a number of economic indicators at the monthly and, occasionally, weekly data in the months surrounding the pandemic. Using standard time-series methodologies (i.e., vector autoregressions) Velde finds that the epidemic and public health interventions had small negative to zero effects on monthly retail sales, employment, pig-iron production, and bank loans. Velde's conclusion accords with Arthur Burns and Wesley Claire Mitchell's (1946) assessment that the epidemic led to a modest, brief recession.

In a non-US context, Jordá et al (2020) find that major pandemics' effects on real asset returns persist for as much as 40 years. Karlsson et al (2014) uncover no discernible effects on earnings, but find that returns to capital were reduced, and that poorhouse admissions increased in Sweden. Percoco (2016) finds that in utero exposure to the virus among Italians reduced later-life educational attainment. Guinmeau et al (2019) report negative effects of exposure to the influenza on long-term health and labor productivity in São Paulo, Brazil. Blickle (2020) finds that German regions experiencing higher mortality rates had lower school spending and were more likely to vote for the Nazis between 1925 and 1933.

Thus, existing research into the consequences of the pandemic reveal a host of negative medium- and long-term consequences. This paper is closest in spirit to Garrett's (2007) in that it assesses the immediate impacts of the virus and lockdowns on economic activity and Velde (2020) in the use of high-frequency data. As Velde notes, the epidemic and NPIs were sufficiently short that any assessment of its immediate and short-run impact requires high-frequency (weekly or monthly) data. Although I make use of contemporary narrative evidence, I also use high-frequency data on business activity, NPIs, and excess mortality to investigate their supply-side and demand-side effects.

4. Data

The principal data on business conditions used here is hand-coded from the source materials, mostly *Bradstreet's* and *Dun's Review*. Information on city-level mortality was compiled by the public health service in the 1930s, and information on business closings and quarantines comes from Bootsma and Ferguson (2007) and Markel et al (2007).

4.1 Excess mortality

Collins et al (1930) reconstruct excess mortality for 35 large US cities for which there is a continuous series of weekly mortality from influenza and pneumonia from the onset of the pandemic in 1918. These two causes of death are combined because most influenza victims die from pneumonia or pneumonia-like complications that develop in consequence of the immune system's response to the viral infection. Prior to the pandemic, they report monthly estimates of excess mortality calculated from data reported in municipal and state health reports, as well as the US Census Bureau's annual *Mortality Statistics*.

The calculated excess mortality for the 31-week pandemic period are relative to estimated median weekly death dates between 1910 and 1916, where weekly rates prior to 1918 are inferred from plots of monthly data. Calculated weekly excess mortality rates for the post-pandemic period are relative to median rates between 1921 and 1927. To further smooth the median relatives, Collins et al (1930) calculate excess mortality rates relative to the five-week moving median weekly death rate. Thus, their excess mortality estimates are calculated for city j in week t as:

$$Excess\ mortality_{jt} = mortality_{jt} - \sum_{jt-2}^{jt+2} \left(\frac{1}{5}\right) median\ mortality_{jt \in 1910-16}$$

The rates calculated in this way are the mortality data used in the analysis of weekly data hereafter. Prior to September 1918, weekly rates are interpolated

from the city-level monthly rates reported in Collins et al (1930) using the ipolate command in Stata.

4.2 Non-pharmaceutical interventions

Dates for which cities closed schools, churches, public transportation, entertainment venues, and restricted the operating hours of some retail businesses come primarily from Markel et al (2007) and Bootsma and Ferguson (2007) and their online appendices. Table 1 lists the NPIs for the seven large southern cities included in subsequent analyses (Atlanta, Baltimore, Louisville, Memphis, Nashville, New Orleans, and Richmond), as well as for a handful of smaller cities.

The first reports of influenza appeared in the second or third weeks of September. Given that the onset of the epidemic is dated to the first week of September in Boston, the virus appeared in southern cities in short order. Most of the NPI orders were issued two to three weeks after the first influenza cases were reported and most were rescinded in whole or in part by the last week of October or first week in November.

The decision to allow public gatherings in early November probably led to the second peak that appeared in most cities between late November 1918 and January 1919. When the Armistice was announced on 11 November, for example, spontaneous public celebrations broke out in cities and towns across the United States. People poured into the streets to celebrate, but this kind of mingling was what the public health authorities had been trying to avoid when they closed schools, churches, public transportation, and some businesses. Health officers in Paducah, Kentucky and Little Rock, Arkansas, in fact, attributed the late-November resurgence in reported cases and deaths to the Armistice-day celebrations (Maupin 1975, Scott 1988). By the end of November, conditions had deteriorated sufficiently in Arkansas that the state health commissioners contemplated a second statewide shutdown.

The resurgence of the virus in late 1918 and early 1919 and its reappearance in January and February 1920 did not elicit similar public health responses affords the opportunity to estimate an endogenous public response

to the virus and disentangle its effects from the NPIs imposed during the peak mortality weeks in October and November 1918. Relying exclusively on the peak mortality period which coincided with closings and quarantines would make separating their independent effect difficult. The second wave and winter 1920 resurgence unfolded without NPIs, which makes it possible to estimate worker and consumer responses to the epidemic.

4.3 Business conditions

Descriptions of contemporary business conditions were drawn from four principal sources, *Bradstreet's: A Journal of Trade, Finance, and Public Economy* (1917-1919), *Dun's Review: A Journal of Finance and Trade, Domestic and Foreign*, *Coal Trade Journal* (1918-1919), and *Textile World Journal. Bradstreet's* and *Dun's* published weekly narrative summaries of local business conditions for a core group of about 40 cities, which were supplemented by monthly reports for another 20 to 30 cities. The narratives for major cities were usually several paragraphs in length. Descriptions of business conditions in smaller cities were usually one to two paragraphs in length. The descriptions often provided some details of specific trades or manufacturing business. The retail narratives tend to focus on grocers and department stores, but dry goods, hardware, and other lines are addressed on occasion. Manufacturing narratives explore the range of local industries.

Bradstreet's reports are particularly useful because the first page of each issue published summary assessments of current conditions in wholesale trade, retailing, manufacturing, and debt collections in each city. With few exceptions, conditions were summarized on a four-point scale: active, good, fair, and slow (sometimes, quiet or dull). This study makes use of the retail and manufacturing rankings.

4.4 Business failures

Business failures also point to potential effects of the Spanish flu pandemic on business activity in the South. Information on business failures comes from *Dun's*, which considers a business closing as a failure if it was a

closing by an individual, firm, or corporation (presumably, meaning proprietorship, partnership, or corporation) engaged in a business activity that involved some loss to creditors.

Both *Bradstreet's* and *Dun's* provided weekly, monthly, quarterly, and annual accounts of business failures. Both publications printed a weekly report broken down by region. The regional analysis below uses the *Dun's* accounts, which reported the number of failures of large businesses (assets greater than $5,000), as well as all business in four regions: East, South, West, and Pacific.[9] The South in *Dun's* is defined (approximately) as south of the Mason-Dixon line and the Ohio River and east of the Mississippi River. Weekly accounts of regional failures provide no information about industry or sector.

Each month *Dun's* provided details on failures in three broad sectors (manufacturing, retail, brokerage and finance), further delineated by principal lines of business. The number of failures in the manufacturing sector, for instance, is further subdivided into several categories including machinery production, textiles, grain milling, and so on. The retail category is divided into such categories as general stores, grocers, hotels and restaurants, liquor, clothing, and dry goods. Sectoral reports include number of failures and their total liabilities, but the monthly data is not reported at the regional level. Thus, the analysis of business failures focuses on the weekly regional data. Monthly sectoral data is used to illuminate the industrial composition and average size of failing businesses.

5. Empirical approach and results

The 1918 pandemic is likely to have had both supply-side and demand-side effects on local business and economic activity (Correia et al 2020). On the supply side, cities that experienced a higher infection and mortality rates likely experienced more pronounced negative labor-supply shocks. Illness-driven absenteeism, mobility restrictions (i.e., shutting down public transport),

[9] Dun's choice to maintain the $5,000 nominal dollar value cutoff to distinguish between large and small business failures means that the average size of large failures declined because the overall price level more than doubled between 1914 and 1919. For this reason, I analyze all business failures rather than its large and small business components.

and self-isolation among workers affected businesses in all sectors, especially manufacturing enterprises with time-sensitive war department contracts. On the demand side, households may have reduced expenditures on consumer goods that required substantial interpersonal contact, such as restaurants, bars, and theaters. Moreover, uncertainty about short- and long-term employment consequences of the pandemic may have depressed demand if the pandemic reduced permanent income, recognizing that survivors may have anticipated higher wages due to the disproportionate mortality among working-age men (Brainerd and Siegler 2003). What follows is the analysis of several high-frequency series designed to shed some light on these separate effects.

5.1 Retail and manufacturing reports and influenza incidence: narrative evidence

Although *Bradstreet's* and *Dun's* provided narrative descriptions of retail and manufacturing activities in more than a dozen southern cities, to keep the discussion tractable this section discusses the experiences of just three cities – Baltimore, Memphis, and New Orleans – that capture the geographic and economic diversity of the South. Baltimore was an important, upper-South manufacturing center. Memphis's principal business was cotton wholesaling and little of its manufacturing, outside lumber, was considered vital to the war effort. New Orleans was the entrepot for manufactured goods moving up and agricultural goods moving down the Mississippi and Ohio rivers. The New Orleans area also had a modest manufacturing base and an important seasonal sugar manufacturing industry.

Turning first to assessments of the cities' retail trades prior to the outbreak, *Dun's* and *Bradstreet's* noted strong sales in all markets despite wartime shortages of many consumer goods. *Dun's* (28 September 1918), for example, reported that Baltimore's shopping districts were "busy" and some retail stores already faced labor shortages due to the draft. A week earlier *Dun's* Memphis (21 September 1918) correspondent notes that labor was "scarce" and the recent draft required the "larger use of female labor" in retail establishments. Correspondents from all three cities reported that retail sales continued to hold up well during the early stages of the pandemic. *Dun's*

reports dated 12 October from Baltimore was that "fall business in … retail lines has opened up briskly; from New Orleans, "retail transactions are holding up well;" and from Memphis, "retail trade is exceeding expectations."

Just one week later, the reports were much less optimistic. *Dun's* (19 October 1918) reported that "owing to the continued influenza epidemic," Baltimore's health authorities had shut down or restricted the hours of "most retail establishments;" the news from New Orleans was that retail trade was "far under average." *Bradstreet's* (19 October 1918) Memphis reporter noted that the "epidemic of influenza also has had some effect, especially on retail trade. Theaters and gathering places are closed;" it's New Orleans assessment was even less encouraging than *Dun's*: "retail trade has been seriously interfered with by the epidemic."

By mid-November, the outlook in all three cities improved as fewer new cases of the infections were reported and flu-related deaths declined. Retail, in fact, appears to have recovered apace. *Dun's* (23 November 1918) positive reports included Baltimore's, which read: 'indications for retail trade during the fall are viewed as being particularly bright, the average purchaser apparently having more money to spend than ever before, and buying freely;" but *Bradstreet's* assessment of Baltimore on the same date read: "influenza has entirely disappeared, but its effects on business are still apparent." *Dun's* reported that retail in New Orleans compared favorably with a year earlier, and in Memphis it was "proceeding satisfactorily." By mid-December, holiday shopping was in full swing and compared favorably to prior years.

< Table 2 about here >

Table 2 provides a date-by-city matrix summarizing my reading of the narrative market analyses. Shaded cells signify that the analysis of a city's business activity made reference to the influenza epidemic using any term such as *influenza*, *epidemic*, or *sickness*. Discussions most often used the term "epidemic of influenza." The letters inside each cell refer to closings or NPIs (C), quarantines (Q), whether retail sales were believed to have been negatively

affected by the epidemic (S), and whether manufacturers faced epidemic-related labor shortages (L). Distinguishing between epidemic-related and draft-related shortages requires a close reading of the analyses. City market reports throughout all of 1918 include repeated references to labor shortages, but most are related to military inductions of young men and women except and until the weeks surrounding peak epidemic mortality.

The table makes clear that the epidemic reduced retail sales in most southern cities. Nearly every weekly report from Baltimore between mid-October and late November makes reference to the epidemic. In five of the seven weeks, there are discussions of slower than normal retail in one or more lines of business, typically department stores or dry goods retailers. Summaries of business activity in New Orleans mention the epidemic and lagging retail sales in six of seven weeks. Reports from most southern cities refer to the epidemic during the five weeks between 12 October and 9 November 1918. Retail sales are below normal in a majority of cities in that five-week period. Narrative accounts point to demand-driven declines, some of which resulted from government-mandated closings or shortened business hours. The residual decline in retail activity followed because at least some regular customers were dead, sick, or self-isolating. The only report to mention that retail suffered from a labor shortage was *Dun's* report for Memphis on 19 October 1918, which read "retail distribution has suffered most … by depletion of working forces."

Table 2 also reveals that manufacturing activity was affected by epidemic-related labor supply shortages, though labor shortages are less often reported than epidemic-related retail sales declines. Correspondents reporting on events in Baltimore, which was one of the southern cities hardest struck by the epidemic, report epidemic-related labor shortages in three of the seven weeks in which the epidemic was mentioned in either *Bradstreet's* or *Dun's*. Charleston, Chattanooga, Nashville, and New Orleans are the other southern cities that reported labor supply shortages in three of these seven weeks. Local reports accord with *Dun's* overall assessments of manufacturing conditions in October and November 1918: "manufacturing activities … have been

appreciably curtailed" (19 October); "maintenance of the previous high rate of production has been rendered impracticable … by the influenza epidemic" (26 October); and "the maintenance of full outputs, meanwhile, have been rendered impracticable by the continuance of the influenza epidemic" (2 November). Other documentary sources (discussed below) make clear that manufacturers across the South were forced to reduce production or, in some cases, completely shut down production facilities because absenteeism rates increased dramatically during the epidemic. Like retailers, some manufacturers had to have witnessed reduced demand, though the narrative accounts suggest that labor shortages played a larger role in decreased production than declining demand. Thus, the narrative accounts point toward predominantly demand-driven declines in retail, and labor supply-driven declines in manufacturing.

5.2 Retail and manufacturing summary conditions and influenza incidence

Bradstreet's summary ratings (i.e., slow, fair, good, active) of retail and manufacturing activity by city offer an opportunity to more systematically investigate the epidemic's impact on business activity in the South. The first step involved matching southern cities with weekly ratings in *Bradstreet's* that also appear in Collins et al's (1930) calculations of weekly excess influenza-related deaths and either Bootsma and Ferguson's (2007) or Markel et al's (2007) lists of cities with known NPI implementation dates. There are seven cities that appear in all three – Atlanta, Baltimore, Louisville, Memphis, Nashville, New Orleans, and Richmond. Richmond receives a summary rating approximately monthly, though narrative reports appear in *Bradstreet's* and *Dun's* more often. I used the narrative reports to develop ratings for weeks in which Richmond does not receive a summary rating in *Bradstreet's*.

City-level retail ratings take on one of four one-word descriptions – slow (or dull), fair, good, and active (or very good). These words are coded on a four-point scale in which slow equals one, fair equals two, good equals three, and active equals four. The four-point rating is then plotted against city-level excess mortality and the dates of the nonpharmaceutical interventions by city. The result appears in Figure 2. The most common summary rating is "good,"

and there is reason to believe that it was the default rating absent some information to suggest a more or less optimistic assessment.

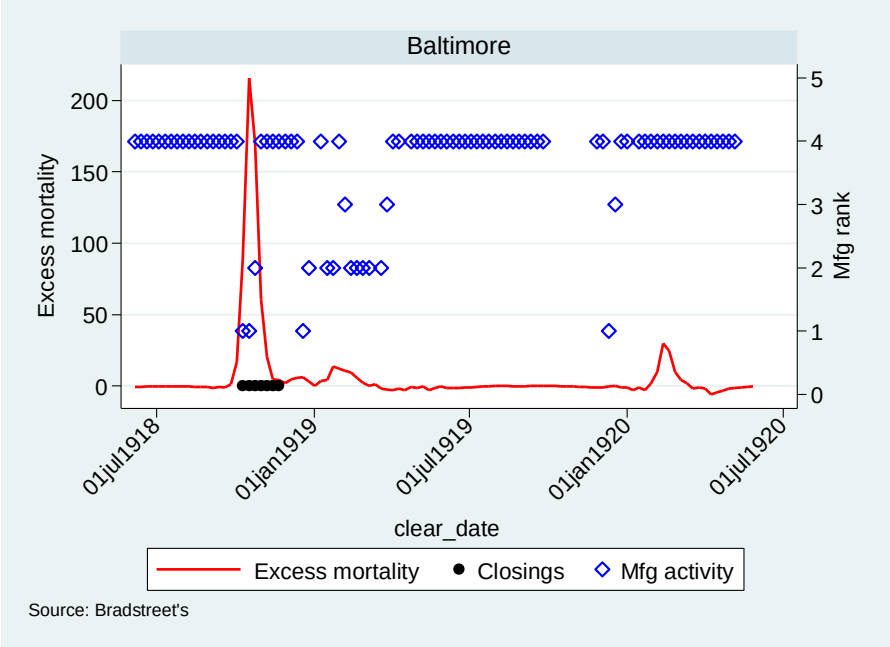
Figure 2
Excess weekly mortality rates and retail sales ratings
Weekly, July 1918 – June 1920

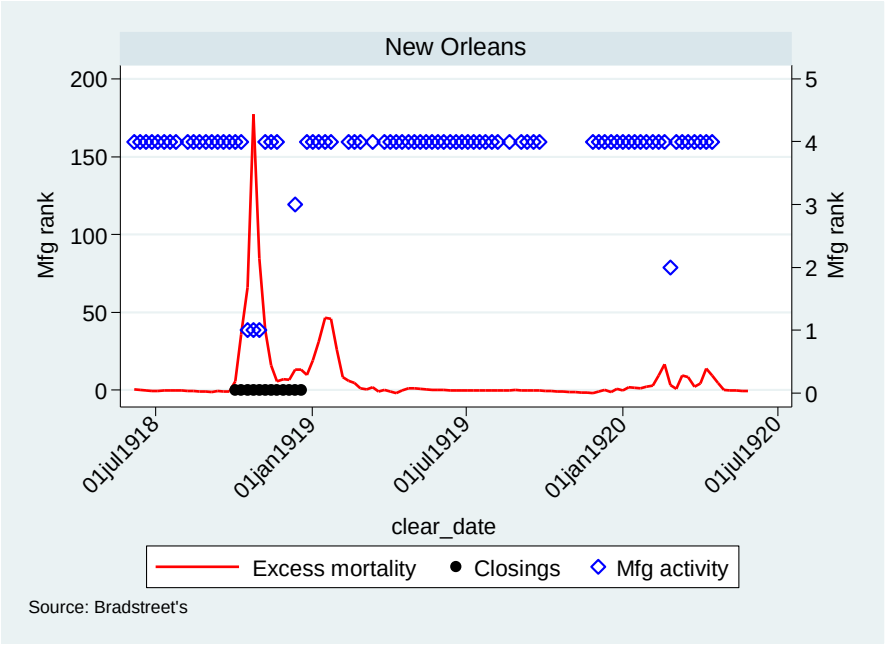
Figure 2 present the results for two of the South's largest cities: Baltimore and New Orleans. (Diagrams for five other cities appear in the appendix.) The red line (left axis) plots the city-level excess mortality rate; the blue diamonds (left axis) plot the weekly retail ratings; and the black circles on the abscissa signify the weeks in which local health authorities ordered closings of schools, churches, or businesses (NPIs). Excess mortality peaks in mid-October across the South, with less deadly secondary outbreaks between December 1918 and February 1919 and again in February 1920. The NPIs, as Bootsma and Ferguson (2007) and Markel et al (2007) document, were implemented as mortality moved toward the peak and stayed in place for a few weeks.

A pattern that repeats across cities is that the retail ratings fall in weeks when the local health authorities shut down high-risk businesses, namely restaurants, bars, saloons, and theaters. A second feature is that the retail ratings also decline during the secondary recurrences when no business closings were mandated. It is likely that the declines in retail activity during the second-wave outbreaks are endogenous demand-side responses; that is, people who are sick or afraid of becoming so choose to avoid public spaces, including retail spaces, with high risks of disease transmission. Narrative accounts, in fact, remark on reduced activity in department stores, dry goods stores, and other retailers selling nonessential goods. Grocers and pharmacies experienced smaller sales declines.

Figure 3 presents a comparable diagram for manufacturing activities in the same six southern cities. The red line plots excess mortality, the black circles the implementation of NPIs, and the blue diamonds in the field the summary ratings of manufacturing (slow = 1; fair = 2; good =3; active = 4). The default rating was active, which may have been the result of war-time demands, and there is less variation in the manufacturing than in the retail ratings, especially in Atlanta, New Orleans, and Nashville. There is, however, substantial variation in Baltimore, Louisville, and Memphis.

Figure 3
Excess weekly mortality rates and manufacturing activity ratings
Weekly, July 1918 – June 1920





To determine whether there is a statistical relationship between *Bradstreet's* retail and manufacturing ratings and the implementation of NPIs or

excess mortality rates, I estimated a seven-city panel fixed-effects logistic regression equation of the following form:

$$l = \log\left(\frac{p}{1-p}\right) = \alpha_j + \beta NPI_{jt} + \gamma EMR_{jt} + \varepsilon_{jt},$$

where p is the probability (=1) of a rating of 3 or better, zero otherwise; NPI indexes those dates when a nonpharmaceutical intervention was in place; EMR is the city-level excess mortality rate at time t in city j; α is a series of city fixed effects, and ε is the error term. No other controls are included in the regressions and the estimates can be viewed as causal only to the extent that the city fixed effects capture all the relevant time-invariant influences, and the city-invariant temporal effects are small. Though neither condition seems likely, regressions at least point toward whether NPIs and endogenous responses to excess mortality rates had independent effects on retail and manufacturing activity.

< Table 3 about here >

Table 3 reports the summary statistics of the variables, the estimated regression coefficients, and marginal effects. The retail ratings for the seven-city panel are 3 or higher for 74.6% of the retail observations and 80.4% of the manufacturing observations. In the period between 29 June 1918 and 27 May 1920, local health authorities issued closing orders (NPIs) for 10.2% of weeks. Excess mortality is 7.9 per 100,000 on average, but the standard deviation reveals what is evident in Figures 2 and 3, namely that the value is close to zero except during the three outbreaks. The minimum value of excess mortality is –5.9; the maximum is 215.7.

The regression coefficients and marginal effects are consistent with a large, but statistically insignificant negative impact of nonpharmaceutical interventions on both retail and manufacturing activity. The estimated marginal effect of NPI in the retail regression suggests that mandated closings

reduced the probability of retail being rated "Good" or "Active" by 5.3%. Mandated closings reduced the probability of manufacturing receiving the same ratings by 4.5%.

The standard approach is to interpret coefficient (and marginal effects) estimates evaluated at the mean, but in this case the mean of the excess mortality rate may not be as informative as other values. A kernel density plot of excess mortality, in fact, shows a distribution with a mass between –3 and +3, and a long right tail (see Appendix Figure A.3). It may be easier to interpret the marginal effect of the pandemic at a handful of critical points in the distribution, which appear at the bottom of Table 3. There is a 55.2% probability of observing a retail rating of "Good" or higher when the excess mortality rate (EMR) is -5. The probability declines to 43.6% at an EMR of +5, and 23.2% at an EMR of +25, the last of which is consistent with mortality rates in all cities during the second- and third-wave outbreaks in early 1919 and early 1920.

Turning to manufacturing ratings, the probability of observing a rating of "Good" or higher declines by 4.5% when local authorities issued shutdown orders. Evaluated at the same three points in the distribution used to analyze the retail rankings, the estimates imply that the probability of observing a "Good" or higher manufacturing rating is 51.9% when the EMR is –5. When the EMR is +5, the probability declines to 47.1%, and falls to 37.6% when the EMR is +25. The likelihood of observing the standard manufacturing rating declines by about 12 percentage points when the excess mortality rate rises from normal (=0) to second-wave (=25) levels.

Absent detailed worker- and firm-level data, it is difficult to translate a 12 percentage-point decline in probability of observing a "Good" rating into economic costs. Estimates of modern data and some back-of-the-envelope calculations might offer some sense of the costs, at least to an order of magnitude. First, about one-third of the population was infected by the Spanish flu, which is about ten times the incidence of influenza-like illness in a typical flu season and case fatality rates in 1918 were about 25 times greater than is typical (i.e., 2.5% case fatality in 1918 versus 0.1% in a typical flu season)

(Taubenberger and Morens 2006; Akazawa et al 2003). Second, Akazawa et al (2003) estimate that the incremental effect of contracting an influenza-like illness in a typical flu season translates into an additional 1.3 days per person missed at work with a per person cost in 2019 dollars of about $250 (≈ $3 - $6 in 1918, see Williamson 2020). If the greater virulence and morbidity associated with the Spanish flu is consistent with 10 times as many days missed and the average daily manufacturing wage was (conservatively) $3.25 in 1918 and per-worker manufacturing income was (conservatively) $810 in 1918, then the economic cost of the pandemic in lost work days was 5.2% of gross per-worker income or 5.7% of per-capita gross domestic product.[10] Descriptions of three critical southern industries that follow in subsequent sessions point to many manufacturing workers missing two to three weeks of work due to worker sickness, self-isolation, or mandated shutdowns. The pandemic took a substantial toll on manufacturing output, which was mostly labor-supply driven.

5.3 'Conditions in the mines have been tragic': Labor supply and coal production

Coal mining was risky in many dimensions: explosions, mine collapses, debilitating later-life black lung disease. An under-appreciated danger to a collier's well-being was the risk of contracting an infectious disease. In 1830s England, John Snow, a founder of modern epidemiology, treated cholera victims at the Killingworth Colliery outside Newcastle, and believed that poor sanitary conditions in mines helped spread the disease (Johnson 2006). It was conducive, too, to the spread of the flu. Once the influenza pandemic passed, Metropolitan Life Insurance Company found that 6.2% of all the coal miners it insured between the ages of 25 and 45 died. By comparison, 3.3% of all insured industrial workers in that age group died, which was comparable to the death rates in hard-hit army camps (Metropolitan Life 1920, Barry 2018, 362). Coal mining demanded strong backs and close contact, which put the most

[10] Estimates are derived from following estimates available at Williamson (2020): production worker hourly compensation in 1918 = $0.36; per capita GDP = $732.35. If we assume a nine-hour workday in 1918 and a 250-day work year, per worker gross income is $810.

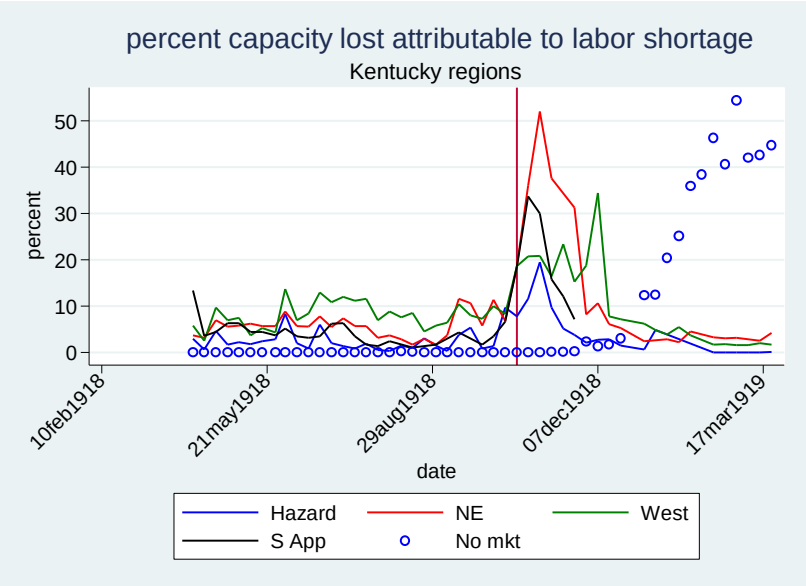
susceptible demographic group – young men – at particular risk. But coal was vital to the war effort. Even as mine managers and federal officials watched the death toll mount in the South's coal fields, it's digging went on.

Because of coal's importance, the United States Fuel Administration, after surveying individual mines in the principal coal-producing regions, established quotas as a percentage of seasonally adjusted maximum daily output. The Fuel Administration's target was 2.1 million tons per day between 1 April and 30 September 1918, and 1.97 million tons per day between 1 October 1918 and 31 March 1919 (*Coal Trade Journal,* 7 August 1918, 974). The United States Geological Survey was given the task of surveying firms and collating the statistics. Beginning 6 April 1918, a trade journal published weekly summaries of coal production by region. As part of the report it also published, in tabular form, reasons for the shortfall from targeted production. The table listed the estimated percent of any shortfall (most weeks the mines reported less than maximum or required output) attributed to rail car shortages, labor shortages, strikes, mine disability (disruptions due to required maintenance or safety concerns), and lack of market. During the war the last listed cause was almost always zero, given industrial and military fuel demands; strikes were rare in wartime coal fields. A shortage of able-bodied men due to the draft created a persistent baseline labor shortage, but this was built into the Fuel Administration's capacity estimates. The epidemic, on the other hand, created acute short-term shortages. Men stayed home because they were sick. Some surely stayed home because they feared contracting the virus.

Weekly values of output, labor shortage percentages, along with total US production, and rail car loadings by 123 principal coal-carrying railroads were collected from *Coal Trade Journal*. On seven reporting dates between 8 June and 20 July 1918, for example, the government reported that coal production across the US fell short of estimated capacity by 17.4% of expected output, on average. Nearly 7.3% of the aggregate shortfall was attributable to rail car shortages, 4.9% to labor shortages, less than 0.1% to strikes, 3.6% to mine disability, and 0.2% to lack of a market.

Coal production is a particularly useful to gauge the magnitude of supply-side effects of the pandemic because changes in output, given the government's military needs, will be almost completely labor-supply driven rather than firms responding endogenously to changes in demand. The percentage of output lost due to "lack of market" remains zero, in fact, until after the Armistice and does not rise above 5% until 4 January 1919, nearly two months after the Armistice.

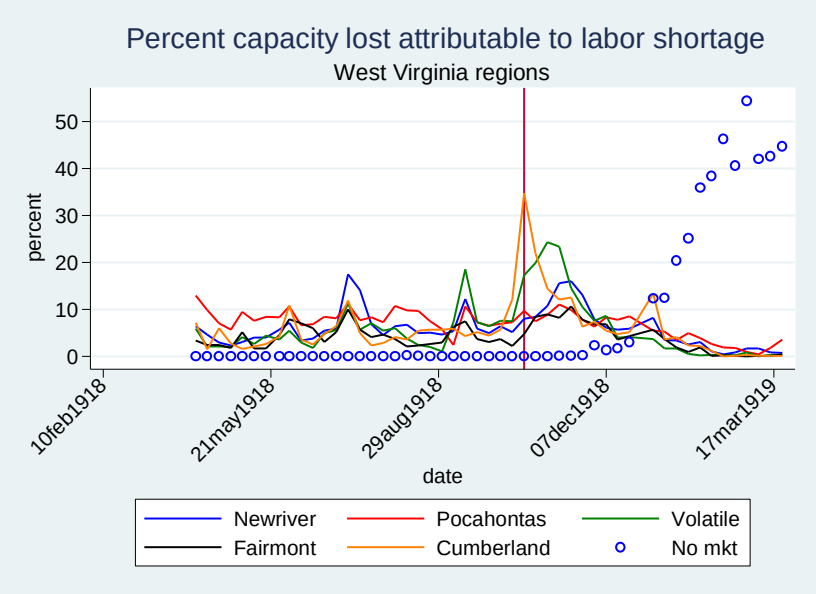
Figure 4
Percent coal mining capacity lost to labor shortages
April 1918 – March 1919
Kentucky's principal mining regions



Figures 4 and 5 plot the percentage of capacity lost attributable to labor shortages for the South's two principal coal regions in Kentucky and West Virginia (graphs for Southwest Virginia and Northern Alabama are similar). With the exception of Kentucky's Western Region, which was centered on Paducah, Kentucky, and the North Alabama Region, the South's mining districts are in a triangle approximately defined by Charleston (WV), Knoxville (TN), and Lexington (KY). The lines in each graph provide the estimated percentage losses due to labor shortages for the major mining regions within

each state. The diamonds plot the losses attributable to no market, and the vertical line signifies 19 October 1918, which Collins et al (1930) identify as the national average peak of the influenza epidemic. Though the *Coal Trade Journal* (30 October 1918) reported that the Spanish flu was "a little slow in reaching the rural districts," its effects were substantial.

Figure 5
Percent coal mining capacity lost to labor shortages
April 1918 – March 1919
West Virginia's principal mining regions



Pessimism reigned in late October concerning the short- and long-term consequences of the epidemic. On 30 October the *Journal*'s account of the Louisville coal market opened with the somber observation that "conditions in the mines have been tragic" over the past two weeks. Some mines were entirely shut down; many others were operating at 50% of capacity. West Virginia's Kanawha district mines reported 733 work hours lost, or about 14% of usual, the previous week. In its discussion of the Baltimore market, the *Journal* (30 October 1918) reported that "not only are many miners too ill to work, but the death list is creating a permanent shortage [of skilled mine labor]." Equally bleak reports appeared until early December, after which the

Journal's discussions of market conditions focused on the anticipated short-term consequences of the peace, many of which foresaw (not inaccurately) an industry wracked by excess supply, falling prices, and worker layoffs.

Using the data reported to the Fuel Administration, it is possible to generate some back-of-the-envelope estimates of output lost to influenza morbidity and mortality. On 28 September 1918, prior to the virus' appearance in the mines, the agency reported it had rated weekly capacity for the eleven southern mining districts to be 3.97 million tons. Most of the districts reached between 85 and 94% of their targets. All regions reported some output lost to labor problems between 0.8 and 7.2% of the target. Weighted by each region's rated capacity, the labor-related shortfall for the week of 28 September was 5.2% of maximum output, which is about average for the pre-pandemic period. Once the pandemic appeared in the mining districts, labor-related losses roughly tripled. For the week of 19 October, labor-related losses were 15.2% of rated capacity and 15.5% for the following week. For the first week in November labor-related losses rose to 18.8% of capacity. Barry (2018, 349) reports that about half of heavy industry labor absenteeism was voluntary, driven by fear of getting sick. If miners responded at the same rates, then about 7 to 10% percent of coal capacity shortfalls was due to workers choosing to self-isolate. Regardless of the cause of worker absenteeism, a rapid, unanticipated loss of 10 to 15% of weekly output for three to four weeks presented logistical and financial challenges for the coal mining industry, the US Fuel Administration, and the war effort.

The *Coal Trade Journal* also noted on several occasions that railroads that served the coal region were also operating short-handed and at reduced capacity, sometimes by as much as one-third to one-half. On 26 October, for example, the *Journal* reported that the Baltimore & Ohio Railroad, which ordinarily loaded between 2,000 and 2,500 coal cars per week in the southern mining districts, had been able to load only 1,000 to 1,500 in the past two weeks because between 40 and 50% of its workers were out sick. These output reductions are also purely labor supply-side effects: there was no endogenous demand-side decline in rail car demand to the epidemic. Military and industrial

enterprise demands for coal and rail services had, if anything, only increased in the last months of war. General Pershing, in fact, had personally asked miners and mine operators to step up; his war machine needed at least 900,000 more tons of coal per month than they had been using in order to prosecute the war. A columnist in the *Coal Trade Journal* responded confidently: "He will get it" (*Coal Trade Journal*, 30 October 1918). He may have, but only through the near-heroic efforts of healthy miners willing to report to work.

5.4 'A demoralizing effect upon the industry': Influenza and southern textiles

In 1918 textile mills represented one of the more important pieces of the South's industrial base. The industry was located along the eastern foothills of the Appalachian Mountains from Danville, Virginia through the Carolinas into northeast Georgia. The South Carolina Upcountry, for example, was home to about three-quarters of the state's 170 cotton textile mills, which operated more than 4.9 million spindles, with a total invested capital of $100 million, value of annual output of $217 million, employed more than 48,000 hands, and paid more than $28.3 million in wages (South Carolina Commissioner 1918, 55). Thus, when the pandemic appeared in South Carolina, its cotton mills accounted for more than half of all capital invested in manufacturing plant and equipment, more than two-thirds of the value of the state's industrial output, and nearly two-thirds of all industrial employment and wages paid to manufacturing workers.

Before the pandemic appeared in the southern textile region, the war had already made itself felt. A South Carolina report noted that military inductions had pulled many young men from the mills. "Women who remain at home," wrote the state labor commissioner, "keep the home fires burning, many of them taking up the burden of the family support, and doing so with great willingness" (South Carolina Commissioner 1918, 4). The commissioner purposefully struck a patriotic tone, of course, but the facts belie his assertion. It was true that between 1916 and 1918 the state's mills increased the real dollar value of output by about 40% and that the number of males employed by the mills declined by about 4,500, but the number of females employed also

decreased by nearly 400 hands. Fewer textile mill operatives were working more.

The second war-related influence was the government's demand for uniforms and tent canvas. By September 1918 cotton mills across the South were operating at full capacity. Before the war Dan River Mills, in Danville, Virginia, typically operated a single 9-hour shift on weekdays. If demand was unusually large it might run a second shift until large orders were filled. As the war neared its end in 1918, Dan River was operating three shifts, which kept its plants operating 24 hours a day (Smith 1960). The Cannon Mills in Kannapolis, North Carolina, too, operated close to capacity filling orders for military-grade textiles (Vanderburg 2013). At least through the Armistice and perhaps beyond, there was no notable decline in demand for cotton textiles manufactured in the South. Any pandemic-related effect operated through the labor-supply channel.

Although the industry's trade journals did not detail the consequences of the pandemic with the level of detail found in the coal trade journals, narrative accounts provide some evidence on the timing and magnitude of its supply-side effects. On 12 October, a Philadelphia jobber returned from a trip through the South and reported that many mills were "severely handicapped by the influenza epidemic;" one mill was so short-handed that it was running just 20 of 300 spinning frames (*Textile World Journal*, 12 October 1918, 28). A report dated 9 October from Raleigh, North Carolina, informed the magazine's readers that infection rates were so high that some mills were shutting down voluntarily to slow it's spread; the report further predicted that several plants in the Carolinas were closed and likely to remain so for the "duration of the epidemic" (*Textile World Journal*, 19 October 1918, 69). Independent reports from 26 October noted that the epidemic spread "with alarming quickness" in the mill villages; that about half the regions mills were either closed or employee absenteeism had been "disastrous;" that mills that shut down tended to remain so for up to two weeks; and mills that continued to operate did so with "25 to 50 per cent of their normal complement of help" (*Textile World Journal*, 26 October 1918, 67, 73, 83).

By mid-November mentions of the epidemic disappeared to be replaced with discussions of how the Armistice would affect demand, whether the government would honor its contracts for the millions of yards of military-grade cloth now stockpiled in mill warehouses, and the time required to retool for civilian production. Prior to the Armistice, there were no discussions of demand shortfalls, falling prices, or inventory accumulations that would otherwise be associated with an endogenous epidemic-driven demand shock.

5.5 "The disease had its influence also on the demand": Influenza and southern lumber

Unlike most other southern industries, the lumber industry's influenza-related troubles were bookended by two unanticipated events that created problems for the industry. The first occurred in late September, U.S. Director General of Railroads William McAdoo, embargoed the shipment of lumber into the northeastern United States. During winter 1917, lumber had accumulated in northeastern cities and tied up rail cars needed to move critical war-related goods. To forestall a reoccurrence, McAdoo restricted shipments into the region, which frustrated southeastern lumber operators. McAdoo's unexpected announcement left lumber mills with stockpiles of lumber and shut off from their principal markets (*New York Lumber Trade Journal*, 1 October 1918, 19). Lumbermen protested the order and complained of government overreach, to no effect (*Southern Lumberman*, 28 September 1918, 23). The second unfolded as the epidemic was waning. Even before the Armistice was signed North Carolina's pine belt producers complained of softening government demand (15 November 1918, 37). When the Armistice was announced, North Carolina's correspondent for the *New York Lumber Trade Journal* (15 November 1918, 37) noted that manufacturers were "confronted with many perplexing conditions which will require the earnest endeavor of the best brains in the industry to solve."

Between these two events, the industry was confronted with unusual seasonal labor-supply shocks, price controls, demands to assist in the Fourth Liberty Loan, and the disruptions caused by the epidemic. The *Southern Lumberman* (21 October 1918, 17B) reported that even though the cotton

harvesting season was winding down, white and black sharecroppers, who had realized high prices for their cotton, were not yet "drifting back to the sawmills." In late September, rising production costs and price ceilings made lumber milling unprofitable for some (*Southern Lumberman*, 5 October 1918, 24). The region's lumbermen were taking an active role in the Liberty Loan, "many of them devoting all of their time to it" Several of the region's manufacturers and wholesalers placed either fearmongering or patriotic-themed, whole-page advertisements in industry trade journals encouraging people to buy bonds (see Figure 6). At the same time, the influenza "made itself felt" across the South (*Southern Lumberman*, 21 October 1918, 17B).

< Figure 6 about here >

The earliest reference in a trade journal to influenza disrupting the South's timber and lumber industry appears in early October, at which time a writer in *Southern Lumberman* opined: "If the Spanish flu is really Spanish in its origin, Spain is abundantly getting even with us for what happened twenty years ago" (*Southern Lumberman*, 5 October 1918, 23). From then through mid-November, bi-weekly assessments of the market for North Carolina-grade pine note the impact of the epidemic. On 14 October, the outbreak was "raging" and interfered with business (*Southern Lumberman*, 19 October 1918). Two weeks later both *Southern Lumberman* and *New York Lumber Trade Journal* reported that sickness was so widespread among mill owners, managers, and workers that many sawmills were shut down.

Although pine lumber producers in Virginia and the Carolinas experienced labor-supply shocks, the industries they served were also hard hit by the virus, which sent ripples through the industry. Furniture factories in Fayetteville, North Carolina suspended operations due to worker absenteeism and cancelled orders of better-grade pine. The principal consumers of North Carolina-grade pine in 1918, however, were makers of wooden boxes used to ship war materiel to France. At the peak of the epidemic in Baltimore, the government ordered its box makers to make coffins instead. But box makers

could not meet the need because box factory workers were out sick and orders for box-grade lumber lagged (*Southern Lumberman*, 26 October 1918 and 2 November 1918). Just as the region's railroads loaded fewer coal cars than usual due to worker sickness, at the height of the epidemic pine shipments out of Norfolk, Virginia were hindered because barge and ship crews were out sick (*Southern Lumberman*, 12 October 1918).

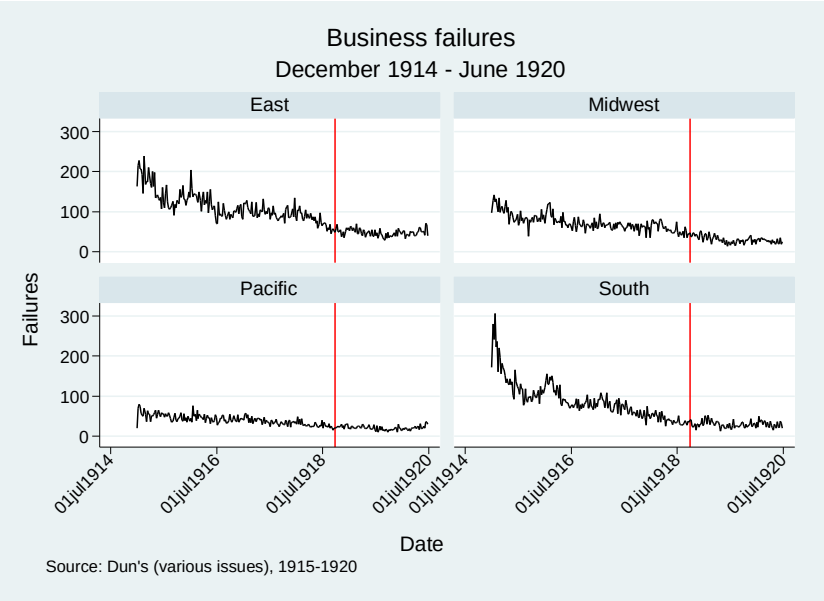
Unlike coal and textiles, industries in which supply-side effects dominated, the South's lumber millers were buffeted by both demand and supply shocks. Employees missed work and shipments of low-grade pine slowed because the government's war planners determined that stockpiles in the Northeast were already sufficient. Moreover, the only alternative to rail transport of its production – shipping on barges through the port at Norfolk – suffered its own debilitating labor-supply shortages.

6. Southern business failures during the pandemic

Both *Dun's* and *Bradstreet's* commented repeatedly on the declining number of business failures during the war, a trend evident in Figure 7. The plots detail the total number of business failures each week between December 1914 and June 1920 in the four regions used by *Dun's* to aggregate and report the data.

Because *Dun's* did not report the number of businesses at risk, it is impossible to calculate a business failure rate, but the South's experience stands out on a per capita basis. The East and Midwest were more populous than the South and, after the large number of failures in early 1915, the number of failures in the East, Midwest, and South are comparable. In late June 1916, for instance, there were 71 failures in the East region, 64 in the Midwest, and 74 in the South. Further, there is no obvious break in any of the series after 26 September 1918 (delineated in the graph), when the pandemic emerged in the eastern US, or on the announcement of the Armistice five weeks later on 11 November 1918.

Figure 7
Business failures by region
December 1914 – June 1920
Source: *Dun's*



To determine whether different timing of the pandemic outbreak, nonpharmaceutical interventions, and the armistice had any effect on regional failures I estimate a panel fixed effects negative binomial (count) model of failures in the four regions. The estimated equation takes the following form:

$$fail_{jt} = \alpha + \beta_1 EMR_{jt} + \beta_2 Pandemic_{jt} + \beta_3 [Pandemic_{jt} \times EMR_{jt}] + \beta_4 NPI_{jt} + \beta_5 Armistice_t + \beta_6 trend_t + \gamma_j + \epsilon_{jt},$$

Where the dependent variable is the regional failures measured as integer count data. Pandemic is an indicator variable that takes the value of one under one of three definitions. The preferred definition is that used by Markel et al (2007), who define the onset of the pandemic for each US city of more than 100,000 residents in 1918 as the date at which the excess influenza-pneumonia mortality rate exceeded twice the baseline rate. I dated the

beginning as the average of the dates for the cities in each of the four regions (see Appendix Table A1 for dating by city and region), and the end as the date at which the excess mortality rate falls below twice the baseline rate for four or more consecutive weeks. A second definition (Pandemic 2) takes a value of one for the period between 26 September 1918 and 30 June 1920. A third definition (Pandemic 3) takes a value of one for every date after 26 September 1928 through the end of the sample.

NPI is an indicator variable that equals one during the average mandated closure dates by region. There is regional variation in dates because NPIs were imposed later (albeit earlier relative to the initial influenza reports) and kept in place longer in the Pacific region than elsewhere. Armistice is an indicator variable that equals one after 11 November 1918. For regional EMR's, I use the excess mortality rates of one representative city for each region: Albany for the East, Richmond for the South, Omaha for the Midwest, and Portland for the Pacific. The choice of city should make little difference. The correlation between the Richmond data, for instance, and every southern city in the Collins et al (1930) data, with the exception of Atlanta, has a correlation coefficient of 0.90 or higher. The model is estimated as a panel region fixed-effects model. The estimates are qualitatively the same with or without the linear trend variable.

Estimated coefficients on the interaction between Pandemic and excess mortality rate can be thought of as a type of continuous treatment difference-in-differences effect, where the treatment is the regional excess mortality rate, interacted with one of three "post" periods of interest (as in Fang et al 2020). The excluded period includes all dates prior to the outbreak of the pandemic, and for certain periods after the pandemic, depending on its specific definition.

< Table 4 about here >

Table 4 provides summary statistics for the four-region panel. The average week saw 63 business failures, though there was substantial regional

and temporal variation. The South, for instance, experienced more than 300 failures in early 1915. Weekly average excess mortality was 2.59 per 100,000, but as Appendix Figure A1 makes clear, the mass of the distribution was centered on zero with a long right tail. Given EMR's non-normal distribution and because negative numbers are a natural realization, the data is transformed using the inverse hyperbolic sine function, which approximates the natural log transformation for positive realizations; it maps zero into zero, and transforms negative values into negative values absent an arbitrary adjustment, as is customarily done with log transformations (Bellemare and Wichman 2019 note that there are subtleties to interpreting estimated coefficients from transformed as elasticities). Nonpharmaceutical interventions were in effect during 6% of the sample dates. By the narrowest (and preferred) definition, the pandemic raged for 10% of the dates, or about 28 weeks. This definition is closest to Cross et al's (1930) dating; by their estimates, the pandemic persisted for 31 weeks after 12 September 1918. Alternative definitions date the pandemic for nearly one-third of the sample dates, as does the Armistice variable.

< Table 5 about here>

Table 5 presents incidence rate ratios (IRRs) from the panel negative binomial regressions. Estimated incidence ratios imply that a one-unit increase in the excess mortality rate (i.e., one more influenza-related death per week above the baseline per-pandemic rate) increased the business failure rate by a factor of approximately 1.03, or about 3 percent, across all specifications. In column (2) the interaction term between the Pandemic and EMR variable implies that, for a one-unit increase in excess mortality, the number of business failures decreased by a factor 0.94 or about 6% during the pandemic proper. It is notable that the implementation of nonpharmaceutical interventions, for a few weeks, and the announcement of the Armistice, up to the end of June 1920 at least, are associated with a decrease in the number of business failures. Under alternative definitions of the pandemic, the effect of the Armistice is

positive but insignificant, which may be due to the near concurrence of dates for Pandemic 3 and Armistice.

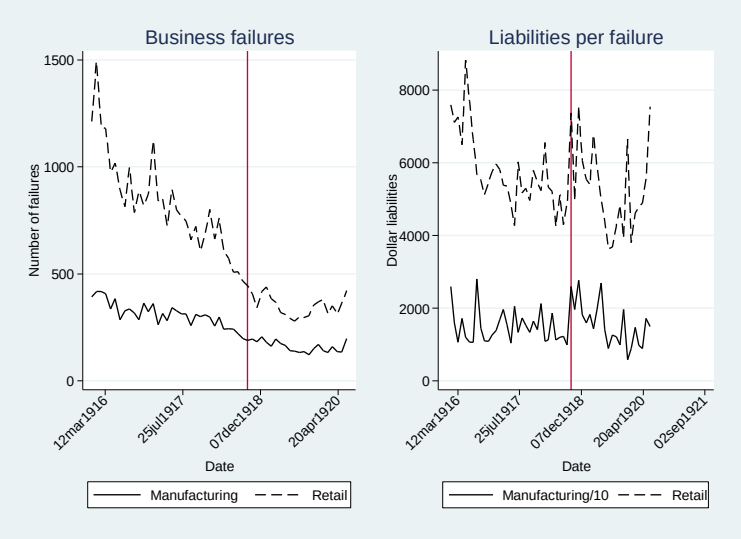
The bottom line is that neither nonpharmaceutical interventions nor the Armistice had much effect on business failures in the weeks (or months) surrounding the pandemic. It is possible that the decline in business failures during the pandemic and the mandated closures may be a consequence of courts being closed, as well as businesses, which may have delayed bankruptcy filings by a few weeks.

A second question that arises with respect to business failures is the sectoral composition of failures. During COVID-19 lock downs in 2020 retail, travel, and restaurants experienced large sales declines. It is useful to understand what happened during the Spanish flu pandemic, knowing that public health authorities closed mostly high-contact, nonessential businesses such as taverns, theaters, restaurants, and so on. *Dun's* parsed its monthly failure reports into three broad categories: manufacturing, retail, and finance. It further subdivided each category into more narrowly-defined sectors. In manufacturing it reported data for machinery, textiles, milling, and others, as well as an aggregate numbers and liabilities for manufacturing. In retail *Dun's* reported separate accounts for general stores, grocers, dry goods, liquor and tobacco, hotels and restaurants, and clothing, among others, as well as all retail failures and their aggregate liabilities. *Dun's* failure accounts did not parse failures by region and sector, but there is no reason to think that the sectoral composition of urban retail in the South would have differed markedly from other regions. Southern manufacturing, however, was different; textiles and agricultural and natural resource processing, such as tobacco, cottonseed oil, and lumber were the region's principal manufacturing industries.

Figure 8 presents the aggregate number of failures and real liabilities per failure for the manufacturing and retail sectors. (Liabilities per failure are adjusted for inflation using the Warren-Pearson index and manufacturing liabilities are divided by 10 to simplify the graph.) As is evident in the regional data, business failures declined from the outbreak of the First World War up to the postwar recession that began in the second half of 1920. There is no

obvious break in the aggregate number of failures around the pandemic in mid-September 1918. Average liabilities per failure, on the other hand, appears to increase around the pandemic in both manufacturing and retail.

Figure 8
Business failures and liabilities per failure, 1916-1920



To better understand the causes of failures, I estimate negative binomial regressions on the count failure data and OLS regressions on aggregate sectoral liabilities on the fine-grained sector definitions using monthly data. The results cannot be interpreted as causal in nature; rather, they are designed to serve as a preliminary investigation of different sectoral responses to the pandemic and mandated closures. For each sector, I estimate regressions of the following general form:

$$y_{jt} = \alpha + \beta_1 Pandemic_t + \beta_2 NPI_t + \beta_3 Armistice_t + \beta_4 trend + e_{jt},$$

The outcome variable, y, is either count failure data or the natural log of liabilities per failure. Pandemic is measured as either the inverse hyperbolic

sine of national average excess mortality as reported in Cross et al (1930) or as a dummy variable equal to one between September 1918 and March 1919. Nonpharmaceutical interventions (NPI) is a noisy dummy variable equal to one between October and December 1918, which captures the approximate dates of business shutdowns in the US; they occurred about two weeks later and lasted about a month longer in the Pacific region. Because NPIs cannot be accurately captured with national data, any estimated coefficient on NPI will be attenuated. Armistice is a dummy variable equal to one after November 1918. The regressions also include a linear trend.

Table 6 provides the summary statistics for the count failure data sample. Retail enterprises reported more failures than manufacturing enterprises. In a typical month 252 manufacturing establishments closed; 626 retailers did so. Nearly 200 grocers failed each month on average, compared to just 17 machine shops.

Table 7 reports incidence rate ratios from negative binomial regressions on the monthly failure count data by narrow sector, as well as the broader manufacturing and retail categories. Generally, the regressions explain only a small fraction of the variance for manufacturing failures; they explain substantially more of the variance in retail establishment failures. Among the principal manufacturing sectors, pandemic-era events are associated with modest and mostly insignificant effects on enterprise failures.

In the retail sector (Panel B), there is some limited evidence of an association between pandemic events and business failures. The exponentiated constants imply that there was an average of 130.3 failures of general stores each month and 322.3 grocery failures. The incidence ratios on the inverse hyperbolic sine of excess mortality in a majority of the regressions, as well as for the overall retail sector, are consistent with an increase in failures of about 1 to 5% for a one arcsin-point increase in excess mortality ($\Delta EMR \approx 1.2$); an increase consistent with a pandemic-like spike in mortality increases failures by about a factor of 3, or about 3 to 15%. General stores, clothing, and dry goods – all of which might be considered sellers of nonessential consumer goods – suffered the largest increase in failures. Grocers and liquor stores experienced

lesser effects. Mandated closings (NPIs) had consistently large and negative effects on contemporaneous retail failures, which, again, might be a consequence of the courts, too, having closed during the pandemic. The announcement of peace in November is not associated with an increase in business failures among either manufacturers or retailers.

< Table 8 about here >

Table 8 provides summary statistics for the aggregate liabilities of failing firms for the same sectors included in the count data. The average aggregate real monthly liabilities of failing machine shops were just less than $500,000; the highest monthly aggregate exceeded $1.7 million. The average aggregate liabilities of monthly failures in the retail sector was about $300,000; the liabilities of liquor store failures were less, grocery failures more.

< Table 9 about here >

Table 9 presents coefficient estimates from OLS regressions of the natural log of real monthly liabilities on the natural log of the excess mortality rate, an NPI dummy, and an Armistice dummy. The log-arcsin specification means that the estimates can be loosely interpreted as the elasticity of failed business liabilities with respect to the excess mortality rate (Bellemare and Wichman 2019). The estimated elasticities are not large and only three are statistically significant at the 5% level. It is interesting, however, that the elasticities for all manufacturing and all retail establishments are significant and imply that a 10% increase in excess mortality leads to a 5.7% increase in the liabilities of failing manufacturing firms and a 4.0% increase in the liabilities of failing retail firms. There is no discernible pattern to the coefficients on NPI or Armistice. If, instead, we are interested in the average size of failing firms, a 10% increase in excess mortality leads to a statistically significant increase in the average size of failing manufacturers of 5.2%; the effect on average retail failures is smaller (1.8%) and insignificant (results not tabulated).

Overall, the evidence on business failures suggests that neither the pandemic nor government-mandated closures had a marked effect on business failures. Increases in the excess mortality rate is associated with a modest increase in the number of failures. No narrow sector of the economy, such a leisure or entertainment, appears to have experienced an adverse effect. That is, despite mandated closures of restaurants, taverns, and theaters, among other businesses, failure rates in these lines of business did not increase. The absence of a discernible effect may be due to several factors: noncompliance with closure orders; the relative brevity of the closures; and that many sectors of the economy continued to operate at something as close to capacity as possible, given the labor supply shocks due to sick and fearful workers not showing for work, during a period when the US government was committed to prosecuting total war in Europe fully aware of its domestic consequences.

7. Concluding comments

In his depiction of London's 1854 cholera epidemic, during which the Golden Square section of the city witnessed more than 500 deaths in ten days, John Snow, one of the founders of modern epidemiology, observed that the death rate would have been much higher had it not been for the "flight of the population" (quoted in Johnson 2006, 169). Still-healthy residents picked up and left. Some tradesmen closed down their storefronts; the ones who stayed open sent their families away. "The most afflicted streets," Snow wrote, "were deserted by more than three-quarters of their inhabitants." Unlike cholera outbreaks, which tend to be localized, the Spanish flu afforded no place to run. The virus killed in major cities and small towns. Even mining camps in remote Kentucky coal fields sometimes buried 10% or more of their residents (Barry 2018). With nowhere to run from the flu, the only protection was to hide – or, in modern terms, to self-isolate.

It is hard to determine how many people self-isolated or for how long during the Spanish flu epidemic. Epidemiological models that incorporate endogenous responses imply nontrivial responses to COVID-19, which necessarily reduces infections and deaths. Daniel Defoe and John Snow

recognized this effect long before it was the object of mathematically rigorous exercises. This study finds that the effects of pandemic-induced closings, sickness, and self-isolation on business were substantial, if short-lived. Some coal mines and textile mills, for example, continued to operate with worker absenteeism rates of 20 to 50%; output declined, for a few weeks at least, by an estimated 10 to 15%. These values are consistent with Barro at al's (2020) estimates, which place the Great Pandemic as the fourth most economic costly event of the twentieth century. Their estimates point to a 6% decline in GDP and 8% decline in consumption. A simple back-of-the-envelope calculation using the values reported here – four weeks (=8% of the work-year) times 50% loss of worker wages due to absenteeism – points to a 4% loss in aggregate per-worker income in large sectors of the southern economy. Thus, the effects of the pandemic documented here are of the same order of magnitude as theirs. More importantly, perhaps, is the finding that the losses were due primarily not to mandated business closures, which were short lived, easily evaded and narrowly targeted, but to the widespread incidence of influenza and the resulting reduction in labor hours. Lockdowns are economically costly in the short term, but so too are spikes in influenza-related morbidity and mortality.

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Table 1
Nonpharmaceutical interventions in southern cities

City	First case date	First intervention date	Intervention days	Source
Atlanta, GA		10/7	29	Bootsma (2007)
Baltimore, MD	9/18	10/9	43	Markel (2007)
Birmingham, AL	9/24	10/9	48	Markel (2007)
Greenville, SC	9/17	10/7	28	Bainbridge (2019)
Huntsville, AL	9/28	10/7		ADPH (2017)
Little Rock, AR	9/20	10/6	29	Scott (1988), Finger (2011)
Louisville, KY	9/13	10/7	145	Markel (2007)
Memphis, TN	9/25	10/10	20	Finger (2011)
Nashville, TN	9/21	10/7	55	Markel (2007)
New Orleans, LA	9/10	10/8	78	Markel (2007)
Paducah, KY	9/18	10/8	35	Maupin (1975)
Richmond, VA	9/21	10/6	60	Markel (2007)
Shreveport, LA	9/27	10/8	38	McLaurin (1982)
Washington, DC	9/11	10/3	64	Markel (2007)
Wilmington, NC	9/19	10/10	by year end	Cockrell (1996)

Table 2
Dun's and Bradstreet's notes of epidemic and its effects

	Oct 12	Oct 19	Oct 26	Nov 2	Nov 9	Nov 16	Nov 23
Baltimore	C S L	C	C S L	S L	S		S
Richmond			S L	S L	S		
Lynchburg							
Wheeling		S	S L	S	S		
Wilmington				S			
Charleston	S L	S L	C S L	S			
Louisville		L		C S			
Memphis	C S	C L	S L	Q	S		S L
Nashville	C S L	S		L			
Chattanooga		L	S L	S	S L		
Atlanta	C	C S	S		S		
Birmingham			L				
New Orleans		S L	S	C S L	S	C S L	S
Mobile	C S L	S					
Sources:	B, 651	B, 667	B, 682	B, 699	B, 715	B, 731	B, 747
	D,726	D, 743	D, 757	D, 771	D, 785	D, 799	D, 813

Notes: S = retail/wholesale sales affected; L = mfg labor affected; C = business closings; Q = quarantine, partial or complete; Green shades = influenza mentioned
Sources: Key B = *Bradstreet's* (1918), page number; D = *Dun's* (1918), page number.

Table 3

Business activity ratings, nonpharmaceutical interventions, and excess mortality

	Summary statistics	Logit regressions			
Dependent variables	Mean	Retail	marginal effects	Manufacturing	marginal effects
	(Std dev)				
Retail rating (0/1)	0.746				
	(0.436)				
Manufacturing rating	0.804				
	(0.397)				
Independent variables					
NPI	0.102	-0.229	-0.053	-0.188	-0.045
	(0.304)	(0.448)		(0.510)	
Excess mortality	7.909	-0.047	-0.011	-0.019	-0.005
	(20.946)	(0.011)**		(0.007)**	
Pr(rating=1|ERM)					
EMR = -5		0.552		0.519	
EMR = 0		0.494		0.495	
EMR = 5		0.436		0.471	
EMR = 25		0.232		0.376	
Observations		457		420	

Notes: clustered standard errors in parentheses. ** implies p-value<0.001

Sources: Author's calculations from data described in text

Table 4

Summary statistics for business failure negative binomial regression sample

VARIABLES	(1) Average	(2) Std Dev	(3) Min	(4) Max
Failures	63.48	40.96	9	306
NPI	0.06	0.23	0	1
Excess mortality	2.59	11.12	-3.75	165.56
ln(Excess mortality)	0.55	1.23	-2.03	5.80
Pandemic	0.10	0.31	0	1
Pandemic 2	0.27	0.44	0	1
Pandemic 3	0.32	0.47	0	1
Armistice	0.30	0.46	0	1
Number of obs	1144			
Number of regions	4			

Sources: Dun's (various issues), 1915-1920.

Table 5
Incidence ratios from negative binomial regressions

VARIABLES	(1) Failures	(2) Failures	(3) Failures	(4) Failures
	Pandemic	Pandemic	Pandemic 2	Pandemic 3
arcsinh(EMR)	1.026**	1.035**	1.031**	1.032**
	[0.008]	[0.009]	[0.010]	[0.010]
Pandemic	0.973	1.111	0.782**	0.771**
	[0.046]	[0.072]	[0.034]	[0.061]
arcsinh(EMR)*Pandemic		0.936**	0.998	0.991
		[0.022]	[0.016]	[0.016]
NPI	0.883*	0.954	0.983	0.981
	[0.050]	[0.059]	[0.056]	[0.058]
Armistice	0.895**	0.887**	1.068	1.115
	[0.027]	[0.027]	[0.044]	[0.080]
Constant	49.227**	49.490**	51.163**	49.480**
	[3.037]	[3.058]	[3.189]	[3.065]
Observations	1,140	1,140	1,140	1,140
Number of rno	4	4	4	4

Notes: all regressions include a linear time trend.
** p<0.01, * p<0.05, + p<0.1
Pandemic: East = 26 September 1918 - 15 May 1919
Midwest = 2 October 1918 - 15 May 1919
Pacific = 5 October 1918 - 28 May 1919
South = 28 September 1918 - 30 January 1919
Pandemic 2: All regions 26 September 1918 - 31 March 1920
Pandemic 3: All regions = all dates after 26 September 1918

Table 6

Summary statistics for sectoral business failures

VARIABLES	Mean	Std Dev	Min	Max
Machinery	17.23	5.52	9.00	36.00
Textiles	33.68	16.48	6.00	77.00
Milling	23.78	12.09	3.00	51.00
General	67.45	39.90	21.00	192.00
Grocer	196.75	82.08	90.00	365.00
Hotels	38.48	12.32	18.00	71.00
Liquor	43.20	27.24	5.00	98.00
Clothing	57.92	34.71	13.00	201.00
Dry goods	34.13	23.47	8.00	121.00
All mfg	252.08	84.72	121.00	418.00
All retail	626.62	288.54	280.00	1,494.00
ln(EMR)	0.54	2.13	-2.58	6.36
Pandemic	0.45	0.50	0.00	1.00
Armistice	0.40	0.49	0.00	1.00
NPI	0.05	0.22	0.00	1.00
obs	60			

Source: Dun's (various issues), 1916-1920

Table 7

Negative binomial regressions on monthly business failures by sector

Panel A: Manufacturing establishments, all manufacturing and all retail

VARIABLES	Machinery	Textiles	Milling	All mfg	All retail
arcsinh(EMR)	1.012	1.013	0.971	0.995	1.015
	(0.023)	(0.033)	(0.028)	(0.016)	(0.016)
NPI	0.937	0.700	0.448*	0.840	0.670**
	(0.204)	(0.218)	(0.144)	(0.129)	(0.100)
Armistice	0.939	0.560*	1.304	0.773*	0.814
	(0.149)	(0.131)	(0.290)	(0.088)	(0.090)
Constant	16.944**	41.544**	38.718**	347.091**	1,039.577**
	(1.551)	(4.935)	(4.264)	(21.529)	(62.553)
Pseudo R-sq	0.00122	0.0444	0.0713	0.0784	0.110
log likelihood	-184.1	-240.1	-214.4	-322.8	-372.9
chi-sq	0.450	22.33	32.93	54.90	91.84

Panel B: Retail establishments

	General	Grocer	Hotel	Liquor	Clothing	Dry goods
arcsinh(EMR)	1.054*	0.989	0.978	1.014	1.036	1.026
	(0.022)	(0.013)	(0.012)	(0.013)	(0.027)	(0.034)
NPI	0.661*	0.694**	0.977	0.788	0.545*	0.479*
	(0.136)	(0.088)	(0.128)	(0.110)	(0.140)	(0.160)
Armistice	1.090	0.812*	0.908	0.568**	0.739	1.125
	(0.164)	(0.075)	(0.081)	(0.053)	(0.138)	(0.279)
Constant	130.353**	322.294**	56.568**	94.432**	94.256**	60.177**
	(10.398)	(16.168)	(2.661)	(4.059)	(9.298)	(7.455)
Observations	60	60	60	60	60	60
Pseudo R-sq	0.131	0.151	0.152	0.287	0.0938	0.0713
log likelihood	-256.7	-293.2	-197.3	-198.5	-259.5	-241
chi-sq	77.12	104	70.79	159.7	53.74	37.01

** p<0.01, * p<0.05

Table 8

Summary statistics for OLS regressions of aggregate liabilities of failing firms by sector

VARIABLES	Mean	Std Dev	Min	Max
ln(Machinery)	12.66	0.96	9.99	14.38
ln(Textiles)	12.11	0.80	9.95	13.22
ln(Milling)	11.41	0.93	8.58	13.22
ln(General)	12.64	0.76	10.61	14.31
ln(Grocers)	13.24	0.49	12.14	14.24
ln(Hotels)	12.34	0.81	10.52	14.16
ln(Liquor)	11.84	0.98	9.09	13.28
ln(Clothing)	12.44	0.78	10.58	14.17
ln(Dry goods)	12.24	1.09	10.31	14.99
ln(All mfg)	15.02	0.52	13.81	16.19
ln(All retail)	14.95	0.58	13.83	16.24
ln(EMR)	0.54	2.13	-2.58	6.36
Pandemic	0.45	0.50	0.00	1.00
Armistice	0.40	0.49	0.00	1.00
NPI	0.05	0.22	0.00	1.00
obs	54			

Sources: Dun's (various issues), 1916-1920.

Table 9

OLS regression coefficients on natural log of monthly aggregate real dollar value of liabilities

Panel A: Manufacturing enterprises, all manufacturing, and all retail

VARIABLES	Machinery	Textiles	Milling	All Mfg	All Retail
arcsinh(EMR)	0.136	0.038	-0.005	0.057*	0.040*
	(0.072)	(0.029)	(0.051)	(0.023)	(0.017)
NPI	0.293	0.190	-0.806	0.110	-0.234
	(0.506)	(0.363)	(0.542)	(0.146)	(0.129)
Armistice	-0.007	-0.562*	1.293**	-0.164	-0.045
	(0.356)	(0.254)	(0.393)	(0.142)	(0.097)
trend	-0.000	-0.001**	-0.002**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	12.609**	13.028**	12.626**	15.642**	15.853**
	(0.230)	(0.110)	(0.173)	(0.109)	(0.082)
R-squared	0.125	0.702	0.440	0.633	0.828

Panel B: Retail enterprises

	(5)	(6)	(7)	(8)	(9)	(10)
	General	Grocer	Hotels	Liquor	Clothing	Dry goods
arcsinh(EMR)	0.085*	0.034	0.016	0.006	0.012	0.012
	(0.032)	(0.018)	(0.051)	(0.041)	(0.041)	(0.060)
NPI	-0.599**	-0.532*	0.786	0.090	-0.280	-0.109
	(0.167)	(0.255)	(0.416)	(0.272)	(0.402)	(0.583)
Armistice	0.562**	0.083	-0.505	-0.598**	-0.213	0.363
	(0.198)	(0.143)	(0.363)	(0.208)	(0.287)	(0.382)
trend	-0.002**	-0.001**	-0.001	-0.001**	-0.001**	-0.002**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	13.883**	13.974**	12.935**	13.116**	13.389**	13.723**
	(0.130)	(0.068)	(0.213)	(0.122)	(0.173)	(0.204)
Observations	54	54	54	54	54	54
R-squared	0.708	0.720	0.406	0.781	0.569	0.515

Robust standard errors in parentheses

** p<0.01, * p<0.05

Figure 6:
Fourth Liberty Loan advertisement
Southern Lumberman (21 October 1918)

How Much Would the KAISER Tax Your Business

?

Think this thought twice over: "If we should fail to win this war what would happen to my business?"
What is left of business in the invaded districts of France and Belgium? What will be left of business here if we fail to crush the sinister power of Prussian militarism? How much would you have left after paying the taxes and levies imposed by a victorious Germany?

Defend Yourself With LIBERTY BONDS

This is not only a war for Democracy and Liberty, but a war of self-defense. Germany menaces our rights, our self-respect, our homes, and our means of livelihood.
Every citizen—every business man—has weapons of defense ready to his hand. These weapons are Liberty Bonds. We cannot all fight with guns and bayonets, but we can all fight with Liberty Bonds.

Buy to Your Utmost

Of course you have bought Liberty Bonds. Every one has. But how *many more* will you buy? The success of the Fourth Loan and of the war itself depends on your answer to that question.
Buy all the bonds you can. Go to your bank and make your arrangements. Buy more than you ever thought you could buy.

Buy to Your Utmost

This Space Contributed to Winning the War by

A. M. RICHARDSON LUMBER COMPANY, Helena, Ark.

Appendix figures and tables

Figure A.1
Excess mortality, retail rankings, and NPIs
Five southern cities

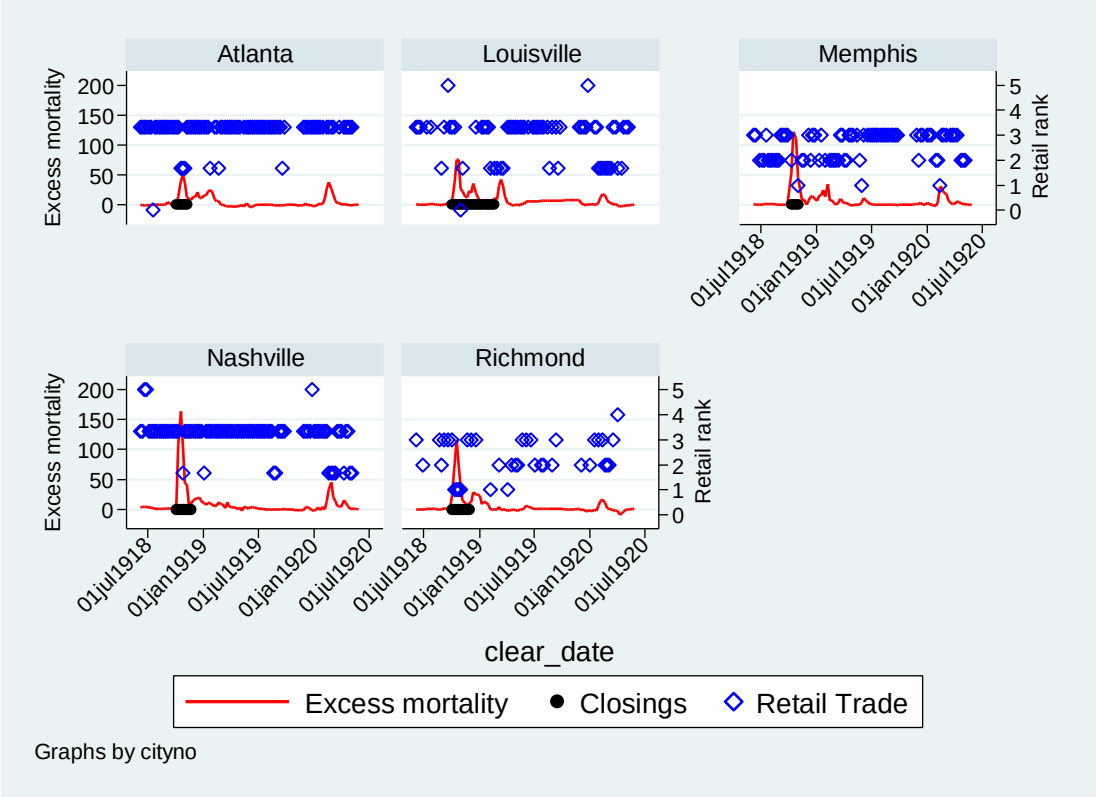

Figure A2.
Excess mortality, manufacturing rankings, and NPIs
Five southern cities

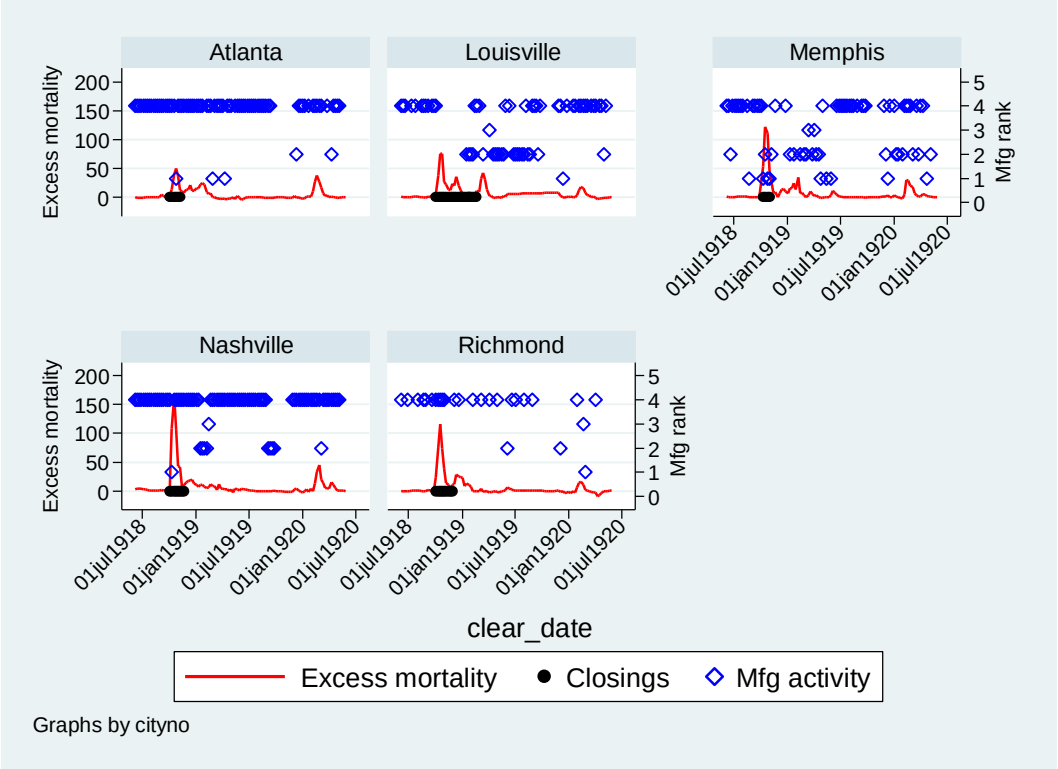

Figure A.3
Kernel density of excess mortality rates

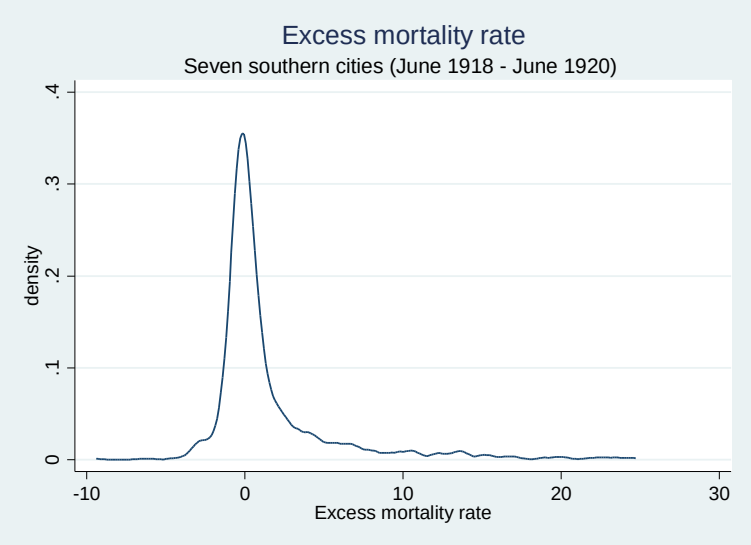

Table A.1

Dates for spanish flu events

Panel A: Relevant dates for first cases, mortality acceleration, and NPIs by region and city

City	State	Population	Region	First Case	Mortality Acceleration	First NPI	NPI days
Albany	NY	113344	east	27sep1918	06oct1918	09oct1918	47
Boston	MA	748060	east	04sep1918	12sep1918	25sep1918	50
Buffalo	NY	506775	east	24sep1918	28sep1918	10oct1918	49
Cambridge	MA	109694	east	04sep1918	11sep1918	25sep1918	49
Fall River	MA	120485	east	09sep1918	16sep1918	26sep1918	60
Lowell	MA	112759	east	09sep1918	16sep1918	27sep1918	59
New Haven	CT	162537	east	14sep1918	23sep1918	15oct1918	39
New York	NY	5620048	east	05sep1918	29sep1918	18sep1918	73
Newark	NJ	414524	east	06sep1918	30sep1918	10oct1918	33
Philadelphia	PA	1823779	east	27aug1918	25sep1918	03oct1918	51
Pittsburgh	PA	588343	east	04sep1918	27sep1918	04oct1918	53
Providence	RI	237595	east	08sep1918	17sep1918	06oct1918	42
Rochester	NY	295750	east	22sep1918	06oct1918	09oct1918	54
Syracuse	NY	171717	east	12sep1918	18sep1918	07oct1918	39
Worcester	MA	179754	east	09sep1918	12sep1918	27sep1918	44
Chicago	IL	2701705	midwest	17sep1918	28sep1918	26sep1918	68
Cincinnati	OH	401247	midwest	24sep1918	04oct1918	06oct1918	123
Cleveland	OH	769841	midwest	20sep1918	07oct1918	05oct1918	99
Columbus	OH	237031	midwest	20sep1918	06oct1918	11oct1918	147
Dayton	OH	152559	midwest	20sep1918	05oct1918	30sep1918	156
Denver	CO	256491	midwest	17sep1918	27sep1918	06oct1918	151
Grand Rapids	MI	137634	midwest	23sep1918	02oct1918	19oct1918	62
Indianapolis	IN	314194	midwest	22sep1918	30sep1918	07oct1918	82
Kansas City	MO	324410	midwest	20sep1918	26sep1918	26sep1918	170
Milwaukee	WI	457147	midwest	14sep1918	06oct1918	11oct1918	132
Minneapolis	MN	380582	midwest	21sep1918	06oct1918	12oct1918	116
Omaha	NB	191601	midwest	18sep1918	04oct1918	05oct1918	140
St Louis	MO	772897	midwest	23sep1918	07oct1918	08oct1918	143
St Paul	MN	234698	midwest	21sep1918	02oct1918	06nov1918	28
Toledo	OH	243164	midwest	21sep1918	13oct1918	15oct1918	102
Los Angeles	CA	576673	pacific	27sep1918	06oct1918	11oct1918	154
Oakland	CA	216261	pacific	01oct1918	08oct1918	12oct1918	127
Portland	OR	258288	pacific	02oct1918	07oct1918	11oct1918	162
San Francisco	CA	506676	pacific	24sep1918	07oct1918	18oct1918	67
Seattle	WA	315312	pacific	24sep1918	01oct1918	06oct1918	168
Spokane	WA	104437	pacific	28sep1918	09oct1918	10oct1918	164
Baltimore	MD	733826	south	18sep1918	29sep1918	09oct1918	43
Birmingham	AL	178806	south	24sep1918	30sep1918	09oct1918	48
Greenville	SC	23127	south	17sep1918		07oct1918	28

Little Rock	AR	65142	south	20sep1918		06oct1918	29
Louisville	KY	234891	south	13sep1918	01oct1918	07oct1918	145
Memphis	TN	162351	south	23sep1918		10oct1918	20
Nashville	TN	118342	south	21sep1918	06oct1918	07oct1918	55
New Orleans	LA	387219	south	10sep1918	01oct1918	08oct1918	78
Paducah	KY	24735	south	18sep1918		08oct1918	35
Richmond	VA	171667	south	21sep1918	29sep1918	06oct1918	60
Shreveport	LA	43874	south	27sep1918		08oct1918	38
Washington	DC	437571	south	11sep1918	23sep1918	03oct1918	64
Wilmington	NC	33372	south	19sep1918		10oct1918	
Panel B: Regional averages							
East				05sep1918	26sep1918	25sep1918	49
Midwest				19sep1918	02oct1918	04oct1918	112
Pacific				26sep1918	05oct1918	12oct1918	140
South				16sep1918	28sep1918	07oct1918	54
Sources: Markel et al (2007).							