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INSTITUTIONAL INERTIA:
PERSISTENT INEFFICIENT INSTITUTIONS IN SPAIN

José Antonio Espín-Sánchez*

* Yale University (Department of Economics)

Contacto: jose-antonio.espin-sanchez@yale.edu

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Resumen

En 1966, después de 700 años, la comunidad de regantes de Mula (España) cambió de un sistema de subasta a un sistema de cuotas para distribuir el agua del rio. El cambio se produjo en ausencia de cambios políticos o tecnológicos. Las cuotas son más eficientes pero requieren que los regantes sean dueños de los derechos sobre el agua. Un regante puede comprometerse a pagar por los derechos en el futuro, y convertirse en prestatario. Sin embargo, bajo este contrato, el regante no se esforzaría ya que todo el producto iría a parar al prestamista. Anticipando este comportamiento, el prestamista no vendería los derechos de agua. Un incremento temporal en los precios del producto incrementó sus ahorros ayudando a solucionar el problema de compromiso.

Palabras clave: Instituciones, Recursos Naturales, Agua, Instituciones Financieras

Abstract

In 1966, after over 700 years, the irrigation community in Mula (Spain) switched from auctions to a quotas to allocate water from its river. This change happened in the absence of either political or technological change. Quotas were more efficient but required that farmers own water property rights. A farmer would promise to pay over time and became a borrower. However, she would not work hard because the output went to the lender. Anticipating this outcome, the lender would not sell the water rights. A temporary increase in output prices increased their collateral solving the commitment problem.

Keywords: Institutions, Natural Resources, Water, Financial Institutions

JEL CODES: **N23, N53, Q25, D02, G23**

Institutional Inertia:
Persistent Inefficient Institutions in Spain

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"There is nothing more difficult to arrange, more doubtful of success, and more dangerous to carry through, than to initiate a new order of things"
Niccolò Machiavelli, *The Prince*

1 Introduction

In recent years we have seen a growing literature on institutional persistence. This is not a new topic (North, 1990; Alston et al, 1996) but it was not until recently that a comprehensive set of empirical papers on the topic emerged. These new empirical papers focus on particular historical episodes and regions of the world, including India (Jha, 2012), South America (Dell, 2010) and Europe (Guiso et al, 2008; Voigtländer and Voth, 2012) among other areas. These papers document institutional persistence and present robust empirical results but lack a formal mechanism that explains the persistence.

In this paper I provide a general framework to explain institutional persistence and institutional change. While I test the model through a particular empirical application, the model can be applied more generally. Traditional explanations for institutional persistence require technological or political change to spark institutional change. This paper provides an alternative mechanism, called *Institutional Inertia*, which explains institutional change in the absence of technological or political change. In addition to providing an explicit mechanism for *Institutional Inertia*, this paper also advances the notion of a transitional institution, *i.e.*, a temporary institution whose sole purpose is to implement the change from the old institution to the new one.

In this paper, I apply this model of institutional change to a particular empirical case. In 1242 the Christian kingdom of Castile and the Muslim kingdom of Murcia signed a treaty stating that Murcia would become a protectorate of Castile. The treaty established that Castile would have political control over Murcia but Muslims living there will keep their assets, their customs and their lives. The Muslim governors of the cities of Mula and Lorca rejected the agreement. The Christian army then conquered both cities by force and expropriated the water property rights in both cities. In both towns, the conquerors then created a shareholder-owned corporation to hold the water property rights. The corporations in each town ran periodic auctions to sell water usage rights and paid dividends to the owners at the end of the year. All the other towns and cities in the region kept their pre- Reconquista system, in which land and water rights were linked and farmers periodically received a fixed amount of water, proportional to their land holdings.

Donna and Espín-Sánchez (2015) showed that, in the present setting, quotas were more efficient than auctions. Although most contemporaries believed that the auctions were inefficient, and observed neighbors in most surrounding towns allocate water by fixed quota, it was not until 1961 in Lorca and 1966 in Mula that the two cities implemented quotas. Hence, an inefficient institution persisted for over 700 years.

In Mula, the old market institution of auctions did not require any restriction on the distribution of water property rights. The new non-market institution of quotas, however, required a particular distribution of water property rights. Each farmer had to own water property rights proportional to the size of her land. If the agent (farmer) was poor, she faced a holdup problem when she tried to buy water property rights from the principal (original owner or Waterlord). Since she could not pay in cash, she would promise to pay in the future, *i.e.*, take on debt. In the presence of uncertainty, however, a debt contract may solicit a sub-optimal level of effort. Thus, the farmer would not be able to make the promised payment with certainty. The Waterlord would refuse such a contract. If the farmer owned the water property rights, she would exert the first-best level of effort and would thus have been able to pay the debt. Moreover, there was also a coordination problem among the farmers. In order to change the institution, farmers, collectively, needed to own a majority of water property rights.

While most scholars rely on a Hobbesian Leviathan to enforce contracts, Elinor Ostrom (1990, 2005) extensively studied the benefits of self-governing institutions like the one I am studying here.[1] The model presented here fits within Ostrom's framework, but concerns the choice between two self-governed institutions (auctions and quotas) rather than the choice of whether or not to self-govern. Mula farmers allocated water through one self-governing mechanism or the other without the intervention of a third party. Moreover, farmers under each regime established their own courts and appointed their own judges. In this paper, I focus on the conflict between water owners and farmer, taking each group as a single entity. That is, I assume that farmers solved the collective action problem.

In general, in an institutional change, a principal chooses an institution, affecting both the principal's and agent's payoff. First the principal chooses the institution, and then the agent makes a monetary transfer to the principal. In a world with perfect information, no bargaining costs and perfect commitment –one in which the Coase Theorem (Coase, 1937) holds– the efficient institution is always put in place. The lack of institutional change in a non-Coasian world results from a misalignment of incentives between the principal and the agent. *Institutional Inertia* happens when the agent must have decision rights under the new institution but cannot commit to pay the principal after the change.
One way to solve this problem is for the agent and the principal to join forces. This will happen, for example, when the agent gains decision rights here, either property rights or political power. When the agent has decision rights, the principal/agent distinction disappears and hence, the institution is efficient. This approach assumes that the agent has no commitment power.

Another explanation of institutional change focuses on technological change that affects principal/agent payoffs. In particular, if the agent's losses under the old institution are sufficiently large, the mechanism preventing the agent from adopting her preferred institution collapses. Thus, the benefits of the change offset the associated transaction costs. Notice that, for this argument to hold, the agent must have commitment power. The agent must also receive gains big enough to cover the transaction costs.

This paper takes a third approach, overlooked in the literature, which requires an increase in the commitment power of the agent. The agent under the new institution should compensate the principal and, since efficiency has increased, the agent's payment to the principal is lower than the agent's gains. If the agent can credibly commit to compensate the principal, then the institutional change will occur. If the agent cannot commit to this payment, then an inefficient institution persists. This can happen even if it is common knowledge that the institution is, indeed, inefficient.

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[1] The Hobbesian *legal centralism* theory has been criticized by Ellickson (1991) among others. Moreover, there are situations in which people are not constrained by formal legal institutions (Posner, 2000), but by some commonly agreed social norms.

This condition for institutional transition –a change in property rights with the promise of a future payment– structurally resembles a debt contract. There is a transitional period –after the principal decides but before the agent pays off the debt– with different rules and incentives than those of either the old or new institution. The transitional institution, here the debt contract, is required only to change from the old to the new institution. In other words, both institutional inertia and a transitional institution only occur when the new institution is more efficient and requires the agent to own property rights.

2 Background

Geographical, historical and social conditions at the time the Christians conquered the Kingdom of Murcia had an important impact on the way institutions were initially set up. After the separation of water and land ownership, the owners of water property rights (Waterlords) were different persons than the land-owners (farmers) and a well-functioning water cartel was established. The Waterlords themselves began to run the auctions. In the 19th century, this cartel was formalized, legalized and named *Heredamiento de Aguas*. The land-owners were small proprietors, with family-size plots, who created their own association, *Sindicato de Regantes*. The aim of this association was, on the one hand, to self-regulate and settle disputes which arose between neighbors and, on the other hand, to keep the balance of power in the market for water.

Tandas (Quotas)

Contemporaries considered quotas the fairest institution. Water ownership was tied to land ownership. Every plot of land was assigned some amount of irrigation time during each *tanda*, a period of three weeks. The amount of irrigation time allocated to each farmer depended on the size of the plots she owned. A tree takes several years to be fully productive, but can die in a given year without sufficient water. Other crops like tomatoes, which take a farmer three months to grow and harvest, incur no losses, beyond the cost of seeding, if the harvest is lost during a drought. Hence, a farmer with a secure supply of water plants trees and receives a higher expected return. This system had the advantage that every farmer periodically got some “fair” amount of water, a desirable feature during a drought. Because of the *insurance* property of this institution, farmers had the security needed to carry out risky investment such as planting trees.

Subastas (Auctions)

The units sold in the auction refer to the right to use the water flowing through the river at a specific date and a specific time, within a window of three hours. In Mula, water property rights were well established and were divided into 832 shares. The functioning of the cartel was similar to a modern corporation: votes were proportional to shares and shares were tradable.[2] The cartel paid dividends once a year.

Southeastern Spain is the most arid region of Europe. It is located to the east of a mountain chain, the Prebaetic System, which includes the Mulhacen, the second highest mountain in Europe. The rainfall frequency distribution is skewed: most years are dryer than the average.

[2] The cartel did not have limited liability, however.

Rain occurs mostly during Fall and Spring. Despite the fact that the region is dry, rivers flowing down the Prebaetic System provide the region with the water needed for irrigation.

More than 90% of the parcels are smaller than one hectare. The environment here makes the moral hazard problem between the landowner and the tenant so important as to render a larger scale of land exploitation unprofitable.[3] Since the land is owned individually but the water irrigation system –the river, the dam and the channels– is managed jointly, farmers must create an institution to manage the common resource.[4] The optimal mechanism in this environment is to *sell* the firm to the agent.[5] Calatayud and Garrido (2011) show that this was indeed the case in eastern Spain. They further show that all contracts in this type of environment require either that the farmer owns the land or that the farmer has a long-term contract with the Landowner providing for compensation of all the improvements. Such a long-term contract is roughly equivalent to the farmer owning the land. In this environment it is optimal for the farmers to own both water and land rights. However, they only own land rights, but not the more expensive water rights, because they are poor and cannot commit to pay back.

If a new economic institution could substantially improve Pareto efficiency, in the absence of transaction costs one would expect the new institution to be put in place. If those with the power to decide are worse off under the new institution, the winners could compensate them to prevent them from blocking the change. The Waterlords could sell their water rights to the farmers. Farmers would then make undistorted decisions and, thus, increase output. However, in Mula, farmers were penniless and could only buy water rights with a promise of future payment.

One option would be to use land as collateral. On the one hand, this would imply that farmers should carry a lot of risk, since they can lose "everything" during a drought. On the other hand, it would be hard for the Waterlord either to take over the land or to sell it to someone else since most potential buyers would likely be in the same financial situation.

Farmers might also be reluctant to collateralize their land. A debt contract also creates inefficiencies in production due to the risk that the farmer bears, even if they are risk neutral. In the likely case that the farmer is risk averse, this inefficiency will be even greater. In the stochastic world of agriculture where weather fluctuates and crop production is differentially sensitive to effort, a debt contract implies that the farmer will get little or none of the output

[3] The argument that, when growing vines or fruit trees, the monitoring costs of the reduction in effort create diseconomies of scale also appears in Hoffman (1996) and Rosenthal (1990).

[4] However, in neighboring non-irrigated areas the structure was radically different. Powerful landowners hired seasonal workers to work in large estates and paid those wages just above their survival needs. These large estates were used to grow cereals and were not irrigated. The goods produced in the *huertas* (irrigated orchards) were also different than those produced in the large estates. *Huertas* produced mainly vegetables and fruits. They were also the main producers of white mulberry leaves during the silk boom in the 16th and 19th centuries. However, large estates produced mostly grain and fodder. *Huertas* produced goods heterogeneous in quality, while large estates produced homogeneous goods that yielded low profit per acre. The former products (citrus, peaches, *etc*) are very sensitive to weather conditions and require constant and close attention.

[5] Since plots are adjacent in a small area, externalities with respect to the choice of crops might be present. For example, trees could prevent severe damage to the soil during a flooding, but only if one's neighbors also have trees.

produced in some states of the world. If this is very likely, the farmer would optimally choose to exert an inefficiently low level of effort. Hence, commitment problems can delay or make impossible an institutional transition. In such a situation, the only way to achieve full efficiency would be to *give* the water rights to the farmers, *i.e.*, *give* the firm to the agent.

2.1 Giving the water to the farmers

Not surprisingly, *giving* the water rights to the farmers for free was the proposition of the newly elected national government in 1931 when a new dam was built (see Figure 6). The government made an offer to the Waterlords of 4.2 M *pesetas* for all the water rights of the Mula River. After the purchase, the government would give water rights to the farmers in proportion to the size of their land holdings, and water property rights would be tied to land property rights. Hence, the commitment problem would be solved and the more efficient institution would be adopted.

The Waterlords took the offer very seriously. They printed a small book with the details of the offer, the opinion of the president and other members of the council and the main conclusions reached during meetings prior to a vote of the general assembly. The opinion of the water owners split into three groups. The group of small owners (1 or 2 shares) was in favor of the sale, at any price. Since these owners were also farmers reliant on a small number of water shares, they would have benefited greatly from the change. Not only would they have received money from their shares, they would have also been awarded more water rights than they had before. The group of middle owners (3 or 4 shares) was also in favor. Many of them were farmers, and would have received roughly the same amount of water rights as under the auction system, but they would have been paid for the water they owned. The group of big owners (5 or more shares) was in favor of the offer only if the price offered was sufficiently high and the payment was made in cash. The offer of 4.2 M *pesetas* was considered a "fair" price according to most of the big owners and the offer was accepted by the Waterlords during their general assembly.

However, the sale was never completed. The Waterlords demanded payment in cash, but the government –the newly established 2nd Republic of Spain– could not afford to pay in cash. The government was unable to make a credible promise of future payment. The concerns of the Waterlords were justified: three months after the delayed payment was rejected, the government defaulted on its national debt. Had the Waterlords accepted the offer from the government, they would not have been repaid. Soon after, the civil war broke out and the prospects for change looked dimmer than ever.

2.2 Transition

By the 1950s and 1960s, though, Spain was in the midst of an economic boom. The government's foreign policy began to change. Borders were opened and trade agreements drafted with the EU and the US. This situation produced an unprecedented boost in the Spanish economy: the *Spanish Miracle*. This boost was especially important for the farmers in Mediterranean Spain. Exports of fresh and dried fruit grew exponentially.[6]

For the first time in their history, the farmers of Mula could produce enough output to create a surplus that could be saved. Improvements in the financial sector and a state policy directed towards increasing local savings and providing easy access to credit for small business created

[6] See Morilla Critz, Olmstead and Rhode (1999).

the perfect environment for savings. By 1966, the combination of a policy of easy lending with the savings accumulated by the farmers in Mula over the previous decade was enough to provide a credible promise of future payments.

After several centuries of continuous operation, the auction mechanism came to an end in 1966. The farmers' union (*Sindicato de Regantes*) reached an agreement with the cartel (*Heredamiento de Aguas*) and the auction was replaced by a system of fixed quotas. Both parties agreed that the *Sindicato* would pay a fixed price for each *cuarta* of the water flowing through the river. The price would be revised every six months. The *Sindicato* then allocated the water among the farmers using quotas.

Throughout this period, the composition of the cartel of Waterlords did not meaningfully change (see Figure 2). After the *Reconquista* over half of the shares of water rights belonged to the *Marquis of Los Vélez*. In the late 19th century the *Marquis of Los Vélez* sold all his shares to the *Marquis of Pidal*. By 1966, those shares belonged to the *Marquis of Pidal* and his sister.

The key to the transition was the credit line a savings bank extended the *Sindicato*.[7] In 1966, the *Sindicato* signed an agreement with the bank for a credit line that could be used only for buying water property rights. Hence, in 1966 the *Sindicato* began buying each of the shares from the original owners. During the transition process from 1966-1981, farmers had to pay an extra fee, proportional to their land area, in order to repay the loan. By 1981, the association owned all the shares and formally changed the legal status of the water. Since then, the water of the Mula River has been tied to the land, in the pattern of other towns in Murcia. Farmers now only have to pay the operational costs of the system in proportion to their land area. They are now owners of both land and water.

2.3 Alternative Views on Institutional Persistence

There has been some discussion in the literature about whether one can even talk about *endogenous* institutional change. After all, if nothing changes, nothing can change. Here, I will use a weak definition of *endogenous* institutional change.

We can define an *exogenous institutional change* as one due to *exogenous* changes in the payoffs of the agents involved or changes in the identity of those with decision power.[8] We can define an *endogenous institutional change* as those due to *exogenous* changes that do not affect payoffs or decision power, but that instead trigger the institutional change through other mechanisms. Examples of changes that fall into this category include those which do not directly affect an agent's payoff, but instead affect their beliefs or commitment ability.

The New Institutional Economics (NIE) literature (see Menard and Shirley, 2005) attributes institutional changes to changes in agents' relative payoffs and transaction costs. Libecap (1978) clearly demonstrated how the evolution towards a more precise definition of mineral property rights in the American West followed the discovery of ore veins. The more valuable the mineral

[7] Information obtained via personal interview with the current president of the *Sindicato*, who is both a farmer and the son of the president of the *Sindicato* in 1966.

[8] Hence, changes in technology, in relative prices, or in demand of certain goods can be considered *exogenous* changes that affect the payoffs of the agents. Revolutions, elections or death of the ruler can be considered as *exogenous* changes that affect the identity of those with decision power.

rights, the greater the value of precise property rights relative to more imprecise ones. The greater the inefficiency gap, the greater the lobbying effort to introduce new legislation. Hence, changes in the relative payoffs of different institutions triggered an institutional change.

Rosenthal (1990) showed how an institutional change was triggered by a change in the identity of those with decision power. After the French revolution, the French government used eminent domain rules to implement changes in property rights that established efficient irrigation works.

Acemoglu and Robinson (2008) argued for the importance of commitment during institutional change. However, the mechanism proposed here requires a type of commitment different from theirs in two important aspects. First, they focus on the commitment ability of the principal (*elite*). In their model, the principal uses democracy as a commitment device to avoid expropriating agents (*citizens*) in the future. To the contrary, I focus on the commitment ability of the agent (*farmer*). Agents here use collateral or upfront payment as a commitment device to prevent them from shirking and to facilitate payback. Second, no transitional institution exists in their model. Thus, commitment ability is relevant only for the new institution (*democracy*). In this paper, commitment plays no role in the old institution, or in the new one. Instead, commitment is only important for the transitional institution. Without a credible commitment from the agent (*farmer*), the principal will never agree to change from the old institution to the transitional institution.

In a study of medieval trade, Greif (2006) proposed an *endogenous* institutional change model based on commitment ability and unintended consequences from previous institutional arrangements. Both this paper and Grief's advance the argument that a change in payoff or decision power does not prompt the emergence of a new institution. In Greif (2006), the change in the principal's beliefs about whether or not the agent will honor their contract leads to a change in the agent's commitment ability. Greif (2006) is a particular case of the general model I present here which accommodates all changes in commitment ability. In the particular case presented here the change in commitment ability comes from changes in collateral not changes in beliefs.[9]

The theories presented above are based on the assumption that all agents involved had perfect information regarding the payoffs of each institution. There are other theories of institutional change based on incomplete information or evolutionary learning. See Schotter (1981) for a discussion on Old Institutional Economics and evolutionary institutional change.

3 Institutional Inertia and the Efficiency of Transitions

This section concerns the problem that the farmers' association (*Sindicato*) faced against the Waterlord's association (*Heredamiento*). For simplicity, I assume that the *Heredamiento* will sell as soon as it finds it profitable. The production function in this economy depends on the state of nature s, the water rights required for irrigation θ and the unobserved effort exerted by a farmer *e, i.e., $f(s, \theta, e)$. s* is a random variable that is realized after the agent has put in effort. The

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problem for each farmer is analogous, up to the amount of water rights that the farmer needs θ. Hence we can get rid of θ to simplify the notation, *i.e.*, $f(s, \theta ,e) \equiv f(s,e)$. There is a unit mass of farmers of 1, thus the production function refers both to the individual farmer or the total production in the economy. The production function $f(s,e)$ is strictly increasing and concave in each argument.

The *Heredamiento* will act as the principal and will offer a contract B to the *Sindicato*. The contract should be based on observables. The contract B chosen by the *Heredamiento* is a standard debt contract, *i.e.*, the *Sindicato* has to pay a fixed amount B. If the *Sindicato* does not pay B (default), the *Heredamiento* incurs a bankruptcy cost $C>0$ and takes over all the output. This standard debt contract is optimal in the present setting: it maximizes the set of parameters under which the sale will occur.[10] The game has three stages. In the first stage, the *Heredamiento* offers a contract B to the *Sindicato*, *i.e.*, the *Heredamiento* decides whether to sell the water rights to the *Sindicato* and the amount to be paid B. In the second stage, each farmer decides how much effort to exert, based on the contract, *i.e.*, $e \equiv e(B)$. In the third stage, after the uncertainty is realized, the *Sindicato* pays the *Heredamiento* the debt B or, in case she cannot pay, the *Heredamiento* gets the collateral of the *Sindicato* and all of the harvest. The farmers have some wealth D that they can use as a down-payment. Let I be the value that the *Heredamiento* assigns to the ownership of water rights which is equal to the market value of the water under the auction system. I assume that $D<I$, otherwise the farmer could use his collateral to buy the water property rights and the transition to a more efficient institution is trivial.
The *Heredamiento* asks the *Sindicato* for a payment B after the output is realized. The *Heredamiento* incurs a risk because the *Sindicato* may not be able to pay the full amount B. Thus, in equilibrium we have $B \geq I$. The *Heredamiento* will sell the water rights as soon as she gets a profit from doing so. This means that the selling price for the *Heredamiento* equals I.

3.1 General Case

The expected payoff of the *Heredamiento* is an increasing function of the level of effort exerted by the farmer. Hence, the *Sindicato* implicitly chooses the expected transfer. The *Heredamiento* sells the *Sindicato* the water rights θ and asks for a fixed amount B to be paid after production occurs. The problem of each farmer is then

$$\underline{V}(B)= Max_e\ V(e,B) \equiv Max_e \{ E_s [max\{ f(s,e)-B,0 \}]-D-e \} \qquad (1)$$

where the expectation is taken over s. The *Sindicato* has to pay B and D to the *Heredamiento* and keep the rest of the output. If the *Sindicato* cannot pay B, *i.e.*, if $f(s,e)<B$, then the *Heredamiento* will take the output and the down-payment, after paying the bankruptcy costs, and the *Sindicato* will get nothing.

Incentive Compatibility requires that the *Heredamiento* should not be worse off selling his water rights

$$W(e,B) \equiv E_s [min\{ B,f(s,e)-C \}]+D \geq I \qquad (2)$$

[10] See Townsend (1979) and Gale and Hellwig (1985) for results on the optimality of the standard debt contract.

In equilibrium the *Heredamiento* will be indifferent, hence equation 2 holds with equality. $W(e,B)$ is the *Heredamiento*'s payoff if he sells the water rights to the *Sindicato* under contract B and the farmer effort is e.

Notice that, for a fixed level of effort e, this is a zero-sum game, *i.e.*, the *Heredamiento* gets what the *Sindicato* does not, except for the bankruptcy costs. With positive bankruptcy costs this is a negative-sum game because the bankruptcy costs are incurred in equilibrium with positive probability.

The first-best (FB) level of effort of this game is equal to the level of effort that a farmer would exert if she owned water property rights equal to θ, *i.e.*, $e^{FB} = argmax_e\, TW(e)$. If the farmer is the owner of the water she never enters into bankruptcy and does not have to pay the bankruptcy costs. The farmer maximizes Total Welfare (TW)

$$TW(e) \equiv \underline{V}(B)+W(e,B)= E\, s\, [\, f(s,e)\,]-e \qquad (3)$$

Notice that the level of effort that the farmer will exert under a debt contract is never greater than the FB level, *i.e.*, $e(B) \equiv argmax_e\, V(e,B) \leq e^{FB}$.

The farmer will put in the FB effort if she always has a large enough down-payment to cover the loan, *i.e.*, $f(s,e(B)) \geq B$ for all s. In this case, the problem of the farmer is identical to the FB. Moreover, since there is no risk, the *Heredamiento* will ask for the minimum acceptable amount in the loan, *i.e.*, $B+D=I$. However, if the *Sindicato* does not have enough collateral, she may not be able to pay back the loan with certainty. In this case the *Heredamiento* may ask for a payment greater than the value he assigns to the water rights to compensate for the risk.

We can solve the game by backward induction. We can write equation 2 as a function of B only

$$\underline{W}(B) \equiv E_s\, [\, min\{\, B,f(s,e(B))-C\, \}\,]+D=I \qquad (4)$$

We are interested in the lowest value of B that satisfies this equation. Equation 4 will have no solution when the value that the *Heredamiento* assigns to the water rights is too big compared to the collateral, *i.e.*, I is too big compared to D, when the reduction in output associated with the reduction in effort due to the holdup is big, *i.e.*, $f_e(s,e)$ is big, and when the bankruptcy costs are high, *i.e.*, when C is high. Let $\underline{D}$ be the minimum amount of down-payment such that equation 4 has a solution. Under any level of down-payment D greater than $\underline{D}$ a transition will occur.[11] This is the key result of the paper.

The long persistence of this inefficient institution can be explained by the high-powered incentives present in the economy, *i.e.*, by the fact that growing fruit trees is an effort-intensive activity, which is represented here by the concavity of the production function in effort. After paying for their living conditions, farmers did not have any money left over to save. Thus, they did not accumulate considerable savings to use as collateral until the 1960s, as shown in Figure 4. Without enough savings farmers could not pay a down-payment big enough to commit to exert a high level of effort. Without the commitment, the *Heredamiento* would not agree to the contract.

[11] The result that down payments can be used to improve efficiency in the allocation of resources is not new in the finance literature (Stiglitz and Weiss, 1981).

Finally, bankruptcy cost here is a proxy for the quality of the institutions. It measures the costs that the lender faces if the farmer defaults on the loan. The improvements in financial institutions and the preferred treatment of rural loans explained in sub-section 5.3 imply lower bankruptcy costs.

3.2 Example

Here I construct a numerical example in order to explain the implications of the model. The numbers do not have any relation with magnitudes in reality. Let $f(s,e)=20\, s \cdot e$. Here s is the amount of precipitation in the farmer's plot. The value of s is 1 or 25 with equal probability. In this economy, if the farmer owns the water rights, she will exert the first-best (FB) level of effort, *i.e.*, $e^{FB}=900$, get an expected output of $E_s[f(s, e\, FB)]=1800$ and obtain an expected surplus of $TW(e\, FB)=900$. The value of owning water for the *Heredamiento* is lower than it is for the farmer. Let $I=800<900=TW(e\, FB)$.

The first thing to notice is that the farmer will go bankrupt if $s=1$ whenever $B>600$. That is, if the debt is too high to be paid in full in the low productivity state, then the farmer will default. When $B \leq 600$ the farmer will never default and will always be the residual claimant of the output. Hence she will put the FB level of effort. If $B>600$ then the farmer will be the residual claimant of the output only when $s=5$, hence she will put in the second-best (SB) level of effort at most. If $B>1250$ the farmer's expected utility is negative. Even though she is the residual claimant of the output when $s=5$, the output that she receives in this case is not enough to offset the effort cost. Hence, the effort of the farmer as a function of the contract offered is

$$e(B)= \begin{cases} e^{FB}=900 & \text{if } B \leq 600 \\ e^{SB}=625 & \text{if } 600<B \leq 1250\text{-}2D \\ 0 & \text{if } B>1250\text{-}2D \end{cases} \qquad (5)$$

When $D=0$, the farmer does not have any money to spend as a down-payment. However, the *Heredamiento* needs at least 800 in expectation, *i.e.*, $B \geq 800$, and thus the farmer exerts at most the SB effort. Under this contract, the farmer does not get any output if $s=1$. With this result, equation 6 becomes

$$W_0(e,B) \equiv 1/2\, [\min\{ B,500\text{-}C \}+\min\{ B,2500 \}] \leq 800 \qquad (6)$$

The minimum value of B that satisfies this equation is $B=1100+C$. Hence, equation 4 has no solution when $D=0$ and $C>150$. In other words, if the *Heredamiento* offers a contract with $B>1250\text{-}2D$ the farmer will not exert any effort and the *Heredamiento* will get nothing. If the *Heredamiento* offers a contract with $B<1100+C\text{-}2D$ it will get less than it is getting while keeping the water rights and running the auction. Hence, when $C>150$ and $D=0$, the *Heredamiento* will not sell the water rights to the farmer under any future payment B. High bankruptcy costs and low down-payment imply no institutional change.

When $D=0$, we need bankruptcy costs to be low in order to have institutional change. Moreover, there is a threshold in the bankruptcy costs that triggers the institutional change. When $D=0$ an institutional change can happen if C is low enough, but the farmer does not exert the first-best level of effort.

If the down-payment is high enough, the *Sindicato* will be the residual claimant in all states, and thus will never default. Moreover, when $D \geq 200$ the *Heredamiento* will offer a contract with $B \leq 600$ and the farmer will exert the first-best level of effort. Notice that, since the farmer will never default in equilibrium, the bankruptcy costs are irrelevant in this case.

Figure 1 shows all the possible equilibrium outcomes depending on the parameters of the model. There are three cases[12]

I. $C>150$ and $D<200$. No institutional change is possible.

II. $C \leq 150$ and $D<200$. Inefficient Institutional change happens (SB).

III. $D \geq 200$. Efficient Institutional change happens (FB).

An efficient institutional change will happen only when the farmers own enough savings to use as a down-payment, regardless of bankruptcy costs. The shape of the indifference equations are specific to the modeling choice of financial imperfections as bankruptcy costs but the qualitative results are valid under more general specifications. In particular, since there are only two realizations of rain, there is only one level of second-best effort. If the rain distribution of rain was continuous, there will be a minimum level of debt $\underline{B}$, below which the agent will exert first-best effort; a maximum level of debt $\underline{B}$, above what the agent will not exert any effort; and the agent will exert intermediate levels of effort for intermediate levels of debt *B*.

3.3 Institutional Inertia

The model presented above shows that, even in a world with perfect contracting, a mutually beneficial arrangement will not be attained if there are commitment issues. These issues are generated by limited liability. In other words, the punishment that the *Heredamiento* can use against the farmer in case of default is limited. This problem vanishes if the farmer has enough wealth to use as collateral. Institutional Inertia, then, is a situation in which a more efficient distribution of water property rights cannot emerge due to lack of commitment from the potential winners, in this case the farmers. Since

Efficiency, when farmers have homogeneous productivity, requires the distribution of water property rights to be egalitarian.[13] Contractual problems may block a new, efficient distribution of water property rights. Moreover, since auctions can be run under any distribution of water property rights, the inverse transition (from *quotas* to *auctions*) could always have been achieved without delay. The Institutional Inertia is asymmetric.

Imagine a situation with several towns. Initially, in each town, both the allocation of water property rights and of the original institution (*quotas* or *auctions*) is established arbitrarily.

[12] When $D>200$ and $C<150$ an inefficient institutional change could happen. However, such a contract will give the principal the same expected payoff as the efficient contract but will give the agent a lower output.

[13] When farmers are heterogeneous in productivity, efficiency requires the expected marginal productivity to be equal among all farmers. Hence, more productive farmers will have greater quotas. In the years following the *Reconquista*, this was indeed the case in Murcia. There were up to seven different categories of land quality that were assigned different levels of water per land unit. The farmers also had to pay their share of maintenance cost proportional to water received, not to land owned. This practice disappeared from all towns during the 19th century, which suggests that changes in technology during that century made all the land of similar quality.

Quotas require the allocation of water property rights to be egalitarian. Farmers start with no wealth but can save some money over time. If *auctions* were more efficient than *quotas*, then the towns in which the original institution was *quotas* will immediately change to *auctions.*[14] In this case there is no Institutional Inertia. However, if quotas are more efficient than auctions, towns with auctions will not switch to quotas until farmers have saved enough to use as collateral.
There are several factors affecting the likelihood of a transition to a new institution:

- A change in *f(·)* can be interpreted as a change in output prices or a change in technology. However, the effect of a change in the production function on the likelihood of the institutional change is ambiguous. An increase in output prices will increase both the value of water for the Waterlords I and for the farmers V. We can see in Figure 3.B that, although prices were rising during the 1950s, by 1966 they were in a clear decline. The next section discusses whether a technological change could have affected the transition.
- A more equal distribution of water property rights implies that many farmers already own water property rights. Hence, the transition is more likely to happen. Fewer farmers face a holdup and there are more farmers who are members of the water cartel and would thus vote in favor of the change. This idea is not in the model which, for simplicity, focuses on homogeneous farmers. The section discusses whether the distribution of water property rights had an impact on the transition.
- The greater the savings of the farmer, the greater the amount available for collateral. With a larger down payment the probability that a transition happens is higher. We can see in Figure 4 that the deposits grew more than threefold during the 1950s and 1960s. I discuss in sub-section 5.2 the effect that the increase in savings had on the transition.
- In the analysis presented above, there is an implicit assumption that lenders earn zero profits in expectation. Greater bankruptcy costs and lender profits mean the transition is less likely. A more developed financial system and cheaper access to credit thus imply that the transition is more likely (see sub-section 5.3).

4 Old and New interpretations of the Empirical Evidence

In this section, first I present the main hypotheses about institutional diversity in the literature and show how they cannot account for the change in 1966. Then I address the empirical predictions made by the model. I show that institutional change cannot be attributed to changes in technology by looking at data from the auction, as well as other micro indicators: the distribution of water ownership, price of water and prices of the output. I show that, with the data available, we cannot predict a structural change in 1966.

The structure of power or ownership within the organization shows no particular trend during the years preceding the change. If the change happened due to an increase in the inefficiency gap, *i.e.*, the difference in output under both institutions, we would observe a decrease in the concentration of water ownership over time. However, as we can see in Figure 2, the structure is very stable during the decades preceding the change. Hence, either all farmers were identical and

[14] Indeed, there is evidence of institutional experimentation during the years immediately following the Christian invasion. The towns of Totana and Librilla –located down the Guadalentin River from Lorca– switched back and forth between quotas and auctions before the 15th century (see Rodríguez Llopis, 1998).

the situation for all of them changed in exactly the same way during the summer of 1966, or there were some externalities associated with the chosen institution or the transition implementation.

This evidence suggests a collective action solution, which is consistent with the idea that the risk of selling water rights is lower if it is mutualized across farmers than if done individually. The evidence is also consistent with some externalities produced by the crops chosen by the farmers. As explained above, the new institution would increase the number of trees farmers planted. Trees would then reduce the damage cause by flooding –by reducing erosion– while at the same time alleviating the incidence of severe droughts –by maintaining humidity through reduced transpiration.

A financial revolution occurred in Spain in the late 1950s and the early 1960s. As shown by the model in the previous section, a more efficient credit market makes an institutional change more likely. The increase in savings during the previous decade, and especially since 1957, had no precedent in the history of Spain (see Figure 4). According to the model, a sufficiently high amount of savings for use as collateral is a necessary condition for a change in institution to occur. The specific amount depends on the other parameters of the model.

4.1 Institutional Diversity

The traditional explanation for institutional differences between Mula and Lorca and the rest of the towns in the region have mainly focused on geographical differences, but those explanations cannot explain the evidence. In this sub-section I explore some of these explanations. I highlight whether or not arguments in each case are consistent with the data. Any explanation for the region's institutional diversity has to account for three main facts: (i) Origin: why did Mula and Lorca have auctions initially?; (ii) Persistence: why did the institutions in Mula and Lorca remain different than those in surrounding towns for centuries?; (iii) Change: why did Mula and Lorca switch from auctions to quotas during the 1960s? The goal of this section is to see whether the current explanations are consistent with these three facts.

According to the traditional hypothesis, towns with auctions were very dry, much more so than the rest of the region (Musso y Fontes, 1847; Lemeunier and Pérez Picazo, 1984). Anderson and Maass (1978) claimed, in line with the spirit of the NIE, that auctions were always more efficient than quotas but were more costly to manage. Hence, auctions were only used when water was very scarce and valuable with respect to the costs of running an auction.

Other studies, more in line with Acemoglu and Robinson (2008), mostly by historians such as González Castaño (1992), have claimed that auctions –or disjoint property rights to water and land– were just another means by which the local elite could exert their power over the peasantry. By controlling the water, the local *elite* could control the *non-elites*. Auctions were then an effective way to exert power only in places where water was very scarce.

The problem with this line of argumentation is its reliance on an incorrect fact. Mula and Lorca were not drier than the towns that had quotas. Moreover, the co-existence of quotas and auctions characterizes all provinces of Mediterranean Spain, from the humid region of Gerona on the border with France to the desserts of Almería and Murcia in the South (López Ortiz and

Melgarejo Moreno, 2005).[15] The argument for relative dryness takes two flavors: either towns with auctions are drier in the sense that they have lower average rain (or the same average but greater variance); or they are drier in the sense that the ratio between available water and irrigable land is lower. We can see in Table 1 that Mula and Lorca are neither especially dry, nor especially humid, with respect to other towns in Murcia.

Table 1 displays a comprehensive sample of towns in the region with irrigation communities (see Figure 5). The most reliable data source for Mula and Lorca comes from their dams and, as we can see, they are around the median. If the argument were correct we would expect towns like Ulea, Fortuna or Alguazas, all of which have quotas, to run auctions. Garrido (2011) has already presented this critique effectively. He points out that there is no correlation between weather or geography and water property rights between regions in Spain.

The second flavor of the relative dryness argument springs from the observation that towns with quotas have a larger amount of water available for irrigation per hectare than do towns with auctions. However, the causality is most likely reversed. When landowners had water property rights, as in the quota system, there was less of an incentive to expand the irrigable land, which meant that more water was available per irrigable acre, as Ruiz Funés (1916) suggested.[16] Moreover, as Garrido (2011) shows, the biggest increase in irrigable land that took place in all towns happened several centuries after the initial institution was put in place. The choice to have an auction or not cannot be a function of scarcity.

Between the 15th and the 19th century, irrigable land tripled both in towns which held auctions – Alicante and Lorca– and in Murcia where quotas were in use (Chacón Jiménez el al, 1979). This pattern suggests that the increase in irrigable land was due to improvement in irrigation technology. Hence, there is no evidence to support the claim that Mula and Lorca were intrinsically different than other towns around them during the 13th century. From the above arguments, one can feel confident that the dryness hypothesis is not true. Even if this hypothesis were true, it could only explain the initial choice of auctions and the persistence of difference. However, it cannot explain the institutional change in the 1960s unless it assumes that the weather dramatically changed in Mula and Lorca in the 1960s. It did not.

Rodríguez Llopis (1998) pointed out that the institutional configuration in place in each town in Murcia by the end of the Middle Ages was the outcome of the tensions between the Crown, the Castilian aristocracy, the regional nobility and the local elites during the 13th century.[17]

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[15] Although only Lorca and Mula were the only cities in Murcia that adopted auctions, there are other cities in all Mediterranean provinces that also adopted auctions. They are always a small minority in every province and the origin of the auctions in such places has not been explored in dept.

[16] If the owners of the water and the owners of the land are the same people, they will restrict the size of irrigable land in order to maximize the average or total output. If the owners of the water are not the owners of the land, they will increase the amount of irrigable land beyond the point that maximizes total output, in order to maximize revenue. They will increase the amount of the irrigable land until the point at which marginal output equals average output. See Gordon (1954) for details.

[17] This initial shock in institutions is similar to that in Chaney (2008).

Water rights were the ideal financial asset for any investor who did not want to reside in the city or work the land. Water rights paid a flow of dividends every year, needed little monitoring and, more importantly, produced a flow payoff negatively correlated with the weather cycle: returns are high during a drought and low during rainy years. Unlike with land rights, the moral hazard problems associated with water rights are comparatively minor because the good is homogeneous and can be easily transferred to another agent. Hence, absentee lords and convents seem like the ideal candidates to hold these water rights if the farmers cannot afford to buy them. The original owners of water rights were the Knights of the Order of Santiago and the Order of the Temple, both of which had participated in the sieges of Mula and Lorca, with the *Maester* (Head of the Order of the Temple) taking the lion's share (Rodríguez Llopis, 1998). During the modern age, and until the end of the auctions, the biggest shareholders in each town were the Nuns Convent –which received shares as donations from members of the nobility in the years after the *Reconquista* (711-1492)– in Lorca and the *Marquis of Los Vélez* in Mula.[18]

This hypothesis is useful in that it can reconcile institutional diversity and homogeneous geography and weather. However, it is incomplete and does not provide an answer for institutional persistence or the institutional switch in the 1960s. The model presented in section 3 combines with this theory to fully explain (i), (ii) and (iii).

4.2 New Institutional Economics

In the absence of a commitment problem, but the presence of transaction costs, NIE (North, 1973; Libecap, 1978) predicts that a new institution, with a more precise definition of property rights, will emerge when the price of the underlying asset is sufficiently high.[19] In the Mula water rights case, the institution transitioned from one with better defined property rights (auction) to one with more diffuse property rights (quota). Quotas imply a reduction in property rights on at least two dimensions. Trading of water rights is forbidden, hence ownership is not transferable. Selling water is also forbidden, hence water usage is restricted.

If the technology improves or the demand for the output increases, the total surplus will increase under both institutions. In other words, both the value of the water for the farmers under the quota and the value of the water for the Waterlords under the auction would increase. Thus, the sign of the change of the inefficiency gap after an increase in the demand of the output is ambiguous and depends on the shape of the production function.

As we can see in Figure 3. B, real output prices declined beginning in 1961. Prices increased in the early 1950s, peaked in 1961, and then decreased. Prices first increased, probably due to the increase in international demand, and then slowly decreased. The shock was transitory, not permanent. While this analysis implies that the long run value of the water did not change,

[18] As during much of the Spanish *Reconquista*, Christian populations were brought to the area with the goal of establishing a Christian base. Hence, the new Christian settlers in Mula started *tabula rasa* and created new institutions. Mula and Lorca were also frontier cities between a Christian kingdom and a Muslim kingdom, which, until the conquest of Granada in 1492, were in a constant state of war. Moreover, since the rule of these two cities was given to the ecclesiastical orders, it is not surprising that the institutions there differed from those in other towns.

[19] Or when the inefficiency gap becomes big enough. The inefficiency gap is the difference in total surplus under the new (more efficient) institution minus the total surplus under the old (less efficient) institution.

farmers' profits in the short run were high enough to provide the collateral needed to change the institution.

Figure 3. A also shows that the real price of water, equivalent to the marginal productivity of water, did not change much during the period considered here. More surprisingly, there is no clear price trend during the 19th century although there might be a slow upward trend at the beginning of the 20th century. In 1923, the construction of a new dam was announced. The dam was finished by 1930. The dam construction explains why prices peaked in 1930 and then dropped in 1931. Farmers, anticipating the increase in supply, increased their demand for water beginning in 1923. They planted more trees to increase their production capacity. The closer to the 1930 shift in supply, the greater the incentive to increase capacity, thus the peak. When the dam opened in 1931, the supply increased and, hence, the price plummeted. Price volatility during the 1930s and 1940s was due to the Spanish civil war (1936-1939), WWII and the post-war period together with the autarky of the dictatorship (1939-1950s). Prices rose dramatically beginning in 1952 under the Spanish government's new foreign policy of openness and export promotion. As with output prices, the rise in input prices also proved temporary. Over time, supply increased to adapt to the new international demand. By 1962, prices were already similar to historical standards and continued to fall throughout the 1960s. Although the demand shock was temporary, farmers in Mula used the opportunity to accumulate savings and capital for the first time in history.

5 Institutional Inertia

5.1 Ownership Distribution

One puzzling issue arises here. Why did each farmer not simply buy water rights and solve her own problem? According to the intuition and the model, buyers should not have waited until everyone had sufficient collateral. Richer farmers could afford to buy some water rights earlier than poorer farmers. Hence, the transition should have been gradual rather than sudden. However, as Figure 2 shows, this is not what happened. The proportion of owners with just one water rights share –an amount insufficient to irrigate the average plot in a universe of 832 shares and about 500 farmers– was constant across time at about 30%. Moreover, the data excludes some farmers who owned no water at all. The distribution of shares remained unchanged by number owned over time.

Several facts could help explain this puzzle. First, wealthier farmers can retain some cash and eliminate their liquidity issues without having to buy water rights. Second, some of the gains from quotas come from internalizing externalities. In addition to the externalities mentioned above, there might also be organizational improvements. Since farmers and water owners are now the same people, conflicts about improving channels and rules of rationing during extreme drought will be easier to solve. Moreover, and related to the third point, a sudden transition is easier because the lender –whether a Waterlord or a financial institution– can use the law of large numbers and eliminate the idiosyncratic risk associated with each farmer. By pooling all the claims into a single claim, the lender must still bear the aggregate risk, but not the idiosyncratic risk, plus any fixed costs that he needs to pay for each debt contract. This means that the risk premium the lender requires is lower. This pooling solution also eliminates the adverse-selection problem by mutualizing debt amongst all farmers. Hence, when externalities and idiosyncratic risk are important, the set of parameters in which the transition happens suddenly outweighs the set of parameters in which the transition happens slowly. Under these conditions we expect a rapid transition.

Third, and most important, farmers began collectively asking for a loan through the labor union *Sindicato de Regantes*. The purpose of a bank is to identify good investments and monitor the agent to ensure loan repayment. In this case, the *Sindicato* has better monitoring technology than either the Waterlords or a potential financial intermediary. The farmers, as members of this organization, are jointly responsible for the loan. Hence, the *Sindicato* can encourage each farmer to pay their share of the loan. Further, it can also prevent farmers from cheating by using both monetary and social sanctions. These facts do not explain why the change took place in 1966 and no earlier, but they do help us understand why the change was sudden rather than gradual.

5.2 Savings and Living Conditions

In Figure 4 A) we see that the evolution of real deposits followed an erratic path during the 19th century. Real deposits grew slowly until peaking during the crisis of 1898 and then declined until the 20th century inter-war period. During Primo de Rivera's dictatorship (1927-1930) deposits seemed to recover until the civil war (1936-1939). Deposits did not grow during or after the war, or during the autarky (1940s). Not until the 1950s did deposits grow again, this time more sharply and steadily.[20]

The graph makes clear that, however erratic and dependent on the macro-environment deposits were, the uniform growth beginning in the 1950s was unprecedented. Living conditions, in addition to the savings of the lower and middle classes, improved during the 1950s and reached a new standard by 1960. This growth was important for Murcia, where both measures initially lagged the national average before catching up by 1957 and then surpassing it. The growth of living conditions and savings, and the peak of real deposits in 1966, are all consistent with the model. In order to solve the commitment problems, farmers had to put up enough collateral to demonstrate a credible payback commitment.

The government offered to buy Mula water rights for 4.2 M *pesetas* in 1931. If we knew how many farmers shared the water we could know how much each farmer had to pay. According to the census data, 452 farmers cultivated Mula land in 1954. Between 1954 and 1966, 537 farmers bought water according to the auction data. This is an upper bound because some farmers could have sold their plot to another farmer or to their child; thus two different names would appear for the same plot's water.

By 1966 the average farmer had 12,000 *pesetas* deposited in a savings bank in Murcia (Figure 4 A).[21] The price of one unit of water could reach more than 4,000 *pesetas* during a drought (Table

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[20] The data available corresponds to the evolution of the average deposit in the region, not the individual deposits of the farmers in Mula. I am implicitly assuming that the evolution of the farmers' deposits follows the evolution of the average deposit. This is a reasonable assumption since these farmers fall within the target audience of depositors at public savings banks.

[21] It is also worth noticing that, in an economy with double-digit inflation, and one in which the daily wage of an unskilled worker was 50-100 *pesetas*, holding 12,000 *pesetas* in cash to bid in the auction during the following year meant high losses in forgone earnings.

2). However, the average price of one unit during a drought would be around 2,000 *pesetas* per unit. The average farmer with trees needs to irrigate several times every year and more frequently during a drought.[22] A back-of-the-envelope calculation suggests that the average farmer would expend 8,000-10,000 *pesetas* buying water in a dry year. Hence, the average farmer in 1966 would be able to buy water for her plot during a drought. However, many farmers with below-average savings would not be able to do so.[23] These farmers might have enough savings to obtain a long-term loan to purchase water property rights –arguably at government subsidized rates– but would be unable to buy the water needed for a single dry year using out-of-pocket cash. In other words, farmers were solvent, but still illiquid, in 1966.

5.3 The Financial Revolution 1957-1962

The last empirical prediction of the model is that more efficient financial markets would help to solve the commitment problem that the Waterlords and the farmers faced. During the 1950s and 1960s, the government's goals were to increase exports, expand the industrial sector, modernize agriculture and provide cheap credit to small businesses and households (Comín 2005 and 2007). The main instrument used for these purposes were the *Cajas de Ahorros* (Public Savings Banks). Crucially, the Public Savings Banks only functioned as financial institutions, rather than charities, when the Ministry of Finance replaced the Ministry of Labor as regulator in 1957 (Comín, 2007).

In 1962, the Bank of Spain was nationalized and new banking regulations were passed in Spain. This new legislation changed the role that Savings Banks played in the financial sector and increased the importance of the ICCA, a national agency which coordinated macro-decisions of the local Saving Banks. The new law also fostered banking specialization, alongside long and medium term stability.

The economic growth that followed Spain's openness to international trade, mostly with western Europe and the US, together with easier access to credit and a more efficient financial sector, reinforced each other in a virtuous circle. Economic growth in the 1960s enabled the Savings Banks to expand their operations due to growing deposits. Further, these banks diversified deposits through new regulations set forth in the Development Plans in 1964.

Figure 4 B) shows how both the size (left) and the amount (right) of rural loans began to increase at an exponential rate in 1951. However, the change in the institution did not occur in 1951, or at any time during the 1950s. It is worth noticing that while the number and size of loans grew exponentially, the number and size of deferred loans remained negligible. This suggests that farmers were usually able to repay the loans, despite the exponential growth.

The rise in prices from extra profits was temporary, and hence, the system's long-run inefficiency was unaltered. However, every year of high prices provided some extra profits, which farmers decided to save. By 1966, although prices had been falling for several years and had reached normal levels, farmers had accumulated enough savings to use as collateral for the purchase of

[22] During a drought only farmers with trees will irrigate, given their higher value for the water. In humid years, farmers with water intensive non-tree crops such as potatoes or tomatoes will also buy the cheaper water to irrigate their crops.

[23] There is no disaggregated data for individual deposits.

water rights. Further, these farmers were able to secure a loan from a Public Savings Bank, a loan a private bank would have denied.

6 Discussion

The inertia produced by the lack of commitment is asymmetric: a system can move from quotas to auctions at any time but requires a specific distribution of water property rights to switch from auctions to quotas. This feature of the institutional inertia model is not intrinsic to auctions. Rather, the model's construction requires one of the institutions to operate under a specific distribution of property rights. In this section I show how the model is applicable to other situations in which land or labor is the scarce resource. Thus, the holdup problem also concerns these other production factors.

Land Reform

While water ownership is not an important issue in some places, the Mula case is very similar to episodes of land redistribution all over the world, especially in Latin America (*e.g.*, 20th century Mexico) and Eastern Europe (*e.g.*, 19th century Russia). In these cases, there was consensus that land would be more productive in farmers' hands but landlords remained unwilling to turn over the land for free. The typical solution to this problem has been a government intervention, whether through guaranteed loans, expropriation without compensation, or something in between.

In the context of the model proposed here, each solution would have different effects. If farmers had to pay back all or most of the value of the land, the holdup problem implies they would not put in enough effort, would not produce enough output and would end up defaulting. This was the case after the Russian abolition of serfdom, as documented by Nafziger (2014). The only way to prevent such a default was to give the land to the farmers for free, or to sell it at a highly subsidized rate. Thus, either landowners' would receive nothing for their land, or would be compensated from taxes on the non-agricultural sectors of the economy. Neither option was politically viable in Russia, or in many other places. It is interesting that in this case the former serfs obtained property rights to their labor for free –their former masters were deprived of that labor without compensation– but were denied property rights to the land they cultivated.

Indenture

Galenson (1984) discussed the case of indenture contracts in America.[24] Indenture was introduced in the 17th century primarily because workers did not have enough money to pay for their trip to America. The main consequences of indenture were workers' lack of effort and poaching by other employers. The intuition is the same as in the water rights case presented here. The employer (principal) needed to hire laborers to work on a plantation. The worker (agent) would have liked to travel to the plantation but did not have enough money. In a world with perfect contracting, or one in which the worker had sufficient funds to pay for the trip, the worker would cover the cost of her own trip and, once on the plantation, agree to the first-best contract. However, the worker could not commit *ex-ante* to not run away from the employer,

[24] See Gupta and Swamy (2014) on the introduction of indenture in India.

renege on her debt for the trip's cost, or find a higher wage with another employer. Hence, the employer proposed indenture, a second-best contract. This contract did not necessarily elicit effort from the worker. Subject to high personal costs associated with lack of freedom and physical punishment, the worker only wanted to finish her term and negotiate a better contract.

Slavery and Manumission

Fenoaltea (1984), citing Moes (1960), argued that “slavery would disappear not because it was unprofitable, but because it was even more profitable to allow the slave to buy himself back,” that is, if the slave had the money. Following the same line of argument as in the indenture case above, slavery existed not because it was optimal but because the slave could not initially buy his freedom since he could not commit to pay the value of his work to the master in the future. Fenoaltea noted the Roman custom of manumission, in which the slave purchased himself from his master after a long period of good service. Again, had the slave had the money to buy his freedom, he would have done so as soon as possible. The only explanation for the delay in manumission is the slave's inability to commit to pay. The slave would “outbid anyone else because he had a sentimental attachment to his person” (Moes, 1960).

7 Conclusions

This paper explains a puzzling transition in irrigation communities in Spain, when some towns which had allocated river water through auctions switched to quotas in the 1960s. This transition is puzzling for two reasons. First, the transition happened in the absence of political instability or important technological changes. Second, unlike most institutional changes over the last two centuries, the allocation mechanism switched from a market institution (auctions) to a non-market institution (quotas).

The rebellion of the local governors in some tows meant that they established auctions in the 13th century. Due to this historical accident they had different institutions than the rest of the towns in the area for over 700 years. The transition was not motivated by a change in decision power over water rights or by a change in payoffs. Rather, what changed was farmers' ability to credibly commit to pay the value of their water rights to property owners. Following a temporary boom in the region's agricultural exports, and national public policy focused on easing small exporters' access to credit, farmers were able to accumulate savings for the first time in centuries. They used these savings as upfront payment (collateral) to buy water rights from the Waterlords. The transition from auctions to quotas was delayed for centuries because, had farmers purchased the water rights any earlier, they would have been unable to pay for them.

Table 1: Rain in several towns in the region.

Town	Sample Period	Average	Standard Deviation
Ulea	1961-1966	150	201
Lorca, C. H. S.	**1933-2007**	**212**	**276**
Fortuna	1952-2010	228	286
Alguazas	1933-1981	234	300
Murcia, C. H. S.	1933-2007	236	297
Jumilla	1912-1930	242	259
Lorca, Castle	**1948-1978**	**243**	**360**
Librilla, C.H.S.	1934-2010	260	350
Yecla	1935-2010	261	289
Mula, *De La Cierva* Dam	**1933-2010**	**262**	**362**
Lorca, *Valdeinfierno* Dam	**1933-2010**	**268**	**338**
Totana	1913-2010	269	344
Mula, C. H. S.	**1953-1978**	**274**	**343**
Murcia, Institute	1863-1955	275	344
Blanca	1945-2008	278	331
Ricote	1944-2010	290	353
Pliego	1954-2010	306	394
Moratalla	1933-2010	308	356

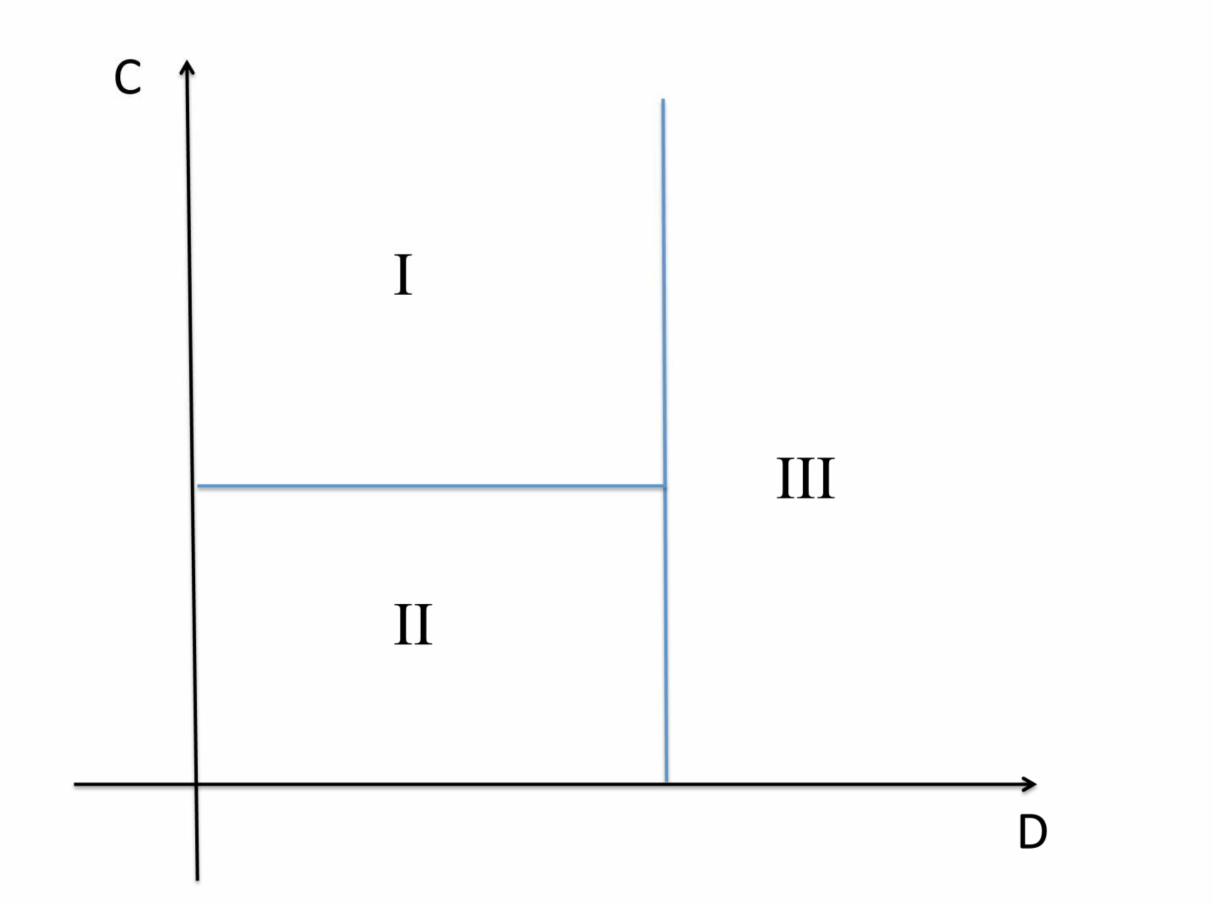
Source: Computed from data from the AEMET. Sorted by average rainfall. Monthly rainfall data measured in millimeters (*mm*). C. H. S. refer to measures by the *Confederación Hidrográfica del Segura,* a public regulatory agency. Towns in bold letters (Mula and Lorca) had auctions while all the other towns had quotas.

Table 2: Summary Statistics of Selected Variables.

Variable	Mean	SD	Min	Max	Obs
Rain (*mm*)	8.53	46.33	.00	980.00	3,834
Price (*pesetas*)	271.61	374	.05	4,830	13,872
Land Extension (*ha*)	5.54	32.24	.25	900	819
Output Price (*pesetas*/*kg*)	15.07	222.52	.02	5,700	964
Kg sold	5,569.70	10,003.76	0	110,000	1,000
#Trees	161.49	493.45	1	12,300	946

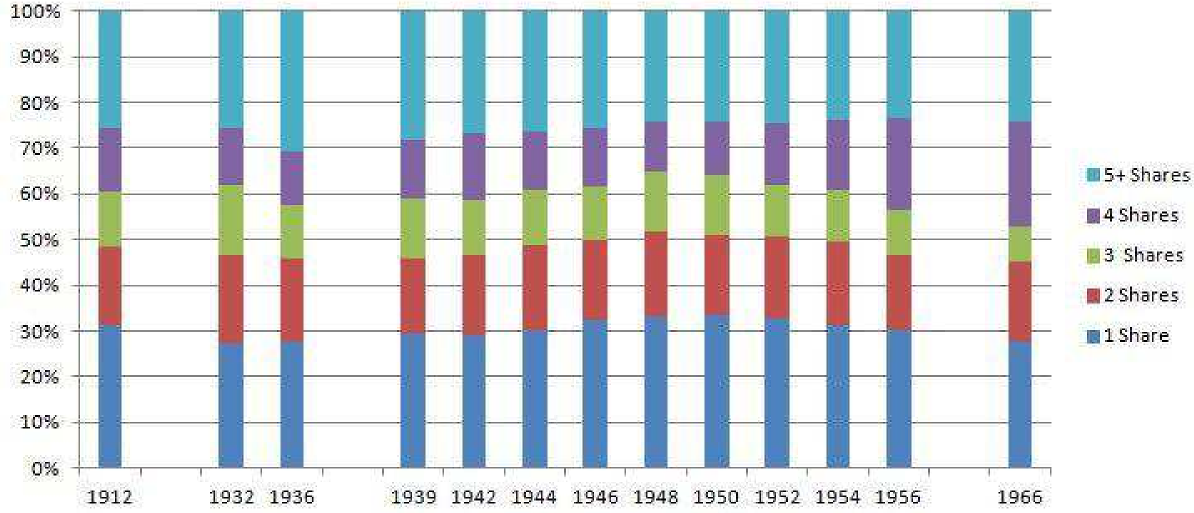
Source: Computed from the data from the Municipal Archive in Mula, section *Heredamiento de Aguas*.

Figure 1: Possible Equilibria.



Possible Equilibria: I) No Institutional Change; II) Inefficient Institutional Change; III) Efficient Institutional Change.

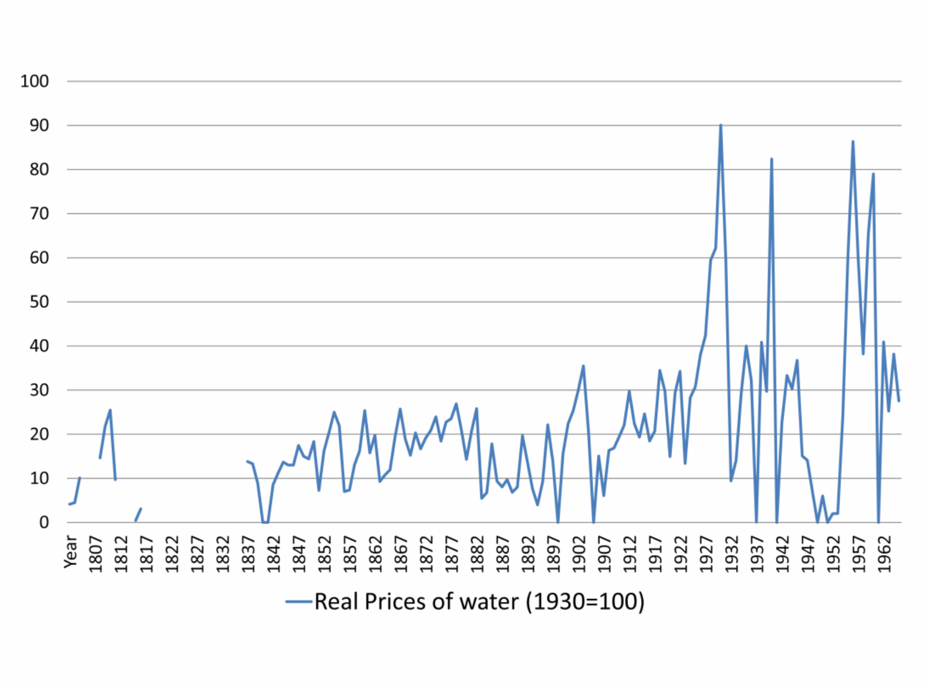
Figure 2: Composition of water owners by holdings during the 20th century.



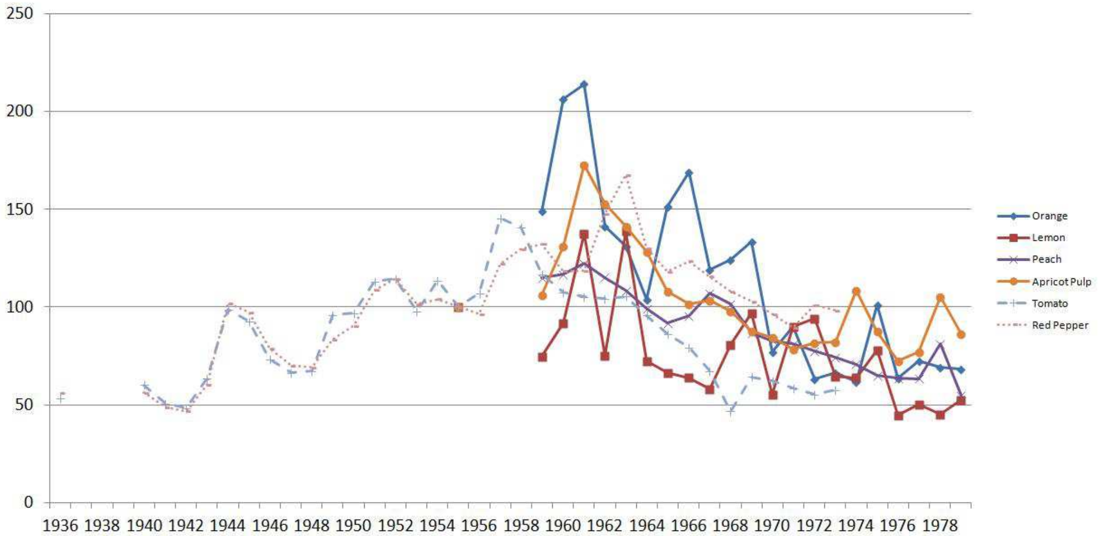
Source: Computed from the data from the Municipal Archive in Mula, *Heredamiento de Aguas*. Some years are missing.

Figure 3: Prices.

A) Real Prices of water (1803-1966), *Pesetas*.



B) Real Prices of Agricultural Products, *Pesetas/kg* (1955=100).

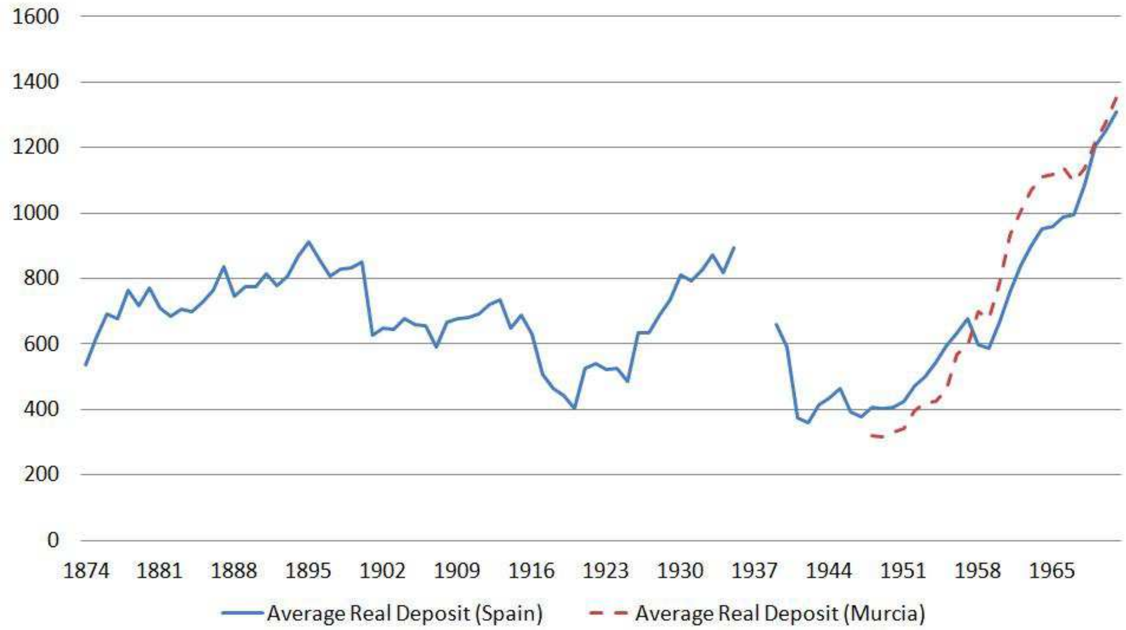


Source: A) Computed from the data from the Municipal Archive in Mula, section *Heredamiento de Aguas*. Some years are missing. Real prices computed using the price index series proposed by Sardá (1998) (Base 1930).

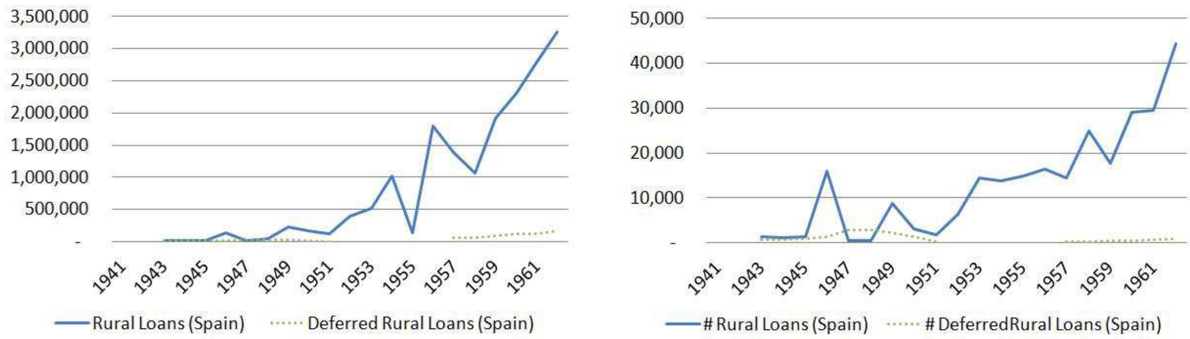
B) Computed from data from INE (*Fondo documental del Instituto Nacional de Estadística*). Price Index for the most common agricultural products harvested in Mula (Base 1955).

Figure 4: Deposits and loans Rural Banks.

A) Average Real Deposits in Rural Banks in Murcia and Spain.



B) Evolution of Rural Loans and Deferred rural Loans in Spain.



Source: Computed from INE (*Fondo documental del Instituto Nacional de Estadística*). Data for Deferred Rural Loans for the years 1952-1956 is missing. A): Average real value of deposits in *pesetas* (Base 1930). B) *Left*: Nominal value of loans in 1,000 *pesetas* for Spain. *Right*: Number of loans in Spain.

References

1 Acemoglu, D. and Robinson, J. A., 2008, “Persistence of Power, Elites, and Institutions,” *American Economic Review*, Vol. 98, No. 1, pp. 267-293.

2 Alston, L. J., Eggertsson, T. and North, D. C., 1996, *Empirical Studies in Institutional Change*. Cambridge University Press.

3 Anderson, R. L. and Maass, A., 1978, *... and the Desert Shall Rejoice: Conflict, Growth, and Justice in Arid Environments*. The MIT Press.

4 Aymard, M., 1864, *Irrigations du midi de l’Espagne.* Eugéne Lacroix.

5 Ballesteros, E. and Reher, D. S., 1993, “Precios y Salarios en Castilla la Nueva: la Construcción de un Índice de Salarios Reales: 1501-1991,” *Revista de Historia Económica*, Año XI, No. 1, pp. 101-154.

6 Banerjee, A. and Iyer, L., 2005, “History, Institutions, and Economic Performance: The Legacy of Colonial Land Tenure Systems in India,” *American Economic Review*, Vol. 95, No. 4, pp. 1190-1213.

7 Brunhes, J., 1902, *L'irrigation dans la Péninsule Ibérique et dans l'Afrique du Nord.* Paris: C. Naud.

8 Calatayud, S. and Garrido, S., 2011, “The price of improvements: agrarian contracts and agrarian development in nineteenth-century eastern Spain,” *The Economic History Review*, Vol. 64, No. 2, pp. 598–620.

9 Chaney, E. J., 2008, “Ethnic Cleansing and the Persistence of Extractive Institutions: Evidence from the Expulsion of the Moriscos," working paper.

10 Coase, R., 1937, “The Nature of the Firm,” *Economica*, Vol. 4, pp. 386-405.

11 Comín, F., 2005, “El nuevo papel de la CECA y las Cajas ante las mayores exigencias de financiación del Estado (1957-1963),” *Papeles de Economía Española*, 105/106, pp. 27-47.

12 Comín, F., 2007, “Spanish Saving Banks and the competitive cooperation model (1928-2002),” *Revista de Historia Economica. Journal of Iberian and Latin American Economic History*, pp. 199-229.

13 Díaz Cassou, P., 1889, *La Huerta de Murcia: Ordenanzas y Costumbres*, Establecimiento Tipografico de Fortanet.

14 Dell, M., 2010, “The Persistent Effects of Peru’s Mining Mita,” *Econometrica*, Vol. 78, No. 6, pp. 1863–1903.

15 Donna, J. and Espín-Sánchez, J. A., 2015, “The Illiquidity of Water Markets,” Job Market Paper.

16 Donna, J. and Espín-Sánchez, J. A., 2015, “Let the punishment fit the criminal,” working paper.

17 Ellickson, R., 1991, *Order without Law: How Neighbors Settle Disputes.* Harvard University Press.

18 Fenoaltea, S., 1984, “Slavery and Supervision in Comparative Perspective: A Model,” *The Journal of Economic History*, Vol. 44, No. 3, pp. 635-668.

19 Gale, D. and Hellwig, M., 1985, “Incentive-Compatible Debt Contracts: The One-Period Problem,” *Review of Economic Studies*, Vol. 52, No. 2, pp. 647-663.

20 Galenson, D. W., 1984, “The Rise and Fall of Indentured Servitude in the Americas: An Economic Analysis,” *The Journal of Economic History*, Vol. 44, No. 1, pp. 1-26.

21 Garrido, S., 2011, “Governing scarcity. Water Markets, Equity and Efficiency in pre-1950s Eastern Spain,” *International Journal of the Commons*, Vol. 5, No. 2, pp. 513-534.

22 Glick, T., 1967, *Irrigation and Society in Medieval Valencia.* Harvard University Press.

23 González Castaño, J., 1992, *Una villa del Reino de Murcia en la Edad Moderna (Mula 1500-1648).* Real Academia Alfonso X el Sabio.
24 Gordon, H. S., 1954, "Theory of a Common-Property Resource: The Fishery," *Journal of Political Economy*, Vol. 62, No., 2, pp. 124-142.
25 Guiso, L., Sapienza, P. and Zingales, L., 2008. "Long Term Persistence," NBER Working Papers 14278, National Bureau of Economic Research, Inc.
26 Greif, A., 2006, *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade.* Cambridge University Press.
27 Hoffman, P. T., 1996, *Growth in a Traditional Society: The French Countryside 1450-1815.* Princeton University Press.
28 Jha, S., 2012, "Trade, Institutions and Ethnic Tolerance: Evidence from South Asia," working paper.
29 Lemeunier, G. and Pérez Picazo, M. T., 1984, *El proceso de modernizacion de la región murciana (siglos XVI–XIX).* Biblioteca Básica Murciana, Extra núm. 1, Murcia, Editora Regional Murciana.
30 Libecap, G. D., 1978, "Economic Variables and the Development of the Law: The Case of Western Mineral Rights," *Journal of Economic History*, Vol. 38, No. 2, pp. 338-362.
31 López Ortiz, M. I. and Melgarejo Moreno, J., 2005, "¿Es eficiente un mercado del agua? Algunas reflexiones a la luz de la historia de España," at Melgarejo Moreno, J. and Molina Giménez, A., *Los Mercados del Agua. Análisis jurídicos y económicos de los contratos de cesión y bancos de agua*. Thomson Civitas.
32 Menard, C. and Shirley, M. M., 2005, *Handbook of New Institutional Economics*, Springer.
33 Moes, J. E., 1960, "The Economics of Slavery in the Ante Bellum South: Another Comment," *Journal of Political Economy*, Vol. 68, No. 2, pp. 183-187.
34 Morilla Critz, J., Olmstead, A. L. and Rhode, P. W., 1999, "'Horn of Plenty': The Globalization of Mediterranean Horticulture and the Economic Development of Southern Europe, 1880-1930," *The Journal of Economic History*, Vol. 59, No. 2, pp. 316-252.
35 Nafziger, S., 2014, "Understanding the Process of Russian Serf Emancipation," working paper.
36 North, D. C., 1990, *Institutions, Institutional Change and Economic Performance.* Cambridge University Press.
37 North, D. C. and Thomas, R. P., 1973, *The Rise of the Western World.* Cambridge University Press.
38 Ostrom, E., 1990, *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge University Press.
39 Ostrom, E., 2005, *Understanding Institutional Diversity.* Princeton University Press.
40 Passa (de), J. J., 1844, *Canales de Riego de Cataluña y Reino de Valencia, Leyes y Costumbres que los rigen: Reglamentos y Ordenanzas de sus principales acequias.* Translation into Spanish by Juan Fiol. Sociedad Economica de amigos del País, Valencia.
41 Posner, E. A., 2000, *Law and Social Norms.* Harvard University Press.
42 Rodríguez Llopis, M., 1998, *Historia de la Region de Murcia.* Editora Regional de Murcia, Monografías Regionales.
43 Rosenthal, J., 1990, "The Development of Irrigation in Provence, 1700-1860: The French Revolution and Economic Growth", *The Journal of Economic History*, Vol. 50, No. 3, pp. 615-638.
44 Ruiz Funés G., M., 1916, *Derecho Consuetudinario y Economia Popular de la Provincia de Murcia.* Establecimiento Tipografico de Jaime Rates, Madrid.

45 Sardá, J., 1998, *La politica Monetaria y las fluctuaciones de la economia española en el siglo XIX*. Ed. Alta Fulla.
46 Schotter, A., 1981, *The economic theory of social institutions*. Cambridge University Press.
47 Stiglitz, J., 1974, “Incentives and Risk Sharing in Sharecropping,” *The Review of Economic Studies*, Vol. 41, No. 2 , pp. 219-255.
48 Stiglitz, J. and Weiss, A., 1981, “Credit Rationing in Markets with Imperfect Information,” *American Economic Review*, Vol. 71, No. 3, pp. 393-410.
49 Townsend, R. M., 1979, “Optimal Contracts and Competitive Markets with Costly State Verification,” *Journal of Economic Theory*, Vol. 21, N. 2, pp. 265-293.
50 Voigtländer, N. and Voth, J., 2012, “Persecution Perpetuated: The Medieval Origins of Anti-Semitic Violence in Nazi Germany,” *Quarterly Journal of Economics*, Vol. 127, No. 3, pp. 1339-1392.

A Data Appendix

Although the process of allocating water in the region has varied slightly over the years, the basic structure has remained essentially unchanged in each town since the 13th century. Land in Murcia is divided into *regadío* (irrigated land) and *secano* (dry land). Irrigation is only permitted in the former. *Regadío* lands are fertile and close to the river, facilitating an efficient use of the region's scarce water. A channel system allows water from the river to reach all *regadío* lands. Since it is forbidden to irrigate lands categorized as *secano*, only the farmers that own a piece of *regadío* land in Murcia are allowed to buy water.

Agricultural Census and Economic data

I use data from different sources for the analysis. Most of the economic data comes from INE (*Instituto Nacional de Estadística*). The data includes prices of agricultural products. Production quantities and area cultivated are available by product at a national and at regional level. I also collect financial data about deposits in public savings banks (*Cajas de Ahorros*) and rural loans provided by the government. I use the price index computed by Ballesteros and Reher (1993) because it covers the whole period considered here (1803-1991). The Ballesteros and Reher index tracks the more volatile Sardá (1998) index of the 19th century.

I augment the data with individual characteristics of the farmers' land, which I obtain from the 1954/55 agricultural census. This census was conducted by the Spanish government to enumerate all cultivating soil, producing crops and agricultural assets available in the country. Here, farmers are potential bidders and their names are matched with the names in the auction data. Individual characteristics of the farmers' land include land type and location, area, number of trees, production and the price at which the product was sold in the census year. It can be seen in Table 2 that *Land Extension*, *Number of Trees* and *Kg sold* vary considerably across farmers.

Auction Data

Auction data is from the historical archive of Mula.[25] Figure 6 shows the oldest auction sheet in the sample, corresponding to May 8th, 1803. The sample for this study includes more than 150 years of auction data spanning from 1803 until August 1st, 1966 when the allocation system was modified from auctions to quotas. Every week, 40 units were sold. Each unit corresponded to three hours of irrigation. No auction was run when the Dam was dry.

Water Ownership data

I collected available water shares ownership records from the historical archive of Mula for 1912-1966. Each record book contains the name of each owner and the number of shares (*cuartas*) she owned. The total number of shares is 832.

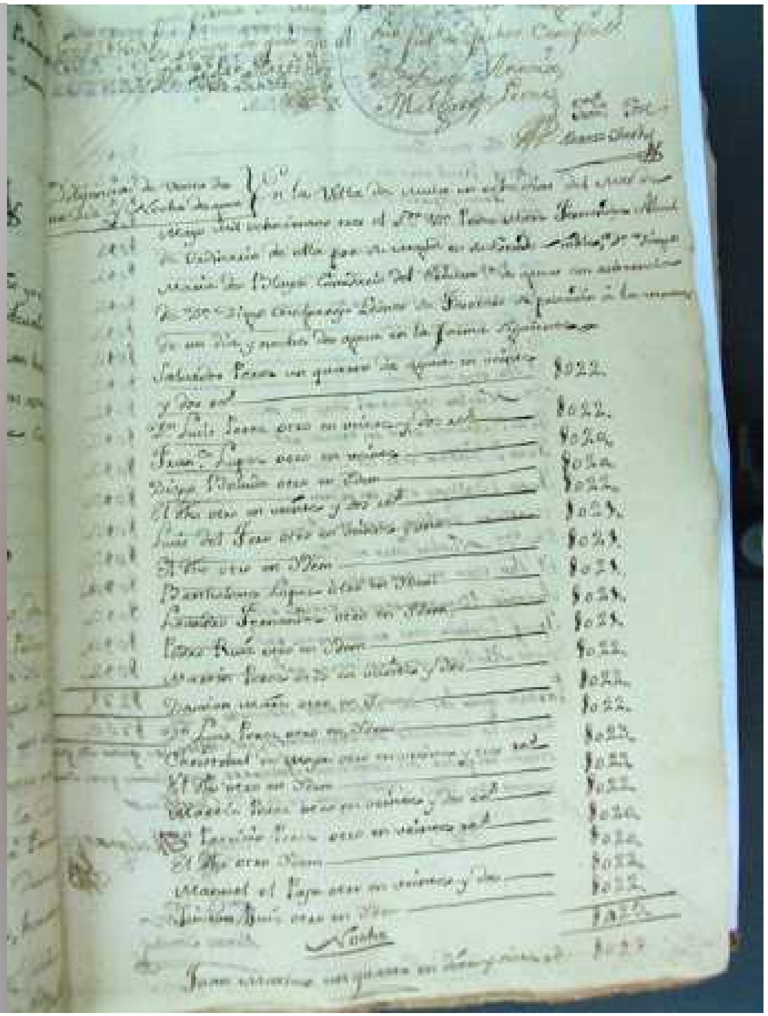
[25] From the section *Heredamiento de Aguas*, boxes No.: HA 167, HA 168, HA 169 and HA 170.

Rainfall data

The auctions data is complemented with daily rainfall data for Mula (1933-1992) from the *Agencia Estatal de Metereología*, AEMET (Spanish National Meteorological Agency). Rainfall in Murcia occurs mainly in spring and autumn. Products grown in the region most require water between April and August. During this cultivation period, when the quality of citrus fruits is more sensitive to water deficits, more frequent irrigation is advisable. Although annual average rainfall is 320 *mm*, most years are dryer than this average: the rainfall frequency distribution is skewed. Torrential rains are uncommon; when they do occur precipitation is high.

Figure 5: Map of Murcia and Towns.

Figure 6: Original Documents.



— 10 —

Cuadro de precios de los diferentes cuartos de agua

		Valor (Pesetas)	%	Preferencia (Pesetas)	Valor con Preferencia (Pesetas)	Total general (Pesetas)
De las cuatro						
Hilas de arriba	7	19,023	14	2,800	21,823	152,761
Treses » »	2	14,267	12	1,800	16,06725	32,13450
Doses » »	13	9,51150	10	1,000	10,51150	136,64950
Unos » »	4				4,75575	19,023
Doses de abajo	10	9,51150	14	400	9,91150	99,115
Unos » »	76				4,75575	361,437
De las cinco						
Hilas de arriba	27	19,023	14	2,800	21,823	589,221
Treses » »	5	14,26725	12	1,800	16,06725	80,33625
Doses » »	35	9,51150	10	1,000	10,51150	378,17250
Unos » »	23				4,75575	109,38225
Hilas de abajo	1	19,023	8	1,600	20,623	20,623
Doses » »	35	9,51150	4	400	9,91150	346,90250
Unos » »	310				4,75575	1,474,28250
De las Seis. - 1.º Sa. María						
Hilas de arriba	2	15,73612	14	2,33332	18,06934	36,13888
Treses » »	1	11,80209	12	1,49999	13,30208	13,30208
Doses » »	2	7,86806	10	83333	8,70139	17,40278
Unos » »	1				3,93403	3,93403
Doses de abajo	10	7,86806	4	33333	8,20139	82,01390
Unos » »	4				3,93403	15,73612
Unos » »	8				3,93403	31,47224
						4,200,00003

Left: Offer made by the government for the full ownership of the water, page 10.
Right: Oldest auction in the sample: “In the city of Mula the 8th of May of 1803, D. Pedro Martínez Fernández, Mayor of the city, [...], D. Diego María de Blaya, Commissioner of the *Heredamiento de Aguas*, D. Diego Melgarejo Leones, Treasurer, the sale of one day and one night of water began, with the following result.”