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I: Introduction

This paper attempts to answer a fundamental question about the effect of a change in a legal standard on the parties to a dispute: How do we know who is benefited by a change in a legal standard? The answer to this question may seem obvious, particularly if you state it concretely: Who will benefit from a change in a legal standard that is more likely to find drivers at fault in automobile-pedestrian collisions?[1] Surely the answer is pedestrians. Stated more generally, how do we know that a rule change that seems to benefit a class of parties to a dispute actually does?

The answers to these questions are perhaps not as obvious as they seem. The reason is that litigants are only a potentially small fraction of the total universe of parties to legal disputes, as legal scholars have long recognized. In particular, many disputes are never brought to trial or even if brought to trial, are quickly settled.[2] When settlement is a possibility, the distributional impact of changes in legal standards becomes murkier. Changes in standards that appear to benefit plaintiffs could in fact benefit defendants if more cases that would have been litigated under the old rule are now settled.[3] Put plainly, being able to avoid costly litigation might confer benefits on both plaintiffs and defendants, while the division of those benefits under a settlement depends upon various factors, such as the strength of the case, the stringency of prevailing standards of proof, whether the negotiations are one-shot or repeated, private information possessed by either party, and the bargaining positions and strengths of the respective parties.[4]

It is unlikely that there is one answer to these questions that applies across all types of changes in legal standards. Changes in standards can vary in their impact on the propensity to

settle rather than litigate, depending upon the context. An important issue is the impact of the changing standard on the uncertainty experienced by parties to a dispute regarding how the new rule will be applied. One can imagine changes that increase uncertainty because the new standards are doctrinally novel or complex. In this case, we may well see an increase in the incidence of litigation. However, one can also imagine changes that reduce uncertainty because the new standards are simpler and easier to interpret, in which case the incidence of litigation may well go down.[5] This fact makes answering the question of the effect of changes in legal standards an empirical one.

The general notion of clarifying vs. muddling standards, as I shall call them, has a specific analogy in some property law scholarship. Not all legal standards are about rights to property, of course, but many are. And as property law theorists have pointed out, legal rules exist that either clarify entitlements to property or muddle those entitlements, what Carol Rose has called "crystal" rules and "mud" rules.[6] This implies that it may be possible to examine changes in the legal treatment of property to shed light on the more general question of who benefits and who loses from changes in legal standards.

An important advantage of pursuing this strategy is that many species of property are exchanged in markets and therefore have a particular market-determined value associated with them. One obstacle to determining the impact of changes in legal standards has been a dearth of compelling evidence. Though we can generally obtain detailed information on litigated cases, this is often not true for cases that are settled. Using a novel data set, for example, George Priest has proposed a measure of legal change based on changes in settlement offers, but these data may be difficult to come by.[7] In this paper, I propose to use market-generated data in order to answer the question of who benefits and who loses from changes in legal standards.

This paper examines the effect of changing legal standards within the context of surface water rights in 19th-century California. During this period, California water law underwent a major evolution, associated with major sectoral transformations in the state economy.[8] Over a span of several decades, the California courts dealt with a wide range of complex issues concerning the relative water rights of competing claimants. This paper focuses on the effects of perhaps the single most important water case decided by the California Supreme Court during this period: the landmark 1886 ruling *Lux v. Haggin*, which embodied a major shift in the legal standard governing the relative rights of important classes of water users.[9]

The *Lux* ruling seems particularly apropos for studying the distributional impacts of changes in legal standards, as it has been the subject of an ongoing debate among historians and legal scholars regarding its true impact on the California water law. Some have argued that it resulted in a great deal of legal uncertainty and interfered with economic growth.[10] On the other hand, I and others have argued that it may have had some efficiency-enhancing properties, by permitting courts to employ rules that economize on transaction and information costs.[11] Which is the more appropriate characterization remains unclear to this day because to my knowledge, no systematic analysis of its effects has ever been undertaken.

In the next section, I develop the theoretical predictions regarding the predicted effects of a change in a legal standard on the propensity of competing claimants to litigate, rather than settle, their disputes. In section III, I then discuss the historical context of surface water law in 19th century California, and place *Lux v. Haggin* within this context. Section IV contains an analysis of data on water disputes filed in the superior courts of Tulare, Fresno, and Kern counties during the 1880's and early 1890's. This analysis shows that the *Lux* ruling had two related effects on water litigation. First, it reduced the number of actions brought in water

conflicts involving a similar pattern of facts. Second, among the actions brought, it increased the propensity to settle rather than take the case to trial. These findings are consistent with the hypothesis that in an important class of water conflicts, the *Lux* ruling clarified the legal standard regarding the level of permissible damages. In doing so, it effectively reduced prevailing uncertainty regarding the property rights of different categories of claimants.

In section V, I provide further qualitative evidence from various superior court cases brought in three California counties that are consistent with these findings. Then, in section VI, I directly address the question of who benefited from the *Lux* ruling by examining evidence from actual land and water deeds. This evidence suggests that claimants in one key category enjoyed an observable increase in the value of their lands after *Lux*, as would be predicted if *Lux* resolved legal uncertainty regarding property rights in their favor. Finally, in section VII, I conclude and present potential avenues of future research.

II: Legal standards, litigation, and settlement

To model the effect of a change in a legal standard, I assume the dispute is over a tort allegedly inflicted by one party on another. I assume that there is a single-dimension index of provable damages D, and that each dispute may be fully described by the amount of such damages inflicted on one of the parties, which is represented as a value of this index.[12] Prior to the court ruling in question, there is a court-chosen threshold level of damages D^{PRE} – the legal standard – which demarcates the maximum allowable inflicted damages for which the defendant is not held liable. That is, the plaintiff A recovers from the defendant B only when actual damages exceeds D^{PRE}. Both A and B are assumed to know the value of this threshold damage level. In any given dispute, there is some actual amount of damages inflicted, which I denote D^{ACT}. Both A and B make a subjective assessment of these damages, based upon the particulars

of the case. However, these damage assessments are subject to uncertainty, perhaps because it may be unclear how B's action will be translated into actual damages to A. Specifically, A and B each ascribe unbiased estimates of damages D^A and D^B, respectively, of:

$$D^A = D^{ACT} + \varepsilon^A \quad (1a)$$

$$D^B = D^{ACT} + \varepsilon^B \quad (1b)$$

where the error terms are normally distributed with expected value of zero and some constant variance. For simplicity, assume the variances are equal, so that: $\varepsilon^A, \varepsilon^B \sim N(0, \sigma^2)$. Together with (1a) and (1b), this immediately implies that $D^A, D^B \sim N(D^{ACT}, \sigma^2)$

Consider now the situation of one or the other parties to the dispute; say, the plaintiff. Based upon his subjective assessment of the amount of damages suffered, he will formulate a probability P_A that he will prevail should his case go to trial, where P_A depends upon the relation-ship between his subjective damage estimate D^A and the legal standard D^{PRE}. Figure 1 shows how this probability is assessed for one particular legal standard, D^{PRE*}. In Figure 1, P_A equals the area labelled P_A under the distribution to the right of D^{PRE*}; that is, P_A is A's subjective probability that actual damages exceeds the legal standard. It should be apparent that given any existing legal standard, there is a one-to-one correspondence between the plaintiff's subjective estimate of damages and his subjective probability of prevailing in trial. A similar argument, of course, holds for the defendant. I will denote as P_B the subjective probability ascribed by the defendant B that he will prevail in trial.

Now consider the entire population of possible plaintiffs, each subject to uncertainty regarding the actual level of provable damages in his particular dispute. Specifically, assume that the error term ε^A of each plaintiff is independent and identically (normally) distributed. With randomness in the process of assessing damages, each plaintiff may choose a different D^A*,

and thus, a different probability P_A. This implies that for the population of plaintiffs, there will be a distribution of probabilities $f(P_A)$, as shown in Figure 2, which is obviously a function of the legal standard D^{PRE}. In a given dispute, I assume that the plaintiff is randomly drawn from this distribution. A similar process is occurring on the defendant side, resulting in a similar distribution $g(P_B)$.[13]

Given this prediction on the effect of a change in the legal standard on the probabilities P_A and P_B, the question is how a change in the standard for liability for damages would affect the propensity to litigate. To answer this question, consider the following game-theoretic model of litigation, which captures the essential elements of the possible strategies available to both plaintiffs and defendants.[14] Plaintiff A is currently deriving value (economic profit) of V_A from enjoyment of his property. Defendant B locates nearby and inflicts damages on A. In doing so, B derives value of V_B. Assume B's activities would damage A in the amount of D. Assume that $V_B > V_A$ and $V_A \geq D$.

If A is damaged, he must decide whether to file suit, or take no action. If A takes no action, then B enjoys value of V_B and A receives value of $(V_A - D)$, in perpetuity. If A files suit, B must decide whether to settle out of court or take the case to trial. Both litigation and negotiation to settle involve certain costs being borne by both A and B. For simplicity, assume that they each incur the same costs: C if they litigate, and C_N if they negotiate. Since litigation is costly, assume $C > C_N$. Two key parameters underlying this model are P_A and P_B, the respective probabilities ascribed by A and B that they will prevail should the case go to trial. As described earlier, in any given dispute these probabilities are selected by a random draw from the existing distribution of probabilities for the population of plaintiffs and defendants. Both A and B are assumed to be risk-neutral.

The extensive form of the game is shown in Figure 3. If B decides to settle, then A and B negotiate over the division of total rents ($V_B + V_A - D$). Their shares of the gains depend upon their relative bargaining strengths, which is represented by the parameter α, where α represents A's share, and $\alpha \in [0, 1]$. Thus, in settlement negotiations, A receives $\alpha(V_B + V_A - D)$, and B receives $(1 - \alpha)(V_B + V_A - D)$. They also both incur costs of C_N.

On the other hand, if B decides not to settle and the case goes to trial, then both parties are taking their chances with a probabilistic outcome. The expected value to A of carrying a dispute through to trial (that is, the value at the litigation node L in Figure 3) is: $V_A - (1 - P_A)D - C$, while the expected value to B is $(P_B V_B - C)$. Settlement occurs when the value to B of settlement is greater than B's expected value of litigation; that is, when $(1 - \alpha)(V_B + V_A - D) - C_N > (P_B V_B - C)$. Solving for P^B yields a litigation threshold value of P_B, above which B will choose to litigate:

$$P_B = [(1 - \alpha)(V_B + V_A - D) + (C - C_N)] / V_B \qquad (2)$$

Interpreting this condition, we can readily see that all else equal, B has greater incentive to litigate when: he has a relatively weak negotiating position [α large]; when the gains from trade from negotiation are small [$(V_B + V_A - D)$ small]; when his stakes are high [V_B large]; and/or when the costs of litigation are relatively small [$(C - C_N)$ small].

Depending on whether he expects B to litigate or settle, A must decide whether or not to file suit. If A expects B to litigate, then A will only file suit if his expected returns from filing suit exceed his returns from not filing suit, or: $V_A - (1 - P_A)D - C > V_A - D$. Solving for P_A, we derive the following threshold probability of P_A, below which A will not file suit:

$$P_A = C/D \qquad (3)$$

This simple condition says that A will be more likely to file suit when the cost of litigation is

small relative to the damages being incurred [C/D small]. Notice also that if litigation costs exceed damages, A will never have incentive to file suit [C/D > 1].

Perhaps not surprisingly, if A expects B to settle, whether or not he chooses to file suit does not depend upon P_A. In this case, he files suit if his expected returns under settlement exceed his returns if he does not file suit, or: $\alpha(V_B + V_A - D) - C_N > V_A - D$. To understand this condition, let us solve for C_N:

$$\alpha(V_B + V_A - D) - (V_A - D) > C_N \qquad (4)$$

If equation (4) is satisfied, then A has incentive to file suit. This condition indicates that all else equal, A will file suit when: his bargaining position is strong [α large]; the potential gains from trade are large [$(V_B + V_A - D)$ large]; the value of his operation net of damages is small [$(V_A - D)$ small] and/or when negotiating costs are small [C_N small].

Figure 4 shows the values of P_A and P_B which will result in litigation and settlement in Nash equilibrium, as functions of important parameters of the model. Broadly speaking, litigation occurs when P_A and P_B are simultaneously high; that is, when A and B are both optimistic that they will win. On the other hand, settlement tends to occur when B is not optimistic about his chances [P_B low]. It should be noted that even when P_B is low, there is no guarantee that A will file suit: A has incentive to file suit only if condition (4) is satisfied. Thus, depending on the values of the parameters in (4), when P_B is low, the Nash equilibrium can be either "A files, B settles" or "A does not file." In either case, of course, there is no litigation.

In this model, the effect of a change in a legal standard may be represented as a simultaneous change in P_A and P_B in which one increases and the other decreases, depending upon the nature of the standard and the direction of the change (See Figure 5). Importantly for our purposes, a change in a legal standard that favors the plaintiff A (and thus, simultaneously

disfavors the defendant B) will tend to result in a greater incidence of Nash equilibria in the settlement region, particularly among cases that might have been borderline candidates for litigation prior to the legal change (that is, close to the dashed vertical line).

III: 19th century California water law

The late 19th century was an extremely important formative period for California surface water law. Beginning immediately after statehood in 1850, the courts began to design a system of water rights to serve the developmental demands of the state economy. The first major demand occurred during the Gold Rush, when miners began to use large amounts of water after the development of hydraulic mining techniques in the early 1850's.[15] It is well-known that increased demand for water gave rise, in the 1850's, to a series of important rulings in which the California Supreme Court created a workable system for establishing, maintaining, and alienating surface water rights, which became known as the system of prior appropriation.[16]

For the purposes of this paper, there are two important things to keep in mind about appropriative rights. First, water for mining was typically used at locations physically removed from the water source and consequently, appropriative rights were rights to divert and thus, to deprive downstream users of water. Second, every appropriative right was for a specific quantity and carried with it a priority date, essentially the point in time when a water claim was filed (and then subsequently developed). Rights perfected earlier in time (senior rights) were satisfied first, meaning that earlier claimants received their full entitlement before later claimants (holding junior rights) could receive theirs. These two features of appropriative rights conferred a considerable advantage on miners who managed to stake their water claims early, especially during the inevitable episodes of drought that occurred with some regularity.

One might be tempted to interpret the development of appropriative rights during the California Gold Rush as a simple example of increasingly explicit and well-defined property rights occurring in response to increases in the value of water.[17] The reality was, however, much more complicated. Most importantly, the California courts operated within a legal environment in which it had been legislatively mandated that they apply principles of English common law to, among other things, craft the various features of water rights.[18] This led to the early recognition of water rights based on a very different doctrine: riparian law, which governed water rights under English common law.

Under riparian law, land ownership conferred the right to use water in physically adjacent waterways. However, water could not be diverted for use on non-riparian lands because all riparian landowners enjoyed coequal rights in the waterway. This meant that riparian rights were not well-suited for mining, as many claims were physically removed from existing waterways. Furthermore, the fact that no user enjoyed temporal priority of claim over other users meant that riparian rights varied as water supply conditions fluctuated. This would probably have discouraged investment in water development, as potential developers would not know how much water they were entitled to.

It should be apparent that riparian and appropriative rights constitute starkly different, and seemingly incompatible, types of property rights. How could both arise under one system of law? The key particular circumstance in California that permitted both kinds of rights to emerge was the fact that lands in the state began as part of the public domain. During the Gold Rush, the mining regions were all on public lands belonging to the federal government. In allowing miners to appropriate water on a first-come, first-served basis, the courts sought to accommodate their need for property rights that were secure. They found doctrinal basis for such rights in the Eng-

lish common law principle of presumption of grant. Since the federal government had taken no action to assert its rights to the mining regions, the courts argued, it could be presumed that it was acquiescing in their occupation by miners. Under such circumstances, claimants had rights superior to subsequent claimants. However, all claimants could be displaced if the government, as the true owner, ever asserted its claim. The courts were able to cite ample precedent from English cases to support this contention.[19]

Riparian rights, on the other hand, derived from grants of public lands made to private citizens under the several disposal acts that comprised federal land disposal policy. As we have seen, under English common law the fundamental basis for riparian rights was ownership of adjacent land. The courts argued that the federal government was the owner of the public lands when California was admitted to statehood and as such, enjoyed riparian rights to all non-navigable waterways thereon. These riparian rights were conveyed to private citizens when those lands were disposed of, unless expressly reserved in the terms of the grant. For state courts to deny that riparian rights were conveyed was to interfere with the right of the federal government to dispose of the public lands.

The public lands basis for defining riparian and appropriative rights also served well in resolving disputes early on between riparians and appropriators. Because early court cases involved disputes among miners during the Gold Rush, the courts took advantage of the fact that almost all mining took place on public lands to affirm the primacy of appropriative rights when in conflict with riparian rights. The reasoning of the California Supreme Court(Court) is illustrated in the landmark case of *Irwin v. Phillips*, involving precisely such a dispute, between miners locating along the banks of a stream and an upstream ditch owner diverting the stream to supply miners with water. In *Irwin* the Court ruled for the ditch owner on the basis that he was

there first, the doctrinal justification being that the miners were not entitled to a riparian right because they did not own their lands. Existing cases upholding riparian rights, the Court argued, did not apply here because the riparian doctrine was "found to rest upon the fact of the individual rights of landed proprietors upon the stream."[20]

Because the *Irwin* court made much of the fact that the dispute took place on public lands, the *Irwin* ruling, and other early rulings that upheld appropriative rights when in conflict with riparian rights, left open the crucial question of whose rights took precedence on privately-owned lands. This omission became increasingly important over time as lands steadily passed into private hands through a series of acts passed by Congress calling for disposal of the public lands. By 1870, at least (?) acres of land in the Central Valley had passed into private ownership, and the privatization process continued in subsequent decades. Furthermore, after 1870 irrigated agriculture began to increase dramatically. The spread of irrigation techniques increased agricultural demand for water, especially in the southern San Joaquin Valley, where irrigation proved to be particularly advantageous.[21] It was thus only a matter of time before the courts would be forced to address the issue of whether or not appropriative rights took precedence over riparian rights on private lands.

In the late 1870's, a series of disputes on private lands involving appropriators and riparians began to make their way to the state Supreme Court. This type of dispute had no good precedent in English common law, and the courts struggled to apply established legal principles to a novel set of circumstances. Through the early 1880's, the Court responded essentially by favoring riparian claims, typically enjoining appropriations which deprived riparians of the use of surface waters. However, these early rulings typically provided little explanation of the doctrinal basis for such rulings. In the 1878 case of *Creighton v. Evans*, for example, the Court issued a

one-paragraph ruling in which it simply declared that the defendant, an appropriator, was "not entitled to divert the water for any purpose", but did not explain why.[22] And though the Court was a bit more forthcoming the following year in *Pope v. Kinman*, stating that "under settled principles, ... the riparian proprietor has a usufruct in the stream as it passes over his land", it did not elaborate much, seeming to assume that the implied primacy over the competing appropriator was self-evident.[23]

Such terse rulings, though nominally pro-riparian, did not settle the relative legal status of riparian and appropriative rights. Consequently, there was much public uncertainty during the early 1880's regarding how the courts were likely to continue to resolve disputes involving competing riparians and appropriators. Newspaper editorials in the Tulare-Kern-Fresno region were regarding the issue as an open one, sometimes taking the position that the courts were unlikely to continue to uphold riparian rights.[24] Pisani recounts that as late as 1885, many state legislators were arguing that the Court might well reverse its earlier pro-riparian position.[25] Throughout this period, the rhetoric of anti-riparians often contained references to "reconstructing" or "reorganizing" the Court if it failed to deny the legitimacy of riparian rights, implying that by doing so its earlier rulings could be reversed.[26]

However, in 1886 the state Supreme Court handed down a carefully-argued, extremely lengthy (over 200 pages) ruling in the landmark case of *Lux v. Haggin*. *Lux* pitted a downstream riparian, the Miller-Lux corporation, against an upstream appropriator, James Haggin. Miller-Lux claimed riparian rights to the Kern River dating from the 1850's, water which was used by Miller-Lux for watering cattle. In the mid-1870's, Haggin began to divert water upstream for irrigation. When drought occurred at the end of the decade, many cattle belonging to Miller-Lux died, and the firm filed suit. In 1881, the superior court of Kern County found for Haggin, partly

on the basis that riparian rights were not entirely suitable to conditions in California, and that denying the upstream appropriations would lead to considerable loss of economic value.[27] However, on appeal the California Supreme Court reversed the lower court ruling, affirming the riparian rights of Miller-Lux and ruling that they took precedence over the appropriative claims of Haggin. In *Lux*, the Court addressed a whole host of doctrinal issues concerning the applicability of riparian law to conditions in California and why, on doctrinal grounds, riparian rights should enjoy primacy over appropriative rights. For the purposes of this paper, the most important portion of the *Lux* ruling was summarized as follows by Justice Ross:

> "In effect, the conclusion reached by the majority is, that the grantee of any legal sub-division of the public lands of the United States or of the state, through or along which a stream of water flows, is lawfully entitled – at least as against any one not a riparian proprietor or previous appropriator – to have the water continue to flow in its natural channel undiminished in quantity and unaffected in quality."[28]

In other words, in such cases the *Lux* ruling established a legal standard of zero permissible damages that could be inflicted by an appropriator on a riparian, under certain conditions. Since the vast majority of private lands in California derived from public land grants, *Lux* made it considerably more difficult for appropriators to divert surface water to the detriment of a riparian who was already present downstream. The opinion exerted an enormous influence over subsequent rulings involving riparians and appropriators, which almost invariably invoked the principles established in *Lux*.

It is worth mentioning that the *Lux* Court did specify several avenues whereby water rights could be transferred from riparian tracts. First, the Court declared that appropriative rights could be acquired by prescription; that is, if a riparian was damaged by a diversion but did not protest within a period of five years, then the diversion could ripen into an appropriative right. Second, irrigation was declared a public use of water, opening up the possibility that water rights could be acquired by condemnation, if compensation was provided. Finally, the Court allowed

for the possibility that under certain circumstances, riparian rights could be transferred through voluntary exchange. To the extent that these avenues were actually pursued, they may have mitigated any impact that *Lux* may have had in tying water to riparian lands.

What are we to make of *Lux*? Among historians and legal scholars, though differing in certain details, there is general consensus that *Lux* exerted an adverse impact on the rational development of water use in early California. Eric Freyfogle (1986), for example, one of its harshest critics, has characterized the opinion as profoundly conservative, one that continues to impede rational water allocation to this day.[29] Others have viewed it as something of an historical anomaly, creating a hybrid legal system with two largely incompatible types of water rights, but not necessarily strongly anti-developmental because to some extent private responses softened its impact.[30] I have argued that the California courts may have considered differing transactions costs in fashioning subsequent rulings in riparian-appropriative disputes, as a means of differentially facilitating exchanges of surface water rights.[31] And there is evidence that the courts made other changes in the law to facilitate transfers from riparian claimants. The difficulty in evaluating *Lux* is that existing studies contain virtually no quantitative evidence regarding how private actors actually responded to the ruling.

IV: Did Lux Reduce Litigation Between Riparians and Appropriators?

In this section, I provide quantitative evidence that the *Lux* ruling altered the nature and extent of litigation over surface water rights, in a manner consistent with the model of section II. This evidence is based on cases involving water disputes collected from the superior courts of Tulare, Fresno, and Kern counties from 1879 through the mid-1890's.[32] I have collected over 300 cases involving a variety of types of disputes over water. These disputes encompass a variety of issues, including damages inflicted by upstream diversions, damages from canal

overflow, right-of-way disputes, non-delivery of water by mutual companies, and non-payment for water delivered. Of these, 104 cases involve alleged damages to riparians caused by diversions by upstream appropriators. The data set includes all water-related cases filed, but not necessarily tried, in court. In fact, most cases were either dropped or settled out of court: in only fifty-one cases did the superior court issue an actual ruling. A superior court ruling was issued in twenty of the 104 cases involving riparians and appropriators. Of these twenty rulings, twelve were subsequently appealed to the California Supreme Court.

Figure 6 reports data on the number of riparian-appropriator suits filed, tried in the superior courts of these three counties, and appealed to the California Supreme Court for the years 1879 through 1895. This evidence indicates several things. First, after 1886 we observe a reduction in the number of suits filed. This is true even if we exclude the data from 1885, which is an obvious outlier in this data set. From 1879 through 1884, the average number of riparian-appropriator suits filed per year was 3.83; from 1887 through 1895, this average fell to 2.56.

Second, after 1886 there is a reduction in the percentage of suits filed that actually go to trial, suggesting a greater incidence of out-of-court settlements. This change is even more dramatic: between the period 1879-1884 and 1887-1895, the percentage of suits filed that go to trial decreases from 60.9% to 21.7%. All of this evidence is consistent with the following interpretation of the model of the previous section: after *Lux*, claimants expected riparians to become more likely to prevail in disputes with appropriators. To the extent that this occurred, fewer suits would have been litigated as appropriators either avoided inflicting damages on riparians [D decreasing] or became increasingly willing to settle out of court [P_A increasing, P_B decreasing].

A third suggestive fact is that beginning in 1885, the incidence of appeals to the Supreme Court in riparian-appropriator cases essentially disappeared. Prior to 1885, the Supreme Court heard a dozen appeals, an average of two per year after 1879. This fact suggests that in the early 1880's, the courts were experiencing a significant amount of uncertainty in how to deal with disputes between riparians and appropriators. The fact that there were literally no appeals after 1886 implies that the issue of riparian primacy became much less contentious and controversial after that date.

One interpretive issue with the raw data reported in Figure 6 is that it does not control for other factors that could exacerbate disputes between riparian and appropriator claimants. One obvious such factor is water availability: one might expect, for example, the number of disputes to increase during years of below-normal precipitation. To allow for this possibility, I performed some estimations in which the number of riparian-appropriator disputes per year is regressed against a water availability indicator *PRECIP*, a dummy variable *LUXDUMMY* which equals one after 1886 and zero before, and a time trend. *PRECIP* is simply the number of inches of recorded rainfall in San Bernardino, the nearest rainfall measuring station for which data is available.[33] The time trend *TIME* controls (imperfectly) for unobservable changing variables that may be varying over time that systematically affect the propensity for disputes between riparians and appropriators.

Table 1 reports the results of estimations on three dependent variables: cases filed (*FILED*), cases tried (*TRIED*), and cases appealed to the CA Supreme Court (*APPEALED*). Each variable is defined as the number of cases per year for each of the years 1879 through 1895.[34] These variables are censored at zero, since *FILED*, *TRIED*, and *APPEALED* all can, and sometimes do, equal zero in a given year. Therefore, the models are estimated using the Tobit

procedure. The results indicate that after the *Lux* ruling, there was a significant decline in the number of riparian-appropriator cases filed, even after controlling for water availability and other trending variables. This is consistent with the predictions of our model regarding the propensity to litigate. The results indicate, however, that *Lux* had a smaller and less significant effect on the number of cases tried, and no detectable effect on the number of cases appealed.

By aggregating all cases in a given year, these Tobit results, though suggestive, do not capture the effect of different circumstances at the level of individual cases. Importantly, in a riparian-appropriator dispute, the likelihood that a case will come to trial may well depend upon whether the appropriator can plausibly claim a prescriptive right to the water. Given the consistent affirmation by the courts of proven prescription claims by appropriators, an appropriator in a position to make such a claim would probably ascribe a higher probability of prevailing in court.[35] In terms of the model of section II, litigation becomes a more likely Nash equilibrium when the appropriator can claim a prescriptive right (unless the appropriator's claim is so strong that the riparian does not even bother to file suit).

In order to control for such a possibility in examining the effect of *Lux*, I performed further analysis at the individual case level. A further advantage of performing the analysis at the individual case level is a considerably larger data set: eighty-nine observations. In this analysis, the dependent variable is a dummy variable *LITIG* equal to one if a case is litigated and equal to zero if settled out of court. Table 2 reports the results of a series of logit estimations, in which *LITIG* is regressed against *PRECIP*, *LUXDUMMY*, *TIME* and also a dummy variable *PRESCRIPTION* which equals one if the appropriator claimed a prescriptive right and equals zero if not. The results indicate that disputes in which the appropriator could claim a prescriptive right were more likely to go to trial, which is consistent with the predictions of my model. In

addition, the results suggest that disputes were more likely to be settled out of court after the *Lux* ruling, which is again consistent with the previous findings. Finally, the results do not indicate any significant time trend in the tendency to litigate, nor any significant impact of general conditions of reduced water availability.

V: Further Evidence on Negotiation

The case files themselves contain a great deal of qualitative information which shed further light on the incentives to litigate rather than cooperate in some fashion. Cooperative avenues that parties to a dispute could pursue included, for example, organizing a mutual ditch company, litigation cost-sharing, direct bilateral negotiation, arbitration, and multilateral water sharing arrangements. The cases depict a complex interplay between litigation and cooperation which defies easy description, but I find evidence for the following propositions. First, cooperation appears to have occurred with some frequency, as a means of economizing on both water development costs and transactions costs. Second, in many identifiable instances of cooperation, none of the involved parties held claims that enjoyed clear legal precedence over the others. Third, cooperation was more attractive, all else equal, when there were larger numbers of competing claimants. Finally, similarly-situated claimants who were engaged in cooperation had incentive to litigate against newcomers claiming rights of their own. All of this seems consistent with the predictions of my model.

One striking feature of this period is the existence of a large number of mutual ditch companies: for example, at least eighteen mutual companies were incorporated in Tulare County during the 1870's alone. These mutuals would appropriate water, construct a dam and main-stem canal, and supply water to member farmers. All members bought shares of stock in the mutual, which determined how much water they were entitled to receive. This stock was

typically trans-ferable, either to other members or to outside parties who wanted to join. Formation of these mutuals permitted economies of scale to be realized, which were significant given the large fixed costs typically involved in developing a surface water source. The mutuals were also the target of numerous actions filed by riparians objecting to their upstream diversions. However, they also served the function of litigating on behalf of members when the water supply of the mutual was being infringed upon. A great many of the cases in the data set involved mutual companies as either plaintiff or defendant, and often both.

Mutuals could also negotiate agreements with outside parties: again, often other mutual companies. In 1896, for example, two mutual companies -- the Pioneer Water Company and the Pleasant Valley Ditch Company -- negotiated an agreement to share the waters of the Tule River. In this case, both parties were claiming appropriative rights. One interesting thing about the agreement was that Pioneer enjoyed a right extremely senior to that of Pleasant Valley. One might expect that under these circumstances, Pioneer would simply take its appropriation, and no agreement would be necessary as Pleasant Valley would simply have to avoid diverting to the detriment of Pioneer. However, also at stake was the amount of water to which Pioneer was entitled. Pioneer was claiming an amount equal to the capacity of its ditch, but it was unclear whether it was actually entitled to this amount, since appropriative rights are based not on capacity but actual use. This uncertainty may have produced a negotiated settlement rather than avoidance of harm. Indeed, the final agreement gave Pioneer an amount considerably less than its ditch capacity, an amount later confirmed by the superior court when it was called upon to settle a subsequent disagreement between the two parties (Tulare #2905)[36].

Riparians, too, engaged in negotiations with other parties, in one prominent instance as a way of sharing the cost of potential litigation. In November 1879, Miller-Lux entered into an

agreement with six other riparian landowners along the lower Kern River to share any future cost of litigating to contest upstream appropriations. The fact that the seven riparians had very different sizes of landholdings (Miller-Lux owned nearly 37,000 acres, while their smallest riparian partner owned 1,280 acres) and therefore, very different stakes in future litigation, could have made it difficult to reach a cost-sharing agreement. However, to reduce negotiation costs, the agreement stipulated that each party's share of total costs would be proportional to the size of their landholdings, making their expected benefits from the agreement commensurate with their costs (Kern # 911). The objective of this agreement was obviously to economize on litigation costs, but it had the additional effect of providing more appropriate incentives to litigate, when litigation by any individual riparian provided public good benefits to other similarly-situated riparians.

Submitting a dispute to arbitration was another possible way to resolve a water conflict. In 1884, for example, a landowner Chidister and a mutual company -- Consolidated People's Ditch Company -- submitted a dispute over overflow damages to arbitration, where the costs of the arbitration were to be shared by the parties (Tulare #940). The arbitrator awarded $500 in damages to Chidister, and the entire dispute was ended quickly. However, arbitration awards could be challenged in the courts, which sometimes defeated cooperation. This occurred, for example, in 1892, when several mutual companies, two riparian landowners, and an irrigation district arbitrated a division of the waters of a stretch of the Kaweah River. This involved establishing an arbitration board among themselves, consisting of five members, each representing different parties to the dispute. An arbitrated agreement was, however, subsequently challenged by one of the riparian owners in 1896, whereupon the Superior Court vacated the agreement.

An example of apparently successful multilateral negotiation occurred in 1897, when several mutual companies located along the much-litigated King's River formally agreed to allocate the available water among themselves. The four signatory companies -- Fresno Canal and Irrigation Company, People's Ditch, Last Chance Water Company, and the Lower King's River Ditch Company -- had been involved in litigation since at least 1880. In that year, the latter three companies had, all on the same day, filed suit to enjoin diversions by the Fresno Canal and Irrigation Company (Tulare #76, #77, and #78), on the basis of priority of claim. In response, the defendant presented evidence that its claims, including the purchase of certain early rights, predated those of any of the plaintiffs. The Superior Court, in March 1892, found that only the defendant's purchased rights predated those of the plaintiffs LKRDC and LCD (the suit involving PDC apparently never made it to trial), and awarded those two companies 159 and 190 cubic feet per sec (cfs), senior to the defendant's award of 100 cfs. This ruling was subsequently upheld by the CA Supreme Court in September 1898.

In the meantime, however, the three prevailing ditch companies found themselves embroiled in additional suits, against the Kings River and Fresno Canal Company later in 1880, and the 76 Land and Water Company in late-1888. The latter suit, against a decidedly junior appropriator, apparently provided impetus for the multilateral agreement, for the arrangement called for the four companies to cooperate to prevent the wrongful diversion of any water from the King's River by the 76 Land and Water Company. The agreement also called for the parties to cooperate to measure and maintain stream flow, and to share in the associated expenses. As a result of this agreement, a total of fifteen pending suits were dismissed. Both the initial litigation and the subsequent multilateral agreement are explainable in terms of our model. Since the appropriative rights of all four litigants dated from around the same time period – the early 1870's

– they probably operated under a lot of uncertainty concerning their relative rights. Our model indicates that such a situation could easily lead to litigation. However, once their rights relative to each other were established, they would have an interest in cooperating to preserve these rights against newcomers.

VI: Did Lux Increase the Value of Riparian Lands?

The evidence presented in the last two sections is broadly consistent with a conclusion that *Lux* constituted a shift in a legal standard in favor of one particular class of users – riparian right-holders – in disputes with appropriators. However, it has not yet been established that *Lux* actually benefited riparian users relative to appropriators, because the incidence of riparian-appropriator settlements increased after the ruling. In this section, we investigate, using market-generated data, the possibility that the *Lux* ruling may have increased the value of lands riparian to surface waterways. If the value of riparian lands in fact increased, and such an increase was not observed in the value of otherwise comparable non-riparian lands, this would support the hypothesis that *Lux* did indeed benefit riparian claimants.

The analysis in this section is based on a data set of actual transactions in land and water from the time period surrounding *Lux*. This data set is comprised of roughly 500 deeds for exchanges of tracts of land and/or water rights in Kern County involving either Miller-Lux or Haggin as buyer or seller over the period from 1872 through 1899.[37] Virtually all of the deeds contain information on the quantity and location of land exchanged, while a smaller number of deeds also transfer a right to a specified quantity of water, mostly as embodied in shares in mutual companies. In addition, virtually all deeds specify a transfer price, though in many deeds the price is set at a nominal level such as $5 or $10, obviously not a reflection of the real value of

the asset being exchanged. After eliminating the deeds with such nominal prices, I am left with 170 observations.

Each of these deeds may be viewed as composite commodities with hedonic attributes, including the quantity, quality, and location of land; the extent of the transferred water right, if included in the transaction; and the *Lux* ruling. In the econometric analysis, we are interested in the marginal effects of each of the hedonic attributes – especially *Lux* – on land value. The dependent variable in the regressions is the natural logarithm of *PACRE*, where *PACRE* is defined as the deed price divided by the number of acres of land transferred, in real 1891-92 dollars. *PACRE* is thus the per-acre price of a tract of land. The log specification is used because of significant right skew in the distribution of *PACRE*, and because preliminary regressions using *PACRE* showed significant heteroscedasticity, as revealed by Breusch-Pagan tests. Histograms of *ln(PACRE)* indicate a substantial reduction in skewness, though heteroscedasticity is not entirely eliminated.

As defined, *ln(PACRE)* will reflect the value of all important attributes of a parcel of land, including *Lux*. However, the effect of *Lux* depends centrally upon whether or not a particular tract of land is riparian to a waterway. In order to partition the data set into riparian and non-riparian tracts, I examined maps of Kern County and identified all quarter-township sections located adjacent to surface waterways.[38] All transferred parcels of land located in these adjacent sections were classified as riparian, all others were classified as non-riparian. I then per-formed a regression analysis of the following model:

$$ln(PACRE) = f(LUX, WATER, Z) + u \qquad (5)$$

where *LUX* is a dummy variable equal to one if the exchange occurred after the *Lux* ruling and equal to zero before; *WATER* is a dummy variable equal to one if the deed included transfer of a

water right (that is, separate from the riparian right which would naturally inhere in riparian lands), and equal to zero otherwise; and *Z* is a vector of other variables that might systematically affect the market value of a tract of land, such as generalized water availability and economic conditions.

I defined two variables to capture the effect of changes in economic conditions. One is the variable *PROD*, which is an annual index of manufacturing production for the entire United States.[39] The other is *WPI*, the annual wholesale price index. These variables were included to capture the macro-impacts of general levels of economic activity and prices on the real value of land. To capture water availability, I used the variable *PRECIP*, as defined in the previous section. In some of the regressions, I included the variable *ACRES*, defined as the number of acres of land exchanged in the transaction, to allow for the possibility that the price per acre might vary with the size of the transaction. Finally, some of the regressions included a time trend *TIME*, simply defined as the year in which the transaction occurred, in order to control for unobservable temporal trends. This model was regressed separately on riparian and non-riparian tracts.

Table 3 reports the results of a series of ordinary least squares regressions of *ln(PACRE)* on various permutations of important regressors, for both riparian and non-riparian tracts. The reported t-ratios are based on White-corrected standard errors. The key finding concerns the impact of the *Lux* ruling on the per-acre prices of riparian and non-riparian lands. Most importantly, I find a significantly positive impact of the ruling on the price of riparian land. The results also show a smaller and less significant negative impact on the price of non-riparian land. These findings suggest that *Lux* may have had a significant redistributional impact on land rents, away from non-riparian landowners and toward riparian landowners. This finding is consistent

with the analysis of section IV that showed a shift from litigation to settlement of riparian-appropriator disputes after *Lux*. However, it goes further by documenting that riparians actually enjoyed additional land rents after the ruling.

The results also show that tracts of land were significantly more valuable when they came with water rights, as expected. This was true regardless of whether land was riparian or non-riparian, though it is interesting that the coefficient on WATER was modestly higher for non-riparian tracts. This finding suggests that there may have been greater value in a conveyance of water for the owners of non-riparian lands, which makes sense intuitively. It is worth mentioning that these findings control for changes in business conditions, which had significant impacts on the value of riparian lands, particularly general price levels. On the other hand, both prices and general business activity were relatively insignificant in affecting the value of non-riparian lands. Finally, these findings also control for short-run changes in water availability, differences in the sizes of the land tracts exchanged, and a temporal reduction in real land prices over time,

VII. Conclusions

This paper has proposed a method of gauging the distributional impacts of changes in legal standards, permitting us to identify the beneficiaries of these changes, and to quantify the magnitudes of the associated benefits. The method applied here has been specifically to land and water prices affected by doctrinal changes in California in the late 19th century. However, in principle the method can be applied more generally in cases where the legal standards affect the content and clarity of rights to property that is exchanged on markets at agreed-upon prices that reflect market value. Being able to apply the method has two requirements: a situation in which changes in standards affect the probability that one class of claimants will prevail in disputes

over property; and available data on actual exchanges of that genre of property and on what price terms. Additionally, if information on litigation and settlement behavior is available, it can be used to confirm the distributional impact of changes in legal standards.

The analysis here also provides important insights into arguably the most important water dispute in California during the 19th century. Whereas existing studies have come to no final consensus on the true economic impact of *Lux v. Haggin* and its common law legacy, we have shown that Lux had important distributional impacts on the value of different classes of water rights. Furthermore, by resolving legal uncertainty regarding the primacy of the different classes of water rights, *Lux* decreased the legal costs associated with conflicts over the use of surface waterways in California, encouraging more settlement of disputes and fewer appeals to the higher court.

It is important to mention that I am not claiming to have shown that the *Lux* ruling, by reducing legal costs, had only unambiguously positive effects on water use efficiency. Cast in a different light, it could be argued that *Lux* affirmed a species of water right which was totally inappropriate for irrigated agriculture in California. Indeed, some critics have charged that *Lux* saddled the state with an unworkable system of water law which tied surface water rights to riparian lands while the considerably more numerous non-riparian agricultural lands went without. In fact, the subsequent history of California agriculture does not bear out this assertion. Why not is a question that merits much more attention, but two events in the immediate aftermath of *Lux* suggest two likely important areas of inquiry for future researchers.

The first was the enactment of the Wright Act in 1887, the year immediately following the *Lux* ruling. The Wright Act authorized the formation of public irrigation districts that were, among other things, empowered to condemn riparian rights within their service areas. Historians

have portrayed the Wright Act as a populist legislative response to the unpopularity of the *Lux* ruling and at the time, many had high hopes that a system of irrigation districts could rationalize water development in the state.[40] However, the irrigation district model struggled for twenty-five years until shortly before World War I, when the state enacted important reforms that effectively fixed the irrigation district model.[41] A better understanding of the early challenges faced by irrigation districts would help us better understand the obstacles to rationalization of water rights during this period.

Another telling event occurred immediately after *Lux*, which provides a suggestive epilogue to the entire affair. Shortly after the *Lux* ruling, the protagonists signed an agreement that effectively transferred two-thirds of Miller-Lux's water right in the Kern River to Haggin, in exchange for which Haggin agreed to share the cost of constructing a dam for Miller. In light of this discussion, this agreement suggests the following interpretation: by clearly awarding the property rights to Miller-Lux, the *Lux* ruling paved the way for a Pareto-improving exchange of rights between the parties immediately involved in the dispute. To the extent that voluntary transactions were pursued more broadly, surface water could have been effectively transferred to non-riparian uses, thus servicing the growth of irrigated agriculture in non-riparian lands. A key issue here would have been the potential existence of transaction costs that may have impeded these transactions. Characterizing subsequent transactions through a transaction cost lens should be the subject of future research.

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Figure 1: Choice of P_A for any given legal standard and subjective damage assessments

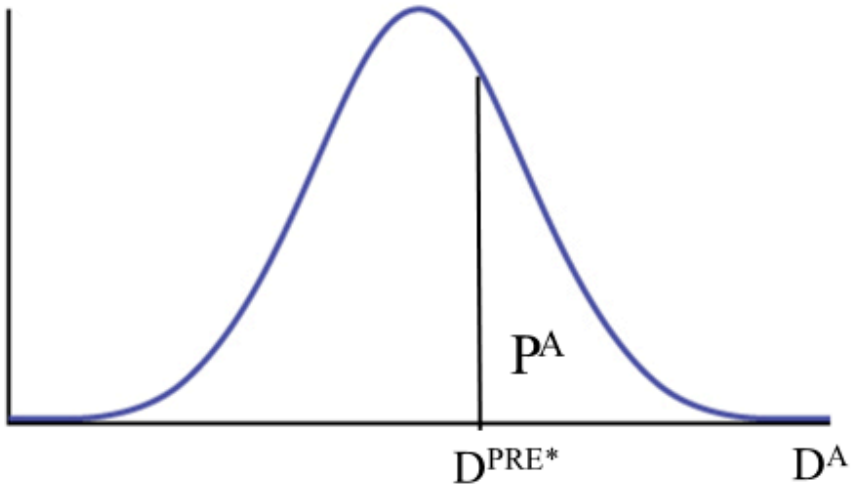

Figure 2: Distribution of probabilities for an entire population of potential plaintiffs

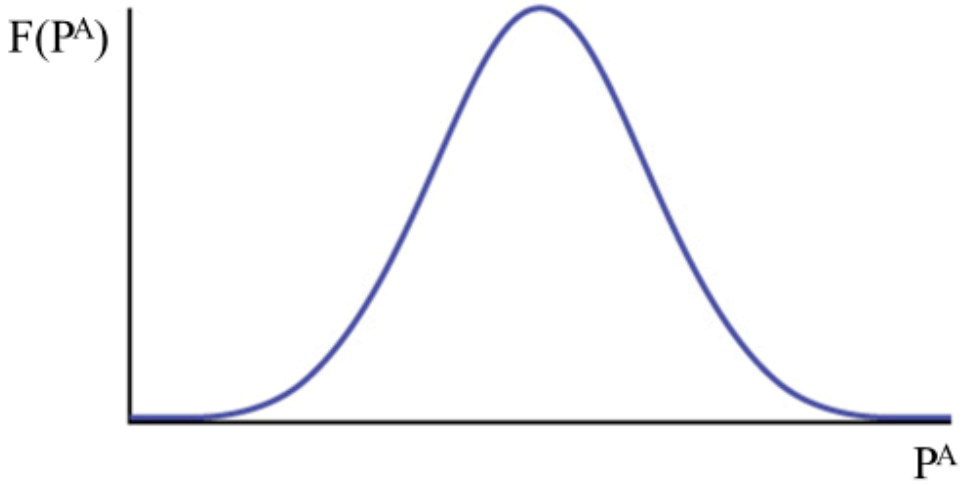

Figure 3: Extensive form litigation game

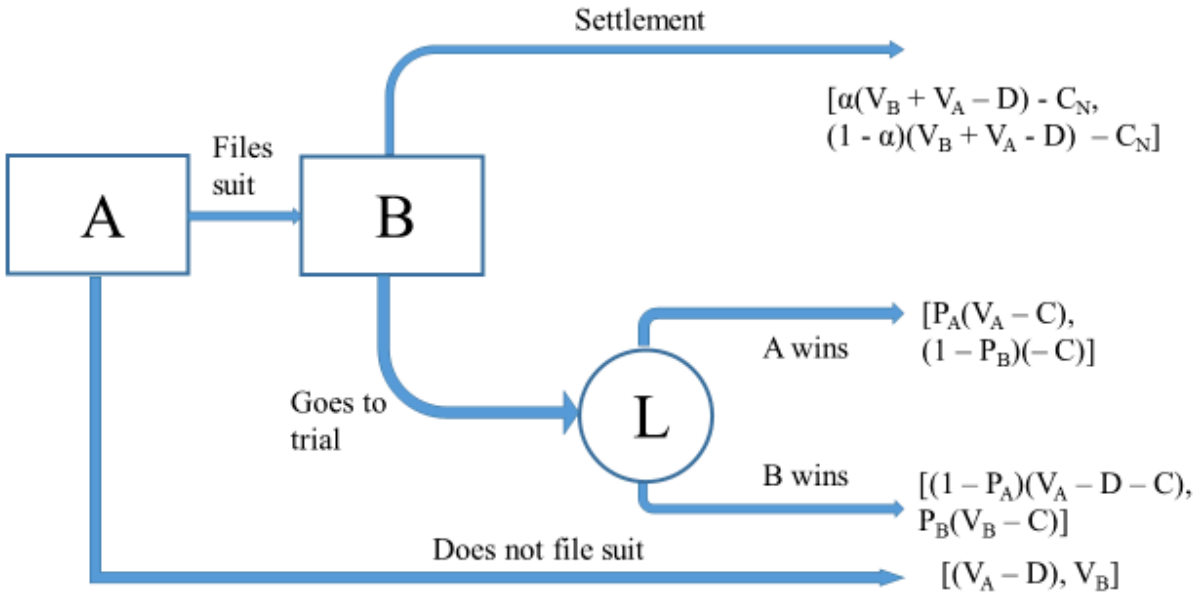

Figure 4: Probability conditions for settlement, litigation

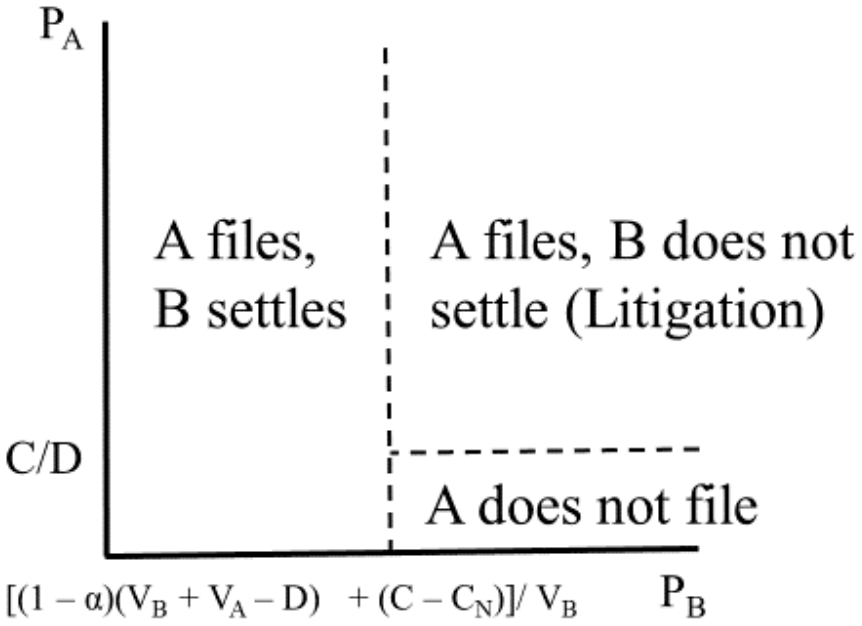

Figure 5: The effect of a change in a legal standard favoring the plaintiff A

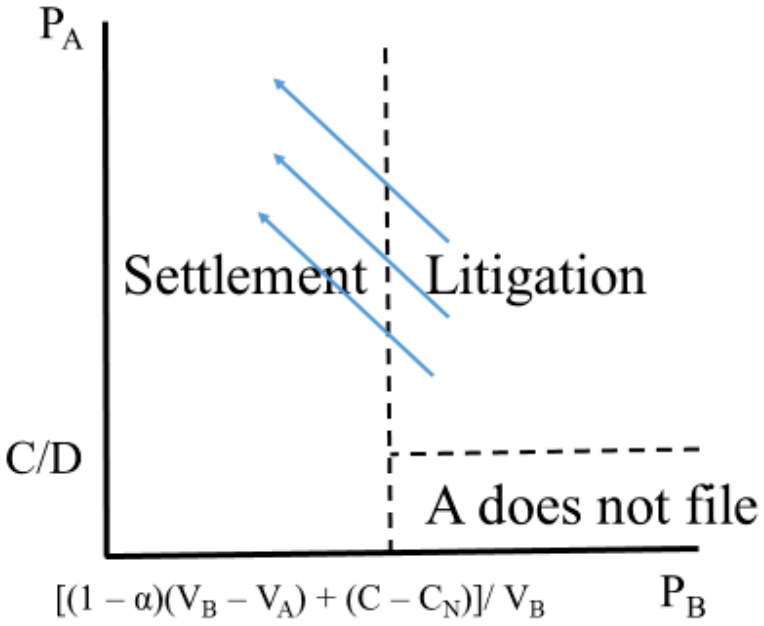

Table 1: Effect of Lux v. Haggin on Riparian-Appropriator Litigation

	# of Cases Filed		# of Cases Tried		# of Cases Appealed	
CONSTANT	6.83***	-441.93	2.51**	-96.53	1.32	900.48**
	(4.89)	(-1.03)	(2.32)	(-0.25)	(1.33)	(2.36)
LUXDUMMY	-3.72***		-5.73***	-3.10***	-3.58	-8.39 -3.68
	(-3.30)	(-2.53)	(-2.66)	(-1.57)	(-0.06)	(-0.04)
PRECIP	-0.17**	-0.18***	-0.06	-0.07	-0.02	0.02
	(-2.45)	(-2.57)	(-1.16)	(-1.17)	(-0.46)	(0.48)
TIME	--	0.24	--	0.05	--	-0.48**
	--	(1.05)	--	(0.25)	--	(-2.36)
Loglikelihood	-27.93	-27.37	-16.13	-16.09	-10.29	-7.57

** Significant at 5%.
*** Significant at 1%.
Figures in parentheses are t-ratios.
Estimation method: Tobit.
Number of observations = 16.

Table 2: Effect of Lux v. Haggin on Trial versus Settlement

	(1)	(2)	(3)	(4)
CONSTANT	-432.91*	-493.14**	-0.12	19.93
	(-1.82)	(-2.19)	(-0.14)	(0.15)
LUXDUMMY	-3.28**	-3.42**	-1.24	--
	(-2.23)	(-2.32)	(-1.36)	--
PRECIP	-0.04	--	-0.08	-0.06
	(-0.85)	--	(-1.46)	(-1.08)
PRESCRIPTION	2.51***	2.61***	2.37***	1.79**
	(2.79)	(2.91)	(2.75)	(2.51)
TIME	0.23*	0.26**	--	-0.01
	(1.82)	(2.18)	--	(-0.15)
Loglikelihood	-41.54	-41.94	-43.18	-44.26
% Correct Predictions	0.798	0.798	0.798	0.775

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.
Figures in parentheses are t-ratios.
Estimation method: Logit.
Number of observations = 89.

Table 3: Effect of Lux v. Haggin on Riparian, Nonriparian Land Values

	Riparian Lands (N = 50)			Nonriparian Lands (N = 119)		
	(1)	(2)	(3)	(4)	(5)	(6)
CONSTANT	31.60***	34.85***	35.10***	10.63	9.16	10.88
	(3.62)	(3.95)	(3.87)	(1.15)	(1.15)	(1.17)
WATER	0.70***	0.66***	0.65***	0.79***	0.78***	0.78**
	(3.11)	(2.96)	(3.02)	(2.63)	(2.64)	(2.60)
LUX	1.07**	0.93**	1.02**	-0.46	-0.49	-0.45
	(2.36)	(2.05)	(2.22)	(-1.31)	(-1.55)	(-1.28)
PROD	0.10	0.13**	0.12**	0.05	0.05	0.05
	(1.65)	(2.37)	(2.00)	(1.02)	(1.02)	(1.08)
WPI	-0.06***	-0.06***	-0.07***	-0.02	-0.02	-0.02
	(-2.78)	(-3.10)	(-3.12)	(-0.82)	(-0.80)	(-0.83)
PRECIP	-0.01	--	-0.02	-0.00	--	0.02
	(-1.09)	--	(-1.21)	(-0.03)	--	(0.01)
TIME	-0.32***	-0.37***	-0.36***	-0.11	-0.09	-0.11
	(-2.98)	(-3.52)	(-3.25)	(-1.02)	(-1.00)	(-1.05)
ACRES	--	0.06	0.06	--	-0.02**	-0.02**
	--	(1.51)	(1.51)	--	(-2.13)	(-2.18)
R^2	0.322	0.330	0.344	0.104	0.110	0.110

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.
Figures in parentheses are t-ratios.
Estimation method: Ordinary Least Squares, with White-corrected standard errors.

[1] It will be recognized that this is the canonical example used in George L. Priest and Benjamin Klein, *The selection of disputes for litigation*, 13 J. Leg. Stud 1 (1984); George L. Priest, *Measuring legal change*, 3 J. Law, Econ, and Org 193 (1987).

[2] George L. Priest, *Selective characteristics of litigation*, 9 J. Leg. Stud 399 (1980); Priest and Klein (1984), *supra* note 1; Priest (1987), *supra* note 1; Keith N. Hylton, *Asymmetric information and the selection of disputes for litigation*, 22 J. Leg. Stud. (1993); Waldfogel, Joel, *The selection hypothesis and the relationship between trial and plaintiff victory*, 103 J. Pol. Econ. 229 (1995); Siegelman, Peter and Joel Waldfogel, *Toward a taxonomy of disputes: New evidence through the prism of the Priest/Klein model*, 28 J. Leg. Stud. 101 (1999).

[3] See, for example, Robert H. Gertner, *Asymmetric information, uncertainty, and selection bias in litigation*, 1 Univ Chi Law Sch Roundtable 75 (1993), at 76.

[4] There exists a vast literature corroborating the importance of these factors. See, for example, Elizabeth Hoffman and Matthew L. Spitzer, *The Coase Theorem: Some experimental tests*, 25 J. Law & Econ 73(April 1982); Lucian A. Bebchuk, *Litigation and settlement under imperfect information*, 15 Rand J. Econ 404(1984); Priest(1987), *supra* note 1; Robert Cooter and Thomas Ulen, *Law and Economics* (5th ed.), 2008, at 442-50.

[5] Priest and Klein(1984), *supra* note 1; Priest(1987), *supra* note 1; Siegelman and Waldfogel(1999), *supra* note 2; Robert Cooter and Thomas Ulen(2008), *supra* note 4. It should be noted that reduced uncertainty will not necessarily induce settlement, if there are other sources of transaction costs, such as private information. See Jason S. Johnston, *Bargaining under rules versus standards*, 11 J. L, Econ, and Org 256(1995); Ian Ayres and Eric Talley, *Solomonic bargaining: Dividing a legal entitlement to facilitate Coasian trade*, 104 Yale L. J. 1027(1995).

[6] Carol M. Rose, *Crystals in mud in property law*, 40 Stan. Law Rev. 577 (1988). See also Carol M. Rose, *Energy and efficiency in the realignment of common-law water rights*, 19 J. Leg. Stud. 261 (1990); Henry E. Smith, *Exclusion and property rules in the law of nuisance*, 90 Va. Law Rev. 966(2004), at 1042.

[7] Priest(1987), *supra* note 1.

[8] For good histories of early California water development, see Donald J. Pisani, *From family farm to agribusiness* (1984); Norris Hundley, *The great thirst* (1992).

[9] The noted western historian Donald Pisani goes even further, calling *Lux v. Haggin* "probably the most important water case decided in the nineteenth-century West". See Donald J. Pisani (1984), *supra* note 8, at 191.

[10] See, for example, Pisani(1984), *supra* note 8; Eric T. Freyfogle, *Lux v. Haggin and the common law burdens of modern water law*, 57 U. Colo. Law Rev. 485 (1986).

[11] Mark T. Kanazawa, *Efficiency in western water law: The development of the California Doctrine,1850-1911*, 27 J. Leg. Stud. 159(1998); Henry E. Smith, *Governing water: The semicommons of fluid property resources*, 50 AZ Law Rev. 445(2008), at 476.

[12] This discussion draws heavily on the model developed in Priest and Klein(1984), *supra* note 1; Priest(1987), *supra* note 1.

[13] It is commonly argued that under conditions of private information, a pre-trial discovery process may act to bring these probabilities into alignment, leading to a greater incidence of settlement. See, for example, Lucian A. Bebchuk, *Litigation and settlement under*

imperfect information, 15 Rand J. Econ 404(1984), at 413; Amy Farmer and Paul Pecorino, *Pretrial bargaining with asymmetric information: Unilateral versus bilateral payoff relevance*, 77 So. Econ. J. 369(2010), at 382. The contention here is that most of the uncertainty in typical water disputes during this period was not so much about the facts of the dispute but rather, about legal doctrine: that is, the legal basis on which judges were actually going to rule. Under these conditions, pre-trial discovery would not have yielded much information.

[14] See, for example, Steven Shavell, *Suit, settlement, and trial: A theoretical analysis under alternative methods for the allocation of legal costs*, 11 J. Leg. Stud. 55 (January 1982); Ivan P.L. Png, *Strategic behavior in suit, settlement, and trial*, 14 Bell J. Econ. 539 (Autumn 1983); Robert D. Cooter and Daniel L. Rubinfeld, *Economic analysis of legal disputes and their resolution*, 27 J. Econ. Lit. 1067(September 1989).

[15] See, for example, Charles W. McCurdy, *Stephen J. Field and Public Land Law Development in California, 1850-1866: A Case Study of Judicial Resource Allocation in Nineteenth-Century America*, Law and Soc. Rev. 235(1976); Douglas R. Littlefield, *Water rights during the California Gold Rush: Conflicts over economic points of view*, 14 W. Hist. Q. 415(1983); Mark T. Kanazawa, *Golden Rules* (2015).

[16] Robert Dunbar, *Forging new rights in western waters* (1983); Pisani(1984), *supra* note 8; Kanazawa (2015), *supra* note 15.

[17] The scholarly literature on the impact of value on the evolution of property rights is vast. For some particularly important studies, see: Harold Demsetz, *Toward a theory of property rights*, 57 Amer. Econ. Rev. 347(1967), Terry L. Anderson and Peter J. Hill, *The evolution of property rights: A study of the American West*, 18 J. Law & Econ. 163 (1975); Gary D. Libecap, *Economic variables and the development of the law: The case of western mineral rights*, 38 J. Econ. Hist. 338 (1978); Dean Lueck, *The extermination and conservation of the American bison*, 31 J. Leg. Stud. S609 (2002).

[18] Edwin W. Young, *The adoption of the common law in California*, 4 Am. J. Leg. Hist. 355(1960); Gordon R. Miller, *Shaping California water law, 1781 to 1928*, 55 So. Cal. Q. 9, at 18-19.

[19] See, for example, McCurdy(1976), *supra* note 15; Freyfogle(1986), *supra* note 10; Kanazawa(1998), *supra* note 11.

[20] *Irwin v. Phillips*, 5 Cal 140, at 145.

[21] By 1890, nearly 43% of all irrigated acreage in the state was located in three counties in the southern San Joaquin Valley: Tulare, Fresno, and Kern. See U.S. *Census of Agriculture* (1890), p.

[22] *Creighton v. Evans*, 53 CA 55, at 56.

[23] *Pope v. Kinman*, 54 CA 5.

[24] *Visalia Weekly Delta*, 4/9/80.

[25] Pisani(1984), *supra* note 8, at 225.

[26] *Visalia Weekly Delta*, 2/11/81; *Visalia Weekly Delta*, 2/25/81.

[27] See M. Catherine Miller, *Flooding the courtrooms: Law and water in the far west*, (1993), at 15; Pisani(1984), *supra* note 8, at 212.

[28] *Lux v. Haggin*, 69 CA 255, at 442. See also Miller (1973), *supra* note 18 at 22.

[29] Freyfogle (1986), *supra* note 10. See also Jeff R. Bremer, *The trial of the century: Lux v. Haggin and the conflict over water rights in late nineteenth-century California*, 81 So. Cal. Q. 197, at 218-20.

[30] See, for example, Lucien Shaw, *The development of the law of waters in the West*, 10 Cal. L. Rev. 443 (1922); Arthur Maass and Raymond L. Anderson, *And the desert shall rejoice* (1978), at 226-30; Pisani(1984), supra note 8, at 245-48; M. Catherine Miller, *Riparian rights and the control of water in California, 1879-1928: The relationship between an agricultural enterprise and legal change*, 59 Ag. Hist. 1 (1985); Miller(1993), *supra* note 27, at 20-21.

[31] Kanazawa(1998), *supra* note 11.

[32] The data on superior court rulings begin in 1879 because this was the first year of the superior court system under the new state constitution. Prior to this time, the state court system consisted of district courts with broad jurisdiction over civil cases, and which also oversaw county courts and justice courts with more limited jurisdiction.

[33] Precipitation data is also available for Los Angeles, which is of comparable distance to the southern San Joaquin Valley. Since precipitation for Los Angeles and San Bernardino were highly correlated ($\rho = 0.96$), I arbitrarily chose to use San Bernardino data. For precipitation data, see *Climatic Survey of the United States*(1954).

[34] These regressions exclude the data from the year 1885, when the vast majority of suits were multiple actions filed by two riparians, Miller-Lux and John Redington, against the same set of appropriators. Including the 1885 data change the values of the estimated coefficients, but not their signs and statistical significance.

[35] In all of the cases included in the Tobit analysis, the appropriator did not claim a prescriptive right.

[36] This method of citation is to be read as follows: the county in which the case was filed, followed by the case number. For those who have not attempted to access Superior Court files before, this is the simplest way to call up the information for civil cases. All water dispute actions were filed as civil cases.

[37] This data set contains every deed involving Miller-Lux or Haggin which is on file at the Kern County Hall of Records.

[38] For the tracts in the data set, the only relevant waterway was the Kern River.

[39] The source for this variable is the NBER Macro History Data Base, *U.S. index of manufacturing production, 1863-1930*. http://www.nber.org/databases/macrohistory/data/01/a01007a.db.

[40] See, for example, Miller(1973), *supra* note 18, at 24; Pisani(1984), *supra* note 8, at 250-53.

[41] See Edward P. McDevitt, *The evolution of irrigation institutions in California: The rise of the irrigation district, 1910-1930*, 56 J. Econ. Hist. 469, at 470.