Settlement, Litigation and the Drainage of Marshes in England and France

1600-1789

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Working Paper # 561

May 1989

ABSTRACT

This paper presents an example of how careful use of game theory can help resolve significant historical questions. Specifically, historians and economists have long wondered why English agriculture grew faster than French agriculture during the period 1600-1800. A cause of French backwardness is examined: the legal constraints on the expansion of the cultivated area. The paper presents a game-theoretic model of litigation and settlement based on the legal rules governing conflicts over property rights to marshes. Because the allocation of property rights to marshes between lords and villages was based on uncertain medieval contracts, rules such as burden of proof were crucial to the disposition of cases. The equilibrium features of the model are analyzed, and they suggest that English legal rules were more favorable to drainage than French rules. Thus different legal institutions may explain a good deal of the divergence in the agrarian development of Britain and France.

I. Introduction

This paper presents an example of how careful use of game theory can help resolve significant historical questions. Specifically, historians and economic historians have long wondered why English agriculture developed so successfully while French agriculture lagged behind in the seventeenth and eighteenth centuries. While recognizing that the causes of the different agrarian experiences are probably multiple, I argue here that different legal institutions explain a significant part of the divergence in the agrarian histories of France and England. One of the most dramatic features of the agrarian development of Britain was the conversion of waste land to farmland. One way to reclaim waste and increase the usable acreage was to drain marshes, a process that, in England, began before the seventeenth century and continued on past the eighteenth. In France, by contrast, little such activity occurred prior to the French Revolution.

Although marshes were most often called wastes, they were in fact a non-negligible part of the rural economy. In low-lying areas marshes were used by villagers to pasture their animals, gather forage and reeds, as well as for fishing. Villagers used the marshes as part of their commons but they did not necessarily own the marshes. In fact, the village as a community and the lord of the village both had rights to the marsh. Even if the lord was, most often, the ultimate owner of the marsh he could not always decide its drainage unilaterally. Indeed authority over drainage was a complex legal issue. The importance of legal rules on marsh drainage is not transparent from the archival records because the concerns of the litigants are with the gains or losses associated with trial rather than the equilibrium consequences of variations in rules such as burden of proof. Game theory allows me to go

beyond the perspective of individual litigants and analyze how different legal rules impact the development of agriculture. Focusing on a specific set of historical events strengthens the game-theoretic analysis because it demands that the settlement and litigation process be modeled in a richer and more detailed fashion than has heretofore appeared in the literature.[1]

The paper presents two set of conclusions, the first set speaks to the cause of the divergent agrarian histories of France and Britain, while the second set addresses the insights of the model into issues not previously treated by the law and economics literature. In general, the paper suggests that courts played an important role in the economic development of England by enforcing contracts and clarifying property rights. In France, however, courts did not provide the same service; in fact courts reduced the abilities of parties to resolve their difference through contractual agreements. In the specific case of marsh drainage, the key difference between England and France was burden of proof. In England, burden-of-proof rules favored lords against villages while the reverse held in France. The allocation of property rights over marshes between lord and village had an important impact on subsequent development, because institutional arrangements within the village made it quite difficult to achieve drainage.

The second set of conclusions pertains more directly to the game theoretic analysis of the economic impact of the law. Accounting for such rules as discovery and burden- of- proof, suggests that these rules may play as important a role in out-of-court settlement decisions as the desire to avoid court costs. Both of these rules are found to have a significant impact on the disposition of cases, out-of-court settlement probabilities and litigation expenditures. More specifically when the burden of proof

is on the plaintiff--as in most civil cases--settlement is most likely to occur and defendant expenditures are minimized.

The paper proceeds as follows: In section II, I present the historical issues. In the third section, I outline the rules of the litigation process. In the fourth section I analyze a game theoretic model of litigation with endogenous costs; and discuss the relationship of the model to the question at hand. In section V, I present the equilibrium and comparative statics results. In Section VI, the results of the analysis are applied to the issue of drainage in England and France. Section VII concludes.

II. Draining Marshes in England and France.

Agricultural historians on both sides of the English Channel agree that extension of the cultivated area through drainage and clearing was the most important source of output gains in Early-Modern agriculture. Joan Thirsk argues that:

> The increase in [England's] agricultural output in the two centuries before 1650,
> however, probably owed less to improvements in productivity than to extension in
> the cultivated area. . . later as the area of easily accessible land diminished, attention
> was increasingly turned in marshy regions to reclamation by drainage.[2]

This pattern of marsh drainage in Britain continued on into the seventeenth and eighteenth centuries. Interestingly enough it was not associated with significant amounts of litigation. In France, by contrast, little drainage seems to have occurred past the thirteenth century, and until the 1750's one finds few attempts to drain marshes.[3] Thus part of the task of this paper will be to explain the sudden change in the attractiveness of drainage to French entrepreneurs. Despite the dramatic increase in the number of individuals attempting to drain marshes in the closing decades of the Old-Regime, none seem to have succeeded. Most of the marshes that remained undrained in France

throughout the seventeenth and eighteenth centuries were in fact drained in the first half of the nineteenth century.

The historical pattern of drainage in England and no drainage in France seems odd. Indeed we do not know of any significant difference in relative prices or factor endowment that should have led to more development in England than in France.[4] Moreover other research indicates that some nineteenth-century French projects would have been quite profitable if undertaken in the eighteenth century.[5] In England, the relative absence of litigation associated with drainage projects runs counter to the intuition that in the face of uncertain property rights, the judiciary will play an important role in allocating the benefits and costs of projects. In France, by contrast, much litigation took place and yet no drainage occurred. This seems inconcistent with the view that litigation would lead to well-defined property rights and hence to drainage. In order to explain the odd pattern of litigation and drainage in England and France it is necessary to take a closer look first at the role of marshes in the village economy, and second at the distribution of property rights over marshes.

For ease of exposition let us consider the problem within a village, which for our purposes is inhabited by peasants who form the community; assume further this village has a marsh and that the lord of the village wishes to drain that marsh. In most regions of England, as in France, originally the lord held title to all the land in the village and a variety of arrangements allowed him to gain revenue from land. These ranged from outright sale or rental of land to direct production through the various shades of serfdom. Each one of these different arrangements was in effect a grant of farm land from lord to peasant. Associated with each grant of farm land were use rights to the land that remained

unfarmed.[6] As a whole the unfarmed land in the village was known as the common. In fact, the

unfarmed land must be divided into two categories: first, the village commons (hereafter the

commons), a certain amount of pasture land that the lord was obligated to provide to the village;

second, the waste, which was the residual unfarmed land in the village. Although there is no doubt

that the legal owner of the commons and the waste was the lord, his authority on the common was

quite small--any change in its use required the approval of the village community. The authority of

the lord over the waste was complete provided that he had not transferred property to a third party

or to the village.

Until drainage occurred there was little to distinguish a marsh that was part of the waste

from the commons, both were equally accessible to villagers. After drainage, the value of the marsh

would be greatly increased and the lord would want to separate it from the commons--in effect enclose

the drained land and rent it out. The crucial legal issue was when did the lord have the right to

drain the marsh over the objections of the village or, in other words, under what circumstances could

the village block the enclosure of the waste? If drainage had occurred whether the marsh was decided

waste or common, the issue of attributing the property rights to the marsh would be of little

economic interest. The distribution of property rights, however, was crucial to the success of drainage.

On the one hand, in the case where the lord had the authority to decide upon drainage alone and

when he would collect most of the surplus we would expect drainage to occur. On the other hand

when the marsh was declared common, drainage was much more difficult because its success depended

on the agreement of part or all of the villagers. One could assume that villagers and lord would have

bargained to some Pareto superior solution given the existence of surplus. Historically, however, this

has not been the case. One frequent barrier to drainage was that villagers held out for larger shares of

the surplus. Theoretical support for intra-village bargaining failures can be found in Mailath and

Postlewaite(1988). In that paper a surplus is to be produced and divided between the members of a

group. Each individual has a privately known reservation value below which he does not desire to

participate in the production and division of the surplus--in our case the drainage of the marsh. Each

individual must anounce his reservation value, knowing that the surplus to be created is likely to be a

good deal larger than the total of the expected reservation values. Mailath and Postelwaite show that

every individual has an incentive to free ride and inflate his announcement above his reservation

value. The reuslt is that the numbers of participitants grows each individual's anouncement goes to

his highest possible reservation offer. The sum of these demands is greater than the surplus and thus

the project fails. Consistent with their analysis, in this paper we will assume that transaction costs

made it very unlikely that the marsh would be drained if it was declared common land.[7]

Had property rights been well defined, the judiciary would have played no role in this chapter

of the agrarian history of England and France. However, property rights to marshes were uncertain

because the title to them had become obscured by the passage of time. As noted above, waste and

commons had originally been indistinct in terms of access and use. Yet the village only had access to

the common as a right and frequently had to pay rent to the lord for the waste--a rent that varied

with the value of the marsh. During the fourteenth and fifteenth centuries some lords who had

become strapped for cash sold their waste to villages, or in return for a lump sum payment and a

small annual fixed fee provided perpetual access to the marsh. Other lords had let the administration of their estates lapse and the villagers had been able to enjoy the use of the waste free of charge. In short, some lords surrendered the waste to the village while some villages usurped the rights of the lords. As a result by the seventeenth century it was rarely possible to distinguish the waste from the commons.

Yet if drainage was to proceed it was necessary to determine who had title to the marsh. In favor of villagers was the fact the marsh had come to be treated as part and parcel of the commons, they had whatever rights occupancy conferred. In favor of the lord was his original ownership of the land. To decide the issue both sides debated the validity of medieval contracts. The problem with these contracts was some of them had been lost, some could be fakes and some could relate to another part of the common land. A village opposing a drainage scheme would bring the issue to court and thus the question of property rights was decided judicially.

III. The Rules of Litigation and Settlement

The judicial confrontation between lord and village was frought with uncertainty because, as I argue below the evidence avaliable to either party was scant and rarely conclusive. In order to model the effect of uncertainty on the judicial process we must first go deeper into the issue of evidence, second we will present the stylized version of the judicial environment.

Because a very long time had passed since the beginning of contractual exchanges between lord and village it was unlikely that they would have retained copies of the same set of contracts. In fact one can argue that village and lords had asymmetric information. The ideal pieces of evidence for

lords were long series of rental payments by the village which varied with the market value of the

marsh. A varying level of rent showed that the lord retained authority over the marsh and thus

probably ownership as well. Because the ownership claims of the lord were most often based on rental

payments it seems likely that the village would know what evidence was available to the lord if the

case was to go to court.

The ideal evidence for a village was the contract that explicitly transferred the marsh to the

common. In the absence of such an explicit contract, other contracts where the lord recognized the

village's ownership of the marsh would be valuable evidence. Although both the lord and the village

had originally had copies of these contracts, they were more valuable to the village than to the lord,

thus the village was more likely to preserve such a parchment than the lord.[8] Moreover it would be

unlikely that the lord would know exactly what contracts had been preserved by the village.

Furthermore some villages probably preserved more documents than others. The villages that had had

more carefull archivists would no doubt have a stronger hand in court.

The stylized facts about evidence suggest that there was assymetric information, that villages

knew what evidence was available to the lord, and that the lord did not know fully what evidence was

avaliable to villages. Given the structure of information it is clear that villages have little to gain

from such rules as discovery. For lords, however, discovery could be an important means of

extracting information from the village. I model discovery as a one time choice for the lords to ask a

fixed set of questions to the village community, in this case, about some contracts potentially held by

the village. The lord may not discover all these contracts. So discovery will succeed in reconciling the

information only part of the time. If discovery succeeds, settlement occurs with probability one in this simple model because village and lord share the same beliefs about the court outcome and both prefer to save on court costs. If discovery fails to reconcile the positions of lord and village, the asymmetry in information remains.

In case of trial neither party to the suit can predict the court's action perfectly. Indeed, although both parties know what contracts they have access to and they may also discover the oppostion's evidence, the litigants do not know with certainty which contracts the court will find valid and which it will reject. In short, what matters for lords is to convince the court that the marsh is waste and for the villagers to demonstrate to the court that it is common. For simplicity I assume that the marsh is either common in which case it is impossible for the lord to convince the court that it is waste, or the the marsh is waste in which case it is impossible for the village to convince the court that it is common. The ability of village or lord to convince the court depends on legal expenditures, i.e. resources spent on presentation, cross examination, and legal expertise. Higher expenditures by the village increase the likelihood that when the village is in the right (the marsh is common) it succeeds in convincing the court that the marsh is common, the same applies for the lords expenditure when the marsh is truly waste. Even if a lord or a village is in the right, however, it is not guaranteed that the court will be convinced, and an unconvinced court applies a burden-of-proof rule.

The final element of the model is the ability to settle out of court. Clearly if there was a lot of drainage in England but no litigation then out-of-court determination of property rights must have

occurred frequently. For simplicity, I collapse the out-of-court bargaining process in to a single out-of-court-settlement offer made by the lord. The only reason to allow the lord to make the final settlement offer is because lords usually initiated formal drainage procedures by presenting villages with a drainage contract that described the division of property rights after the completion of drainage--in effect a settlement offer.[9]

IV. A Game-Theoretic Model of the Litigation and Settlement

The model presented here builds not only on the stylized fact presented above but also on the game-theoretic treatment of settlement and litigation developed in the literature of law and economics. The papers most relevant to my analysis are Bebchuk (1984), and Reinganum and Wilde (1987). The key difference between their models is that Bebchuk has the uninformed party make the settlement offer, while Reinganum and Wilde give that opportunity to the informed party. Whether the informed or the uninformed party makes the offer affects the probability of settlement as well as the magnitude of the expected transfer between plaintiff and defendant. While Bebchuk's model is closest to the one developed herein, it is too sparse in institutional details to afford insight on the role of burden of proof in accounting for the different histories of French and English marshes. Both Bebchuk and Reinganum and Wilde were concerned with the effect of asymmetric information on the probability of out-of-court settlement. Hence they modeled trials as lotteries with fixed costs. Their results are fully confirmed within this model, but incorporating further institutional detail provides a finer understanding of the settlement and litigation process.

Bebchuk and Reinganum and Wilde focused on the impact of different rules for allocating

litigation costs between plaintiff and defendant on equilibrium trial probabilities. Their papers thus

did not consider that judicial outcomes typically are unpredictable in large part because documenting

claims is uncertain and expensive. To truly understand the effect of litigation costs on the judicial

process, one has to examine the relationship between legal expenditures and outcomes; burden of

proof and settlement; as well as discovery and the disposition of cases. The model presented below

confronts these issues in a specific historical context; yet the conclusions extend beyond the problem of

allocating property rights between lord and village.

The Model

For clarity the next few sections, which are devoted to the formal model, ignore the history of

drainage in England and France. The historical implications of the model will be disscussed in Section

VI. In keeping with the details of marsh drainage the model involves two parties, a lord (defendant)

and a village (plaintiff). On the village land there is a marsh which provides pasture to the villagers

at no cost. The lord wants to drain the marsh but it may belong to the village commons. If the

marsh is found to be common then the village is entitled to decide over the issue of drainage and the

marsh remains undrained. The lord receives nothing and the village maintains its pasture. Profits in

the absence of drainage are zero for the lord and the village. If the marsh is found to belong to the

lord it will be drained and the lord will make a profit π. The village will receive a small compensation

less than the value of the free pasture, so this outcome will lead to a loss for the village of λ.[10]

Villages can be of two types: strong (denoted by a subscript s) or weak (denoted by a subscript w);

the probability a village is weak is denoted p. In any village the probability that the marsh is

common is β_i and the probability that it is waste $(1-\beta_i)$. In strong villages the probability that the marsh is common is greater than in weak ones $(\beta_s > \beta_w)$.

In the first stage of the process, nature draws the village's type, which is revealed to the village. The village is only partially informed about his right to compensation because its type is only the probability that the marsh is really common. The lord knows neither the true allocation of the marsh (waste or common) nor the village's type, but he knows the probability distribution of types of villages, and the probability that the marsh is common given types. This structure makes the village better informed than the lord in keeping with the earlier discussion while maintaining that both parties are uninformed about the true nature of the marsh, in keeping with the irregular record-keeping of the early-modern period.

In the second stage of the process, the uninformed lord applies a discovery rule which reveals the type of the village with probability δ. Discovery is modeled as a process of asking questions before the settlement offer is made. There is no need to model the issue of discovery costs as they are all borne before the out-of-court settlement offer is made; as a result all discovery costs are sunk.[11] With probability δ the lord discovers the set of contracts owned by the villages that bear on the issue of marsh ownership. In this case the lord knows the type of the village and makes a settlement offer (denoted S) equal to the expected value of trial for a village of that type. The offer is accepted with probability 1. With probability $(1-\delta)$ discovery fails and the lord must make his settlement offer uninformed.

If discovery has failed and the lord has made an uninformed settlement offer, the village

either sues in court (with probability k_i) or accept the offer (with probability $1-k_i$). If the village

accepts the offer, the game ends; if it sues, a trial occurs and both parties bear court costs. Going to

court involves both fixed and endogenous costs. The fixed costs of the village are denoted F_v, those of

the lord F_l. Fixed costs are intended to capture such things as the cost of delay and the fixed legal

expenses associated with the trial. The endogenous costs of villages of type i are denoted c_i, those of

the lord c_l. These are the costs of preparing arguments, presenting the evidence and cross

examination. Because the model is designed to emphasize the distinction between the true nature of

the marsh (waste or common) and the ability to demonstrate the truth, I have introduced the issue of

evidence and the necessity to convince the court.

In case of litigation, both parties are able to hire lawyers to do research for them and to

present evidence to the court. The court makes a decision about the village's right to the marsh based

on the evidence brought to the trial and the strength of the arguments presented by the lawyers.

Based on their parties' evidence and on cross examination, lawyers will either convince the court or

their efforts will be inconclusive. In this model judges and courts do not try to infer the original

parameters of the case (p, β_s and β_w) but rather they try to infer the true state of the marsh

(common or waste) from the arguments presented by the lawyers. Thus courts only care about the

arguments presented by both parties. For simplicity again, I assume that a litigant's lawyer can only

act in his favor. So if a village has evidence that the marsh is waste the village's lawyer will not

report that evidence. The lord's lawyer, however, may through examination bring that evidence to

light. I also do not allow for the possibility that the litigants can mislead the court. Thus, in the case

of common marshes the court can only be convinced it is a common marsh. These assumptions allow me to simplify the model so that the efforts of a party's lawyer only matter when that party is in the right. I can therefore separate the effects of village (plaintiff) expenditures and the effects of those of the lord (defendant).

If the court is convinced by either party that the marsh is common (waste) then the court awards the property rights to the village (lord). If after the closing arguments, the court remains unconvinced, the court awards the marsh to the village with probability t. Variations in t are equivalent to variations in the burden-of-proof rules. Indeed, burden-of-proof rules come into play only when the court remains unconvinced. For example, if t is 0, then the burden of proof rests completely on the village. Since when the court finds that the marsh is common there is no change in revenue, applying the burden-of-proof rule leads, in expected value, to a loss for the village of $(1-t)\lambda$ and a profit for the lord $(1-t)\pi$.

For cases where the marsh is actually waste, the probability the lord convinces the court that it is actually waste, given expenditure c, is defined as a concave and differentiable function $E_l(c):\mathbf{R}^+\to[0,1]$. The probability of convincing the court that it is common is 0. For cases where the marsh is common, the probability the village convinces the court that it is common, given expenditure c, is defined as a concave and differentiable function $E_v(c): \mathbf{R}^+\to[0,1]$. The probability of showing that the marsh is waste is 0. Furthermore, the conditions sufficient to avoid the uninteresting equilibrium where neither player expends any legal resources are:

$$\frac{\partial E_v(0)}{\partial c} > \frac{2}{\beta_s\lambda} \text{ and } \frac{\partial E_l(0)}{\partial c} > \frac{2}{(1-\beta_s)\pi}.$$

Because convincing the court is a probabilistic event, even when the marsh is truly common it is possible for the court to remain unconvinced. If the burden-of-proof rule is not fully on the lord the court may to decide the marsh is waste (an event that occurs with probability 1-t). The problem is now sufficiently well specified that we can write down explicitly the expected returns to trial for the village and the lord. The expected value of going to court for the village is:

$$\Lambda_i(c_i) = \beta_i\Big((1-E_v(c_i))(1-t)\lambda\Big) + (1-\beta_i)\Big(E_l(c_i)\lambda + (1-E_l(c_i))(1-t)\lambda\Big) - c_i - F_v. \tag{1}$$

The lord's revenues given the village's type are.

$$\psi_i(c_l) = \beta_i(1-E_v(c_i))(1-t)\pi + (1-\beta_i)\Big(E_l(c_i)\pi + (1-E_l(c_i))(1-t)\pi\Big) + c_l + F_l \tag{2}$$

Equations (1) and (2) are enough to specify the allocation of marshes between waste and common in the absence of settlement opportunities. As the discussion in section VI will make clear, in seventeenth-century France the state discouraged out-of-court settlements of property rights questions. Marshes were therefore allocated by judicial decision. Proposition 1 suggests that burden-of-proof rules play a crucial role in the disposition of case when there are no settlement opportunities.

Proposition 1: If the parties can not settle out of court then the probability the marsh is declared waste is $\beta_i\Big((1-E_i(c_i))(1-t)\Big) + (1-\beta_i)\Big(E_l(c_l) + (1-E_l(c_l))(1-t)\Big)$. In the absence of settlement opportunities the burden-of-proof rule will allocate strictly more marshes to the commons as t increases, thus if t is 1, it is least likely that marshes will be drained.

In England as well as in eighteenth-century France settlement opportunities were avaliable, to examine these cases we must specify the objectives of the lord and the village if out-of-court settlement is possible. The expected value to the lord of going to court is:

$$V_l(c_l) = q\psi_w(c_l) + (1-q)\ \psi_s(c_l).\tag{3}$$

Here q is the lord's belief about the probability that the village is weak if the village has refused the settlement offer. If out-of-court settlement is possible then the expected value of deciding whether the marsh is common or waste for a village of type i is :

$$V_i(k_i, c_i) = (1-k_i)S + k_i\ \Lambda(c_i)$$

$$= (1-k_i)S + k_i\Big((1-E_v(c_i))(1-t)\lambda + (1-\beta_i)\big(E_l(c_i)\lambda + (1-E_l(c_i))(1-t)\lambda\big) - c_i - F_v\Big),\tag{4}$$

while the returns to a deciding whether the marsh is common or waste for the lord are:

$$\Pi_l(S, c_l) = \Big(p(1-k_w) + (1-p)(1-k_s)\Big)(\pi - S) + pk_w\psi_w(c_l) + (1-p)k_s\psi_s(c_l)\ \text{or,}$$

$$= p\Big((1-k_w)(\pi-S) + k_w\big(\beta_s(1-E_v(c_w))(1-t)\pi + (1-\beta_w)\big(E_l(c_l)\pi + (1-E_l(c_l))(1-t)\pi\big) + c_l + F_l\big)\Big)$$

$$+ (1-p)\Big((1-k_s)(\pi-S) + k_s\big(\beta_s(1-E_v(c_s))(1-t)\pi + (1-\beta_s)\big(E_l(c_l)\pi + (1-E_l(c_l))(1-t)\pi\big) + c_l + F_l\big)\Big).\tag{5}$$

Definitions

To complete the formal structure of the model we must define the strategies of the village and the lord and choose an equilibrium concept.

A strategy for the lord is a settlement offer S, and a level of legal expenditures, c_d that may depend on S. A strategy for a village of type i is a probability the villages refuses the settlement offer, k_i that will depend on S, and a level of legal expenditures c_i that may depend on S and k_i. Although the village may randomize in deciding whether or not to accept the lord's offer, the lord only observes the outcome of the village's action. In equilibrium, of course, the villages' actions will have to be incentive compatible.

A sequential equilibrium of this game has four elements: (1) a set of legal expenditures, $c_l{}^*$, $c_w{}^*$, $c_s{}^*$, that maximize the returns from trial ($\Lambda(c_i)$ and $V(c_l)$); (2) a pair of litigation decisions, $k_w{}^*$, $k_s{}^*$ that are optimal given an offer of S^* and the expected returns from trial; (3) a settlement offer, S^*, that minimizes the lord's cost of sorting the property rights given what each party expects to get at trial ($\Lambda(c_i{}^*)$ and $V(c_l{}^*)$); (4) if a trial occurs, the lord's beliefs about the village's type must satisfy Bayes' rule: $q^* = \dfrac{pk_w{}^*}{pk_w{}^* + (1-p)k_s{}^*}$. In short the equilibrium requirement is that at each stage of the game equilibrium strategies must be both optimal and incentive compatible.

V. Equilibrium and Comparative Statics

Equilibrium

Theorem 1: There exist at most two equilibria to this game, E_1 and E_2. In E_1 weak villages randomize between going to court and settling, and strong villages all go to court. In E_2 all villages settle out of court. The equilibria are characterized by:

(1) optimal levels of expenditures for villages are given by

$$\frac{\partial E_v(c_i{}^*)}{\partial c} = \frac{1}{\beta_i(1-t)(\lambda)}, \quad i=s,w;$$

(2) optimal expenditures for the lord are given by

$$\frac{\partial E_l(c_l{}^*)}{\partial c} = \frac{1}{[q^*\beta_w + (1-q^*)\beta_s](t)(\pi)};$$

(3) Optimal litigation probabilities for each equilibrium are as follows:

$$k_w{}^* \varepsilon \ [0,1] \text{ and } k_s{}^* = 1 \text{ if } S^* = S_1{}^*, \quad k_w{}^* = k_s{}^* = 0 \text{ if } S^* = S_2{}^*.$$

(4) Optimal settlement levels, $S_1{}^*$, $S_2{}^*$ (corresponding to E_1, E_2) are defined by: $S_1{}^*$ maximizes the lord's revenues when strong villages sue with probability one, and $S_2{}^* = \pi_s (c_s{}^*)$.

(5) The Bayesian beliefs of the lord are $q^* = \dfrac{pk_w^*}{pk_w^* + (1-p)}$ if the equilibrium is E_1, and $q^* = 0$ if the equilibrium is E_2. All proofs are given in the Appendix.

One of the two equilibria of the litigation process is rather uninteresting from a game theory perspective. When the litigation costs of the lord are very high, or when the probability that villages are weak is small enough, the lord will minimize his losses by making a high settlement offer, this leads to a type E_2 equilibrium. In a type E_2 equilibrium the lord makes a settlement offer that compensates even the strong villages and as a result no one goes to court. In a type E_1 equilibrium, however, some litigation takes place because strong villages sue with probability 1, while weak villages randomize between accepting the lord's offer and going to court.

Corollary 1: Except for knife edged cases all equilibria are locally unique.

Corollary 1 allows us to derive comparative statics results for both equilibria.

Comparative Statics

Since the comparative statics results are most interesting in the case of E_1, we focus on it. All the comparative statics results (except for those concerning evidence expenditures and litigation probabilities) also apply to the other equilibrium, and because they can be derived straightforwardly no proofs are given. As with most of the literature, in this case higher village fixed court costs lead to lower settlement offers. Indeed, when weak villages face higher fixed court costs they will be willing to accept a lower settlement offer. Increasing village fixed costs also leads to a higher acceptance probability. Higher lord court costs increase the magnitude of the settlement offer and also raise the probability that the offer is accepted. Thus as court costs rise litigation falls.

An increase in the value of pasture on the undrained marsh (λ), leads to a higher settlement offer, a higher probability of litigation and greater expenditure on evidence by the village. Increasing the value of the drained marsh (π), while holding the value of the undrained pasture constant, results in an increase in the litigation expenditures of the lord but does not affect the probability of litigation or the size of the settlement offer.

Definition: Let $V_i(\tau)$ be the expected value of going to court for a village of type i when the burden-of-proof rule is τ, and $c_j(\tau)$ be the the optimal level of expenditures for litigant j given a burden of proof rule of τ.

Proposition 2: if $\dfrac{\partial c_l(\tau)}{\partial t} < p[1-k](\dfrac{\partial V_s(\tau)}{\partial t} - \dfrac{\partial V_w(\tau)}{\partial t})$, for all τ in [0-1] then there exists a unique t^* such that if $t < t^*$ then the equilibrium selected is E_2 and if $t > t^*$, E_1 is selected.

In words the condition for Proposition 2 to hold is that, a fall in t leads to a smaller decline in expected total court costs than in the difference between the expected award to a weak village and the expected award to a strong village. This condition is likely to hold in the case of marsh drainage, because the high degree of uncertainty in the validity contracts suggest that courts would remain most often unconvinced independent of the level of legal expenditures by lord and village. If the court is unlikely to be convinced the overall investment in legal expenses will be small relative to fixed court costs or to the difference between possible awards. Changes in the burden-of-proof rule will, nonetheless, have a big impact on the difference between the value of going to court for strong and weak villages, because cases are most often decided by burden of proof.

Beyond Proposition 2, a few comparative statics results illuminate the importance of burden

of proof. As the burden-of-proof rule becomes more favorable to the lord (equivalently, as t is decreased) the lord will lower his settlement offer--because the probability the marsh is declared common also falls. Thus, making the burden of proof bear more strongly on the village strengthens the hand of the lord not only in court but also in the settlement stage. Finally, as t falls, the evidence expenditures of villages of either type rise, while the expenditure of the lord falls. Indeed in this model, as the court's rule for allocating undocumented cases becomes more favorable to the lord, his incentive to expand resources on lawyers falls.

The impact of discovery on settlement is clear: as the probability of discovery rises the ex-ante expected settlement to weak villages falls and the expected settlement to strong villages rise. Indeed settlement offers are made either under imperfect or under perfect information. If the lord does not know who he faces he makes one offer to all. In an equilibrium of type 1 that offer is rejected with probability 1 by strong villages, however if discovery succeeds the lord knows the village is strong and so he will offer such a village a higher compensation. If the probability of discovery rises it is more likely ex-ante that the lord will know that the village is strong raising the ex-ante expected settlement.

In the case of weak village the ex-ante settlement offer falls as discovery rises. If discovery succeeds, the lord knows the villages is weak, so he is willing to devote more resources to arguing in court, than if there is a positive probability that the village is strong. Higher legal expenditures by the lord reduces the expected court award for the village and thus reduces the settlement offer. Therefore a weak village is always offered less when it has been identified than when discovery has failed. So an

increase in the probability of discovery helps the lord to discriminate between weak and strong

villages, lowering the expected compensation to weak villages and increasing the expected

compensation to strong ones. Changing the costs of discovery--which are borne by the party with

information--does not affect either the compensation offer, or the probability of trial because discovery

costs are fully sunk at the settlement stage.

VI. The Model and English and French Drainage.

The histories of drainage in England and France provide good opportunities to test the model

developed above. One of the model's conclusions is that burden of proof has an important impact on

the settlement level and the probability of out-of-court settlement. First, because the burden of proof

varied between France and England on the question of drainage, the model yields different predictions

for each country. Second, in the case of France, the model predicts a change in the pattern of activity-

-litigation and drainage--in the last fifty years of the eighteenth century after the enactment of

reforms designed to ease the constraints on out-of-court settlements.

A. England

The stylized facts presented earlier on the history of drainage in England suggested that

drainage occurred in the absence of litigation. Historians have also noted that there were regular if not

frequent occurrences of violence surrounding the drainage of marshes from the commons.[12] The

absence of litigation suggests that most property rights were allocated out-of-court, in effect that

England corresponds to a type 2 equilibrium in the model--one where all villages are compensated

outright. Such an equilibrium is likely to arise if the difference in the expected value of trial between

strong villages and weak villages is small enough relative to court costs that lords settle with everyone. The features that could have lowered the value of trial for English villages include a low value of marsh pasture (λ), and institutions that reduced the probability of winning for villages. As I argued earlier, since the similar agrarian technologies used in England and France would have made the value of marsh pasture similar in both countries, we must look to institutions to understand what made trials unappealing to English villages. In fact, trials were unattractive to English villages because they bore the burden of proof in cases dealing with ownership of marsh land. The historical evidence that villages bore the burden of proof is compelling. In the statute of Merton (1235) and again in the statute of Westminster(1285), Parliament and the king reaffirmed that the village was only entitled to limited pasture and that the waste was the private property of the lord.[13] These statutes remained the basis of the law regulating common and waste until well into the nineteenth century. Moreover in the absence of a contract explicitly transferring the marsh from waste to common, the village was not to interfere with any reclamation project.

Putting the burden of proof on the village corresponds to $t=0$ in the model. In this case not only was the village sure of losing all the cases where the marsh was actually waste (with probability $1-\beta_i$), but the village would lose all the cases where the marsh was common unless it could convince the court that it had a valid contract to the marsh (a probability equal to $\beta_i(1-E_v(c_i))$). Given the requirement for contractual evidence, the fact that villagers used the marsh for pasture was of little help to the village and it was very unlikely that the village could convince the court. Formally, when t is zero, the value of going to court minimized for all villages ($\Lambda_i(c_i)=-\lambda (1-\beta_i E_v(c_i))- c_i- F_v$), a fact

that reduces the expected transfer from lord to village independent of which equilibrium is sellected.

More importantly, Proposition 2 suggests that when the village bears the burden of proof a type 2

equilibrium is the most likely outcome (out-of-court settlenment occurs with probability one). Thus it

was possible for the lord to compensate a village at far less than the value of the pasture, by for

example transferring a small portion of the waste to the common.

By the seventeenth century the medieval statutes that regulated the drainage of marshes had

been tried and tested and villages knew quite well the limited extent of their property rights. A

measure of the importance of contract law over the commons appears in Lindley (1982, page 32):

> Sir John [Mowbray] as the then manorial lord [of Epsworth], in return for their
> consent to his enclosure of part of the commons granted the commoners the
> remainder free from any further improvements by the lord or his successors. This
> agreement was enshrined in an indenture dated May 1359, a document treasured by
> the commoners and carefully preserved in the parish church of Haxey in a specially
> prepared chest bound with iron...The whole parish was kept regularly aware of the
> document's existence as the chest was placed under a window which depicted Sir
> John Mowbray holding a document, commonly reputed to be the indenture...Hence
> [in 1629] Epsworth commoners were fully conscious of their unassailable legal position
> on the question of title.

It seem clear that the villagers felt that the strength of their title rested directly on their ability to

produce the physical contract that Sir John Mowbray had granted them. The very strength of the

commoners of Epsworth underscores the weakness of most other villages. For most other villages these

contracts, if they had ever existed, were not preserved with such care and often lost. As a result the

villagers' legal means of protecting their access to the marsh had been closed off and they resorted to

extra legal means of pressure on the lord and the king to redistribute the surplus from drainage: they

revolted. But because the king was one of the largest landlords in England, he had no interest in

hearing the complaints of villagers and changing the law.[14] So the revolts were put down, and more

importantly the marshes were drained with little litigation.

B. Seventeenth-Century France

In France, however, things were never so simple. First, the burden of proof in the case of marsh drainage was always against the lord.[15] Second, the king required that property rights be judicially determined, in effect ruling out the possibility of out-of-court settlements. As a result of the burden-of-proof rule, villages had a particularly strong hand. Unless the lord could convince the court that in the last thirty years the village had recognized by contract that the marsh was waste, it would be declared common. From Proposition 1 we know that this is the case where drainage is least likely to proceed after litigation. Moreover the French rules minimized the lord's profit from sorting out the property rights $(\psi_i(c_l) = \left(p(1-\beta_w)+(1-p)(1-\beta_s)\right)E_l(c_l)\pi - c_l - F_l)$. One should note that if fixed court costs are very high or if it is difficult to prove one's case ($E_l(c_l)$ is very flat) then $\psi_i(c_l)$ may be negative and a lord would not want to go to court. This was precisely the case in seventeenth century France because rent-seeking practices in the judiciary led to very high court costs[16] and the high degree of uncertainty about the validity of contracts also reduced the probability the lord would convince the court.

French institutions seem to have made it very unlikely that the lord would win in court even if the village was weak and thus drainage was unlikely to occur after the court decided the property rights' issue. Had the village and the lord been able to settle out of court, we might presume that the profits from drainage would have been an incentive for lord and village to reconcile their differences privately. Because the lord was in a disadvantaged position if litigation occurred, the village would

have been compensated at a high level, yet drainage would have occurred and the burden-of-proof rule would have had only redistributive consequences. In France it was impossible to settle out of court, and worse very high court costs made lords unwilling to invest in a judicial determination of property rights. Accordingly in the seventeenth century, no marshes were drained and there was no litigation.

Given the fiscal problems it faced, the crown was reluctant to change the law surrounding marshes.[17] Unlike in England, in France lords were exempt from many land based taxes. In Northern France, this exemption was personal and was thus transferred to all land acquired by nobles. While the marsh remained in its pastoral use the crown was able to make the villagers bear some tax, however if the land was transferred to the lord, such tax revenue would be eliminated. This problem transcended the simple issue of marshes because some villages attempted to sell most of their land in order to reduce their tax burden.[18] To reduce the erosion of the tax base the king insisted on a judicial determination of property rights over any potentially common land and more specifically over marshes and lay the burden of proof on the lord. The likelihood of institutional change was further reduced by the fact that the king of France, unlike the king of England, did not own a significant portion of his country, and as a result he had little to gain directly from successful marsh development.

C. Eighteenth-Century France

As the eighteenth century progressed, concerns with total agricultural output led the crown to attempt to revise the rules of marsh drainage. The crown announced several times that it would support endeavors to drain marshes and that it would liberalize the out-of-court settlement process.[19]

In effect, the crown continued to require a settlement compensation in land, which for the village would be one-third of the marsh if it was waste and two-thirds if it was common. If two-thirds were offered, however, then the marsh was recognized as common and drainage would be decided by the village after the rule for dividing the village's share among the inhabitants had been agreed upon.[20]

Whatever the royal government's intentions the law accomplished little. The revised settlement rules led to systematic offers of one-third of the marsh to the village, which, in nearly all cases, were refused by the villages. The announced support of the crown for drainage projects can be translated into an announced shift in t away from 1, raising the probability that the lord would be awarded the property rights to the marsh. Both reforms should have raised the probability of success for drainage projects. In fact a number of factors made the new law inoperative. Because villages could not agree upon internal division rules, a settlement where the village received two-thirds of the marsh promised that the marsh would remained undrained. If only one-third of the marsh was offered by the lord to the village, however, only villages with weak property rights would accept such a settlement, and there were relatively few of those. Indeed, over the course of the sixteenth and seventeenth century, villages had been able to acquire squatter's rights to marshes by simply pasturing their animals on the waste for generations.[21] Thus, the settlement opportunities offered by the royal reforms were far to limited.

The announced change in the burden-of-proof rule, could have increased the number of successful drainage projects by increasing the likelihood that the court decided the marsh was waste, and thereby raising the frequency of drainage. Yet these reforms depended on the ability of the crown

to control the judiciary. Despite the absolutist trappings of the Bourbon monarchy, and the king's oft

proclaimed judicial supremacy, the crown remained unable to impose any reform on the judiciary.

Like many other reforms, the liberalization of drainage was viewed as an attack on privileges--a

complex set of customary and contractual relationships that offered rents to groups and individual in

French society. Judges systematically opposed any change in the law that threatened privilege and in

this case always sided with villages.[22] Lords and developers filed and litigated approximately thirty

cases in Normandy between 1740 and 1789, but none led to drainage. There was only one instance of

violence, when a small group of villagers destroyed the early phase of a drainage project. Because no

one in the French administration was willing to investigate the issue, drainage was abandoned.[23]

Proposition 1 allows us to confront one final question: what would have been the pattern of

development if despite, the impossibility of out-of-court settlement, France had had the same burden

of proof rule as England. Because the property rights to marshes were very unclear burden-of-proof

rules played a crucial role in deciding whether marshes were waste or common. If t was 1 as in France

marshes would be deemed waste with probability. $d(1)= \left(p(1-\beta_w)+(1-p)(1-\beta_s)\right)E_l(c_l)$. Had the

opposite (British) rule applied the probability courts would have decided a marsh was waste would

have been $d(0)= p\beta_w(1-E_v(c_w))+(1-p)\ \beta_s(1-E_v(c_s)) + p(1-\beta_w)+(1-p)\ (1-\beta_s)$. As noted in

Proposition 1, $d(0)$ represents a larger proportion of marshes drained than $d(1)$. Furthermore if, as I

argued above, evidence presented by parties determined only a fraction of case, the probability a

marsh was deemed waste under the British rule would be significantly higher than under the French

one. The conclusion seems unescapable: had France had Britain's burden-of-proof rule far more

marshes would have been drained prior to the French Revolution.

D. After the French Revolution

The French Revolution swept away the entire property rights issue over marshes by assigning all common land to villages. During the 1820s a number of legal reforms made it much easier to divide common property. After 1823, all that was required for drainage was a majority vote in the municipal council (village government), approved by the central authorities. As a result a large number of common marshes were divided and drained in the early nineteenth century. In fact most of the marshes that had remained undivided through out the eighteenth century in Normandy were divided and drained in little more than two decades after the end of the Napoleonic Wars.[24]

The institutional regime that prevailed after the French Revolution was markedly different from the one that held sway under the Old-Regime. Under the new regime drainage proceeded swiftly, testimony that the solutions to the institutional problems of the Old-Regime were multiple. One could have assigned the property rights to the lord (as in Britain). One could also give them to the village and reduce the transaction costs surrounding intra-village bargaining. Under either solution to the institutional problem drainage would proceed, which is the crucial issue in terms of economic growth, but the possible two solutions had dramatically different redistributional consequences. Under the Old-Regime, political organizations seem to have been so concerned with redistribution that they stifled economic growth rather than resolve issues of uncertain property rights. During the French Revolution marshes were allocated to the villages and not the lords and while villages benefited from the transfer what mattered was that drainage could proceed.

VII Conclusion

This paper points to the importance of asymmetric information in court outcomes, but it departs from the previous literature by recognizing that plaintiffs and defendants can expend resources to increase the likelihood of a favorable judgement. In this model the ability to hire legal expertise to shore up one's claims affects court decisions directly and settlements indirectly. The distribution of court costs among plaintiffs and defendants also affects court outcomes and settlement, yet when the plaintiff bears the burden of proof, the defendant chooses to expend only the fixed cost of litigation regardless of the cost of legal expertise. The model thus illustrates the importance of legal rules once litigation expenditures are endogenized, because given a burden-of-proof rule the defendant and the plaintiff value the services of lawyers differently. Furthermore, when the difference between the expected value of court outcomes for strong and weak type plaintiffs is high relative to court costs (that is when there is a lot of uncertainty about who the plaintiff is) the defendant has an incentive to make an offer that will separate the weak plaintiffs from the strong.

A model that describes not only the trial process but also the litigants' search for evidence before the settlement stage may provide further insight into the issue of out-of-court settlement. But even the simple model described in this paper indicates how specific institutional rules—such as burden of proof on the plaintiff or respect for precedent—constrain the equilibrium settlement offers and litigation probabilities.

This simple model helps identify one of the many causes of the divergent experiences of England and France: differing burden of proof rules. The conclusion of the paper that legal rules have

an important impact on economic growth goes far beyond the question of marsh drainage. In the case of Europe specifically, historians have noted that while British lords and landowners seem to have retained ultimate control of the land, French peasants prevailed over lords to become landowners. Robert Brenner (1976) suggests that the state played a crucial role in upholding the rights of peasants in France and those of lords in England. This paper argues that in an epoch of highly uncertain property rights, a change in legal institutions such as the burden-of-proof rule is sufficient to dramatically alter the distribution of landownership. Indeed, it can be shown that the difference in burden-of-proof rule applied to marshes in England and France also applied over the question of medieval peasant property. Thus judicial rules favored peasant property in France while in English lords were more likely to receive all residual claims to the land. To the extent that economic development required significant coordination among landholders and if coordination was costly then the allocation land to peasant rather than lords may have slowed economic development.

Our exploration of the allocation of marshes between waste and common, and in the long run between drained and undrained highlights the importance of institutions in explaining economic performance. It seems inescapable that France had a set of institutions that were particularly hostile to drainage whereas England's institutions encouraged lords to drain marshes. Finally, this research suggests that game theory has an important role to play in economic history by providing a method for the analysis of institutions.

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Notes

1) Burden-of-proof rules, for example, have tended not to be analyzed. See, however, Sobel (1985)

and, Rubinfeld and Sappington, (1987).

2) Thirsk (1967) p. 607.

3) Rosenthal (1988) pp. 33-49.

4) See the reports of provincial officials in Archives Nationales H^1 1488-1490 (hereafter A.N). In fact

the scarcity of pasture in France should have made drainage more profitable there than in England.

5) Rosenthal (1988) pp. 28-30.

6) Ault (1972) p. 16.

7) Intravillage bargaining successes seem to have been crucially dependent on the social choice rule

that prevailed in the village. In England medieval statutes transformed the unanimity rule into a

majority rule while in France unanimity was required until the 1820s. Not surprisingly in England

more common marshes were drained than in France. For French evidence on intravillage disputes see

A.N. $H^1$1492-1500 and Archives Departementales Calvados C 4201 (hereafter A.D. Calvados).

8) One should also note that the evidence presented in French cases of marsh drainage were preciselly

contracts of sale or transfer for villages and rental receipts for lords A.D. Calvados C 4200-4230.

9) The results of the analysis in terms of drainage would not differ substantially if the villages were to

make the final settlement offer. However it is a different game theoretic problem entirely, cf. Section

IV and Reinganum and Wilde(1986).

10) The assumption that π is greater than λ is only meant to suggest that ex ante marsh drainage

was though to be profitable. In fact in many cases it was unsuccessful (see Summers (1976) and Darby (1983) for evidence that on the eastern edge of England many drainage schemes failed).

11) Discovery cost would be borne primarily by the villages and they would benefit the lord. Thus the lord will always demand that the village expand the maximum resources possible in dicovery. Because we focus on sequential equilibria, past expenditures do not directly affect future decisions.

12) Thirsk (1967) p. 223, also Summers (1976) pp. 104-109, Darby (1983) pp. 57-61 and 67 and Lindley (1982).

13) Rothwell (1975) pp. 352 and 455-456. For nineteenth-century interpretations see Maidlow (1867) and Cooke (1864).

14)Thirsk (1967) pp. 260-276.

15) See for example A.D. Calvados C 4200-4230 for cases where villagers argue that they have pastured their flocks on the marsh for a long time without paid any explicit rent for the marsh and win a judgement in their favor.

16) Derlange (1987) p. 53, Dewald (1987) pp. 154, 262-263 and A.C. Calvados C. 4226

17) Mousnier (1971) and Esmonin (1913).

18) Derlange (1987) p. 57.

19) See the edicts of 1765 on division of the commons and those of 1766 that applied to marshes were neither were ever enforced (A. N. H[1] 1480-1511).

20) See A. N. H[1] 1496.

21) See for example, A.N. H[1]1486 and note 15 supra.

22) Of all marsh-drainage cases in Normandy only one was decided in favor of a lord. It was brought by the Abbey of Troarn, and concerned a marsh that was quite distant from any village. The Abbey unlike lay lords maintained exceptional records.

23) See Archives Nationales H[1] 1496.

24) See Rosenthal (1988) pp 40-44.

Appendix

Proof of Theorem 1: The proof uses backwards induction. First, I solve for the optimal expenditures, $c_w{}^*$, $c_s{}^*$ and $c_l{}^*$, given q and S. Second, I solve for the optimal litigation probabilities, $k_w{}^*$, $k_s{}^*$ given S. Third, I solve for the optimal settlement offer S^*.

1. Legal Expenditures

Assume that the settlement offer, S, has been refused and that the post-settlement probability that the village is weak is q. The players now simultaneously choose their legal expenditures. The village chooses c_i to maximize $\pi_i(c_i)$. The first order condition is:

$$\frac{\partial \Lambda_i}{\partial c_i} = \frac{\partial E_v(c_i)}{\partial c_i} \lambda \beta_i (1-t) - 1 = 0.$$

The lord must choose $c_l{}^*$ to minimize $(\lambda(c_l))$. The first order condition is:

$$\frac{\partial V_l}{\partial c_l} = \frac{\partial E_l(c_l)}{\partial c_l} \pi \left(q(1-\beta_w) + (1-q)(1-\beta_s) \right) t + 1 = 0.$$

The concavity of $E_v(.)$ and $E_l(.)$ as well as assumption 5 are sufficient to guarantee that a solution to both problems will exist. Assume that the rationality constraints do not bind. First order conditions will be necessary and sufficient because concavity insures that the second order conditions hold. Thus $c_i{}^*$ and $c_l{}^*$ are defined by:

$$\frac{\partial E_v(c_i{}^*)}{\partial c} = \frac{1}{\beta_i(1-t)\lambda}, \quad \text{and,} \tag{6}$$

$$\frac{\partial E_l(c_l{}^*)}{\partial c} = \frac{1}{[q(1-\beta_w)+(1-q)(1-\beta_s)]t\pi}. \tag{7}$$

Note that only the lord's litigation expenditures depend on litigation probabilities (k_i) through q.

2. Optimal Litigation Levels

Fix S. Let $c_l{}^*(k_w, k_s)$, $c_w{}^*$, $c_s{}^*$ be the equilibrium expenditures. village s of type i will choose $k_i{}^*$ to maximize Π_i. Let x_j be the probability that village s of type j litigates. Then let $k_i{}^*(S, x_j)$ be the best response of village s of the other type to such a litigation probability. Since there are only two types of village s we can write simply $k_i{}^*(S,x)$. Without loss of generality we can assume that $k_s{}^*(0,x)=1$ (otherwise $S^*=0$ which leads to a trivial problem). Furthermore accepting an offer of λ with probability 1 is a dominant strategy because trials are costly, so $k_w{}^*(\lambda,x)=k_s{}^*(\lambda,x)=1$.

Throughout the proof of the next two lemmas the reference to S will be suppressed because S will be

fixed. Hence $k_i^*(S,x)$ will simply be $k_i^*(x)$.

Lemma 1: For each S there exists at most one equilibrium pair $k_w^*(S)$, $k_s^*(S)$ of litigation levels.

Proof: To prove the lemma, first examine type 2's litigation decision. Going back to (5) and

differentiating with respect to k_s gives :

$$\frac{\partial V_s}{\partial k_s} = -S + \pi_s(c_s^*) + k_s(1-\beta_s)\frac{\partial E_l(c_l^*)}{\partial c_l}\frac{\partial c_l^*}{\partial k_s} \, t\lambda = 0 \, . \tag{8}$$

Clearly $k_s(1-\beta_s)\frac{\partial E_l(c_l)}{\partial c_l}\frac{\partial c_l}{\partial k_s} t\lambda$ is the only part of (11) that depends on k_s and it is non-negative and

increasing in k_s. Therefore we only need to evaluate $\frac{\partial \Pi_s}{\partial k_s}$ at $k_s = 1$. If $\frac{\partial \Pi_s}{\partial k_s}$ is positive at 1 then type

2 sues with probability 1, if $\frac{\partial \Pi_s}{\partial k_s}$ is negative, type 2 accepts with probability 1. Differentiating (8)

with respect to k_w gives:

$$\frac{\partial^2 V_s}{\partial k_s \partial k_w} = t\lambda(1-\beta_s)\left(\frac{\partial E_l(c_l^*)}{\partial(c_l)}\frac{\partial c_l^*}{\partial q}\frac{p(1-p)k_s^*}{\left(pk_w^*+(1-p)k_s^*\right)^2} \right.$$

$$\frac{\partial E_l(c_l^*)}{\partial c_l}\frac{\partial^2 c_l^*}{\partial q^2}\frac{2(1-p)p^2 k_w^* k_s^*}{\left(pk_w^*+(1-p)k_s^*\right)^3}$$

$$\left. \frac{\partial^2 E_l(c_l^*)}{\partial c_l^{*2}}\left(\frac{\partial c_l^*}{\partial q}\right)^2\frac{2(1-p)(pk_s^*)^2}{\left(pk_w^*+(1-p)k^*\right)^3} \right). \tag{9}$$

Because $E_l(.)$ is increasing and concave, (9) is negative. It is important to note that changes in k_w

only affect the profitability of going to court. As k_w increases the value of going to court falls for type

2 because the lord spends more on research when his priors that he faces weak types increases. As the

value of going to court falls strong village s sue less, however (13) may not bind so k_s^* is weakly

decreasing in k_w.

The same analysis also allows us to characterize the reaction function of type 1 village s. The

profits of type 1 villages, however, increase with the probability that type 2 villages refuse the

settlement offer because as type 2 villages go to court with greater probability lords fight less

$(\frac{\partial^2 V_w}{\partial k_w \partial k_s} \geq 0)$. Clearly changes in type j's probability of going to court only affect the other type's profits of litigation, not those of accepting. The best response function of type 1 to type 2's litigation probability is monotonic increasing and continuous. Type 2's is reaction function to type 1's trial probabilities is either constant at one or at zero, or for some $\overline{k}_w$ type 2 village s profits are maximized exactly when he sues with probability one $(\frac{\partial V_s(1, c_s)}{\partial k_s} = 0)$ in which case type 2's reaction function is discontinuous. If k_w is less than or equal to $\overline{k}_w$, then $k_s = 1$ and if k_w is greater than $\overline{k}_w$, then $k_s = 0$. Thus, there exist at most one equilibrium pair for each offer (S) such that k_w^* is best response to k_s^* and vice versa.

Lemma 2 : If there is a discontinuity in k_s^* at $\overline{k}_w$ then $k_w^*(1) \leq \overline{k}_w$.

Proof: First note that given that the settlement offer is S and that village s of type 1 litigate with probability $\overline{k}_w$ village s of type 2 are at an optimum at $k_s^* = 1$ so $\frac{\partial V_s}{\partial k_s}$ is zero when $k_w = \overline{k}_w$ and $k_s = 1$.

Now let us look at $\frac{\partial V_w}{\partial k_w}$ evaluated at $k_w = \overline{k}_w$ and $k_s = 1$:

$$\frac{\partial V_w(\overline{k}_w, 1)}{\partial k_w} = -S + \pi_w(c_w^*) + \overline{k}_w(1 - \beta_w)\frac{\partial E_l(c_l^*)}{\partial c_l} \frac{\partial c_l^*}{\partial k_s} t\lambda . \tag{10}$$

β_w is less than β_s and $\overline{k}_w (1 - \beta_w)\frac{\partial E_l(c_l^*)}{\partial c_l} \frac{\partial c_l^*}{\partial k_s} t\lambda$ is negative . Thus

$$\frac{\partial V_w(\overline{k}_w, 1)}{\partial k_w} < \frac{\partial \Pi_s(\overline{k}_w, 1)}{\partial k_s} = 0 \Rightarrow k_w^*(1) < \overline{k}_w. \quad \square$$

Lemma 2 guarantees the existence of a unique pair of equilibrium litigation probabilities despite the fact that the best response function of strong village s (type 2) may not be continuous. Indeed, if it is continuous, it is either constant, at 0 or at 1; and then the fact that type 1's best response function is monotone guarantees that the equilibrium will be unique.

If the best response function of type 2 is discontinuous, then it is 1 when k_w is low and 0

when k_w is high. Lemma 2 says that in that case strong village s will litigate with probability one and that weak village s will not go to court for sure. Thus for any S, the equilibrium pair of litigation probabilities is unique. Furthermore strong village s always use pure strategies. □

Definition 6: z_i is a reservation settlement for type i if and only if (1), $k_i^*=1$ for all $S> z_i$, and (2), $k_i^*=0$ for all $S< z_i$. z_i is a reservation like offer if only (1) or (2) hold.

Lemma 3: There exists one reservation settlement offer for strong village s (type 2) and two reservation like offers for weak village s (type 1).

Proof: The best response functions village s are decreasing with S ($\frac{\partial^2 V_i}{\partial S\, \partial k_i}=-1$). Given that $k_s^*=0$ if S=A and $k_s^*=1$ if S=0 and that k_s^* is a razor's edge reaction function, there must exist z_s such that $k_s^*=0$ if and only if $S> z_s$, and $k_s^* =1$ if $S < z_s$. z_s is the reservation offer of type 2.

Similarly define $\bar{z}_w$ such that $k_w^*(S)=0$ if and only if $S>\bar{z}_w$. Define $\underline{z}_w$ as the S such that weak village s sue with probability one if and only $S< \underline{z}_w$. $\underline{z}_w$ and $\bar{z}_w$ exist because the best response of type 1 is a continuous decreasing function of S.□

Lemma 4 : Weak village s never litigate more than strong village s.

Proof: Suppose first that $k_s= 0$ then $S>\pi_w$ but $\pi_w> \pi_s$ so $S > \pi_s$ so $k_w=0$. Now suppose $0<k_s<1$ then $S=\pi_w$ but $\pi_w>\pi_s$ so $S>\pi_s$ so $k_w=0$. So type 1 village s will litigate with positive probability only if type 2 village s litigate with probability one. Therefore weak village s (type 1) never litigate more then strong ones. □

From lemma 4 we know that the reservation offer of strong types is accepted by weak types with probability one $(z_s>\bar{z}_w)$. Thus if strong village s accept the settlement offer, then weak village s

accept the offer as well. For any settlement offer above $\bar{z}_w$ $q^* = 0$, and the lord will spend the least

documenting his claim. Define $\bar{c}_l$ to be his litigation expenditures in this case. Then $z_s = \pi_s(c_s^*, \bar{c}_l)$.

Lemma 2 allows us to easily define out of equilibrium beliefs for the lord . The natural extension of q^*

above z_s when no trials should occur is clearly $q^* = 0$. To find $\underline{z}_w$ and $\bar{z}_w$ it suffices to set solve the

first order condition for $V_w(k_w, c_w)$, the profit function for type 1 village s or:

$$S = \pi_w(c_w^*) + k_w^*(1-\beta_w)\frac{\partial E_l(c_l^*)}{\partial c_l}\frac{\partial c_l^*}{\partial k_w} \, t\lambda, \tag{11}$$

$\underline{z}_w$ is the S that solves (11) when $k_w = 1$ and $k_s = 1$. $\bar{z}_w$ solves (11) when $k_w = 0$ and $k_s = 1$.

To avoid the trivial equilibrium where the settlement offer is 0 and everyone accepts, I

assumed that strong village s would always sue if offered 0. However weak village s may accept a zero

offer with positive probability ($\underline{z}_w \leq 0$ or $\bar{z}_w \leq 0$). If either $\underline{z}_w \leq 0$ or $\bar{z}_w \leq 0$, we can redefine them

without loss of generality to be 0. The possible equilibrium litigation levels are described in table 1 :

[Table 1 about here]

3 Optimal Settlement

Now that optimal expenditures and litigation probabilities have been determined let us

consider the choice of settlement offers by the lord .

Claim: There are only three potential equilibrium settlement offers: 0, $\bar{S}$, z_s, where $\bar{S}$ minimizes

$(1-k_w^*)S + k_w^* \psi_w(c_l^*)$ subject to $\bar{S} \, \varepsilon \, [\underline{z}_w, \bar{z}_w]$.

Proof: Other potential equilibrium settlement offers are ruled out because they are dominated by

those listed above. For example, settlement offers greater than $\bar{z}_w$ but less than z_s are dominated by

$\bar{S}$. If offered a settlement between $\bar{z}_w$ and z_s, type 1 village s still accept the offer with probability

one but get higher settlement. Type 2 village s' behavior is also unchanged, they sue with probability

one. So the lord pays strictly more and thus $\underline{z}_w$ dominates S but $\bar{S}$ dominates $\underline{z}_w$. Now for $S\varepsilon[0,\underline{z}_w]$, 0

is a weak local minimum. For $S\varepsilon[\underline{z}_w, \bar{z}_w]$ the lord 's revenue function is:

$$\Pi_l(S,c_l)=p[1-k_w{}^*]S+k_w{}^*(\psi_w(c_l{}^*)) +(1-p)(\psi_s(c_l{}^*)). \tag{12}$$

The first order condition for the lord is:

$$\frac{\partial\Pi_l(S,c_l)}{\partial S}=1-k_w{}^* -\frac{\partial k_w{}^*}{\partial S}\Big(\psi_w(c_l{}^*)-S\Big)=0. \tag{13}$$

The second order condition always holds because $\dfrac{\partial^2\Pi_l(S,c_l)}{\partial S^2} = -2\,\dfrac{\partial k_w{}^*}{\partial S} \geq 0$. The loss function, thus,

has a unique minimum between $\underline{z}_w$ and $\bar{z}_w$. Call $\bar{S}$ the settlement that minimizes the loss function

between $\underline{z}_w$ and $\bar{z}_w$.□

The only possible equilibrium offers are $0, \bar{S}, z_s$. 0, however is never an equilibrium offer

unless $\bar{S}=0$. The argument must be divided into two cases: $0 < \underline{z}_w$ and $0 > \underline{z}_w$. Consider first $0< \underline{z}_w$.

Now let us compute the difference in the revenues of the lord if he offers 0 and if he offers $\bar{S}$:

$$\Pi_{ll}(0) -\Pi_{ll}(\bar{S})= k_w{}^*\pi_w(c_w{}^*) - \bar{S}. \tag{13}$$

but $\quad \bar{S} = \pi_w(c_w{}^*) + k_w{}^*(1-\beta_w)\dfrac{\partial E_l(c_l{}^*)}{\partial c_l}\ \dfrac{\partial c_l{}^*}{\partial k_w}\ t\lambda. \tag{14}$

Note that $k_w{}^*(1-\beta_w)\dfrac{\partial E_l(c_l{}^*)}{\partial c_l}\dfrac{\partial c_l{}^*}{\partial k_w}\ t\lambda <0$. So $\Pi_{ll}(0)-\Pi_{ll}(\bar{S})>(c_l+c_w+F_l+F_v)\,k_w{}^*$ which is positive.

Therefore 0 is dominated by $\bar{S}$.

Now suppose $0>\underline{z}_w$, then 0 belongs by assumption to the interval $[\underline{z}_w, \bar{z}_w]$. On that interval

the unique minimum of the lord's revenue function is $\bar{S}$ so 0 cannot be an equilibrium offer unless it is

$\bar{S}$ and $E_0=E_1$. Therefore there remain only two possible equilibria:

$$E_1 =(c_l{}^*, c_w{}^*, c_s{}^*, k_w{}^*(\bar{S}), 1, \bar{S}, \frac{pk_w{}^*}{pk_w{}^*+(1-p)}),$$

$$E_2 =(\ \bar{c}_l, \ c \ _w{}^*, \ c_s{}^*, \ 0, \ 0, \ z_s, \ 0)^1.$$

This completes the proof of Theorem 1

Proof of corollary 1: suppose the equilibrium is unique and E_1 then $\Pi_l(\overline{S}) > \Pi_l(z_s)$.

Let $\Pi_l(\overline{S}) - \Pi_l(z_s) = 2\epsilon$. $\Pi_l(.,x)$ is continuous in x where x belongs to $\{\lambda, \ \pi, \ t, \ \beta_w, \ \beta_s, \ p, \ F_l, \ F_v\}$ thus

for each x there exist δ such that $|\Pi_l(,x+\delta)| < |\Pi_l(.,x) + \epsilon|$. Thus $\Pi_l(\overline{S},x+\delta) - \Pi_l(z_s,x+\delta) < 0$. Now let

δ^* be the smallest of aqll δ. E_1 is the unique equilibrium in the ball of radius δ_* centered at

$\{\lambda, \ \pi, \ t, \ \beta_w, \ \beta_s, \ p, \ F_l, \ F_v\}$. Therefore the equilibrium is locally unique.□

Appendix Note

1) One should note that, strictly speaking, in E_2 strong village s are indifferent between settling and litigating. At first glance, the indifference of strong village s suggests that there is a continuum of mixed strategies for these village s in this equilibrium and two pure strategies, one where they sue and one where they settle. Yet if strong village s sue with positive probability then z_s no longer minimizes the lord's revenue function. So if strong village s litigate with positive probability when offered z_s, then there is no sequential equilibrium. Thus E_2 remains the only sequential equilibrium.

	$S < \underline{z}_w$	$S \ \varepsilon \ [\underline{z}_w, \overline{z}_w]$	$S\varepsilon \ [\overline{z}_w, z_s \ [$	$S \geq z_s$
$k_w{}^*$	1	[0,1]	0	0
$k_s{}^*$	1	1	1	0

Table 1

Optimal Litigation Probabilities Given Village Type and Settlement Level