You Gotta Fight for Your Right? Publicly Assigned but Privately Enforced Property Rights

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April 12, 2019

Abstract

Establishment and enforcement of property rights is often seen as a key tenet of a productive society. Many argue that the absence of formal public institutions to establish and enforce property rights necessarily leads to conflict and violent private enforcement of property rights. By re-examining the decision problem of the "early entrants" into the property market, we argue that the mitigation of violent conflict begins when the property is first claimed though the claimants' anticipation of the likelihood that their ownership will be challenged in the future. We perform a large-scale empirical test of the implications of this model (and of similar papers) by looking at the effect of the Homestead Acts—an exogenous increase in publicly assigned, but privately enforced, property rights—on the occurrence of violence on the American frontier. Exploiting variations in the assignment of homestead grants across states and time, we find that increases in homestead claims cause a statistically significant but economically insignificant increase in homicides. We conclude that there is no evidence that the assignment of privately enforced property rights meaningfully increases violence, and that settlers of the American West, as a whole, behaved in a manner consistent with rational conflict avoidance.

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1 Introduction

What would happen in the absence of government? In the 17th century, Thomas Hobbes predicted, among other things, that individual efforts to protect property would lead to disorder, chaos, and ultimately violence (Hobbes, 1996)—violence that carries significant costs (Smith et al., 2014). However, there is a fascinating body of research that casts doubt into the Hobbesian prediction of chaos and violence in the absence of government (Dixit, 2007; Umbeck, 1977a,b; Powell and Wilson, 2008; Leeson, 2013; Powell and Stringham, 2009). Given the current institutionalized state of the world, most of this literature relies on historical accounts or lab experiments to make the claim that individuals are able to cooperate in the absence of a formal institution without killing each other to resolve disputes. Even in the most seemingly improbable of situations, groups at odds with each other have found ways to cooperate without formal public institutional intervention (Leeson, 2009). Many, however, still hold firm to the notion that public institutions are the only way to enforce contracts. In this paper, we explore the relationship between property rights and violent conflict with new theoretical and empirical arguments.

An emerging issue in modern society, as sort of a Hobbesian offshoot, is the establishment of property rights by a public institution with little or no public enforcement of those rights. Most obviously, this has been observed to be the case in the least-developed areas of the world where officially governments exist, but practically they do little to enforce property rights (Leeson, 2007b; Leeson and Williamson, 2009). Similar arguments have been made, some even recently (Sessions, 2017), that extra-legal enforcement necessarily requires violence (Owens, 2011). This may quickly become the case in some US communities where evidence of distrust in law enforcement—those primarily tasked with enforcing property rights—is growing.

For instance, there is a long history of distrust in law enforcement in some communities[1] that ultimately stems from a lack a property rights enforcement. In an effort to save money, or as a misguided use of the data, some cities have begun programs that limit the degree to which police officers respond to 911 calls particularly those that involve property crimes (Dardick and Gorner, 2013; Kostanich, 2016). Even if police do respond to calls but respond slowly, if time is any factor at all, a slow response serves the same as not responding at all and creates the same lack of public property rights enforcement.[2] In other cities, officers

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[1]See Fryer (2017) for an explanation of that distrust or Henry (2015) for a specific example of how that distrust is earned.

[2]It took police 31 minutes to respond to Jasmyn Houster-Carter whose throat was slit by her estranged boyfriend. She called 911 three times. The last time she called she said, "I'm dying . . . Tell them I'm

have been instructed to not respond to home invasion calls or engage in anything that may lead to high speed pursuits (Luthern and Spicuzza, 2017). In all of these instances, the government has established the property right, but the local enforcers of that right have either completely opted out of enforcement, or at best only weakly enforce those rights. If we extend this line of thinking to include civil liberties as property rights, much of the Black Lives Matters movement is based on established rights by the government that many feel are not being properly enforced. What was initially a problem created by the distance and isolation of a rural setting is increasingly becoming an issue to urban environments.

So while we may look to pirates (Leeson, 2007a), diamonds (Bernstein, 1992) and prisons (Skarbek, 2012) to address how formal cooperation exists to establish extralegal property rights in the absence of an overarching public institution, what should we expect to occur in the more modernly relevant scenario of the publicly assigned but not enforced property right? To answer this question, we propose a model of endogenous property choice. By re-examining the decision problem of the "early entrants" into the property market, we argue that the mitigation of violent conflict begins when the property is first claimed though the claimants' anticipation of the likelihood that their ownership will be challenged in the future—that is, an anticipation of a lack of public enforcement of their property rights. Previous studies have focused on the details surrounding the formation, behavior and rules enforcement of privately formed institutions. Here, we abstract away from the mechanisms of how and when formal private institutions form and take them as given based on the plethora of public choice literature suggesting that in some instances they do form. The cost associated with our approach is that we are not able to point to a specific rule, agreement or pact that allows land owners to privately enforce property rights.[3] The benefit, however, is that we are able to essentially average the effects of private enforcement of property rights from across the country using a large-scale observational empirical test of the implications of our model by looking at the effect of the Homestead Acts—an increase in assigned, but not publicly enforced, property rights—on the occurrence of violence on the American frontier. Exploiting variations in the assignment of homestead grants across states and across time, we find that the increase in homicides due to increases in homestead land grants is small enough to be considered a precisely estimated zero. We conclude that there is no evidence

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dying," (Henry, 2015). One of the commonly cited reasons for the crime in pre-bankruptcy Detroit was one hour response times compared to 11 minutes in most other cities (Fletcher, 2013)

[3]Even if we were able to track down every private institution that helped protect property rights over disputed land, it is not clear that is even the approach we would want to take, as it seems unrealistic to think that a formal private institution would form in every instance of a land dispute. That is, surely many conflicts over unenforced property rights were settled amicably by neighbors in the complete absence of privately formed institutions.

that the assignment of privately enforced property rights meaningfully increases violence, and that settlers of the American West, as a whole, behaved in a manner consistent with rational conflict avoidance.

1.1   Property Rights and Violence

Coase (1960) first outlined the importance of property rights as a tool to motivate actors to internalize external costs. In the absence of property rights, many have shown that common resources are over-consumed and often squandered (Libecap, 2011). Even when theory suggests an assignment of property rights, institutions tend to drag their feet in making the decision to assign the rights (Libecap, 2011). Among others, one key assumption in Coase (1960) is that property rights can be assigned and enforced. The ability to assign property rights depends on the ability to demarcate the good. Resources like the stock of fish in a lake are more difficult to assign compared to a stationary resource like land (Libecap, 2011).

Anderson and Hill (1975) developed a framework for how property rights are developed and enforced using the context of the American West. They propose a neoclassical decision making framework in which effort dedicated to forming and enforcing property rights evolves according to changes in the benefits (such as changes to the monetary value of the property) and costs (such as the introduction of barbed wire). In related work, Anderson and Hill (2004) outline many examples of how the natural development of property rights (both formal and informal) led to rural land occupations that existed with little to no violent conflict despite a lack of legal enforcement of property rights or any other form of government intervention. In the case of the American West, property rights were defined and protected by what Anderson and Hill (2004) describe as institutional entrepreneurs—that is, those who had personal interest in seeing property defined and protected such as cattle rancher associations, miners in mining camps, and migrants on wagon trains. In many of these cases, Anderson and Hill (2004) point out that the system of property rights generated by these interested groups circumnavigated the need for violent enforcement of property rights.

Beneath the discussion of resource allocation through the assignment of property rights is the assumption that it is possible to protect property rights after they are assigned. Commonly, governing public institutions play the role of property assignor and protector. The degree to which institutions are willing to protect, both explicitly and implicitly, property rights plays an important role in economic growth (Williamson and Kerekes, 2011). Absent of a central governing body, only the interested parties that remain are left to hash out the

assignment and protection of property rights. There is however, substantial evidence that private assignment and protection of property rights still can exist in the absence of a central governing body.[4] The Black Death, for instance, played an important role in molding property rights in the 14th Century (Haddock and Kiesling, 2002). Additionally, the population expansion of rural areas necessitated a common law rule for property rights (Alston et al., 2012).

While a commonly held popular opinion that property rights must necessarily be enforced through violence, research into historical records from a variety of societies suggest alternative methods for property rights enforcement. Leeson and Nowrasteh (2011) and Leeson (2014a) give accounts of two very different groups in two very different surroundings that developed non-violent methods of property rights enforcement and the conditions that needed to occur for their respective property rights protection methods to hold. Despite some evidence to the contrary a common depiction of the rural American West, by popular press and academics alike, is a place full of lawlessness and violence (Benson, 1998; DiLorenzo, 2010). Reasons attributed to the "wildness" of the US West include the absence of a central authority to assign and enforce property rights and boundaries (Alston et al., 1998), the lack of a defined court system, a self-selected group of inhabitants prone towards violence (Franz, 1969) and an attitude of individualism (Elliot, 1944). Some historians take this argument further to suggest that the current day level of tolerance for violence can be tracked back to the West (McGrath, 1984). Additionally, many historians have decidedly opted to propose explanations for the violent West rather than first providing evidence of violence (McGrath, 1984).

Alston et al. (2012) theorize that of the four possible origins of property rights and enforcement of those rights, there are only two specific scenarios in which property rights might be enforced through violence. The first scenario is one in which property rights are privately established (*de facto* assignment) and property rights are afterwards reassigned and weakly enforced by the government (*de jure* enforcement). The second scenario is when there is *de jure* assignment of property rights–rights established by the government–and weak private, or *de facto*, enforcement.[5]

The first scenario is thoroughly explored by Alston et al. (1998) and McFerrin and Wills

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[4]Private enforcement of property rights suggests the lack of a governmental protection—understanding, of course, that private enforcement can, at times, take the form of a formal, private institution. We use the idea of private protection and enforcement of property rights interchangeably throughout this paper as though they are one in the same, recognizing however, that differences do exist.

[5]Both scenarios also require no imbalance in violence potential—that is, no clear ex ante—for conflict to occur.

(2007). Alston et al. (1998) found that a government's willingness to expropriate land actually encourages violent resolution of property rights disputes between squatters and land owners. Pointing out key differences between the case of Brazil and homesteading in the American West, McFerrin and Wills (2007) frame the findings in Alston et al. (1998) in the context of the Homestead Acts and the West and find that only under certain conditions violence will be used to resolve disputes surrounding property rights.[6] In context of the Johnson County War, McFerrin and Wills (2007) show that all the conditions that exist to increase the probability that land will be disputed through violence occurred. Similarly, Couttenier et al. (2017) document a phenomenon in the development in the US West where the conditions were met to incite violence. There are, however, many situations in which those conditions do not hold. Allen (1991) points to a literature on property rights that suggests that engaging in violence makes the cost of enforcement greater than the value of the disputed good in many cases. Even a credible threat of violence may be prohibitively costly if the articles required to make the threat serve no other purpose (Smith et al., 2014). Other than a few infamous exceptions, this scenario is a likely characterization of much of settlement of the "wild" West.

We attempt to characterize the second scenario outlined by Alston et al. (2012). In this situation violent conflict may arise if there is a reasonably balanced probability that either party will win in a violent conflict. These types of land disputes, McFerrin and Wills (2007) argue, might have stemmed from a conflict between two parties looking to make a private claim on the land through the Homestead Acts.

1.2 The Homestead Acts

The conversation surrounding the Homestead Acts has long been controversial (Allen, 1991). First passed in 1863, the Homestead Act was a decision by congress to allow settlers private ownership of public land provided that the applicant paid a $10 entry fee, maintained permanent dwelling on the property for five years—later reduced to three years—and provided evidence that the property had been improved. This act came as a refinement of previous federal attempts to dispose of large tracts of land publicly obtained in the 19th Century (Allen, 1991). As an alternative to five years of permanent residence, the Homestead Act also allowed individuals the right to buy the land for $1.25 an acre after six months of residence though that price was probably higher than the value of the land (McFerrin and Wills,

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[6]The probability that a conflict will result in violence increases when either value of the land or support from the federal government increases, or costs of disputes, property rights protection, support from local government, or the relative population of ranchers decreases.

2007). Initially, settlers were only able to make claim on 160 acres of land. This amount was expanded to 320 acres in 1909 and 640 acres in 1919. The purpose of the acreage restriction was to increase population density in the Midwest, but the plot size did not serve the needs of the arid farming conditions in the West (Allen, 1991). During this time period, other large scale measures to dispose of public lands included the Timber Culture Act (1873) and the Desert Land Act (1877). The purpose of these measures was to generate tax revenue, but it is also likely that they were used as a tool to make claim on disputed territories and likely drove the urbanization of the American West. Around the turn of the 20th Century, the composition of those who received homesteading land shifted from a group of people who had previously inhabited the land, such as cattle ranchers, to a group of people looking for land to inhabit, such as farmers. This is due, at least in part, to the boom in wheat prices (Alston et al., 2012). While it may seem unlikely that assignment of homestead properties would go unenforced publicly in the 20th century in light of important advances in telephones, automobiles, and electricity, but in all actuality most farmers did not enjoy these luxuries until after the second World War. During the 1920's in the South, less than 2% of farms had trucks or tractors, 4% had electricity, and 20% had phones. In the West, less than 7% of farms had trucks or tractors, 15% had electricity, and 35% had phones. Even by 1940, only 9% of Southern farms had trucks, 18% had electricity, and 10% had phones. A similar story is true for farmers in the West (U.S. Bureau of the Census, 1952).

Record of the amount of land disposed through the Homestead Acts was kept in great detail. Figure 1 outlines the spatial distribution of homestead land granted in the early 20th century. There is, however, little evidence that the federal government made any substantial effort to enforce the property rights of the settlers. While some land offices did exist, the government was generally slow and sporadic in their attempts to establish them, and the offices were far removed from the public lands disposed when they did (Allen, 1991; McFerrin and Wills, 2007). Thus, it is reasonable to think that private owners would still opt for private enforcement—possibly through violence (McFerrin and Wills, 2007). Indeed change in the composition of homesteaders from ranchers to farmers that occurred in the beginning of the 20th Century had many of the characteristics identified by Alston et al. (2012) as most likely to stir violent conflicts—most notably, property rights assigned, but not enforced, by the government and incumbents and challengers with relatively similar probabilities of victory.

However, while there are definitely accounts of violent conflict in the rural West, and admittedly those stories are certainly the most entertaining to tell, the fact remains that violent conflict is often life threatening. While people generally value protecting their land, they usually value their lives more. It thus stands to reason that an individual looking to

settle and develop land would make the decision of which land to settle based not only on the perceived quality of the land but also the probability that the rights of the land will fall under conflict.

2   Endogenous Property Choice & Conflict Avoidance

While others have developed models of property rights and conflict (Alston et al., 1998; McFerrin and Wills, 2007), those models reflect more closely the open range era of the US West between 1870 and 1900. In order to illustrate how individuals can avoid conflict even in the absence of public property rights enforcement, we develop a model in which the choice of property is endogenous. That is, individuals first choose the type of property they want to possess and then choose the level of violence or effort to use to defend that property. The second stage of this model is a simplified version of the model utilized by Alston et al. (1998) and by McFerrin and Wills (2007). The defining feature of this model is that the individual's choice of property affects the likelihood that they will have to defend their property or engage in conflict. By modeling the choice of property with anticipation of future conflict and self-enforcement, we can more completely explain the evolution of conflict and why overall levels of conflict may be high or low. Furthermore, this model explains the dynamics of conflict when *de jure* property rights are clearly assigned but not necessarily enforced by the government—a situation that is still relevant today.

While the full derivation and details of our model are available in the Appendx A, we summarize the main results here. Proofs of these results are available in Appendix C.

Theorem 1. *Individuals compensate for increased risk of conflict due to decreased public enforcement of property rights by choosing property for which they are less likely to be challenged.*

That is, when the expectation of conflict increases, individuals will mitigate this risk by choosing less desirable or lower-valued property. We call this a *conflict avoidance response*. This type of behavior will directly decrease the probability that violent conflict will occur through the offsetting decrease in the probability of challenge to property rights. Importantly, this means that an anticipated decrease in the public property rights enforcement will trigger a response in the owner at the time of choosing his property that will reduce the likelihood of conflict. However, it is not obvious how conflict avoidance will affect violence in the event that a challenge to ownership still occurs. We address this issue in the following corollary.

Corollary 1. *An anticipated decrease in the public enforcement of property rights will unambiguously decrease violent effort by a challenger in the event that a challenge to property ownership occurs, which is an indirect effect of the conflict avoidance response.*

Taken together, Theorem 1 and Corollary 1 cast doubt on the popular idea that a lack of public enforcement of property rights will lead to violent challenges to ownership and individuals protecting their own property with violence. Instead we see that when individuals anticipate a lack of public enforcement, they will act preemptively to reduce the likelihood of challenge and decrease violent effort from a challenger should a challenge occur.

Theorem 2. *Individuals compensate for increased probability of defeat due to a lack of government intervention in conflicts by choosing property for which they are less likely to be challenged.*

Owners will not only react to a change in the likelihood of confrontation, but also a change in the likelihood of a favorable outcome in the event that conflict does occur. Theorem 2 implies that if there is an expected decrease to net benefits of owning property due to a decrease in likelihood that the owner will be able to prevail over a challenger (should a challenge occur), then owners will preemptively try to mitigate this loss by choosing property that would be less enticing to a potential assailant. However, we must again be careful to examine how this will affect violence should a conflict occur.

Corollary 2. *In the standard case without endogenous property choice, violent effort by a challenger would unambiguously increase when the likelihood of government intervention decreased, and the change in violent effort from the owner in this case is ambiguous. In the case of endogenous property choice, the conflict avoidance response will reduce or eliminate an increase in violence by a challenger. The effect on the violent effort of the owner is still ambiguous.*

Corollary 2 also shows that if a lack of government involvement in conflicts is anticipated, the conflict avoidance response will actually decrease in the violent effort of the challenger in addition to decreasing the incentive to challenge for ownership of the property in the first place (as shown in Theorem 2).

The results of our model suggests that unenforced property rights are not likely to cause violent conflict as long as the prospect of conflict is anticipated by an individual at the time the property is chosen and alternative property is available. Even when conditions may appear to promote violent conflict to defend property rights, we will still likely see very little

violence in reality if individuals anticipate this change and optimally choose marginally less valuable property to avoid conflict *ex ante* which will also work to decrease violent effort from any potential challenger.

The idea that property owners may preemptively dissipate rents to avoid conflict has been previously explored. Leeson (2014b) suggests that the historical practice of the human sacrifice by the Konds of India served, in part, to reduce the wealth of the community to make a raid on their resources less attractive and that the practice was ended when a system of property rights protection between different communities was established by the government. Likewise, Leeson (2007c) explains how pre-colonial West African communities avoided being raided by powerful traders by refusing to produce a tradable amount. Our model (and the empirical results that follow) reinforces and adds to this literature and offers a framework for thinking about preemptive rent dissipation in the context of "frontier" models of property rights, such as Alston et al. (1998) and McFerrin and Wills (2007).

It is worth noting that our model does not suggest that preemptive conflict avoidance is the *only* reason for low levels of violence. For example, if there is a significant imbalance in violent potential, then the weaker opponent will typically acquiesce to the demands of the stronger without conflict (Alston et al., 2012; McFerrin and Wills, 2007). Because of this, individuals may choose to band together in groups to create this power imbalance. As an example, early settlers from the Church of Jesus Christ of Latter-day Saints[7] were able to successfully protect established property rights with almost a complete absence of violence in the Utah territory from an organized and coordinated attack from the federal government, known as the Utah War (Furniss, 2005). In this context, optimal conflict avoidance for the individual land owner would undoubtedly lead to land acquisition in or near the Church community. Furthermore, as long as the individuals in the group were sufficiently homogenous, we would expect intra-group conflict to be low (Alston et al., 2012). Our model, instead, helps us understand why violent conflict will still be low even when these conditions are not met.

3   Empirical Framework

The primary implication of our model—that an expansion of unenforced property rights is unlikely to cause an increase in violent conflict—is testable. Thus, like Alston et al. (1998)

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[7]While commonly referred to as "Mormons", we employ the full name of the Church in an effort to conform with the Church's style guide outlined here: https://www.mormonnewsroom.org/article/name-of-the-church.

we estimate a reduce form model using aggregated data (US states and territories, in our case). The Homestead Act represents a large, expansion of legal rights to property, but those rights went largely unprotected by the government due to the remote location of homestead tracts. Additionally, the lack of law enforcement would necessitate the private enforcement of rights to all private property, not just a defense of the homestead itself. Thus, examining how the expansion of homestead land grants affected violent outcomes provides a succinct observational insight into the nature of the relationships between property rights and violent conflict. Furthermore, the diversity of types of settlements (located from South Florida to Northwest Oregon) and the extended time frame allow for a comprehensive empirical analysis.

The observable data also allow us to investigate the mechanism of conflict avoidance. Our model suggests that individuals preemptively avoid conflict by choosing less valuable (and thus, less enticing) property. However, if land values in a state or territory are generally of higher value, then this kind of conflict avoidance behavior would be more difficult. Thus, we would expect that the increase in unenforced property rights caused by homesteading would be more likely to cause violent conflict in areas and time periods when land values are high. To the extent that individuals can still endogenously choose property anticipating conflict, though, we would still expect the overall effect of homesteading on violent outcomes to be small.

3.1 Econometric Model

Recalling that our model implies that homesteaders settle land based on land value and conflict avoidance, we test the conclusion that violent conflict will be rare and depend on land values by estimating a state fixed effects model, reporting within state estimates, of the effect of homestead land granted on violence, and is as follows:

$$\ln(v_{it}) = \beta_1 H_{it} + \beta_2 L_{it} + \beta_3 H_{it} \cdot L_{it} + \phi Z_{it} + s_i + y_t + e_{it} \tag{1}$$

The dependent variable is the natural log of our measure of violence that varies by state, i, in time, t. The matrix Z represents an array of covariates. The model also includes state fixed effects, s, that vary by state, i, and year effects, y, that vary by time, t. The inclusion of s_i makes the resulting estimation of β_i a within-state estimator. The independent variable of interest, H_{it}, is a measure of the amount of private land granted through the Homestead Acts, and serves as our proxy for private property that requires private enforcement of

rights.[8] From the model, we expect the value of property to have an effect on violence and to influence the level of violence caused by homesteading. Thus we include the average land value in each state in a given year, L_{it}, and the interaction between land values and the number of homestead acres granted. Identification comes from exploiting the state/year level variation in Homestead land granted. For a summary of public lands expropriated, please see Table 1 and Figure 1.

In a recent survey of much of literature on crime and deterrence, Chalfin and McCrary (2017) point to several potential pitfalls in the empirical crime literature. Chief among them is the (in)ability to distinguish between deterrence and incapacitation which in practice manifests itself as omitted variables, selection bias, simultaneity, and reverse causality. For instance, Chalfin and McCrary (2017) go to great lengths to explain how much of the early literature on the relationship between policing (both in terms of manpower and policing practices) failed to account for critical omitted variables, and suffer from questions of causality–specifically, the direction of causality between crime and the size of the police force. They conclude that the most convincing work done on crime comes when exploiting a plausibly exogenous shock. Similar to other empirical work on crime, our empirical strategy requires careful consideration of theses common shortcomings. For instance, in the context of causality direction, there is some evidence to suggest that the Act was passed in an effort to inhabit disputed territories of the US (Allen, 1991). While this may be one of the motivations for the passage of the Act, there is no evidence that this goal influenced the actual decision of land granting. In fact, most all applicants who met the guidelines explained previously were granted the land requested. It is important to also recall that the identification comes from the state/year variation in land granted, so the original purpose of the law should have little influence on the year-to-year variation in land granted. Additionally, even if it were the express purpose of the government to grant land in the hope that a violent land conflict would ensue, this would, at worst, overestimate the results. In context of the results we find, it would just mean that the small effect we estimate would be even smaller.

Discussing the literature on proactive policing—research examining how the intensity of policing for lower level crimes affects more serious crimes—Chalfin and McCrary (2017) point to the need to account for factors influencing both the outcome, more serious crimes, and the independent variable, increases in lower level crime arrests. Our empirical framework is not

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[8]β_1 is the reduced form estimate of v_x and s_x or v_w and s_w from Appendix A. Put differently, β_1 is the equilibrium amount of violence from challengers supplying violence, s_x, and property owners "demanding" violence. Recall that property owners choose land based on, among other things, the possibility of property rights enforcement by conflict. So in a sense, choosing attractive land that invites dispute is demanding some level of conflict.

immune to this sort of omitted variable bias. For instance, we do not directly observe what might be critical individual level information about the characteristics of those applying for homestead land. If, for instance, early movers for a land grab were speculators and companies looking to secure natural resources or property for railroad expansion, that might be an important variable to consider and might affect property rights challenges, as corporations or speculators may have greater means to protect the land. This was likely more the case in the early years of homesteading rather than the 20th century data we analyze (Alston et al., 2012; Couttenier et al., 2017).

3.2   Data

Violence that results from property rights disputes might take many forms including non-lethal physical altercations, lethal physical altercations, and other methods such as false accusations in an effort to falsely imprison the offending party. So, while a good measure of violence is needed in order to attempt to estimate the amount by which private enforcement of land explains the variation in violence, unfortunately, the FBI did not begin to collect data on violence and crime until the 1930s, and even that lacked a good national measure of violence (Owens, 2011). There is however, some data on murder rates dating as far back as 1900 from the Census Mortality Database. In addition to homicides, this database includes information on death by cause, including accidental gun deaths, illnesses, as well as information on death by gender and age. The first year of reporting only 10 states reported data, but most states had entered the registry by 1920.[9] We use crime and mortality data starting in 1900 through 1940 which includes all deaths including those classified by the Census as "Indian" nativity though there is evidence to suggest that the Native American death rate was underreported during this time (Meriam, 1971). Homicide rates are not a perfect predictor of violence, but rather the most extreme form of violence. While murders might serve as a reasonable proxy for violence generally and is what we employ as our dependent variable, it surely does not account for all forms of violence that may have arisen from property disputes.

One difficulty of any analysis that spans a historical period of time is the availability of relevant data. With regard to a measure of private land, however, the General Land Office of the Department of the Interior collected data on the acreage of homestead land granted

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[9]To ensure that entry into the database was not a decision endogenous to homicide rates, we predict the year of entry into the database as a function of the homicide rate in that year, and found no correlation. Those results are available upon request.

by state and year as far back as 1870.[10] As discussed previously, land began to be granted through the Homestead Act shortly after the passage of the Act in the 1860s and continued through the 1940s (Allen, 1991).[11] We measure homestead land granted by state and year in thousands of acres granted. To measure the average land value by state by year, we use data collected by the US Department of Agriculture's National Agriculture Statistical Service (NASS) database. The NASS has, to some degree, conducted surveys of all aspects of agriculture production since 1862, though a shift in emphasis in 1905 led to much more accurate collection of statistics. Collected at the state level, the NASS data has been shown to be highly comparable to Census data with the obvious advantage of reporting yearly as opposed to the decennial data (Edwards and Howe, 2015). The variable is an estimate of the average value of all agriculture land, including buildings, measured in real dollars per acre by state by year.

Given the nature and purpose of the Acts, the land granted under the Acts may be a good proxy variable to measure the prevalence of privately owned, but not publicly enforced, property and will act as our independent variable of interest. Homestead lands were not, however, randomly assigned across states. As mentioned previously, Allen (1991) argues that land was more likely to be granted in regions where the government wanted to create a claim on disputed areas. Table 1 and Figure 1 report a summary of how land was granted. Figure 1 groups states by the sum of all the land granted in our time period. We see predictably that land was granted almost exclusively to Western and Southern states.

It could be the case that homestead land granted is associated with some underlying trend in mortality. To check for this, we also estimate the extent to which homestead land granted might explain the variation in other mortality variables such as the total mortality level, the mortality rate of smallpox, and the rate of suicide by firearm. Our analysis also includes state and year fixed effects and a number of controls that have been shown to be important covariates in historical crime models (Owens, 2011). Those include the proportion of the state that is black, proportion of the state that is between the ages of 6-20, the education rate (which is (estimated by the adult literacy rate), population density, and the urbanization rate (defined as the percent of the state population living in a place with more than 2,500 people). Additionally, our theoretical model suggests that access to firearms may play a role in determining optimal level of conflict avoidance becaue it would affect the cost of invading and defending. To control for this, we include in each regression a control for the rate of gun

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[10]This data is available in hard copy form from various years of the Statistical Abstracts of the United States.

[11]The Homestead Acts officially ended in 1934, but the Department of the Interior report some land granting into the late 1940s.

related accidental deaths.[12]

3.3   Results

The main results can be seen in Table 2. The dependent variable is the natural log of the state homicide rate. The standard errors in every model are clustered at the state level, and each model includes state and year fixed effects. Column 1 of Table 2 includes no covariates, and column 2 includes covariates. We see that the effect of expropriating public land is about a 0.026% increase in homicides. That is, for every 1,000 acres of Homestead land granted, we would expect an increase in homicides of 0.026%. This result suggests that the raw homicide count increased by 0.04 homicides per 1,000 acres of land granted because of the need to privately protect property rights. Put differently, we predict only 1 in 66 homesteads granted resulted in a violent conflict that lead to a death.[13] These results can be thought of as a precisely estimated zero; meaning that while technically homicides did increase in relation to homestead land granted, practically the effect confirms arguments made previously that the vast majority of property owners chose, under certain conditions, to resolve property rights disputes in non-violent ways.

There is no evidence that land values independently increase violence; in fact, the imprecisely estimated coefficient is negative. Recall that this variable measures the value of all land in the state, not just expropriated land. Thus, it is not surprising since most high valued property is in areas of property rights are enforced. The more interesting coefficient is on the interaction between acres of homestead land granted and land values, for which there is evidence that land values increase the marginal effect of homesteading on violence. This is consistent with previous results and provides some context for our theoretical framing which suggest that higher land value increases the incentive for violent conflict. However, recall the results from our model suggest that violence will be a rare occurrence given the endogenous nature of land choice. The coefficient on the interaction between land value and homestead land granted is very close to zero. In both specifications a one standard deviation increase in land values only increases the marginal effect of homestead acres granted by about a third. This may suggest that even when the conditions for increased violence identified by Alston et al. (1998) and McFerrin and Wills (2007) exist (such as high property values), overall levels of violence will still be low when individuals can preemptively take action to avoid

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[12]All of these controls, including the death data we employ as placebo tests come from Owens (2011).

[13](103.5664/0.32)/(103.5664*(181*0.00026))=66.4 where 103.56 is the average amount of land granted per state per year in our dataset (in 1,000s of acres), and 0.32 is an assumed homestead size of 320 acres in 1,000s of acres, 181 is average count of homicides, and 0.00026 is estimated marginal effect

confrontation.

3.4   Robustness

To ensure that the measured relationship is not actually capturing a general, underlying trend in mortality, we run a series of robustness checks to determine any relationship between homestead land granted and typical measures of mortality. One specific concern is that homestead lands were expropriated in areas where death was more (or less) prevalent, so our supposed measured effect is actually just the result of differences in death rates generally. If there is an underlying trend in mortality that drives the main results, those results should be also seen in other measures of mortality such as the total mortality rate, the suicide rate, the rate of deaths from diabetes, the rate of influenza-related deaths, and the rate of syphilis deaths.[14] Those results can be seen in Table 3. Each row represents a unique regression where the dependent variable varies across rows. Each dependent variable is expressed as a logged rate. There appears to be no discernible pattern in death rates that is correlated with homestead land granted—some coefficients are positive, some are negative and only one is statistically significant.

An additional consideration is the effect to which the timing between settling on the property and gaining property rights plays a role in the relationship between violence and private enforcement of property rights. Recall the stipulation that settlers must inhabit the land for five years prior to gaining ownership. In the five-year period of inhabitation prior to ownership, settlers may conceivably need to protect the land. That is, homicides rates up to five years after the current time period may be related to the current amount of homestead land granted. It is unclear, a priori, if a settler might have to use violence more frequently during the initial or final years of inhabitation. Table 4 attempts to measure any heterogeneous timing effects. Each row represents a unique regression where the dependent variable in each regression is the logged homicide rate for each year prior to full ownership and a five year moving average. We see in Table 4 that the effect of homesteading on violence varies very little across time (although it may decrease by the fifth year). This further suggests that not only do individuals use non-violent techniques for property rights resolution, but also the precisely estimated zero persists across various timing schemes.[15]

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[14]This is not meant to be an exhaustive list, but rather a diverse selection of causes of death (violent, chronic illness, and disease).

[15]In addition to these robustness checks, the results are generally insensitive to the inclusion of state specific time trends and the inclusion/exclusion of outliers on both ends of the distribution of homestead land granted. These results are available upon request.

4   Conclusion

In the context of the ongoing conversation, these results seem to suggest that the conditions necessary for property rights to be enforced with violence were not terribly common—at least in the first part of the 20th century. That is not to suggest that the necessary conditions required to incite violence were never met. Couttenier et al. (2017) found a positive relationship between property rights enforcement and homicides though their study is restricted to a handful of localities with available homicide data.[16] What appears to be the case, however, is that introducing the notion of preemptive conflict avoidance can help explain why some situations of new unenforced property rights evolve with little overall violent conflict while others evolve in a manner that includes a high degree of violence.

Conflict avoidance is an effective strategy when there is a large degree of variance in property types which allows individuals to effectively choose property for which their rights are not likely to be challenged. Limited choice of property, on the other hand, is more likely to lead to confrontation and violence.[17] Choosing less valuable property may not only mean lower-priced property, but also could mean choosing more remote property and also more general activities that would both decrease the likelihood of confrontation and also decrease the value of the property to the owner. Alternatively however, it could also be the case that individuals or groups with the means to protect property chose the highest value land because they had the means to protect it. In this instance, subsequent homesteaders choosing lower valued land is not a result of conflict avoidance but rather a limited property choice.

In light of these results however, it is plausible that new property rights and western settlement did not involve a significant amount of violent conflict because the appropriate conditions existed for conflict avoidance.[18] Settlers could easily reduce the probability of

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[16]It is important to note, however that the identification strategy of Couttenier et al. (2017) rest on an assumption of independence between mineral discoveries and statehood. This assumption runs counter to their results in their Table 1 that shows that mineral discovery is a statistically significant driver of statehood and runs contrary to accounts of key players in the application for statehood that cite mineral discoveries as a justification for statehood. As an example, William A. Egan, the first governor of Alaska, stated the discovery of oil deposits in the Swanson River in 1957, "...provided the economic justification for statehood for Alaska," which was subsequently gained 17 months later (Walker, 2002).

[17]It should be noted that the connection between preemptive conflict avoidance and the lack of conflict resulting from 20th century homestead claims partially hinges on the assumption that there was sufficient heterogeneity in choosable properties. If the lands allocated for individual homesteading were all of relatively low value, then conflict may be low because none of the property available was worth fighting over. Empirically, of the ten states with the most variation in homestead land granted, we observe an average standard deviation in land value of around 11 real dollars per acre off of a mean of around 20 real dollars per acre.

[18]An interesting area of future research will be to further explore the extent to which homestead appli-

violent confrontation because there was a large variety of unclaimed property to choose from (they could move to a more remote location, for example). Today, conflict avoidance may take the form of, for example, avoiding wearing expensive jewelry in areas where the probability of being mugged is high or not buying an expensive car in an area where carjackings are common and law enforcement response is slow or nonexistent.

While we have provided evidence that a lack of public property rights enforcement will not necessarily increase violence, that is not to say that publicly assigned but privately enforced property rights is costless. The conflict avoidance response that we show in our model is another form of rent dissipation. In a traditional model of conflict, value of the effort expended by both players fully dissipates the rent of the prize. In our model, owners preemptively dissipate rents (by choosing less valuable property) in an attempt to avoid conflict and decrease the effort from a challenger.

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cations were actually realized and legitimized by the government. While this may not necessarily alter the levels of violence that exists to protect property during the trial period, it does provide additional variation to exploit.
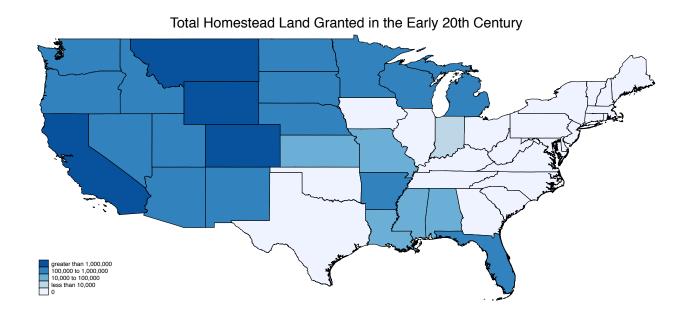
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Figure 1

Total Homestead Land Granted in the Early 20th Century

greater than 1,000,000
100,000 to 1,000,000
10,000 to 100,000
less than 10,000
0

Tables

Table 1: Summary Statistics

	Mean	Std. Dev.	Min	Max
Homicide Rate	7.74	6.43	0.15	49.96
Homestead Acres Granted (1,000's)	316.6	680.8	0.005	4732.8
Land Value	42.04	27.64	4	131
% Pop. Black	0.041	0.105	0	0.526
% Young	0.271	0.034	0	0.339
Education Rate	0.924	0.062	0.001	0.977
Population Density	20.10	17.95	0.82	75.77

Table 2: The Effect of Private Land Granted on Homicides

	Log Homicide Rate	
	(1)	(2)
βs		
Homestead Acres Granted (1,000's)	0.00033***	0.00026***
	(0.000045)	(0.000048)
Land Value	-0.0020	-0.0018
	(0.0015)	(0.0016)
Homestead × Land Value	0.0000024*	0.0000021**
	(0.0000012)	(0.00000084)
Controls		
Percent Black		-0.053**
		(0.023)
Percent Young		-0.015
		(0.028)
Percent Literate		-0.0030
		(0.0096)
Percent Urban		0.035***
		(0.0091)
Population Density		0.0012
		(0.0016)
Accidental Gun Deaths (per 100K)		0.033
		(0.022)
N	1290	1290
R-squared	0.87	0.88
Joint F-test of βs	20.43	10.53

State level clustered standard errors in parenthesis. The dependent variable is the natural log of state homicide rates. Private land granted is measure in thousands of acres granted through the Homestead Act.

* $p<0.1$ **$p<0.05$ ***$p<0.001$

Table 3: The Effect of Private Land Granted on Other Death Rates

	Homestead	Land	Interaction	N	R^2	F-test
Total Mortality	-0.000016 (0.000027)	-0.00024 (0.00031)	0.00000012 (0.00000088)	1097	0.92	0.58
Suicides	0.00010** (0.000043)	-0.00027 (0.0012)	0.00000065 (0.0000011)	1289	0.89	3.28
Gun Suicides	0.00016 (0.00014)	-0.00062 (0.0015)	0.0000019 (0.0000038)	1290	0.76	1.23
Diabetes	-0.000035 (0.000036)	0.00046 (0.00074)	-0.00000063 (0.00000040)	1096	0.99	1.14
Influenza	-0.00011 (0.00015)	-0.0019 (0.0015)	0.0000049 (0.0000049)	1097	0.93	4.05
Syphilis	-0.010 (0.015)	-0.040 (0.048)	-0.00057 (0.00055)	144	0.99	0.52

Table 4: The Effect of Private Land Granted on Death Rates 5 Years Post Grant

	Homestead	Land	Interaction	N	R^2	F-test
Year Granted	0.00027*** (0.00005)	-0.0019 (0.002)	0.0000021*** (0.0000008)	1290	0.88	11.7
2nd Year	0.00024*** (0.00005)	-0.0014 (0.002)	0.0000019* (0.000001)	1240	0.91	7.71
3rd Year	0.00019*** (0.00006)	-0.00086 (0.002)	0.0000012 (0.000002)	1191	0.91	3.83
4th Year	0.00011 (0.00008)	-0.00070 (0.002)	-0.00000079 (0.000003)	1142	0.91	1.74
5th Year	0.0000039 (0.00007)	-0.00071 (0.002)	-0.0000042** (0.000002)	1093	0.92	1.97
Moving Avg	0.00010* (0.00006)	-0.0017 (0.002)	-0.0000015 (0.000001)	1093	0.95	2.32

Appendix

A   An Extended Model of Conflict

To begin, we must consider the probability that a property owner will have his ownership challenged by another party is less than one. We assume this probability, $\rho(L, x)$, is a function of the value of the property chosen, L, and the level of property rights enforcement, x. We assume that confrontation is more likely when individuals choose higher valued property—that is, $\rho_L > 0$—and less likely when there is a greater degree of property rights enforcement—that is, $\rho_x < 0$.[19,20] The future property owner's first stage problem is

$$\max_{L} \ U(L, x, \rho, \Lambda) = \left[1 - \rho(L, x)\right] L + \rho(L, x)\hat{\Lambda}^H \tag{2}$$

where $\hat{\Lambda}^H$ is the homesteader's value function from the second stage, which is described below.

If there is a challenge to the ownership of the property chosen, the problem becomes nearly identical to those described by Alston et al. (1998) and McFerrin and Wills (2007); thus, we adopt a simplified version of those models here. In the event of an attack from a challenger, each property owner must choose the level of effort (or violence), v, to exert in order to repel an attacker should the need arise given the level of violent effort chosen by the challenger, s. These parameters determine the probability of victory, $\gamma(v, s, w)$, and the costs of violent effort, $c(v)$ and $k(s)$. The the probability of victory is also affected by w, the willingness/availability of government institutions to defend property rights after a challenge to ownership is made. We assume that $\gamma_v > 0$, $\gamma_s < 0$, and $\gamma_w > 0$. We also assume that both cost functions are increasing with respect to violent effort. Thus, the maximization problems for the homesteader and the analogous invader are

$$\max_{v} \ \Lambda^H = \gamma(v, s, w)L - c(v) \tag{3a}$$

$$\max_{s} \ \Lambda^I = \left[1 - \gamma(v, s, w)\right] L - k(s) \tag{3b}$$

The model is solved by backward induction. The Nash equilibrium of the second stage,

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[19]We use subscripts to denote the partial derivative with respect to a particular variable.

[20]This need not necessarily be an assumption because both results would be the natural result of modeling a potential attacker's decision to invade. We choose to model this instead as probability to simplify the exposition of the model.

(v^*, s^*), simultaneously solves the following first order conditions

$$\gamma_v L - c_v = 0 \tag{4a}$$

$$-\gamma_s L - k_s = 0 \tag{4b}$$

That is, v^* and s^* are the optimal levels of violent effort from the defending property owner and attacker, respectively, in a conflict over property of value L.

The property owner is tasked with choosing the optimal value of property (L^*) to claim while anticipating the affect this choice will have on his future decision to defend the property if necessary. Thus, any future level of combative effort $(v^*$ and $s^*)$ is a function of the value of the property chosen in the first stage. The utility maximizing choice of land can be found by plugging $\Lambda^H(v^*, s^*)$ into Equation (2) and evaluating the first order condition with respect to L. The optimal choice of property value is:

$$L^* = \frac{1 - \rho(1-\gamma) - \rho_L c}{\rho_L(1-\gamma) - \rho\gamma_s s_L} \tag{5}$$

where subscripts denote derivatives, as above.[21] This equation tells us how optimal choice of land value changes with respect to the other model parameters.

Both Alston et al. (1998) and McFerrin and Wills (2007) thoroughly examine how key model parameters—such as area land values, the level of property rights enforcement, and the relative balance of power in the area—are likely to affect the violent effort in the event of conflict. We do not rework this analysis, as it is completely consistent with our model in the event that a conflict occurs. Rather, we utilize a complementary framework to focus on the role the choice of property plays in determining the likelihood that a violent confrontation occurs at all. It is important to notice that many of the potential determinants of violence, like those considered by Alston et al. (1998) and McFerrin and Wills (2007), will also predictably change the probability any challenge is made to claimed property, which can be anticipated by the settler. Recall that $\rho(L, x)$ is the probability that a challenger will attempt to seize the owner's property, and that this probability is inversely affected by the level of property rights enforcement, x. Thus doing comparative statics on L^* with respect to ρ tells us how the property owner would react to an increase in the probability of conflict like the result of a decrease in property right enforcement, x.

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[21]Note that deriving this result require substituting the constraint imposed by Equation (4a) into the first order condition with respect to L.

B   Reaction functions of second stage

Our second stage model is similar to, but not exactly like, the models used by Alston et al. (1998) and McFerrin and Wills (2007). Thus, a description of the reaction functions of the owner and challenger to each others strategic activity is warranted. We can obtain the slope of the reaction functions by differentiating the first order conditions from the second stage with respect to the opposing individual's instrument.[22] This yields:

$$v_s = \frac{-\gamma_{vs}L}{\Lambda_{vv}^H} \qquad\qquad s_v = \frac{\gamma_{vs}L}{\Lambda_{ss}^I} \qquad\qquad (6)$$

where γ_{vs} is the cross derivative of γ and Λ_{vv}^H and Λ_{ss}^I are the second order conditions for the owner and challenger, respectively. Because we know the denominators of both functions are negative, the sign of these functions depends on the sign of γ_{vs}. If we make the reasonable assumption that an increase in violent effort from one party has less of a marginal impact when his opponent is exerting higher levels of violent effort, then $\gamma_{vs} < 0$ and $v_s < 0$ and $s_v > 0$—or that violence is a strategic substitute for the owner and a strategic complement for the challenger. Of course, if $\gamma_{vs} > 0$, then the opposite is true. Those familiar with the models in Alston et al. (1998) and McFerrin and Wills (2007) will recall their was no such ambiguity in the sign of the reaction functions and that there models resembled the case in which $\gamma_{vs} > 0$. This is because both of these models have the violent effort by the owner and challenger each only affecting separate and independent probabilities. While this is arguably justifiable in the specific context of the situations those authors model (property rights independently enforced by two different authorities), it does not make sense in a generalizable model of conflict. Furthermore, this assumption does not allow the probabilities of victory to resemble a typical *contest success function*.[23] For example, in a two-player contest with a typical contest success function, the sign of the cross-partial derivative depends on which player is devoting the most effort. However, the way that Alston et al. (1998) and McFerrin and Wills (2007) model the probability of victory causes their pseudo cross-partial derivative, $\gamma_v\theta_s$, to be always positive, which is why their reaction functions have unambiguous signs.

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[22]For more details about this procedure, see Alston et al. (1998).

[23]The two most common types of contest success function are the ratio function, $p_i = \frac{x_i^k}{\sum_i x_i^k}$, and the difference function, $p_i = \frac{ke^{x_i}}{\sum_i ke^{x_i}}$.

C   Proofs

C.1   Proof of Theorem 1

Individuals compensate for increased risk of conflict due to decreased external enforcement of property rights by choosing property for which they are less likely to be challenged. That is, $L_\rho^* < 0$.

Proof.   Differentiating L^* with respect to ρ and simplifying yields

$$L_\rho^* = \frac{-\rho_L(1-\gamma)^2 + \gamma_s s_L(1-\rho_L c)}{[\rho_L(1-\gamma) - \rho\gamma_s s_L]^2}$$

which will take the sign of its numerator. Since both ρ_L and $(1-\gamma)^2$ are greater than zero, we know the first term, $-\rho_L(1-\gamma)^2$, is less than zero. Likewise, we know that the first part of the second term, $\gamma_s s_L$, is less than zero since, all else equal, an increase in the value of property would increase the effort applied by the challenger (see Appendix B), which would decrease the likelihood of an owner victory. In order to sign the second part of the second term in the numerator, $(1-\rho_L c)$, we must look to Equation (5). Since the denominator of L^* is always positive, it must be the case that $(1-\rho(1-\gamma)-\rho_L c) > 0$ in order for $L^* > 0$. Since $(1-\rho_L c) > (1-\rho(1-\gamma)-\rho_L c)$, it must be the case that $(1-\rho_L c) > 0$. Thus, $\gamma_s s_L(1-\rho_L c) < 0$, and the numerator of the expression is unambiguously negative. Therefore, $L_\rho^* < 0$.

$\square$

C.2   Proof of Corollary 1

An anticipated decrease in the external enforcement of property rights will unambiguously decrease violent effort by a challenger in the event that a challenge to property ownership occurs which is a result of the conflict avoidance response. That is, $s_x > 0$. The effect on the owner's violent effort, v, is ambiguous.

Proof.   A decrease in public enforcement of property rights would cause an increase in ρ, which would cause a conflict avoidance response, as shown in Theorem 1. That is, owners will choose lower valued property in order to offset the increased risk of a challenge to their ownership. In the event that a challenge still occurs, we must then examine the reaction functions of both the owner and

challenger to a change in public property rights enforcement, which could normally be obtained by differentiating the first order conditions (from the second stage problem) of each with respect to the parameter x and solving for v_x and s_x, respectively. However, since the parameter x does not enter the second stage, we know $v_x = v_L L_\rho \rho_x$ and $s_x = s_x L_\rho \rho_x$. Since $L_\rho \rho_x > 0$, we can simply look at how each individual's reaction function changes when L changes:

$$v_L = \frac{-(\gamma_v + \gamma_{vs} L \cdot s_x)}{\Lambda_{vv}^H} \qquad\qquad s_L = \frac{-(\gamma_s + \gamma_{vs} L \cdot v_x)}{\Lambda_{ss}^I}$$

Solving this system of equations and simplifying yields

$$v_L = \left[\frac{-\gamma_v}{\Lambda_{vv}^H} + v_s \left(\frac{\gamma_s}{\Lambda_{ss}^I} \right) \right] (1 - v_s s_v)^{-1} \tag{7a}$$

$$s_L = \left[\frac{\gamma_s}{\Lambda_{ss}^I} - s_v \left(\frac{\gamma_v}{\Lambda_{vv}^H} \right) \right] (1 - v_s s_v)^{-1} \tag{7b}$$

Since Λ_{vv}^H and Λ_{ss}^I are the second order conditions of the second stage, we know both of these terms are negative. As we have previously, we assume that $\gamma_v > 0$, $\gamma_s < 0$, and $\gamma_{vs} < 0$, which means $v_s < 0$ and $s_v > 0$. Thus, $(1 - v_s s_v) > 0$, and it is unambiguously true that $s_L > 0$. Therefore, $s_x > 0$. However, the sign of v_L is ambiguous. The first term is the size of the shift in $v(s)$ due to a change in L, and the second term is the size of the shift in $s(v)$ due to a change in L weighted by the slope of of $v(s)$. Thus, v_L will tend to be positive as the size of the shift in $v(s)$ increases relative to the size in the shift in $s(v)$ or as the owner becomes less reactive to changes in s. Since the sign of v_L is ambiguous, the sign of v_x is also ambiguous.

$\square$

C.3 Proof of Theorem 2

Individuals compensate for increased probability of defeat due to a lack of government intervention in conflicts by choosing property for which they are less likely to be challenged. That is, $L_{(1-\gamma)}^* < 0$.

Proof.   Doing comparative statics on L^* with respect to the probability of defeat (decrease in the probability of victory, γ) reveals how a owner will react to an

exogenous increase in violent effort of a challenger or a decrease in the likelihood of government intervention should conflict occur—even when we hold the probability of meeting a challenger fixed. Differentiating L^* with respect to $(1-\gamma)$ yields

$$L^*_{(1-\gamma)} = \frac{\rho^2 \gamma_s s_L - (1-\rho_L c)}{[\rho_L(1-\gamma) - \rho \gamma_s s_L]^2}$$

The sign of the derivative is, again, given by the numerator. We know $\rho^2 > 0$, $\gamma_s s_L < 0$, and $(1-\rho_L c) > 0$ (see explanation is Corollary 1). Thus, $L^*_{(1-\gamma)} < 0$.

$\square$

C.4   Proof of Corollary 2

In the standard case without endogenous property choice, violence effort by a challenger would unambiguously increase when the likelihood of government intervention decreased, and the change in violent effort from the owner in this case is ambiguous. In the case of endogenous property choice, the conflict avoidance response will reduce or eliminate an increase in violence by a challenger. The effect on the violent effort of the owner is still ambiguous.

Proof.   Since w is a parameter that enters into the second stage, it is appropriate to compare the equilibrium outcome of our model to one without endogenous property choice. We start by establishing the effect of a change in w on conflict when there is no conflict avoidance response. That is, we will differentiate the first order conditions of the second stage problem while treating L as exogenous and solve the resulting equations for $\widetilde{v}_w$ and $\widetilde{s}_w$. The derivatives of the first order conditions show:

$$\widetilde{v}_w = \frac{-L(\gamma_{vw} + \gamma_{vs}\widetilde{s}_w)}{\Lambda^H_{vv}} \qquad\qquad \widetilde{s}_w = \frac{L(\gamma_{sw} + \gamma_{vs}\widetilde{v}_w)}{\Lambda^I_{ss}} \tag{8}$$

Solving this system of equations and simplifying yields

$$\widetilde{v}_w = -L\left[\frac{\gamma_{vw}}{\Lambda^H_{vv}} - v_s\left(\frac{\gamma_{sw}}{\Lambda^I_{ss}}\right)\right](1 - v_s s_v)^{-1} \tag{9a}$$

$$\widetilde{s}_w = L\left[\frac{\gamma_{sw}}{\Lambda^I_{ss}} - s_v\left(\frac{\gamma_{vw}}{\Lambda^H_{vv}}\right)\right](1 - v_s s_v)^{-1} \tag{9b}$$

We have previously established or assumed that $\Lambda^H_{vv} < 0$, $\Lambda^I_{ss} < 0$, $v_s < 0$, and

$s_v > 0$. This leaves the terms γ_{vw} and γ_{sw}, which show how the marginal impact of an increase in violent effort changes with a greater chance of government intervention. We will assume that an increase in government involvement will decrease the impact of effort by either party because it is likely that the government can supply significantly more violent effort than the owner or challenger. This implies that $\gamma_{vw} < 0$ and $\gamma_{sw} > 0$.[24] Thus, we know that $\gamma_{sw}/\Lambda_{vv}^{H} < 0$ and $\gamma_{vw}/\Lambda_{ss}^{I} > 0$. Therefore, s_w is unambiguously negative. The sign of v_w is ambiguous, however. It would tend to be negative, like s_w, as the shift in $v(s)$ gets larger relative to the shift in $s(v)$ weighted by the the slope of $v(s)$ or as the slope of $v(s)$ approaches zero.

With the baseline case established, we can now examine how the outcome changes when conflict avoidance behavior can occur. To do this we must consider when calculating the comparative statistics that not only will an anticipated change in the likelihood of government intervention in conflict change the optimal levels of violence, but also that optimal land choice will change in anticipation of what will occur in the second stage. Differentiating the first order conditions with respect to w while treating L as endogenous and solving for v_w and s_w yields:

$$v_w = \frac{-(\gamma_v L_\gamma \gamma_w + \gamma_{vw} L + \gamma_{vs} L s_w)}{\Lambda_{vv}^{H}} \qquad s_w = \frac{\gamma_s L_\gamma \gamma_w + \gamma_{sw} L + \gamma_{vs} L v_w}{\Lambda_{ss}^{I}} \qquad (10)$$

Solving this system of equations and simplifying yields

$$v_w = \widetilde{v}_w + L_\gamma \gamma_w v_L \qquad (11a)$$

$$s_w = \widetilde{s}_w + L_\gamma \gamma_w s_L \qquad (11b)$$

where $\widetilde{v}_w$ and $\widetilde{s}_w$ are given in Equation (9) and v_L and s_L are given in Equation (7). Focusing first on s_w, we have previously established that $\widetilde{s}_w < 0$ and $s_L > 0$; $\gamma_w > 0$ by assumption, and $L_\gamma = -L_{(1-\gamma)} > 0$. Thus, we can unambiguously say that $s_w > \widetilde{s}_w$. For v_w, on the other hand, the effect is still ambiguous because both $\widetilde{v}_w$ and v_L have ambiguous signs.

$\square$

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[24]Since s negatively affects γ, positive movement in γ_s indicates diminished marginal change.