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A View Through High-Frequency Data**

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What Happened to the US Economy During the 1918 Influenza Pandemic? A View Through High-Frequency Data

François R. Velde*

Federal Reserve Bank of Chicago

April 17, 2020

Abstract

VERY PRELIMINARY

Burns and Mitchell (1946, 109) found a recession of “exceptional brevity and moderate amplitude.” I confirm their judgment by examining a variety of high-frequency data. Industrial output fell sharply but rebounded within months. Retail seemed little affected and there is no evidence of increased business failures or stressed financial system. Cross-sectional data from the coal industry documents the short-lived impact of the epidemic on labor supply. The Armistice possibly prolonged the 1918 recession, short as it was, by injecting momentary uncertainty. Interventions to hinder the contagion were brief (typically a month) and there is some evidence that interventions made a difference for economic outcomes.

*The views presented here do not necessarily reflect those of the Federal Reserve of Chicago or the Federal Reserve System. I thank without implicating Gadi Barlevy, Jeff Campbell, and François Gourio for very helpful discussions; Chris de Mena for gallant service beyond the call of duty; Matthew Song and Richard deThorpe for outstanding research assistance.

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v1.0 9 Apr 2020

v1.1 17 Apr 2020: minor typos, improved presentation of local projections

1 Introduction

As we grapple with events that are unprecedented in many ways and not quite unprecedented in others, we search for historical events that can shed light in our current darkness. The most recent pandemic of scale comparable to the Covid-19 pandemic took place in 1918.¹ This paper studies the impact of that pandemic on the US economy. In contrast to Correia, Luck, and Verner (2020), I focus on the short-term impact of the epidemic, up to a year rather than one to five years out, and my perspective is anchored in time series, so I rely on high-frequency times series (weekly, monthly, and bi-monthly).

I begin by briefly reviewing the facts of the epidemic. I then use a collection of monthly time series to document that a sharp but very short-lived recession coincided with the epidemic. The effect is most visible in manufacturing, while retail is affected modestly. Contemporary commentary confirms the fast rebound and suggests that the recession was prolonged by the end of World War I, just as the epidemic waned, and the resulting uncertainties over the return to a peacetime economy.

I then use high-frequency cross-sectional data to confirm the visible but brief impact of the epidemic and of the intervention measures (closings of certain businesses) that were adopted at the time. Banking data shows a financial sector functioning as it should (increasing loans). Conspicuously, there is no evidence of stressed balance sheets in the nonfinancial sector: business failures were on an uninterrupted downward trend, and cross-sectional data fails to find any effect of mortality. Fine-grained data from the coal industry allows me to trace the labor supply shock from the epidemic but I find no connection with the fall in demand for coal that followed the Armistice. I construct an index of local business conditions from weekly qualitative reports and use it, along with measures of payments volumes, to examine if the speed with which economically costly interventions were put in place made a difference in economic outcomes. I find clear evidence that interventions changed the dynamics of the epidemic and affected economic activity by reducing the number of infected, though broader effects (through a reduction in demand or activity) proves elusive.

There are of course differences between 1918 and 2020, some of which I review briefly: monetary and fiscal policy was hyperactive before the epidemic began and financial markets sailed through the episode with nonchalance. This obviously makes easy comparisons difficult, but there is still value in documenting properly at least one episode of pandemic, if only to provide a sanity check for future theorems about economics of pandemics.

2 The 1918 Pandemic in the US

The general features of the 1918 pandemic are well known and I will therefore be brief. From origins, both biological and geographic, that remain unclear² it swept the world

¹There were three influenza pandemics in the 20th century: 1918, 1957, and 1968 (Kilbourne 2006), but the other two had no visible economic impact (Congressional Budget Office 2006).

²The earliest recorded outbreak in the U.S. was early March 1918 in a US Army camp in Kansas (Vaughn 1921, 70), but Olson et al. (2005) show the distinctive W-shaped pattern of mortality by age in New York City in

in waves. The first wave, in spring 1918, propagated from the US to Europe, probably through troop movements (Patterson and Pyle 1991). Its virulence was noticed in May 1918 as it spread through Europe.³ It may have mutated sometime in August, as a much more lethal second wave spread through Europe and simultaneously arrived in New England in late August or early September. Deaths peaked in the US after several weeks and the epidemic was waning by November 1918, although some areas were affected by a third wave in the winter or early spring 1919.

Mortality

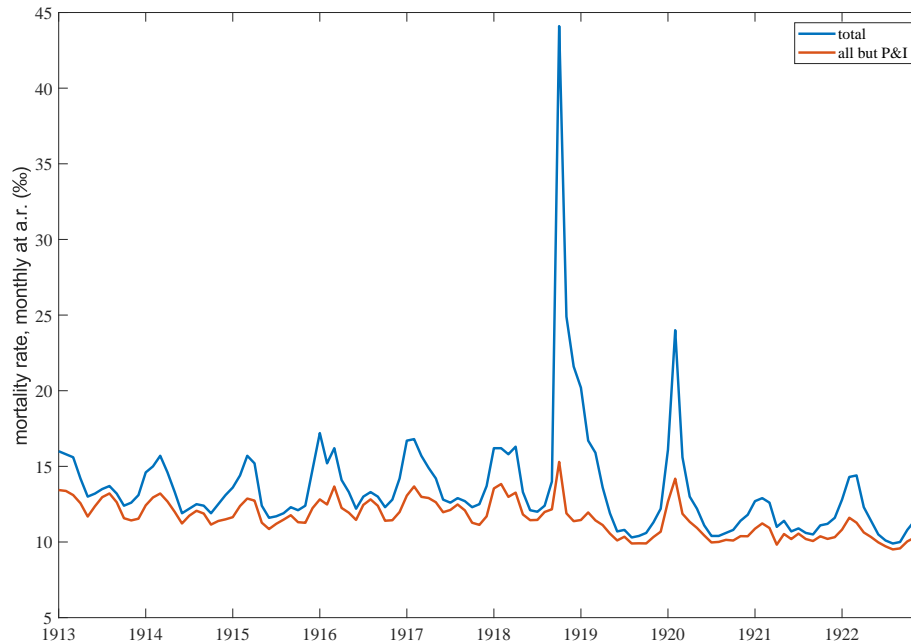


Figure 1: US mortality rate for all causes, and for all except influenza and all forms of pneumonia (P&I), monthly 1913–23. Source: Census Bureau, *Mortality Statistics* (1913–21).

While “most patients experienced symptoms of typical influenza with a 3- to 5-day fever followed by complete recovery” (Kilbourne 2006), the lethality of the virus was unusual. Figure 1 compares the US monthly mortality rate from all causes and from all but pneumonia and influenza (P&I).⁴ In all years influenza represented a substantial and seasonal component of deaths, peaking between January and March of each year. The year 1918 obviously stands out. A late, but relatively small peak in April 1918 may correspond

February–April 1918.

³It probably started on the west coast of France. Belligerents having little incentive to inform their adversary of their weakened condition, the illness was reported at first only in neutral countries such as Spain, hence its name of Spanish influenza. As the *Irish Times* of May 31, 1918 noted without visible irony: “It is remarkable that the countries suffering from these epidemics [Sweden and Spain] should both be neutral countries.”

⁴A few technical details. First, I will rely entirely on mortality data because there is no data on cases. Second, the mortality data are available for the “registration states” which registered deaths completely (in principle at least 90%). Registration did not cover the whole nation until 1933. From 1913 to 1921 the number of states in the registration area went from 24 to 34, representing 62 to 80% of the estimated US population. Finally, causes of death were reported but deaths by influenza and all forms of pneumonia (bronchopneumonia, lobar pneumonia, and other pneumonia) need to be taken together to study the incidence of the epidemic because of variation in reporting (in 1918, the ratio of reported influenza deaths to pneumonia deaths varies from 0.4 in North Carolina to 2.0 in Montana).

to the first spring wave, and was followed by the outsize peak of October 1918 and another smaller peak in February 1920.

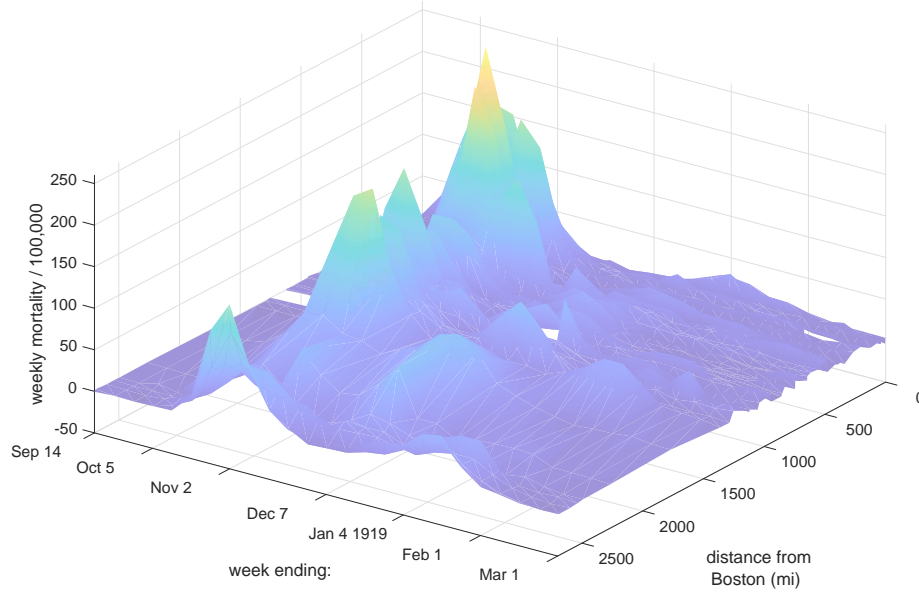


Figure 2: Excess P&I mortality rates of 47 US cities plotted against time (in weeks) and distance from Boston. Source: Collins et al. (1930).

Figure 2 shows the spatial and temporal pattern of the 1918 epidemic in the US, by plotting excess P&I mortality for 47 cities at a weekly frequency (Collins et al. 1930).⁵ The spatial dimension is reduced to one by using distance from Boston, the starting point of the epidemic. The figure shows that the epidemic propagated rapidly, peak mortality varied widely across cities, and mortality rates fell back within weeks except for the third wave in some places.

	excess mortality				
	all ages		ages 20–60		
	Jul 1918– Jun 1919	Jul 1919– Jun 1920	1918	1919	1920
in thousands	516	72	300	65	52
as % of population (103m)	0.50	0.07			
as % of 20-60 age group			0.56	0.12	0.10
as % of labor force (39m)			0.77	0.17	0.13

Table 1: Estimated excess influenza and pneumonia (all forms) mortality in the U.S., relative to 1913–17.

The influenza waves of 1918–20 are related in another way, namely the pattern of mortality by age. Figure 3 shows the mortality rate by age group for successive years.⁶ The years 1913–17 display an identical “U-shaped” pattern of mortality high for the young and old and negligible for ages 5 to 60. The years 1918–20 display a “W-shaped” pattern,

⁵This is the data set used in Hatchett, Mecher, and Lipsitch (2007) and Markel et al. (2007). Excess mortality is defined relative to 1921–27 mortality rates.

⁶More technicalities: the *Mortality Statistics* report annual (but not monthly) numbers of deaths by age group and cause of death. I use the US age distribution reported in *Historical Statistics of the United States* for the population as a whole, scaled by the relative share of the registration states, to obtain death rates by age groups.

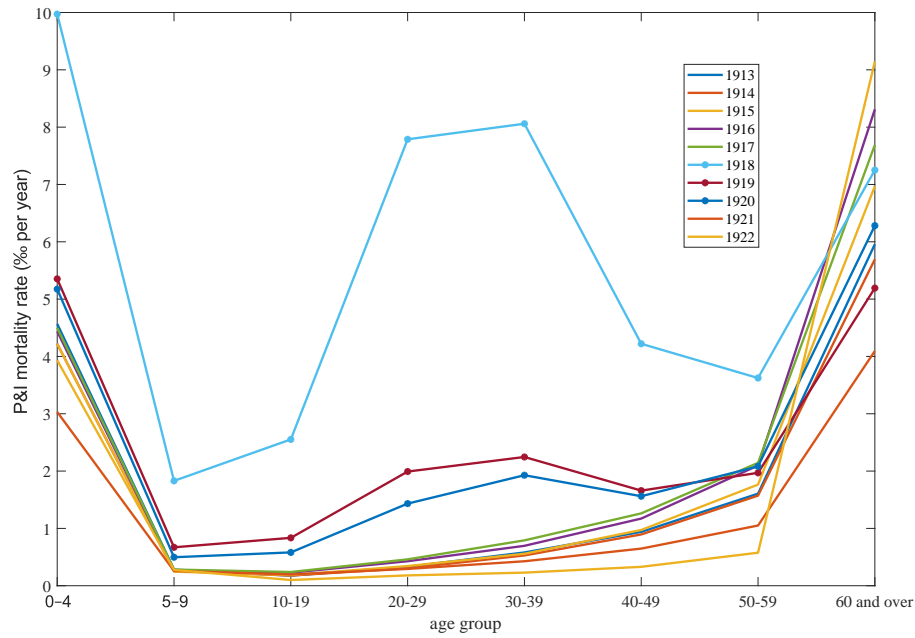


Figure 3: P&I mortality in the US (registration states) by age group, 1913–22. Source: Census Bureau, *Mortality Statistics* (1913–21).

particularly pronounced in 1918 but present in the next two years. The overall mortality (applying the death rate of the registration states to the whole population) is shown in Table 1. This unusual age pattern means that the labor force was much more affected by the lethality, and presumably by the symptoms, than in any other influenza season; more even than World War I, in which US casualties (battle deaths and other deaths) were 116,000.

Non-pharmaceutical interventions

Several papers (Bootsma and Ferguson 2007; Hatchett, Mecher, and Lipsitch 2007; Markel et al. 2007) examine the effectiveness of non-pharmaceutical interventions (NPIs) on mortality outcomes, using the same weekly mortality data for various US cities (43 and 17 respectively) from Collins et al. (1930). As described in those papers, NPIs, imposed mostly by cities but sometimes at the state level, took a wide variety of forms ranging from shutting down public gatherings and crowded places to staggering business hours, closing schools, imposing quarantines for infected people, requiring masks, etc. No intervention went as far as closing non-essential businesses, as have the lockdowns of the 2020 pandemic.

More recently Correia, Luck, and Verner (2020) have used the same mortality data and the measures of NPI defined in Markel et al. (2007) to study how mortality and interventions affected medium and long-run economic activity. My focus will be instead short-term outcomes, with a slightly different measure of NPI.

Markel et al. (2007) measure the NPIs by sorting them into three categories and counting the number of days during which measures of each category are applied: thus, a day on which schools and bars are closed and sick people are quarantined counts as 3. But all measures would not have similar economic effects, quarantines and self-isolation would

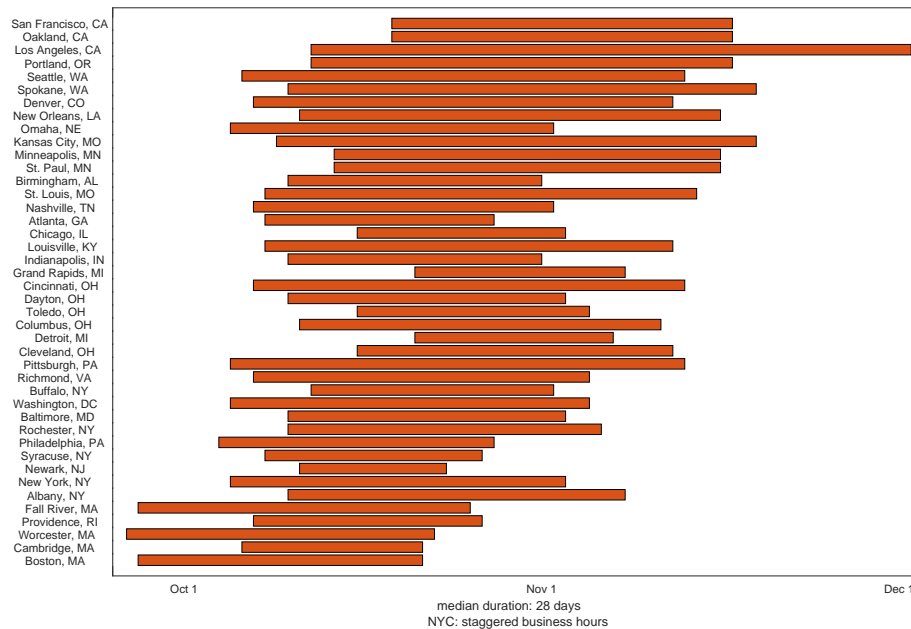


Figure 4: Timing and duration of closings in 43 US cities. Source: Hatchett, Mecher, and Lipsitch (2007), <http://influenzaarchive.org>, and various newspapers.

presumably be much less impactful on the economy (as opposed to the epidemic) than closing bars and theaters. In addition this one-time measure of intensity of NPI is not practical for time-series purposes. For these reasons I concentrate on the timing and duration of closings of businesses.

Figure 4 shows the duration of closings across US cities. Notably, New York City did not close any businesses but instituted staggered business hours.⁷ The median duration was 28 days, the earliest closing started on September 25 and the latest on October 14. Hence, the cross-sectional variation in timing and duration of closings is quite limited.

3 Looking for the recession: in the time series

The epidemic and the interventions were very concentrated in time, compared to the frequency at which economic phenomena are normally measured. If we want to detect and measure the *immediate* impact of the epidemic (and, possibly, that of interventions) on the economy we will need high-frequency data, at a minimum monthly or bi-monthly. The second challenge is the absence of many modern constructs that we typically use, because “data” are always constructed to some degree, particularly aggregate data. Finally, although much data was published by public and private actors,⁸ systematic collection by government agencies was only beginning.⁹ As a result, many modern series begin, annoyingly for us, in January 1919.

⁷New York’s cumulative excess P&I mortality was 0.51%, below the median of 0.55%.

⁸E.g., the weeklies *Commercial and Financial Chronicle* and *Bradstreet’s*. In academia, the *Review of Economic Statistics* (which became R.E.Stat.) began in 1919, edited by Warren M. Persons and publishing exactly what its title announced.

⁹The BLS’s *Monthly Labor Review* and the Fed’s *Bulletin* began in 1915, the BEA’s *Survey of Current Business* began in 1921. The NBER was founded in 1920.

GNP

If we start at the top of the aggregation chain, we immediately run into difficulties. In 1918, national income accounting had not been invented, let alone implemented. Only in 1932 did the Federal government commission Simon Kuznets and the NBER to construct NIPA (national income and product accounts), which he did starting for the year 1929. He later he extended the annual series to 1919 and even earlier, but felt that it was unsuitable for business cycle purposes such as ours (as opposed to the study of trends). Nevertheless, his work and that of his students led to the so-called “standard” annual series, recently challenged and revised by Balke and Gordon (1989) and Romer (1989) who provided their own annual estimates.

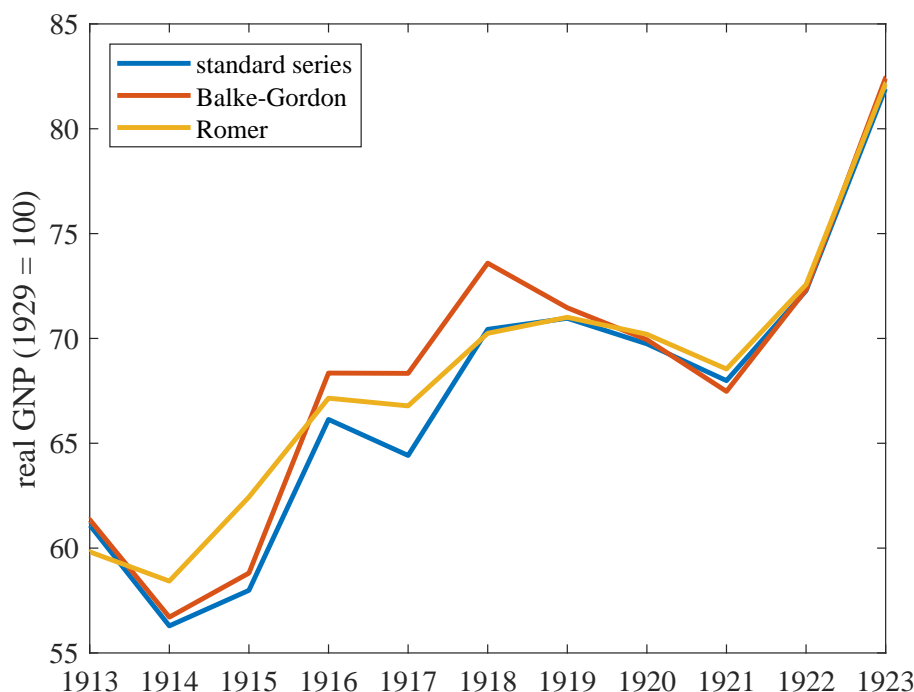


Figure 5: Modern estimates of GNP. Sources: Balke and Gordon (1989) and Romer (1989), HSUS Table Ca211.

The three series are annual and are plotted for our time period in Figure 5. Although they show very close agreement after 1919 when data becomes more abundant, they disagree on our period of interest. The standard series and the Romer series peak in 1919 and drop only by 3.5% over the ensuing two years 1920 and 1921, while the Balke-Gordon series peaks in 1918 and drops by 8% over three years.

Interestingly, Romer (1988) extensively discusses US output during and after World War I and does not mention the influenza epidemic at all, let alone link it to the recession that is visible in the annual data, that of 1920–21.

The recession of 1918–19

In fact, business cycle historians do find a cyclical downturn at the time of the epidemic, but it is not the recession of 1920–21. In their classic work, (Burns and Mitchell 1946,

78,109) find a business cycle peak in August 1918 and a subsequent trough in April 1919, but note the “exceptional brevity and moderate amplitude” of the recession.¹⁰ The data they used was a vast array of economic time series at the monthly frequency.¹¹ The rest of this section essentially follows in the footsteps of Burns and Mitchell, examining some of the same monthly time-series to ascertain the timing and extent of the 1918 recession. In the absence of aggregate constructs I will resort to a wide array of series, in the hope of picking up signs of the recession in different sectors of the economy. For this purpose we can be less picky than modern historians: how far back the series extend, what long-term trends drive them, are less important than their sensitivity to the cycle of interest. In the next section I will use more modern methods and rely on the cross section as well.

Industrial production

We begin with a classic measure of economic activity, industrial production. The series we use is that of Miron and Romer (1990), plotted in Figure 6. The standard NBER recessions are indicated by the usual yellow stripes. The series peaks in July 1918 and bottoms out 20% lower in January 1919, but rebounds almost immediately to the prior level and oscillates thereafter in the same range until the next peak of March 1920. The ensuing contraction, by contrast, is much more severe and prolonged: the trough is reached fourteen months later and the contraction is by half.

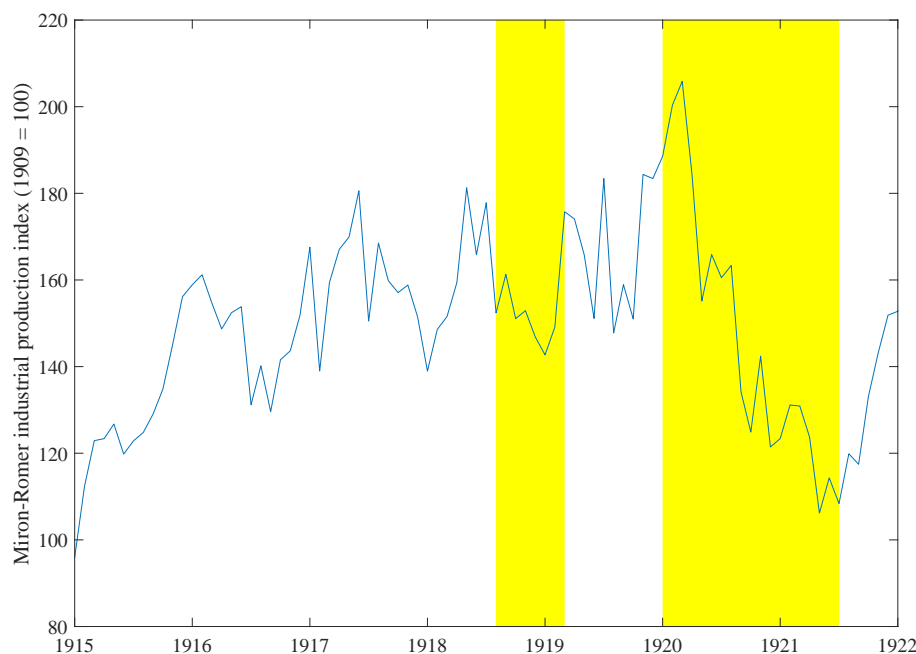


Figure 6: Industrial production. Source: Miron and Romer (1990).

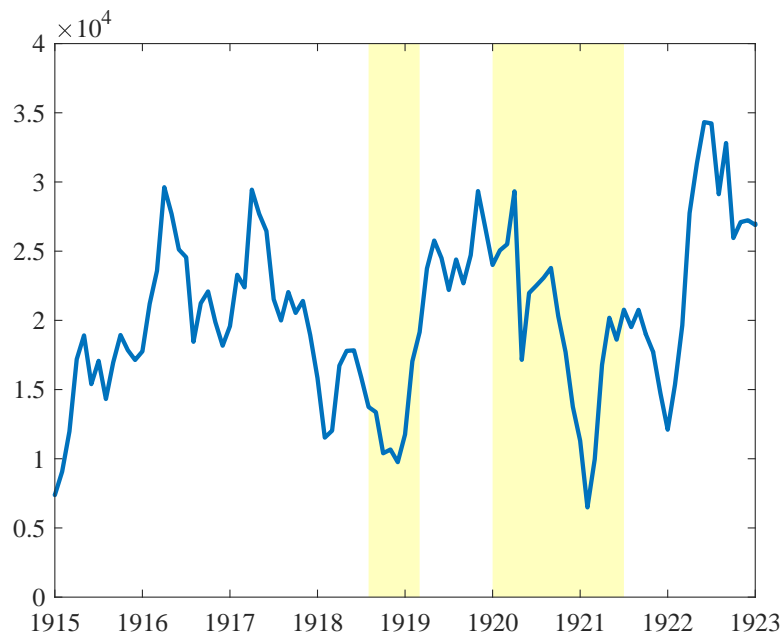


Figure 7: Railroad freight car load shipments from automobile factories. Source: *Moody's Transportation* 1924, p. xxxviii.

Consumer Durables

The automobile industry was, of course, a very recent one in 1918, although at that date there were already over six million vehicles registered in the country. During the war the production of vehicles for civilian use was not considered essential but it continued nevertheless. Figure 7 is a measure of factory shipments on a monthly basis. A slowdown seems to start slightly before the epidemic itself, but otherwise the recession is quite visible, with a fast rebound from January 1919. The scale of the downturn in 1920–21 is much larger.

Retail

Copeland (1929) provides data on the volume of retail trade. The data comes from two mail-order stores (Sears-Roebuck and Montgomery-Ward), two five-and-ten-cent store chains (Woolworth and Kresge), one grocery chain in the New York Fed's district, one drug chain (Liggett and Co), one dry-goods and clothing chain (JC Penney and Co), and five department stores all near New York City.¹² He concedes the "scarcity and peculiar nature" of the data prior to 1919 and that it represents probably less than 3% of total retail sales. It is particularly limited in geographic scope, and as it happens New York City was the one major city to eschew the use of business closings, relying instead on quarantines, isolation, tracking of infections, and an education campaign (Aimone 2010). This, however, only affects the grocery and department store index.

¹⁰The modern, "official" dating (nber.org/cycles.html) is August 1918 to March 1919 (Moore and Zarnowitz 1986), while Romer (1994) moves the peak back a month to July 1918.

¹¹Romer (1994) discusses in detail the data and methods used at the early NBER to date business cycles.

¹²The proportion of familiar names is probably correlated with the reader's age.

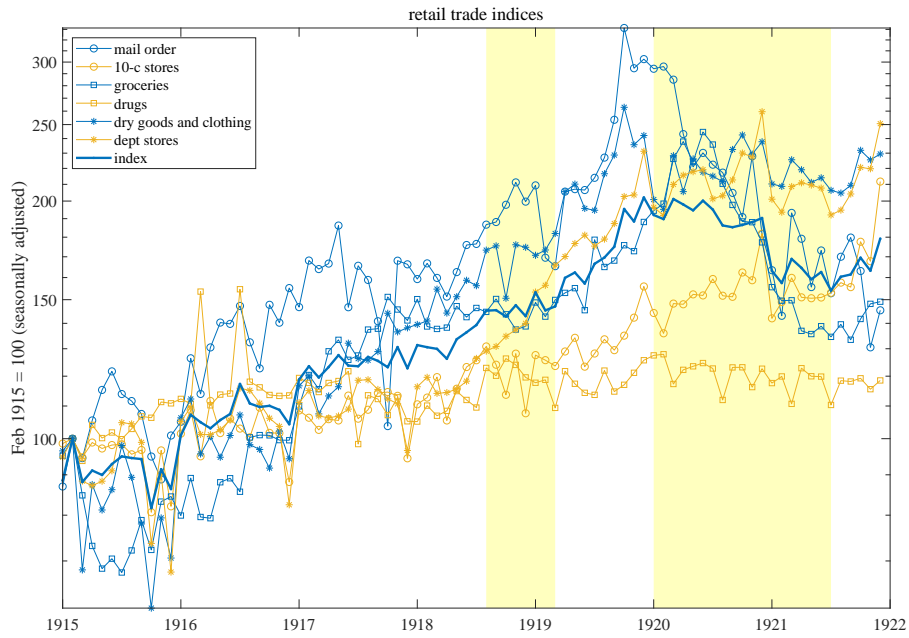


Figure 8: Indices of retail sales by type of store, monthly (s.a.). Source: Copeland (1929).

	mail order	ten-cent	grocery	drugs	dry goods, clothing	dept store
Sep 1918	0.8	-5.2	3.8	-2.2	1.2	1.4
Oct	6.0	-13.2	-0.7	2.8	-13.1	4.4
Nov	13.1	-2.1	-5.0	0.9	1.6	6.4
Dec	6.9	-17.7	-4.2	-2.7	0.8	8.4
Jan 1919	12.1	-2.5	2.8	-4.2	-1.5	18.8
Feb	-9.2	-3.9	-1.4	-3.4	0.0	21.2
Mar	-11.4	-5.5	3.5	-11.0	5.0	28.5

Table 2: Percent change in retail indices relative to August 1918.

Table 2 shows the movements in the seasonally adjusted volume indices relative to August 1918. Perhaps not surprisingly the drugstore did well in October and November, as did the mail-order chains, an early version of the “Amazon effect”; and both suffered in early 1919 as the epidemic waned. Dry goods and 10-cent stores and groceries suffered during the epidemic, again as one might expect, but bounced back more or less quickly. It is again worth noting that the retail indices respond quite significantly in the 1920–21 recession.

The picture meshes with reports from the Federal Reserve Bank of Philadelphia that in October “the number of customers visiting the stores decreased about one-third and the volume of sales from 30 to 50 percent” but in November “retail trade improved wonderfully and merchants expressed the belief expressed the belief that the buying during the balance of the year would more than make up the loss caused by the epidemic” and by December “retail trade was exceptionally good, retailers of men’s wearing apparel reporting business 25 per cent ahead of December, 1917. With the war over, the public believed there was no further need for stringent economy and felt free to purchase liberally all kinds of goods.” Likewise, The New York Fed reported that “the influenza epidemic caused a very excessive slackening in business during October. Following the signing of

the armistice, retail sales increased decidedly in nearly all lines, due partly to the decrease of influenza, but principally to the relaxation of the rigid economies practiced during the war. The result was a holiday trade of record proportions” (Federal Reserve Board 1919b, 375,423–24).

Employment

Data on employment is relatively sparse, particularly at the monthly frequency (Monthly Labor Review 1926). The national census of manufacturing was quinquennial from 1899 to 1919 and became biennial in 1921: it thus skipped over the year of the pandemic. The monthly collection of employment data began at the state level in New York in 1914, while Wisconsin began bimonthly collection in 1915. The BLS also began data collection at about the same time, but the scope enlarged only in the 1920s. Massachusetts carried out annually a census of manufacturing that collected monthly data for the past year: this data was retrospective but covered all establishments, while the other three monthly reports covered only a fixed set of establishments. Ohio’s census was similarly comprehensive, as it covered all employers of five or more persons and recorded employment on the 15th of each month. All series measure employment in manufacturing only.

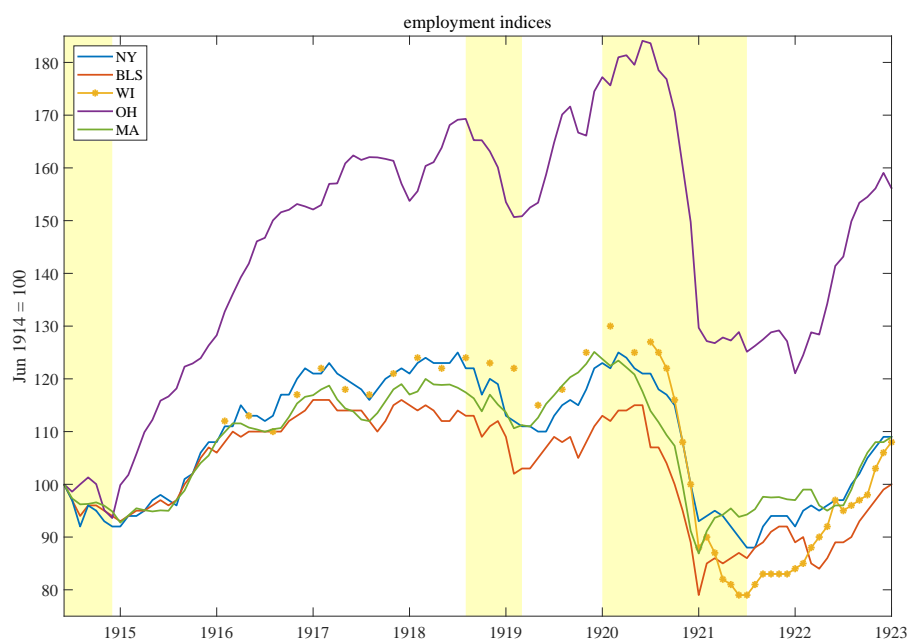


Figure 9: Employment indices for the nation (BLS), New York, Massachusetts, Wisconsin, and Ohio. Source: Monthly Labor Review (1926), Bureau of Labor Statistics (1932), and Commonwealth of Massachusetts (1913–1922).

The five series are represented in Figure 9 and present broadly similar behavior. From the peak in summer 1918 New York’s index falls by 15%, the BLS by 12%, Ohio by 11%, Massachusetts and Wisconsin by 7%. All indices then recover over the course of twelve months and regain their previous levels by December 1919 at the latest; Massachusetts and Ohio by August 1919. The fall in 1920–21 is substantially worse (30 to 40%), levels remain depressed for longer, and the ensuing recovery only begins in early 1922 although

once it starts it is extremely rapid.

Payment volumes

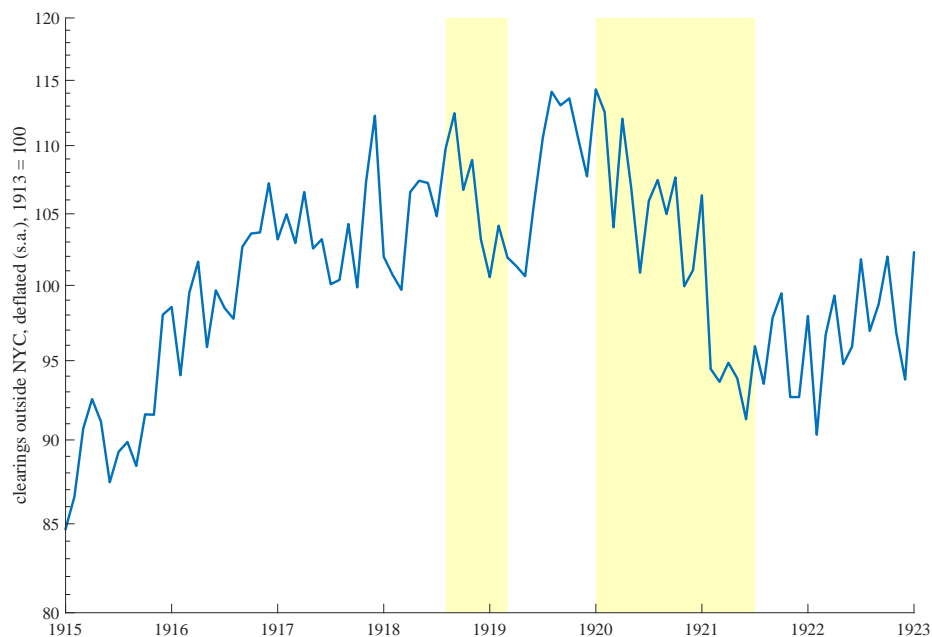


Figure 10: Deflated bank clearings outside New York City (s.a.). Source: NBER macro-history database, series m12018ba, from Macaulay (1938, A255–A270).

A favorite series of early statisticians trying to measure the business cycle¹³ was the volume of bank clearings reported by various cities' clearing houses. This seems like a good reason to glance at it—but we will revisit it in the cross-section as well. Typically New York's clearings, which reflected settlements of stock market transactions, were excluded for business cycle purposes. Miron and Romer (1990) do not use them to measure production because they are neither pure quantity nor pure price, but they are worth inspecting. Clearings in fact increase during the epidemic proper, but register a sharp fall in early 1919, quickly reversed. It should be noted that February 1919 brought the end of wartime price controls: the wholesale price index registered an abrupt 8% fall in that month, and retail prices fell by 5.5% on average from January to March 1919 (see Figure 25). Hence clearings are also shown as deflated: the size of the fall during the recession is about the same magnitude (10%) but the timing is a little different. Note again that the contraction during the 1920–21 recession is about twice as large.

Business failures

Two credit rating agencies, Dun and Bradstreet (the firms merged in 1933) systematically collected data on business failures, for which Bradstreet required that it involve “some loss to creditors of individuals, firms or corporations engaged in ordinary commercial

¹³See Persons (1919), the first editor of the *Review of Economic Statistics*, and Rorty (1923), co-founder of the NBER.

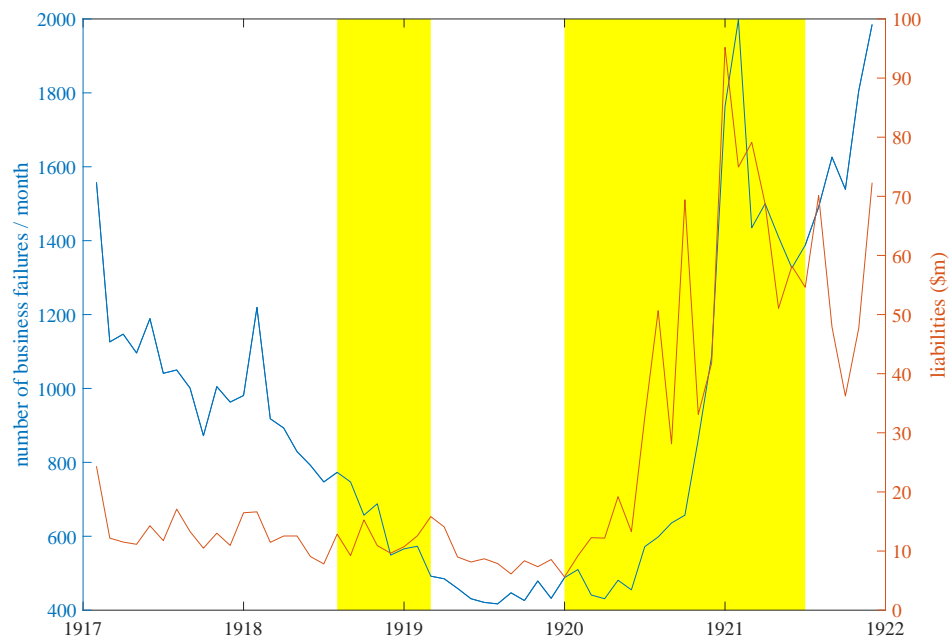


Figure 11: Business failures (number and liabilities). Source: *Bradstreet*, NBER macrohistory database.

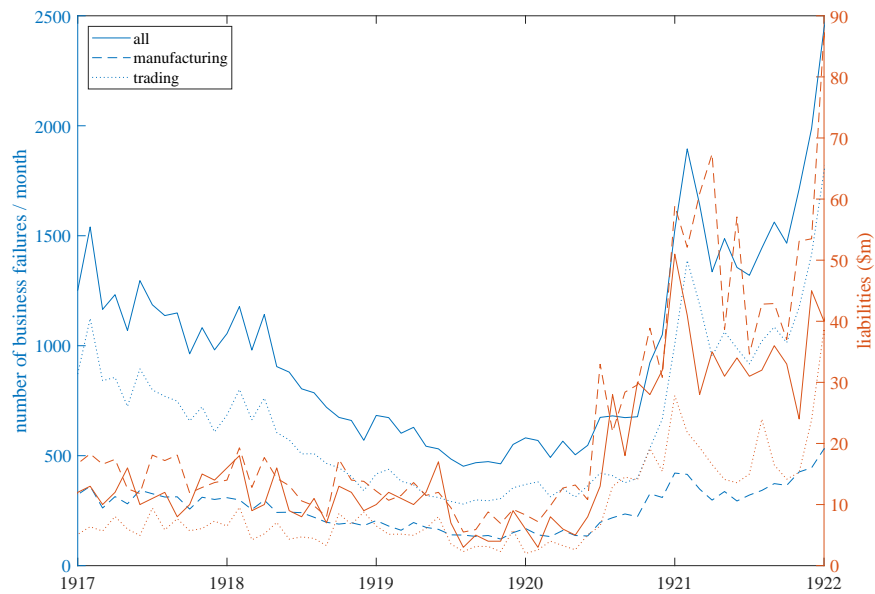


Figure 12: Business failures (number and liabilities) for all commercial, manufacturing, and trading. Source: *Dun*, NBER macrohistory database.

operations,” which excluded professionals (Persons 1919, 44, who judges it “comprehensive”). The data from these two firms is shown in Figures 11 and 12. The most striking aspect of the series is the almost complete absence of a surge in failures during the 1918 recession (note that the data are not seasonally adjusted). In fact, the number of failures goes down steadily. In contrast, the number of failures rises by a factor of four or five during the 1920–21 recession.

Bradstreet’s analysis of the year 1918 is worth quoting (Feb. 1, 1919, p. 77):

Failure returns for 1918 reflected unprecedented prosperity of a vast proportion of the country’s inhabitants, due mainly to the stimulus of a highly successful war conducted at a distance, so that few unfavorable effects were to be seen or felt. The results were total business casualties below any thing witnessed for a third of a century, liabilities that compared favorably with any but the best of years, an unprecedentedly small number of banking casualties, and a smaller proportion of failures to those engaged in business than ever before recorded since *Bradstreet’s* records of Business Mortality were first made up. . . . There were some unfavorable features met with in the year, notably extremes of cold and heat in winter and summer, a severe drought causing partial failures of corn and cotton, an unprecedentedly fatal epidemic, government interdiction ending in partial paralysis of a number of important industries, notably building, brewing, distilling and automobile manufacturing, and accompanying restriction of all but most essential operations in other lines. On the other hand, there was first and foremost a hothouse stimulation of all lines aiding in war operations, immense demand from government sources for all kinds of materials and products that could be used in war, active employment at high wages for all who could work with their hands, and a vastly enlarged purchasing power of the mass of the people. . . It is an additionally interesting feature that, notwithstanding the slowing down in business that followed fast upon the signing of the armistice and the interruption to trade at many centers by the influenza, so great was the momentum in business and so profitable had been the previous months’ trade, that the lowest monthly totals of casualties ever recorded were reached in the closing quarter of the year.

Contemporary testimony

The sharp but brief downturn in production, the transient impact on retail are well attested from the reports of the Federal Reserve Banks on the conditions in their districts.

It is legitimate to wonder if the reports were not biased by patriotic ardor, especially on the part of quasi-public institutions such as the Federal Reserve Banks, whom it behooved to describe the war effort in the most positive and encouraging way. That does not seem to be the case in the description of the epidemic’s first effects. In fact, the tone of the October reports is forthright and vivid (Federal Reserve Board 1918, 1126–40). In Boston, “The epidemic of influenza which has prevailed during the past month has seriously interfered

with business. Production of all kinds has been restricted. Retailers in large centers have had a material falling off in business, while those serving small local trade have to a considerable extent reaped benefits. . . Cotton mills have been seriously retarded by shortage of labor due, to a considerable extent, to the illness of employees . . . Retail business has been adversely affected by restrictions on shopping and by the weather." In New York, "influenza has greatly hampered production in certain centers, although the situation is not yet as serious as reported in some of the other districts." In Philadelphia "a heavy loss in production was occasioned by the influenza epidemic. . . The influenza epidemic had greatly affected the coal output. Conservative estimates show that it has caused, a decline in the production of anthracite coal of from 250,000 to 300,000 tons per week, some of the collieries being compelled to close." Although Cleveland reported that "so far the epidemic of influenza has not contributed to any great extent in the labor shortage," Atlanta stated that "Alabama coal output showed a considerable decrease in September, and the spread of the influenza, coupled with labor shortage, caused the October reduction, leaving the outlook far from bright." In Saint Louis "the influenza epidemic, and the measures taken to combat it, have had a disturbing effect on certain branches of business in this district. Theaters, schools, churches, and other meeting places have been closed entirely, and some of the large stores have been compelled to open later and close earlier than usual. This has especially handicapped retail trade, though other lines have also been affected. Some activities have suffered considerably on account of the depletion of their working forces through contraction of the disease." In Dallas "unseasonably warm weather, accompanied by the influenza epidemic, has had a very serious effect on business in nearly all parts of the district during the past 30 days, and trade is generally inactive as a result." In Kansas City "added to the labor shortage October and the first half of November saw serious complications resulting from a general epidemic of Spanish influenza among all classes of workers throughout the district. No branch of industry escaped. The mines were especially disorganized, many men being incapacitated from one to two weeks. In many cases it was difficult to maintain operations. Factories and large industrial plants were affected in the same way and in the same proportion. Men, on returning to their work proved unequal to their former tasks."

The rapid reversal after the epidemic is likewise attested by the monthly reports of November 1918 (Federal Reserve Board 1918, 1220–36), by which time the Armistice made self-censorship unnecessary. In Boston "conditions are rapidly returning to normal." In New York, the epidemic was "fairly well checked by November, and business was proceeding at top speed" and retail trade "showed a decided gain toward the end of November"; "sales by retailers, which were somewhat restricted at the beginning of the period under report because of the influenza epidemic and the spirit of war economy, showed a decided gain toward the end of November." In Philadelphia "a more normal situation has resulted from the waning of the influenza epidemic." In December Richmond said that "the subsidence of the prevalent influenza permitted the reopening of churches, schools, and other places of gathering. . . trade has been spotted and below normal during the influenza period, but on the whole prosperous and on a sound basis. . . the effects of the

influenza are passing.” In Atlanta “the mercantile business, while reported fair, is not very good, owing to the influenza epidemic, which prevented many traders from visiting stores, and resulted in a considerable curtailment of sales. Business, however, is increasing, and a large holiday trade is anticipated.” In St. Louis “the influenza epidemic is on the decline in this district, and the bans placed on business to combat it, in most instances, have been lifted. Department stores, theaters, etc., are now operating as usual, and schools, churches, lodges, etc., are again open. This has materially helped the retail trade. It is also being stimulated by Christmas shopping, which is being done early this year in response to the requests of merchants.” In Kansas City “the high tide of business . . . shows a continued upward sweep, in spite of slight and temporary checks which may be attributed to special factors, such as the influenza epidemic, elections, the financing of the fourth Liberty loan, and the cessation of hostilities. As a whole, the situation is viewed with optimism and upon the broad assumption that America’s task of equipping and provisioning a large part of the world has only begun.” In Dallas there was “general dullness in business” but “it is expected that this slump in trade will be only temporary; in fact, reports now indicate that the situation is somewhat improved, and we believe the worst of the danger is over.”

By the January 1919 issue of the *Federal Reserve Bulletin*, covering December 1918, the epidemic ceased to be mentioned.

The uncertainty associated with the Armistice is also apparent in many reports: New York reported that after the Armistice “followed a period of uncertainty and hesitation with regard to the steps necessary to readjust business to a peace basis. Gradually Government restrictions, such as priority rules, were removed, and many lines were able promptly to return to approximately their prewar bases. Many other industries, however, felt obliged to pursue a waiting policy pending announcement of the Government’s program for cancellations and the disposal of Government-owned stocks of raw materials.” In Philadelphia “there was a strongly defined tendency to mark time, with a view to determining the probable extent of readjustment after the war, the consensus of opinion was that the period of readjustment would be relatively short, to be followed by an era of industrial activity” (Federal Reserve Board 1919b, 373,424) “Practically throughout the country the month of January [1919] has been characterized by the uncertainty incident to a period of transition in business.” The hesitation revolved around prices of commodities and raw materials: “Uncertainty, not only among consumers, but also among those who would ordinarily be in the market for raw materials with which to manufacture goods, concerning the possibility or probability of a further drop in values, tends in the same direction” (Federal Reserve Board 1919a, 104,109).

Summing up

Visual inspection of the series leads to a consistent conclusion: the 1918 recession was mild and quickly reversed, and stands in very sharp contrast to the 1920–21 recession. Our series do not fail to detect recessions: indeed, that is why students of business cycles

used them at the time. The 1918 recession, often overlooked in business cycle histories, was simply not that remarkable, particularly compared to the one that followed.

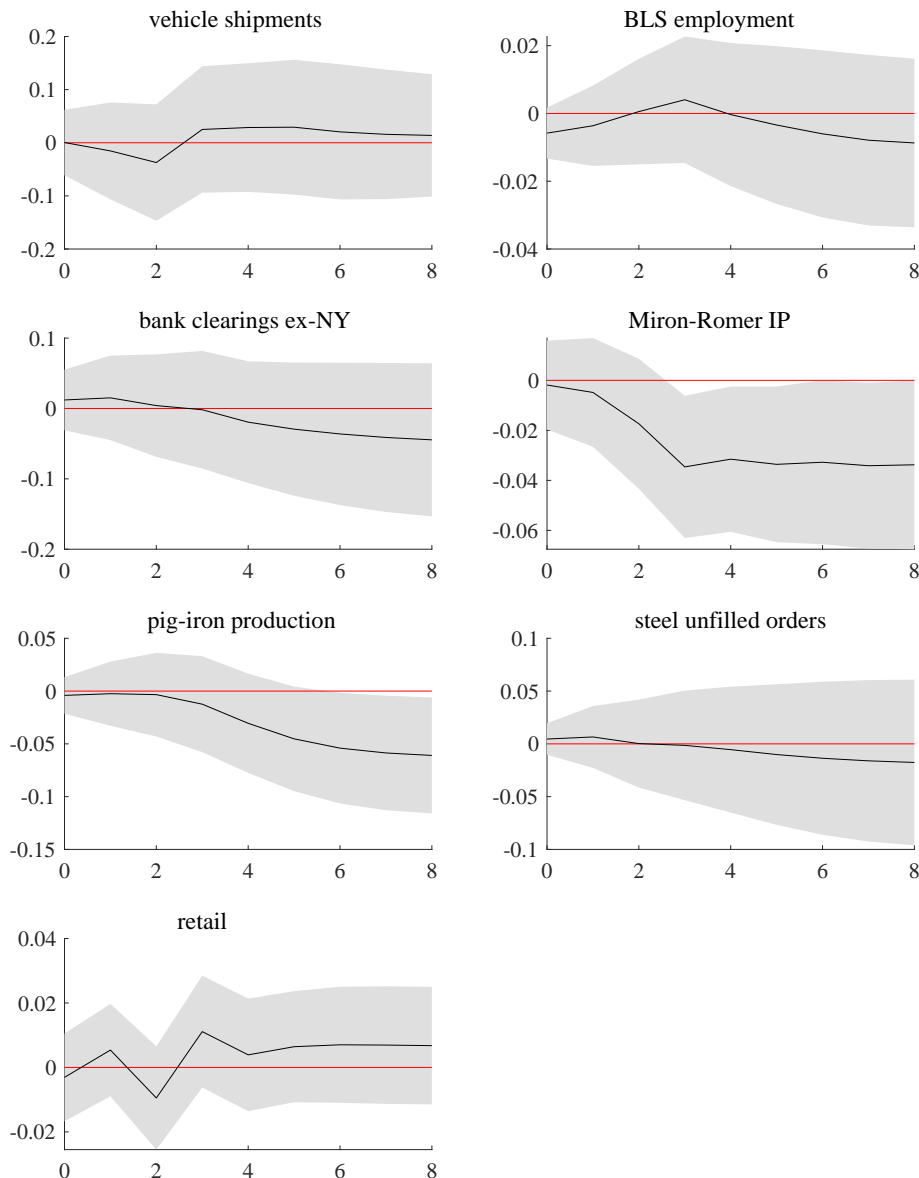


Figure 13: Impulse response functions from monthly bivariate VARs with national excess P&I mortality. See text for scaling and sources.

Did it have anything to do with the influenza epidemic? It certainly coincided with it, and contemporary economic commentary did not fail to note the impact of the epidemic both on labor supply and, through business closings, on trade. To investigate this relation with more than time-series graphs, I present in Figure 13 impulse response functions from a sequence of bivariate VARs. Each VAR has the monthly national excess P&I mortality rate in 1918–19 and one monthly economic variable: vehicle shipments as in Figure 7, the BLS index of employment of Figure 9, bank clearings excluding New York as in Figure 10, the Miron-Romer industrial production index of Figure 6, pig-iron production (in tons) and US Steel Corporation’s unfilled orders (both in tons, from the NBER macrohistory database), and the retail index of Figure 8. The VARs have four lags and

include month-of-year fixed effects; the sample periods are those of the available series.¹⁴ The identification is that mortality does not respond contemporaneously to the economic variable. The responses are to a shock of 2.3 deaths per thousand, which was the peak reached by mortality in October 1918 (see Figure 1).

Industrial series (pig iron, industrial production) show a statistically significant and durable but mild response. The other responses are not well estimated. Employment shows a drop that is quickly reversed, as do vehicle shipments, while bank clearings initially rise and then fall. Retail shows no consistent response.

The cross-section will allow us further to probe the link between the epidemic and the recession.

4 Looking for the recession: using the cross section

In this section I investigate the relationship between the epidemic and economic activity. The goal is to understand the mechanism linking the two and how interventions to slow the epidemic affected it, the tool is the cross section, the constraint is data availability.

There are two levels of cross section that can be used: city and state. As described above, Linder and Grove (1947) provide monthly mortality data at the state level for thirty states, while Collins et al. (1930) provide excess P&I data for 47 cities. In addition, at the city level we have measures of NPIs, namely closings and reopenings of business: mostly places of entertainment and socializing (theaters and movie theaters, dance halls, bowling alleys, “saloons,” restaurants, etc).

In the first two sections

The coal industry

I will focus on one particular industry. Mining at the time employs around 1m people or 2.5% of the labor force. The second-most important component of the Miron-Romer IP index is shipments of anthracite, a form of coal mostly used for domestic heating and principally mined in Pennsylvania. The other major form of coal was bituminous or soft coal, used for industrial purposes and mined throughout the United States. Figure 14 shows weekly production estimates for both types of coal. Production of anthracite peaks in the last week of August and bottoms out in the first week of March 1919 56% lower. Bituminous coal peaks in the last week of September and bottoms out in the first week of April 1919 46% lower. Both outputs regain their peak levels in early October 1919 just before the onset of strikes and labor disputes.

It is possible to learn more about the causes of the fall in output, from statistics generated by the US Fuel Administration, created when the US entered World War I to manage the production and distribution of national energy sources. Every week the administration collected and published reports by mine operators on their production relative to capacity, and explanations for the shortfall classified as car shortage (transportation), mine

¹⁴I end all VARs in December 1928. Vehicle shipments start in January 1914, unfilled orders in June 1910, industrial production in January 1884, bank clearings in January 1875, pig-iron production in January 1877, BLS employment in June 1914, and retail sales in July 1914.

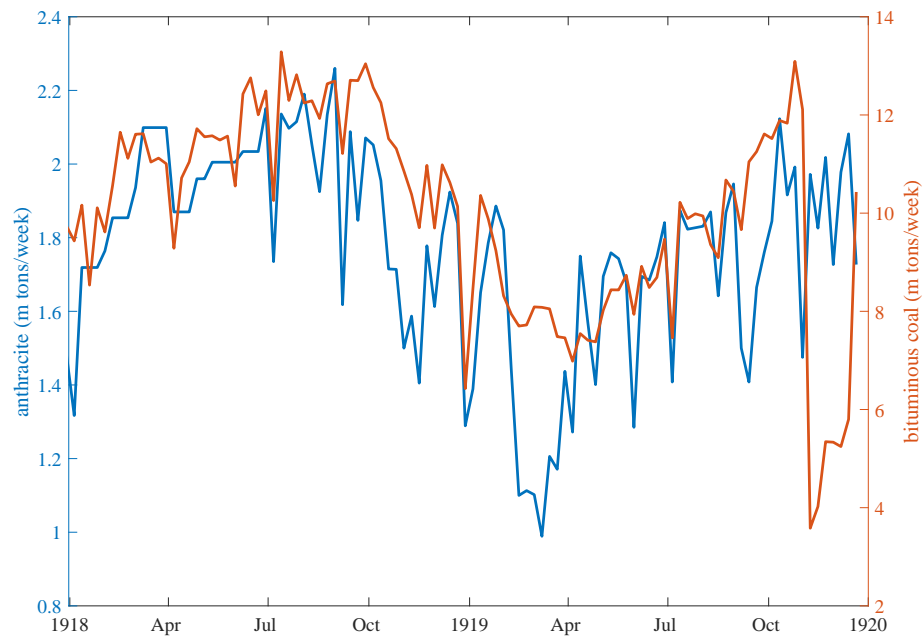


Figure 14: Weekly production of anthracite and bituminous coal in the United States. Source: United States Fuel Administration (1919) and the *Coal Trade Journal*, various issues.

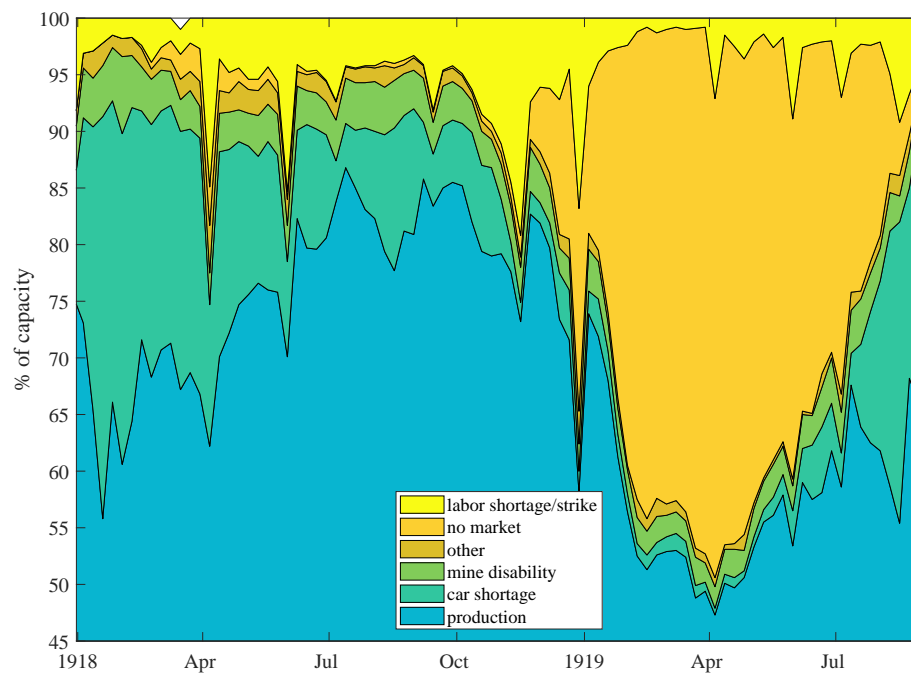


Figure 15: Capacity utilization as reported by mines, weekly. Source: United States Fuel Administration (1919) and the *Coal Trade Journal*, various issues.

disability, labor shortage, strikes, and “no market,” i.e., low demand. The reports came from mines representing between 65 and 90% of total national output across the country, and they are published by producing regions, which I aggregate into states.

Figure 15 plots the weekly decomposition of capacity utilization based on these reports, for the country as a whole. Aside from punctual events¹⁵ the figures shows how labor shortages grew sharply in October and peaked mid-November, and fell back by mid-January to the August level. The continued diminution in mine output was then driven by another factor, “no market,” which grew from November 1918 to April 1919 and then subsided. Contemporary observers saw several factors at play. An analysis in the *Coal Trade Journal* (March 5, 1919) saw the “primary causes” as “the sudden cessation of hostilities abroad and the unusually mild winter at home,” while the “chief secondary causes” were “the unpreparedness of the country for peace and the delays incident to the settlement of war contracts and the clarification of the government’s future attitude toward business enterprises of all kinds”. The comment alludes to the fact that the Federal government relinquished control over the coal industry in late January 1919, withdrawing price controls and regional restrictions (the US had been divided into regions and coal could not be shipped across regions).

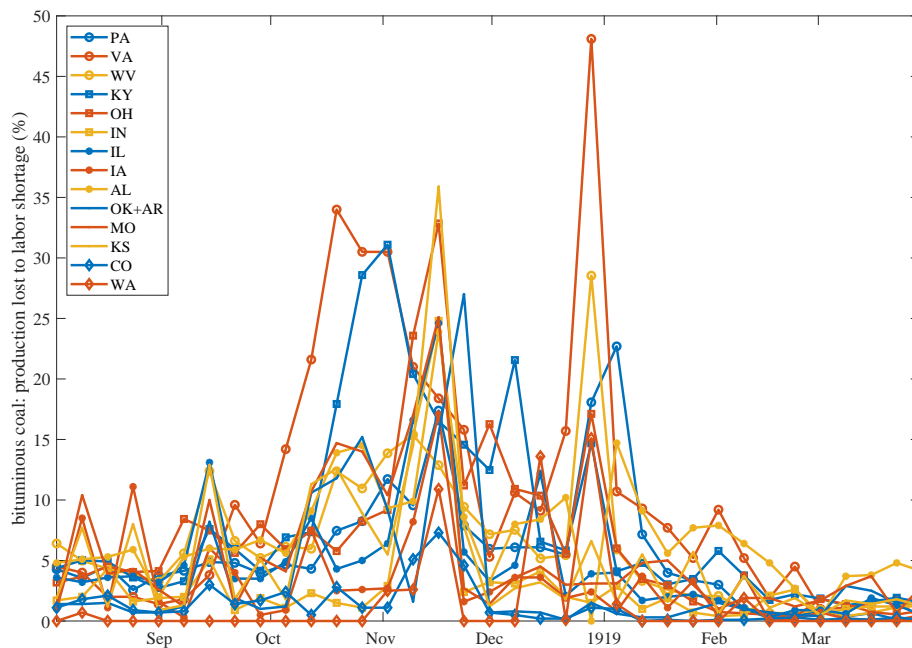


Figure 16: Capacity unused because of labor shortage, weekly, by state. Source: United States Fuel Administration (1919) and the *Coal Trade Journal*, various issues.

It is tempting to think of the epidemic as a supply shock giving rise (through “labor shortage”) to a subsequent fall in demand (“lack of market”): in terms of Figure 15, the yellow begetting the orange. The cross section data shows that the story is not so simple. We can confirm that the epidemic reduced labor supply, but there is no linkage to lack of market.

¹⁵Onetime sharp surges in labor shortages (weeks ending Apr. 5 1918, Jun. 1 1918, and Dec. 28 1918 reflect holidays. On Sep. 12 1918 registration day (for military service) also affected labor supply.

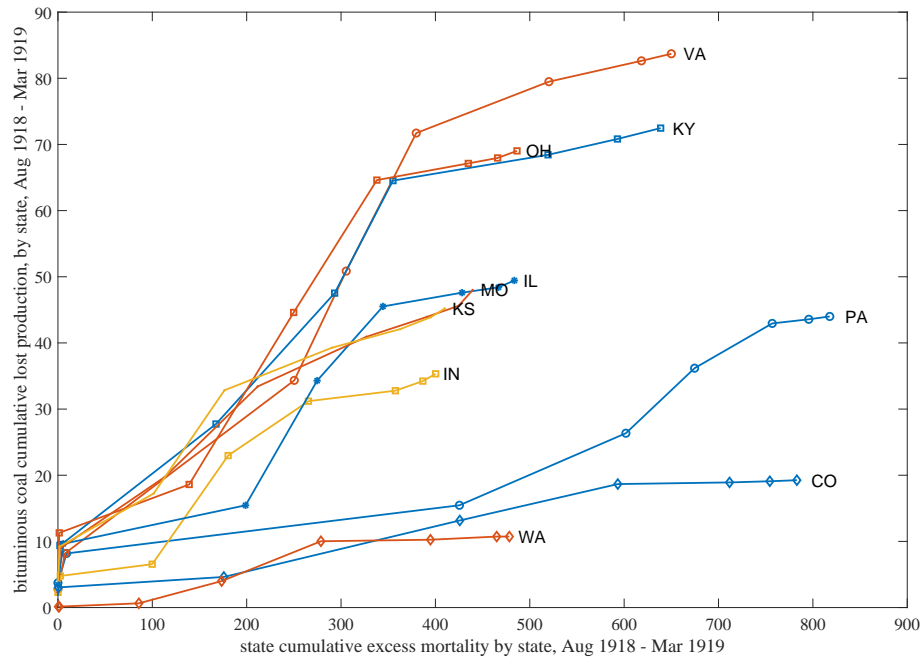


Figure 17: Cumulative excess mortality by state and cumulative lost production, Aug 1918-March 1919.

First, the evolution of labor supply state by state is shown in Figure 16. Aside from two special weeks (September 12, registration for military service, and Christmas), a pattern of waves is discernible reminiscent of the epidemic's waves. Virginia is the first hit, closely follow by Kentucky; the rest of the states (both Midwest and West coast) peak in mid-November. The west of the country seems less affected and second wave is apparent in some states (Kentucky, Alabama, Ohio).

Figure 17 confirms the relation between mortality and the labor supply shock by state. The x-axis plots the cumulative excess P&I mortality rate starting in August 1918. Each line is a state, and each marker on the line is a month; because excess mortality is nearly always positive in this period, time runs from left to right. The vertical axis shows the cumulated output loss due to labor shortages for each state. The relation between the two is clear except for the two western states (Washington and Colorado), but the slopes differ markedly across states. The first-hit states (Virginia and Kentucky) also experiences the steepest relation between mortality and labor shortage.

Finally, Figure 18 addresses the possibility of a link from labor supply shock to aggregate demand. It shows the relation, or rather the lack thereof, between mortality and the labor shortage it induced on one hand, the ensuing shortfall in production due to lack of demand on the other hand. The two regression lines are not consistent with each other and the slope coefficients are not significant (p-values of 0.37 and 0.47).

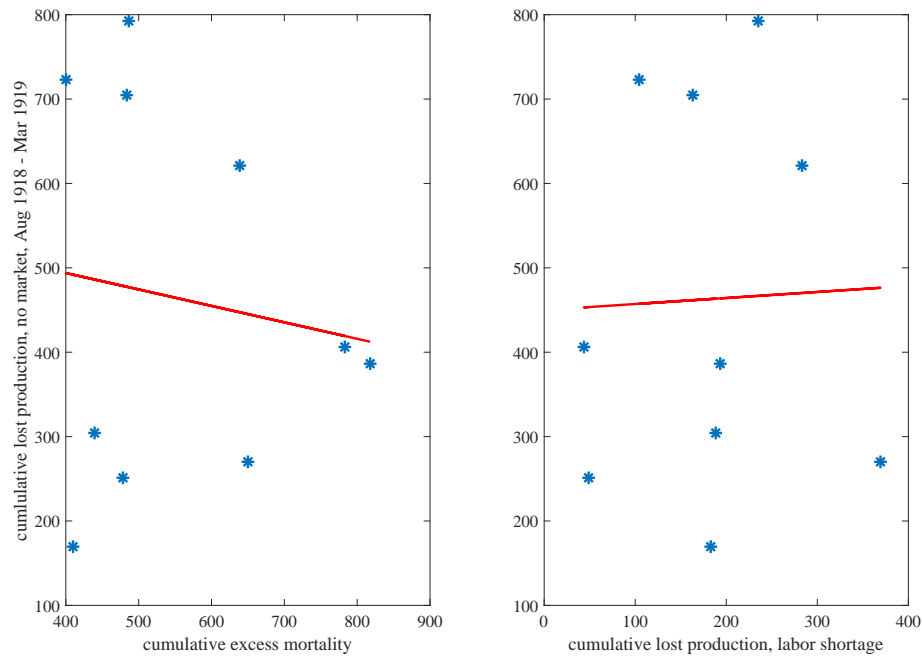


Figure 18: Relation between cumulative excess mortality, resp. cumulative lost production due to labor shortage, and cumulative lost production due to lack of market, Aug 1918 - Mar 1919. Red lines are regression lines.

Banking data

The complexity of US banking regulation means that the data are dispersed in various sources. There are two major ways to divide banks, by charter and by membership of the Federal Reserve System.

According to the first distinction national banks, chartered under the National Bank Act, are regulated by the Comptroller of the Currency whose annual reports provide some balance-sheet data on call dates, six times a year. Non-national banks are chartered by state, and data are available if the state banking regulator published it, which is the case for some of the states for which we have vital statistics, albeit at varying call dates.¹⁶ Members of the Federal Reserve System could be national or state banks; the Fed published some data for its members' balance sheets, but mostly broken down by Federal Reserve district, which does not neatly overlap with the state-level mortality statistics. We do, however, have data for member banks located in the twelve district cities on call dates.

From the Comptroller's annual reports we have the national banks' total assets and their loans and discounts on call dates by state and for reserve cities. I use the thirty states and the thirty-seven reserve cities for which we have excess P&I mortality data, and the mortality data is summed into bimonthly series. The sample runs from December 1916 to November 1921 (thirty call dates). I use local projections of assets and loans (in logs) on

¹⁶National banks represented between 40 and 43% of all bank assets between 1896 and 1922. I plan to collect the state-level data and extend the present analysis.

bimonthly mortality, of the following form, with i denoting either region or city:

$$\begin{aligned}\Delta \log(\text{assets}_{i,t+h}) &= \beta_h m_{i,t} + \sum_{k=1}^4 \gamma_k \Delta \log(\text{assets}_{i,t-k}) + a_i + b_t, & h = 0, \dots, 6 \\ \Delta \log(\text{loans}_{i,t+h}) &= \beta_h m_{i,t} + \sum_{k=1}^4 \gamma_k \Delta \log(\text{loans}_{i,t-k}) + a_i + b_t, & h = 0, \dots, 6\end{aligned}$$

The response of these variables to mortality is shown in Figure 19, scaled by the median city's shock size. The city-level evidence is somewhat stronger, although these cities are the most important financial centers. They show a rise in loans after four months, reversed in the following four months. They also show a one-time rise in total assets.

Figure 20 separates cities that moved early (starting date of closings before the median) from those that moved late. It suggests that the rise in bank balance sheets is mainly in the cities moving late, while early movers see the rise much later. Conversely, the rise in loans seems to be happening in the early-moving cities while the later fall is in the late-moving cities. The error bands are wide, so caution is needed here, but there is a hint of evidence for the financial sector increasing its loans during the epidemic, more so in the cities that moved early.

High-frequency city-level evidence

The evidence presented here comes from *Bradstreet's, A Journal of Trade, Finance, and Public Economy*. Every issue, published on Saturday, abounded with information of all kinds. The section "Measures of movements" included some of the information used above, such as the data on coal mines and business failures. The section "Financial, money and exchange" reported bank clearings, that is, the volumes of net clearings through the local clearing houses on a weekly basis.

	wholesale	retail	manufacturing	collections
good (72%), active	1059	968	1170	1042
fair (98%), better,	503	569	243	548
quiet (57%), steady, quieter, improving, increasing	158	170	152	15
slow (55%), dull, slower, irregular, uncertain	35	47	69	104
restricted (33%), reduced, curtailed, backward, poor, unsettled	5	5	72	7

Table 3: Classification of adjectives describing business conditions in *Bradstreet* with number of occurrences, July 1918 - June 1919. The most common adjectives in each group is in bold and followed by its share in parentheses.

Another feature of *Bradstreet's* was the "trade at a glance" box at top right of the front page, which reported on various cities' business conditions in "wholesale and jobbing trade," retail, manufacturing and industry, and collections on commercial debt. Condition in each city and activity was described by a single adjective, with additional remarks for the city as a whole. The most common adjectives are shown in Table 3, as I have

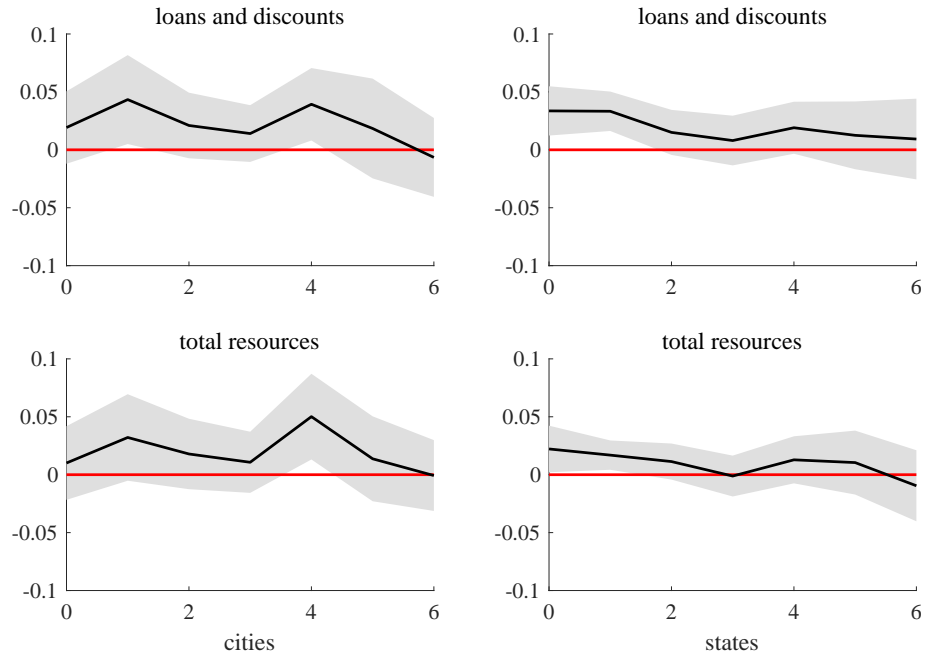


Figure 19: Impulse response functions from local projections of national banks' loans and discount and total resources (in logs) on city (resp. state) mortality. The units of the x-axis are periods of two month (between call dates). The response is to a shock of 0.1% mortality (100 deaths per 100,000) in one month.

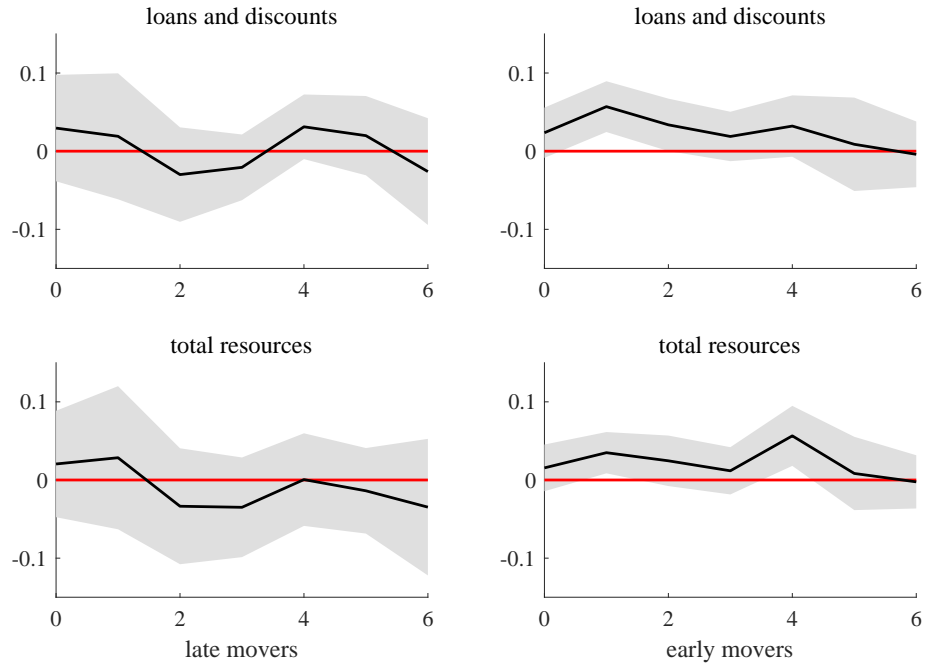


Figure 20: Same IRFs as Figure 19, separating cities who imposed closings early (before the median date) and late.

classified them into five groups. This sorting is of course discretionary, but in each class one adjective is overwhelmingly common: in effect, the hierarchy between “good,” “fair,” “quiet,” “slow,” and “restricted” is the backbone of my classification. Each class is assigned a score from 5 to 1, and an average across the four activity categories yields an indicator of business condition for each week in each city (the list of cities is in the Appendix). The number of occurrences reported in Table 3 suggest that, between July 1918 and June 1919, business conditions were rarely worse than “quiet.” This is consistent with the results of the previous section about aggregates, although on its own it might not be fully convincing. In a war, and even in the absence of outright censorship, patriotic ardor could have biased reporters and editors toward more cheerful adjectives.

To analyze the impact of the epidemic and of interventions on the economy, I use the following variables. The first, taken from Markel et al. (2007) is an indicator of the week in which the city’s P&I mortality first reached a threshold level defined as twice the baseline level for that week of the year. The second is an indicator of the week in which theater and other closings were imposed in that city. I carry out local projections of mortality, log of bank clearings excluding New York deflated by the retail cost of food (Cl), and business conditions (BC) on these two shocks. Specifically:

$$\begin{aligned} \text{mort}_{i,t+h} &= \beta_h S_{i,t}^j + a_i + b_t, & h = 0, \dots, 16, \quad j = 1, 2 \\ BC_{i,t+h} &= \beta_h S_{i,t}^j + \sum_{k=1}^8 \gamma_k BC_{i,t-k} + a_i + b_t, & h = 0, \dots, 16, \quad j = 1, 2 \\ \log(Cl_{i,t+h}) &= \beta_h S_{i,t}^j + \sum_{k=1}^8 \gamma_k \log(Cl_{i,t-k}) + a_i + b_t, & h = 0, \dots, 16, \quad j = 1, 2, \quad i \neq \text{NYC} \end{aligned}$$

where $\{S_{i,t}^j\}_{j=1,2}$ is a dummy variable that is zero in all weeks except the one in which (1) the mortality threshold was reached, or (2) closings were imposed.

Figure 21 shows the impulse responses from the two shocks. Mortality rises after the epidemic threshold is reached, then falls back. It rises in the week in which closings begin, but falls within two weeks: this is of course not a sign that closings cause a contemporaneous increase in mortality, but rather that closings probably respond to such an increase. The volume of transactions is affected about five weeks after the epidemic shock, and a week after closings by about 10%, but not any further. Business conditions show a weakening three weeks after the epidemic hits and a week after closings. In short, however imperfect our measures, they do pick up some impact of the epidemic and the closings on economic activity.

To evaluate the impact of the speed of intervention on economic outcomes, I split the sample of cities depending on the (possibly negative) time elapsed between reaching the threshold of epidemic and the date of closing. Early movers are those for whom that elapsed time is below the median. Figures 22 and 23 compare early movers and late movers). The response of mortality is very similar in shape but quite different in scale: it is much larger for the early movers, strongly suggesting that moving early or late was endogenous to the epidemic. Clearings do not seem to respond either to the epidemic shock or to the closing shock for early movers. By contrast, late movers have a sizeable

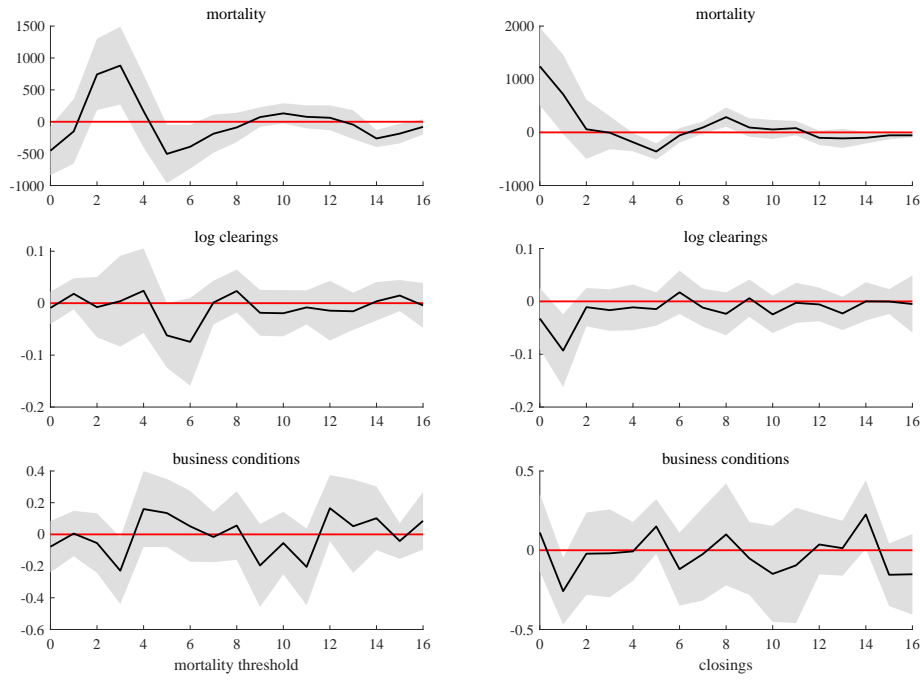


Figure 21: Impulse response functions from local projections on onetime shocks (mortality threshold and closings).

contraction in payments five weeks after the epidemic shock and after the closing shock: the response that we noticed for the cities as a whole comes entirely from the later movers. For business conditions, the cities that would turn out to move late end up slightly more affected by the mortality shock three weeks later. The response of business conditions to closings seems slightly worse for early movers. The size of the standard error bands, of course, make such nuances subject to caution.

A lightly structural estimation

The approach in this section is “lightly” structural because it does not fully confront the endogeneity of closings strongly suggested by the previous section, but at least tries to disentangle the identify the impact of closings on mortality and economic activity from the dynamic behavior of the variables.

To this effect we¹⁷ use the SIR (susceptible-infected-recovered) model of epidemiology as adapted by economists (Atkeson 2020; Alvarez, Argente, and Lippi 2020; Eichenbaum, Rebelo, and Trabandt 2020). Appendix 2 presents a simple SIR model in which susceptible agents (S) are infected by infected agents (I) at a rate β , infected agents become “recovered” agents (R) at a rate γ , of which a fraction ϕ are in fact deaths. The cumulated deaths is D_t , current mortality is the change in D_t or ΔD_t . In addition, economic activity is a linear function of both the number of susceptible and recovered ($S + R$) and of the infected I , the latter with possibly lower productivity. In the model NPIs (closings) reduce the productivity of both types of agents, but also change the dynamics of the epidemic by reducing the rate at which susceptible agents are infected. Appendix 2 shows how to

¹⁷The change in pronoun reflects the contributions of my colleague Gadi Barlevy.

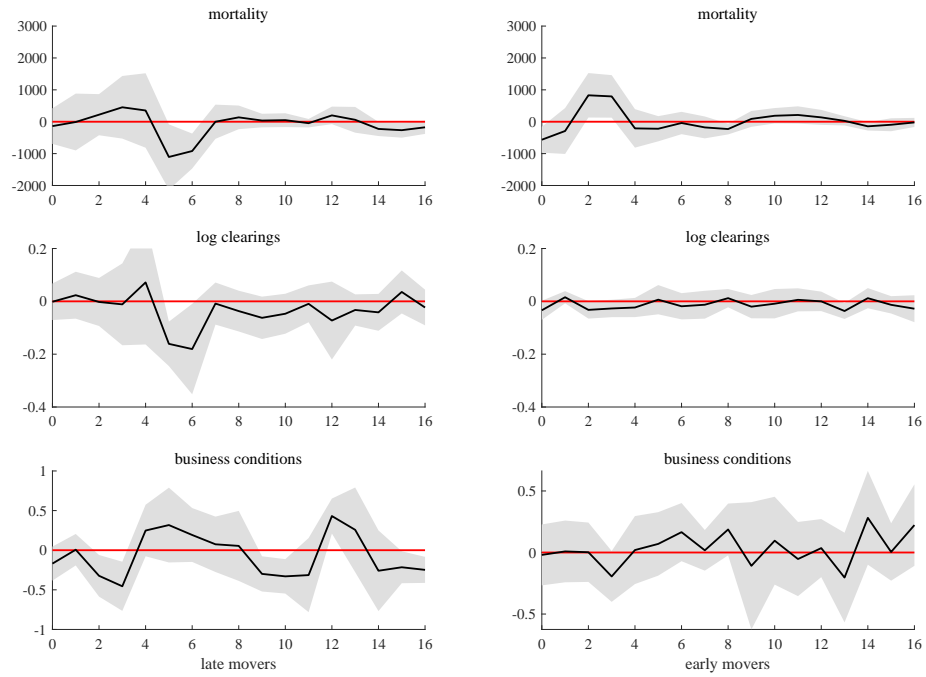


Figure 22: IRFs from local projections, response to the mortality threshold.

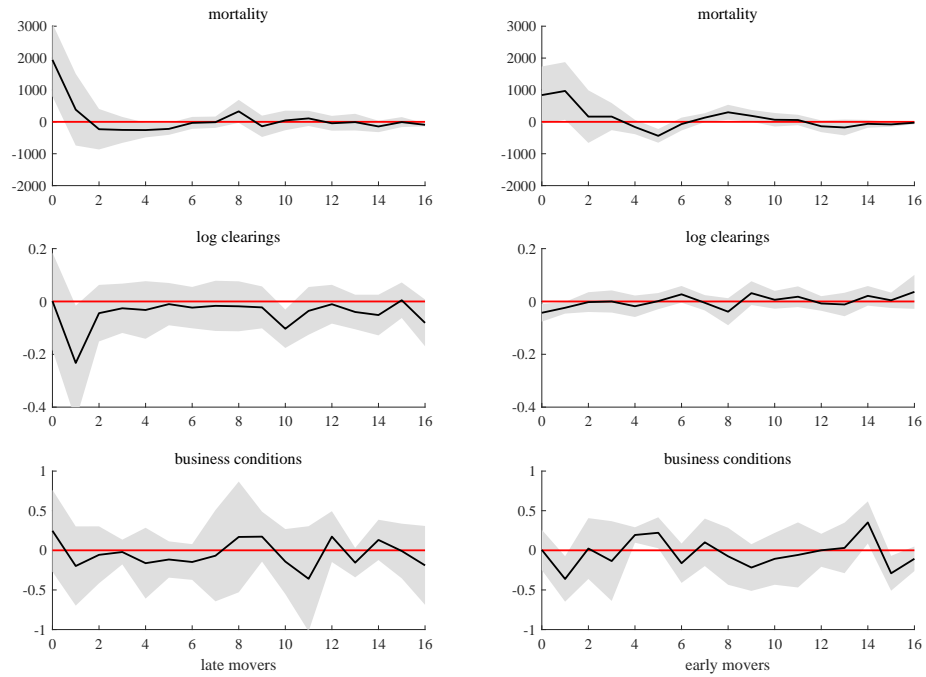


Figure 23: IRFs from local projections, response to closings.

express mortality and economic activity and as a linear function of future, current, and past mortality, as follows:

$$\Delta D_t = (1 + \beta_{t-2} - \gamma) \Delta D_{t-1} - \frac{\beta_{t-2}}{\phi\gamma} (\Delta D_{t-1})^2 - \frac{\beta_{t-2}}{\phi} D_{t-2} \Delta D_{t-1} \quad (1)$$

$$Y_t = w_t - w_t D_t - \frac{w_t w_t^i}{\phi\gamma} \Delta D_{t+1} \quad (2)$$

Equation (1) captures the dynamics of mortality, equation (2) those of economic activity. The effect of NPIs appears in the time subscript on the infection rate β and the productivities w and w^i of healthy and infected. NPIs affect deaths (which is what we measure, rather than infections) with a 2-period lag. In the equation for activity the lead of mortality appears as regressor because the current number of infected I_t , which affects current output, translates into future mortality ΔD_{t+1} . If the NPI affects infections today, it will affect output today and mortality next period.

The regression results are shown in Table 4.

The dynamics of mortality conform well to the SIR model, with coefficients of the right sign and magnitude. The implicit estimate of the rate at which infected recover per week (γ) is 0.5, and the rate of infection (β) is about 1.3 to 1.5, yielding a value of $R = \beta/\gamma \simeq 2.8$. Closings affect mortality as predicted by reducing β to 0.6–0.8 and R to 1.3–1.5. Note that economic activity does not help predict mortality.

The regressions of economic outcomes are shown with and without lags.¹⁸ Future mortality (as proxy of current infections) clearly affects current output negatively, which, in the model, means that the productivity of the infected is lower than the susceptible. From this coefficient, the constant, and the coefficients of the mortality equation one can back out a loss of productivity of the infected of 15 to 40%. NPIs attenuate that channel (reduce the coefficient on ΔD_{t+1}) to some extent, but the effects are not statistically significant and of the wrong sign for business conditions. The direct effect of NPIs on economic activity, which should be picked up by the closings dummy, is harder to detect: the estimates are very small and insignificant. The coefficients on the current cumulative mortality are not significant and of the wrong sign, suggesting that the (permanent) loss of workers is not the main channel through which activity is affected.

Business failures

Bradstreet reported every week the number of business failures at the regional level (six regions of the US). I aggregate the weekly city-level data into the corresponding regions to try and detect any impact of mortality.¹⁹ Then I compute a local projection of the weekly change in business failures in each region on the region's mortality as follows:

$$\Delta \text{fail}_{i,t+h} = \beta_h m_{i,t} + \sum_{k=1}^8 \gamma_k \Delta \text{fail}_{i,t-k} + \sum_{k=1}^3 \delta_k m_{i,t-k} + a_i + b_t, \quad h = 0, \dots, 16$$

¹⁸For business conditions, requiring lags reduces the number of observations because *Bradstreet* did not report continuously for all cities. For clearings, the significance of the fourth (weekly) lag is robust and likely due to monthly seasonality in payments.

¹⁹The mortality proxy for each region is the population-weighted average of per 100,000 mortality rates of cities in that region. The regions are defined in terms of states, but we have state-level mortality at the monthly frequency only.

dependent variable:	ΔD_t		conditions		clearings	
ΔD_{t-1}	1.810*** (0.144)	1.980*** (0.199)				
$(\Delta D_{t-1})^2$	-9.38e-05*** (1.85e-05)	-9.85e-05*** (2.02e-05)				
$D_{t-2}\Delta D_{t-1}$	-4.37e-05*** (5.48e-06)	-5.07e-05*** (8.30e-06)				
$1_{t-2}\Delta D_{t-1}$	-0.667*** (0.160)	-0.727*** (0.220)				
$1_{t-2}(\Delta D_{t-1})^2$	7.59e-05*** (1.87e-05)	7.05e-05*** (2.24e-05)				
$1_{t-2}D_{t-2}\Delta D_{t-1}$	1.25e-05 (8.76e-06)	2.16e-05* (1.14e-05)				
ΔD_{t+1}			-3.41e-05 (2.76e-05)	-5.75e-05*** (2.21e-05)	-1.22e-05** (5.64e-06)	-1.03e-05*** (3.73e-06)
D_t			3.70e-06 (6.14e-06)	1.01e-06 (4.24e-06)	6.07e-07 (2.84e-06)	4.03e-08 (1.39e-06)
$1_t\Delta D_{t+1}$			-2.89e-05 (5.96e-05)	-4.91e-06 (6.25e-05)	2.68e-06 (8.56e-06)	7.74e-06 (7.27e-06)
1_tD_t			-2.19e-05* (1.32e-05)	-5.55e-06 (9.40e-06)	-2.28e-06 (4.33e-06)	2.93e-06 (2.90e-06)
1_t			0.0855 (0.278)	-0.0489 (0.244)	-0.0347 (0.0995)	-0.130 (0.0852)
business conditions (BC):						
BC_{t-1}		9.854 (59.62)		0.328*** (0.0656)		
BC_{t-2}				0.0934 (0.0703)		
BC_{t-3}				-0.0247 (0.0410)		
BC_{t-3}				0.0700 (0.0556)		
log real clearings (Cl):						
$\log Cl_{t-1}$		-217.7 (146.4)				0.396*** (0.0485)
$\log Cl_{t-2}$						0.0954 (0.0637)
$\log Cl_{t-3}$						-0.0139 (0.0433)
$\log Cl_{t-4}$						0.151*** (0.0337)
constant		1,244 (927.3)	4.987*** (0.127)	2.767*** (0.341)	5.586*** (0.0457)	2.125*** (0.483)
observations	1,153	632	773	563	900	900
number of cities	33	23	27	24	25	25

Table 4: Panel regressions of mortality ΔD , business conditions index, and log deflated bank clearings on leads and lags of mortality and cumulative mortality (D) and a dummy $1_{ct} = 1$ if businesses were closed during week t . Time and city fixed effects included; robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure 24 shows some impact from mortality, although never quite significant and equally positive or negative. The magnitudes, in any event, are very small: the impact of one death per million is on the order of $1e-3$ failures per million, or 0.1 failures for the US population (100 million). The peak weekly mortality at the national level was on the order of 600 per million: hence $1e-3$ on the vertical scale of Figure 24 means 60 failures nationally.

Prices

A final word on the behavior of prices: as mentioned above, the US was under partial price controls during the War, and the controls were removed on Feb. 1, 1919. Prices actually

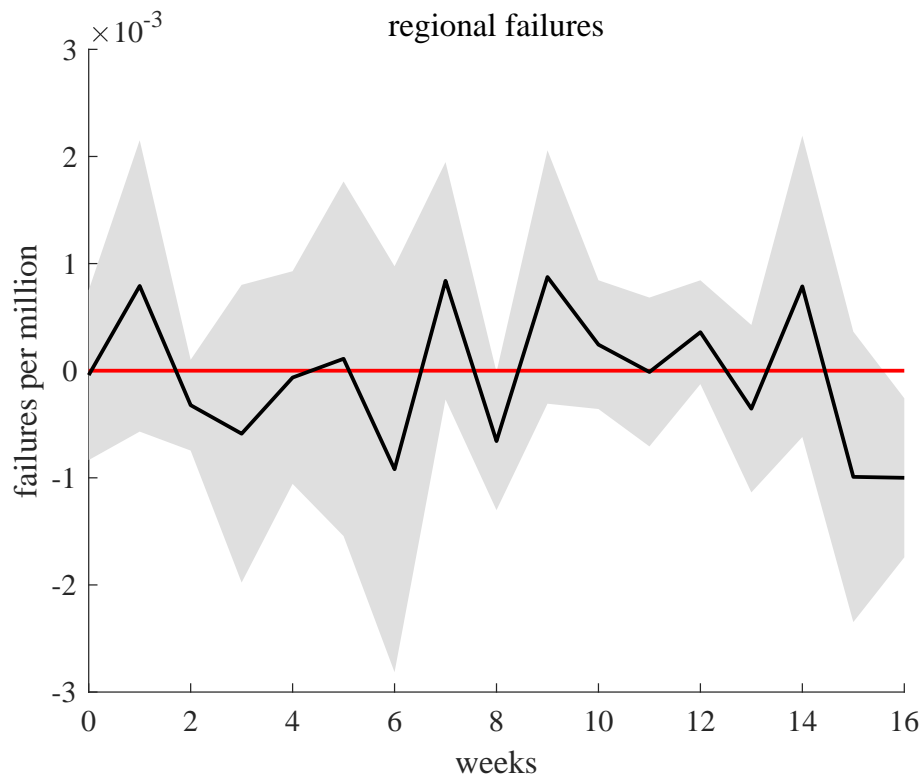


Figure 24: Response of the number of failures reported by *Bradstreet* to city excess P&I mortality aggregated at the regional level.

fell, as government stopped buying large quantities of raw materials at guaranteed prices. The effect is shown in Figure 25.

Interestingly, there is a hint of cross-sectional impact of the epidemic on prices. Figure 26 regresses the change in 12-month inflation between 1918 and 1919 (specifically, September 1917 to August 1918 versus September 1918 to August 1919, to set the comparison frame on the onset of the epidemic). There is a mild negative relationship: a city experiencing half as much as the median cumulative mortality would see a fall in inflation of about 3%.

5 1918 and 2020

A century elapsed between the two pandemics. The world has changed and circumstances are different. Before concluding, I recall some of these differences, not because they make the 1918 experience irrelevant, but because they may help us understand why the pandemic had limited short-run effects.

The US economy has changed. In 1914, the population was roughly evenly split between rural and urban, whereas the ratio is 5 to 1 now. Agriculture accounted for 33% of employment, and manufacturing another 28%; the shares today at 2% and 8%. Home production probably accounted for a much larger share of output than today. The size of the Federal government was about 1% of GDP, the Federal Reserve System had barely begun to function.

By the time of the pandemic, of course, the United States had entered World War I

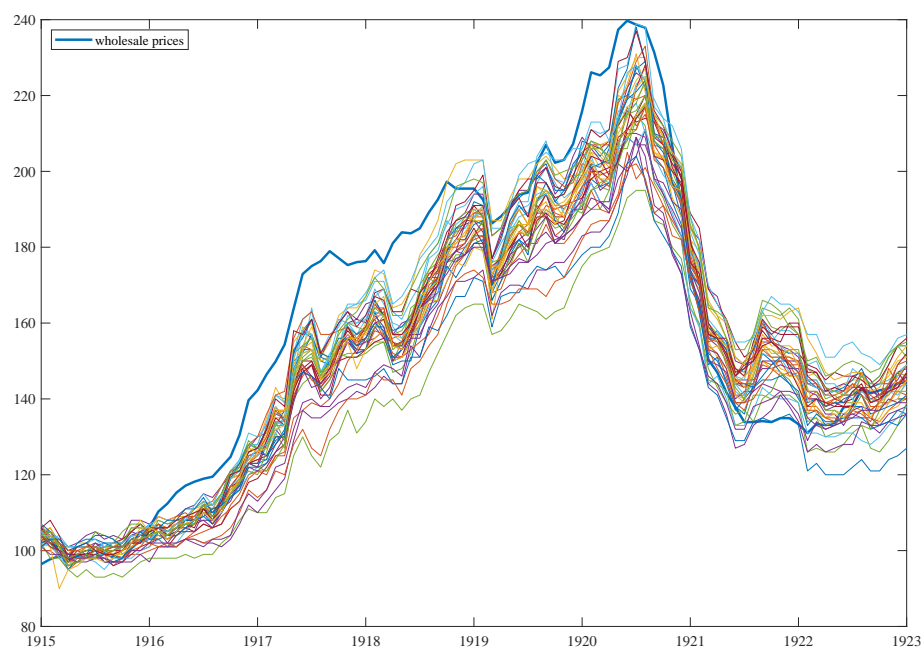


Figure 25: US wholesale price index and retail cost of food in 32 US cities. Source: *BLS Bulletin 334*, 36–43.

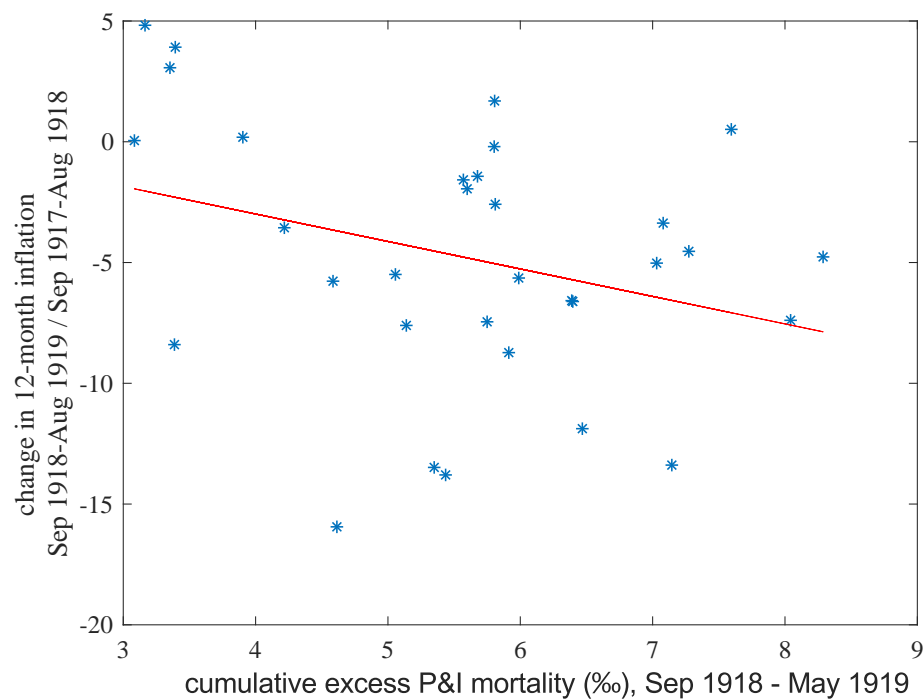


Figure 26: Cumulative excess P&I mortality and change in inflation in 32 US cities. The slope of the regression line is -1.138 (0.644).

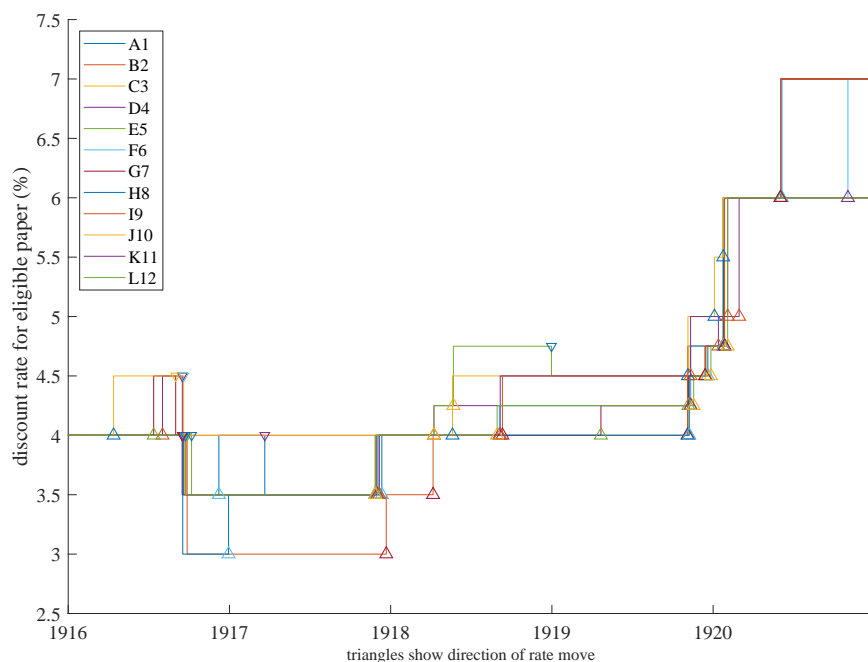


Figure 27: Federal Reserve Banks' discount rates on eligible paper, Jan 1916 - Dec 1920. Source: Federal Reserve Board (1943).

(in April 1917) and the Federal Government was running a deficit of 20% of GDP and increasing the debt from virtually nothing to 36% of GDP. Two and a half million men (five times the casualties of the pandemic) were in the armed forces: in camps in the US, on ships, or in trenches in France. The US economy, which had already been producing for the Allies, had moved to war production, and government contracts and regulations determined quantities and prices in many sectors, leaving little scope for animal spirits.

The Federal Reserve System's policy was to support the Treasury borrowing: "the Federal Reserve became to all intents and purposes the bond-selling window of the Treasury, using its monetary powers almost exclusively to that end" and this "subservience to the Treasury" lasted until mid-1919. (Friedman and Schwartz 1963, 216,225).

Practically, this meant that the Fed lent at banks at below market rates to support the purchases of government debt (Liberty Loans or short-term Treasury certificates) by them or their customers (Meltzer 2010, 1:84–90). This gave Fed leaders the appearance of not directly monetizing the debt (poor form under gold standard orthodoxy) but achieving the same purpose.

Four Liberty Loans and one Victory Loan were issued from 1917 to 1919 at rates set by Congress, rising from 3.5% to 4.75%. The Third Liberty Loan, at 4.5%, had concluded in May 1918, and the Fourth was floated at 4.25% in the midst of the epidemic, in September 1918. The Reserve Banks saw to it that the bonds remained close to par and lent at preferential discount rates of 4 to 4.5%.

The interest rates²⁰ set by the Fed are shown in Figure 27. Before the pandemic rates ranged from 4 to 4.75%. Over the following twelve months six banks changed their rates,

²⁰The plural is requisite because each of the twelve Banks set its own rate.

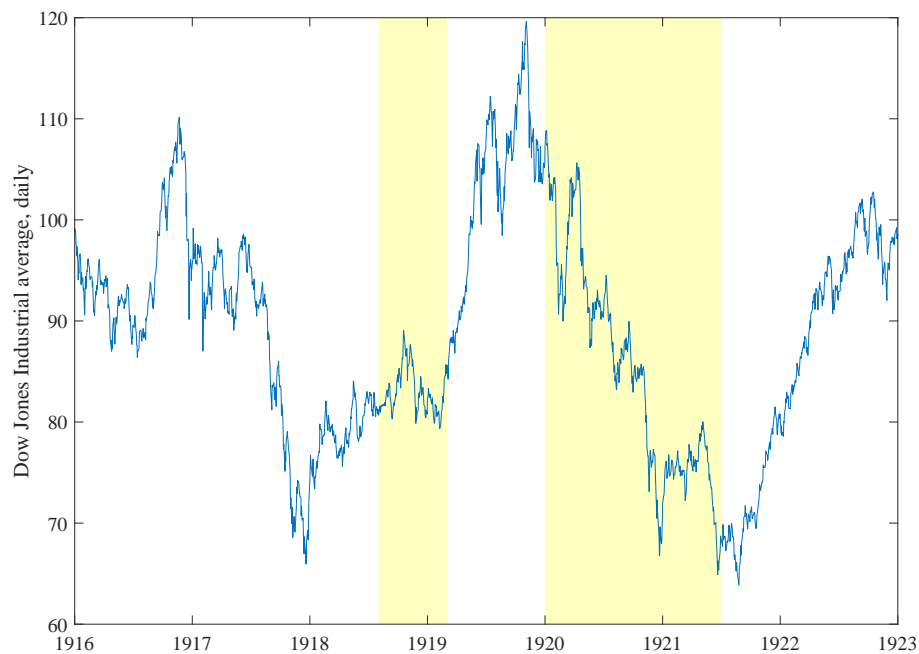


Figure 28: Dow-Jones industrial stocks index, daily, Jan 1916 - Dec 1921. Source: Bloomberg.

all but one upward.²¹ Only Richmond cut its rate on Dec. 30, 1918, and modestly at that: from 4.75% to 4.5%. It is moreover apparent from the Fed's *Annual Report* that the main concern arising from the pandemic was its deleterious effect on floating the 4th Liberty Loan: the large rallies held to encourage patriotic saving could not be held, and banks didn't have the clerks to handle the paperwork.

Against this background of a serendipitously massive monetary and fiscal policy, financial markets displayed great equanimity during the pandemic. Figure 28 reminds us that the US stock market did quite well during the epidemic. From August 14, 1918, when the influenza's arrival in the US is first mentioned in newspapers, to October 18, when nationwide deaths peaked at 20,000 per week, the Dow Jones Industrial rose 9%. Only in the second half of November, after the armistice, did it fall back to its summer level where it remained until it started climbing again in late February 1919, to gain 50% in nine months. The 1920–21 recession cut the DJIA's value in half.

Figure 29 plots short-term commercial rates in New York. Call money rates are rates on short-term loans to finance stock holdings, the time money rates are 90-day, and the commercial paper is "choice 60-90 day two-name paper." All rates remain steady from July to October 1918 and begin to fall in November 1918, the month of the Armistice.

As in many previous graphs, the contrast with the recession of 1920–21 is striking, here with a very large spike in short-term interest rates caused by the Fed's sharp tightening in the face of mounting inflation. This, and the general wartime context, suggests that the

²¹San Francisco raised from 4% to 4.25% on Aug. 29; Atlanta from 4% to 4.25% on Sep. 3; Dallas from 3.5% to 4% on Sep. 5; Minneapolis from 4% to 4.5% on Sep. 10; Chicago from 4% to 4.25% on Apr. 21, 1919.

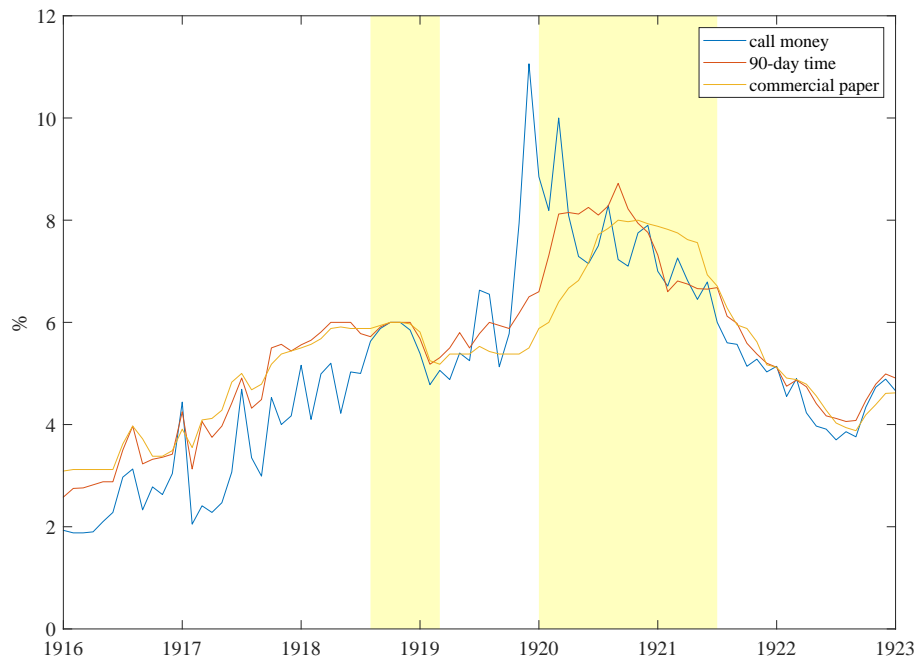


Figure 29: Commercial short-term interest rates in New York, monthly, Jan 1916 - Dec 1922. Source: Macaulay (1938, A142–61).

stance of monetary and fiscal policy can matter even in the face of a pandemic.

6 Discussion, Related literature, and Conclusion

The 1918 recession was mild and brief. This seems surprising given the size of the demographic shock, on the order of 0.5% of the labor force and the population. The coal industry data confirms that labor supply was indeed an important channel affecting industrial output, but the impact was very brief. If anything, the recession might have been even briefer (or unnoticed) without the uncertainty brought by the Armistice. The need to shift from wartime to peacetime economy became more probable as rumors of peace talks floated in October 1918 and a certainty on November 11. The government had been heavily involved in the economy in various ways, first of all by running a deficit of 20% of GDP and using it for government purchases. Non-essential economic activities like construction and consumer durables were curtailed. Prices were controlled, in some cases by floors and others by ceilings. All this was presumably coming to an end, but contemporaries were uncertain about the timing. By March 1919 the uncertainty had dissipated, the economy had worked through various internal imbalances, and expansion resumed.

The literature on the economic consequences of the 1918 pandemic is relatively limited so far, but can be expected to grow.²² The survey by Bell and Lewis (2004) concludes that it had “very limited macroeconomic effects in relative terms.” Brainerd and Siegler (2002) look at the growth rate of states in the years after the pandemic and find evidence of higher growth rates in the 1920s for states more affected by the epidemic, which they say might be a sign of return to trend growth. Karlsson, Nilsson, and Pichler (2013) study the

²²The pandemic has been studied by economists for its demographic consequences (Clay, Lewis, and Severini 2015) or as an instrument to investigate various questions (Hilt and Rahn 2018).

impact on income in Sweden, and find a negative impact on capital income and poverty rates (after 1920) but no effect on earnings.

Two recent papers revisit the pandemic. Related to the disasters literature, Barro, Ursúa, and Weng (2020) use annual aggregate data for a cross-section of countries and find evidence for sizeable effects of the mortality caused by the pandemic on GDP (negative), stock prices (negative), and inflation (positive). The approach here is different, since I drill in on one particular country rather than search for worldwide patterns.

Correia, Luck, and Verner (2020) use a different approach, in the line of Brainerd and Siegler (2002), by examining the impact of mortality and of NPIs on outcomes in later years using the cross-section of cities and states (1919 to 1923). They find large negative impact of mortality, and positive impact of interventions, on output, employment, bank balance sheets, and consumer durables five years after the epidemic. The results are particularly interesting in the light of the data contemporary to the epidemic, raising questions about the mechanism for transmission from the short-term to the long-term.

The point of this paper is not to predict that the 2020 pandemic will not have economic consequences. Pandemics need not be disasters, but they can be, as circumstances differ in many ways. But, in the relative dearth of comparable episodes, it is natural to reach to the nearest analog and draw conclusions—for this purpose, getting the facts right about the 1918 recession seems important.

The main conclusion is that the pandemic coincided with, and very likely contributed to a mild recession from which the economy rebounded quickly. Output was affected through a negative labor supply shock, but demand seems to have reacted very little, and there was little damage done to the balance sheets of the nonfinancial or financial sector. NPIs affected mortality, as is known from the epidemiological literature, but had limited implications for contemporaneous economic outcomes. My conclusion contrasts with the recent evidence on long-run outcomes (Correia, Luck, and Verner 2020). The challenge in reconciling the two sets of findings is to identify a state variable through which the disturbance of 1918 could have propagated all the way to 1923.

Appendix 1: City-Level Data

	mortality		closings		data available:		
	peak	total	start	end	clearings	conditions	banks
Albany, NY	166	646	Oct 9	Nov 7			x
Atlanta, GA	50	339	Oct 7	Oct 26	x	x	x
Baltimore, MD	216	647	Oct 9	Nov 2	x	x	x
Birmingham, AL	75	581	Oct 9	Oct 30			x
Boston, MA	162	727	Sep 27	Oct 20	x	x	x
Buffalo, NY	145	458	Oct 11	Nov 1	x	x	x
Cambridge, MA	127	528	Oct 5	Oct 20			
Chicago, IL	88	390	Oct 15	Nov 2	x	x	x
Cincinnati, OH	68	557	Oct 6	Nov 12	x	x	x
Cleveland, OH	88	581	Oct 15	Nov 11	x	x	x
Columbus, OH	50	406	Oct 10	Nov 10	x	x	x
Dayton, OH	91	378	Oct 9	Nov 2			
Denver, CO	77	703	Oct 6	Nov 11	x		x
Detroit, MI	53	308	Oct 20	Nov 6	x	x	x
Fall River, MA	166	640	Sep 27	Oct 24			x
Grand Rapids, MI	36	227	Oct 20	Nov 7			x
Indianapolis, IN	41	335	Oct 9	Oct 30	x	x	x
Jersey City, NJ	143	297					
Kansas City, MO	76	708	Oct 8	Nov 18	x	x	x
Los Angeles, CA	69	535	Oct 11	Dec 1	x	x	x
Louisville, KY	75	560	Oct 7	Nov 11	x	x	x
Lowell, MA	125	534					
Memphis, TN	122	568			x	x	x
Milwaukee, WI	38	339	Oct 11	Nov 4	x	x	x
Minneapolis, MN	39	316	Oct 13	Nov 15	x	x	x
Nashville, TN	163	690	Oct 6	Nov 1	x	x	x
Newark, NJ	105	575	Oct 10	Oct 22			
New Haven, CT	114	591					
New Orleans, LA	177	759	Oct 10	Nov 15	x	x	x
New York, NY	93	506	Oct 4	Nov 2	x	x	x
Oakland, CA	114	544	Oct 18	Nov 16			x
Omaha, NE	85	580	Oct 4	Nov 1			x
Philadelphia, PA	257	804	Oct 3	Oct 26	x	x	x
Pittsburgh, PA	133	829	Oct 4	Nov 12	x	x	x
Portland, OR	61	544	Oct 11	Nov 16	x	x	x
Providence, RI	107	599	Oct 6	Oct 25			
Richmond, VA	116	514	Oct 6	Nov 4			x
Rochester, NY	75	401	Oct 9	Nov 5			
St. Louis, MO	57	422	Oct 7	Nov 13	x	x	x
St. Paul, MN	57	422	Oct 13	Nov 15	x	x	x
San Francisco, CA	148	715	Oct 18	Nov 16	x	x	x
Seattle, WA	52	461	Oct 5	Nov 12	x	x	x
Spokane, WA	76	528	Oct 9	Nov 18	x	x	x
Syracuse, NY	151	566	Oct 7	Oct 25			
Toledo, OH	58	386	Oct 15	Nov 4	x		x
Washington, DC	147	639	Oct 4	Nov 4	x		x
Worcester, MA	130	644	Sep 26	Oct 21	x		
median	91	544	Oct 9	Nov 4			
N	47		43		31	27	37

Table 5: List of cities with mortality data in Collins et al. (1930) and available data on closings, bank clearings, and business conditions. Mortality is excess P&I in deaths per 100,000.

Appendix 2 (with Gadi Barlevy): Dynamics inspired by the SIR model

Economists are fast becoming familiar with the SIR (susceptible, infected, recovered) model of epidemic dynamics and adapting it into economic models (Atkeson 2020; Alvarez, Argente, and Lippi 2020; Eichenbaum, Rebelo, and Trabandt 2020). This appendix

uses it to derive a simple regression equation.

Consider the following discrete time version of the SIR model. The population of 1 consists of three groups: The stock of susceptible, S_t , the stock of infected, I_t , and the stock of recovered, R_t . At each date, we have

$$S_t + I_t + R_t = 1$$

The stocks evolve according to the following law of motion:

$$S_{t+1} = (1 - \beta_t I_t) S_t \quad (3)$$

$$I_{t+1} = (1 + \beta_t S_t - \gamma) I_t \quad (4)$$

$$R_{t+1} = R_t + \gamma I_t \quad (5)$$

Condition (3) implies that the fraction of susceptible who become infected is equal to $\beta_t I_t$, so proportional to the fraction of agents infected at date t . We allow β to vary over time to leave room for interventions intended to curb the epidemic. Condition (4) implies that the stock of infected grows by those formerly susceptible who become infected, but that a constant fraction γ of those previously infected recover, a euphemism which means they either die or become immune. Finally, condition (5) keeps tab on the total number of recovered agents. The initial condition is that $R_t = 0$ at date $t = 0$ and $I_t > 0$ at date $t = 0$.

Suppose that a fraction $\phi \in (0, 1)$ of those who recover from infection die. We focus on deaths since death rates because that is the only data available in the historical record for the 1918 pandemic. Alvarez, Argente, and Lippi (2020) and Eichenbaum, Rebelo, and Trabandt (2020) make ϕ dependent on the number of infected to model the effect of an overwhelmed health care system, but lacking knowledge of the health care system's capacity and usefulness in 1918 we neglect this aspect here and assume that ϕ is constant.

The cumulative deaths at date t satisfy $D_t = \phi R_t$. In addition, a fraction ϕ of all infected who transition to recovery die, meaning the change in deaths is given by

$$\Delta D_t \equiv D_t - D_{t-1} = \phi \gamma I_{t-1}$$

Since $S_t + I_t + R_t = 1$, we have

$$\begin{aligned} S_t &= 1 - I_t - R_t \\ &= 1 - \frac{\Delta D_{t+1}}{\phi \gamma} - \frac{D_t}{\phi} \end{aligned}$$

We can substitute this into (4) to arrive at a law of motion for the number of new deaths each period using only data on deaths:

$$\begin{aligned} \Delta D_{t+2} &= (1 + \beta_t S_t - \gamma) \Delta D_{t+1} \\ &= (1 - \gamma) \Delta D_{t+1} + \beta_t S_t \Delta D_{t+1} \\ &= (1 - \gamma) \Delta D_{t+1} + \beta_t \left(1 - \frac{\Delta D_{t+1}}{\phi \gamma} - \frac{D_t}{\phi} \right) \Delta D_{t+1} \\ &= (1 + \beta_t - \gamma) \Delta D_{t+1} - \frac{\beta_t}{\phi \gamma} (\Delta D_{t+1})^2 - \frac{\beta_t}{\phi} D_t \Delta D_{t+1} \end{aligned}$$

or, more compactly,

$$\Delta D_t = f_{\Delta D} \left(\Delta D_{t-1}, (\Delta D_{t-1})^2, D_{t-2} \Delta D_{t-1} \right) \quad (6)$$

Next, we consider economic activity, using the Alvarez, Argente, and Lippi (2020) framework. They assume that all living agents supply one unit of labor inelastically with productivity w if they are susceptible or recovered and $w_i \leq w$ if they are infected. Total output is given by

$$Y_t = w(1 - I_t - D_t) + w_i I_t. \quad (7)$$

Replacing $D_t = D_{t-1} + \Delta D_t$ and using (6) to replace ΔD_t we can rewrite this as

$$\begin{aligned} Y_t &= w(1 - I_t - D_t) + w_i I_t \\ &= w - (w - w_i) \frac{\Delta D_{t+1}}{\phi \gamma} - w D_t \end{aligned}$$

Following Alvarez, Argente, and Lippi (2020) we model NPIs such as social distancing as forcing a fraction $1 - \theta$ of living agents to stay at home. The remaining fraction θ work and produce. The assumption is that only those who work can bump into each and meet, and so we must replace (3) with

$$S_{t+1} = (1 - \tilde{\beta} I_t) S_t \quad (8)$$

where $\tilde{\beta} = \beta \theta^2$. For output, we must replace (7) with

$$Y_t = \tilde{w}(1 - I_t - D_t) + \tilde{w}_i I_t \quad (9)$$

where $\tilde{w} = w\theta$.

We find that ΔD_{t+1} is a linear function of $[\Delta D_t \quad (\Delta D_t)^2 \quad D_{t-1} \Delta D_t]$ with theoretical coefficients $b \equiv [1 + \beta_t - \gamma \quad -\beta_t/\phi\gamma \quad -\beta_t/\phi]$, and Y_t a linear function of $[1 \quad \Delta D_{t+1} \quad D_t]$ with theoretical coefficients $[w_t \quad -(w_t - w_{it})/\phi\gamma \quad -w_t]$. This suggests a regression of mortality on mortality lagged, lagged squared, and lagged and interacted with cumulated deaths. The ratio b_3/b_2 would yield an estimate of γ , while $\beta = b_1 - 1 + \gamma$.

A regression of economic variables on *future* mortality (as proxy for current infected) and current cumulated deaths. To test whether the coefficients β and (w, w_i) change during NPIs, we add to the regression interactions of all regressors with a dummy equal to 1 during a NPI and 0 otherwise.

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