Ghost Towns and Big Cities: Historical Mining and Economic Activity in the American West*

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Abstract

This paper identifies the impact of gold and silver mining discoveries in the American West on the origins and death rates of western towns and the region's long-run population distribution. Between 1850 and 1940, the discovery of mining sites increased the likelihood that a town formed nearby relative to other locations. Many of these towns eventually died, however, due largely to their relatively poor geography. Nevertheless, locations near mining sites exhibit conditional persistence: they are denser today than surrounding areas, but only when accounting for geographic confounders. Our findings suggest that historical mining activity influenced the locations of cities and towns in the American West and geography helped determine their long-run prospects for survival.

Keywords: agglomeration, American West, ghost towns, mining, path dependence

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Introduction

History is replete with accounts of cities and towns that have risen to prominence only to disappear with time. But the past also reveals that the location of economic activity can be remarkably resilient. In the American West, settlements formed as migrants attracted by gold and silver discoveries began arriving in 1848 with the California Gold Rush. Across the region in 1850, based on data produced for this study, 60 percent of the workforce was employed in the mining industry and 40 percent of the population lived within five miles of a mining site. By 1940, however, these shares had both declined to less than five percent and many western towns had disappeared altogether. At the same time, mining-adjacent cities such as Denver and Sacramento became durable commercial centers that outlasted many of their counterparts. How did mining activity ultimately influence the spatial distribution of the western population, and what explains why some cities and towns were more apt to die while others were seemingly poised to survive?

We seek to answer these questions by combining both historical and modern population data with information on western mining site discoveries. We rely on the digitized locations of historical gold and silver sites in 12 western states produced by the USGS (U.S. Geological Survey 2005a). Included in this dataset is a site's year of discovery, which allows us to explore the role of new mining activity on the formation of western towns. This information is linked to a grid representing all possible locations in the American West, a longitudinal dataset of population in ever-settled census places—i.e., cities, towns, or villages—from 1850–1940 (Berkes, Karger, and Nencka 2023), and a cross-sectional dataset of population density for census blocks in 2010. We use these datasets to examine the origins of western cities and towns, their risk of death over time, and the region's long-run spatial distribution of economic activity.

We begin with an event-study approach to identify whether areas were populated in response to nearby mining site discoveries. We find that the likelihood of settlement was significantly greater in locations within five miles of such a discovery than in those located farther away, an effect that peaks at 40 years after discovery and reverts to zero after 80 years. To understand this process of mean reversion, we employ a town-level hazard analysis to provide evidence behind the risk of collapse among western towns. We find that towns near mining sites faced significant headwinds in the form of relatively poor geography. Furthermore, the populations of such towns were significantly older than those of other towns, a characteristic that hastened town collapse in the American West. However, while such towns were at higher risk of collapse the longer they existed, when accounting for a host of confounding factors, they exhibited a much smaller baseline risk of collapse than surrounding towns and a lifespan advantage of nearly 40 years. These findings suggest that factors other than the exhaustion of nearby gold and silver mines contributed to the rise of ghost towns in the American West.

This paper also aims to identify whether geography and historical mining activity continue to cast their shadows on the spatial distribution of the western population. We show that, when accounting for their relatively poor geographic characteristics, areas within five miles of a historical mining site are at least 35 percent denser in population today than surrounding locations and are thus more developed than their geography alone would predict. This conditional persistence suggests a role for both path dependence and geography in shaping the long-run spatial distribution of economic activity in the American West.

The conditional persistence found in our study reveals the long-run impact of historical resource extraction on town locations in the western US. Studies focused on the economic impact of extraction activities have yielded mixed results. Clay and Jones 2008 find that miners in California generally received small, if any, economic profits, while merchants or other service providers often experienced positive economic outcomes through the commercial growth that followed from increases in mining activity. Studies at other levels of analysis show that the extraction of natural resources increased local income in Peru (Aragón and Rud 2013), wages and manufacturing productivity in US counties (Allcott and Keniston 2018), income and population density in southern US counties (Michaels 2011), and city growth in Europe beginning in 1750 (Fernihough and O'Rourke 2020). On the other hand, negative long-run effects in the US are found on local employment and income in western counties dependent on oil extraction in the 1970s and 1980s (Jacobsen and Parker 2016), population and manufacturing activity in coal-mining counties between 1870 and 1970 (Matheis 2016), and entrepreneurship and employment growth in areas near historical coal mining (Glaeser, Kerr, and Kerr 2015). While many of these studies focus on large-scale extraction of natural resources such as coal or oil, our results suggest that even relatively small-scale, spatially dispersed resource booms can form durable settlements in affected locations that meet the right geographic conditions.

Our study most closely relates to the literature on path dependence in the location of economic activity. Spatial persistence can come through several channels, including natural advantages, agglomeration economies, and sunk investments (Lin 2015). Studies of wartime bombings show only temporary effects on city populations and the location of economic activity in Germany, Japan, and Vietnam (Davis and Weinstein 2002; Brakman, Garretsen, and Schramm 2004; Miguel and Roland 2011). In the modern Americas, areas with high precolonial density are denser today even after the trauma of colonization inflicted upon native populations (Maloney and Caicedo 2016). These results suggest that natural advantages greatly influence city locations.[1] In other contexts, large shocks have had permanent effects on the size and density of urban populations, in which case self-reinforcing agglomeration economies generate path dependence in the location of economic activity. Portage sites, once a nuisance for the transportation industry but no longer relevant, became areas for commerce that ultimately established agglomeration economies and persist to the present day (Bleakley and Lin 2012). Temporary shocks led to long-lasting effects on population sizes in British cities reliant on cotton textile manufacturing during the US Civil War (Hanlon 2017) and in resettled areas following the migration of World War II German expellees (Schumann 2014). While existing studies on path dependence show either permanent effects on population size and density or complete mean reversion following a shock, little is known about whether geography and history can interact to influence long-run outcomes in the location of economic activity. We fill this gap by demonstrating that a temporary population boom in locations with natural disadvantages can have persistent effects once geographic characteristics are accounted for.

Also influential in generating path dependence in the location of economic activity is infrastructure. Research in this area has found that railroad investment encouraged urbanization and settlement in many historical contexts—from the US and Sweden to India and Kenya (Atack et al. 2010; Berger and Enflo 2017; Donaldson 2018; Jedwab, Kerby, and Moradi 2017). Towns in Sweden established by a king's decree hundreds of years ago are thriving today due to sunk investments, even while getting off to inauspicious starts in suboptimal locations (Cermeño and Enflo 2019). Closely related to our study is work by Hodgson 2018, who finds an "agglomeration shadow" whereby post offices that were almost connected to new expansions of the railroad—i.e., those located at some intermediate distance from the railroad—were less likely to survive than either connected or isolated post offices. Whereas Hodgson 2018 focuses on the probability that old post offices survived to 2010, our study analyzes the role of mining activity in forming new western settlements. Although these settlements formed in suboptimal locations, they were not formed by decree or by way of transportation improvements but rather the settlement decisions of western migrants in search of landbound riches. We show that the prospects for ultimate survival in

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[1] Geography also has a substantial influence on the concentration of industry (Ellison and Glaeser 1999), housing supply (Saiz 2010), population settlement (Rappaport and Sachs 2003), city locations (Bosker and Buringh 2017), and the distribution of economic activity worldwide (Henderson et al. 2018).

this setting were highly dependent on local geography.

We add to another strand of literature focused on the role of mining in the settlement of the American West. Western mining activity began in an economically and institutionally nascent setting in which large population settlements were virtually nonexistent until European settlers began to migrate to the region after the discovery of gold in 1848. Property rights emerged in response to increased competition for land and the right to mine it through the formation of self-governing mining districts (Libecap 1978; Umbeck 1977). Order was preserved through legal codes established by these districts (Clay and Wright 2005). The western frontier during the nineteenth century was thus an open-access setting in which rules governing mineral extraction emerged to meet local needs as sites were discovered (Libecap 2007). Scholars continue to debate the impact of these institutions and the mineral rushes they facilitated, not only on economic development and political outcomes but also on the decimation of indigenous peoples and the environment.[2] While not without controversy, this large-scale migration fostered growth in economic activity across the American West. Little is known, however, about its impact on the origins, locations, and evolution of western towns, a gap this paper aims to fill.

Historical Background

The American West experienced a flurry of mineral discoveries and migrants in the middle of the nineteenth century. Along with notions of exploring the frontier, gold and silver functioned as catalysts for expanding ambitions and investment (Curtis 2013; White 2012). Before the arrival of mineral-seekers, the region was populated by largely nomadic American Indian tribes and self-subsisting Mexican farmers (Belich 2009; West 1998). Only a few Europeans penetrated the area before 1845, primarily through military excursions or exploration and hunting expeditions (West 1998). In 1848, when James Marshall discovered gold in Sutter's Mill, California, news spread quickly, and soon the state was receiving emigrants from the Midwest and East and from continents as distant as Australia, Asia, and South

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[2] Some scholars focus on the increases in immigration and economic development that came with the rushes (Brands 2010; Hahn 2016; West 1999), while others focus on the environmental degradation they caused (Curtis 2013; Andrews 2008; Isenberg 2005; Lecain 2009; Rohe 1986; Immerwahr 2019; Meinig 2000; Frymer 2017). Madley (2016, p. 10) focuses on the impact on California's indigenous population between 1846 and 1873, which had fallen by as much as 80 percent over this period. Studying the cultural and political outcomes of frontier settlement, Bazzi, Fiszbein, and Gebresilasse 2020 show that frontier locations today exhibit greater levels of individualistic behavior and opposition to big government, while Brodeur and Haddad 2021 find that former gold rush counties in the US have larger present-day LGBT populations.

America (Mountford and Tuffnell 2018).

The discovery of gold and silver in other states also attracted large influxes of people. Areas near mining sites began to build infrastructure such as railroads, telegraphs, ditches, and houses as towns sprang up overnight (Mountford and Tuffnell 2018; Silverberg 1968). While not every migrant stayed in the West for the long term, the establishment of markets and industry outside of mining led to sustained population growth in western states. Areas that were once uninhabited by settlers of European origin were transformed into dense population centers (Curtis 2013).

Many people were induced to migrate westward by the opportunities provided through placer mining, which involved sifting for gold and silver flakes in a flowing river. Migrants, typically poor or otherwise facing financial hardship in the East, were attracted to the potential to make money through the discovery of gold or silver (West 1998). Placer mining was ideal for this demographic since it required very little prior knowledge or physical capital. As placer deposits waned, however, the majority of remaining minerals were stuck in lodes and veins within the mountains themselves, thus requiring capital-intensive deep-mining techniques to extract them. Extraction of this nature encouraged the corporatization of the mining industry and gave way to the more sophisticated practice of deep mining over the nineteenth century (Isenberg 2005; Belich 2009; Curtis 2013; Limerick 2006). The likelihood of striking it rich declined for the individual miner in the late nineteenth century, and with it the allure of mining for a vast group of migrants.

Both placer mining and deep-mining techniques required an institutional structure for governing the orderly extraction of minerals. The establishment of mining districts often fulfilled this need. These districts established laws governing mining claims and private property rights within their boundaries. Miners often elected their own president, secretary, judge, treasurer, and recorder to carry out various administrative duties. Districts also established stipulations and regulations surrounding common goods such as water and timber. The institutional order offered by these districts likely attracted ever more people. One such example is the Comstock Lode, a large gold and silver mining region in Nevada. In 1859, the Gold Hill District was established to govern extraction and a similar government at Virginia City soon followed (Libecap 1978). Output in the Comstock Lode rose ten-fold between 1859 and 1861; at the same time, the local population rose from 100 to 20,000 people (p. 343).

As shown in Figure 1, employment in mining in the American West dominated other forms of employment early on. But mining was too uncertain and unstable an endeavor to remain the predominant industry of the western economy. Well before the turn of the twentieth century, agriculture and cattle ranching had surpassed mining in economic importance and more and more settlers became retail merchants, service providers, and manufacturing workers (Belich 2009; West 1998; White 1993). Over time, ghost towns began to dot the landscape. But death was not an inevitable outcome of this process of change. As Silverberg 1968 describes, there were "degrees of ghostliness" among the ghost towns, and some mining towns never died.[3] Although the western mining industry had declined in importance by the late nineteenth century, it had already staked its claim on the region's development.

Data

In the early days of the American West, economic activity expanded both spatially and temporally as gold and silver were discovered across the region. An empirical study of this episode requires that we measure not only the timing of new town formations and mine discoveries, but also the exact locations of these phenomena. The first portion of our analysis focuses primarily on town origins and deaths between 1850 and 1940, the last census year in which individuals can be linked to their census places using the algorithm developed by Berkes, Karger, and Nencka 2023. The last portion of our analysis considers population density and nighttime light intensity from 2010. Our sample consists of observations from 11 states in the US Census Bureau West region: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. We also include observations from the western half of South Dakota—specifically, areas west of –101 degree longitude. Including this portion of South Dakota captures activity near the Black Hills, which was an important mining location during this time.[4] We combine information from several sources to create rich longitudinal and cross-sectional datasets focused on the 1850–1940 and 2010 periods.

Mining Site Discoveries

Our primary explanatory variable of interest is proximity to the historical mining sites that most attracted early migrants, namely those that mined gold or silver. The geographic coordinates of these mining sites are gathered from the USGS Mineral Resources Database

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[3] Economic research on ghost towns has focused on rural decline from a theoretical perspective that links wages, housing rents, and amenities (Graves, Weiler, and Tynon 2009).

[4] Our results are similar when including all of South Dakota. See the section "Mining and the Origins of Settlement in the American West."

(U.S. Geological Survey 2005a). Of all past and present mining sites in our sample region, 3,824 mined gold or silver either exclusively or with other minerals and were discovered no later than 1940.[5] These sites act as our reference points for determining mining proximity.

Figure 2 shows the locations of the mining sites used in our study. Historical gold and silver sites, which we identify as those discovered between 1851 and 1940, were located in all 12 states. Relatively few sites existed in the Pacific Northwest and Wyoming, while many more were near the Rocky Mountain and Sierra Nevada mountain ranges in Colorado, California, and Nevada. The figure shows a large degree of spatial variation in the locations of old mining sites, with tight clustering occurring in some areas and wide dispersion in others. This spatial variation is useful for identifying the impact of mining activity on western town origins and development.

Another useful feature of the data is variation in the timing of mining site discoveries. Figure 3 shows the distribution of discovery years for the full sample of historical gold or silver sites. We collapse discoveries by decade (1851–1860, 1861–1870, and so on) to align with the timing of the census population data. While mining sites were formed in all decades up to 1940, the mid-to-late nineteenth century represents the primary period of discovery. More than half of the gold and silver mining sites in our sample were discovered before 1890. The distribution of discovery across time is consistent with the historical accounts of gold and silver seekers rushing westward in periods when the idea of striking it rich was most promising, thus producing different frontiers in the process (Paul 1974, p. 11).

Historical Town Locations and Their Population

The primary outcome of interest in the first stage of our analysis is town existence. We construct town-level population sizes using full count census data from IPUMS (Ruggles et al. 2021) and census places as defined by the Census Place Project (Berkes, Karger, and Nencka 2023). We also gather the following demographic variables: male share, median age, literacy rate, and mining employment share. Using the Census Place Project (CPP)

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[5] Many sites do not contain information on discovery dates and thus do not enter into our analysis. In compiling the dataset, the USGS emphasized data accuracy over completeness (U.S. Geological Survey 2005b), and thus if a site's discovery year had conflicting sources of information, the field was left blank. In other cases, sites were so small that they were never officially registered as claim sites. In a study of the relationship between homicides and historical mineral deposits across the US, Couttenier, Grosjean, and Sangnier 2017 use the USGS Mineral Resources Database and show that: 1) the likelihood that a site has a discovery date is not explained by latitude or longitude; 2) discovery dates were more likely recorded for valuable deposits such as gold or silver; and 3) sites with discovery dates are not systematically different in size. These points together give us confidence that our dataset of mining locations captures the most prominent gold and silver sites during this period and that our results are not systematically biased.

crosswalks, we create a balanced panel of 7,626 western cities and towns from 1850 through 1940, except for 1890 due to the absence of census population schedules for that year. This sample size of places decreases slightly in our event-study and hazard analyses due to each method's approaches to estimation, which we discuss later.

The CPP procedure links individuals and households to their sub-county place of residence using information for places from the National Historical Geographic Information System (NHGIS) and the Geographic Names Information System (GNIS). Over time, these places combined with bigger cities, formed anew, or completely disappeared. To achieve temporal consistency of locations while accounting for annexations and border changes, the CPP method clusters places into larger units and assigns them geographic coordinates. These clustered places uniquely represent both small towns and big cities.[6] We are thus able to follow the populations of cities and towns as they grow or decline while accounting for changes in their spatial boundaries, furthermore ensuring geographically isolated mining towns remain as distinct observations through time. Our dataset is completely balanced with places having zero population in years in which no population level is observed. Overall, this procedure alleviates concerns about attrition from the dataset due to annexation or border changes.

In some census years, the CPP procedure is unable to identify the exact location of every person or household in the census because some of them do not have recorded place names. These situations were most likely to occur in cases where people lived on isolated farms or in isolated areas without settlement or community names. For individuals with place names recorded in the census, the match rate to a specific town or city location is 100 percent. The CPP procedure adds additional value by matching unclear cases to a consistent place over time, thus assigning more people to city and town locations than those using only the census place names in publicly available datasets such as IPUMS (Berkes, Karger, and Nencka 2023). For our purposes, this means that we are likely to observe zero population for a particular place–decade observation due to the complete absence of people rather than due to failed matches. On the other hand, if old mining towns are disproportionately unnamed in the census, a small population may exist in these locations in periods in which we observe none.

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[6] We use the clustering parameters recommended by Berkes, Karger, and Nencka 2023. These parameters combine large cities with their expanding suburbs to consistently define places over time, but also help to maintain the geographic distinctness of surrounding towns. The procedure combines two places i and j that are within $100 * K_{cluster} * max\{sharepop_i, sharepop_j\}$ miles of each other, where $sharepop_i$ is the proportion of total census population mapped to census place i across all years and $K_{cluster} = 5$. A higher value for $K_{cluster}$ yields a larger coverage area for clustered places, while a lower value yields a smaller coverage area. See Figures 4–6 in Berkes, Karger, and Nencka 2023 for a visual representation of the clustered places in several states using their preferred parameters.

Such a phenomenon would bias our estimated treatment coefficient for mining proximity downward, and thus we view our estimates relying on the census place data as a lower bound.

Post Office Data

We augment our census place analysis with an alternative approach using information on post office openings and closures to proxy for economic activity, as in Hodgson 2018. The years in which post offices were in existence are well-recorded and have been compiled by Blevins and Helbock 2021. We measure whether a post office is present in each grid cell for each census year between 1850 and 1940.

Potential Town Locations

There are numerous potential locations for cities and towns in the vast geographic space of the western US. To empirically study the potential for development in all locations over time, we divide the 12 western states in our sample into a grid of cells following Bosker and Buringh 2017. For each census decade, we link the coordinates of towns identified in the CPP algorithm to individual cells. We choose cells to be roughly 1 km^2 in size, which is small enough that each location contains no more than one census place's coordinates and large enough to make our methods computationally feasible. We exclude areas covered completely by water, which yields a sample of nearly 3.2 million observations. We also use the geographic coordinates of post offices in each census year to link them to the cells in which they were located.[7] The final sample of grid cells includes all potential locations—rural or otherwise—that could have been populated during this time. Each of these locations is then linked to data on geography, distance to important features, and other characteristics.

Modern Outcomes

The last stage of our analysis focuses on modern population density as the primary outcome of interest. We gather 2010 US Census data on population at the block level, which yields

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[7] While the post office openings and closures are observed every year rather than once a decade, the computational demand required to estimate a model at the annual level that still uses our same grid of millions of locations is enormous. As Bosker (2022, p. 5) discusses, small grid cell sizes combined with many time periods quickly introduces computational challenges. Given this trade-off, we elect to maintain the same grid as our town locations and use census years rather than introduce dozens of new time periods and dimensions.

roughly 2.2 million observations in our sample region (Manson et al. 2020). To address the concern that census blocks are endogenous to population, we also consider an alternative outcome of nighttime light intensity from 2010 (National Geophysical Data Center 2003). We determine mean nighttime light intensity for each individual cell in our grid of possible locations.

Geographic, Regional, and Market Proximity Variables

We link our datasets to a variety of geographic and regional variables, including measures accounting for elevation and ruggedness (Nagi 2014), physiographic province (U.S. Geological Survey 2011), state, distance to the West Coast, and distance to the nearest river (U.S. Department of Transportation 2022). Physiographic provinces represent distinct regions, each with their own geological features. There are 12 such provinces in our sample region. We use data compiled by Atack (2016) in our hazard analysis to measure each town's distance to the railroad in each census year. We also measure—in census years—each place's distance to the nearest city containing at least 10,000 residents. Overall, these variables capture many town-specific characteristics associated with nearby mining activity, settlement origins, and survival over time.

Methods and Results

Our analysis follows in three parts. First, we use an event-study approach to explore the degree to which towns formed in locations (grid cells) near mining site discoveries relative to other locations during the 1850–1940 period. We then shift to a town-level survival analysis to determine why some towns eventually died while others survived as mining activity receded in economic significance in the American West. Lastly, we identify the impact of proximity to historical mining sites on today's spatial distribution of economic activity.

Our approach throughout the study uses spatial proximity to mining site discoveries as a measure of exposure to mining, or treatment. The aim in defining proximity in this way is to capture those western towns and locations that were most reliant on mining activity. We define locations within five miles of a mining site (in straight-line distance) to be in this treatment group. The areas covered by this radius were well within an easy day's journey of a gold or silver site by horse or wagon.[8] We show evidence in the next section that a

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[8] As Hodgson (2018, p. 65) suggests, in a typical day, people could take a loaded wagon about 22 miles or ride horseback nearly 40 miles.

five-mile radius is a relevant catchment area for early settlers of the western frontier.

Mining and the Origins of Settlement in the American West

A simple picture motivates the spirit of our event-study approach. Figure 4 shows where the western population settled over time on average, in terms of both a location's likelihood of having a town and the size of that town, relative to the nearest mining site. The relationship between mining site proximity and the likelihood of settlement is just visible in 1850, a period in which many western places are still unsettled by migrants of European descent. But by 1860 areas within just a few miles of a mining site are much more likely to be settled than those located farther away. Although still fairly prominent in 1940, this relationship had weakened since 1860 as areas farther from mining sites gained cities and towns.

Across the nineteenth and twentieth centuries, the average location's population size decreased with distance to the nearest mining site. This relationship was strongest in the nineteenth century and less monotonic in the twentieth century, when areas farther away began to grow in population as the region became less reliant on mining. By 1940 a new pattern had emerged: locations with the largest cities and towns on average were located roughly 30 miles away from the nearest mining site rather than within just a few miles. Nevertheless, a generally negative—though increasingly more irregular—relationship between population size and distance to the nearest mining site is evident throughout the 1850–1940 period.

Figure 4 suggests that mining sites served as focal points for settlement in the American West during the nineteenth century, a phenomenon that persisted well into the twentieth century. It also shows that locations within five miles of a mining site were more likely to be settled than other locations between 1850 and 1940. We define these areas to be in our treatment group. Areas that were always located more than five miles from a mining site between 1850 and 1940 comprise our control group, while areas that were already within five miles of a site in 1850 are excluded from the analysis. This exclusion ensures that the composition of our control group remains unchanged over time, which provides clearer estimates of the treatment effect.

Two features of our sample and data inform our approach. First, we focus on the 1850–1940 period since it coincides with the available census place data. While this period extends beyond the nineteenth century boom in gold and silver mining, it provides a long-run view and further places the nineteenth century in broad historical perspective. Second, we allow all locations once treated to remain so throughout our study period, even if they are near mining sites that had ceased production at some point before 1940. This approach allows us to examine the evolution of town locations and long-run development based on historical, often temporary, exposure to mining. It also ensures that we rely on a large sample of mining sites since relatively few have information about their production years.

The staggered nature of mining site discoveries over time suggests that an event study approach is appropriate in our setting. To make use of this empirical feature, we follow methods proposed by Callaway and Sant'Anna 2021 that allow for estimation of heterogeneous treatment effects over time. This estimator provides causal estimates for all group–time average treatment effects using observations available for each two-by-two comparison. Focusing on outcome variables at both the extensive (i.e., town existence) and intensive (i.e., town population size) margins, we estimate a model described by the following:

$$y_{id} = \alpha_i + \delta_d + \sum_{k=-90}^{80} \beta_k NearSite_{id}^k + \epsilon_{id}, \tag{1}$$

where y_{id} is our outcome of interest for location i in decade (census year) d, α_i is a location fixed effect, δ_d is a decade fixed effect, $NearSite_{id}^k$ is an indicator equal to one for location i in year k relative to exposure to a newly discovered mining site in a particular decade (e.g., 1851–1860, 1861–1870, and so on) and zero otherwise, and ϵ_{id} is an error term. The parameters of interest are β_k, which are measured each census year k relative to the period of exposure to a nearby mining site. Because census places are first observed in 1850, and exposure is first observed in the decade ending 1860 and last observed in the decade ending 1940, k ranges from -90 (pre-treatment) to 80 (post-treatment).[9] With this approach, we estimate decade-specific average treatment effects (β_k) of being exposed to a mining site for k years compared to never having been exposed. We present our main results graphically and report 95 percent confidence intervals using standard errors clustered at the 1940 county level. We cluster at this level since census places within counties likely experienced spatial autocorrelation in economic development based on localized factors.[10] We report average treatment effects on the treated (ATT) before and after exposure to a mining site. All treatment coefficients are interpreted relative to the period just before treatment occurs to

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[9] Since census observations in 1890 are missing, 1880 serves as the last available pre-treatment period for areas that were treated in 1900. Additionally, the 1900 treatment group includes locations treated between 1881 and 1900 rather than a typical 10-year span. This implies that some locations may have been exposed for 20 years by the time the first treatment effect is estimated. Estimation using post offices rather than census places shows similar average treatment effects, and thus we do not suspect that the missing census observations for 1890 greatly influence our results.

[10] Clustering at other levels such as physiographic province, state, and grid cell yield similar results. See Figure A1 in the Online Appendix.

align with standard reporting of event-study results (Roth 2024).

Identification of the treatment effect in this setting requires that: (1) parallel trends in outcomes among exposed and non-exposed locations would exist in the absence of treatment, and (2) towns did not disproportionately arise in locations before the discovery of nearby mining sites. To make the first condition even more plausible, we follow methods proposed by Callaway and Sant'Anna 2021 to determine a propensity score for $NearSite$, which is used to match treatment cells to control cells for the purpose of comparison over time. Locations are matched based on the following (pre-existing) geographic variables: mean elevation, ruggedness (defined as the standard deviation of elevation within a grid cell), (ln) distance to the West Coast, (ln) distance to the nearest river, latitude, longitude, and their interaction. This matching method helps ensure pair-wise comparisons between geographically similar treatment and control areas, and thus relaxes the unconditional parallel trends assumption and further accounts for geographic confounders that could influence local settlement over time. Weights are assigned based on the quality of the match and average treatment effects are estimated based on these weights. This method is also doubly-robust, as it provides unbiased estimates of the treatment effect if either the outcome model or treatment model is misspecified (Sant'Anna and Zhao 2020). We show graphical evidence that these two important conditions are met. Our results (shown in Figure A2 in the Online Appendix) are similar using unconditional comparisons.

We begin with an analysis of the likelihood that a location is settled over time. Our first outcome variable is an indicator equal to one if a grid cell has a census place and zero otherwise, thus representing the extensive margin of settlement in our analysis. Panel (a) of Figure 5 shows evidence that towns were more likely to arise in locations near a newly discovered mining site than elsewhere. The evidence further suggests that treatment and control locations were similarly likely to be settled in the decades before exposure to a mining site, which builds confidence that the post-treatment coefficients are unbiased.[11]

Aside from showing an early settlement advantage for locations near mining sites, the results also suggest that such locations experienced a rise-and-decline pattern of settlement. The peak period of settlement in mining locations occurred 40 years after exposure, followed by a relative decline in the likelihood of settlement until 80 years out, at which time they were just as likely to have towns as control locations. This outcome implies a tendency toward mean reversion in the relative likelihood that a town exists in mining-adjacent locations,

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[11] We have explored different treatment definitions, including the use of ten and fifteen mile radii. The results, which are shown in Figure A3 of the Online Appendix, are similar across these treatment definitions.

possibly due to a high rate of town deaths in these areas.

Did exposure to a mining site also lead to population growth in settled areas? To focus on the intensive margin of development, we exclude from the sample locations with zero population in a given year. The result is an unbalanced panel of locations, each of which has a population. If mining site discoveries also fostered intensive growth, then new exposure should have led to an increase in population size in these settled places, even if they were not formed by mining activity initially. Panel (b) of Figure 5 shows the results of testing this hypothesis where (ln) population is the outcome variable. The evidence suggests that settled locations did not grow in size upon the discovery of nearby mining sites. Instead, the primary effect of such discoveries was on the extensive margin of town formation.

Thus far we have relied on population data generated by the CPP method. To address potential concerns of measurement error in our population variable, we use post office openings and closures to proxy for the existence of towns, as in Hodgson 2018. Panel (c) of Figure 5 shows the treatment coefficients from estimation of equation (1) using the presence of a post office as our outcome variable. The pre- and post-treatment coefficients are very similar to those shown for the likelihood of town settlement: a post office is more likely to exist in locations near newly discovered mining sites compared to other areas, with the highest likelihood of existence occurring at 40 years following discovery. This peak is followed by a relative decline in settlement prospects among treated locations until 80 years out, which is when it rises considerably. While this last result differs from that obtained for towns, we hesitate to emphasize this difference since the coefficients are estimated by comparing only the sample of locations in 1940 that were treated in the 1851–1860 period to their corresponding control locations. In any case, both towns and post offices exhibit a 70-year pattern of rise and decline following treatment.

One episode in the history of post offices is worth mentioning. Many post offices closed due to the Postal Service's introduction of a Rural Free Delivery (RFD) policy in 1902. This policy aimed to provide delivery service to rural residents, which reduced the need for many small post offices distributed across rural areas and encouraged the centralization of postal services in larger branches. Thus, many post offices may have closed beginning around 1900 due to the introduction of RFD rather than the disappearance of towns themselves. However, evidence suggests that post offices that closed due to RFD were often the smallest and least used locations, and thus correlated with local economic activity (Fuller 1972; Hodgson 2018). The rise-and-decline pattern we identify for both towns and post offices supports this interpretation of RFD closures.

We also conduct two robustness checks related to the construction of our sample. First, we conduct our analysis using alternative grid cell sizes: 0.25, 6.25, and 25 km^2. The results, which are shown in Figures A4–A6 in the Online Appendix, are not sensitive to the choice of cell size. Second, we include the entire state of South Dakota rather than just the western half. Expanding the sample to include the eastern portion of the state does not significantly alter the results (see Figure A7 in the Online Appendix).

The findings thus far suggest several things. First, exposed locations share similar settlement trends as non-exposed locations in the years before the discovery of nearby gold and silver mines. This outcome suggests that mining site discoveries were exogenous to town formation. Second, the discovery of mineral resources influenced where population settlements began in the American West: towns were significantly more likely to form in locations near newly discovered mining sites relative to other areas, and this settlement advantage existed at least 70 years. Third, mining activity's effect was extensive but not intensive: it influenced where people settled but did not increase the size of already settled places. Lastly, areas near mining sites experienced mean reversion in the likelihood of settlement over time. This pattern is consistent with the accounts in American history of the rapid appearance and eventual collapse of many western mining towns. The next section explores whether such towns were indeed at greater risk of death due to mining proximity or whether other factors and phenomena explain the relative decline shown in Figure 5.

The Death of Western Mining Towns

The history of the American West would not be complete without the stories of ghost towns dotting the region's landscape as mining sites were exhausted. This outcome was not inevitable for all mining towns, however, as many of them ultimately survived the mining industry's relative decline. For instance, in Montana, the mining town of Bannack reached its peak population of 1,375 people in 1880, but had completely disappeared by the middle of the twentieth century. The gold town of Helena, on the other hand, was settled in the 1860s and continues to thrive as the state's capital city today.

We have shown that settlement of the western frontier was positively related to the discovery of nearby mining sites but that this advantage began to wane 40 years after exposure in a process of mean reversion. Mining activity thus became less and less salient as a focal point for population settlements over time. Why did locations near a mining site experience a decline in the likelihood of having a town? To answer this question, we explore the death of western mining towns through a hazard analysis using place-level data.

Figure 6 motivates our approach by showing the probability of survival and empirical hazard rates across mining and other towns. The figures show that mining towns (i.e., those near mining sites) were less likely to survive over time and that this likelihood fell at a greater rate than it did for other towns. This difference across time can also be seen in panel (b), which shows that the risk of death was always greater for mining towns than it was for other towns, and this also depended on a town's age. For instance, at 40 years of age, a mining town's risk of death stabilized while other towns were increasingly less likely to die until about 50 years after being established. Overall, mining towns were at higher risk of death during this period, which is consistent with our previous results showing a relative decline in the likelihood of town settlement near mining sites over time (see Figure 5).

We consider several possible explanations for, or correlates of, the average mining town's high risk of death seen in Figure 6: poor geography, distance from transportation and the nearest large city, vapid agglomeration economies, and unfavorable demographic characteristics.[12] Geography unsuitable for housing and large-scale development can explain why mining towns died over time at a greater rate than other towns (Burchfield et al. 2006; Saiz 2010). For example, areas at high elevations and featuring rough terrain are more costly to build up with infrastructure than other areas. Another hypothesis is that long distances from transportation or large markets (i.e., big cities) can increase the risk of collapse by constraining growth in productivity and local economies, although studies showing agglomeration shadows suggest that these relationships can be nonlinear (Hodgson 2018; Bosker and Buringh 2017). Nevertheless, railroad construction in the nineteenth century led to urbanization (Atack et al. 2010) and higher agricultural land values (Donaldson and Hornbeck 2016) in places that received access. Smaller population sizes can also increase the likelihood of death by reducing the potential for self-reinforcing agglomeration economies to build over time (Beltrán Tapia, Díez-Minguela, and Martinez-Galarraga 2018). Lastly, certain demographic characteristics may be associated the greater risk of town death among mining towns. As Bazzi, Fiszbein, and Gebresilasse 2020 show, the frontier was disproportionately settled by prime-aged men, which combined with an over-reliance on the mining industry and an unskilled population, may be related to the risk of town death in the long run.

Our approach seeks to identify the channels and correlates of survival through an exploration of the risk that a town died between 1850 and 1940 using a Cox proportional hazard model. We follow a procedure similar to that conducted by Cermeño and Enflo 2019, in

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[12] There are other possible reasons for decline, such as a lack of local investment in roads, schools, and other infrastructure. Unfortunately, data measuring such factors are either sparse or unavailable during our study period.

which the authors aim to identify the factors that explain the persistence of king-established towns in Sweden. We focus on explaining town death as a function of several historical variables that capture our hypothesized channels of survival. To maintain consistency with our event-study sample, we exclude places that were within five miles of a mining site in 1850. Also, places that were first populated in 1940 are excluded since they are not at risk of death in that year. We estimate the following model:

$$h_i(t) = h_0(t) \exp\left(\beta NearSite_i + \delta(NearSite_i \times t) + \mathbf{X}_i\gamma\right) \tag{2}$$

where $h_i(t)$ represents the probability that town i dies at time t, $NearSite_i$ is an indicator equal to one if town i is within five miles of a mining site and zero otherwise, and $\mathbf{X}_i$ includes our channels of influence. The baseline hazard is $h_0(t)$. Variables in $\mathbf{X}_i$ are factors that can shift the hazard rate and are potentially correlated with both mining activity and town lifespans. We also include latitude, longitude, and their interaction throughout, as well as physiographic province and state fixed effects. Standard errors are clustered at the 1940 county level to account for any spatial autocorrelation that occurs among places located within the same county boundaries.[13]

In equation (2), $NearSite$ should capture unobserved differences that explain the risk of death for towns near mining sites compared to those farther away. The question is whether adding controls that account for our channels and correlates of survival changes the values of β and δ or alters their relevance. These parameters reflect the risk of death for towns near mines both initially (β) and over time as they age (δ). We begin with a basic specification and then introduce our hypothesized channels of influence separately to determine the ways in which town death was influenced by factors other than mining. We report hazard ratios for each coefficient to indicate how each factor influences the risk of death among western towns. If the hazard ratios for mining proximity change in meaningful ways as more controls are added, then these other factors explain town decline rather than proximity to a mining site itself.

We include in all specifications latitude, longitude, and their interaction. The vector of control variables that represents the channels of decline includes the following geographic variables: elevation, ruggedness (the standard deviation of elevation in areas within five

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[13] In some cases, towns show gaps in population over time—i.e., register a population in one census year, no population in the next census year, and a population again in subsequent years. We consider towns with such gaps to still exist in the intervening years where no census population is shown. Excluding observations with population gaps from the analysis yields similar—and generally stronger—results. See Table A6 in the Online Appendix.

miles of a town site), (ln) distance to the West Coast, and (ln) distance to the nearest river. For variables measuring distance to transportation and markets, we include (ln) distance to the railroad and (ln) distance to the nearest city with at least ten thousand people. Key population and demographic variables include (ln) population, male share, median age, literacy rate, and mining employment share. Distance to rail and the nearest large city, as well as all demographic variables, are measured in each census year.

Table 1 shows the initial differences in means for our sample, stratified by proximity to the nearest mining site. Summary statistics for distance to rail, distance to the nearest large city, population, and demographic variables represent values in the first year of town existence. The results suggest that significant differences exist between towns near mining sites—i.e., those located within five miles of a mining site at any time in our period of study—and other places. Specifically, compared to towns located far from such sites, those near mining activity were located at higher elevations and in more rugged terrain, were closer to the West Coast and initially farther from rail and large cities, and disproportionately older, male, and mining-dependent. The differences are each statistically significant at the one percent level, which suggests that these factors may contribute to the higher risk of death among mining towns. The table also shows the number of deaths across groups, which support our hypothesis that mining towns experienced higher rates of death as suggested in Figure 5.

Table 2 shows the hazard ratios determined from estimating equation (2). Our basic specification is shown in column (1). The results suggest that, while there is no estimated difference in baseline hazards across mining and other towns, mining towns are at greater risk of death as they age. This outcome is depicted in panel (a) of Figure 6. Column (2) adds fixed effects for state and physiographic province, as well as latitude, longitude, and their interaction. In this specification, towns near mining sites are at roughly 15 percent less risk of death initially, although this advantage erodes over time so that, in total, mining towns gain a lifespan advantage of about 16 years.[14]

Columns (3)–(7) of Table 2 show the results when adding the variables representing our hypothesized channels of influence. Column (3) shows the results when accounting for geographic characteristics. Doing so reduces the magnitude of the proximity hazard ratio considerably: compared to column (2), the baseline risk of death for towns near mining sites is now nearly 28 percent lower than it is for other towns. This outcome suggests

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[14] The duration of the mining advantage is calculated as the ratio of the baseline proximity coefficient to its time-varying interaction coefficient.

that geographic factors help explain why mining towns declined: when accounting for them, mining proximity reduces the baseline hazard considerably. Based on these coefficients, towns near mining sites experienced a lifespan advantage of roughly 30 years compared to other towns with observationally similar geographic characteristics.

Column (4) includes our controls for distance to the railroad and the nearest large city. In this specification, distance to rail does not influence the average western town's risk of death, while isolation from the nearest large city actually reduces this risk. This outcome may be due to big cities attracting people from nearby declining towns, thus leading to their complete abandonment. Both the baseline and time-dependent risks of death for mining towns remain the same as that shown in column (2). Thus, the relatively higher risk of death among mining towns was not due to long distances from rail or a large city.

The specification in column (5) includes population size. Large populations helped reduced the risk of town death, which suggests that towns benefited from agglomeration economies generated by larger populations. Column (6) adds a suite of demographic variables. The results show that towns with older populations were at higher risk of death during this period. Notably, a heavy reliance on the mining industry itself was not an important determinant of town death, which may imply that our mining proximity indicator is picking up much of the variation in mining dependence across western towns. Furthermore, compared to column (2), both the baseline and time-dependent risks of death are reduced for mining towns, which suggests that favorable demographic factors such as younger populations were important in protecting towns from death. The mining advantage when accounting for the demographic variation across towns is almost 26 years.

Lastly, we include in the specification shown in column (7) all controls representing our channels of influence. The results for mining proximity when doing so are stronger than those shown in other specifications: towns near mining sites show a roughly 24 percent lower baseline risk of collapse, which yields a lifespan advantage of 36 years compared to other towns when also considering that their relative risk of death increases by 0.7 percent per year. This outcome suggests that much of the risk of death for mining towns is attributable to geographic and demographic characteristics that negatively influenced their survival and not proximity to mining itself. Our estimated lifespan advantage of 36 years for mining towns is remarkably close to the peak at 40 years in the relative probability of settlement shown in panel (a) of Figure 5. According to the hazard analysis, and consistent with our previous findings, towns were abandoned at a higher rate after this time. Although mining proximity eventually became a liability, it first acted as an early hedge of protection from the risk of collapse.[15]

To ensure that our results are not sensitive to different specifications and approaches, we conduct the following robustness checks as shown in the Online Appendix: including higher order polynomials in latitude and longitude (Table A1); clustering standard errors at other levels such as physiographic province (Table A2), state (Table A3), and census place (Table A4); and using post office closures as a measure of town deaths (Table A5). Results using these different approaches are similar to our main findings, although the baseline and time-dependent risks of death differ in the post office results compared to the census place results. Nevertheless, the general conclusion remains: the risk of death was higher among places near mining sites due at least in part to their relatively poor geography.

We also consider whether certain factors either mitigated or increased the risk of death among mining towns relative to other towns. Figure 7 shows the results of interacting each of our key variables with mining proximity to estimate the baseline risk of each of these characteristics for mining towns.[16] The results show that mining towns located farther from the railroad experienced a lower baseline risk of collapse relative to other towns similarly situated from the railroad. This outcome suggests that mining activity helped insulate towns from collapse through factors other than easy access to rail. All other factors were equally influential across mining and non-mining towns.

To test the hypothesis that individual characteristics of the mining sites themselves may also influence the risk of town death, we interact $NearSite$ in equation (2) with each of the following characteristics of the nearest mine: placer mining site (versus a capital-intensive site), large or medium production site (versus a small site), and production length in years (i.e., years active). While these variables are given in the USGS dataset (U.S. Geological Survey 2005a), the results should be interpreted with caution since information is missing for many observations. Based on this limited sample, there is no evidence that individual mining site characteristics significantly influenced the risk of death for nearby towns (see Figure 7).

The poor geography of mining towns in the American West made them ghost towns over time, while their older populations were also positively associated with their risk of decline. In an unconditional comparison, mining towns show no greater baseline risk of

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[15] One of the main differences between the results in column (7) of Table 2 and those in previous columns is that distance to rail decreases the baseline risk of death among western towns in the full specification. This result may be due to a powerful agglomeration shadow where relatively isolated towns were more likely to survive than those located at intermediate distances from rail (Hodgson 2018).

[16] Only distance to the West Coast, distance to the nearest river, and male share show statistically significant time-varying coefficients. We elect to show results using a simple model of the baseline risk.

death compared to other towns, but nevertheless died at a faster rate the longer they existed. However, when comparing places with similar characteristics, mining towns experienced a significantly smaller baseline risk of death than did other towns, thus giving them a lifespan advantage that lasted almost 40 years on average. This outcome suggests that locations near historical mining sites may still be alive with activity today, a hypothesis that we explore in the next section.

The Long-Run Impact of Historical Mining

We now consider the long-run implications of the dynamic processes we have explored in the previous sections using modern population data at the census block level. This section presents evidence of the long-run influences of historical mining activity and geography, which our results suggest had an outsized influence on the prospects for town survival. We estimate the relationship between proximity to historical mining sites and today's population density, conditional on our full set of geographic variables.

Figure 8 motivates our approach by showing the relationship between average population density—measured as people per square mile—and distance to the nearest gold or silver mining site discovered between 1851 and 1940. Density generally declines with distance to the nearest site, with peaks and valleys occurring at locations very similar to those shown for 1940 population size in Figure 4. While the 1940 and 2010 data are not a perfect comparison, their similar patterns suggest at least two things: 1) the spatial distribution of economic activity has remained fairly stable since 1940, well after employment in the mining industry had reached its nadir; and 2) current agglomeration patterns in the American West are related to a location's proximity to historical mining activity. It is this second relationship we now explore at greater depth.

The population density gradient depicted in Figure 8 does not account for the geographic and location-specific characteristics that are expected to influence population density. To control for these features, we estimate the following model:

$$\ln(Density_{ips}) = \alpha + \beta NearSite_i + \mathbf{X}_i\gamma + \sigma_p + \lambda_s + \epsilon_{ips}, \tag{3}$$

where $Density_{ips}$ refers to population density (people per square mile) in census block i located in physiographic province p and state s, $NearSite_i$ is an indicator equal to one if a block's centroid is within five miles of the nearest historical mining site as of 1940 and zero otherwise, $\mathbf{X}_i$ is a vector of geographic controls, σ_p are physiographic province fixed effects,

λ_s are state fixed effects, and ϵ_{ips} is an error term. We aim to mitigate omitted variables bias by including in $\mathbf{X}_i$ mean elevation, ruggedness (i.e., standard deviation of elevation), (ln) distance to the West Coast, (ln) distance to the nearest river, latitude, longitude, and their interaction. To account for blocks with zero population, we add one to the population level before calculating density and taking its natural logarithm. Since census block boundaries are at least partially constructed to accommodate a certain level of population—and are thus endogenous to population density itself—locations dense in population will naturally have more census blocks than other areas. To account for this phenomenon, we weight estimations of equation (3) with the area of census blocks. Standard errors are clustered at the 2010 county level to account for spatial autocorrelation.

Table 3 shows the results of estimating equation (3) using data on population density from 2010. The coefficient in the basic specification in column (1) is statistically insignificant, which suggests that areas near old mining sites and those farther away are similarly dense with people. The model estimated in column (2) adds to the basic specification controls for latitude, longitude, and their interaction. Accounting for these features also yields a statistically insignificant result.

Column (3) adds to the specification shown in column (2) the following controls: mean elevation, ruggedness, distance to the West Coast, and distance to the nearest river. Compared to blocks located more than five miles away from an old mining site, the average block nearer to these sites is more densely populated when accounting for geographic variation across locations. This result is statistically significant at the one percent level. Additionally, the difference in the mining proximity coefficient between column (2) and column (3) suggests that at least some of our geographic variables are positively correlated with mining site proximity. In particular, since areas near old mining sites are relatively isolated and rugged, each of which reduces density on average, omitting these variables leads β to be negatively biased.

Adding in physiographic province fixed effects, as shown in column (4), yields a similar coefficient to that shown in column (3). Further adding in state fixed effects (column (5)) changes it very little. Based on the specification in column (5), which uses our full set of geographic and location-specific controls, areas near historical mining sites are significantly denser than areas farther away. Columns (6)–(8) show similar results to columns (1), (3), and (5) when estimating equation (3) in levels. This outcome suggests that log-transforming population density does not influence the general results. Based on our most conservative estimate in column (8)—and a weighted mean of 58 people per square mile—areas within five miles of a historical mining site are roughly 35 percent denser on average than areas farther away when accounting for geographic confounders.

We employ a host of robustness checks on our results, which are shown in the Online Appendix. These exercises include using cubic polynomials in latitude and longitude (Table A7), estimating unweighted regressions (Table A8), and using different strategies to estimate standard errors (Table A9). We also consider in Tables A10 and A11 an inverse hyperbolic sine transformation of our dependent variable and estimation of a Poisson model via Chen and Roth 2024. Overall, our findings are not highly sensitive to employing these different approaches and methods.

As mentioned above, one concern with using census blocks as units of analysis is the arbitrary nature of their boundaries. While our weighting scheme helps account for this problem, another approach is to use nighttime light intensity as an alternative measure of economic activity using the grid cells from the first portion of our analysis. The results using mean light intensity as the outcome, shown in Table 4, are very similar to those using population density. Areas near old mining sites are more intensely lighted at night than areas farther away, but only when accounting for geographic characteristics. Thus, we are confident that the density differential estimated across locations is not biased by the way block sizes are determined.[17]

We have shown that, if not for their relatively poor geography, areas near old mining sites in the American West would likely be even more densely populated today. Our results showing the dynamic influence of both historical mining and geography raise an interesting question: when did geography's influence on the region's settlement patterns begin to dominate that of mining? To answer this question, we estimate equation (3) for each census year from 1860–1940 and 2010 where our outcome variable is an indicator for the existence of a census place in a particular grid cell. We estimate both a basic specification and one including geographic controls, noting the difference for each year in the mining proximity coefficients across these specifications. Figure 9 shows the results of this exercise, which suggest that mining proximity played a substantial role throughout the nineteenth century until 1930, at which time the positive effect of such proximity is completely absent unless confounding geographic factors are accounted for. This same result showing the negative influence of poor geography also existed in 1940 and has persisted to 2010. Thus, mining's dominant influence lasted well into the nineteenth century until geography took over as a

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[17] We conduct a host of robustness checks on our nighttime light results. These exercises, which are similar to those conducted for census blocks, yield similar results to those shown in Table 4 and are shown in Tables A12–A14 of the Online Appendix.

dominating influence on the locations of western cities and towns.

Conclusion

This study provides evidence that historical gold and silver mining activity helped determine the locations of cities and towns in the American West. Natural resources attracted migrants to the western frontier, and early on, locations near mining site discoveries were more likely to establish towns than other areas. But many of these sites were eventually exhausted of easily accessible minerals. After roughly 40 years, the average mining town began to show signs of relative decline and eventually disappeared at a greater rate than surrounding towns. We find that the decline of local mining activity itself did not presage the emergence of ghost towns, but rather the poor geography associated with the mining towns themselves. Mining town populations were also older than those of their non-mining counterparts, a characteristic that increased the risk of collapse among western towns. Locations near old mining sites show conditional persistence in the location of economic activity: they are denser today than surrounding areas, but only when accounting for geographic confounders. Thus, both mining activity, through its role in the formation of towns and settlements, and geography, through its influence on town lifespans, have shaped the spatial distribution of economic activity in the region. The discovery of mining sites helped determine the origins and locations of population settlements and geography determined whether they would last.

Even as many mining towns had collapsed by the middle of the twentieth century, the influence of the mining industry over the distribution of population across the American West has not disappeared. Areas near historical mining activity are denser today than those farther away when accounting for confounding geographic characteristics. This conditional persistence could have operated through unobservable sunk investments or through large populations that contributed to the cascading effect of agglomeration economies. While we do not identify the specific mechanisms at work in this study, we have shown that mining site discoveries played a substantial role in determining where populations ultimately settled in the American West.

References

Allcott, Hunt, and Daniel Keniston. 2018. "Dutch Disease or Agglomeration? The Local Economic Effects of Natural Resource Booms in Modern America." *Review of Economic Studies* 85 (2): 695–731.

Andrews, Thomas G. 2008. *Killing for Coal: America's Deadliest Labor War.* Cambridge, Massachusetts: Harvard University Press.

Aragón, Fernando M., and Juan Pablo Rud. 2013. "Natural Resources and Local Communities: Evidence from a Peruvian Gold Mine." *American Economic Journal: Economic Policy* 5 (2): 1–25.

Atack, Jeremy. 2016. *Historical Geographic Information Systems (GIS) Database of U.S. Railroads.*

Atack, Jeremy, Fred Bateman, Michael Haines, and Robert A. Margo. 2010. "Did Railroads Induce or Follow Economic Growth?: Urbanization and Population Growth in the American Midwest, 1850–1860." *Social Science History* 34 (2): 171–197.

Bazzi, Samuel, Martin Fiszbein, and Mesay Gebresilasse. 2020. "Frontier Culture: The Roots and Persistence of "Rugged Individualism" in the United States." *Econometrica* 88 (6): 2329–2368.

Belich, James. 2009. *Replenishing the Earth: The Settler Revolution and the Rise of the Anglo-World, 1783–1939.* New York, New York: Oxford University Press.

Beltrán Tapia, Francisco J., Alfonso Díez-Minguela, and Julio Martinez-Galarraga. 2018. "Tracing the evolution of agglomeration economies: Spain, 1860–1991." *The Journal of Economic History* 78 (1): 81–117.

Berger, Thor, and Kerstin Enflo. 2017. "Locomotives of Local Growth: The Short- and Long-Term Impact of Railroads in Sweden." *Journal of Urban Economics* 98:124–138.

Berkes, Enrico, Ezra Karger, and Peter Nencka. 2023. "The Census Place Project: A Method for Geolocating Unstructured Place Names." *Explorations in Economic History* 87:101477.

Bleakley, Hoyt, and Jeffrey Lin. 2012. "Portage and Path Dependence." *Quarterly Journal of Economics* 127 (2): 587–644.

Blevins, Cameron, and Richard W. Helbock. 2021. *US Post Offices.* https://doi.org/10.7910/DVN/NUKCNA. Harvard Dataverse, V1.

Bosker, Maarten. 2022. "City Origins." *Regional Science and Urban Economics* 94:103677.

Bosker, Maarten, and Eltjo Buringh. 2017. "City Seeds: Geography and the Origins of the European City System." *Journal of Urban Economics* 98:139–157.

Brakman, Steven, Harry Garretsen, and Marc Schramm. 2004. “The Strategic Bombing of German Cities during World War II and its Impact on City Growth.” *Journal of Economic Geography* 4 (2): 201–218.

Brands, H. W. 2010. *American Colossus: The Triumph of Capitalism, 1865–1900.* New York, New York: Doubleday.

Brodeur, Abel, and Joanne Haddad. 2021. “Institutions, Attitudes, and LGBT: Evidence from the Gold Rush.” *Journal of Economic Behavior and Organization* 187:92–110.

Burchfield, Marcy, Henry G. Overman, Diego Puga, and Matthew A. Turner. 2006. “Causes of Sprawl: A Portrait from Space.” *Quarterly Journal of Economics* 121 (2): 587–633.

Callaway, Brantly, and Pedor H.C. Sant’Anna. 2021. “Difference-in-Differences with Multiple Time Periods.” *Journal of Econometrics* 225 (2): 200–230.

Cermeño, Alexandra L., and Kerstin Enflo. 2019. “Can Kings Create Towns that Thrive? The long-term implications of new town foundations.” *Journal of Urban Economics* 112:50–69.

Chen, Jiafeng, and Jonathan Roth. 2024. “Logs with Zeros? Some Problems and Solutions.” *The Quarterly Journal of Economics* 139 (2): 891–936.

Clay, Karen, and Randall Jones. 2008. “Migrating to Riches? Evidence from the California Gold Rush.” *The Journal of Economic History* 68 (4): 997–1031.

Clay, Karen, and Gavin Wright. 2005. “Order Without Law? Property rights during the California gold rush.” *Explorations in Economic History* 42:155–183.

Couttenier, Mathieu, Pauline Grosjean, and Marc Sangnier. 2017. “The Wild West *Is* Wild: The Homicide Resource Curse.” *Journal of the European Economic Association* 15 (3): 558–585.

Curtis, Kent A. 2013. *Gambling on Ore: The Nature of Metal Mining in the United States.* Boulder, Colorado: University Press of Colorado.

Davis, Donald R., and David E. Weinstein. 2002. “Bones, Bombs, and Break Points: The Geography of Economic Activity.” *American Economic Review* 92 (5): 1269–1289.

Donaldson, Dave. 2018. “Railroads of the Raj: Estimating the Impact of Transportation Infrastructure.” *American Economic Review* 108 (4-5): 899–934.

Donaldson, Dave, and Richard Hornbeck. 2016. “Railroads and American Economic Growth: A “Market Access” Approach.” *Quarterly Journal of Economics* 131 (2): 799–858.

Ellison, Glenn, and Edward L. Glaeser. 1999. “The Geographic Concentration of Industry: Does Natural Advantage Explain Agglomeration?” *American Economic Review* 89 (2): 311–316.

Fernihough, Alex, and Kevin Hjortshøj O'Rourke. 2020. "Coal and the Industrial Revolution." *The Economic Journal* 131:1135–1149.

Frymer, Paul. 2017. *Building an American Empire: The Era of Territorial and Political Expansion.* Princeton, New Jersey: Princeton University Press.

Fuller, Wayne E. 1972. "Rural Free Delivery in Hardin County." *The Annals of Iowa* 41 (6): 1049–1072.

Glaeser, Edward L., Sari Pekkala Kerr, and William R. Kerr. 2015. "Entrepreneurship and Urban Growth: An Empirical Assessment with Historical Mines." *The Review of Economics and Statistics* 97 (2): 498–520.

Graves, Philip E., Stephan Weiler, and Emily Elizabeth Tynon. 2009. "The Economics of Ghost Towns." *The Journal of Regional Analysis and Policy* 39 (2): 131–140.

Hahn, Steven. 2016. *A Nation Without Borders: The United States and its World in an Age of Civil Wars, 1830–1910.* New York, New York: Viking.

Hanlon, W. Walker. 2017. "Temporary Shocks and Persistent Effects in Urban Economies: Evidence from British Cities after the U.S. Civil War." *The Review of Economics and Statistics* 99 (1): 67–79.

Henderson, J Vernon, Tim Squires, Adam Storeygard, and David Weil. 2018. "The Global Distribution of Economic Activity: Nature, History, and the Role of Trade." *The Quarterly Journal of Economics* 133 (1): 357–406.

Hodgson, Charles. 2018. "The Effect of Transport Infrastructure on the Location of Economic Activity: Railroads and Post Offices in the American West." *Journal of Urban Economics* 104:59–76.

Immerwahr, Daniel. 2019. *How to Hide an Empire: A History of the Greater United States.* New York, New York: Farrar, Straus / Giroux.

Isenberg, Andrew C. 2005. *Mining California: An Ecological History.* New York, New York: Hill / Wang.

Jacobsen, Grant D., and Dominic P. Parker. 2016. "The Economic Aftermath of Resource Booms: Evidence from Boomtowns in the American West." *The Economic Journal* 126 (593): 1092–1128.

Jedwab, Remi, Edward Kerby, and Alexander Moradi. 2017. "History, Path Dependence and Development: Evidence from Colonial Railroads, Settlers and Cities in Kenya." *The Economic Journal* 127 (603): 1467–1494.

Lecain, Timothy J. 2009. *Mass Destruction: The Men and Giant Mines that Wired America and Saved the Planet.* Brunswick, New Jersey: Rutgers University Press.

Libecap, Gary D. 1978. “Economic Variables and the Development of the Law: The Case of Western Mineral Rights.” *The Journal of Economic History* 38 (2): 338–362.

———. 2007. “The Assignment of Property Rights on the Western Frontier: Lessons for Contemporary Environmental and Resource Policy.” *The Journal of Economic History* 67 (2): 257–291.

Limerick, Patricia Nelson. 2006. *The Legacy of Conquest: The Unbroken Past of the American West.* New York, New York: W.W. Norton / Company.

Lin, Jeffrey. 2015. “The Puzzling Persistence of Place.” *Business Review.*

Madley, Benjamin. 2016. *An American Genocide: The United States and the California Indian Catastrophe, 1846–1873.* New Haven, Connecticut: Yale University Press.

Maloney, William F., and Felipe Valencia Caicedo. 2016. “The Persistence of (Subnational) Fortune.” *The Economic Journal* 126 (598): 2363–2401.

Manson, Steven, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. 2020. *2010 Census SF 1b - PCT HCT Tables.* http://doi.org/10.18128/D050.V15.0. IPUMS National Historical Geographic Information System.

Matheis, Mike. 2016. “Local Economic Impacts of Coal Mining in the United States 1870 to 1970.” *The Journal of Economic History* 76 (4): 1152–1181.

Meinig, D.W. 2000. *The Shaping of America: A Geographical Perspective on 500 Years of History, Volume 3: Transcontinental America, 1850–1915.* New Haven, Connecticut: Yale University Press.

Michaels, Guy. 2011. “The Long Term Consequences of Resource-Based Specialisation.” *The Economic Journal* 121 (551): 31–57.

Miguel, Edward, and Gérard Roland. 2011. “The Long-Run Impact of Bombing Vietnam.” *Journal of Development Economics* 96 (1): 1–15.

Mountford, Benjamin, and Stephen Tuffnell. 2018. *A Global History of Gold Rushes.* California: California University Press.

Nagi, Rajinder. 2014. *Terrain.* Esri’s World Elevation Services [Map].

National Geophysical Data Center. 2003. *Version 2 DMSP-OLS Nighttime Lights Time Series.* NOAA.

Paul, Rodman Wilson. 1974. *Mining Frontiers of the Far West.* Albuquerque, New Mexico: University of New Mexico Press.

Rappaport, Jordan, and Jeffrey D. Sachs. 2003. “The United States as a Coastal Nation.” *Journal of Economic Growth* 8:5–46.

Rohe, Randall. 1986. “Man and the Land: Mining’s Impact in the Far West.” *Arizona and the West* 28 (4): 299–388.

Roth, Jonathan. 2024. “Interpreting Event-Studies from Recent Difference-in-Difference Methods.” *Working paper.*

Ruggles, Steven, Catherine A. Fitch, Ronald Goeken, J. David Hacker, Matt A. Nelson, Evan Roberts, Megan Schouweiler, and Matthew Sobek. 2021. *IPUMS Ancestry Full Count Data: Version 3.0 [dataset].* Minneapolis, MN. http://doi.org/10.18128/D014.V3.0.

Ruggles, Steven, Sarah Flood, Ronald Goeken, Megan Schouweiler, and Matthew Sobek. 2022. *IPUMS USA: Version 12.0 [dataset].* https://doi.org/10.18128/D010.V12.0.

Saiz, Albert. 2010. “The Geographic Determinants of Housing Supply.” *The Quarterly Journal of Economics* 125 (3): 1253–1296.

Sant’Anna, Pedro H.C., and Jun Zhao. 2020. “Doubly Robust Difference-in-Differences Estimators.” *Journal of Econometrics* 219 (1): 101–122.

Schumann, Abel. 2014. “Persistence of Population Shocks: Evidence from the Occupation of West Germany after World War II.” *American Economic Journal: Applied Economics* 6 (3): 189–205.

Silverberg, Robert. 1968. *Ghost Towns of the American West.* Athens, Ohio: Ohio University Press.

U.S. Department of Transportation. 2022. *Navigable Waterway Network Lines.* US DOT: ArcGIS Online.

U.S. Geological Survey. 2005a. *Mineral Resources Data System.* Edition 20160315 [map]. Reston, Virginia. https://mrdata.usgs.gov/mrds/.

———. 2005b. *Mineral Resources Data System.* USGS Science Data Catalog. 3e55bd49-a016-4172-ad78-7292618a08c2.

———. 2011. *US Physiographic Regions.*

Umbeck, John. 1977. “The California Gold Rush: A Study of Emerging Property Rights.” *Explorations in Economic History* 14:197–226.

West, Elliott. 1998. *The Contested Plains: Indians, Goldseekers, and the Rush to Colorado.* Lawrence, Kansas: University Press of Kansas.

———. 1999. “Golden Dreams: Colorado, California, and the Reimagining of America.” *Montana: The Magazine of Western History* 49 (3): 2–11.

White, Richard. 1993. *It’s Your Misfortune and None of My Own: A New History of the American West.* Tulsa, Oklahoma: University of Oklahoma.

White, Richard. 2012. *Railroaded: The Transcontinentals and the Making of Modern America.* New York, New York: W.W. Norton / Company.

Table 1: Summary Statistics and Differences in Means, by Mining Site Proximity

	Mining site proximity: Near (1)	Far (2)	(1) – (2) (3)	*t*-stat (4)
Geography:				
Elevation (feet)	1561.44	1126.10	435.33	16.71
	(671.19)	(693.68)	(26.05)	(0.00)
Ruggedness	189.88	97.61	92.27	29.26
	(87.71)	(83.19)	(3.15)	(0.00)
Distance to West Coast (miles)	398.38	471.22	-72.83	-6.13
	(221.48)	(324.99)	(11.89)	(0.00)
Distance to river (miles)	254.29	250.56	3.73	0.51
	(175.63)	(195.73)	(7.30)	(0.61)
Transportation and city:				
Distance to rail (miles)	108.07	64.05	44.02	7.11
	(217.78)	(156.62)	(6.19)	(0.00)
Distance to city $>$ 10K (miles)	141.02	108.50	32.52	8.60
	(121.59)	(97.42)	(3.78)	(0.00)
Population:				
Population	592	537	55	1.07
	(1977)	(1278)	(52)	(0.29)
Demographics:				
Male	0.71	0.61	0.10	24.78
	(0.14)	(0.10)	(0.00)	(0.00)
Median age	28.5	24.0	4.66	22.33
	(6.0)	(5.5)	(0.21)	(0.00)
Literacy rate	0.93	0.92	0.01	0.80
	(0.14)	(0.17)	(0.01)	(0.42)
Mining employment	0.22	0.03	0.19	42.18
	(0.23)	(0.10)	(0.00)	(0.00)
No. of towns	790	6,495	7,285	
No. of town deaths	423	2,719	3,142	

Notes: In parentheses, standard deviations are reported in columns (1) and (2), standard errors in column (3), and *p*-values in column (4). Summary statistics for distance to rail, distance to city, population, and demographic variables represent values in the first year of town existence. Towns near mining sites are those that were located within five miles of a newly discovered gold or silver site in any year between 1851 and 1930. Towns far from mining sites are those that were more than five miles away from such a site throughout the sample period. Towns that were already exposed to mining in 1850 or were first formed in 1940 are excluded. Ruggedness is defined as the standard deviation of elevation in areas within 5 miles of a mining site. Mining employment and male populations are expressed in shares of total population.

Sources: Berkes, Karger, and Nencka 2023; Ruggles et al. 2021; U.S. Geological Survey 2005a; Atack 2016; Nagi 2014; U.S. Department of Transportation 2022.

Table 2: Hazard Ratios for the Risk of Town Death

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Near mining site	1.082	0.845**	0.722***	0.845**	0.864*	0.766***	0.763***
	(0.091)	(0.065)	(0.056)	(0.066)	(0.066)	(0.063)	(0.061)
Near mining site × time	1.012***	1.011***	1.011***	1.011***	1.007***	1.010***	1.007***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Geography:							
Elevation (thsds. of feet)			1.514***				1.370***
			(0.093)				(0.077)
Ruggedness			1.081***				1.049**
			(0.025)				(0.025)
ln(Distance to West Coast)			0.993				1.011
			(0.040)				(0.040)
ln(Distance to river)			1.052*				1.058*
			(0.031)				(0.031)
Transportation and city:							
ln(Distance to rail)				1.021			0.973**
				(0.014)			(0.014)
ln(Distance to city $>$ 10K)				0.867***			0.812***
				(0.027)			(0.028)
Population:							
ln(Population)					0.728***		0.720***
					(0.013)		(0.013)
Demographics:							
Male						0.963	0.749
						(0.230)	(0.167)
Median age						1.035***	1.007**
						(0.004)	(0.003)
Literacy rate						1.031	0.834*
						(0.122)	(0.090)
Mining employment						0.912	1.069
						(0.140)	(0.161)
Mining advantage (years)	None	16.1***	30.5***	15.8***	21.5***	25.9***	36.2***
		(5.2)	(5.3)	(5.1)	(7.9)	(5.5)	(8.9)
Geographic coordinates		✓	✓	✓	✓	✓	✓
Physiographic province FE		✓	✓	✓	✓	✓	✓
State FE		✓	✓	✓	✓	✓	✓
Log likelihood	-26,689	-26,345	-26,285	-26,327	-26,064	-26,292	-25,972
No. of observations	18,700	18,700	18,700	18,700	18,700	18,700	18,700

Notes: Hazard ratios are shown using exponentiated coefficients from estimation of equation (2). There are 7,285 unique towns in the dataset. The variable 'Near mining site' is an indicator equal to one if a town is located within five miles of a gold or silver mining site and zero otherwise. Towns already exposed to mining in 1850 or that first appear in 1940 are excluded. Geographic coordinates include latitude, longitude, and their interaction. The duration of the mining advantage is calculated as the ratio of the main coefficient for 'Near mining site' to its time-varying interaction coefficient. For more information on variable definitions, see the main text. Standard errors, which are shown in parentheses, are clustered at the 1940 county level. Standard errors for the duration of the mining advantage are calculated using the delta method (nlcom command in Stata). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Sources: U.S. Geological Survey 2011; Berkes, Karger, and Nencka 2023; Ruggles et al. 2021; U.S. Geological Survey 2005a; Atack 2016; Nagi 2014; U.S. Department of Transportation 2022.

Table 3: Today's Population Density Near Historical Mining Sites

	Dependent variable:							
	ln(Population density)					Population density		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Near mining site	-0.115	-0.158	0.639***	0.688***	0.708***	-12.263	32.323***	20.852**
	(0.147)	(0.145)	(0.099)	(0.080)	(0.077)	(12.976)	(11.236)	(10.555)
Geographic coordinates		✓	✓	✓	✓		✓	✓
Geographic controls			✓	✓	✓		✓	✓
Physiographic province FE				✓	✓			✓
State FE					✓			✓
Adjusted R^2	0.000	0.008	0.313	0.351	0.361	0.000	0.033	0.040
No. of observations	2,232,456	2,232,456	2,232,456	2,232,456	2,232,456	2,232,456	2,232,456	2,232,456

Notes: The results are based on estimation of equation (3). Each observation is a census block and regressions are weighted by census block area. The dependent variable in columns (1)–(5) is (ln) population density in 2010 where the value of one is added to the population level before calculating density (people per square mile). The dependent variable in columns (6)–(8) is population density in levels. Blocks within five miles of a mining site discovered by 1940 are considered to be located near a mining site. Geographic coordinates include latitude, longitude, and their interaction. Geographic controls include mean elevation, ruggedness, (ln) distance to the West Coast, and (ln) distance to the nearest river. The mean and standard deviation of population density, weighted by census block area, are 58.19 and 819.80. For more information on variable definitions, see the main text. Standard errors, which are shown in parentheses, are clustered at the 2010 county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Sources: U.S. Geological Survey 2011; Manson et al. 2020; U.S. Geological Survey 2005a; Nagi 2014; U.S. Department of Transportation 2022.

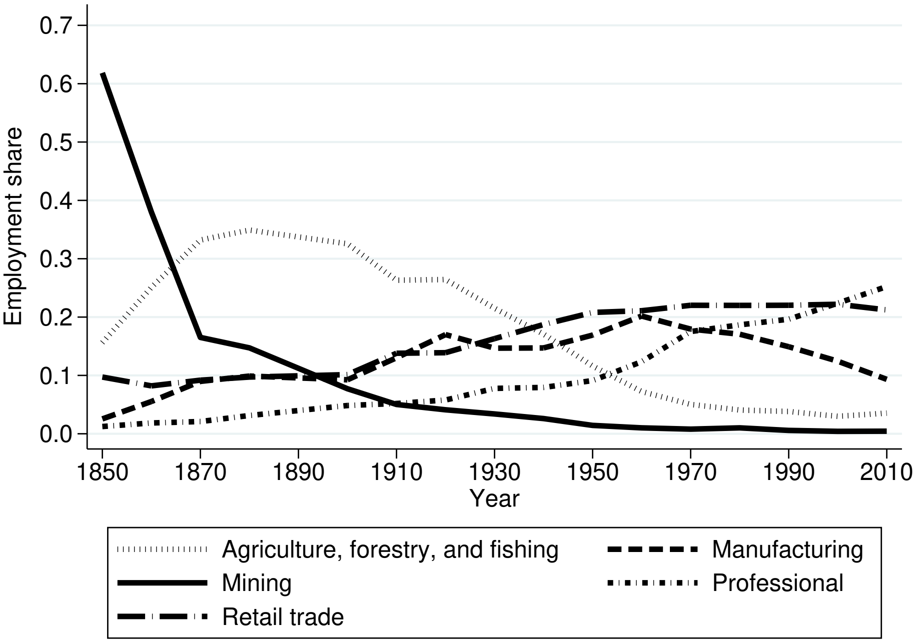
Table 4: Nighttime Light Intensity Near Historical Mining Sites

Independent variable	(1)	(2)	(3)
Near mining site	-0.025	0.055^{***}	0.058^{***}
	(0.020)	(0.018)	(0.016)
Geographic coordinates		✓	✓
Geographic controls		✓	✓
Physiographic province FE			✓
State FE			✓
Adjusted R^2	0.000	0.139	0.185
No. of observations	3,144,856	3,144,856	3,144,856

Notes: The results are based on estimation of equation (3), where the dependent variable is (ln) mean nighttime light intensity in 2010. Each observation is a grid cell that is roughly 1 km^2 in size. Cells within five miles of a mining site discovered by 1940 are considered to be located near a mining site. Geographic coordinates include latitude, longitude, and their interaction. Geographic controls include mean elevation, ruggedness, (ln) distance to the West Coast, and (ln) distance to the nearest river. For more information on variable definitions, see the main text. Standard errors, which are shown in parentheses, are clustered at the 2010 county level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

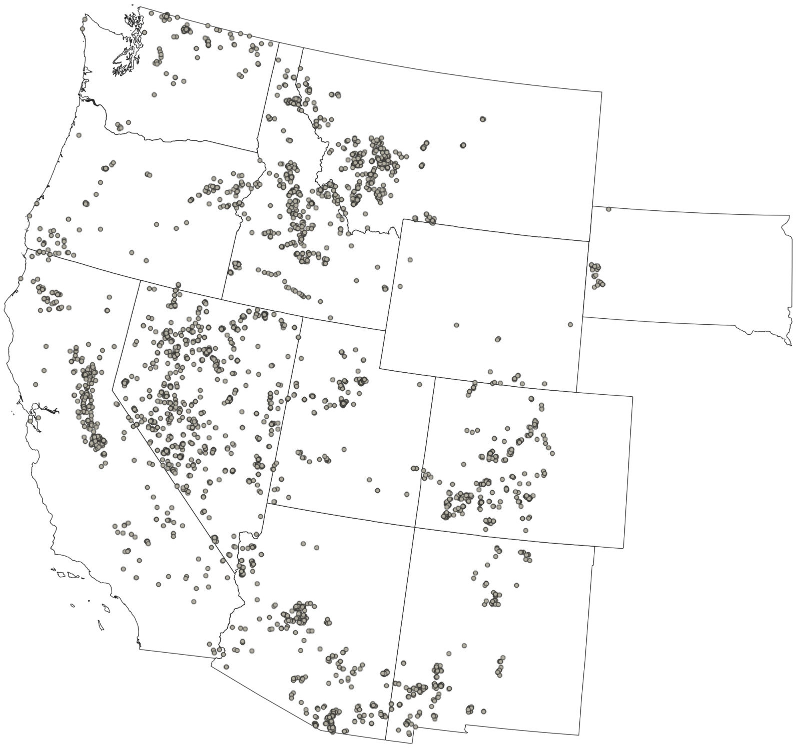
Sources: National Geophysical Data Center 2003; Nagi 2014; U.S. Department of Transportation 2022; U.S. Geological Survey 2011.

Figure 1: Employment in Western States from 1850–2010, by Sector



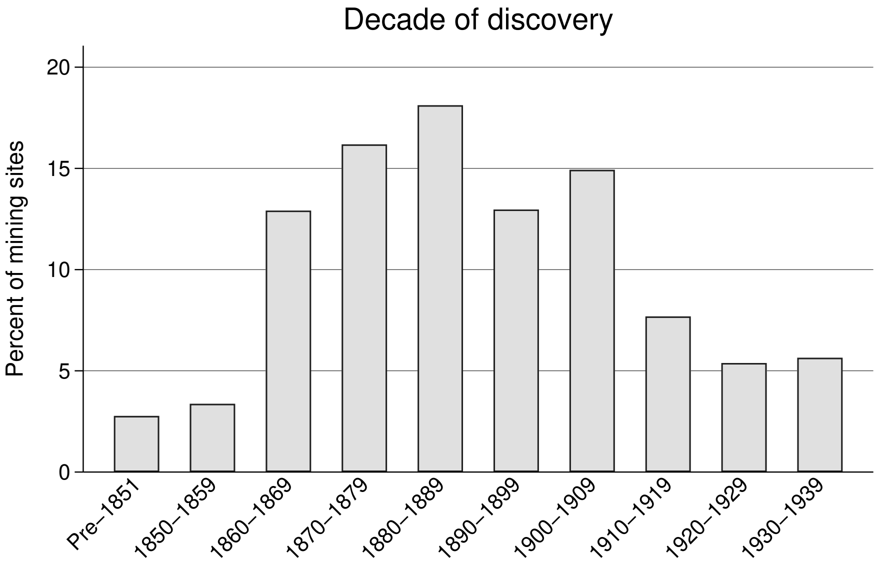
Notes: The figure shows the share of total employment across five economic sectors for the 12 states in the study's sample.
Source: Ruggles et al. 2022.

Figure 2: Gold and Silver Mining Sites Discovered by 1940



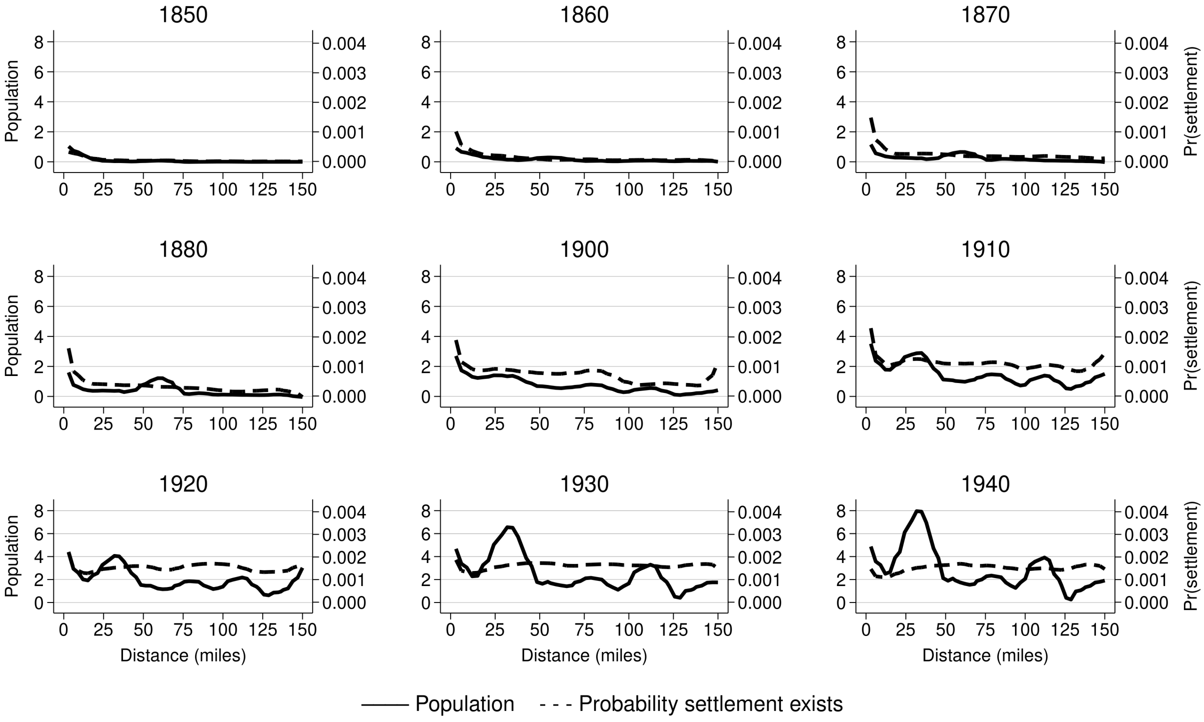
Notes: The figure shows the locations of gold and silver mining sites that were discovered by 1940 for the 12 states in the study's sample.
Source: U.S. Geological Survey 2005a.

Figure 3: Gold and Silver Mining Sites, by Decade of Discovery



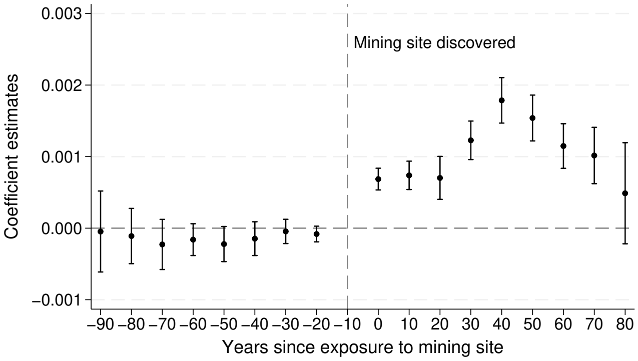
Notes: The figure shows the distribution of discovery dates across 3,824 sites that mined gold or silver before 1941 across the 12 states in the study's sample.
Source: U.S. Geological Survey 2005a.

Figure 4: Population and Distance to Nearest Mining Site, by Census Year

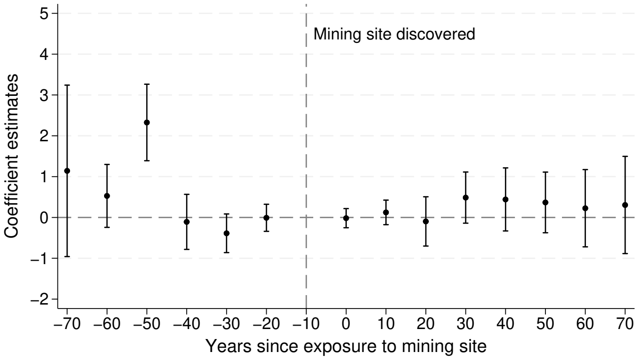


Notes: Each panel displays, for a particular census year, the probability that a settlement exists and its average population size as a function of distance to the nearest gold or silver mining site. The sample consists of all locations (grid cells) within 150 miles of a mining site. A local polynomial regression (order 2) is estimated using Stata's lpoly procedure.
Sources: Berkes, Karger, and Nencka 2023; Ruggles et al. 2021; U.S. Geological Survey 2005a.

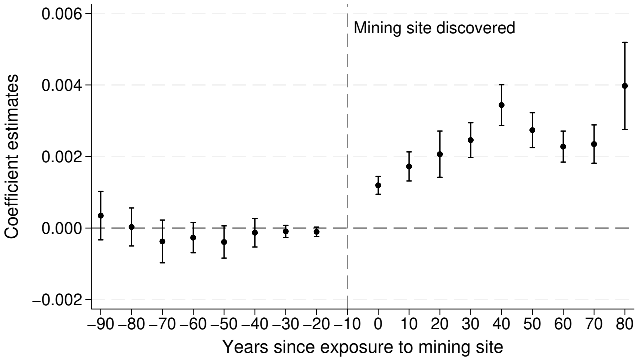
Figure 5: The Impact of Mining Activity on Town Settlement, Population, and Post Office Establishments



(a) Settlement exists



(b) Population size

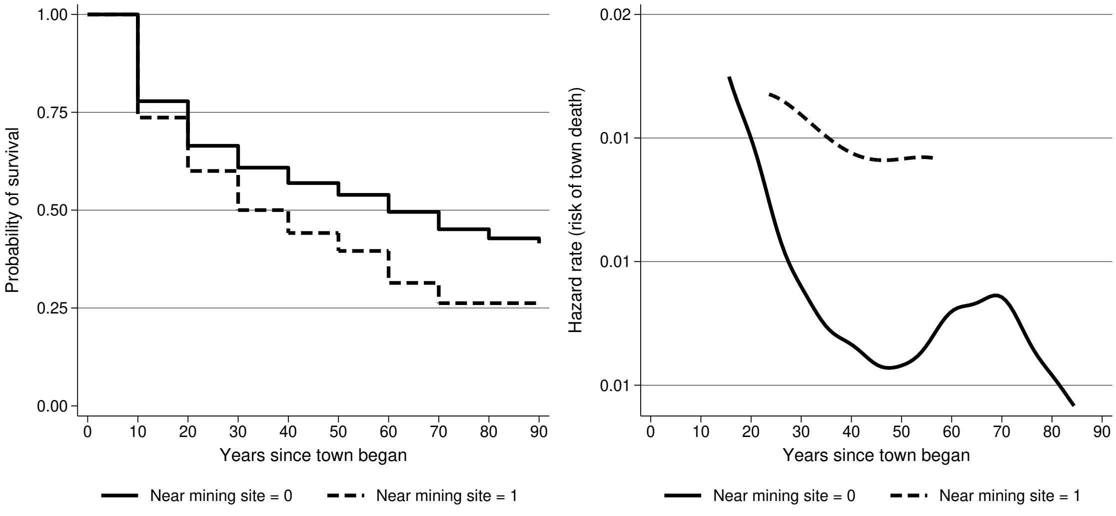


(c) Post office exists

Notes: The figures show the estimated coefficients from equation (1) and 95 percent confidence intervals for the ATT estimated using the methods outlined in Callaway and Sant'Anna 2021. The sample consists of cells that are roughly 1 km^2 in size. The outcome variable is an indicator for presence of a census place in panel (a); ln(population) in panel (b), excluding census places and locations with zero population; and presence of a post office in panel (c). In each case, treatment and control groups are matched based on pre-existing geographic observables (elevation, ruggedness, (ln) distance to West Coast, (ln) distance to nearest river, latitude, longitude, and their interaction). Treatment is measured as a binary indicator for mining site exposure—i.e., being within five miles of a mining site. The date of treatment occurs at $t = -10$; all coefficients are interpreted relative to that date. Standard errors are clustered at the 1940 county level.

Sources: Berkes, Karger, and Nencka 2023; Blevins and Helbock 2021; Ruggles et al. 2021; U.S. Geological Survey 2005a; U.S. Department of Transportation 2022; Nagi 2014.

Figure 6: Probability of Town Survival and the Risk of Town Death, by Mining Site Proximity

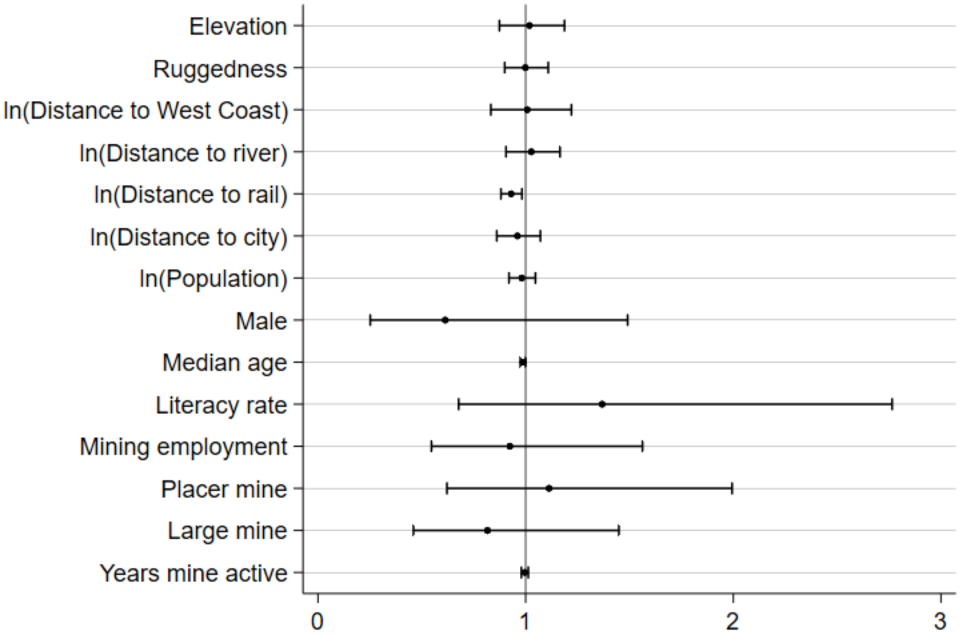


(a) Probability of survival

(b) Empirical hazard rate

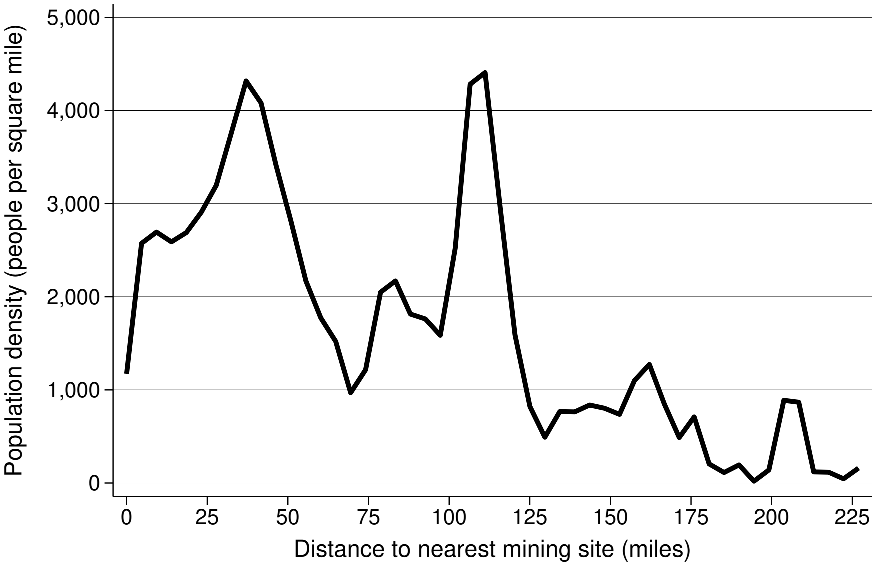
Notes: The figures show the survival probabilities and empirical hazard rates for western towns by proximity to a mining site. Census places are considered to be near a mining site if they are within five miles of a site discovery.
Sources: Berkes, Karger, and Nencka 2023; Ruggles et al. 2021; U.S. Geological Survey 2005a.

Figure 7: Heterogeneous Effects by Mining Site Proximity



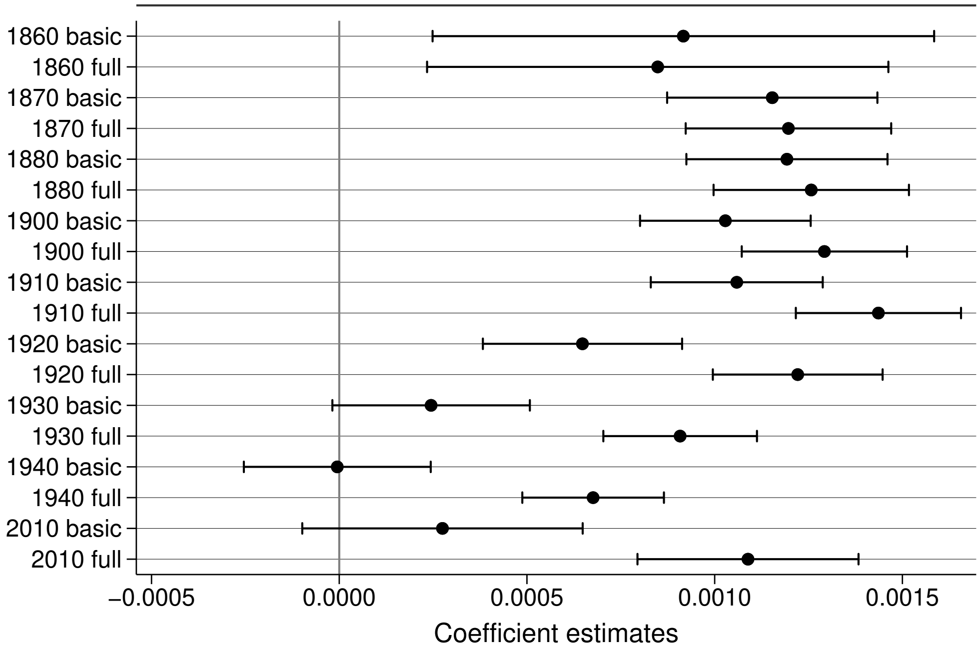
Notes: The figure shows the hazard ratios calculated form an estimation of equation (2) where mining site proximity is interacted with each listed characteristic. Mining site proximity is measured as an indicator equal to one if a census place is within five miles of a mining site and zero otherwise.
Sources: Berkes, Karger, and Nencka 2023; Ruggles et al. 2021; U.S. Geological Survey 2005a; Nagi 2014; U.S. Department of Transportation 2022; Atack 2016; U.S. Geological Survey 2011.

Figure 8: Population Density and Distance to Nearest Historical Mining Site, 2010



Notes: The figure displays the average population density (people per square mile) of census blocks as a function of distance to the nearest historical (1851–1940) gold or silver mining site. The sample consists of all census blocks in 2010. A local polynomial regression (order 2) is estimated using Stata's lpoly procedure. *Sources:* Manson et al. 2020; U.S. Geological Survey 2005a.

Figure 9: Likelihood of Town Settlement Near Historical Mining Sites, 1860–2010



Notes: The figure is based on estimation of equation (3) and shows coefficient estimates for $NearSite$ and 95 percent confidence intervals. The sample consists of all grid-cell locations. The outcome variable is an indicator for the presence of a town (i.e., its coordinates) in a particular cell. The results for both basic and full specifications are shown for each year. The basic specifications include no controls. The full specifications include the following controls: elevation, ruggedness, (ln) distance to West Coast, (ln) distance to nearest river, physiographic province fixed effects, state fixed effects, latitude, longitude, and their interaction. Standard errors are clustered at the 1940 county level for years 1860–1940 and the 2010 county level for 2010.
Sources: Manson et al. 2020; U.S. Geological Survey 2005a; U.S. Department of Transportation 2022; Nagi 2014; U.S. Geological Survey 2011.