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RESEARCH ARTICLE

New(spaper) evidence of a reduction in suicide mentions during the 19th century US gold rush

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Abstract

I analyze the relationship between state-level economic shocks and suicides using gold mined in the United States (US) between 1840 and 1860 as a large unexpected economic shock. Mined gold was an unexpected and large economic shock of up to 3.5% of GDP. This provides as good as random variation to the local economy that I use to estimate the effect of economic changes on suicides. Comprehensive mortality data by state and year does not exist for the US for 1840–1860. Thus, I use web-scraped data from a newspaper archive and use suicide mentions per 100,000 pages to proxy for suicides. Overall, results show that mined gold is linked with an apparent reduction in newspaper suicide mentions in line with previous research.

KEYWORDS

economic shock, gold rush, newspaper, suicide

JEL CLASSIFICATION

N31, I15, J11

1 | INTRODUCTION

The relationship between the aggregate economic situation and mortality has been the focus of many studies since Ruhm (2000). Prior work using US data has estimated that for most causes of mortality, improvements in the overall economy lead to lower mortality (Fishback et al., 2007; Ruhm, 2000). The consistent exception to this is suicides. The US Suicide Prevention Resource Center reports the total costs of all attempted and completed suicides to be \$93.5 billion per year (Substance Abuse and Mental Health Services Administration, 2019). However, except for Fishback et al. (2007), there are no causal estimates of how aggregate economic changes affect suicides.¹

In this paper, I estimate the relationship between the arguably exogenous change in the economy induced by gold mining and suicide mentions. It is hard to think of an exogenous change in this context as that change needs to affect an entire economy sufficiently to affect suicides. At the same time, it needs to be unexpected such that people cannot adjust their behavior in anticipation of the change. I exploit the US gold rush as an event that plausibly fulfills these criteria. The gold rush was unexpected and peaked very fast, with mined gold making up 3.5% of nominal federal GDP.²

I use two-way fixed-effect estimation to show that the gold rush reduced suicides. The analysis is performed on a state-year panel that consists of values for mined gold from 1840 to 1860 and suicide mentions per 100,000 pages in regional newspapers as a proxy for suicides (Kronenberg, 2021).

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A concern is that suicide mentions decline when gold is newly discovered because articles about the discovery crowd out suicide mentions. I estimate my models with and without controlling for gold mentions, and the coefficients from models with gold mentions do not meaningfully vary from the same models without gold mentions. Other concerns are geographic spillovers and aggregation. Lindo (2015) discusses what can be learned from analyzing the relationship at different geographic levels. He stresses that more can be said about spillovers at lower levels of disaggregation. Janke et al. (2020) estimate a model that allows for dynamic and interdependent responses of morbidity in different local areas to economic conditions at the local and national levels.

Furthermore, Janke et al. (2020) select the optimal local area for the analysis using a statistical approach. They argue that the standard model, which I use here, underestimates the extent of the countercyclical relationship. Ruhm (2000) recommends using more than 15 years to avoid the estimates being sensitive to the start and end date of the data. Thus, the data I use here fulfills the recommendations formulated by previous work.

This study diverges from the literature as I look at an economic shock, something that so far has only been done by Fishback et al. (2007) (Gerdtham & Ruhm, 2006; Miller et al., 2009; Ruhm, 2000, 2015, 2016; Stevens et al., 2015). Fishback et al. (2007) exploit exogenous variation in the New Deal.³

Further, this study uses gold mining and is thus the first study to explore the relationship between economic shocks and suicides pre-1900. Beyond the intrinsic historical value of exploring a yet unexplored period in US history,⁴ this period is interesting concerning the level of fragmentation of the social safety net (Geloso & March, 2021; Hannon, 1984a, 1984b, 1985; Lindert, 2004). Thus, to some extent, the results can be extrapolated to countries currently on the US's level of economic development in the mid-19th century. Following Inklaar et al. (2018), 24 countries had lower real GDP per capita in 2011 US\$ in 2016 than the United States in 1850 (\$2825).⁵ However, this might be an underestimation as the effect likely varies with cultural norms, specifically, norms relating to gold. Bhalotra et al. (2020) have shown that neonatal mortality in India is linked with the world gold price.

Nevertheless, the results of this study are in line with results from other periods, such as Fishback et al. (2007) and Ruhm (2000), namely that large positive shocks to the aggregate economy reduce suicides.

2 | BACKGROUND

This section briefly describes the existing knowledge and the historical background concerning 19th-century gold mining in the US.

2.1 | Literature

Le Suicide by French sociologist Émile Durkheim is the first academic study on suicides. Durkheim (1897) derives four different kinds of suicide based on a trade-off between social integration and moral regulation. Anomic suicide is the relevant one for the relationship between the economy and suicides. In this case, an economic shock (positive or negative) leads to confusion about where an individual is headed in life, with some reacting to this confusion by committing suicide. The first economic study on suicides is by Hamermesh and Soss (1974), who state that the share of individuals who die by suicide can be derived from

$$S(a) = f[-Z(a, YP)] \quad (1)$$

where a is age, YP permanent income, Z is a function decreasing with age and increasing with permanent income, $f(\cdot)$ is the density function of the suicide distaste factor b . The distaste factor subsumes things like norms that are key in the sociological approach. The instantaneous suicide rate is then the share of individuals at age a for whom $Z(a, YP) = -b$. Based on this, Hamermesh and Soss (1974) derive the prediction that the suicide rate falls when the economy improves. Thus, the prediction is that the suicide rate moves countercyclical. One might expect the opposite for causes of death linked to economic prosperity, either directly through, for example, consumption, or indirectly through, for example, air pollution (Cutler et al., 2016).

My reading of the literature is that there are two streams. The first considers the relationship between individual changes in income or wealth and how they relate to (mental) health (Eliason & Storrie, 2009a, 2009b; Kronenberg et al., 2017; Sullivan & von Wachter, 2009a, 2009b). The second stream analyzes how changes in a measure of the aggregate economy relate to changes in an aggregate measure of health (Fishback et al., 2007; Gerdtham & Ruhm, 2006;

Gonzalez & Quast, 2011; Miller et al., 2009; Ruhm, 2000, 2015, 2016; Stevens et al., 2015). Both streams are connected by Johnston et al. (2020). They link changes in the world commodity prices of several commodities to Australian mining workers' perceived job security and mental health. They find that higher commodity prices lead to higher job security, which improves mental but not physical health.

I focus on the empirical literature looking at how aggregate economic changes affect suicides (Fishback et al., 2007; Gerdtham & Ruhm, 2006; Gonzalez & Quast, 2011; Miller et al., 2009; Ruhm, 2000, 2015, 2016; Stevens et al., 2015). In Figure 1, I ignore the sign of the coefficients to focus on the magnitude, implicitly assuming that the effect of positive and negative economic changes is symmetric.

The figure emphasizes that most of the existing research from the US has focused on study periods that are very close to each other and that often overlap. The results by Fishback et al. (2007) and Ruhm (2015) have the lowest magnitude, while Ruhm (2000) has the largest magnitude. The figure again highlights that suicides are understudied in this literature. The review by Bellés-Obrero and Castelló (2018) contains 53 studies. Following their Table 1, only eight studies have suicide as an outcome, while key studies in this literature, like Ruhm (2000), note the special case of suicides. There are, of course, studies looking at mental health outcomes (Bradford & Lastrapes, 2014; Charles & DeCicca, 2008; Currie & Tekin, 2015; McInerney & Mellor, 2012). While mental health (care) is a crucial channel, suicidal individuals partially base their decision on rationally explainable thought processes, as Hamermesh and Soss (1974) suggested and empirically confirmed by Campaniello et al. (2017). This implies that it is helpful to look at the whole picture between economic changes and suicides in addition to exploring potential channels.

2.2 | 19th-century gold rushes

Even though the first recorded gold discovery in the US took place in North Carolina at the beginning of the 19th century, the beginning of the first gold rush is arguably the discovery of gold at Sutter's Mill in January 1848, when James Marshall accidentally discovered gold while building a mill (Fetherling & Fetherling, 1997).

Figure 2 displays the amount of gold mined in each state and year in troy ounces.⁶ The figure presents gold mined in the 24/50 US states that ever discovered gold, implying that gold was discovered in roughly half of all US states.

The variation in the mined amounts of gold between states in which gold was discovered is considerable (see Figure 2). Figure 3 shows mined gold as a share of federal GDP. The figure shows that mined gold as a share of US GDP varied from practically 0% in 1848 to over 3% in 1852. It thus seems likely that the importance of gold to the state economy varied substantially.

Gold discoveries in new areas were accidental, as in the case of Sutter's Mill. However, even with improved methods and better knowledge of the geology of gold, miners cannot precisely forecast the places and amount of gold (Goldfarb et al., 1998).

Historical research shows that financial gains from the gold rush were made on average by those supplying goods and services in those areas and not the miners themselves (Clay & Jones, 2008).

3 | DATA

3.1 | Newspaper data

State-year data on suicides for the 19th century is scarce. The only existing source is the mortality censuses. For the study period (1840–1860), this implies that data is only available for 1850 and 1860. Furthermore, the mortality census only covers areas once they received statehood. This thus provides little data for any type of empirical analysis. Whipple (1922) also raises concerns about the accuracy of the morbidity registration, and modern counterparts confirm this point. Haines (2001) reports that death registration similar to current standards began in the 1930s. McGuire and Coelho (2011) argue that from 1850 to 1900 deaths are undercounted due to recall bias, as respondents had to recall deaths for the entire year preceding the census year. Moreover, Fernandez (2019) shows that even current CDC suicide statistics are severely affected by differential professional standards for coroners in the US.

Therefore, I use data from the National Digital Newspaper Program (NDNP). The NDNP is a collaboration between the National Endowment for the Humanities (NEH) and the Library of Congress. Their joint website *Chronicling America* provides access to digitized historical newspaper pages. NEH-funded institutions (hereafter awardees) from all US states con-

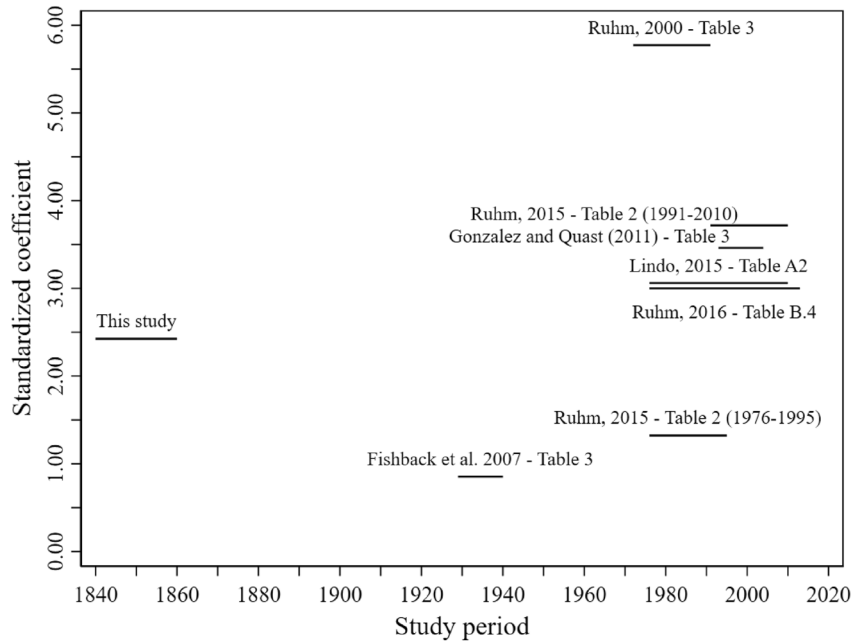


FIGURE 1 Overview of the existing literature. *Note:* Inclusion in this graph is based on studies looking at the relationship between state-level economic variation and suicides. Standardized coefficients represented on the y-axis represent coefficients divided by standard errors. The x-axis represents the study period of the depicted studies. Miller et al. (2009) is not included because no standard errors are reported in the study. For this graph, I assume that the effect of economic changes on suicides is symmetric for positive and negative economic changes. This assumption allows me to ignore signs and focus on the magnitude of the estimated effects

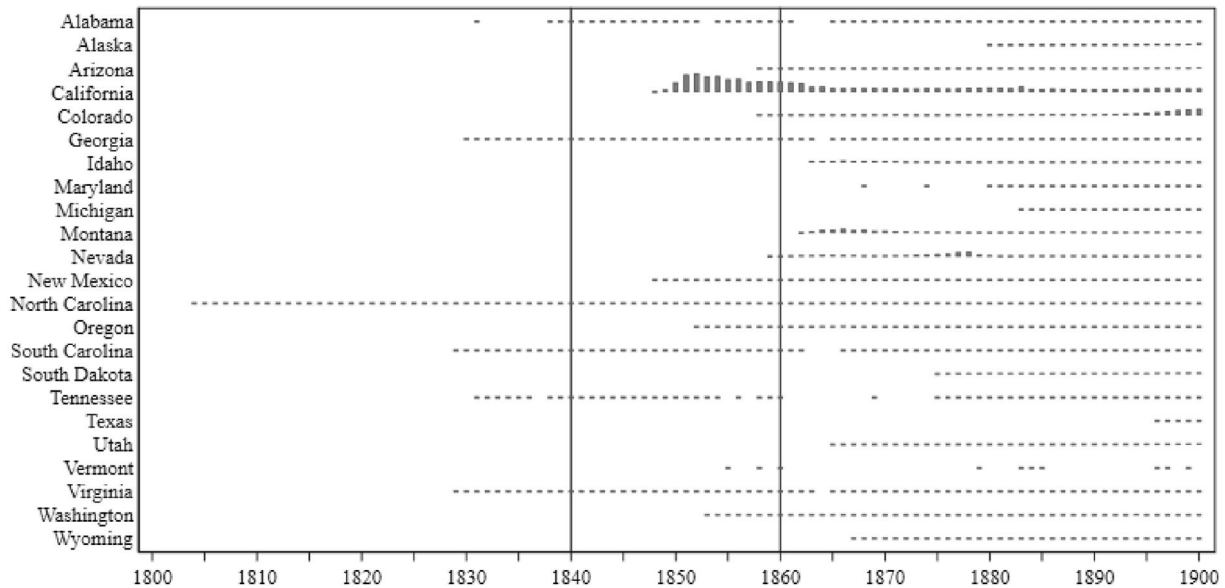


FIGURE 2 Gold mined Over time and by states. *Note:* The figure represents the amount of gold mined in a state and year in troy ounces. A troy ounce is 31.1 grams. The exact values are in Craig and Rimstidt (1998). This figure is meant to give an overview of the variation in gold mined. States without gold discoveries are not presented for brevity. The vertical lines represent the start and end of the study period. This graph was produced in Stata 15.1 using the tabplot (Cox, 2016)

ducted the digitization. Awardees digitized 100,000 pages a year since 2005, except for 2006. The historical years from which newspaper pages are digitized vary by year but are in the range 1777–1963. Within the grant criteria, which are states and historical time windows, the awardees decided which pages they scan. Some awardees were funded multiple times, so more newspaper pages from those states are available (see Tables A1 and A2 in the online appendix). For further information regarding the newspaper data, I refer to Kronenberg (2021) and the Chronicling America website.⁷ In essence, this dataset is an example of textual corpora available to answer exciting questions - relating to economic history (Gutmann et al., 2018).

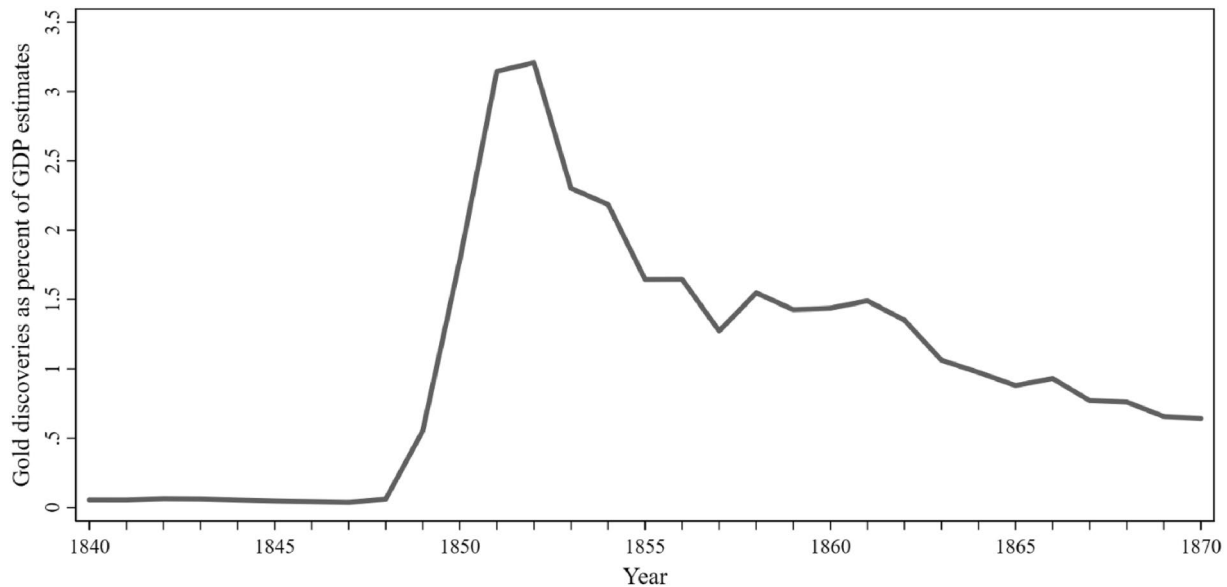


FIGURE 3 Mined gold as a percentage of GDP. *Note:* The y-axis indicates mined gold as part of GDP for each year between 1840 and 1900. Ticks on the x-axis indicate 5-year intervals. Nominal GDP estimates have been obtained from Global Price and Income History Group's Internet site: <http://gpih.ucdavis.edu> (last accessed 20.02.2019). Gold data are obtained from Craig and Rimstidt (1998)

I search this archive for occurrences of the term “suicide(s).” The result is a dataset of all mentions of suicides within the archive. Given that I have more pages for some states and years than for others, I divide the total number of suicide mentions by state and year by the total number of newspaper pages per state-year cell and multiply by 100,000. This approach is analogous to cause-specific mortality, usually reported as deaths per 100,000 individuals for a specific disease/cause (e.g., suicide).

Of course, this measure is only helpful if suicide mentions are related to suicides. Kronenberg (2021) reports that for this data source and Maine, there are 1.45 mentions per suicide and that there is substantial covariation between other measures of mental well-being and the suicide mention measure.

3.2 | Gold data

Data on the amounts of gold mined by state and year have been obtained from Craig and Rimstidt (1998). This variable is coded as metric tons of gold mined on state and year level. The official gold price is fixed at \$20.67 during the observation period (National Mining Association, 2012). The silver to gold ratio was also stable throughout the study period, and hence a metric ton of gold had the same economic value from 1840 to 1860.

3.3 | Control variables

During the 19th century, the US experienced a high degree of external and internal migration. There is no source of population numbers on a state-year level. Thus, to capture variation in migration patterns by ethnic group, the number of newspapers in each state-year cell per language group is coded. The overall distribution of languages over time in the raw data is described in Kronenberg (2021). For each language, a variable is created that gives the number of newspapers for that state and year. For sample size reasons, some languages are grouped: the first group is Czech, Polish, Slovenian, and Croatian, the second group is Danish, Swedish, Norwegian, Icelandic, and Finnish, and the third group is comprised of Spanish, Italian, and French. Cherokee and Hawaiian were not grouped despite small numbers due to the lack of similar languages. German is not clustered because it is the language that appears the most after English, and thus enough observations are available without grouping.

A variable that describes how often a state-year combination was sampled is prepared as some combinations of states and historical years are sampled more often than others (see Section 3.1). For example, the combination Arizona and the

year 1881 is coded as four, as newspapers from Arizona were scanned four times, and each time 1881 was covered in the award period. In contrast, the year 1879 was coded as three because the 2008 award covers 1880–1922.

I also gathered data on the full-time equivalent post-offices by state and year from the United States Postal Service.⁸ John (2009) reports that in 1841 nearly 80% of the civilian federal employees were postmasters. Acemoglu et al. (2016) and Acemoglu et al. (2015) argue that the post office was the state's infrastructural power. To establish a post office, the federal government appoints a single postmaster free to hire additional employees as necessary. Post offices were often set up before the actual settlement started (Acemoglu et al., 2016).

The post office variable is analogous to full-time equivalents for workers. Thus, the variable takes the value one if one post office was open in a state for the entire year. The additional advantage of this variable is that, during the 19th century, many newspapers were distributed via postal services (Olds, 1995).

3.4 | Data inclusion criteria

I restrict the final dataset to the years 1840–1860 for numerous reasons. First, newspaper data before 1840 is scarce due to fewer grants covering the period and fewer existing newspapers (for more detail on this, see Kronenberg, 2021). Second, the gold rush starts very fast and then peaks around 1852, but there is no clear end (see Figure 3). However, the American Civil War (1861–1865) likely had large effects on suicides and gold mining, which is why I chose 1860 as the end date of the analysis.

In terms of geographical restrictions, I have dropped all observations that are not from current states, current districts, or territories – like the District of Columbia, Puerto Rico, Guam, etc. The reason they are dropped is that NEH grants are only given to current-day states. Thus, it is unknown which state organization scanned those pages, and it is therefore impossible to correctly account for the data-generating process. Furthermore, the gold data by Craig and Rimstidt (1998) are reported based on current states. Thus, I do not know whether and if how much gold was mined in areas that are not current US states.

The final restriction is that I have only used local newspapers in the newspaper dataset. Local newspapers are defined as those distributed only within one state. This is meant to limit spillovers in suicide reporting.

4 | ECONOMETRIC APPROACH

I use a specification that has become standard in this literature (see Lindo, 2015; Ruhm, 2000; Stevens et al., 2015) to estimate the relationship between the value of mined gold and suicide mentions. Using subscript j for state and t for year, the base specification is:

$$S_{jt} = \alpha_t + G_{jt}\gamma + GM_{jt}\delta + F_j + F_{jt} + X_{jt}\beta + \epsilon_{jt} \quad (2)$$

where S_{jt} is the number of suicide mentions per 100,000 pages in newspapers published and distributed in state j in year t . G is the amount of gold mined in metric tons in state j in year t . GM are the gold mentions per page; gold mentions are rare and coded per page instead of per 100,000 pages. Controlling for the number of gold mentions controls for changes in gold mentions due to gold discoveries. Otherwise, a potential concern is that increasing gold mentions due to gold discoveries crowd out suicide mentions and thus bias G downwards. X is a vector of further variables described above and ϵ the error-term. The year-specific intercept (α_t) holds determinants of suicide mentions constant that vary across all states over time in the same way, such as federal laws, innovations in gold mining, and the general economy. The state fixed-effect (F_j) holds constant state-specific time-invariant factors like state geography or climate, which are fixed within states and do not vary over time.⁹ Holding geography fixed is essential as some geographical features (e.g., rivers) make gold mining easier. F_{jt} is a state-specific linear time trend interaction in four-year intervals with state identifiers. F_{jt} thus accounts for factors that vary over time within states (Stephens & Yang, 2014). Interacting single years and states is not possible due to collinearity.

A concern is that celebrity suicides are widely reported on and are over-counted using the outcome measure. Kronenberg (2021) has shown that there are 1.45 mentions per suicide in this data. The year-specific intercept should capture part of that, but to further account for that, I estimate the model with an adjusted outcome measure, which only counts one suicide mention per day and newspaper. The downside of this approach is that I might miss a suicide if multiple

suicides are reported on the same day and in the same newspaper. However, a further advantage is that this approach accounts for cases in which a newspaper mentioned the same suicide more than once, for example, if an article is printed on more than one page. Overall, this problem is likely a minor issue.

The error term is clustered at the state level in all cases. Clustering is necessary as errors are likely correlated within states; not adjusting for this correlation could lead to misleadingly small standard errors. The fixed-effect approach taken here might already reduce the concern of the within-state correlation of the error term. However, it is unlikely that it thoroughly addresses the problem. I follow the suggestions in Cameron and Miller (2015) and implement the model using the within estimator and not the least squares dummy variable estimator. The estimator is implemented with the `xreg` command in Stata 15.1 with the `vce(robust)` option (Cameron & Miller, 2015).

The model estimated here is called a Two-Way Fixed-Effects (TWFE) model. TWFE models have extensively been used to evaluate policies introduced in, for example, US states over time (see, e.g., Stevenson & Wolfers, 2006). However, recent work has pointed to some issues with TWFE models (de Chaisemartin & D'Haultfœuille, 2020; Goodman-Bacon, 2021; Sun & Abraham, 2020). However, these papers only address TWFE models with a binary variable (usually policies switching on with time) and not the case of a continuous variable like mined gold. One solution to several of the issues raised is an event-study design. Unfortunately, an event-study approach is impossible as the first gold discovery per state varies substantially (see Figure 2), and most first-discoveries fall outside the time window for which data are available.

5 | RESULTS

The main specification has a large coefficient of -98 and a wide 90% confidence interval ranging from -6 to -168 . This lack of precision is unsurprising given the sample size of 480 observations. Figure 4 illustrates that the association between mined gold and suicide mentions is negative and large. The first specification equals Equation (2). The variations are switching GM_{jt} , X_{jt} , and F_{jt} on and off as well as changing taking S_{jt} as suicide mentions per 100,000 pages and as the adjusted measure. The adjusted measure only counts at most one mention per newspaper and day and then aggregates to mentions per 100,000 pages.

Varying the controls, adding gold mentions or time trends to the model, or adjusting the outcome in most cases mildly changes the magnitude of the association of the main specification in both directions. Nevertheless, only in 2 of the 14 specifications does the association become imprecise with respect to the 95% but not the 90% confidence interval. Given the small sample size, a concern is that outliers could drive the results. Therefore, I run the main specification 1000 times, each time leaving out a random 10% of the sample. The result is Figure 5, which shows that the coefficient of the main specification (-98 represented by the solid vertical line) is very close to the center of the distribution (-99) of the coefficients from the 1000 re-estimations.

Furthermore, the right tail of the distribution ends below -40 . Thus, there is no instance in which the sign of the coefficient changes. The graph further emphasizes that mined gold had a negative association with suicide mentions and that a small number of extreme outliers does not drive the results.

Figure 6 shows that the results are also qualitatively unaffected by varying the sample window. This is important, as the literature has suggested that estimates of the relationship between the economy and health might be sensitive to the start and end date of the analysis. Ruhm (2000) suggests that researchers should use more than 15 years to avoid the estimates being sensitive to the data's start and end date. The 20 years of data I use here fulfills this recommendation. However, I also re-estimate the model by varying the beginning and end years until I reach the recommended minimum of 15 years. Figure 6 shows the main model re-estimated with start years 1841–1845, keeping the end year fixed at 1860 and varying the end year from 1855 to 1859 while keeping the start year fixed at 1840. The solid horizontal line at -98 is the coefficient, and the dashed horizontal lines are the 90% confidence interval of the specification equal to Equation (1) using the whole sample. Varying the start year slightly nudges the coefficient towards zero as more years are dropped from the estimation. The coefficient for the 1845–1860 sample even turns insignificant. For the variation in the end year, the coefficient for 1840–1855 is insignificant. This coefficient and the coefficient for 1845–1860 are based on the smallest sample. Thus, the lack of precision is unsurprising. However, the coefficients for 1840–1856 and 1840–1857 are substantially larger than the coefficient from the main estimation. This is potentially explained by the sample window ending at the peak of the gold rush. The coefficients for 1840–1858 and 1840–1859 already closely resemble the main specification.

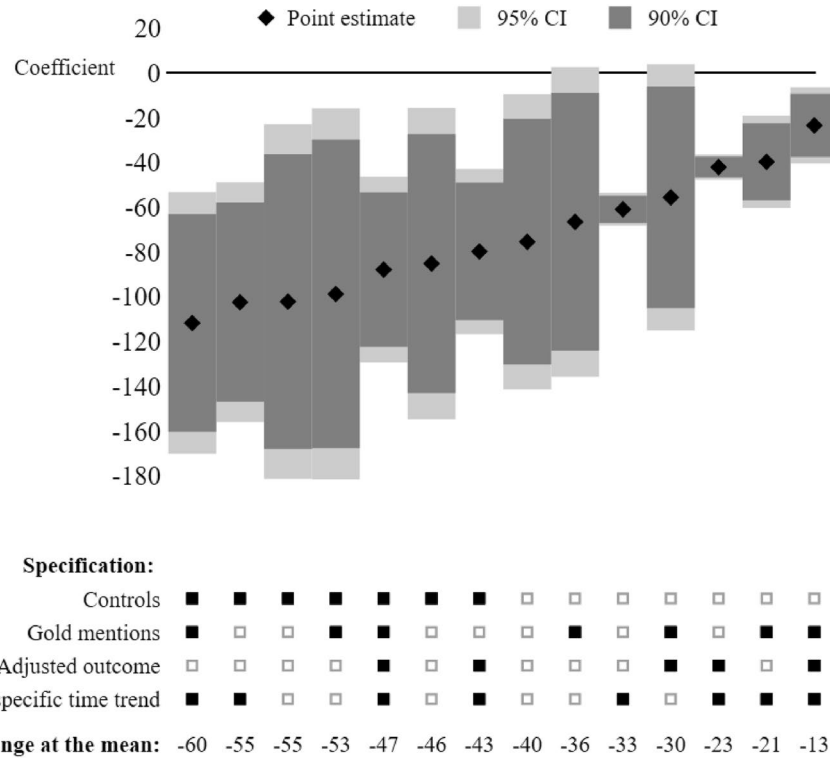


FIGURE 4 Specification curve. *Note:* The graph shows the results of Equation (2) switching GM_{jt} , X_{jt} , and F_{jt} on and off as well as varying the outcome between suicide mentions per 100,000 pages (default) and the adjusted outcome, which only counts one mention per day and newspaper before aggregating to mentions per 100,000 pages. The sample is based on state-year observations from 1840 to 1860, totaling 480 observations. In all regressions, the error is clustered at the state level. The graph is based on code provided by Hans H. Sievertsen at <https://github.com/hhsievertsen/speccurve>. Specification curves generally were originated by Simonsohn et al. (2020)

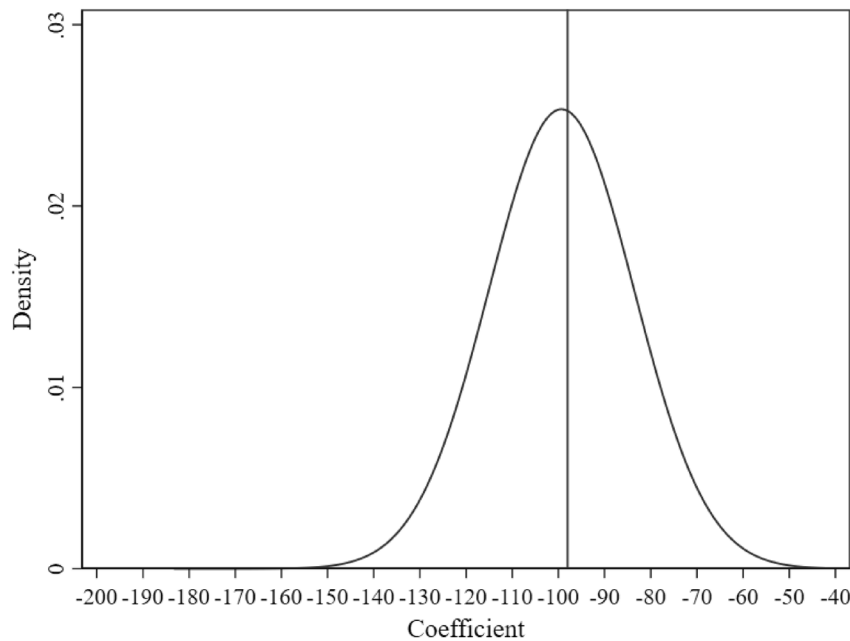


FIGURE 5 Do outliers drive the result? *Note:* The distribution results from 1000 re-estimations of the main model, with each re-estimation dropping a random 10% of the sample. Thus, these 1000 estimations are conducted on 432 instead of 480 observations. The vertical line represents the coefficient of the entire sample. The median of the distribution is -99, the coefficient for the whole sample is -98

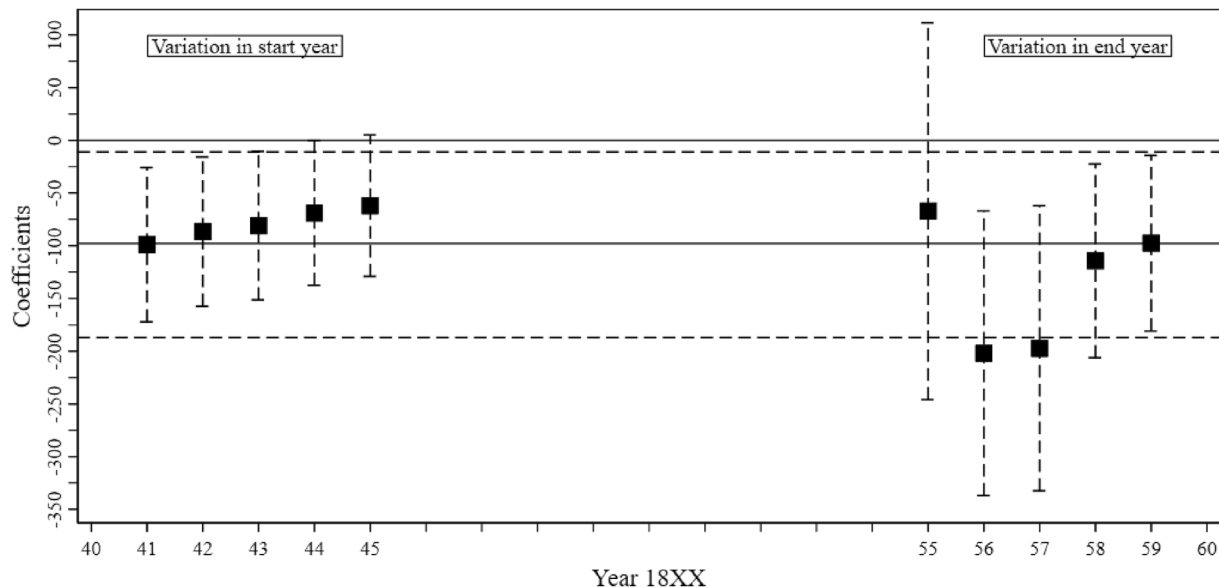


FIGURE 6 Are the results sensitive to varying start and end years of the sample? *Note:* The five coefficients on the left present re-estimations of the main model by starting the sample at the indicated years (1841–1845) but keeping the end year fixed at 1860. The five coefficients on the right present re-estimations of the main model by ending the sample at the indicated years (1855–1859) but keeping the start year fixed at 1840. The solid horizontal and dashed horizontal lines indicate the coefficients and the 90% confidence interval of the main specification

5.1 | Back of the envelope cost-effectiveness calculation

This section provides a rough cost-effectiveness calculation. There are evidently caveats comparing cost-effectiveness measures over a century and a half. Yet, the benefit of putting the results into context outweighs those caveats, which should still be kept in mind.

For this calculation, the dollar value of a ton of gold in 2019 is necessary. An ounce of gold is 31.10 grams at \$20.67. The price of a ton of gold in 1900 is thus \$664,566.12, which converted to 2019 is \$20,264,753.44. Therefore, to know the dollar value associated with reducing suicide mentions by one, the relevant coefficients are divided by \$20,264,753.44. This then allows a rough comparison of the effectiveness of mined gold in this study versus modern suicide prevention in terms of cost-effectiveness.

For the coefficients presented in Figure 4, the dollar value per suicide mention averted ranges from \$181,212 to \$863,541. Kronenberg (2021) has shown that the data contains 1.45 suicide mentions per suicide. Thus, the range for averted suicides is \$124,974 to \$595,545. This is substantially lower than the \$1,935,784 estimated by Fishback et al. (2007). Yet, it is still a lot more than the cost of effective suicide prevention summarized by Knapp et al. (2011), which ranges from £15,726 (\$20,056) after 1 year to £29,235 (\$37,283) after 10 years.

The results thus indicate that gold discoveries are ineffective compared to targeted suicide prevention measures (Knapp et al., 2011). The result should reassure policymakers that they have practical tools available to counter any adverse suicide effects of economic downturns. However, this should be interpreted with caution given the changes in culture, social safety nets, mental health care, and stigmatization of suicide over the last century and a half.

6 | DISCUSSION

I examine how gold mining from 1840 to 1860 is associated with suicide mentions in local newspapers in the US. The economic change induced by mined gold in the US was large, with about 3.5% of US GDP at the peak. This is the second study after Arthi et al. (2020), considering the effect of an economic change on cause-specific mortality for the 19th century. This context is crucial because it has a fragmented social safety net (Kiesling & Margo, 1997). It thus helps us to gain more insights into how economic shocks are related to suicides.

The results show that mined gold is associated with large reductions in suicide mentions, with the mining of one metric ton reducing suicide mentions by 98.

Nevertheless, while the novel data allows me to generate new insights, the downside is that analysis is only possible on the aggregate level. This is important, as migration (of gold miners), unobservable in this dataset, could change the pool of individuals available in gold mining states versus states without gold mining. This could bias the results, especially if migrants to different states had a different predisposition to committing and reporting suicide due to, for example, differential religious composition. The analysis attempts to control for this via language proxies (see Section 3.3) as no data on religion or even stigma are available.

Historical analysis shows that, in California, the main characteristics of migrants are males, low age, low literacy, and a short distance to California before the first gold discovery (Clay & Jones, 2008). Thus, gold rush states are faced with an inflow of a group that has higher suicide rates than other demographic groups (Canetto & Sakinofsky, 1998; Standish, 2021). Consequently, migration would likely increase the suicide rate in gold rush states. Indeed, the suicide mentions per 100,000 pages in state-year cells with gold mining are substantially higher than those without gold mining (4479 vs. 2923). Thus, migration likely makes it harder to detect any suicide-reducing effect of gold mining.

However, Arthi et al. (2020) observe a negative economic shock to cotton-producing regions in Lancashire. By exploiting a complete census the day before the economic shock, they can account for migration in their analysis. They find that once they account for migration, the negative economic shock worsened overall mortality, while their estimates would have shown improved mortality if they had ignored migration. Arthi et al. (2020) do not consider suicides. They argue that mortality increased in Lancashire among the elderly and that in the migration receiving areas, mortality increased due to the spread of contagious diseases. Both channels seem unlikely to relate to suicides. However, it is prudent to interpret the estimates presented here as the net effect of gold mining and migration.

An important caveat is that, given widespread xenophobia and racism, it is likely that most suicides in the data likely refer to white Europeans. For example, sinophobia was prominent during the gold rush. Several laws were passed taxing miners for mining, but this only applied to Chinese miners (see Foreign Miners' Tax Act of 1850 and the Foreign Miners' License Tax Act of 1852 in California).

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CONFLICT OF INTEREST

The author has no conflicts to report for this work.

DATA AVAILABILITY STATEMENT

The newspaper data are available on the website of the author. The gold data and other data used are freely available from the cited sources.

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ENDNOTES

- ¹ A distinct literature looking at how individual level changes in income and wealth affects health exists with many causal estimates (Eliason & Storrie, 2009a, 2009b; Sullivan & von Wachter, 2009a, 2009b).
- ² See Figure 3 for a more detailed presentation of gold as a share of GDP.
- ³ Bellés-Obrero and Castelló (2018) provide a good overview of the overall literature on economic changes and health.
- ⁴ Arthi et al. (2020) also look at economic changes in the 19th century, but do not consider suicides and focus on the UK. Even though the economic shock they exploit, the civil war, originates in the US.
- ⁵ These countries are Afghanistan, Burundi, Benin, Burkina Faso, Central African Republic, D.R. of the Congo, Comoros, Ethiopia, Guinea, Gambia, Guinea-Bissau, Haiti, Liberia, Madagascar, Mali, Mozambique, Malawi, Niger, Rwanda, Sierra Leone, Togo, Uganda, Yemen, and Zimbabwe.
- ⁶ A troy ounce is roughly 31.1 grams.
- ⁷ The Chronicling America website is <https://chroniclingamerica.loc.gov> (last accessed February 23, 2021).
- ⁸ The data can be accessed at <https://webpmt.usps.gov/pmt010.cfm> (last accessed April 23, 2019).
- ⁹ State geography and climate are likely changing within state. However, processes such as global warming are slow and take hundreds of years or longer, while “only” 2 decades are observed here. Thus, from the perspective taken in the model, they do not vary within state.

REFERENCES

- Acemoglu, D., García-Jimeno, C., & Robinson, J. A. (2015). State capacity and economic development: A network approach. *American Economic Review*, 105(8), 2364–2409. <https://doi.org/10.1257/aer.20140044>
- Acemoglu, D., Moscona, J., & Robinson, J. A. (2016). State capacity and American technology: Evidence from the nineteenth century. *American Economic Review*, 106(5), 61–67. <https://doi.org/10.1257/aer.p20161071>
- Arthi, V., Beach, B., & Hanlon, W. W. (2020). Recessions, mortality, and migration bias: Evidence from the Lancashire cotton famine. *American Economic Journal: Applied Economics*, (forthcoming).
- Bellés-Obrero, C., & Castelló, J. V. (2018). *The business cycle and health*. Oxford Research Encyclopedia of Economics and Finance.
- Bhalotra, S., Chakravarty, A., & Gulesci, S. (2020). The price of gold: Dowry and death in India. *Journal of Development Economics*, 143, 102413.
- Bradford, W. D., & Lastrapes, W. D. (2014). A prescription for unemployment? Recessions and the demand for mental health drugs. *Health Economics*, 23(11), 1301–1325.
- Cameron, C., & Miller, D. (2015). A practitioner’s guide to cluster-robust inference. *Journal of Human Resources*, 50(2), 317–372. <https://doi.org/10.3368/jhr.50.2.317>
- Campaniello, N., Diasakos, T. M., & Mastrobuoni, G. (2017). Rationalizable suicides: Evidence from changes in inmates’ expected length of sentence. *Journal of the European Economic Association*, 15(2), 388–428.
- Canetto, S. S., & Sakinofsky, I. (1998). The gender paradox in suicide. *Suicide and Life-Threatening Behavior*, 28(1), 1–23.
- Charles, K. K., & DeCicca, P. (2008). Local labor market fluctuations and health: Is there a connection and for whom? *Journal of Health Economics*, 27(6), 1532–1550.
- Clay, K., & Jones, R. (2008). Migrating to riches? Evidence from the California gold rush. *The Journal of Economic History*, 68, 997–1027.
- Cox, N. (2016). Speaking Stata: Multiple bar charts in table form. *STATA Journal*, 16(2), 491–510.
- Craig, J., & Rimstidt, D. (1998). Gold production history of the United States. *Ore Geology Reviews*, 13(6), 407–464.
- Currie, J., & Tekin, E. (2015). Is there a link between foreclosure and health? *American Economic Journal: Economic Policy*, 7(1), 63–94.
- Cutler, D. M., Huang, W., & Lleras-Muney, A. (2016). *Economic conditions and mortality: Evidence from 200 years of data*.
- de Chaisemartin, C., & D’Haultfœuille, X. (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review*, 110(9), 2964–2996. <https://doi.org/10.1257/aer.20181169>
- Durkheim, É. (1897). *Le suicide: Étude de sociologie*. Alcan.
- Eliason, M., & Storrie, D. (2009). Does job loss shorten life? *Journal of Human Resources*, 44(2), 277–302.
- Eliason, M., & Storrie, D. (2009). Job loss is bad for your health—Swedish evidence on cause-specific hospitalization following involuntary job loss. *Social Science & Medicine*, 68(8), 1396–1406.
- Fernandez, J. M. (2019). The political economy of death: Do coroners perform as well as medical examiners in determining suicide? *SSRN Electronic Journal*. <http://doi.org/10.2139/ssrn.3360656>
- Fetherling, D., & Fetherling, G. (1997). *The gold crusades: A social history of gold rushes, 1849–1929*. University of Toronto Press.
- Fishback, P., Haines, M., & Kantor, S. (2007). Births, deaths, and new deal relief during the great depression. *The Review of Economics and Statistics*, 89(1), 1–14.
- Geloso, V., March, R. J. (2021). *Rent seeking for madness: The political economy of mental asylums in the United States, 1870 to 1910*. Public Choice. <http://doi.org/10.1007/s11127-021-00890-1>
- Gerdtham, U.-G., & Ruhm, C. J. (2006). Deaths rise in good economic times: Evidence from the OECD. *Economics and Human Biology*, 4(3), 298–316.
- Goldfarb, R., Phillips, G. N., & Nokleberg, W. (1998). Tectonic setting of synorogenic gold deposits of the Pacific Rim. *Ore Geology Reviews*, 13(1), 185–218.

- Gonzalez, F., & Quast, T. (2011). Macroeconomic changes and mortality in Mexico. *Empirical Economics*, 40(2), 305–319.
- Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*. <https://doi.org/10.1016/j.jeconom.2021.03.014>
- Gutmann, M. P., Merchant, E. K., & Roberts, E. (2018). “Big data” in economic history. *The Journal of Economic History*, 78(1), 268–299.
- Haines, M. R. (2001). The urban mortality transition in the United States, 1800–1940. *Annales de Démographie Historique*, 101(1), 33–64.
- Hamermesh, D. S., & Soss, N. M. (1974). An economic theory of suicide. *Journal of Political Economy*, 82(1), 83–98.
- Hannon, J. U. (1984). Poverty in the antebellum northeast: The view from New York State's poor relief rolls. *The Journal of Economic History*, 44, 1007–1032.
- Hannon, J. U. (1984). The generosity of antebellum poor relief. *The Journal of Economic History*, 44(3), 810–821.
- Hannon, J. U. (1985). Poor relief policy in antebellum New York state: The rise and decline of the poorhouse. *Explorations in Economic History*, 22(3), 233–256.
- Inklaar, R., de Jong, H., Bolt, J., & vanZanden, J. (2018). *Rebasing Maddison: New income comparisons and the shape of long-run economic development*.
- Janke, K., Lee, K., Propper, C., Shields, K., & Shields, M. (2020). *Macroeconomic conditions and health in Britain: Aggregation, dynamics and local area heterogeneity*.
- John, R. R. (2009). *Spreading the news: The American postal system from Franklin to Morse*. Harvard University Press.
- Johnston, D. W., Shields, M. A., & Suziedelyte, A. (2020). Macroeconomic shocks, job security and health. *American Journal of Health Economics*, 6(3), 348–371. <https://doi.org/10.1086/708929>
- Kiesling, L. L., & Margo, R. A. (1997). Explaining the rise in antebellum pauperism, 1850–1860: New evidence. *The Quarterly Review of Economics and Finance*, 37(2), 405–417.
- Knapp, M., McDaid, D., & Parsonage, M. (2011). *Mental health promotion and mental illness prevention: The economic case*.
- Kronenberg, C. (2021). A new measure of 19th century US suicides. *Social Indicators Research*. <https://doi.org/10.1007/s11205-021-02674-y>
- Kronenberg, C., Jacobs, R., & Zucchelli, E. (2017). The impact of the UK National Minimum Wage on mental health. *SSM-population health*, 3, 749–755.
- Lindert, P. H. (2004). *Growing public: Volume 1, the story: Social spending and economic growth since the eighteenth century (Vol. 1)*. Cambridge University Press.
- Lindo, J. M. (2015). Aggregation and the estimated effects of economic conditions on health. *Journal of Health Economics*, 40, 83–96.
- McGuire, R. A., & Coelho, P. R. (2011). *Parasites, pathogens, and progress: Diseases and economic development*. MIT Press.
- McInerney, M., & Mellor, J. M. (2012). Recessions and seniors' health, health behaviors, and healthcare use: Analysis of the Medicare Current Beneficiary Survey. *Journal of Health Economics*, 31(5), 744–751.
- Miller, D. L., Page, M. E., Stevens, A. H., & Filipiski, M. (2009). Why are recessions good for your health? *American Economic Review*, 99(2), 122–127. <https://doi.org/10.1257/aer.99.2.122>
- National Mining Association. (2012). *Historical gold prices: 1833 to present*.
- Olds, K. B. (1995). The challenge to the US postal monopoly, 1839–1851. *Cato Journal*, 15, 1.
- Ruhm, C. J. (2000). Are recessions good for your health? *The Quarterly Journal of Economics*, 115(2), 617–650. <https://doi.org/10.1162/003355300554872>
- Ruhm, C. J. (2015). Recessions, healthy no more? *Journal of Health Economics*, 42, 17–28.
- Ruhm, C. J. (2016). Health effects of economic crises. *Health Economics*, 25, 6–24.
- Simonsohn, U., Simmons, J. P., & Nelson, L. D. (2020). Specification curve analysis. *Nature Human Behaviour*, 4(11), 1208–1214. <https://doi.org/10.1038/s41562-020-0912-z>
- Standish, K. (2021). A coming wave: Suicide and gender after COVID-19. *Journal of Gender Studies*, 30(1), 114–118. <https://doi.org/10.1080/09589236.2020.1796608>
- Stephens, M., & Yang, D.-Y. (2014). Compulsory education and the benefits of schooling. *American Economic Review*, 104(6), 1777–1792. <https://doi.org/10.1257/aer.104.6.1777>
- Stevens, A. H., Miller, D. L., Page, M. E., & Filipiski, M. (2015). The Best of Times, the Worst of Times: Understanding Pro-cyclical Mortality. *American Economic Journal: Economic Policy*, 7(4), 279–311. <https://doi.org/10.1257/pol.20130057>
- Stevenson, B., & Wolfers, J. (2006). Bargaining in the shadow of the law: Divorce laws and family distress. *The Quarterly Journal of Economics*, 121(1), 267–288. <https://doi.org/10.1093/qje/121.1.267>
- Substance Abuse and Mental Health Services Administration. (2019). *Key substance use and mental health indicators in the United States: Results from the 2018 national survey on drug use and health (HHS publication No. PEP19-5068, NSDUH series H-54)*. Center for Behavioral Health Statistics and Quality.
- Sullivan, D., & von Wachter, T. (2009a). Average earnings and long-term mortality: Evidence from administrative data. *The American Economic Review*, 99(2), 133–138.
- Sullivan, D., & von Wachter, T. (2009b). Job displacement and mortality: An analysis using administrative data. *The Quarterly Journal of Economics*, 124(3), 1265–1306. <https://doi.org/10.1162/qjec.2009.124.3.1265>
- Sun, L., & Abraham, S. (2020). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*. <https://doi.org/10.1016/j.jeconom.2020.09.006>
- Whipple, G. C. (1922). *Vital statistics an introduction to the science of demography* (2nd ed.). John Wiley & Sons.

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