Anarchy, Property Rights, and Violence:
The Case of Post Gold Rush California

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This paper uses new data from the squatter wars of the 1850s and 1860s in California, a period in which property rights were extremely uncertain, to investigate two issues related to property rights: i) the links among anarchy, production, and violence and ii) why contracts, which were available and enforceable in California, were so rarely used to mitigate the negative effects of uncertain property rights. The results have implications for understanding the historical development of agriculture in the United States, since squatting on agricultural land was prevalent throughout the United States, and for understanding agriculture in the Third World, since uncertain property rights in agricultural land are still an issue today.

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1. Introduction

This paper uses new data from the squatter wars of the 1850s and 1860s in California, a period in which property rights were extremely uncertain, to investigate two basic issues with respect to property rights. First, what are the links among anarchy, production, and violence? Second, why were contracts, which were available and enforceable in California, so rarely used to mitigate the negative effects of uncertain property rights?

Anarchy stemmed from the change in national government, which created uncertainty about how property rights in lands granted by Spain and Mexico would be treated by the United States. The uncertainty took decades to resolve as land commissions, federal district courts, and in some cases the United State Supreme Court scrutinized Spanish and Mexican land grants and boundaries. In the mean time, squatters took control of parcels of land on land grants in the hopes that the courts would find the grants invalid, at which point the land would become part of the public domain, and the squatters could purchase their land from the federal government. Although owners of land grants had the nominal right to evict squatters, doing so required expensive court proceedings, the outcome was not always certain, and enforcement could be problematic.

Squatting on agricultural land has a long history both in the United States and in the Third World. Squatter problems arose in the thirteen original colonies, many parts of which were covered with overlapping property claims, in the territory that the United States acquired from foreign governments and in many parts of the public domain.[1] The

[1] Some of the major figures include Paul Gates (1962/3, 1964, 1991) (California and elsewhere), Donald Pisani (1994) (California) and Allan Bogue (1958) (the Midwest). In addition, there are many, many papers in history journals that mention squatters in specific localities. Some examples include Jockers (2004) on Western Pennsylvania, Jordan (2001) on Alabama, Gatreau (1995) on Louisiana, Laurie (1994)

previous historical literature on squatting in the United States has largely been based on anecdotal evidence.[2] This paper draws on a new data set of squatter activity in California, data from the Census of Population of 1860, and data from the Censuses of Agriculture for 1860-1890. Taken together, these data provide a much more detailed picture of squatter behavior including location, production, violence, and contracting than has previously been possible.

Squatting in the Third World has received considerable attention recently both from the World Bank and from individual scholars. The magnitude of the issue is large – Hernando de Soto estimates that 40-53 percent of rural land in the Third World and former Communist nations is not formally titled.[3] While interest in squatter problems has been significant, the number of empirical studies of squatting has been relatively small and the number that focus on rural squatting even smaller.[4] This paper provides new evidence, albeit from an historical setting, on patterns of rural squatting, the incidence of violence, and the role of the government in preventing violence and resolving anarchy.

The paper is organized as follows. Section 2 describes in greater detail the origin of the anarchy in California. Section 3 briefly describes models of anarchy and then presents evidence on the identity of squatters and their location decisions. Section 4 presents estimates of the effect of uncertain property rights on agricultural output and examines patterns of violence. Section 5 presents data and a model that highlight the

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on Oklahoma and Kansas, McCluggage (1989) on the Old Northwest (Illinois), Taylor (1989) on Maine, Sturtevant (1987) on Massachusetts, Goodall (1984) on New York, Ramage (1977) on Kentucky, Jones (1968) on Tennessee.

[2] One interesting exception is Kanazawa (1996), which analyzes Congressional roll call data on votes related to pre-emption rights, but does not include data on individual squatters.

[3] de Soto (2000), p. 35.

[4] See World Bank (2002), Field (2003, 2004) using data on urban squatters from Peru, Lanjouw and Levy (2002) using data on urban squatters in Equador, Besley (1995) using data from rural Ghana, and Alston,

reasons why contracts were only rarely used to mitigate the uncertainty regarding property rights. Section 6 concludes and discusses the implications of the findings for squatting in other contexts.

2. The Source of Anarchy in California: A Change in National Government

Anarchy in California was caused by the uncertainty in property rights associated with the change in national governments from Mexico to the United States. It was greatly exacerbated by the large area covered by Spanish and Mexican land grants and the dramatic increase in population associated with the gold rush.

Land Claims

To settle what was then a remote frontier, the Spanish and Mexican governments had made grants to citizens and naturalized citizens of one to eleven leagues (4,428 to 48,708 acres) of land. Almost all owners received grants during the Mexican period under the Colonization Act of 1824 and the Supplemental Regulations of 1828.[5] When granting ended in 1846 as a result of American occupation, about 750 grants had been made. These grants, which were primarily used as cattle ranches, covered more than twelve million acres of exceptionally fertile coastal and valley land.[6] In the Treaty of

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Libecap, and Schneider (1995, 1996) and Alston, Libecap, and Mueller (1999, 2000) using data from rural Brazil.

[5] To acquire land under these acts, an individual began by submitting a petition to the governor. The petition and attached documents included the request for land and the reason for the request, a description and sketch of the land, and personal information about the applicant. The governor sent these materials to a local official, the *alcalde*, who attested to the petitioner's standing in the community and verified that the land was unoccupied. If the *alcalde's* report, the *informe*, was positive, the governor would usually make the concession by issuing a *concedo*. The *alcalde* then put the grantee in formal possession of his land. Upon the completion of this, grantees submitted the papers related to the grant to the territorial legislature for its approval.

[6] Twelve million acres is equal to about one-third of the land in farms in California in 1964 (37 million acres) and nearly one-half the land in farms in 1997 (28 million acres). At the end of the process, 551 patents were issued for 8.9 million acres.

Guadalupe-Hidalgo (1848), the United States had pledged to protect property rights in the lands ceded by Mexico.

Congress delayed taking action on the issue until 1851, when it finally passed the California Land Act. Under the act, an individual with a Spanish or Mexican land grant could submit documentary evidence of their claim to the land commission. The commission would then investigate the claim and issue a decision on the claim's validity. Either side – the federal government (as the residual claimant for all land) or the claimant – could then appeal the commission's decision to the U.S. District Courts in California and from there to the U.S. Supreme Court. Once validity had been established, a claim was surveyed, any boundary disputes were resolved, and the federal government issued a patent for the land.[7] The entire process from the initial submission of a claim to receipt of a patent took, on average, seventeen years. Rejected claims and unclaimed land would become part of the public domain and eventually be opened to settlement.

Eight hundred and thirteen land claims were submitted under the act by the March 1852 deadline. (Figure 1 shows the location of claims that were ultimately confirmed.) Claimants and settlers had no real insight into the outcome of the process, however. Thomas Larkin, a prominent landowner, acknowledged the fundamental uncertainty of the situation in an 1851 letter to his half-brother John Cooper: "It's impossible for us to foretell whether Govt. will construe titles by the letter or by the spirit; if the former, it will prove bad for many landholders."[8] The attitude of the courts could, and to some extent did, shift. So although the first decisions of the land commission in 1853 were

[7] As with the public domain, patents definitively established the recipients' property rights.
[8] Larkin VIII, p. 365. T. O. Larkin to John Bautista Rogers Cooper, January 9, 1851.

quite favorable to claimants, there was continuing uncertainty about the resolution of property rights.

During the period of uncertainty about the ultimate resolution of property rights, there was also uncertainty about interim use rights. Although the courts tended to uphold claimants' rights, there were some early pro-squatter rulings.[9] The political climate constantly shifted, with the passage of state legislation favorable to squatters in 1849/50, 1856, and 1858 and the overruling of the first statute by federal legislation and the striking down of the latter two by the courts. To add to the confusion, there was always the prospect of new federal legislation, such as Senator Gwin's 1852 attempt to pass favorable pro-squatter legislation. Eventually confusion diminished, and the courts awarded claimants legal rights to use and exclude others from their property. Their legal rights stemmed from the fact that they had greater 'color of title' than did squatters whose claim, if any, derived from the federal government's rights.

Demand for Land

The gold rush of 1848-9 created few immediate problems, because most land grants did not extend to mines. By increasing the population in California from 15,000 in mid-1848 to 265,000 in mid-1852, however, the gold rush had set the stage for conflict.

One effect of the population increase was a tremendous increase in the demand for land. The uncertain validity of land claims and their ill-defined boundaries limited the federal government's ability to respond to this demand by selling land from the public domain.[10] As a result, during the 1850s land safely in the public domain was often

[9] The politics are detailed in Gates (1991), Chapter 6, pp. 156-184.

[10] Individuals had submitted sketches with their original petition, but as Henry Halleck found in his 1849 report on land titles, "These sketches frequently contain double the amount of land included in the grants;

unsuitable for agriculture. For instance, most of the 11,151,000 acres brought onto the market between 1857 and 1860 were located in the Mohave Desert and the as-yet-unirrigated San Joaquin valley.[11]

Although desirable agricultural land was, practically speaking, unavailable from the government during the 1850s, interested individuals could purchase land claims in the market. Buying a whole claim or a share of one was, however, problematic for three reasons. First, although owners often provided some assistance, individuals had to pay for the land claim. The amounts were typically greater than $1000, getting financing was difficult, and interest rates were typically 2 to 4 percent per month. To provide some sense of the scale of purchases, income per capita in the United States was less than $100 in 1840 and 1880, and income per capita in California was less than $200 in 1880. Second, by 'buying a lawsuit', one committed to make uncertain and potentially sizable payments for litigation and other expenses. For claimants, the lawyers' fees for bringing a claim before the land commission typically fell between $500 and $1500. Appeals to the federal district courts cost $100 to $500, and appeals to the United States Supreme Court cost $600 to $1000.[12] These numbers did not include other litigation expenses, the survey, or boundary litigation. During this interval, the land was typically not generating much income, so claimants had to have enough resources to fund the litigation. Third, as we shall see, squatters were an ongoing issue.

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and even now very few of these grants have been surveyed or their boundaries fixed." (Halleck (1850), p. 122.)

[11] Gates (1991), p. 312.

[12] Gates (1991) pp. 17-18 and Larkin X, pp. 22-23, Adolphus Carter Whitcomb and Thomas Oliver Larkin, Agreement, September 29, 1852. Lawyers sometimes agreed to work on a contingency basis, with the usual fee being one quarter of the land to carry the claim to the land commission and the district court. Gates (1991) p. 18.

Rather than buy land, many individuals squatted with the intent of acquiring property rights through pre-emption. From the late eighteenth century on, Congress had, in a number of instances, conferred pre-emption rights on settlers – individuals who were squatting on the specific tracts of public land. Pre-emption rights allowed these settlers to buy the land they were on from the government at a fixed price rather than at auction. In the Preemption Act of 1841, Congress extended these rights to settlers on most *surveyed* land that was in the public domain. Individuals could buy up to 160 acres at $1.25 per acre. In 1853 Congress specifically extended pre-emption rights to settlers in California and other western states, although almost no land had yet been surveyed. Anticipating the passage of such a bill, some squatters in California declared their intent to exercise pre-emption rights even before 1853. For instance, in 1852 a ranch manager reported to one owner: "A portion of the settlers are ... [taking] up what they call a preemption of 160 acres."[13]

Although owners of land grants had the nominal right to eject squatters from their land, exercising this right was rarely easy. Ejection suits were expensive. Only five estimates of ejection costs have been found. The amounts varied significantly and appear to have exhibited economies of scale: $18.60 to eject one, $218 to eject one, $500 to eject two, $700 to eject thirty squatters, and $1000 to eject an unknown number.[14] An owner, if he won, was usually allowed to recover court costs from the squatters, but he only rarely saw the money.

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[13] Larkin IX, p. 83.

[14] Javier Alviso v. Orson Lyon, Third District Court, Santa Clara County (1863). A. Ensworth to C. Couts, July 3, 1861, Couts Collection, Huntington Library. In the Supreme Court of the State of California. T. M. Slaughter, Plaintiff and Respondent, vs. Fowler & Gates, Defendants and Appellants, Huntington Library 384144. The Sonoma County Journal, August 27, 1858. Larkin X, p. 133, Samuel A. Morison to Thomas Larkin, Mar. 6, 1855. In one instance, the attorney estimated that the squatter had spent $350 fighting ejection. A. Ensworth to C. Couts, July 3, 1861, Couts Collection, Huntington Library.

Paying court and lawyers fees did not guarantee success. In the Third District Court, Judge McKee sided against the owner in ten of the forty-seven cases, or about 22 percent of the time.[15] In Santa Cruz county, "a landholder – the victim of members of a squatters' club who had broken into his meadow, cut the hay, and built houses – sought redress only to find that every one of the jurors was a member of the Squatters' League."[16]

A decision against a squatter, if obtained, did not mean that it would be enforced. Presumably some squatters bowed to the inevitable and left. Examples of peaceful departure have largely been lost, however, because the writers of letters, newspaper accounts, and government reports tended to report instances of armed conflict. For instance, in 1853 in Napa county "near open warfare developed between thirty-five masked settlers and the sheriff and his posse."[17] In 1861 squatters on the Chabolla grant refused to leave the grant, although the United States Supreme Court had sustained the owner's title. Intimidated by the squatters' cannon and arms, the sheriff's posse abandoned him, and the squatters marched in the streets of San Jose.[18]

3. Squatters and Squatting

Models of anarchy offer insight into who will squat, where they will squat, and where violence will be observed. In models of anarchy such as Skaperdas (1992), Grossman and Kim (1995) and Hirshleifer (1995), agents are posited to act in maximizing ways. For example, agents are posited to make the optimal division of effort

[15] General Index, Third District Court of the State of California, Santa Clara County.
[16] Dick (1970), p. 79.
[17] Gates (1991), p. 165.
[18] Cosgrave (1948), p. 26, and Gates (1991), p. 307.

between production and activities related to securing or expanding property rights. Although it is outside of those models, individuals can be thought of as making an optimal decision to squat, in the sense that it is ex ante, the highest valued use of their time. We would expect squatters to be from the lower end of the socioeconomic scale, for at least two reasons. First, squatting involved having to maintain property rights through a substantial physical presence on the land. This probably limited, at least to some degree, their ability to work extensively off the land (for evidence from urban squatters in Peru, see Field 2003). Second, as we shall see, squatting involved some physical risk. Once individuals had decided to squat, they can be thought of as choosing an optimal location. Finally, anarchy models predict that agents will make greater investment in securing or expanding property rights in areas with the most valuable land (i.e., areas with the greater numbers of owners and squatters). Thus, violence will be more common in these areas.

The data on squatters and squatting come from two types of sources: i) the 1860 United States Census of Population and the 1860-1890 United States Censuses of Agriculture, and ii) primary and secondary historical sources including newspapers, correspondence, legal documents, court records, and books on specific land grants.[19] All books on specific land grants held by the Huntington Library and the Bancroft Library at the University of California at Berkeley, the two most important research libraries for California history, were consulted. The results were supplemented with newspaper reports, legal documents, and court records. Wherever possible, reports from secondary sources were traced to primary sources. Data were also collected on violence or threats

associated with squatting and on squatters leasing or purchasing land from the owner. Our data set of squatting is almost certainly not exhaustive. It probably does represent, however, nearly all of the cases in which there were substantial numbers of squatters. It is important to note that we do not address the issue of squatting in cities. Cities were if anything more anarchic, but squatting there is very poorly documented, and so is beyond the scope of the present work.

Squatters and Owners

The available descriptions of squatters are exceptionally vague and offer little direct evidence on their numbers. Hubert Howe Bancroft (1888), an influential nineteenth century historian, provides a typical description: "Among the new-comers, besides the element utterly destitute of honorable principles, there was another and strong element, mainly from the western states and Oregon, of those strong in the faith that by the 'higher law' they were entitled to lands as free American citizens."[20] Other discussions of squatters also suggest that they were American males.[21] Because squatters left almost nothing in the way of written records, we know very little else about who they were. [22]

The 1860 Census of Population 1-in-100 public use sample for California provides additional insight into the possible identity of squatters. Of the 3,609 people sampled in California, there were 556 men ages 20-59 who were white, native born, and

[19] The 1850 Census of Population data is of limited use due to the loss of records for a number of counties and the difficulties of conducting the Census at the peak of the gold rush.
[20] Bancroft (1888), p. 535.
[21] See, for example, Bancroft (1888), Cleland (1941), Gates (1991), Hittell (1898), Pisani (1994), Pitt (1966), Robinson (1948), and Royce (1886). Most of the discussion has focused on the 1850 Squatter Riots in Sacramento, which are not addressed in this paper because they occurred in a city.
[22] The documentary evidence that has survived, typically newspaper accounts of violence or threats of violence, rarely mentions names, and mobility makes it unlikely that if names had survived, they could be

living in a land grant county.[23] Some of the 556 men were likely squatters, although squatters may have evaded enumeration and so may be underrepresented in the sample. More specific identification of squatters is problematic, since it is not clear what squatters would have listed as an occupation and what they would have reported for the contemporary value of any real estate owned.[24] For instance 442 men report owning no real estate, but squatters may have viewed themselves as owning the land and therefore have reported a positive value.

Table 1 lists the characteristics of the 556 men in the sample in aggregate and by the four most common occupational classes – mining, laborer, farmer, and other non-occupational response – and a fifth category representing all other. Miners were young, held the least real property, and were largely single. Farmers were the oldest, held the most real property, were the most likely to be married, and had the largest family sizes. Of the 111 farmers, 56 are listed as not owning any real estate, which suggests that they may have been tenants or squatters.[25] Squatters may also have come from the non-occupational response category, since these individuals were poor on average and it seems unlikely that adult males would not be working.[26]

A complementary approach to quantifying the total number of squatters is to use data from the 1860 Census of Agriculture. The 1860 Census provides counts of farms for

uniquely matched to the 1850 or 1860 manuscripts for the Census of Population. On the extreme mobility in California during this period, see Mann's (1982) study of Grass Valley.

[23] Individuals born in California are considered native born.

[24] According to IPUMs "The full value was to be reported even if the property was encumbered by a lien, mortgage, or other debt." http://www.hist.umn.edu/~rmccaa/ipums-europe/usa/pincome/realpropa.html

[25] Thirty-one of the 56 list some personal property, so non-response is at best a partial explanation.

[26] In the non-occupational response category, there are categories for keeping house, disability, in school, and retired. These individuals all fell into the all other non-occupational response category (occ1950 = 995).

seven size classifications: 3-9, 10-19, 20-49, 50-99, 100-499, 500-999, and 1000+ acres. The number of farms in each of these categories is shown in Table 2a.

As we discussed previously, squatters fairly uniformly took up a preemption of 160 acres. Thus, if squatting was a problem, counties with land grants should have more farms in the 100-499 acre category than counties without land grants. In 1860, there were 6,519 farms in the 100-499 acre category, out of a total of 13,960 farms in California. Of the 6,519 farms in this category, 5,426 were in land grant counties. Only 18 of the 750 original land grants were in the 100-499 acre category, so the vast majority of 10-499 acres farms were probably held by squatters.[27]

To the extent that the 1860 Census of Agriculture was accurate, and squatter-held lands were counted as farms, 5,426 represents an upper bound on the number of rural squatters.[28] This number is a close match to the 56 farmers (representing 5600 individuals) in the 1860 Census who were listed as not owning any real estate. The closeness of the match may well be accidental, but the magnitudes appear to be similar.

In Table 2b, we assume that some farms in the 100-499 acre category in land grant counties, specifically the proportion equal to the share in non-land grant counties of the same type, represented settlement on what would have eventually have become the public domain, small land grants, or subdivision of larger land grants. This generates smaller estimates of squatter-held farms. In column 1 of Table 2b, we regress farms with 100-499 acres as a share of all farms on a dummy variable for land grants and a dummy variable for a county being in the North. The latter is included because squatting was more prevalent in the North near San Francisco and on agricultural land near the mines.

[27] As evidence in Section 5 indicates, by 1860, squatters in some locations may have purchased their lands from the owners.

The coefficients on both dummy variables are significant and have the expected sign. The coefficient on land grants indicates a point estimate of 1,860 squatter farms in land grant counties. In column 2, we replace the dummy variable for North with an interaction term between North and land grants, where the variable is equal to 1 when a county is in the North and has land grants. The coefficient on this term is significant, although the coefficient on land grants is no longer significant. The coefficient on the interaction term indicates a point estimate of 2,856 squatter farms in northern land grant counties. Thus, the point estimates of 1,860 and 2,856 together with the upper bound of 5,426 squatter-held farms provide rough estimates of the number of squatters in 1860.

We know surprisingly little about the contemporary owners of land grants. The original grantees are well documented. All were Mexican citizens, although naturalized citizens, most of whom were born in the United States, received roughly 16 percent of the grants.[29] By the time that the claims were submitted to the claims commission in 1852, the percentage of claims owned by non-Mexicans had risen to 42 percent. Owners frequently sold all or an undivided fraction of their claim to other parties, and the timing of these transfers is very difficult to reconstruct. The fraction held by Americans likely rose further after 1852.

The 1860 Census 1-100 sample provides some additional detail regarding probable owners of land grants. In Table 1, we listed the characteristics of the 55 farmers who held real estate. In addition, at the bottom of Table 1, we list the characteristics of native-born farmers, native-born non-farmers, and foreign-born men who reported

[28] Urban squatters – individuals squatting on city or town lots – may well have been more numerous.
[29] Gates (1991), pp. 39-40. Bowman (1966), p. 4 and Bowman (nd)

owning more than $5000 in real estate. These individuals were very likely to have owned land grants.

Location of Squatting

Theodore Hittell, a prominent nineteenth century historian, provided a general description of the incidence of squatting: "All around the bay of San Francisco and in most all portions of the country where Spanish or Mexican grants existed, there were squatters and squatter claims."[30] Figure 1 is a map showing the location of confirmed land grants. Grants tended to be clustered around the three major cities of the Mexican period – San Francisco, Monterey, and Los Angeles and to be proximate to the coast. Grants were primarily used to raise cattle for the hide and tallow trade. Thus proximity the coast was important, because it limited the distances that the hides and tallow had to be transported. There were some larger grants along waterways in the interior, but these tended to be relatively undeveloped.

Table 3a presents examples of land grants that had squatters, including the county in which the land grant was located, the year in which squatting occurred, if known, and the approximate number of squatters, again if known. There is typically little evidence regarding the number of squatters on a land grant, although the numbers in a few instances appear to have been large. For instance, in 1850 the Peralta family's grant, San Antonio, part of which became the town of Oakland, came under siege by squatters.[31] On February 11, 1854, the Alta California reported, "Three hundred people claimed portions of the grant by conveyance from the Peralta family; others held under Castro; and fifteen hundred settlers [squatters] were said to be on the land, mostly without any

[30] Hittell, p. 678.
[31] Bancroft (1888) IV, pp. 475-8.

title."[32] The latter number almost certainly includes many individuals who were squatting on town lots in what would later become Oakland, California. Tables 3b and 3c present additional data from the California Supreme Court and the Santa Clara County Court on the incidence of squatting. [33]

If squatters were making optimal location decisions, we would expect the presence of squatters on a land claim and their number to be positively correlated with the size of the land grant and the value per acre of the land. In the absence of values of land on specific ranches, we use three proxies for this value: i) county-level measures of the value of agricultural land from the 1860 Census of Agriculture, ii) county-level measures of population density from the 1860 Census of Population, and iii) the county's distance from San Francisco. The distributions of all three variables are highly skewed, so all variables are logged.[34]

The data include all 813 land claims submitted under the California Land Act by the March 1852 deadline. From this set, we dropped claims for individual cities, claims that did not include information on size, and claims greater than 20 leagues to reach a final sample size of 750 land claims.[35] Table 4a presents summary statistics for these claims. The mean (median) size of the land claims was 3.76 leagues (3 leagues), which is 16,687 (13,314) acres. We observe squatting on 71 of the 750 land claims. Claims were matched with county-level data on population density, land value, and distance from San

[32] Gates (1991), p. 165. Fremont's Mariposa allegedly had 15,000 squatters, but most of these were miners. Larkin IX, p. 434, Ebenezer Larkin Childs to Thomas Larkin, March 18, 1856.
[33] The district courts for the state of California had original jurisdiction over disputes involving title or possession of real property. Davis (1973), p. 261.
[34] Substituting value and value squared for the logged proxy for value gave very similar results.
[35] Claims greater than 20 leagues were almost twice the maximum grant size of 11 leagues. More importantly, these typically had poorly defined boundaries, which makes it impossible to identify their location. These claims were almost all ruled invalid by the courts.

Francisco.[36] The mean values for density, land value, and distance were: 4.42 people/square mile, $6.65/acre, and 132.29 miles.

To identify the determinants of squatting, we estimate the following logit model:

$$S_i = \alpha + \beta_1 \, lnV_i + \beta_2 \, lnZ_i + \varepsilon_i, \qquad (1)$$

where S is a dummy variable which assumes a value of 1 if land claim i had one or more squatters, and 0 otherwise; V is the proxy for value; Z is the size of the claim in square leagues; and ε is an error term. Standard errors are corrected to account for the correlation of the error term within counties.

We expect both the coefficient the size of the claim and the coefficient on county value to be positive. The coefficient on size is likely to be positive for two reasons. First, if squatters were distributed by chance, the probability of observing a squatter on a larger claim would be higher. Second, as size increases the cost of deterring squatters would increase. The coefficient on value is also likely to be positive, because the claim would have become more attractive to squatters. The attractiveness of claims in higher value counties is likely to be mitigated by two factors. First, the owners of claims in these counties may have invested greater resources in deterring squatting. Second, as more squatters took up land, crowding and the lower quality of the remaining land in the county was likely to make squatting relatively less attractive for prospective squatters.

Table 4b reports the results of the regressions. The coefficient on the log of claim size is positive and statistically significant across the four specifications. In columns 1 and 2, the log of population density and the log of land value are both positive and statistically significant. One possible concern is that these variables are to some degree

[36] If claims spanned multiple counties, they were assigned to the county in which the majority of the land fell.

endogenous, if squatters comprise a large share of the population or if the presence of squatters has a significant affect on land value. Thus in columns 3 and 4, we use alternative proxies for value that are more plausibly exogenous. In column 3, we use a dummy variable for whether the county was in the northern part of the state. The available historical evidence suggests that northern and southern counties differed in their development over this period, with land in the northern counties being significantly more valuable.[37] The coefficient on North in column 3 is positive and significant. In column 4, we use the log of the distance from the county to San Francisco. The coefficient on the distance to San Francisco in column 4 is negative and significant.[38] This evidence is consistent with the results in Table 2b from the 1860 Agricultural Census on the location of 100-499 acre farms, many of which were likely held by squatters. In both cases, the results suggest that squatters were responding to economic incentives when making their location decisions.

4. Output and Violence

One of the primary predictions of models of anarchy is that when property rights are uncertain, there will be less investment in production and more investment in activities related to securing or expanding property rights.

Agricultural Production

[37] On the difference among the counties, see Gates (1991) and other standard histories of the period such as Bancroft (1888). Southern counties were those below Santa Cruz and include Monterey, San Benito, Fresno, and Inyo counties and all counties south of these counties. Northern counties were all other counties.

[38] In unreported regressions, we found that when North or the log of the distance to San Francisco were added to the regressions in columns 1 and 2, North and the log of the distance to San Francisco were not significant

The historical evidence on squatter and owner production is very sketchy. The general impression one receives is that both owners and squatters produced very little. To the extent that any significant production occurred, it appears to have been in wheat and perhaps livestock, which was movable. As California historian Rodman Paul noted, "The fact that grain offered a quick return, with payment at the end of the very season in which the wheat was planted, and that it demanded a minimal initial investment were attractive features in a land where rates of interest on capital were high and where title to much of the best and most accessible land was shrouded in uncertainty."[39] The effect of uncertainty of title on farmers' willingness to invest in their land was widely discussed.[40]

In Table 5, we use data from the 1860-1890 Censuses of Agriculture to examine agricultural output as a function of the presence of land grants and whether the county is a northern county or not. We normalize agricultural output by all acres in farms.[41] San Francisco County is dropped in all regressions, because it included only the city and not substantial additional agricultural acreage. In this respect it was quite different from the counties that included other large cities such as Los Angeles, Monterey, and Sacramento.

Columns 1-4 of Table 5 show that counties with land grants had statistically significantly lower output per acre in 1860 and that the effect declined in 1870, 1880, and 1890. The initial negative effect in 1860 was substantial. For example, the agricultural output per acre of a county with land grants was 50 percent of one standard deviation lower than the agricultural output per acre of a county without land grants. The effects

[39] Paul (1973), p. 20.
[40] See Alta California 1851, Jan 11, Paul (1973) p. 22 quoting Hittell (1863) , and Transactions of the State Agricultural Society (1866), p. 74 .
[41] The results are similar if we normalize by improved acres.

are similar if the dummy variable for land grants is replaced by the log of the number of land grants.[42]

These results raise at least two possible concerns. One concern could be that land grant counties were well suited for cattle grazing, but poorly suited for higher value crops. The convergence in output per acre between 1860 and 1890 suggests this is not the case. Overall, to the extent that the coefficient on land grants is biased, we believe it is biased upward because counties with grants tended to be counties with higher quality land. A second concern might be that land grant counties had more acres in production than non-land grant counties, which led to the lower output per acre.[43] Land grant counties had roughly twice as many improved acres as non-land grant counties in both 1860 and 1890, which suggests that the number of improved acres is not determining the outcome.

Column 5 of Table 5 adds the variable farms with 100-499 acres as a share of all farms to the regression in column 1. This represents a way to investigate the effect of squatting in 1860 on agricultural output, since few farms of this size were preemptions on surveyed land or land grants. Individuals were either squatting on unsurveyed government land or squatting on land grants. The coefficient on the dummy variable on land grants falls by about a third and becomes insignificant. The coefficient on the share of 100-499 acre farms is negative and significant, suggesting that farms of this size are associated with low output. For a northern county with land grants, the effect of increasing the share of these 100-499 acre farms from the mean of 0.47 to 0.63 (an

[42] The number of land grants is based on land claims submitted to the land commission and not on claims that were actually confirmed. The number is a simple count.
[43] A similar issue regarding productivity per acre on the frontier is discussed in Olmstead and Rhode (2002).

increase of one standard deviation) would be to decrease average production per acre by 15 percent, from $1.20 to $1.04.

Another approach is to compare 1860 output per acre to 1890 output per acre in land grant and non land grant counties. In 1860 property rights were uncertain, whereas in 1890 property rights had largely been resolved. If uncertainty had an effect on agricultural decisions, we would expect agricultural output per acre to be lower in 1860 relative to 1890 in counties with land grants than in counties without land grants. Column 6 of Table 5 shows that agricultural output per acre in 1860 as a fraction of agricultural output in 1890 per acre was indeed lower in counties with land grants and higher in northern counties. Using agricultural output in 1860 as a fraction of agricultural output in 1890 as the dependent variable is problematic for a number of reasons, so in columns 7-8 we use the log of 1890 agricultural output per acre as the dependent variable. In column 7, the log of 1890 agricultural output per acre is regressed on dummy variables for being a northern county and a county with land grants and on the log of 1860 agricultural output per acre. In column 8, we interact both of the dummy variables with the log of 1860 agricultural output. The coefficient on land grants was positive in both cases, indicating that counties with land grants had higher 1890 output per acre either absolutely or as a function of 1860 output per acre. Thus, it appears that the contemporary commentary was correct – uncertain property rights in land led to lower initial levels of agricultural development.

The historical evidence suggested that to the extent that squatters and owners were producing, they were producing wheat or possibly livestock. In Table 6, we examine the effect of land grants on the log of wheat output per improved acre and the log of livestock value per acre for 1860. In column 1, land grant counties had

significantly higher wheat production per improved acre. In column 2, the effect remains significant when we control for the share of 100-499 acre farms. The coefficient on the share of 100-499 acres farms is negative but insignificant, which is consistent with squatters producing relatively little. The coefficient on land grant indicates, however, that to the extent that owners and squatters were engaging in production, wheat was a popular crop. When we conduct the same exercise for livestock per acre in columns 3 and 4, the coefficient on land grant is negative and insignificant, suggesting that by this measure, owners and squatters were not producing more livestock.

Investment in Property Rights

Squatters' investments in property rights appear to have taken a variety of forms including remaining on the property, marking boundaries, fencing, threatening or using violence to protect their property, engaging in law suits, and forming squatters' leagues. Squatters' leagues were reported for most counties and for a number of individual grants. The leagues served two purposes: i) defining and registering property rights and ii) organizing violent and non-violent activities to protect their property rights. For example in 1872, the Monterey Squatters League wrote to a landowner, David Jack "...you have been the cause of unnecessary annoyance and expense to the settlers... Now if you don't make that account of damages to each and every one of [us] within ten days, you son of a bitch, we will suspend your animation between daylight and hell."[44] The League and the City of Monterey sued Jacks in Superior Court, but Jack was not found to have committed any crime. Historian Zoeth Eldredge notes that "In Santa Clara county the "Squatters League" organized an armed force, resisted the execution of the sheriff's writ,

[44] Quoted in Monterey County Historical Society, Oct 2001 article "Land King: The Story of David Jack" by Kenneth C. Jack.

held public meetings and barbecues—which the sheriff's men attended—and indulged in many speeches regarding their rights as American citizens."[45]

Squatters also engaged in expropriation of the owner's property. For instance, in 1853 a ranch manager warned one owner, "[squatters] are using and distroying a great deal of your firewood and timber."[46] In more extreme cases, squatters also consumed or confiscated the owner's cattle.[47]

Owners' investments to deter squatter entry and expropriation were limited, since fencing and policing a large area was both prohibitively expensive and unlikely to deter squatters. The boundaries of grants were rarely well defined and owners did not pursue definition with any great vigor. Part of this was strategic, since when owners finally did survey their property, boundaries would be adjusted – in some cases dramatically so – to include developed land.[48]

Owners' investments in property rights took the form of law suits and occasionally violence against squatter property. Lawsuits were the preferred form, however, since the owner was potentially liable for damage to squatters' property. Tables 3b and 3c provide evidence on lawsuits that reached the California Supreme Court and the Santa Clara County Court. If the courts and sheriff could not removes squatters, owners occasionally resorted to more drastic measures. For example, Mayo Newhall later recounted that on their Todos Santos ranch: "A man was found who, for the consideration of $100, would go on the premises and take possession for us.... One day,

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[45] Eldredge, Zoeth Skinner. *The Beginnings of San Francisco*. 1912: San Francisco

[46] Larkin IX, p. 317. M. T. McClellan to Thomas Larkin, Dec. 22, 1853. For more on this, see Larkin IX, p. 83, Charles Sterling to Thomas Larkin, Feb. 10, 1852, and Clay (1999).

[47] For instance, squatters on the Peralta family's ranch (which covered what is now Oakland and the surrounding area) were eating their cattle. Daily Alta California, July 14, 1853.

[48] For discussion of this practice, see Clay (1999) and Gates (1991).

when all members of the [squatter] family were absent from the premises, the house, in some mysterious manner, caught fire, which consumed all the woodwork–the roof, floors, et cetera."[49]

Violence

The foregoing discussion suggested that violence should be positively correlated with the size of the land grant and the value per acre of the land, because of the greater investments in protecting and expanding property rights. To test this relationship, we will employ two definitions of violent activity: i) a strict one in which the historical record has to clearly indicate injury, death, or property destruction, and ii) a more liberal one in which the historical record only needs to indicate that threats were made or that squatters had an armed confrontation with owners or government officials. We observe violence on 14 of the 71 claims with squatters and violence or threats on 25 of the 71 claims. Like our identification of squatting, this may not represent all instances of violence or threats, but it probably does include the most significant cases, particularly of actual violence. Although ideally one could observe the number of distinct violent activities, we code land grants 1 if there was ever evidence of violent activity and a 0 otherwise.

To identify relationship between violence and our proxies for *N*, we estimate the following logit model for each of our definitions of violence:

$$S_i = \alpha + \beta_1 \, lnV_i + \beta_2 \, lnZ_i + \varepsilon_i, \qquad (2)$$

where *S* is a now dummy variable which assumes a value of 1 if claim *i* had one or more instances of violence or violence and threats, and 0 otherwise; and the other variables are the same as in equation *(1)*.[50]

[49] Newhall (1992), p. 77.

Table 7 reports the regression results for the two measures of violence conditional on observing squatting. In columns 1-3, the dependent variable is 1 if violence is observed and 0 otherwise, and in columns 4-6, the dependent variable is 1 if violence or threats are observed and 0 otherwise. In column 1, the coefficient on the log of the size of the land grant is marginally insignificant, and we drop this term in columns 2 and 3.[51] In all three columns, either the log of population density or the log of land value is positive and significant, indicating that violence was more prevalent on more valuable land. This is consistent with the prediction that to the extent more valuable claims have more squatters, there will be more investment in offensive activities and thus more observed violence.

Somewhat less intuitively, the distance to San Francisco is also consistently positive and significant, which indicates that violence was more prevalent the further claims were from San Francisco.[52] The significance of both value and of distance may reflect countervailing effects. It may be that because of the higher density of squatters on claims closer to San Francisco, owners consciously tried to avoid inflaming squatters. In contrast, owners in more remote areas may have been more likely to file ejection suits, thereby precipitating violence. The pattern may also reflect selection effects in the data, such as underreporting of squatting further from San Francisco unless it was accompanied by violence.

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[50] Recall that we may be observing a subset of all instances of violence or threats. As long as observing violence or threats conditional on observing squatting is not correlated with proxies for value or with the size of the claim, estimates will be unbiased. If observing a contract is positively correlated with value or size, estimates will be biased upward.

[51] The log of size was not significant in any of these specifications. A dummy variable for being a northern county was also never significant.

[52] Conditional on squatting, the correlation of the log of population density with the log of distance is -0.33 and the correlation of the log of land value with the log of distance is -0.37, so it reasonable to include both density or value and distance.

When we relax the definition of violence to include threats in columns 4-6 of Table 7, the variables used in columns 1-3 have little explanatory power. This is may reflect the fact that threats are cheap to issue and thus likely to occur on any grant with squatters, irrespective of value or location.

5. The Failure of Bargaining

California had a legal system to enforce contracts. Thus, owners and squatters could have entered into rental or other land tenure contracts. Both parties would in principle have benefited – owners by receiving at least a nominal payment, and squatters by having the security to raise crops or invest in improvements. Owners received an additional indirect benefit, which was that developed land tended to raise the price of nearby undeveloped land.

The puzzle is that despite these advantages, rental contracts were relatively uncommon. The historical literature has had little to say on the failure of contracting. Paul Gates (1991), a noted agricultural historian, for example, rather superficially accounts for the failure to reach tenure contracts by stating, "Tenancy was rarely a satisfactory position for an American brought up on the assumption that land in the United States was cheap and that everyone would have a piece of it and a share in the prosperity the future was sure to bring."[53]

Evidence on Contracting

A contract was not always necessary, because some owners chose to ignore squatters. For instance, although Luis Robideau complained in 1861 about the squatters on Jurupa, some occupied land as late as 1876, which suggests that the owners had

elected to ignore the problem.[54] Owners might ignore squatters because there were a large number of them, because the land was not very valuable, or because they were hiring them as laborers. The last explanation was unlikely, though, because Indians and Mexicans were cheaper and less problematic than most squatters.

Other owners offered squatters rental contracts. A few squatters, seeing the advantages, entered into a rental contract voluntarily. For those who did agree initially, security of their property rights appears to have been the primary consideration. A ranch manager reported to an agent of the owner in 1852 that "they appear willing to take leases for 3 & 5 years … Some are very desirous of arranging this business as soon as possible, as they are anxious to go on making improvements – fencing, putting in crops &c and wish to know the footing upon which they will stand."[55] Rental contract were, however, not very common. Of the 71 documented cases of squatting, we observe *any* rental agreements in just 13 instances. And in these 13 instances, only a few squatters would have had such agreements.[56]

Although the distribution of outcomes could be the result of biases in the data, Thomas Larkin's experience suggests voluntary tenure contracts were difficult to reach. The owner of three of the land grants – Boga, Jimeno, and Huichica – on which leases were reported, Larkin offered nominal contracts to all takers. Although the rent was not expected to cover the costs of writing the contract, the vast majority of squatters refused to participate. In at least one case, Larkin's threat of ejection transformed someone who

[53] Gates (1991), p. 158.
[54] Gates (1991), p. 308.
[55] Larkin IX, pp. 139-140. Charles Bolivar Sterling to William J. Eames, Sept. 30, 1852.
[56] As with squatting and violence, what we observe is likely a subset of all rental agreements.

was "originally a squatter" into someone who "now acknowledges your title."[57] However, in the case of three other land grants – Sotoyome, Bodega, and Tzabaco – the parties agreed to leases only after squatters had fought, and lost, a costly battle over ejection.[58]

A few owners offered squatters the opportunity to purchase their land without having to support the costs of litigation. Beginning in 1852, Thomas Larkin gave the squatters on his Huichica Rancho the opportunity to buy at a price of $10 an acre for the best land.[59] In 1853 Andres Pico set a price of $1.25 an acre for his Moquelemos claim.[60] Demand at that point does not appear to have been very high. We observe squatters on 18 of the 71 grants eventually purchasing land from the owner. This typically occurred only after claims were confirmed and owners' property rights were more secure. By 1856, Talbot Green, Thomas Larkin's property manager, wrote to Larkin about sales on nearby claims: "The squatters are now beginning to want to buy. Mr. Thoms sold 300 acres for twenty dollars per acre. Another squatter offers the same price for 100 acres, and another fifteen for 200 acres. I think as soon as the news comes out of the confirmation of Redding's grant he will be able to sell all the land he wants to sell at that price, or at least the portion now occupied by squatters."[61]

In Table 8, we explore the determinants of leasing and buying. We estimate the following logit model for observing leasing (buying) conditional on observing squatting:

$$S_i = \alpha + \beta_1 \, lnV_i + \beta_2 \, lnZ_i + \varepsilon_i, \qquad (3)$$

[57] Larkin IX, p. 128. Charles Bolivar Sterling to Thomas Oliver Larkin, Sept. 6, 1852.
[58] Gates (1991), pp. 307-8. Royce (1886).
[59] Larkin IX, p. 119, John Frisbee to Thomas Larkin, August 6, 1852, and X, p. 174, Memorandum on Huichica Lands, July 24, 1855.
[60] Gates (1991), p. 203.
[61] Larkin X, p. 240. Talbot Green to Thomas Larkin, Feb. 9, 1856,

where *S* is a now dummy variable which assumes a value of 1 if claim *i* had one or more instances of squatters' leasing (buying) land, and 0 otherwise; and the other variables are the same as in equation *(1)*.[62]

In column 1, the coefficients on size, land value, and population density are all statistically significant. The fact that leases are observed more frequently on larger claims may reflect the practical issues associated with ejecting larger numbers of squatters and thus the greater incentives owners have to offer contracts.[63] Interestingly, in column 1 land value and population density have different signs, despite being highly correlated (0.81).[64] Leases are observed more frequently on claims in counties with higher land values, but less frequently on claims in counties with higher population density. The positive relationship between leases and land values suggests that the value of reaching a contract may have been higher. The negative relationship between leases and population density suggests that reaching a lease may have been more difficult in counties where squatters were closer together. We will explore the negative relationship between population density and observing leases further later in this section. In columns 2 and 3, we add dummy variables for observing violence or threats to see what their effect is on the likelihood of reaching a lease. Neither is significant.

In column 4, where the dependent variable is now observing any squatters buying land, the coefficient on population density is negative and statistically significant. Squatters in counties with higher population densities are less likely to be observed

[62] Recall that we may be observing a subset of all contracts. As long as observing a contract conditional on observing squatting is not correlated with proxies for value or with the size of the claim, estimates will be unbiased. If observing a contract is positively correlated with value or size, estimates will be biased upward.
[63] It may also reflect a greater probability of observing contracts conditional on their having existed.
[64] It is worth noting that neither is significant when included individually whether or not we control for distance from San Francisco.

buying their land. Size and land value are not statistically significant. In column 5, we examine the effect of violence on observing buying. The coefficient on the dummy variable for violence is negative and statistically significant, and the coefficient on population density remains negative and statistically significant. The negative effect of violence suggests, unsurprisingly, that we are less likely to observe squatters purchasing land. This may be because owners are less likely to offer the land at preferential prices or because squatters are less likely to purchase given the opportunity to buy. In column 6, we replace violence with threats. The coefficient on the dummy variable for threats is not significant.

In sum, what we observe is that: i) leases are more likely on larger claims, ii) land purchases are less likely on claims on which we observe violence, and iii) leases and land purchases are less likely in areas with higher population density.

A Model of Contracting

To identify the reasons for failure, we model individual owner's and squatter's decisions. Assume, as was the case in California, that property rights are well-defined for the (short) periods over which owners and squatters are contracting. Further assume that squatters and owners are profit maximizing. The contracting problem would be relatively simple if it were just a single period problem between a single squatter and a single owner. Most of the economics literature on contracting has focused on cases where a single pair of individuals or organizations fails to contract or on cases where a group of heterogenous players fails to reach a single multi-player contract (see Libecap 1999 for a discussion of this literature). Here the problem is more complex, because many pairs of individuals are contracting at different points in time. The multiperiod

nature of the problem and the existence of these other pairs may make it more difficult to reach a contract. The details of the model are presented in the appendix.

A number of comparative statics come out of a multiperiod analysis of the owner's problem. It is straightforward to show that an owner can always design a rental contract that offers at least as high a payoff to the owner as tolerating squatters. So the choice for the owner is whether to offer a contract or eject the squatter. In the appendix, we show that the likelihood of offering squatters a rental contract is higher, if (i) the opportunity cost of tolerating a squatter is lower, (ii) the cost of ejection is higher, or (iii) the conditional probability of having to eject squatters in the next period is higher.

The possibility of having to eject multiple individuals from the same piece of land is important because of its relationship to two types of externalities. The first type is the effect that an owner's current decisions have on future squatting. Establishing a reputation for ejecting squatters could create an incentive for future squatters to locate elsewhere. The second type is the effect that other landowners have on an owner's decision. If other owners were ejecting their squatters and a given (non-ejecting) owner was not, then future squatters would be more likely to squat on the non-ejecting owner's land. Conversely, if other owners were tolerating their squatters and a given (ejecting) owner was ejecting squatters, then future squatters would be less likely to squat on the ejecting owner's land.

Assume, as was the case in California, that at least some owners find it in their interest to offer squatters a rental contract. The question then is whether squatters, conditional on being offered a contract, will accept. The multiperiod analysis of the squatter's problem similarly generates a number of comparative statics. A squatter will be less likely to accept a contract, if (i) the benefits from additional security of tenure are

lower, (ii) the social costs of accepting a contract are higher, or (iii) the (subjective) probability the squatter assigns to the owner tolerating his presence if he rejects the contract is higher. For example, the benefits from additional security will be low if the squatter does not plan to engage in significant agricultural activities. The costs of accepting a contract will be high if other squatters impose a penalty on the squatter for accepting a contract. And the benefits of accepting the contract depend on whether the squatter believes that the owner will tolerate his presence or eject him if he refuses.

Evidence on the Reasons for the Failure of Contracting

The model identifies specific reasons why owners and squatters may have failed to reach tenure contracts. In this subsection, we present evidence from the historical record regarding these reasons.

The model identifies three conditions under which an owner would want to offer a contract: (i) the opportunity of tolerating a squatter was low; (ii) the cost of ejection was high; and (iii) the owner was likely to have to eject additional squatters in the next period. Some owners, notably Thomas Larkin, viewed squatters as having net benefits, since they tended to raise the value of nearby undeveloped land and offered a ready market for land sales if land claims were confirmed. So the opportunity cost of tolerating a squatter would have been low. As was discussed previously, the available evidence on dollar cost of ejection indicates that the cost of ejecting a squatter was relatively high. To the extent that an owner believed that squatting had net benefits and that the cost of ejection was high, he would be predisposed to offering a contract

The value of a contract for some owners may have been mitigated by the possibility of having to eject additional squatters in the next period. Recall that this is related to two externalities. The first was the link between an owner's current behavior

and future squatting. The importance of developing a reputation for ejecting squatters became evident to Captain Folsom in 1854. When Folsom bought off a group of squatters rather than fight them, the group moved immediately to another site that he owned. This time he fought and eventually drove them off.[65] More generally, owners and squatters seem to have had the sense that they could affect patterns of settlement. Coin B. Storm, in an 1852 letter to Thomas Larkin, asked to be Larkin's agent and remarked, "[your land] lacks settlers of the right stamp," implying that he could address this problem.[66]

The second externality was the effect on one owner of other owners' behavior. There is no direct evidence of squatters stampeding to more tolerant owners' land. On the other hand, when land owned by Thomas Larkin, who tended to tolerate squatters, became cluttered, Charles McIntire decided instead to settle on adjacent land owned by Salvador Vallejo.[67] Thus, Vallejo was affected by Larkin's decision to tolerate squatters.

Overall, the owners faced a variety of factors when deciding whether to offer squatters a contract or eject them. We know, however, that some owners did offer squatters contracts and that most squatters rejected these contracts unless ejection was a virtual certainty.

The model identifies the three reasons why squatters would reject a contract if offered: (i) low benefits, (ii) peer pressure, and (iii) a low subjective probability of ejection. The benefits of a voluntary contract for squatters who did not engage in agriculture might have been small. For squatters who wanted to make or already had

[65] Hittell (1898) III, p. 684.
[66] Larkin IX, p. 117. Coin B. Storm to Thomas Larkin, July 29, 1852
[67] Larkin IX, p. 112. Charles McIntire to Thomas Larkin, July 5, 1852.

made investments in houses, fences, clearing trees or other improvements, however, a voluntary contract with low rent would appear to have been a cheap form of insurance.

Pressure by other squatters not to accept voluntary leases would seem to have played a role in the refusal of even nominal contracts, such as those offered by Thomas Larkin. Michael McClellan, a squatter on the Huichica ranch, reminded Thomas Larkin that "there is no man who has paid more respect to your title and advocated it all the time than myself, and all my neighbors on your grant are my enemies on that account except John McGimpsey below me on the creek."[68] Members of formal squatters' leagues exerted even more pressure on other members not to accept voluntary leases. Recall that in Table 8, we found that leases were less common on claims in counties with higher population densities. This is consistent with peer pressure playing an important role in contracting.

The squatters' beliefs about the likelihood of ejection remain unknown. A certain optimism about their ability to avoid ejection is suggested by the fact that in 1861 "five hundred men in San Mateo and seven thousand in Santa Clara County were sworn to resist further arbitrary ejections" from the Las Pulgas land grant.[69] Early on before the owners' property rights were definitively established and squatters' property rights in their improvements were definitively rejected, the optimism may well have been warranted. Further, delaying reaching a contract may have been useful, because it allowed time for new information to arrive regarding both the legal climate and the owner's propensity to eject. The role of imperfect information as a factor in failure to

[68] Larkin X, pp. 165-166. Michael T. McClellan to Thomas Larkin, July 4, 1855.
[69] Sacramento Bee quoted in Gates (1991), p. 307.

reach a contract has been emphasized in other settings (Libecap 1999, Kennan and Wilson 1989, Cramton 1992).

A related issue could well have made bargaining difficult. Squatters may have had self-serving biases about what was fair. Self serving biases arise when people decide that what is in their interest is also 'fair' and refuse to accept offers that they perceive as unfair (Babcock and Loewenstein 1997). Considering that owners' rights were well established at the time, Orson Lyon, the defendant in an 1863 ejectment suit, could be interpreted as having a self serving bias. Lyon argued, "That land is Public land belonging to the United State of America and at the time of the entry by this Defendant said land was vacant ... this Defendant made entry on said lands for the purpose preempting the same under the laws of the government."[70] Lyon expressed the beliefs of many squatters, who felt that large land grants were un-American and that all of the land in California should have become part of the public domain and opened to entry.[71]

Together with peer pressure, any biases in individual squatters' beliefs about what was fair and what the probability of ejection was could easily lead to the failure of bargaining. Given the lack of a contract, squatters then had little incentives to engage in agriculture, so any priors about the low benefits to a contract became self-fulfilling. The California experience also suggests that in other settings private contracting between owners and squatters is unlikely to spontaneously arise and thereby mediate the negative effects of uncertain property rights.

Ejection and Violence

[70] Javier Alviso v. Orson Lyon, Third District Court, Santa Clara County (1863).
[71] Pisani (1994) reviews much of the squatter debate.

For the squatter, leaving peacefully following the loss of an ejection suit would appear to have had a higher payoff than resisting, which put his person and property at risk. If a squatter left peacefully, however, he lost – and the owner gained – all of his improvements. This division suggests that the squatter might have been able to gain by threatening to destroy his improvements, unless the owner paid him for them. If he could obtain a positive payoff from the owner for his improvements with positive probability, then the squatter could always have gained by threatening to destroy his improvements.

An owner could have responded to the threat either by paying the squatter for his improvements or ignoring it. Given that buying out claims they would otherwise get for free was costly, owners would only have paid if they viewed the threats as credible. If all squatters were the same, then their threats would all have been either credible or not credible. If the owners could determine which it would be, then violence should never have been observed, because either the owner paid or the squatters left peacefully.[72]

Violence could occur, however, if squatters were of different types unknown to the owners. If squatters differed, for instance, in their levels of risk aversion, they may have used violence as a way to signal that their type. Having to engage in violence in order to signal their type was costly, so squatters only wanted to do so if the benefits of resisting were greater than the costs of violence. If an owner viewed a squatter's threat to do further damage as credible, then he may have preferred to pay to avoid further violence.

[72] Similarly, if all owners were the same, then either all owners would pay squatters who resisted, or they would all refuse to pay. In the latter case, squatters would not resist.

This describes a signaling model. In equilibrium, low types leave peacefully and high types fight. For a summary of these models, see Fudenberg and Tirole (1991), Chapter 11.

The historical record supports the hypothesis that violence was a way for some squatters to signal their willingness to engage in further violence. Squatters specified prices for which they would give up their claims. Nicholas Gray, for instance, reported to William Eames in 1851: "He [the squatter] said if he was paid the sum he expended in building his house about $1000 (a frame house 1 1/2 stories lined within & covered with iron) he would give up his claim."[73] Before A. Drullard began to shoot at him, John Balkwill had offered to leave for $1200. The offer had been rejected.[74] The owners of San Bernardino, however, ended their one-year standoff with Jerome Benson by paying him.[75] And thirty families on Pulgas resisted but left with an "equitable allowance" for their improvements.[76]

6. Conclusion and Implications

Extremely uncertain property rights in California in the 1850s and 1860s caused by the change in national governments together with the population pressures of the gold rush led to widespread squatting on agricultural land held by the owners of Spanish and Mexican land grants. Both direct historical evidence on the location of squatters and indirect evidence from the 1860 Census of Agriculture indicate that squatters chose to squat on high value land. Cross sectional regressions for 1860 and growth regressions for 1860-1890 show that agricultural production per acre in counties with land grants was significantly negatively effected. The low levels of agricultural production suggest that squatters may have been investing in protection of property rights. Anecdotal evidence

[73] Larkin IX, p. 68. Nicholas Gray to William J. Eames, Dec. 10, 1851.
[74] Hittell (1898) III, p. 689-690.
[75] Robinson (1948), p. 127.
[76] Gates (1991), p. 203.

on squatter investment in property rights and direct evidence on patterns of violence indicate that, consistent with models of anarchy, squatters appear to have invested more in protecting their property rights on higher value land. Violence was also a common tool to extract payment after the courts had definitively recognized owners' property rights. Thus, the location and timing of violence were to some degree predictable.

The magnitude of the negative effect of uncertain property rights on agricultural production in California suggests that losses in United States agricultural output from insecure property rights during the eighteenth and nineteenth centuries may be significantly larger than previously recognized.[77] Property rights are known to have been uncertain in many parts of the original thirteen colonies, in territory acquired from foreign governments, and in the public domain prior to sale. The conventional story is that the movement westward typically involved movement into more marginal soils, leading to lower average productivity. While the quality of the soil may have been lower in some locations, lower productivity may also reflect farmers' need to invest in property rights.[78]

Although the courts could enforce contracts, land tenure contracts between owners and squatters were rare. The model identified reasons why owners might prefer to eject squatters rather than offer a contract, even though ejection was costly. Yet, several owners offered contracts, and squatters routinely rejected such offers even at extremely low rental rates. Peer pressure from other squatters, benefits to delay early on, and self serving biases about what was fair all appear to have contributed to the failure of

[77] Unfortunately, data on output prior to 1860 is quite limited, without new data it may not be possible to quantify the magnitude of the loss.
[78] Olmstead and Rhode (2002) discuss the conventional story and Parker and Klein's productivity calculations, which support the conventional story.

contracting. This left little to be done about the low output other than wait for the resolution of property rights.

The federal and state governments took crucial steps that affected the scope of squatting and the degree of violence associated with squatting. The California state government punished criminal conduct by both squatters and owners and forced owners to use the courts to evict squatters.[79] Thus, violence tended to take the form property damage or gunfire and typically did not lead to serious injury or death. The federal and state governments, despite repeated attempts by squatter interests, did not ultimately give squatters rights in their improvements or other forms of quasi-rights.[80] The federal and state legislatures were able to resist efforts of squatter lobbying groups, in part because the courts were made solely responsible for resolution of property rights disputes. This resistance limited the incentives for new individuals to engage in squatting, and likely indirectly limited the scope of violence.

The California experience provides insights that may be useful for understanding squatting in other settings, notably the Third World. The effects of insecure property rights in the Third World on output and access to capital markets have already received significant attention from policymakers and academics (World Bank (2002), Field (2003), Field and Torero 2004), Lanjouw and Levy (2002), Besley (1995), and Alston, Libecap, and Schneider (1995, 1996)). Perhaps it is not surprising that even if land tenure contracts were enforceable, private contracting between squatters and owners is unlikely to spontaneously arise on a large scale to mitigate the negative effects of insecure property rights. Two lessons that have received less attention are that i) patterns

[79] On crime and punishment of crime in California, see Berk et al (1981), Friedman and Percival (1981), McKanna (2002), and Bakken (2003).

of squatting and violence are to some degree predictable, and ii) the government can affect incentives to squat. To the extent that patterns of squatting and violence are predictable, whatever the cause, resources can be allocated to the highest risk areas to prevent or mitigate the effects of violence. Alston, Libecap, and Mueller (1999, 2000) examine violence and government in the context of rural Brazil and find that the government was providing an incentive for squatters to take up land and engage in violent behavior, which induced the government to intervene. In California, the patterns of violence stemmed from different causes, namely, squatter and owner investment in property rights, and an endgame in which squatters used violence to extract payment for improvements. Government enforcement of existing criminal and property law and resistance by policymakers and the courts to modification of existing property rights to allow for squatter rights can make squatting less attractive than it might otherwise be. Legislative bodies may be able to commit not to intervene by making the courts the focal point for dispute resolution.

[80] See Gates (1991), Chapter 6 (pp. 156-184).

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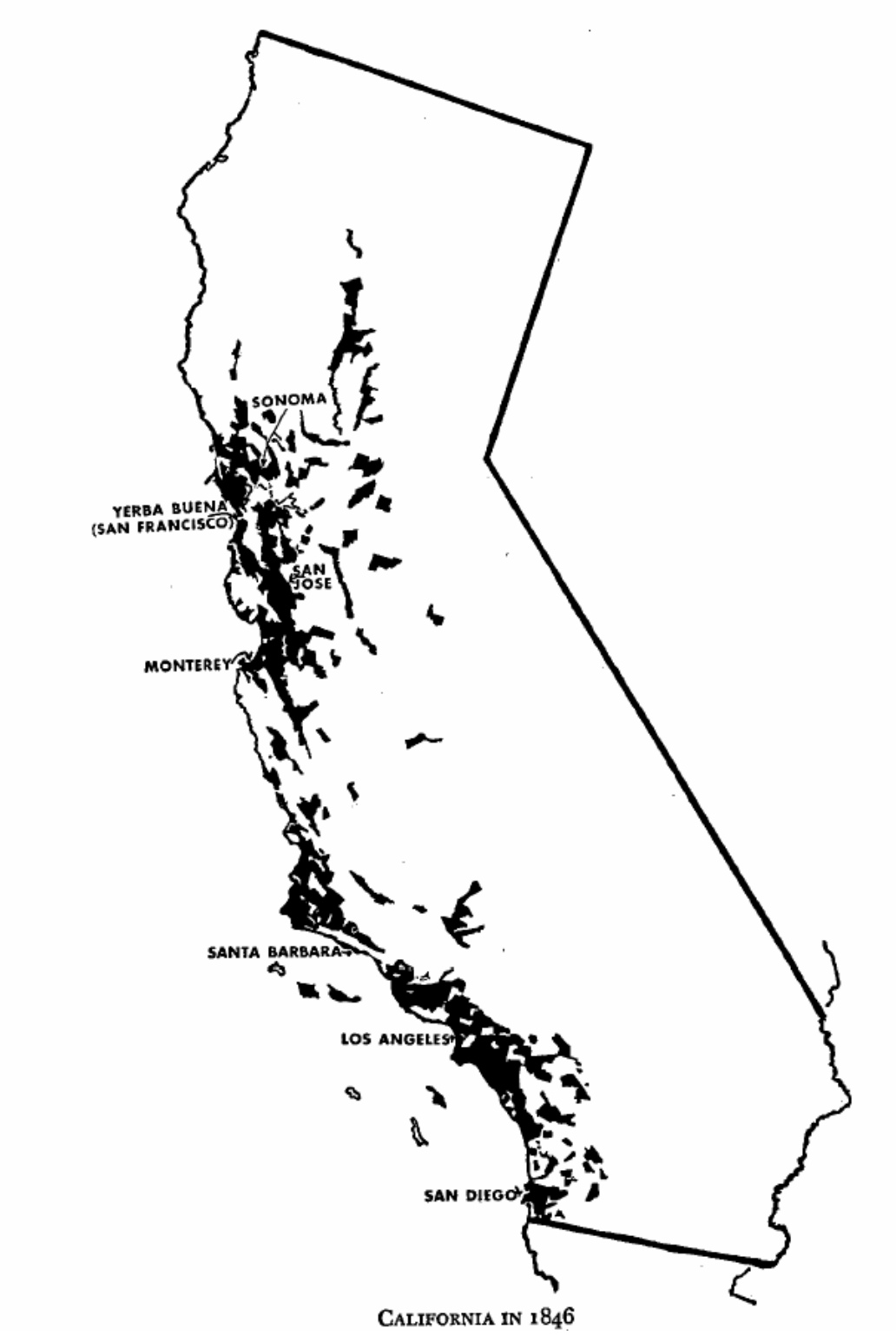
Figure 1: Map Showing Location of Land Grants



From Robinson (1948), p. 68.

Table 1: Characteristics of White Native-Born Men Living in Land Grant Counties

Occupation	Age	Real Property	Personal Property	Currently Married	Family Size	Number obs.
All	31.8 (8.0)	648 (3303)	777 (3388)	0.41 (0.49)	2.35 (2.22)	556
Mining	31.4 (7.2)	40 (321)	100 (270)	0.05 (0.21)	1.31 (0.85)	124
Laborers	28.2 (6.4)	126 (1352)	114 (362)	0.41 (0.49)	1.73 (1.77)	123
Farmer (owner or tenant)	33.8 (8.1)	2019 (6469)	2535 (7039)	0.63 (0.48)	3.75 (2.45)	110
Nonoccupational response	32.2 (10.7)	15.6 (88.4)	462 (1879)	0.53 (0.51)	3.6 (2.9)	32
Other	33.3 (8.3)	693 (2357)	659 (1410)	0.51 (0.50)	2.4 (2.3)	166
Farmer with $0 real property	32.1 (7.9)	0	767 (1350)	0.63 (0.49)	3.8 (2.3)	56
Farmer $1-4999 real property	35.9 (7.9)	1276 (868)	2800 (4581)	0.59 (0.50)	3.5 (2.6)	44
Farmer > $5000 real property	35.2 (9.1)	15270 (15450)	10483 (18910)	0.82 (0.40)	4.2 (2.9)	11
Non-farmer > $5000	39.9 (7.2)	10333 (5123)	3772 (3762)	1 (0)	2.9 (1.7)	9
Foreigner > $5000 real prop.	34.8 (6.5)	8000 (4123)	2300 (2334)	0.8 (0.45)	4.4 (1.9)	5

Notes: All data are from the IPUMs 1860 1-100 sample of the Census of Population. With the exception of the last row, the sample is restricted to white males ages 20-59 who were native born and live in land grant counties. Mining is occ1950 = 650; farmer is occ1950 = 100, laborer is occ1950 = 820 or 970, nonoccupation response is occ1950 = 995, other is all other occ1950 codes. Numbers in parenthesis are standard deviations.

Table 2a: Indirect Evidence on the Number of Squatters in 1860

	Farm 3-9	Farm 10-19	Farm 20-49	Farm 50-99	Farm 100-499	Farm 500-999	Farm 1000+
Farms in LG counties	596	788	1,671	1,928	5,426	409	231
Farms in non-LG counties	229	299	644	489	1,093	127	31
Farms in North	744	944	2,059	2,228	6,312	511	241
Farms in South	81	143	256	189	207	25	21

Table 2b: Indirect Evidence on the Number of Squatters in 1860

	(1)	(2)
Dep. Var.	100-499 farms/ all farms	100-499 farms/ all farms
Land Grant	0.166*** 0.060	-0.113 0.081
North	0.280*** 0.073	
Lg*North		0.280*** 0.073
Constant	0.032 0.088	0.313*** 0.049
Adjusted RSquared	0.273	0.273
Observations	43	43

Notes: Data is from the 1860 Census of Agriculture. San Francisco is excluded. In this and all subsequent tables, * indicates the coefficient is significantly different from zero at the 10 percent level, ** indicates the coefficient is significantly different from zero at the 5 percent level, and *** the coefficient is significantly different from zero at the 1 percent level.

Table 3a: Squatting on Land Grants – Examples from Primary and Secondary Sources

Land Grant	**County**	**Year**	*# of squatters*
San Antonio	Alameda	1850, 1853	1500 in 1854
San Leandro	Alameda		indeterminate
Boga	Butte		indeterminate
Arroyo Chico	Butte	1851	indeterminate
Moquelemos	San Joaquin	1853	indeterminate
Jimeno	Colusa	before 1855	indeterminate
Larkin Children's	Glenn		indeterminate
Mission San Gabriel	Los Angeles	1855	300-500
Punta de los Reyes	Marin	1854	indeterminate
Mariposa	Mariposa		15,000 in 1856
Huichica	Napa		indeterminate
La Jota	Napa	1859	indeterminate
Jurupa	San Bernardino	1861	25
San Bernardino	San Bernardino	1857	1
Pescadero	San Joaquin	1856/7	indeterminate
Pulgas	San Mateo	1853, 1861	at least 26
Dos Pueblos	Santa Barbara	after 1866	indeterminate
Jesus Maria	Santa Barbara	1874	2
San Marco	Santa Barbara	1863	at least 17
Santa Rosa	Santa Barbara	1861	1
Todos Santos	Santa Barbara		a family
Yerba Buena	Santa Clara		indeterminate
Shoquel	Santa Cruz	after 1850	indeterminate
San Buenaventura	Shasta	1856	indeterminate
Suisun	Solano	1854	at least 3
Bodega	Sonoma	1859	at least 30
Petaluma	Sonoma		indeterminate
Sotoyome	Sonoma	after 1859,1862	indeterminate
Tzabaco	Sonoma	1853, 1858	200
Los Saucos	Tehama	1856	indeterminate
Ex Mission San Buenaventura	Ventura	1869	indeterminate
Sespe	Ventura	1877	indeterminate
Honcut	Yuba	1850-1	indeterminate
New Helvetia (Sacramento)	Yuba	1849-50	indeterminate

Notes: Under year, blanks indicate that the timing could not be determined. In cases where a grant overlapped multiple counties, it was assigned to the county in which the majority of the land was located.

Table 3b: Squatting on Land Grants – California Supreme Court, 1850-1869

Number of Ejection Cases Related to Squatting		52
Number in San Francisco		4
Number where location cannot be identified		23
Number matched to land grants		25
Land Grant	**County**	*Year Cases Reach CSC*
*San Antonio	Alameda	1853
San Lorenzo	Alameda	1861
Fernandez	Butte	1859
*La Jota	Napa	1859
Omochumnes	Sacramento	1856
Rio de los Americanos	Sacramento	1860
Campo de las Franceses	San Joaquin	1861
*Pulgas	San Mateo	1860
Canada de Guadalupe Visitacion y Rodeo Viejo	San Mateo	1862
San Mateo	San Mateo	1861
Pastoria de las Borregas	Santa Clara	1861, 1867
Rinconada de los Gatos	Santa Clara	1854
Ulistac	Santa Clara	1867
Los Putos	Solano	1860
Roblar de la Miseria	Sonoma	1862, 1864
Johnson's Ranch	Yuba	1860
*New Helvetia	Yuba	1854 (2), 1857, 1860 (3), 1861

Notes: *'s indicate that evidence of squatting was found elsewhere in the historical record (these grants are also listed in Table 3a).

Table 3c: Squatting on Land Grants – Santa Clara County, 1863-1868

Number of Ejection Cases Related to Squatting		83
Number Filed but Later Dropped		36
Number Filed and Prosecuted		47
Of 83, number in San Jose		9
Of 83, number where location cannot be identified		70
Of 83, number matched to land grants		4
Land Grant	**County**	*Year Cases Reach SCC*
Portrero de Santa Clara	Santa Clara	1863
Rinconada del Arroyo de San Francisquito	Santa Clara	1863/4
San Juan Bautista	Santa Clara	1863
San Ysidro	Santa Clara	1863

Notes: Ejection cases represented 11 percent of the caseload over the period 1863-1868. Of the 9 cases in San Jose, 6 were dropped and 3 were brought to trial. Of the 4 matched to land grants, 2 were dropped (Portrero and Rinconada) and 2 were brought to trial (San Juan Bautista and San Ysidro). Of the 70 remaining cases, 28 were dropped and 42 were brought to trial.

Table 4a: Summary Statistics for Land Grants

	Mean	SD	Median	Min	Max
Claim size (1 league = 4438 acres)	3.76	3.58	3	.00004	20
1860 Population density (people/sq.mi)	4.42	4.81	1.40	.23	24.99
1860 Land value (dollars/acre)	6.65	5.88	5	1	18
Distance to San Francisco (miles)	132.29	120.62	77.6	12.6	392

Notes: As noted land value and population density are values based on the 1860 Censuses of Population and Agriculture. Distance to San Francisco is the distance from the centroid of the county.

Table 4b: Logit of Squatting on Land Grants

	(1)	(2)	(3)	(4)
Dependent variable	1 = observe squatting on land grant 0 = do not observe squatting on land grant			
Lnsize	1.070*** 0.233	1.089*** 0.235	0.966*** 0.256	1.116*** 0.271
Lnpopdens	0.973*** 0.254			
Lnlandvalue		0.766*** 0.252		
North			1.691*** 0.644	
LndistSF				-0.476** 0.220
Constant	-5.436*** 0.634	-5.239*** 0.714	-5.038*** 0.684	-2.024** 0.984
Pseudo R squared	0.151	0.135	0.122	0.101
Observations	750	750	750	750

Notes: The standard errors are clustered by county to account for the correlation across grants in the values of population density, land value, and distance from San Francisco.

Table 5: Effect of Land Grants on Agricultural Output

	(1)	(2)	(3)	(4)
Dep. Var.	Ln (Output/acre) 1860	Ln (Output/acre) 1870	Ln (Output/acre) 1880	Ln (Output/acre) 1890
Land Grant	-0.504**	-0.144	-0.031	0.297*
	0.232	0.192	0.161	0.161
North	2.242***	1.086***	0.672***	0.330
	0.282	0.233	0.195	0.197
Constant	-0.554	0.694***	0.681***	0.822***
	0.340	0.267	0.225	0.227
Adjusted RSquared	0.659	0.323	0.208	0.096
Observations	43	49	51	52
	(5)	(6)	(7)	(8)
Dep. Var.	Ln (Output/acre) 1860	1860 Output/ 1890 Output	Ln1890 Output	Ln1890 Output
Land Grant	-0.334	-0.263*	0.837**	
	0.248	0.131	0.323	
North	2.528***	0.333**	-1.076**	
	0.322	0.1553	0.429	
100-499 farms share	-1.020*			
	0.596			
Ln 1860 output			0.367**	0.363*
			0.168	0.193
LG*Ln 1860 output				0.068**
				0.025
North*Ln 1860 output				-0.087**
				0.035
Constant	-0.521	0.319*	9.767***	9.832***
	0.333	0.189	1.917	2.134
Adjusted RSquared	0.675	0.192	0.333	0.326
Observations	43	42	42	42

Notes: All amounts are in nominal dollars. Output per acre was falling in part due to an agricultural depression in the 1880s. It is possible to aggregate the 1870 and 1880 counties to match the 1860 counties. The counties were not made geographically consistent across columns 1-4. In columns 6-8, nine 1890 counties were aggregated to match the 1860 counties. One 1860 county was dismantled and that county was aggregated with the successor counties, reducing the number of 1860 observations in columns 6-8 from 43 to 42.

Table 6: Effect of Land Grants on Wheat and Livestock in 1860

	(1)	(2)	(3)	(4)
Dep. Var.	Ln(wheat/acre)	Ln(wheat/acre)	Ln(livestock/ac.)	Ln(livestock/ac.)
Land Grant	0.399** 0.195	0.502** 0.211	-0.275 0.201	-0.352 0.220
North	0.028 0.237	0.201 0.275	1.151*** 0.244	1.021*** 0.286
100-499 acre farms as share all farms		-0.617 0.508		0.464 0.529
Constant	0.738** 0.285	0.201 0.275		0.901*** 0.296
Adjusted RSquared	0.054	0.065	0.398	0.438
Observations	43	43	43	43

Notes: Wheat is measured in bushels and is divided by improved acres. Livestock is measured in dollars and is divided by the sum of improved and unimproved acres.

Table 7: Logit of Violence/Threat on Land Grants

	(1)	(2)	(3)
Dependent variable	1 = observe violence on land grant 0 = do not observe violence on land grant		
Lnsize	0.525 0.325		
Lnpopdens			0.901*** 0.227
Lnlandvalue	1.141** 0.491	1.033** 0.466	
LndistSF	1.226** 0.499	1.231** 0.508	1.013*** 0.386
Constant	-9.718*** 3.142	-8.551* 3.083	-7.291*** 2.126
Pseudo R squared	0.113	0.098	0.118
Observations	71	71	71
	(4)	(5)	(6)
Dependent variable	1 = observe threat or violence on land grant 0 = do not observe threat or violence on land grant		
Lnsize	0.682 0.500		
Lnpopdens			0.365 0.251
Lnlandvalue	0.472** 0.240	0.337 0.245	
LndistSF	-0.379 0.311	-0.301 0.251	-0.322 0.257
Constant	-1.403 1.055	-0.183 0.992	-0.120 1.012
Pseudo R squared	0.062	0.035	0.036
Observations	71	71	71

Notes: The standard errors are clustered by county to account for the correlation across grants in the values of population density, land value, and distance from San Francisco. In unreported regressions, the variable North was not significant in any of the above specifications when it was substituted for the log of distance.

Table 8: Logit of Lease/Purchase on Land Grants

	(1)	(2)	(3)
Dependent variable	1 = observe squatter lease on land grant 0 = do not observe lease on land grant		
Lnsize	1.344** 0.554	1.614** 0.784	1.235** 0.557
Lnpopdens	-2.014** 0.805	-3.027* 1.558	-2.125*** 0.816
Lnlandvalue	1.943** 0.772	2.582** 1.250	1.819** 0.735
LndistSF	-0.739 0.524	-1.342 0.907	-0.615 0.553
Violence		2.152 1.712	
Threat			1.272 0.942
Constant	-1.572 2.637	0.064 2.981	-1.946 2.886
Pseudo R squared	0.157	0.230	0.203
Observations	71	71	71
	(4)	(5)	(6)
Dependent variable	1 = observe squatter purchase on land grant 0 = do not observe purchase on land grant		
Lnsize	2.144 1.388	2.289 1.454	2.222 1.474
Lnpopdens	-1.772* 1.014	-1.633* 0.991	-1.782* 1.061
Lnlandvalue	1.441 1.270	1.366 1.329	1.588 1.416
Violence		-1.954** 0.856	
Threat			-0.707 0.761
Constant	-4.821 3.825	-4.917 4.068	-4.984 4.152
Pseudo R squared	0.216	0.269	0.229
Observations	71	71	71

Appendix

The Owner's Decision

Variable:	Definition:
T	number of time periods until resolution of property rights, which is assumed to be fixed and known to both owners and squatters
β	the owner's discount rate
o	the one period opportunity cost of the use of the land
x	the one period cost of any externality arising from squatting
s	the owner's subjective probability that he will win the case at time T
p	the probability that if a squatter is on the land the owner will have to eject him (i.e., the squatter will not leave voluntarily) at time T
c	the cost of ejecting one squatter
α	the percentage reduction in the one period externality, x
r	the one period rent
e	the probability that if the owner ejects a squatter he will have to eject a squatter from the same land the next period

The owner can take three possible actions against a squatter.[81] If he tolerates the involuntary contract, he loses both the one-period opportunity cost, *o*, and the one-period cost of any externality that the squatter may impose, *x*, in each of *T* periods. The owner believes that he will win his case at the end of *T* periods with probability *s*. If he wins, he will have to eject the squatter with probability p, which will cost an amount *c*. Thus the total cost of the involuntary contract for an owner with a discount rate β is:

$$IVC(T,\beta,o,x,s,p,c) = \left\{\sum_{i=0}^{T-1}\beta^{i}(o+x)\right\} + \beta^{T}s\cdot p\cdot c.$$[82]

[81] It is assumed that squatters will only agree to buy the land after the resolution of the uncertainty at time T. Thus, sale of the land is not one of the owner's choices.

[82] In this model, it is assumed the owner would never want to deviate from his original decision. This can verified by showing that there is no time k at which it is profitable to change.

If he enters into a voluntary contract, in each period the opportunity cost, *o*, and the externality, *x*, are offset by the rent, *r*, and any reduction in the externality, αx.[83] Thus the total cost of a voluntary contract for an owner with a discount rate β is:

$$VC(T,\beta,o,\alpha,x,r,s,p,c) = \left\{\sum_{i=0}^{T-1}\beta^i(o+(1-\alpha)x-r)\right\} + \beta^T s\cdot p\cdot c.$$

If the owner ejects the squatter, he pays a cost, *c*, and will have to eject another squatter from that land in the next period (and any subsequent period) with probability, *e*.[84] Thus the total cost of an ejection for an owner with a discount rate β is:

$$E(T,\beta,e,s,p,c) = \left\{c + \sum_{i=1}^{T-1}\beta^i e\cdot c\right\} + \beta^T s\cdot p\cdot c\cdot e.$$

Reputation enters through *e*, the probability of having to eject another squatter in the next period. Stronger reputational effects will result in lower values of *e*. Incorporating the externality associated with the existence of many owners lowers *e* even further.

The owner therefore chooses a contract by solving the following minimization problem:

$$\text{Min}\left[\left\{\sum_{i=0}^{T-1}\beta^i(o+x)\right\} + \beta^T spc, \left\{\sum_{i=0}^{T-1}\beta^i(o+(1-\alpha)x-r)\right\} + \beta^T spc, \left\{c+\sum_{i=1}^{T-1}\beta^i e\cdot c\right\} + \beta^T spce\right].$$

Note that the owner will always choose a voluntary contract over an involuntary contract, because he will always be at least as well off under the voluntary one and will be better off if the sum of the rent and the mitigation of externalities is positive. Hence the owner need only decide between a voluntary contract and ejection. He will choose to eject if:

$$\left\{\sum_{i=0}^{T-1}\beta^i(o+(1-\alpha)x-r-ec)\right\} - c(1-e)\left\{1-\beta^T sp\right\} \geq 0$$

The inequality indicates that ejection will be more likely for higher values of *o*, the opportunity cost; *x*, the externality; *s*, the owners' subjective probability of winning his

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[83] The rent, r, that an owner offers is assumed to be incentive compatible. In other words, if it is offered, the squatter will agree to the contract. The constraints may be such that r = 0 and therefore $\alpha = 0$. The voluntary contract is assumed to last T periods. It is straightforward to show that neither party would prefer a shorter contract.

[84] In this model, e is assumed to be fixed. A more complex model would allow e to vary with the number of prior ejections.

case; or *p*, the conditional probability of having to eject a squatter at time *T*. Similarly, ejection will be more likely for lower values of *c*, the cost of ejection; α, the reduction in the externality; *r*, the one period rent; or *e*, the conditional probability of having to eject a squatter the next period. The comparative statics on β, the owner's discount rate, and *T*, the number of periods until determination of property rights, depend on the sign and the magnitude of $(o + (1 - \alpha)x - r - ec)$.

The Squatter's Decision

Variable:	Definition:
f	the cost of violence to the squatter
I	what the squatter receives from the owner for his improvements
w	the squatter's subjective probability of receiving payment I from the owner
T	number of time periods until resolution of property rights, which is assumed to be fixed and known to both owners and squatters
δ	the squatter's discount rate
a	the one period gain from use of the land
b	the additional one period benefit from a voluntary contract
r	the one period rent
q	the one period penalty imposed by other squatters for accepting a contract
v	the squatter's subjective probability that he will win the case at time T
V	the net value of the land that the squatter receives he wins the case
t	the squatter's subjective probability that the owner will tolerate his presence if he rejects the voluntary contract.

It is easiest to understand the squatter's decision to accept or reject a contract by first understanding what might happen if he does reject it and the owner decides to eject him.

The Decision to Leave or Violently Resist Ejection

If a squatter simply leaves voluntarily, he gets a payoff of 0 and the owner gets the value of his improvements. If, however, the squatter signals to the owner through

violence that he will fight for the value of his claim, he may receive payment for his improvements. If fighting involves some cost, *f*, for which he will receive a payment, *I*, for his improvements, with probability *w*, then his payoff if he resists is: $V(f, I, w) = -f(1-w) + (I-f)\cdot w$. Thus, he solves the following maximization problem: $\text{Max}\ \{0, -f(1-w) + (I-f)\cdot w\}$. If the expected payoff to resisting is greater than zero, then the squatter resists.

The Decision to Accept or Reject a Contract

If offered a voluntary contract, a squatter can either accept it or reject it. If he accepts it, in addition to the one-period benefit, *a*, he receives a benefit, *b*, pays rent, *r*, and is subject to a penalty, *q*, which other squatters impose on him for accepting a contract, in each of *T* periods. The squatter believes that he will win the case at the end of *T* period with probability *v*. If he wins, he retains land with value *V*. Thus the total benefit of a voluntary contract for a squatter with a discount rate δ is:

$$VC(T, \delta, a, b, r, q, v, V) = \left\{\sum_{i=0}^{T-1} \delta^i (a + b - r - q)\right\} + \delta^T v \cdot V.$$

If he rejects a voluntary contract, then his benefits depend on (i) whether the owner tolerates or ejects him and (ii) if the owner ejects him, whether the owner pays him for his improvements or not. If his subjective probability of toleration is *t*, then

$$R(f, I, w, T, \delta, t, a, v, V) = t\left\{\left(\sum_{i=0}^{T-1} \delta^i a\right) + \delta^T v \cdot V\right\} + (1-t)\cdot \text{Max}\ (0, -f(1-w) + (I-f)w).$$

The squatter therefore chooses a response to the owner's offer by solving the following maximization problem:

$$\text{Max}\left[\left\{\sum_{i=0}^{T-1} \delta^i (a + b - r - q)\right\} + \delta^T vV,\ t\left(\left\{\sum_{i=0}^{T-1} \delta^i a\right\} + \delta^T vV\right) + (1-t)\cdot \text{Max}\ \{0, Iw - f\}\right].$$

Note that if $(b - r - q) \geq 0$ and t is high or $Iw - f \leq 0$, then the squatter will always choose the voluntary contract. The problem in terms of actually reaching a voluntary contract is that *r* may have to be negative in order for the squatter to prefer it to the alternatives. If so, Coasian bargaining will break down.