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Order without law? Property rights during the California gold rush[☆]

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Abstract

The paper reconsiders the nature of mining districts and property rights during the California gold rush. According to a widely accepted view advanced by Umbeck [Explorations in Economic History 14 (1977) 197; A Theory of Property Rights with Application to the California Gold Rush. Iowa State University Press, Ames, IA, 1981], in the absence of effective legal authority, district codes established secure property rights in mining claims. Such accounts neglect essential aspects of the economic context, specifically that the gold rush approximated an open-access race for a small number of high value deposits. We show that mining district codes gave equal attention to the rights of claim-jumpers as to claim holders, a balance that in practice generated chronic insecurity and litigation. A simple game-theoretic model illustrates stylized features of the situation.

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1. Introduction

The California gold rush is among the most famous chapters of American history, but its economic essence remains ambiguous, implicitly contested by two coexisting views. In the popular perception, a “gold rush” refers to a chaotic scramble for high-profit opportunities in an open-access setting, where the premium is on speed. The academic literature, however, says something quite different. Among law-and-economics specialists, the mining districts of the California gold rush are often cited as canonical examples of the emergence of secure property rights in the absence of legal authority. The mining claim system may be seen as a simple application of the “first possession” principle, where the earliest arrivals secured rights by marking and working a claim ahead of anyone else. The novelty was that miners acted without legal authority. Writing in the tradition of [Demsetz \(1967\)](#), [Umbeck](#) theorized that “as land values rise and population increases, property rights will change from a communal sharing arrangement to private property in which each individual is assigned exclusive rights to a piece of land and all the income derived from it” (1981, p. 48). So effective and legitimate were the mining districts, in the standard narrative, that they persisted long after the arrival of civil government, and their codes and customs ultimately became the basis for American mining law.¹

In a recent contribution, [Zerbe and Anderson \(2001\)](#) advance the discussion by showing that mining district rules were shaped by cultural norms of fairness as well as by marginal costs and benefits. Whereas [Umbeck](#) argued that claim size was dictated by the implicit threat of violence, for example, [Zerbe and Anderson](#) point out that claims were always of equal size for all miners in a district, regardless of their strength or the strength of their group (pp. 128–131). More generally, they argue: “Focal points arose from a common culture in the gold fields that stressed individualism, equality, respect for property, and rewards commensurate to work” (p. 138). However, the cultural themes identified by [Zerbe and Anderson](#) are very broad—Lockean fairness and Jacksonian democracy—and they do not consider how these concepts account for the significant *deviations* between mining district rules and conceptions of property rights that prevailed in other nineteenth century American settings. Comparisons may be drawn with the Midwestern claims clubs, which protected the property of squatters prior to the auction of federal farm land; and with the cattlemen’s associations of the late 19th century, which established and protected grazing rights on the open range, where obtaining legal title to the land itself was infeasible. In both of these cases, the institutions

¹ [Umbeck \(1977, 1981\)](#) and [Shinn \(1885\)](#), for example. [Umbeck’s](#) thesis is accepted by [Ellickson \(1991, p. 246\)](#); [Barzel \(1997, pp. 85–86\)](#); and [Shavell \(2004, pp. 23–24\)](#). [Umbeck](#) is also cited favorably in American economic history textbooks. See [Walton and Rockoff \(1998, pp. 179–180\)](#).

elicited far more member participation in mutual rights enforcement than did mining claims.²

By offering procedural alternatives to violence that were acceptable to a majority of miners in a district, the mining codes did indeed provide order as contrasted with wasteful and destructive conflict. But “order” is not synonymous with secure property rights. In this paper, we argue that the main historical features of mining districts may best be understood by viewing them not as simple enforcers of claim rights, but as institutions for managing access to a non-renewable resource whose precise locations were uncertain, in a high-turnover setting that approximated open access. The mining codes recognized this underlying context and acquiesced in it, by codifying the rights of claim jumpers as well as claim holders, carefully specifying numerous procedures and ongoing actions that were required in order to maintain a claim. Contrary to much common usage, “claim-jumping”—entry onto a marked but unoccupied claim—was not a violation of the rules but a common method of beginning work on a mining site.

Previous interpretations draw upon analogies to production-oriented activities such as farming, neglecting a basic feature of the gold rush context: miners were in a “race” to discover a limited number of high-yield, non-renewable deposits in the Sierra. Typically a miner worked a claim only long enough to determine its potential. If he decided it was a relatively low-value claim—as most were—he continued the search for one of the legendary bonanza sites. Because miners were continually looking for new and better sites even as they worked their present holding, mining district rules were as much concerned with procedures for abandonment and repossession of claims as they were with protection of the rights of existing claimholders.

To investigate this hypothesis, we make use of evidence from the historical record and the insights of game theory. The evidence comes from a number of sources—miners’ diaries, newspapers, court records, and a data set of 147 mining district codes. The codes shed light on the norms that defined access rights, while diaries, newspapers, and court records indicate that mining claims were shakier in practice than they appeared to be on paper. Disputes and litigation persisted despite frequent appeals to the state courts, suggesting that the problem lay with the incentive structure itself, rather than in the institutions of enforcement.

To formalize the analysis, we present a simple game-theoretic model to illustrate two stylized facts from the gold rush mining fields: claim jumping as an equilibrium phenomenon, and the lack of third party enforcement. The model suggests that the institutional structure was shaped by the economic nature of gold-mining, specifically the incentives for mobility implied by the “race” for high-yield sites.

² Although their primary focus is the “cultural hypothesis” rather than the economic effects of the mining codes, Zerbe and Anderson suggest in a concluding paragraph that the mining camps were “remarkably orderly” only until the middle of 1850, after which time “the work rules of the earlier miners no longer sufficed, and indeed proved to be inefficient and litigious” (p. 138). On this reading, the views of Zerbe and Anderson on the functioning of the mining codes may be quite similar to ours. See also Zerbe (2001, pp. 254–266).

As we argue in Section 7, the persistence of race-like conditions is indicated by the sharply spiked time path of gold production, which contrasts with what one would expect in a counterfactual world of private ownership. Other features of California during the 1850s, such as high monthly interest rates and speed-oriented clipper ships, confirm this picture of a society obsessed with time. The underlying reason, we suggest, was the inextricable jointness of production and search in the gold rush era.

2. The gold rush

While working to construct a sawmill on the south fork of the American River in January 1848, James Marshall discovered gold at Sutter's Mill. Less than two weeks later, and without knowledge of the discovery, the United States and Mexico signed the treaty of Guadalupe Hidalgo, ending the Mexican War and ceding California to the United States. News of gold on American territory spread quickly across the country during the second half of 1848, and was confirmed by no less than Presidential authority when James K. Polk included it in his message to Congress in December of that year. As of June 1848, an estimated four to five thousand miners were at work in the gold district. By December 1849, the number had risen to 40,000 on its way to a peak of 100,000 in 1852.³ They came from all regions of the United States, from all walks of life, and from countries all over the world.⁴

Having come to make a fortune and then go home, the time horizon of the mining population was short, especially at first. Studies of population turnover show extraordinarily low rates of geographic persistence among gold rush miners (Mann, 1982, p. 227). The short time horizon is also supported by aggregate statistics. Arrivals by sea are conservatively put at 167,000 from 1849 through 1852; overland migration is less certain, but lower-bound estimates are more than 160,000 over the same period. Total arrivals were as much as 50% larger than the recorded 1852 non-Indian population of 223,856, suggesting that many newcomers had already left.⁵ In part, these patterns simply reflect the composition of the population, almost exclusively young adult males. But high mobility also reflected the transitory economic character of gold mining.

In the first few years, most of the gold was found in so-called *placer* deposits, in loose fragments along river channels, mixed with sand and gravel. Not only was placer gold easily accessible, but the methods of extracting the metal from the gravel were extremely simple, essentially a circular hand method performed by a single

³ These figures come from contemporary estimates, summarized in Paul (1947, p. 43).

⁴ Wright (1940, 1941). Zerbe and Anderson present census data on the birthplaces of the 1850 California population (p. 120), which they interpret as support for the cultural hypothesis (because 75% were from the US and another 15% from Europe).

⁵ Estimates of overland migration are summarized in Wright (1940), p. 342. Passenger arrivals by sea may be found on p. 341. Note that a substantially higher figure for 1849 immigration is presented in the *State Register and Book of Facts* (1857).

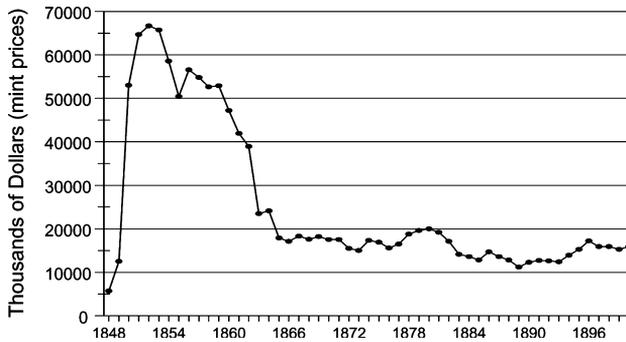


Fig. 1. California gold production 1848–1900. Source: Berry (1984, pp. 74, 76, 78).

man with a pan. Relatively few of the forty-niners had previous mining experience, and beginners readily picked up the panning technique. As early as 1848, however, miners began to make use of a larger machine called a “rocker” or “cradle,” with which three or four men working together could process a larger volume of “dirt” in a day. During the winter of 1849–1950, the “long tom” was first introduced in California. This instrument was an outgrowth of the cradle, but still larger, with two 12-ft sections operated by three to six men, and requiring a continuous stream of water. Thus, from an early point gold mining became more of a small group than a purely individual activity.⁶ Even with the upgrading of equipment, these methods were simple and the fixed capital requirements small, making entry irresistibly attractive to thousands. This attraction is reflected in the rapid growth of gold output between 1849 and 1853 (Fig. 1).

3. Mining in a legal vacuum

No federal mining law was in existence at the time gold was discovered. By another coincidence, Marshall’s discovery came just two years after an important turning point in national minerals policy. Frustrated by widespread non-compliance and fraud in its attempts to gain revenue from lead and copper mines, the federal government abandoned all administrative apparatus and enforcement machinery pertaining to minerals on the public domain in 1846 (Mayer and Riley, 1985, Chapter 2; Wright, 1966).

Moreover, Mexican law was also not in effect. On February 12, 1848—evidently still without knowledge of the gold strike—Colonel James B. Mason (commander of the American military forces) declared: “From and after this date, the Mexican laws

⁶ This paragraph draws on Ostrom (1990, pp. 50–66). Quartz mining began as early as 1849, and enjoyed a speculative boom during 1850–1852, followed by a collapse in 1852–1853. As placer deposits became exhausted, quartz mining gained as a share of the total; but even in the 1860s, 90% of the state’s gold production derived from placers. Ostrom (1990, pp. 286–287).

and customs now prevailing in California, relative to the denouncement of mines, *are hereby abolished*.”⁷ Mason’s intention was to protect private property in land from preemption (“denouncement”) for minerals under Mexican law. The effect, however, was to thwart any attempt to develop private mineral titles using Mexican rules. But having neither authorization nor capacity, Mason put no new system in place, and declined to evict trespassers from the public domain. Over the next three Presidential administrations, proposals were advanced in Congress for a variety of schemes to license, lease or sell mineral lands in California, but none were adopted. Thus, thousands of fortune-seekers raced each other westward, in the belief that gold was free for the taking, subject neither to government control nor to private landownership.

For some months, gold mining went forward under truly wide-open conditions, subject to no regulation of any kind.⁸ This state of affairs could not last, however. Increased population in the mines, particularly after mid-1849, created a demand for some type of allocation system.

The first change was the emergence of the idea of a claim. Legal historian Andrea McDowell shows that concept of a “claim” as an area of land as opposed to a hole in the ground did not become standard until 1849, though there were scattered uses of the term earlier. Within a matter of months, however, some basic rules became widely accepted, which McDowell calls the “common law or customary law of the diggings” (2002, p. 15). Perhaps the most fundamental of these rules was that tools left in a hole indicated that the miner was still actively mining, and so the hole and the immediately adjacent land should not be interfered with.⁹

Soon after the idea of a claim, we see miners meeting to set down rules for a geographic area, the mining district. Umbeck refers to the mining codes as “contracts,” Rousseauvian agreements to foreswear violence for the sake of collective gain. But district rules were not contracts in any standard sense—agreements among a list of signers to respect and enforce each other’s rights.¹⁰ Mining district codes were “laws of the land” for a specified area, rules, and procedures binding on all miners in that district, founding members and newcomers alike. Miners meetings *might* have committed members to contractual obligations, and this alternative might have maintained mutual enforcement more effectively than loosely structured codes. Yet these options were not chosen, nor to our knowledge seriously considered.

⁷ Quoted in Yale (1867, p. 17).

⁸ As Mason wrote in his report of August 17, 1848: “Conflicting claims to particular spots of ground may cause collisions, but they will be rare, as the extent of the country is so great, and the gold so abundant, that for the present there is room and enough for all...” Quoted in Paul (1966, p. 96).

⁹ McDowell quotes from an account by miner Felix Paul Wierzbicki, written in September, 1849: “A tool left in the hole in which a miner is working is a sign that it is not abandoned yet, and that nobody has a right to intrude there, and this regulation, which is adopted by silent consent of all, is generally complied with.”

¹⁰ Libecap (1989, p. 11) extends this usage further, using the term “contracting” to refer not only to private bargaining but also to lobbying activity directed towards politicians and bureaucrats. Both authors mean to include all voluntary efforts to reduce the dissipation of rent. But their use of the term “contract” obscures the distinction between binding commitments by individuals and other forms of collective or political activity.

As one might expect in such a setting, miners drew upon precedent and analogy when establishing these laws. Although the mining districts have long been celebrated as expressions of the Anglo-Saxon “instinct for self-government,” early observers were well aware of the influence of Mexican mining law. Lawyer Henry Halleck wrote in 1860:

The miners of California have generally adopted as being best suited to their particular wants, the main principles of the mining laws of Spain and Mexico, by which the right of property in mines is made to depend upon *discovery* and *development*; that is, *discovery* is made the source of title, and *development*, or working, the condition of continuance of that title. These two principles constitute the basis of all our local laws and regulations respecting mining rights (Halleck, 1860, p. v).

In his 1867 treatise on mining law, Gregory Yale similarly argued that the role of American ingenuity in designing the codes had been exaggerated, in that most rules and customs were “easily recognized” from earlier mining traditions, primarily the Spanish-American system that had grown up under the ordinances of New Spain. The doctrine that claims must be worked or were subject to forfeiture, for example, was “precisely the principle of the *Ordenanzas de Minería*.” (Yale, 1867, pp. 58, 66). Mexicans were by no means dominant at the early miners meetings, but their concepts may have had disproportionate influence (as they did in matters of technique), because they had more experience in mining than most of the newcomers.¹¹

It is not necessary, however, to view the mining codes as alien to US cultural values. As Zerbe and Anderson note, the first-come, first-served rule had strong salience as a fairness norm (pp. 133–135). Assigning ownership on the basis of “first possession” is a longstanding principle in Anglo-American common law (Lueck, 1998). Nowhere was this dictum more vividly on display than in the settlement of American public lands in the nineteenth century. The Preemption Act of 1841 (culminating a long history of “special” preemption acts) virtually institutionalized the practice of “squatting” (establishing a claim by occupancy) and the principle that family-size plots would be provided to those meeting settlement and improvement conditions. These analogies were frequently noted in gold rush discussions.¹² Elements of a typical mining district code closely paralleled those of Midwestern Claim Clubs agreements, pertaining to public land that had not yet been put up for sale: the size of claims; directions for marking, registering, and transferring claims; and procedures for settling disputes over contested claims (Bogue, 1958, p. 236).

Although the analogy to farmland informed the design of the miners’ codes, the effects in the two cases were quite different. Whereas squatters’ rights and preemption rights were intermediaries on the path to fully established ownership rights, such an

¹¹ Some of the Americans had participated in earlier gold rushes in the Southern Appalachians. But their numbers could only have been a small part of the total, and there is no record of mining districts in these cases, most of which took place on privately owned land. See Young (1982, pp. 373–392) and Williams (1993, pp. 50–54, 78–83).

¹² Ellison (1926). See also the discussion in Libecap (1989, pp. 34–36).

evolution did not occur in the gold mining districts. In understanding this divergence, one clue lies in a third widely accepted norm found in nearly all the early mining codes, the requirement that a claim must be worked to be maintained. Though ostensibly only a logical extension of preemption-homestead principles (limiting rights to bona fide settlers), work rules in gold mining compelled districts (and later the courts) to define “work,” and to identify legitimate reasons for non-work (such as illness and lack of water), thereby generating an endless stream of disputes and litigation. The system had some resemblance to the common-law doctrine of “adverse possession,” according to which property can be occupied and claimed if the original owner does not take active steps to evict trespassers (Lueck, 1995, pp. 415–416). But on the spectrum between secure property rights and use-it-or-lose-it, the mining codes were at an extreme end in favor of the latter. Any slacking of effort on the miner’s part exposed him to charges of having abandoned the claim. Prior occupation was not sufficient to repossess a claim: the plaintiff also had to demonstrate that he had in fact complied with district work rules. Otherwise, the claim was liable to be “jumped,” a standard procedure for entry into gold mining, one which was legitimated by the mining codes.

We suggest that the main historical features of mining districts may best be understood by viewing them as institutions for managing access to mining sites, in a high-turnover setting that approximated open access. As McDowell notes, participation in miners’ meetings was not restricted to claimholders.¹³ Typically the codes begin with an announcement such as: “At a meeting of the miners of Union Quartz Mountain, held this 30th day of February 1851... the following Rules and Regulations were unanimously adopted” (1880 Census Report, p. 332). We cannot recover the internal politics of these early meetings with any precision, but if the group were divided between claimholders and latecomers without claims, it seems apparent that the only way to secure the votes of the latter was to assure them that the early arriv-ers would not be allowed to appropriate the entire district indefinitely. Both the provisions of the codes and their operation in practice suggest that the primary objective was not to strengthen the security of *existing* claims, but to place reasonable *limits* on those claims by setting explicit standards to be met for an incumbent to retain a claim against new arrivals.

But McDowell advances a subtler argument. She suggests that whether they held claims or not at a point in time, miners operated behind a Rawlsian “veil of ignorance,” visualizing themselves as claim-jumpers as easily as claim protectors (2002, pp. 5–7, 23–31). We interpret this proposition as reflecting the pervasiveness of the

¹³ A referee has called our attention to some possible exceptions to this statement. The 1856 codes for both Little Humbug Creek and Maine Little Humbug state: “No person shall have voice or vote in a miners meeting or at arbitration that occurs in this mining District except he either holds a claim or is working in this mining district” (1880 Census, pp. 291, 292). We interpret this as an exclusion of non-miners, but not a restriction to claimholders. The Empire Hill code was extended by one year “at a meeting held pursuant to a call by the claim holders” (1880 Census, p. 343); but the report of the next year’s meeting uses the customary phrase, “a meeting of the miners.” The only true documented case seems to be the Illinoistown quartz district code of March, 1863, which barred non-claimholders from *future* meetings (1880 Census, pp. 310–311).

“search” and “race” aspects of gold mining. The key difference between mining districts and claims clubs or cattlemen’s associations lay in the fact that gold mining was a race to find a small number of high payoff claims. To be sure, “search” activity was inseparable from “production,” because only by the hard work of digging and sluicing could a miner-pro prospector learn whether a particular location was worth pursuing or not. Meanwhile, the “race” aspect was intensified by the keen awareness that high-yield gold sites were limited, gold was depletable, and many others were looking for the same limited number of deposits. If these features of the situation were paramount, it is perhaps understandable that mining district codes made relatively little attempt to exclude new entrants and favor incumbents. In essence, they acquiesced in the high-turnover state of affairs and focused instead on prescribing rules for the orderly turnover of mining sites.

4. Mining district rules

To document this hypothesis, we have assembled a data set of surviving mining district codes.¹⁴ Thus far, we have located codes for 147 mining districts from the period 1849–1880.¹⁵ Contemporary reports indicate that there were 141 mining districts by the time California became a state in September 1850, and 500 mining districts by 1866.¹⁶ This suggests that our data set includes roughly 30% of all mining district codes. Fig. 2 shows, however, that the set contains almost exclusively codes written after statehood. This timing reflects both the absence of printing presses in California before 1850 and the fact that later codes were more likely to survive. Because we are interested in early mining districts, we concentrate here on 52 codes written between 1850 and 1852.

Even from a cursory reading, it is evident that the codes devoted as much or more attention to restrictions and requirements on claim holders as to protecting their rights. For example: the code for the Poverty Hill, Yorktown and Chili Camp in Tuolumne County, adopted September 6th, 1851, contains nine articles. Two of these place size limits on claims; two restrict the number of claims that may be held; another sets down stringent marking procedures; and two others require that the miner be present and working the claim if water is available.¹⁷ These rules hardly

¹⁴ Many of these were collected for the 1880 Census Report on Precious Metals (Volume 14). We have assembled the rest of the set from county histories, newspapers and surviving documents. A full list of codes and sources is available on request.

¹⁵ In his study of mining districts, Umbeck compiled a data set of 106 placer district constitutions and 74 quartz district codes. For comparison, our data set comprises 95 placer districts and 66 quartz districts. The difference between the two data sets is attributable to the incompleteness of Umbeck’s citations and the fact that some references did not include the full text. These gaps prevented us from using 29 of his codes. Our data set does include 10 codes that do not appear in Umbeck’s data set.

¹⁶ The estimate of 141 codes as of September, 1850, appears in Rodman (1909, p. 88). The estimate of 500 as of 1866 appears in Browne and Taylor (1867, p. 226).

¹⁷ The code is recorded in the *Miners & Business Men’s Directory* (1856). The remaining articles provide for exceptions when a person discovers a new lead, or when a claim is located on a ditch or ravine that has formerly been worked. In the latter case, ditch digging can qualify as labor sufficient to hold the claim.

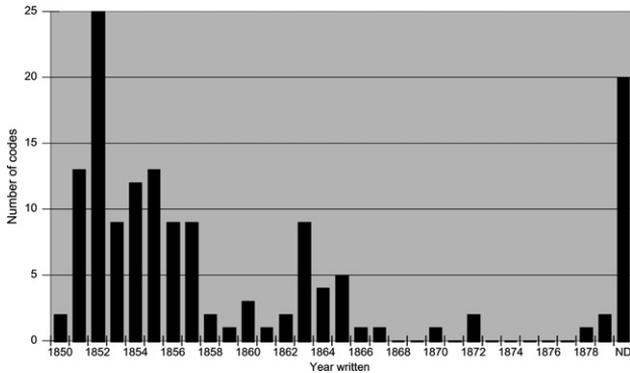


Fig. 2. Sample mining district codes.

qualify as a pledge of mutual protection by property owners. But in the gold rush context, they can be understood as a codification of the rights of a larger group of would-be claimants.

To be sure, mining codes varied in the extent to which they favored claim holders as opposed to prospective jumpers. One of the oldest surviving codes, for the Gold Mountain Mining District in Nevada County (passed December 30, 1850) might be considered “pro-holder,” because it allowed claims to be held without tools being left or work being done until the first day of April 1851, and because it provided stiff penalties (forfeiture of all “rights upon the mountain”) for anyone who “takes away or uses tools of another without permission,” or who “throws dirt or rock upon the claim of another.” Apparently influence had swung to the other side a year later, however, because the revised version required that claims be recorded by October 1851 “on pain of forfeiture” and severely tightened the rules for marking a claim.¹⁸

We tabulated the attributes most frequently found in our sample of 52 early codes (Table 1). It may be seen that restrictions on property rights lead the list. Limits on claim size and number (most commonly, one claim held by occupation), as well as work requirements, were nearly universal. A majority of the codes specified procedures for marking and recording a claim, as well as for sale or transfer. For the most part, however, these early codes were sparse and incomplete, covering only a subset of what might be considered the basic elements of a mining claim system. Our interpretation of this truncation is that the codes were understood as addenda, supplementary to the customs and usages that prevailed more generally. Indirect references to recording or work requirements suggest that such conventions often prevailed on matters that were not explicitly covered. When disputes were taken to court (as discussed in the next section), judges typically referred to ‘customs and usages of miners’ as well as to ‘regulations’ as a basis for adjudication.

¹⁸ “[E]very claim shall have a center stake driven upon it, which shall be three and a half inches in width by one in thickness of the length of two feet and which must be driven at least one half of its length into the ground.” US Census (1880, p. 331).

Table 1
Summary statistics for 52 codes from 1850 through 1852

Attribute	Number with given attribute
Claim size	52
# Claims hold by occupation	47
Work requirements	42
Existence of a recorder	42
Allowance for sale/transfer	36
Requires that claim be recorded	33
Marking claim	30
Dispute resolution	24
Allows claims by company	12
Bonus for discovery	10
Boundaries of mining district	9
Exceptions for working	8
Restrictions on foreign miners	8
Defines claim abandonment	4
Property rights in water	3
Property rights in additional land	3
Rules for calling meetings	2
Rules for changing rules	1

In one sense, this analysis supports Zerbe and Anderson's view that powerful shared cultural norms worked to preserve order in the gold fields. But the documents do not support the assertion that mining districts were examples of well-functioning participatory local democracy. Disputes over claims were sure to arise, because of the need to determine whether work rules had been satisfied. Yet only 24 codes specified how disputes would be resolved, and several of these implied that district-level procedures were not expected to be final.¹⁹ "Political" rules that would be basic in an ongoing democracy (rules for calling meetings or rules for changing rules) were rarely included. None of the codes committed miners to mutual enforcement, as indeed would have been difficult because districts did not specify the identity of their memberships. In many cases, locally drafted rules simply atrophied. For example, the preamble to the Magalia mining district constitution stated that "the Old laws of this District have been long since lost and abrogated by the custom and usage of miners," suggesting that mining there had been governed more by custom and usage rather than by the district code.²⁰ As a result, relatively few of the mining districts compiled anything resembling the continuous political record that one would expect to find in a democratic entity.

In Tables 2–4, we track variations in mining codes by time period (1850–1852, 1853–1856, and 1857 onward) and mining type (placer versus quartz). Work requirements were nearly as standard as limits on claim size, and in fact became more

¹⁹ The rules for the Columbia Mining District (considered by Browne and Taylor to be "as good as any in the State") describe an arbitration procedure that concludes, "leaving the defeated parties to appeal to the Courts if they shall see fit to do so." Browne and Taylor (1867, pp. 238–240).

²⁰ US Census (1880, vol. 14, p. 323). No date is given for adoption of the new rules.

Table 2
Changes in code attributes by period (%)

Attribute	1850–1852	1853–1856	1857 and after
Number of codes	52	56	115
<i>Percentage of codes with attribute</i>			
Claim size	100	96.4	95.7
Claims hold by occupation	90.4	85.7	91.3
Work requirements	80.8	85.7	92.2 ^b
Exceptions to work requirements	15.4	51.8 ^a	42.6 ^b
Define abandonment	7.7	23.2 ^a	33.0 ^b
Allowance for sale/transfer	69.2	83.9	66.1
Allows claim by company	23.1	53.6 ^a	72.2 ^b
Bonus for discovery	19.3	28.6	55.6 ^b
Boundaries of mining district	17.3	55.4 ^a	78.3 ^b
Existence of a recorder	80.8	53.6 ^a	79.1
Dispute resolution	46.2	35.7	20.0 ^b
Rules for calling meetings	3.8	10.7	28.7 ^b
Rules for changing rules	1.9	12.5 ^a	17.4 ^b

^a Significantly different from 1850 to 1852 at 5% confidence (two-sample *t* test with unequal variance).

^b Significantly different from 1850 to 1856 at 5% confidence (two-sample *t* test with unequal variance).

Table 3
Code attributes by type of mining (%)

Attribute	Placer	Quartz	Quartz/mixed
Number of codes	81	80	116
<i>Percentage of codes with attribute</i>			
Claim size	98.8	96.3	95.7
# Claims hold by occupation	91.4	86.3	87.9
Work requirements	86.4	86.2	88.8
Exceptions to Work Requirements	50.6	8.8 ^a	24.1 ^a
Define abandonment	22.2	18.8	25.9
Allowance for sale/transfer	92.6	46.3 ^a	50.9 ^a
Allows claim by company	53.1	47.5	56.0
Bonus for discovery	17.3	51.3 ^a	62.1 ^a
Boundaries of mining district	60.5	42.5 ^a	57.7
Existence of a recorder	67.9	77.5	81.0 ^a
Dispute resolution	45.7	23.8 ^a	17.2 ^a
Rules for calling meetings	17.3	18.8	19.8
Rules for changing rules	9.9	13.8	13.8
Property rights in water	25.9	2.5 ^a	3.4 ^a
Property rights in land	27.2	5.0 ^a	6.0 ^a

Note. Quartz/mixed contains quartz districts plus those that have both placer and quartz.

^a Significantly different from Placer at 5% confidence (two-sample *t* test with unequal variance).

prevalent over time in both placer and quartz districts. The view that work requirements were the primary locus of disputes and litigation is supported by the rising incidence of exceptions to these requirements in the codes, primarily in placer districts. One also observes an increase in the number of codes that contain explicit def-

Table 4
Code attributes by mining type and period (%)

Attribute	Placer 1850–1856	Placer 1857 →	Quartz 1850–1856	Quartz 1857→
Number of codes	39	42	40	40
<i>Percentage of codes with attribute</i>				
Claim size	100	97.6	97.5	95.0
# Claims hold by occupation	92.3	90.5	80.0	92.5
Work requirements	82.1	90.5	80.0	92.5
Exceptions to work requirements	38.5	61.9 ^a	7.5	10.0
Define abandonment	15.4	28.6	10.0	27.5 ^a
Allowance for sale/transfer	94.9	90.5	52.5	40.0
Allows claim by company	30.8	73.8 ^a	27.5	67.5 ^a
Bonus for discovery	17.9	16.7	32.5	70.0 ^a
Boundaries of mining district	46.2	73.8	15.0	70.0 ^a
Existence of a recorder	66.7	69.0	75.0	80.0
Dispute resolution	56.4	35.7 ^a	27.5	20.0
Rules for calling meetings	5.1	28.6 ^a	2.5	35.0 ^a
Rules for changing rules	7.7	11.9	2.5	25.0 ^a
Property rights in water	17.9	33.3	5.0	0
Property rights in land	12.8	40.5 ^a	5.0	5.0

^a Significantly different from 1850 to 1856 at 5% confidence (two-sample *t* test with unequal variance).

initions of abandonment. In themselves, defining exceptions and abandonment could make claim-jumping either easier or harder. What we can say is that these rules were continuing objects of attention.

In both placer and quartz districts, a rising share of the codes provided explicitly for claim holdings by “companies,” or groups of miners, reflecting the rising scale of mining operations; a majority contained such provisions by the mid 1850s. The contrast between placer and quartz codes, however, is also interesting. Because quartz mining was more capital-intensive and less dependent on the availability of water, we find fewer exceptions to work rules and virtually no attempt to define rights to water in quartz districts. On the other hand, whereas the bonus for new discoveries appeared in only a minority of placer districts, by 1857 such an incentive was offered by 70% of quartz districts. Presumably the disparity reflected greater externalities or interconnectedness in quartz seams as opposed to placer sites, as well as the rising difficulty of locating rich new deposits over time.

In broad terms, these patterns confirm Umbeck’s view that mining codes adapted to the circumstances of local mining districts. Some trends, such as the greater attention to defining district boundaries, were common to both placer and quartz districts, perhaps reflecting greater uniformity statewide.²¹ Others, such as exceptions to work requirements, allowance for sale or transfer, and rights to water, were much

²¹ Writing in 1867, Yale stated that “these customs and usages have, in progress of time, become more general and uniform; and their leading features are now the same throughout the mining regions of the State” (p. 62).

more prevalent in placer districts, presumably because of the difficulty of satisfying work rules (conversely, the ease of claim-jumping) in placer mining. But to the extent that one may infer behavior from the prevalence of rules to deal with that behavior, these tabulations do not imply that the rights of claim holders relative to claim jumpers became clearer or more secure over time. As we argue in the next section, such a proposition is far from evident, even as miners turned to the state courts for assistance in settling disputes over mining claims.

5. Property rights in practice

Both customary usage and district rules struck a balance between the rights of claimholders and the rights of searchers. Understanding this mutuality of purpose helps to explain why property rights in gold mining claims were even less secure in practice than one might infer from the codified rules themselves. This insecurity arose both from ambiguity in the rules and from failure to enforce the rules. Because ambiguity created the need for dispute resolution and enforcement of the outcome, both are about enforcement.

Enforcement was important, because it provided incentives to obey the rules. Enforcement can happen at one of three levels—first party, second party, or third party. Under first party enforcement, the person punishes himself through feelings of guilt. Unfortunately, this mechanism is inherently unobservable. Under second party enforcement, the person hurt by a violation punishes the violator. Thus, the second party would be the miner whose property rights were threatened. Under third party enforcement, others not directly affected by the violation punish the violator. Third party could be the state in the person of, say, the justice of the peace. Or the third party could be other miners, either officially constituted by the district or acting independently. At each level, the threat of punishment provides individuals with incentives to comply with rules or norms (Ellickson, 1991, Chapter 7).

In a sense all miners had an interest in rule enforcement, and one might have expected that informal methods could be effective, even where formal mechanisms did not. But third-party enforcement was essentially a public good, and suffered from classic problems of under-supply and free-riding.²² Thus, miners often had to fight or risk losing their claims.²³

“Claim jumping” simply means that a miner began work on a previously claimed site. Whereas “claim jumper” was a fighting word on Iowa farmland, mining district

²² Peter Decker recorded the following in his diary for April 23, 1850: “Armstrong of Hewley Company turning the river above came with a black eye requesting our presence in the Bar to see justice done between his company and claimants on Frenchmans Bar concerning a river claim. Seeing many other miners go did not deem move necessary and continued work.” Giffen (1966).

²³ In 1851 an American miner recorded a typical example of second party enforcement. He and his friends were mining, and another group of miners tried to jump part of the claim. After tense discussions, all avowed that they would return the next day, and if necessary fight. Fortunately, the next day “the other parties did not appear.” McKeeby (1924, p. 146).

codes explicitly condoned both the term and the practice.²⁴ According to Yale's summary of miners' law:

Any individual who is satisfied that the rules have been violated, and that the claimant has worked a forfeiture, may proceed to enter the claim according to the rules, and take possession of the claim upon notice. In mining parlance, the claim is *jumpable*.²⁵

In January 1851, one miner wrote from Yuba River, "Much jumping of claims and difficulty about claim regulations" (Giffen, 1966, p. 251). In 1850, a miner recorded in his diary: "We therefore laid claim to some ground in the creek that had already been worked by others." Another miner appeared and explained the reasons why he had not been working his claim. The next day, seeing that they were outnumbered, the writer and his friend left peaceably.²⁶ As a form of enforcement for rules regarding marking and working claims, jumping may have increased the overall degree of compliance to these rules. But it often meant that even a miner whose claim was entirely legitimate had to stay on the site almost full time to avoid the risk of jumping, which would embroil him in a potentially costly dispute and jeopardize the claim.

Enforcement problems were especially severe for foreigners. Some codes placed explicit restrictions on claims by non-citizens (8 of 52 in Table 1), providing legal pretext for dispossession. For instance, in April 1849 Americans attacked Chilean, Mexican, and Peruvian miners on the American River, taking their claims (Nilan, 1999, Chapter 3). Chinese miners were common targets, especially after enactment of the state Foreign Miners Tax in 1850 (Langworthy, 1932, p. 159; Markus, 1979, Chapter 1). In January 1851 a miner recorded in his diary that Americans had driven two parties, one of Mexicans and one of Frenchmen, off valuable claims in Bear Valley (Canfield, 1920, pp. 42–44). Fortunately for the Frenchmen, some concerned miners rallied and put them back in possession of their claims—a rare example of third-party enforcement.

When third party intervention did take place, the miners did not always perceive the outcome as fair or legitimate. One miner who was involved in a dispute noted that on the day of arbitration, his opponents brought dozens of miners with them. "I had only a few friends with me, and they advised me not to submit my case to them to be determined by a majority vote; so I refused to arbitrate before that crowd" (McKeeby, 1924, pp. 148–149).

²⁴ For example, Article 11 of the Lone Star District By Laws reads: "Any person jumping or taking possession of any claim (forfeited for not complying with the laws on recording or the laws on labor) and fulfilling the requirements of the Art 5 on recording and articles 8 and 9 on labour shall be considered and will be the owner of the claim." Bancroft MSS C-A 293, vol. 5.

²⁵ Yale (1867, p. 81). Italics in original.

²⁶ McKeeby (1924, pp. 130–131). A newcomer could also help his case by removing sticks or stones that marked the boundary. An 1852 editorial in the *Sonora Herald* indicated that "Hundreds of such cases yearly occur in reference to mining claims." *Sonora Herald*, October 23, 1852 as cited in Martinez and Drummond (1936, p. 30).

Contemporary public debate clearly recognized the insecurity and instability of the claim system. As an 1852 editorial in the *Sonora Herald* put it: “Miners, intelligent, practical miners may prate till they are hoarse of the insecurity of title.”²⁷ Another editor complained “that every good claim has to pay toll to the legal profession and that every two or three claims supported at least one lawyer.”²⁸ The widespread reported hostility to lawyers in the gold camps suggests that a fair number of people earned their living in this occupation at the time.²⁹ Despite the ostensible clarity and simplicity of the system, therefore, miners who held valuable claims had to devote extensive energies to protecting their rights against jumping and other forms of intrusion.³⁰

These difficulties undoubtedly account for the rising participation of the California courts in mining disputes. Even before their jurisdiction became official in 1851, state courts were being asked to resolve mining disputes.³¹ Surviving court records from this early period are rare. Fortunately, the Tuolumne County archives contain some County and District court cases from the term of 1850. Mining disputes appeared frequently, and we found no indication that these appeals were considered out of order or inappropriate.³²

Table 5 shows that more than one hundred mining-related cases reached the State Supreme Court prior to the first federal mining law in 1866. State Supreme Court appeals were presumably only a fraction of the total volume at District and County courts, but they may index the overall trend, with a lag of perhaps one to three years. By this reading, litigation did not decline as the courts’ jurisdiction over mining cases became clarified; instead, the numbers accelerated across the 1850s, reaching a peak during 1857–1860. Evidently, only the decline in gold production and the mining population ultimately reduced pressure on the legal system.

Although some aspects of mining law may have become firmer and more consistent through this process, as often as not the courts reached their decisions by over-

²⁷ *Sonora Herald*, October 23, 1852, cited in Martinez and Drummond (1936, p. 30).

²⁸ Cited in Martinez and Drummond (1936, p. 34).

²⁹ Rohrbough (1997, pp. 88, 153). Bakken (1991, pp. 1–2) notes that it was not unusual to practice law in local justice courts, without having been admitted to the bar.

³⁰ The situation was similar in Nevada silver mining, a late 1850s spillover from the California gold rush. Libecap (1978, pp. 52–57; 1989, pp. 40–41) shows that the Nevada silver mining districts were quickly overwhelmed by disputes over priority of discovery, location of veins, and reassertion of rights to apparently abandoned claims, leading to pressures for “more formal and permanent arrangements.” The San Francisco *Alta California* wrote on March 7, 1860: “There are very few claims of any value [on the Comstock] not in the utmost confusion of title and mystery of description” (quoted in Libecap, 1989, p. 41). Because the bulk of Libecap’s analysis concerns the effects of Nevada state mining legislation, it is outside the scope of this paper.

³¹ McCurdy (1976, p. 243) states that the practice of claim-jumping “inundated the courts with suits for ejectment,” but he acknowledges that documented evidence from court records is sparse.

³² One such case was *Loomis & Co., vs. Plummer & Co.*, taken first to the Alcalde and then appealed to the County Court, July 19, 1850. Plummer & Co. stated that they had established their claim, but Louis & Co. “still persists in trespassing.” Witnesses for the defendants said that they had only “two letters on the Mark” and thought that “two letters would not hold a claim.” The arguments make reference to Sec 3 and Sec 11 of what seem to be mining district rules. These records are in the Tuolumne County Museum in Sonora, California. We are grateful to Ken Mayhan and Ray Milenna for assistance with these archives, and to Petra Moser for transcribing these obscure handwritten documents.

Table 5
California supreme court mining cases, 1850–1866

Year	Total cases	Water rights	Claims	Sectors	Companies
1850	3	0	0	0	1
1851	0	0	0	0	0
1852	0	0	0	0	0
1853	2	1	1	0	0
1854	1	0	1	0	0
1855	6	4	0	2	0
1856	7	2	4	1	0
1857	19	13	3	0	2
1858	21	6	8	2	5
1859	12	6	3	1	1
1860	12	0	3	4	1
1861	4	0	2	1	1
1862	3	1	2	0	0
1863	12	3	5	1	3
1864	4	0	4	0	0
1865	2	0	1	0	1
1866	3	0	2	0	1
Total	111	36	39	12	16

Source. California Supreme Court Reports.

Note. Cases were assigned to one category only. Water rights cases concerned disputes over access to water, either within or across mining districts. “Claims” cases were disputes over possession, use or transfer of mining claims. “Sectors” cases dealt with priority between mining and other economic sectors, chiefly agriculture. “Companies” cases were disputes within mining companies.

ruling the explicit rules of mining districts. Indeed, in 17 years of litigation, we are unable to identify a single clear case in which the Court upheld an idiosyncratic or unconventional local rule or decision by a mining district, as opposed to the “customs and usages” that were becoming standard at the state level. Thus, one cannot reasonably maintain that mining districts succeeded in maintaining “order” by enlisting the courts to enforce locally determined rules.³³

6. Theory: claim jumping as an equilibrium phenomenon

In this section, we use a simple game theoretic model to explain two stylized facts regarding mining districts: (i) jumping as an equilibrium phenomenon and (ii) the lack of third party enforcement of property rights. Assume that there are N players, a subset Q , $N/2 < Q < N$, of which each control a single asset that pays 1 in every period. No player controls more than one asset by fiat or due to cost constraints

³³ One of the standard solutions to common-property resource allocation problems is a system in which rules for each locality are promulgated locally, and then enforced by central authority. See Ostrom (1990, pp. 15–18).

(endogenously). Assume that players randomly decide which asset to seize and that seizure is verifiable. Also assume that all players can observe all other players' past participation in third party punishment.

Property rights can be enforced in one of two ways. Under second party enforcement, when faced with an invader, player q either fights or leaves. If he fights, both parties bear a cost h and get an expected one-period payoff 0.5 (assuming the players are equally matched and no value is destroyed). The probability that a player without the asset will randomly attempt to seize the asset of a player that has one is $p = (N - Q)/Q$. If $h < 0.5$, then players without assets will always attempt to seize assets, because seizure is profitable even if the player only maintains control of the asset for one period. The more interesting case is if $h \geq 0.5$, so that the seizure is only profitable if the player is able to maintain control of the asset for more than one period.

Under third party enforcement, when faced with an invader, player q informs all other members of Q and they collectively drive off the invader. A number of possible strategies could provide players with incentives to participate in this punishment. We assume that the strategy is: if you do not help fight off invasion, no one will help you fight off an invader. Let sp denote second party enforcement, tp denote third party enforcement, and ni denote no invasion.

Proposition 1. Second party enforcement: *There exists an $h > h_{spni}^*$, players without assets do not invade in equilibrium, because the cost of invading exceeds the potential benefits.*

Third party enforcement: *There exists an $h > h_{tpni}^*$, players without assets do not invade in equilibrium, because the cost of invading exceeds the potential benefits. Note that since $h_{tpni}^* < h_{spni}^*$, there is a region in which third party enforcement can support property rights and second party enforcement cannot.*

Proof. See the Appendix for the proofs of Propositions 1–3. We find a result similar to that found in other repeated game models that examine property rights enforcement (Greif, 1993; Clay, 1997). Third party punishment may be able to prevent invasion, in circumstances where second party punishment cannot.³⁴ Note that invasion is different from jumping, since jumping involves moving onto a nominally unoccupied claim, whereas invasion means moving onto an occupied claim.

³⁴ To examine the effect of heterogeneity, assume that some people are better fighters than others, perhaps because they are better shots or have a higher propensity for violence. Thus, some fraction of the population is type S and the remainder is type W. Assume for simplicity that there are at least Q type S. In a fight between type S and type W, type S always wins. In a fight between type S's, each has an equal probability of winning. Also assume that the initial endowment of assets is random. If type is observable and enforcement is second party, then type S's drive out type W's without any violence, since W's know they will lose. If type is not observable, then there may be some initial transition period in which type S's invade claims. Once type S's acquire all Q claims, then we are back in the setting described initially. If type is observable and enforcement is third party, then type W's will be able to maintain their property rights. Thus, heterogeneity alone cannot explain jumping or why mining districts differed from the other two institutions. In early days of all three institutions the strong may have driven out the weak, but then the institution should have stabilized.

For jumping to be a feature of equilibrium, some claims must be unoccupied. For simplicity, we will model the search/race aspect of mining as players having some positive probability l of leaving their claim to search for another one. In a more complete model, this could be endogenized. Players not currently in possession of a claim either because they do not have a claim in the previous period or because they left their claim at the end of the previous period are randomly matched with claims with probability $m = lQ/(N - (1 - l)Q)$. Players that are not matched are free to invade a claim.

Proposition 2. *Second party enforcement: There exists an $h > h_{\text{spni}}^*$, players without assets do not invade in equilibrium, because the cost of invading exceeds the potential benefits. $h_{\text{spnil}}^* < h_{\text{spni}}^*$, so second party enforcement is easier when individuals leave than when they do not.*

Third party enforcement: There exists an $h > h_{\text{tpnil}}^$, players without assets do not invade in equilibrium, because the cost of invading exceeds the potential benefits. There will, however, be jumping in equilibrium. $h_{\text{tpnil}}^* < h_{\text{tpni}}^*$, so third party enforcement is easier when individuals leave than when they do not. As before $h_{\text{tpnil}}^* < h_{\text{spnil}}^*$, so there is a region in which third party enforcement can support property rights and second party enforcement cannot.*

The foregoing result accounts for jumping, but in a rather uninteresting way. Players that leave their claim leave permanently, never to return. Entrants simply move onto an unoccupied claim, something which one would think of as relatively uncontroversial. In practice, jumping was controversial, because previous occupants often returned and wanted the claim back. The rules suggest that miners' views of the relative rights of the two parties depended on whether the previous occupant left for a valid or invalid reason. Valid reasons included sickness, acquisition of supplies, or lack of water. Invalid reasons included departing to prospect for new claims.

We will assume that the previous occupant's probability of returning is r and of having a valid excuse is v and that the validity is verifiable. In a world of second party enforcement, however, the validity of the excuse is irrelevant. All that matters is whether the previous occupant is willing to fight for the claim or not. If validity is verifiable, then one strategy for the miners is to provide third party enforcement for valid absences and not for invalid absences. In equilibrium under third party enforcement, only those individuals with valid excuses attempt to repossess their claims.

Proposition 3. *Second party enforcement: The validity of the excuse is irrelevant, so the environment reduces to the environment in Proposition 2. As in Proposition 2, what matters is the magnitude of h_{spnil}^* .*

Third party enforcement: The validity of the excuse is relevant here. Interestingly, it does not have any effect on h^ , since refusal to leave a claim if the owner returns with a valid excuse is the same as invading a claim. As in Proposition 2, what matters is the magnitude of h_{tpnil}^* .*

This predicts that we should only observe the return of miners with valid excuses for their absences. A key problem in reality was that excuses were difficult or costly to verify. In the absence of verifiability, each party would argue that they should

have property rights to the claim. Unless expectations about whom ‘should’ be awarded the claim can be coordinated; we would expect third party enforcement to break down. No player wants to invest in third party enforcement today because future aid in enforcing his property rights is too uncertain. Note that the fundamental problem lies not with the rules but with the search/race nature of the activity. Thus the nature of the activity, specifically the incentives for mobility, together with unverifiable reasons for absences can lead to exactly the type of outcome we observe—jumping and a breakdown of third party enforcement, as related to jumping.

In practice third party enforcement was likely to break down for a related reason, namely information transmission. When third party enforcement works, it works because of the link between past behavior and future assistance. That is, players are willing to help other players defend their property rights because of the expectation that other players will help them. As a result of the race aspect of the game, however, players’ past behavior may not be readily observable. Once the link between the past and the present is broken, miners no longer have an incentive to engage in third party enforcement.

7. The big picture: aggregate symptoms of undue haste

Some writers seem to regard the gusher of California gold as self-evident confirmation of the security of property rights.³⁵ The rapid growth of production is, however, equally consistent with common-pool extraction conditions and/or poorly defined property rights. Fig. 1 shows a rapid increase of California gold output from 1849 to its peak in 1852, followed by almost continuous decline throughout the subsequent decade. These aggregate patterns reinforce our interpretation of the micro-economic character of mining districts and the claim system.

Economists have long maintained that reward structures characterized in this way—“races” in which the winners get large prizes, while the losers get little or nothing—tend to generate inefficient, socially unproductive dissipation of rents. The theoretical literature on patent races shows that winner-take-all races result in excessive entry by firms, wasteful duplication of effort, and costly “undue haste” in the effort to come in first.³⁶ Defenders of the first possession rule, on the other hand, argue that in practice, legal rules and institutions emerge to mitigate these costs. For resource stocks such as farmland, early, unambiguous establishment of clear title minimizes wasteful conflict (Rose, 1985, p. 81). Where the resource is instead a flow, such as oil, water, or fish, a variety of ownership forms and access rules are possible. For

³⁵ “In this fashion, property rights and other institutions first emerged in the gold fields of California, and with them an outpouring of millions of dollars of gold.” Walton and Rockoff (1998, p. 181).

³⁶ Dasgupta and Stiglitz (1980) and Barzel (1968). Wright (1983) shows that the race equilibrium is analogous along a time dimension to Gordon’s average-product rule for exploiting an open-access resource (Gordon, 1954). An application to land distribution in American history is Anderson and Hill (1990, pp. 177–197).

example, common property systems may restrict access to a group of early claimants, thereby reducing rent dissipation even though insiders are not managed (Lueck, 1995, pp. 422–430).

The question is, how do the gold mining districts fit into this framework? As a one-time, non-renewable resource, gold does not clearly correspond to either scenario. The clarity of rights that one associates with first-possession rules was undermined by work requirements and legitimized claim-jumping. So mining claims were not typically the first step on the path to full ownership, as in the case of farmland.³⁷ Yet mining district rules also were not designed to exclude entry by outsiders, in the manner of the cattlemen's associations.³⁸ As we have seen, non-claimholders were not excluded from miners' meetings, and the procedures for claims (including claim-jumping) were available to newcomers as to incumbents.

The timing of gold production depicted in Fig. 1 implies a *prima facie* case for excessive haste and the persistence of open access during the 1850s. In his classic article on non-renewable resource extraction, Hotelling (1931) showed that under plausible assumptions the optimal stock of a known resource declines continuously.³⁹ This path corresponds to a counterfactual history in which the gold fields and mineral rights were privately held prior to the 1848 discovery, or were assigned by mining district rules shortly thereafter. Whether such a privatized system was historically feasible may be debated, but it nonetheless offers a useful benchmark for diagnostic purposes.

Perhaps the most decisive indication of persistent open-access conditions is the evidence on returns to gold mining. H. H. Bancroft pointed out that if you divide annual gold output by available rough estimates of the number of miners, you obtain average annual earnings of less than \$600 per year in 1852, or "barely \$2 a day."⁴⁰ Such returns were considerably less than the wages of unskilled labor in gold rush California, estimated by Margo at between \$3.00 and \$4.00 per day during 1851–1853, after peaking at \$7.20 in 1850.⁴¹ Rough as these comparisons must be, they

³⁷ On claims clubs, see Bogue (1958). See also Kanazawa (1994).

³⁸ Like the miners, cattlemen on the public domain had no legal property rights in land. But as the open range began to fill up in the 1870s, associations of incumbent cattlemen assigned themselves "range rights" on the basis of priority, refusing entry to "outside parties." Members committed themselves to non-cooperation with intruders, most effectively by denying access to the local "roundup." See Osgood (1929, pp. 114–175); Dennen (1976, pp. 436–428); Hibbard (1924), Chapter XI.

³⁹ Equivalence between this path and competitive equilibrium (i.e., under secure, non-monopolized property rights) is shown in Dasgupta and Heal (1979). It makes little difference on this count whether we postulate a single private landowner or many. Under plausible assumptions, monopoly has no effect on the rate of depletion. See Stiglitz (1976). Particular so in the present case, where the price of gold was fixed by government policy.

⁴⁰ Bancroft (1884–1890, vol. 6, p. 424). Similar calculations show little variation from year to year. Using the estimates cited in Section 2, one obtains: 1850, \$680; 1852, \$480; 1853, \$693; and 1854, \$680.

⁴¹ Margo (2000, p. 141). An alternative wage series developed by James Gerber (1997) places the average wage at more than \$5.00 per day throughout the period 1850–1855, figures that would make our case even stronger.

support the inference that rents in gold mining were dissipated by free entry.⁴² They also supports Bancroft's more colorful conclusion that mining "was a lottery wherein a vast number of blanks were overshadowed by the glitter of the few prizes. The great majority of diggers obtained little more than the means to live at the prevailing high prices, and many not even that." One miner came back into camp after some weeks' absence with what he considered a good yield, only to find that his wife by laundry work had earned much more (pp. 422–423).

The prevalence of rent dissipation during the gold rush is relatively evident. The more challenging question is why these conditions persisted in the face of ostensibly functional mining district institutions. To explain this puzzle as an institutional failure within the standard property-rights framework, one might look for answers to some now standard variables. For instance, the number of miners was large, they came from different economic, social, and national backgrounds, and those who came to California may have been self-selected risk takers. In principle, any of these features could have prevented the emergence of stable property rights.

While the number of miners, their heterogeneity, and their risk taking nature may have been contributing factors, we regard most of these as endogenous to the nature of gold mining as an economic activity in which production was inseparable from search.⁴³ Virtually every gold rush diary repeats the cliché that mining was a lottery, where payoffs were enormous for the lucky few, but with little proportionality between effort and reward. As a miner from Michigan wrote: "It is unevenly deposited, so that large and rich deposits are comparatively few. Those who happen to find them (for it is all a matter of chance) will make fortunes, while thousands will accumulate but little, and many return home as poor as when they left."⁴⁴

The idiosyncratic character of gold mining knowledge is also relevant to the literature on first possession. Rules that appear to be inefficient in static terms are often said to have dynamic efficiency properties in the search for knowledge. According to the "prospect theory" of intellectual property, for example, the patent system encourages the best and brightest potential innovators to seek out valuable new techniques and discoveries, thus advancing the knowledge frontier (Kitch, 1980). Clearly the extent and location of gold deposits was not known in advance, and for this reason it seems evident that the first-come, first-served principle encouraged the "further, and faster, discovery of gold" (Zerbe and Anderson, 2001, p. 135). In recognition of the external benefits of new knowledge, a majority of the quartz mining codes awarded extra claims to the first miner to discover a new gold deposit (Table 3).

⁴² This point is also made by Barzel (1997, p. 86).

⁴³ The jointness of search and production is evident in gold rush diaries. For example: "Carlisle and I stayed and dug and Lorenzo went off on a scout to look for better diggings." Dutton (1910, p. 476). "Each day found us prospecting, digging and panning in every manner possible, but we met with no success worth mentioning. Finally we extended our efforts from our claim by the creek, to the adjoining country—bars, flats, river beds, slides, crevices, and alluvials, whatever favoring spot we happened upon, there we tried our luck, but with all our efforts we discovered little dust." Hale (1923, p. 115).

⁴⁴ The *Gold Rush* (1974, p. 114). McDowell (2002, p. 62) writes that it would be easier to list the handful of accounts that do *not* call mining a lottery than to present a representative sample of the great majority that do.

But was the extension of the gold knowledge frontier efficient, as compared to a counterfactual world of private property rights in mineral lands? In this case the incentive to search, like the incentive to produce quickly, boils down to the gains from speed. The *ex ante* private returns to accelerated search were clear. But there was little social return to discovering and extracting \$300 million dollars worth of gold within five years time (however such a return might be defined for a price-supported commodity such as gold), as opposed to spreading the production across time. To be sure, a regime of widely distributed private land holdings might also have been inefficient on this score, because of externalities in information about gold sites. But even if the claim system encouraged search activity that would not otherwise have occurred, it would be difficult to argue that the costly, duplicative efforts of thousands of independent amateurs constituted an effective way to organize the process. The public-good character of geological knowledge was ultimately recognized with the appointment of a California state geologist in 1860, and subsequently with federal exploratory initiatives that evolved into the United States Geological Survey in 1879 (David and Wright, 1997, pp. 226–229).

Many features of the gold rush scene correspond to this image of an economy infused with an inordinate premium on speed. “Time is money” was the watchword throughout the gold fields, encouraging techniques that maximized the yield of gold per day rather than per cubic yard of ore (Brands, 2002, pp. 200–201). According to Thomas Berry, interest rates in San Francisco averaged more than nine percent *per month* throughout 1850, surely higher than could be attributed to the pure rate of time preference or the physical return on investment capital. Rates came down slowly in later years, but remained above two percent per month throughout the 1850s (Berry, 1984, pp. 237, 242).

Symptomatic of the demand for speed was the 1850s rise of the American clipper ship, whose streamlined shape and large sail area shortened the voyage to California from 125 days to less than 90. As a high-cost technology, clippers were in decline by the end of the decade, well before competition from steam and railroads became significant. The majority of clipper ships were built for the California market, and their short-lived heyday corresponded closely to the timing of the California gold rush.⁴⁵

8. Conclusion

The mining districts of the California gold rush have long celebrated as remarkable examples of orderly institution-formation in the absence of formal legal authority. This renown is fully deserved. When faced with the need to share access to gold-bearing land, miners gathered, established mining districts, and formalized prevailing customary norms as rules in district codes. The alternative may well have been wasteful and destructive violence. The mining codes thus may be said to have established order, where far worse scenarios may readily be imagined.

⁴⁵ Delgado (1990, pp. 44–46). This discussion also draws upon Williams (1997).

But “order” is not synonymous with secure property rights as conventionally understood. To be sure, those miners who discovered what they knew to be a rich site could call upon the code’s rules and procedures to exclude intruders; since no property rights are absolute, this is indeed a form of property rights. But the claim system codified by the mining districts also institutionalized claim jumping, and by so doing fostered insecure rights and chronic litigation, which spilled into the courts very early in the process. This paper argues that the key to diagnosing the situation lay in the nature of the economic activity in which gold miners were engaged, a race to find a small number of highly profitable lodes. One can imagine a hypothetical alternative in which mining lands were privately held, so that returns to search as well as production activity were internalized by owners. Under such a system, the gold rush would have been a slower, less costly and presumably more orderly affair than the turbulent phenomenon participants and historians have described ever since. One may argue plausibly that such private property rights would not have been enforceable in 1850s California. Be that as it may, this is not what the mining codes attempted to do. Instead, they acquiesced in the underlying situation and tried to balance the rights of claimholders and the rights of searchers. Thus, we suggest mining districts and codes should be understood as institutions for managing access to search sites, for a non-renewable resource whose precise locations could only be determined by production.

Appendix A.

Notation

h = cost of invading

p = probability of being invaded, $(N - Q)/N$

d = discount rate

k = probability of winning under third party enforcement

l = probability of exogenously leaving a claim

m = probability of being matched with a claim = $lQ/(N - (1 - l)Q)$

rv = the probability of returning with a valid excuse

ni = not invade

i = invade

cl = decision to leave the claim when invaded

cf = decision to fight for the claim when invaded

Proof of proposition 1. *Second party, Not invade*

$$V_{ni} = 0 + dV_{ni}$$

$$V_i = (0.5 - h) + 0.5dV_{ni} + 0.5dV_{cl}$$

$$V_{cl} = 1 + dV_{cl}$$

$$V_{cf} = 1 + dV_{cl}$$

Solving for V_{cl} and V_{ni} gives:

$$V_{cl} = 1/(1 - d)$$

$$V_{ni} = 0$$

So whether to invade for one period and conform thereafter depends on whether $V_{ni} - V_i > 0$, or by substitution $-(0.5 - h) - 0.5d(V_{cl} - V_{ni}) > 0$. Rearranging yields $h > 0.5 + 0.5d/(1 - d) = h_{spni}^*$ which can only hold if h is fairly large. So (not invade, leave) is a subgame perfect equilibrium for $h > h_{spni}^*$.

Third party, Not invade

$$V_{ni} = 0 + dV_i$$

$$V_i = (k - h) + (1 - k)dV_i + kdV_c$$

$$V_{cl} = 1 + dV_{cl}$$

$$V_{cf} = 1 + dV_{cl}$$

Solving for V_{cl} and V_i :

$$V_{cl} = 1/(1 - d)$$

$$V_{ni} = 0$$

So whether to not invade for one period and conform thereafter depends on whether $V_{ni} - V_i > 0$, or by substitution $-(k - h) - kd(V_{cl} - V_{ni}) > 0$ or rearranging, $h > k + kd/(1 - d) = h_{tpni}^*$. Thus, (not invade, leave) is a subgame perfect equilibrium for $h > h_{tpni}^*$. Note that as k , the probability of winning if you invade, falls, so will the minimum h necessary to guarantee property rights. Also note that since by assumption $k < 0.5$, $h_{tpni}^* < h_{spni}^*$. \square

Proof of proposition 2. *Second party, Not invade*

$$V_{ni} = 0 + (1 - m)dV_{ni} + mdV_{cl}$$

V_{ni} reflects the fact that a non-invader may or may not be matched with another claim in the next period.

$$V_i = 0.5 - h + 0.5(1 - m + l - lm)dV_{ni} + 0.5(1 + m - l + lm)dV_{cl}$$

V_i reflects the fact that an invader may win the claim and keep it in the next period; win the claim, be forced to leave in the next period, and either match or not match with another claim; lose the claim and be matched; or lose the claim and not be matched.

$$V_{cl} = 1 + (l - lm)dV_{ni} + (1 - l + lm)dV_{cl}$$

$$V_{cf} = 1 + (l - lm)dV_{ni} + (1 - l + lm)dV_{cl}$$

Solving for V_{cl} and V_{ni} gives: $V_{cl} = A/(AB - md^2l + m^2d^2l)$, where $A = (1 - d + dm)$ and $B = (1 - d + dl - dlm)$ $V_{ni} = (md)/(AB - md^2l + m^2d^2l)$

So whether to invade for one period and conform thereafter depends on whether $V_{ni} - V_i > 0$, or by substitution $-(0.5 - h) - 0.5d(1 - m)(1 - l)(V_{cl} - V_{ni}) > 0$. V_{cl} and V_{ni} are solved for above. Note that $V_{cl} > V_{ni}$ because $(1 - d + dm) > dm$. Rearranging yields, $h > 0.5 + 0.5d(1 - m)(1 - l)(V_{cl} - V_{ni}) = h_{spnil}^*$, which can only hold if h is large. Thus (not invade, leave) is a subgame perfect equilibrium for $h > h_{spnil}^*$.

To show that $h_{spni}^* > h_{spnil}^*$, we need to show that $1/(1 - d) > (1 - m)(1 - l)(V_{cl} - V_{ni})$. Multiplying through by $(1 - d)$, substituting for V_{cl} and V_{ni} , and going through some algebra leads to the condition that $1 > [C - (1 - d)(m + l - lm)]/C$, where $C = (AB - md^2l + m^2d^2l)$. $(1 - d) > 0$ and $(m + l - lm) > 0$, thus the condition holds and $h_{spni}^* > h_{spnil}^*$.

Third party, Not invade

$$V_{ni} = 0 + (1 - m)dV_{ni} + mdV_{cl}$$

$$V_i = k - h + ((1 - m)(1 - k) + kl - klm)dV_{ni} + (m(1 - k) + k - kl + klm)dV_{cl}$$

$$V_{cl} = 1 + (l - lm)dV_{ni} + (1 - l + lm)dV_{cl}$$

$$V_{cf} = 1 + (l - lm)dV_{ni} + (1 - l + lm)dV_{cl}$$

Since k only enters in V_i , solving for V_{cl} and V_{ni} yields the same answers as in the second party case:

$$V_{cl} = A/(AB - md^2l + m^2d^2l)$$

where $A = (1 - d + dm)$ and $B = (1 - d + dl - dlm)$

$$V_{ni} = (md)/(AB - md^2l + m^2d^2l)$$

So whether to invade for one period and conform thereafter depends on whether $V_{ni} - V_i > 0$, or by substitution $-(k - h) - k(1 - m)(1 - l)d(V_{cl} - V_{ni}) > 0$. V_{cl} and V_{ni} are solved for above. Note that $V_{cl} > V_{ni}$ because $(1 - d + dm) > dm$. Rearranging yields $h > k + k(1 - m)(1 - l)d(V_{cl} - V_{ni}) = h_{tpnil}^*$. Note that $h_{tpnil}^* < h_{spnil}^*$, and that $h_{tpnil}^* < h_{tpni}^*$. Thus, (not invade, leave) is a subgame perfect equilibrium for $h > h_{tpnil}^*$. □

Proof of proposition 3. If we assume that players only care about profit maximization, returning with or without a valid excuse is equivalent to invading a claim for second party enforcement. All players care about is the cost of invasion and their likelihood of success, which we have assumed is 0.5. So unless having a valid excuse alters these, the results for second party enforcement are the same as in Proposition 2.

Third party enforcement is another matter, since the objective is presumably to enforce property rights. As specified in the rules, some types of absences negate property rights, while others do not. As we saw in propositions 1 and 2, if h is too small, third party enforcement will break down and we will observe invasion. (A simple example is if $h < k$, in which case there will be expected one-period benefits to invading.)

Third party, Not invade, Give up claim if previous owner returns with valid excuse

Note that refusal to leave a claim if the owner returns with a valid excuse is the same as invading a claim. Thus, the conditions to check are the same as the conditions in Proposition 2. □

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