

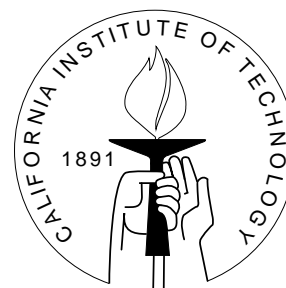
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EMERGENCE OF ENDOGENOUS LEGAL INSTITUTIONS: THE RURAL CHARTERS IN NORTHERN ITALY

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Abstract

Common-pool resources create a well known social dilemma, and to solve the problem the recent literature in economics has focused on how repeated interaction can promote informal cooperation without the need for formal legal or political institutions. This paper examines a particular example of a common resource: common property in alpine communities of Northern Italy between the 13th and the 19th century. There, rather than relying on repeated interaction alone, users created formal mechanisms that regulated behavior and access to the common property via quotas and time restrictions. Because the formal institutions existed side by side with the sort of repeated interaction that would breed informal cooperation, there was a paradoxical redundancy of institutions.

On one hand, formal regulations were probably the best way to limit the overuse of the commons. We consider the tradeoff between developing formal regulations versus relying on informal cooperation. Under certain conditions, the cost of building formal institutions is repaid by a large gain in efficiency.

On the other hand, the users themselves had to create and administer the formal institutions, and since the benefits of formal regulations are a public good, each individual has an incentive to free ride. The collective action problem of providing regulatory services was surmounted thanks to the repeated interaction among users. The paradox is thus resolved.

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1. INTRODUCTION*

In this paper we are concerned with the use of a common-pool resource, which constitute an instance of social dilemma. Individual decisions to use the common resource lead to a sub-optimal outcome that is often called tragedy of the commons (Gordon, 1954; Hardin, 1968). In this situation economists have typically suggested two classes of solutions. One class is the intervention of a political authority, such as in the case of the Enclosure Acts in Britain or regulatory authorities. Another class of solutions relies on the results from the repeated game literature for the emergence of spontaneous cooperation among the users. In this paper we investigate a third class of solutions, self-governance, where a group of agents establishes a set of legal rules for their members and an organization to implement those rules.

Empirically there are many instances of self-governance. Ostrom (1990) and Bromley (1992) have reported of several instances of self-government of commons all around the world, from farmers in the Andes, to fishermen in Turkey, to villages in Modern Age Japan. Netting (1981) and Stevenson (1991) have carried on studies on Swiss peasants. Casari (1998) describes the communal forest and grazing land of the Trentino region in the Italian Alps. In all these cases there were formal regulations but no external authority chose the rules or was responsible for the enforcement of those rules.

We investigate under which set of conditions would self-governance emerge as possible solution to a social dilemma. We assume that the central state was too weak or too costly to call into play. Several questions arise. Can repeated interaction among agents overrule short-term temptations to free ride so that no regulations at all would be necessary? If not, can the group

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modify the conditions in a way to support such informal cooperation? Can self-governance be a better solution? What are the relations between the informal relationship of people in the group and the formal aspects of institutions (Greif, 1998a)? What incentives do agents have to provide the necessary institutions for self-governance?

We examine these questions looking at the centuries-old organization of the management of common forests and pastures in the communities of the Trentino, in Northern Italy (Figure 1). The commons were managed by the communities through self-governing institutions that were coded in formal documents called *Carte di Regola*, or rural Charters. The rural Charters emerged in the Principality of Trento as a legal innovation in the 13th century and thrived for about six centuries. A Charter was a legal agreement among the members of the community, on one hand, and between the community and the ruler, on the other, that allowed the community to establish and enforce local economic regulations.¹

< Figure 1 about here >

This paper presents a game theoretical and property rights examination of this pre-modern institutional framework. While this contribution is about the management of communal resources other studies have applied similar arguments to institutions facilitating private enforcement of rules (Hay and Shleifer, 1998) and trade (Greif, 1998b, Clay, 1997, Greif, Milgrom, and Weingast, 1994). In particular, Milgrom, North and Weingast (1990) explains how the merchant codes governing medieval commercial transactions in Europe promoted the trust necessary for efficient exchange when the individual traders had short-run temptations to cheat. Honest trade was promoted through a system of private judges that kept a centralized record of the reputation of individual merchants.

Similarly, Greif (1993) describes an institution that surmounted a commitment problem intrinsic in the relations between Maghribis merchants operating in the Muslim Mediterranean area and their oversee agents in 11th century trading contracts. The agency problem between merchants and agents was overcome through the use of coalitions: they were groups of traders whose member merchants were expected to hire only member agents and were cheating agents were subjected to the punishment of all member merchants in the coalition.

As the authors point out, the key to understand those pre-modern trading institutions is the theory of repeated games with imperfect monitoring. Provided that a continuing relationship

is established and that agents can monitor each other to some degree, informal cooperation can emerge without state enforcement of contracts (Rubinstein, 1979; Green and Porter, 1984; Fudenberg and Maskin, 1986; Kandori, 1992a; Fudenberg, Levin, and Maskin, 1994).

In general, cooperation is less than full, and more accurate monitoring results in a higher level of cooperation (Abreu, Pearce and Stacchetti, 1986, 1990; Kandori, 1992b). The focus of Milgrom, North and Weingast (1990) is on such monitoring institution, which takes the form of a third party – the judge - that collects and verifies information and then shares it with anyone needing it. The traders have an incentive to be honest because suspected cheaters are punished through a temporary ostracism from the community in the form of refusal to trade.

In contrast, Greif (1993) illustrates how the Maghribis merchants punished dishonest overseas agents using informal mechanisms.

The present study applies the theory of repeated games with imperfect monitoring as well and improves upon previous studies by taking up on three issues that have not yet been extensively examined. First, we are dealing not with long-distance trade but with land use, where the possibility of trespassing can undermine spontaneous cooperation. The problem with trespassing is that if outsiders could easily enter the common resource, then they can reap the benefits of villagers' own cooperation efforts. The villages of Romeno, Don, and Amblar provide a colorful reminder of the importance of this matter. The peasants of the three villages owned in common a side valley mainly covered by forest. The valley was delimited on three sides by steep mountains and in the only side where the access was feasible, the entrance was so narrow that villagers built a gate on it and provided the gate with a lock. As the 1459 Charter states, the only key was kept in the church of the village of Romeno. In this way the community governor could have easily controlled everybody who went into the valley to log trees.² In other, less fortunate cases, the enforcement of property rights toward outsiders absorbed significant resources. The rural Charters reduced substantially the transaction costs of enforcing property rights.³

Secondly, because migration undermined the nature of the continuing relationship within each village, institutions that promoted cooperation had to be robust to this additional threat. The issue of the incentives to maintain a long-term relationship will be extensively analyzed because of their crucial role in informal cooperation. Contrary to a common belief (Andreatta and Pace, 1981), the prohibition to trade communal land was not essential to ensure a long-term relationship among villagers. The Trentino communities could, and sometimes did, sell the commons. Instead, what guaranteed a long-term interaction was an elaborate form of village

citizenship that discriminated between insiders and outsiders and granted selected rights to the insiders. A key feature was the cost associated with the choice to leave the village.

The third issue concerning the situation of the Northern Italian communities is actually a paradox. By establishing village citizenship rules, protecting property rights against outsiders, and by gathering information on users' actions, the communities created just the conditions needed to sustain informal cooperation among the users of the commons. Yet, instead of relying on informal cooperation they used formal regulations, which is a surprising paradox. Interestingly, most of the formal regulations concern the actions of insiders. Consider, for example, what happened in the community of Mezzolombardo. On July 18, 1589 the governor (*Giurato*) of the village recorded that a gentleman named Michel had been caught while illegally collecting firewood on common land. As a result he had to pay a fine for like other neighboring communities, Mezzolombardo regulated villagers' use the community forests, pastures, and wastelands by restricting time and place of access or imposing quantity restrictions.⁴ Mezzolombardo was hardly alone in enforcing these regulations via fines. Indeed, hundreds of other communities in the Trentino region of the Italian Alps did the same, as did villages throughout Europe.⁵

The questions are then, on one side, why wasn't informal cooperation sustainable or effective? On the other side, as informal cooperation was not the way the resource was managed, why was the community concerned about a long-term relationship among the users?

Here we define institutions as “non-technologically determined constraints that influence social interaction and provide incentives to maintain regularities in behavior” (Greif, 1998). In particular, **formal institutions** are defined as *legal constraints that can be enforced in court*. In contrast, informal institutions are constraints that do not rely on a court of law neither for defining what constitute improper behavior nor for administering punishment. An important example of this kind is **informal cooperation**, *that is the coordination on a strategy that supports an equilibrium yielding a better outcome than the “tragedy of the commons” outcome in a repeated game*.

The next section (Section two) applies the theory of repeated games to the situation of villagers using a common a renewable resource, such as a forest or a pasture, and outlines the conditions under which informal cooperation was possible and effective. Some of these conditions are then analyzed in more depth. Section three examines the role of membership rules in locking the villagers in a long-term relationship. Section four deals with formal sanctioning institutions to stop trespassers and immigrants. Section five discusses the role of information-gathering institutions to monitor individual actions. Section six suggests reasons why the

Northern Italian communities adopted formal sanctioning institutions for insiders instead of relying on informal cooperation while Section seven explains how the second order social dilemma of building such formal institutions was solved. The conclusions discuss the broader implications of the paper, setting forth the relative advantages and disadvantages of formal and informal institutions.

2. WAS INFORMAL COOPERATION POSSIBLE?

One might think that the rural communities of Northern Italy offered the ideal situation for observing the Folk theorem in action: the villages were small and isolated in a mountain area, the villagers interacted with one another, and remained in the same village for generations. Upon closer inspection, however, it becomes unclear whether the Folk theorem actually applies. In fact, whether the Folk theorem operated turns out to depend on the presence of formal institutions purposely created to make it work. This section presents the collective action problem through a simple model, offers taxonomy of institutions, and then addresses some issues related to the theory of repeated games. A comment about the efficiency of informal and formal institutions follows.

A well-known body of the literature argues against unregulated common ownership of resources (Gordon, 1954; Clark, 1990). In the Trentino region a significant part of the land was owned in common on a village basis. Forests covered almost half of the surface while grazing land and meadows covered about one third of it and an overwhelming portion of both was owned in common.⁶ For instance, in 1780 in a relatively large village (Levico) 95% of the forests was common ownership and so was 66% of the meadows and pastures. The analogous shares in a high mountain village (Predazzo) were 100% and 60%.⁷

The essence of the argument against common property is that it creates individual incentives that lead to a sub-optimal outcome, or to a “tragedy” in Hardin’s words. The dilemma can be captured by the following simple model that is set in a zero transaction cost world.

Consider a renewable resource of size L , such as a piece of forest, that yields revenues according to a function $Y = a \cdot L \cdot Q - b \cdot Q^2$, where $Q = \sum_{i=1, \dots, N} q_i$ is the total quantity harvested by all the N users and a, b, L are positive technological parameters. Each user i independently takes the decision to harvest a quantity of timber $q_i \geq 0$. Harvesting involves a cost linearly increasing in the quantity appropriated, $C_i = c \cdot q_i$ and so the user is left with a profit (rent) given by the difference

between the revenues appropriated and the costs borne, $\pi_i = \frac{q_i}{Q}Y - cq_i$. The user's revenues depend in a non-linear fashion on the user's appropriation level and on the appropriation of the others in the group. At the group level profits are simply $\Pi(L,Q)=Y \cdot c \cdot Q$. This is a standard model of a renewable resource first formalized by Gordon (1954). An exhaustive treatment can be also found in Clark (1990) and Baland and Platteau (1996).

The maximum profit that the group can extract from the common resource of size L , $\Pi^*(L)$, is obtained when the group harvests the resource at an optimal level Q^* , where the social marginal cost, $N \cdot c$, is equal to the social marginal benefit, $a \cdot L - 2 \cdot b \cdot Q^*$. When there is common ownership and owners have unlimited rights to use the resource, the outcome will be less than optimal. Group profits will be a fraction of the potential level, $\Pi(L,Q) = E(Q) \cdot \Pi^*(L)$, where E is the efficiency function, $0 \leq E(Q) \leq E(Q^*) = 1$. In particular, there will be an overuse of the resource at the symmetric Nash equilibrium (NE) appropriation level compared to the optimal level, $Q^{NE(N)} > Q^*$, for any group size N bigger than one, and such overuse translates into a lower efficiency, $E(Q^{NE(N)}) < 1$.⁸

A different arrangement is open access (OA), a situation where there are no property rights to the resource and anybody can harvest it. In that case agents will access and use the resource as long as there is a positive profit to make out of it. Formally, such open access situation is studied computing the limit of the Nash equilibrium when the number of users goes to infinity. The result is a severe overexploitation of the resource, $Q^{OA} = 2Q^*$, and a total destruction of the potential profits that could be made out of the resource, $E^{OA} = 0$ and so $\Pi^{OA}(L) = 0$. Zero efficiency means that the revenues collected from the resource are just enough to cover the harvesting costs. This situation is called *severe* tragedy of the commons in order to distinguish it from the Nash equilibrium outcome that could result from an unregulated common ownership. Figure 2 offers a simple illustration of the various levels of rent that two users could extract from a resource.

< *Figure 2 about here* >

According to the model presented, the users of a common ownership resource in the absence of regulations earn less than what they potentially could if the resource was properly managed (NE

versus SO in Figure 2). This ‘tragedy’ is always better than an open access situation where the net earnings of users are nil (NE versus OA).

When the interaction among the users of a commons is indefinitely repeated – as it was among the villagers in Trentino – the outcome does not have to be a ‘tragedy’ (NE) but might indeed be optimal (SO). This result has been proved under a variety of assumptions in the Folk theorems, or as Myerson calls it, the General Feasibility Theorems: “The general feasibility theorem can be interpreted as a statement about the power of social norms in small groups, such as families, partnerships, and cliques. According to the general feasibility theorem, if the individuals in a group know one another well, can observe one another’s behaviors, and anticipate a continuing relationship with one another, then social norms can sustain any pattern of group behavior, provided it makes each individual better off than he would be without the group. When we go from small groups into larger social structures, however, the assumption that everyone can observe everyone else may cease to hold, and general feasibility can fail” (Myerson, 1991, p. 349-50). Such imperfect monitoring of individual actions turns out to have been a problem also for the Northern Italian communities. Moreover, the interaction among the villagers was not spontaneously repeated. Specific, formal institutions had to be established to bring the condition closer to the one needed to sustain Folk theorem-type cooperation. To see why, let us first sketch a general typology of formal and informal institutions. For our purposes, there are three types of institutions:

1. **Community-building institutions** aim at defining the borderlines of the common land and to identify a stable group of users (insiders) separated from the rest of the people (outsiders). They are formal institutions that legally define property rights.
2. **Information-gathering institutions** refer to the processes of collecting information about individual actions of insiders and outsiders and about the level of the physical stock of the common resource, evaluating the reliability of the information, and sharing it with all insiders.
3. **Sanctioning institutions** are the formal or informal ways chosen to punish a perceived free-riding behavior of insiders and outsiders.

Each type of institution has a role in solving the collective action problem. The remaining of this section focuses on the central role of some formal institutions in promoting informal cooperation, beginning with community-building institutions. By informal cooperation we mean

any improvement of the outcome above the ‘tragedy’ level (NE) that is achieved without formal sanctioning of insiders. An agent is thus said to ‘cooperate’ when she reduces her use of the common resource to a level below her one-stage best response level and her action improves the group outcome.

Historically, the first step that villages took to use their commons more effectively was to establish a legal title to the common land and a form of village citizenship. Those two formal institutions transformed the legal status of forests and pastures from open access to close access. They were enforced not through the expensive court system of the Prince, but through a decentralized and self-administered system.

In fact, without a formal sanctioning institution to enforce property rights toward outsiders – either Prince or village courts - informal cooperation among the villagers themselves is doomed to fail because any effort to limit the over-use of the commons would be compensated by an increased harvesting activity by outsiders. Consider for example a situation where there are N users from the village itself (insiders) and M potential trespassers (outsiders). In the absence of legal property rights and of a court system to punish trespassers, the number of users is in practice $N+M$. Any cooperation agreement among insiders to limit resource use simply makes trespassing more profitable for outsiders and so more frequent. More outsiders could decide to use the common (increase in M)⁹. The only effective way to deter trespassing is through a system of legal sanctions. Folk theorem type strategies would succeed only when users isolated from the outside world but not when trespassing is easy, because outsiders can easily escape community punishment. They might poach at the common and never show up again or they might free ride temporarily on other communities until the original one has reverted to a cooperative mode. In short, informal cooperation would be a failure without community-building institutions. In particular, without having a well-defined group of users that have exclusive access to the resource, the outcome would be a severe tragedy of the commons (OA in Figure 2).

Protection from outside free riding without repeated interaction among insiders would ensure an improvement over the severe tragedy of the commons (namely a transition from OA to NE) but not the optimal outcome (SO). The expectation of a continuous interaction was guaranteed by a specific form of property rights on the common land that was in place to make it costly for insiders to leave the community. A description of this important feature will be given in the next section.

Assume that proper community-building institutions were in place and there was an expectation of continuous interaction. Under these conditions, informal cooperation was possible provided that the agents were able to detect if the others cooperated: that way they could decide whether to keep cooperating or to switch to punishing. An insider had two ways to assess the cooperation level of the others, both of them imperfects.¹⁰ One way to detect cooperation levels was to monitor the individual actions directed at resource use of all the other insiders. It turns out, however, that such actions could be only partially observed. A second option was to look at the physical stock of the resource and from it infer the aggregate cooperation level of all the other agents.

By simply observing the physical stock of the common forest or pasture, a villager could have inferred what others had harvested and thus whether they were cooperating. In other words, instead of observing the people the villagers could have observed the land. The signal collected in this way however was not necessarily precise; the peasants had a good idea of the physical stock of the resource but did not know exactly how many trees were in the forest or the exact quantity of grass on the ground compare to what was optimal¹¹. Such a noisy signal might be enough to sustain some cooperation, although not full cooperation. We can see how much by applying the Green-Porter model - which explains oligopolistic collusion with imperfect monitoring - to the exploitation of a common renewable resource¹² (Green and Porter, 1984 extended by Abreu, Pearce, and Stacchetti, 1986, 1990). Given the information available, some level of informal cooperation could have ensured a better outcome than the “tragedy of the commons” situation but it would still be a sub-optimal one (GP, from Green-Porter, in Figure 2).

There are two types of costs associated with informal cooperation with imperfect monitoring: one is due to the frequency with which the group reverts to punishment (α), which is in general positive and generates a low payoff (Π'); the other cost derives from the inability in general to support the socially optimal outcome during the cooperative periods ($\beta < 1$).

$$\Pi^{GP} = (1-\alpha) \beta \Pi^* + \alpha \Pi', \quad 0 < \alpha, \beta < 1, \quad \Pi^* > \Pi'$$

The higher the noise level of the signal, the worse the outcome because of a higher chance of punishment α and/or a lower best attainable cooperation level β .

A similar reasoning can be done when cooperation is assessed looking at individual use levels of insiders. The information collected leads to an estimate of the cooperation level. Since the information is less than perfect, the estimate is uncertain and informal cooperation will be

able to support an outcome that is better than the ‘tragedy’ outcome (NE) but in general worse than the socially optimal outcome (SO). The poorer the information and the more uncertain the estimate will be, the worse the outcome will be. The adoption of formal information gathering institutions could reduced the uncertainty and improve the outcome.

Instead of relying on informal cooperation among insiders, the Trentino communities adopted formal regulations to manage the common forests and pastures. The two arrangements relied on a very different sanctioning mechanism for insiders. Informal cooperation, we know, relies on the threat of a punishment. The punishment is triggered by an aggregate use level that exceeds an established threshold and it takes the form of a temporary overexploitation of the common resource. All the insiders are involved in the punishment and this behavior is self-enforcing in the sense that no external authority is needed to administer it. By contrast, formal regulations use individual punishment of insiders. If somebody violates one of the rules governing the villagers’ behavior, she is subjected to an individual punishment. Such a system is self-governing in the sense that the insiders choose the rules and are responsible for their enforcement.

The rural Charter system was thus an instance of self-governing regulations with formal sanctioning institutions to punish insiders. A typical from the Charters might be an individual quota and an associated monetary fine for violators of the quota. Other rules temporarily prohibited villagers from harvesting specific areas in the common forest and pasture. To enforce those rules, the community appointed guards to patrol the land and officials to try alleged violators. These formal institutions for information-gathering and sanctioning were costly to build and maintain and those costs need to be subtracted when comparing the efficiency of different arrangements.

This paper does not present empirical data to support the superiority of formal regulation in the management of the commons over informal regulations. The comparison is between two second-best outcomes, and the arrangement that can deliver a higher income stream to the owners of the resource is likely to vary according to environmental conditions such as informational conditions and enforcement technologies. The fact that both options, informal and formal, were available and that the Northern Italian communities chose formal regulations through the rural Charters induces to assume that the latter option was more efficient once transaction costs were taken into account.

To sum up, in a context of repeated interaction among insiders, the tragedy of the commons might be avoidable if the Folk theorem applies. Two necessary conditions were first formal sanctioning institutions to prevent free riding from outsiders and secondly a property rights arrangement to promote long-term interaction among insiders. According to the theory of repeated games, though, the best attainable outcome would have still been sub-optimal because the cooperation level of insiders could be only imperfectly observed, either through the individual actions of the agents or through the condition of the common resource. The Trentino villages did not rely on informal cooperation among insiders but adopted a formal regulation system.

The following three sections cover in depth some crucial aspects of the rural Charter system that have been just mentioned here, namely the role of membership rules in locking the villagers in a long-term relationship and in controlling immigration, the formal sanctioning institutions to stop trespassers, and the information-gathering institutions to monitor individual actions.

3. PROPERTY RIGHTS AND CONTINUING RELATIONSHIP

Without a long-term relationship among the legitimate users - the *vicini* – no informal cooperation could be achieved. In fact, there was a continuing interaction among the *vicini*. It was not, however, a ‘natural’ occurrence but the intended consequence of the type of chosen property rights arrangements on the commons. This section illustrates the specific content of those property rights in terms of freedom to leave the village, to sell and divide up the common land. Emigration - the individual decision of an insider to leave the village - was possible but costly. Selling or dividing the common land was possible only with the consent of a large majority of the owners. These details were vital in ensuring a continuing interaction and therefore the applicability of Folk theorems to this situation.

The peasants were not forced to live in the village. They used to migrate seasonally to the nearby Veneto and Lombardia areas (Figure 1). In the beginning of the Nineteenth century, every winter there was a flow of a few thousand workers going outside Trentino (Perini, 1852). This temporary emigration activity had been going on for a long time (Grosselli, 1999). Emigration could take place also toward other villages within the Trentino, granted that the newcomers would be accepted. There were hundreds of separate communities and there is no obvious reason to assume a long-term interaction within the same community.

Despite this right to emigrate, few villagers decided to permanently leave the community. The same family names can be found in the same small village and nowhere else literally for centuries¹³. The fathers of the village owned and managed the commons and would transferred them one day to their sons, then to their grandchildren, and so on. The interaction among the *vicini* was a long-term one and the likelihood that the interaction took place the following year was so high that we are as close as we can get in a real world setting to the theoretical assumptions of infinite repetition.

Why did villagers not leave the original community? Because there was an individual right to exit the community but exercising such right was costly. The crucial point is that anybody had the political freedom to leave the village, but no claim could be made of the community common resources. He could sell his individually owned house and fields but not his share in the community land. According to current property laws, if three persons own a piece of land in common and one of them wants to get out of the estate for no reason, she has the right either to sell her part to anybody or to be refunded by the other two. The arrangement in the North Italian villages was rather different. No Charter ever mentions the right of a *vicino* to be refunded of the value of his share of common land in case he leaves the community, let alone the procedures to satisfy that right. Moreover, there was a prohibition on trading his right to membership. On the contrary, there are indications that additional punishments were added to the decision to leave. To begin with, if a community member no longer lived in the village (*non ha fuoco*), he could not use any more the common resources. In addition, if he returned to the village, he had to perform his chores (*obbligbi* or *fattioni*) upon his return to the community, but sometimes could not use the common forest and pasture for one additional year¹⁴.

In practical terms, the villagers were locked into a long-term relationship one with another because the individual decision to leave the community in which a peasant was born involved losing the right to use the common land, at least while not presently living there, possibly for longer than that, and sometimes forever. Other features of the property right arrangement further support the view that it was an explicit intention of the community to set up a lock in mechanism.

The common land could be collectively sold and divided up among insiders. For instance, the villages of Nago and Torbole sold part of their common forest to an outsider and divided up another portion of their forest into individual assignments¹⁵. Tradability of the land was not an issue; the real concern was how that was done. The rights of alienation and division were specifically design in a way to safeguard the lock-in mechanism that we have just described.

Every detail in the property rights arrangement on the common land is aimed at promoting a long-term relationship.

As mentioned, parcels of the common forest and pasture were sometimes assigned to the members of the community in exclusive individual use. Such assignments were internal arrangements and the external legal property rights on the land always belonged to the community. In fact, when a member left the village, he also had to return his individual assignment to the community because it constituted a proper portion of the common resource. In addition, whenever the single villager could transfer his rights on the assignment, the buyer had to be a member of the community.¹⁶

What could have been a threat to informal cooperation was an individual right to sell a share of common land to others. A *vicino* did not have this right. Otherwise, he could have taken advantage of the common resource by generously appropriating timber and overgraze the common pastures and then alienate his property right before the others would punish him using a Tit-for-tat strategy. That is why the right to sell the common land was always a collective right that belonged to the community as a whole. The rural Charters required the consent of a wide majority of the *vicini* for the alienation decision¹⁷.

In conclusion, the property rights arrangement on the common land promoted a long-term interaction among the *vicini*, because the option to exit the community was costly. The individual *vicino* had the right to use the common resources according to the community rules and the right to participate in shaping those rules but no right to secession with compensation. Under these conditions, free riding was not profitable because avoiding the cost of the punishment involved facing the greater cost of leaving the community. Hence, the best behavior was not to exit the community but to cooperate and eventually voice complaints during the community gatherings (Hirshman, 1972).

4. PROTECTING THE COMMUNITY FROM OUTSIDERS

Without restrictions to immigration and trespassing, the community land would be in practice available to everyone. As this section explains, the commons in Northern Italy were common ownership and not open access resources. First, there was a form of village citizenship or membership to govern the access to the commons by immigrants. The pillar of such system was the distinction between the group of legitimate users and regulators of the commons, called

the *vicini* (“neighbors”, insiders) and all the others, called the *forestieri* (“strangers”, outsiders).¹⁸ The second element that safeguarded the common ownership was a system of decentralized enforcement of property rights toward illegal trespassing. The rural Charters provided the legal tool for the delegation of jurisdictional powers from the Prince courts to village officers. Although it did not result in a perfect enforcement of property rights, this institutional innovation decreased transactions cost of common ownership. We will begin with an analysis of the membership system.

The most rewarding free-riding action was probably to settle down in a village with a high per capita endowment of common resources and acquire full rights to use the commons. We might expect the members of the “poorest” communities to attempt moving into the “richest” communities. For persons without any memberships, acquiring any village membership would make them better off since they could access the commons for free. There were basically two tricks to acquire membership, through marriage with a *vicino* and through living long enough in a village.¹⁹ Both the tricks and the correspondent countermeasures will be described.

The membership right entitled all the family members of the *vicino* to use the common resource and the *vicino* himself to participate and vote in the village assemblies that decided on various matters. The right was transmitted from father to son, but usually the son of a *vicino* would be recognized as a separate member only when moving out of his father’s household with his wife. Since the membership right was usually inherited through a male lineage in all the villages, the wives would move to the husband’s community and the system would be in balance.²⁰ There was however a legal loophole in the system and specifically in the remote valley of Fiemme. Up to 1582, in the Fiemme Valley the right to be a *vicino* was inherited by both sons and daughters of a *vicino*. Since the endowment of common forests and pastures was definitely richer in Fiemme than in many other communities, men from other villages tried to marry women from the Fiemme Valley. The practice became so widespread that the assembly of the *vicini* of Fiemme decided at one point to restrict the inheritance of commons’ rights to sons only, as it generally was in most of the other Trentino communities. In a letter to the Prince dated 16 November 1583, the community governor actually complained about the “mess and losses” caused by immigrants and argued in favor of a reform.²¹

Another possible way to gain access to the commons was to simply become a resident of the village and slowly work the way into a de facto user status. The *vicini* were more than alerted to those kinds of guys and usually dictated the following list of conditions for admission. First, the

community needed to give explicit approval before an outsider could use the commons, or even before settling down in the village. Secondly, the newcomer had to pay an annual fee. Thirdly, the right could not be transmitted to descendants.

The *vicini* wanted first of all to screen out people not worthy of trust (*degni di fede*) and would sometimes ask prospective residents, as in the Charter of Cles for convincing proofs of an honest life and of decency.²² In the Charters where the procedure is mentioned, the consensus of the *vicini* needed to be nearly unanimous.²³

Admitting additional users on the common resource meant giving away a share of the claims on the resource profits, which is equivalent to alienate a portion of the property rights. The existing users wanted not only to have a say about the admission decision but also to be compensated for the reduction in their share of resources. In corporate law, this right is analogous to the right of shareholders to deliberate about the emission of new preferred shares and decide about their price. Interestingly enough, in 1671 the community assembly of the village of Cis stated - in the very same article of their Charter - that admitting a new member had to be deliberated with the same majority as the one adopted for selling the common land (any group of three or more *vicini* could veto the decision).²⁴ The annual fee was usually assessed on a case-by-case basis and in proportion to the expected use of the forest and pasture, looking at the size of the family or the number of animals owned.²⁵

The acquired right to use the common land was tied to the designated person. It could not be sold or automatically passed on to descendants. Moreover, most of the times the new user could not participate or vote in the village assemblies and was considered an “outsider resident” but still *forestiero*.

Since sneaking into the community as a would-be new member hardly went unnoticed, outside free riders could only trespass. Such action was unanimously prohibited in the rural Charters (see Table 1). Outlawing trespassing, though, was not enough to eliminate it.

One might think that villagers could call in state courts to stop trespassing. But using the state court system to protect the property rights was often impractical because of the high costs involved. At the same time, enforcing the legal property rights on the common forests and pastures was essential to achieve an efficient management. The rural Charters emerged in the 13th century as a legal innovation to reduce the transaction costs involved in enforcing property rights on the land.²⁶ The rural Charters (*Carte di Regola*) were formal documents drawn up by a notary in front of the village assembly and then sent to the Prince of Trento for official approval. An approved Charter

awarded the villagers with the authority to enforce the rules listed in the Charter and in particular with the powers to appoint guards (*saltari*) and inflict monetary sanctions to trespassers.

But even though the Charters created a more efficient, decentralized enforcement of the property rights, not all trespassers were discouraged by the threat of a fine.²⁷ The enforcement of property rights was in fact likely to be incomplete because of the monitoring costs and the costs of collecting the fine. Detecting a trespasser, bringing her to court, and cashing the fine were time-consuming. If either the potential damage was small or the action was too difficult to detect then the community would not profit by engaging in a stricter enforcement of property rights. For instance, detecting trespassing during the night requires a higher effort. In order to discourage it, the community usually doubled the penalty. Instead increasing the probability of catching the person p , the expected gain from trespassing can be lowered by raising the amount of the fine s . A formal model of the decision is sketched in the appendix.

The punishment level, however, was constrained by both economical and legal upper bounds. Under some conditions, there is a level of nominal amount of the fine that could ensure in theory a complete enforcement because the expected punishment $p \cdot s$ can be raised above the actual benefit of trespassing.²⁸ In practice, there was a ceiling to the maximum fine that could be imposed because of two constraints. The economic constraint comes from the fact that most peasants were poor and did not own much that could be taken away in order to pay the fine. Setting a fine higher than the value of their belongings did not necessarily increase the threat of the punishment. Besides these economic considerations, the rural communities in Trentino could not legally establish fines above a maximum amount set by the central political authority. A 1586 ordinance of the Prince of Trento called the *Moderatio Betta* set a limit of 5 *ragnesi* for any fine stated in the rural Charters. The Prince granted some self-governance powers to the local communities but did not want them to substitute the ordinary courts and laws on more relevant issues. Physical punishments, for instance, were not allowed because criminal law was the exclusive realm of feudal authorities. The rule was binding on the communities as it is evident by the many attempts to include higher fines and from the subsequent censoring from the Prince bureaucrats when approving the Charters.²⁹

In conclusion, there were membership rules and a deterrence mechanism for trespassing that effectively restricted the access to the community land to a well-defined group of users. The enforcement against trespassers was imperfect and – as it will be discussed later on – this made the signal about insiders' cooperation level more uncertain. Moreover, the rural Charters were

convenient legal tools to lower the transaction costs of fighting trespassing but they might have been - and actually were - employed also for other tasks.

5. MONITORING INSIDERS

Although less difficult to monitor than outsiders' actions, insiders' usage levels of the common resource were not fully known by the other insiders. As already discussed, imperfect monitoring of insiders might undermine informal cooperation. Once property rights on the common resources are legally well-defined and enforced and once insiders face a continuing relationship, informal cooperation can be sustained provided that each insider can assess the cooperation level of the others, so that she could decide whether to keep cooperating or to switch to punishing. This section discusses one way to detect free riding, simply by observing the actions of appropriation of the common resource of all the other insiders.

Several cues suggest that monitoring individual actions of insiders was problematic. Consider, for instance, the common prohibition of harvesting grapes in individually owned vineyards before a date designated by the village assembly (Table 1). This apparently odd rule is quite sensible when monitoring is imperfect or costly. If all peasants were in the vineyards to harvest the same day, they could have checked one another's behavior at no additional cost. Without this regulation, instead, it would have been easy for a peasant to pick the grapes of his neighbors without being noticed.³⁰ In addition, during the weeks before harvesting day, the community paid a guard to police the vineyards all day long - and sometimes all night, too. The existence of guards indicates that monitoring was costly but necessary.³¹

More generally, there was a widespread fear of thefts from the fields. There were frequent complaints of robberies of fruits and vegetable. In order to reduce this risk, the peasants adopted inefficient agricultural practices, such as tiny vegetable gardens located nearby houses and shrunk areas devoted to orchards (Monteleone, 1964).³² Sanctions for thieves were doubled when monitoring was particularly difficult such as at night or if the thief was an outsider (Table 1).³³ A further example of imperfect monitoring was the prohibition to stay overnight or during religious holidays in the high mountain meadows and forests. The 1586 Charter of Sanzeno explains that the aim of the rule was to avoid free riding on the common resource or thefts in individual plots. Given that everybody else was in the village or observing the no-work custom, the free rider would have been difficult to catch.³⁴

In conclusion, individual appropriation actions of insiders were not public information. On the contrary their knowledge required in general costly monitoring activities. The examples given above show however how appropriate information-gathering institutions could bring a community closer to an ideal situation of perfect monitoring.

In order to gather additional information about insiders' behavior, the Charters adopted three kinds of methods: a direct one - through guards hired to patrol the land - and two indirect ones - through an imposed re-organization of production to make actions more readily observable and through a monetary incentive for whoever would discover the violation of a rule. All three ways involved costs for the community, which is evidence that a positive benefit was expected from it.

Some guards were hired to patrol the high mountain pastures and forests (*saltari del monte*) while others were in charge of patrolling the meadows nearby the village (*saltari di campagna*).³⁵ The *saltaro* received a share, usually one third, of the fine collected by anybody that he caught breaking one of the Charter's regulations. If an ordinary *vicino* reported a violation to the governor's officials and the report was recognized to be grounded, he - instead of the *saltaro* - would receive a share of the cashed fine.

Gathering information about insiders was costly but the same guards could be employed to report both trespassing and insiders' behavior. The economies of scope of the two activities were likely to be very high. Moreover, for reasons similar to the ones put forward for trespassing in the previous section, it was unlikely that knowledge about insiders' actions would be perfect. The interested reader can look at the model in the appendix.

We should still keep in mind that a lot of information about others' actions was acquired as a byproduct of daily activities of the villagers and was coming without a cost, especially because of the small size of villages. The population of most villages was in the order of few hundred people. In the village of Don just twelve heads of families gathered in 1493 to draw a new Charter.³⁶

Besides gathering information, two important roles of monitoring institutions were to validate knowledge and to disseminate it among all insiders. Uncontrolled rumors of a free riding action that quickly spread among insiders could trigger a collective punishment, even if the claim is wrong. To avoid such an inefficient outcome, it would pay to follow an established procedure and investigate alleged violations in order to come up with corroborated and unbiased conclusions. Efficiency might also suffer if insiders receive private signals about the actual level of

cooperation of the other insiders. Suppose, for instance, that just one user believes that a violation occurred and switches to a punishing mode. The following period the increase in use could trigger everybody else's to punishing. A perturbation of any of the private signals could provoke a cascade that drags the whole group to the punishment mode. Here appropriate institutions could help to promote coordination among agents in the choice between cooperation and punishment (Kandori and Matsushima, 1998; Compte, 1998; see note 9).

Village courts and periodic meetings of the *vicini* did precisely this: they helped to accomplish both goals of validating and disseminating information about free riding actions. A village court would hear witnesses, read the Charter, and come up with an 'official truth' about the alleged violation. The court would also eventually inflict a monetary fine to the insider, since there were formal sanctioning institutions for insiders. In principle, however, the two functions of validating knowledge and punishing the agent are distinct and the former one is relevant also for informal cooperation. There are in fact parallels elsewhere in the world. For example, in some Bolivian communities that rely on informal sanctioning institutions, the leader of the village publicly announces when somebody has violated a norm governing the use of the common resource. The announcement thus works as a coordination device to trigger the punishment by all the villagers.³⁷

< *Table 1 about here* >

To sum up, monitoring of insiders' actions was imperfect but proper institutions could improve the efficiency of informal cooperation through the gathering, validation, and sharing of information. Moreover, there were economies of scope between institutions to monitor insiders and to detect illegal trespassers. Having information about individual actions' of all insiders is one way to assess the cooperation level of insiders but there is the alternative to look at the level of physical stock of the resource. Nevertheless, it has the advantage of enabling the community to inflict individual punishments, either using social sanctions or formal sanctioning institutions.

6. INSTITUTIONS TO SANCTION INSIDERS

Up to this point, we have established the need of community-building institutions and formal sanctioning for outsiders in order to apply the Folk theorem and mentioned the possibility to employ information-gathering institutions to improve the outcome. This section goes one step

further by comparing the advantages and disadvantages of formal over informal sanctioning institutions in charge of punishing free-riding behavior of insiders. The Northern Italian communities adopted formal sanctioning institutions for insiders.

When monitoring is imperfect, informal cooperation involves sizable losses for the insiders. The reason is that informal sanctions in the form of a temporary overuse of the common resource by all the insiders inflict a cost on both free riders and cooperators, a cost that is a deadweight loss for the group. Under perfect information conditions, a self-interested agent never free rides in equilibrium because she knows that the group will surely revert to a punishment mode and the individual cost from the punishment outweighs the benefit of free-riding. But with imperfect monitoring the group is not able to assess with certainty if somebody free rode. For instance a signal of bad condition of the resource could be the result of insufficient cooperation or of some external shock, such as unfavorable weather conditions. There were at least two sources of uncertainty on the signal S about the condition of the common forests and pastures: first, an imperfect survey of the current condition of the resource; second, because of chances of thefts from outsiders. Since the enforcement of property rights toward outsiders was not absolute, the theft of an outsider could have been mistakenly interpreted as free riding behavior of an insider and triggered a punishment. In other words, the undetected appropriation by outsiders was an additional and independent source of bias because the same stock of resource could have been the results of various combinations of insider and outsider appropriation levels.

The optimal strategy with imperfect monitoring is to tolerate some degree of apparent overuse of the common resource but revert to a punishment mode whenever the signal is below a given threshold. The implication is that in equilibrium there are recurrent, costly collective punishments of insiders and when there is no punishment the outcome is still less than optimal. The mechanism is very different with formal sanctioning institutions. Formal sanctions are fines that an official of the community forces the free rider to pay, although most of the time the payment is voluntary. The circumstances under which the punishment was inflicted were specified in the rural Charters and so were the amounts of the fines.

The main advantage of formal over informal sanctions was that the formers were mostly a transfer of resources within the community and not a deadweight loss. In the Trentino communities, revenues from fines were divided between the officers, the person who brought the violator in front of the court, and the community treasury. Sometimes a share of the fine - usually one third but sometimes half - was paid to the Prince or to the local feudal lord. In the sample of

Charters surveyed in Table 1, a payment was required from 35% of the communities. This transfer from the community to the Prince was not a cost but rather a rent. Since formal regulations were successful compared to the alternative of informal cooperation and since the Prince had the power to approve or revoke a Charter, he claimed part of the surplus for himself.³⁸

The only real variable cost of inflicting a fine came from assessing the violation and eventually having to force the payment, so that a fraction ϑ of the revenue R was wasted in the process of cashing it. This cost includes the resources employed to monitor the individual actions of insiders. While informal cooperation can rely on aggregate knowledge of resource use, formal sanctioning needs information about individual actions. This last point brings us to the second advantage of formal sanctions, namely the punishment is directed toward the free rider only and not to the whole group. A mistake in detecting a violation is therefore less costly with formal sanctioning institutions.

On the other hand, the main disadvantage of formal sanctions was the sunk cost of creating and maintaining additional formal institutions. The *vicini* had to agree upon a set of regulations and to finance the monitoring activity and the court system. Writing an official document such as a rural Charter involved non-recoverable costs and so was spending time in the community meetings to listen and vote on an endless list of small issues. There were however strong complementarities between these activities and the institution-building necessary for the enforcement of property rights toward outsiders. Both required appointing guards to monitor individual actions and once a guard was patrolling the forest looking for outsiders, it took little extra effort to report the actions of insiders as well. Prosecuting outsiders required courts and officials in charge of cashing the fine. The same machinery could be used for insiders. Notwithstanding these considerations, the extra monitoring efforts and the creation of formal regulations for insiders were a cost for the community.

From the fact that the Trentino communities chose formal sanctioning institutions for insiders while informal sanctioning was available, I conclude that the former was probably more efficient in the sense that the formal sanctioning payoff was greater than the informal sanctioning payoff:

$$\Pi^* - C - \vartheta R - TC > (1-\alpha) \beta \Pi^* + \alpha \Pi' - TC, \quad 0 < \alpha, \beta < 1, \quad \Pi^* > \Pi'$$

Here TC are the transaction costs common to formal and informal sanctioning, C is the additional sunk cost of formal regulations of insiders, and Π^* is the maximum group profits in an ideal zero transaction cost world.

The greater efficiency of formal sanctioning institutions is not a general conclusion but depends upon informational and technological conditions. For instance, the efficiency of informal cooperation depends from the quality of the signal about the condition of the resource. The more erratic was the pattern of trespassing by outsiders and the worse was the signal. A formal regulation of insiders was likely to be more efficient for villages nearby a main road or in a heavily inhabited valley than in isolated villages. Another central variable was the wage level. Institution-building is a labor-intensive activity, so the lower the salary relative to the value of timber or milk and the more likely is that a community would choose formal sanctioning for insiders.

An informal sanctioning alternative to the collective overuse of the resource could be used to support cooperation, namely social sanctions. A social sanction occurs when an agent voluntarily performs a costly act in order to punish somebody who has violated a norm of the society. The strategies employed in a Folk theorem usually consider punishments taking place in the same realm of the resource use in the form of a temporary or permanent non-cooperative mode. People living in the same village however were involved in several other interactions besides the use of the common resource. Free-riding behavior on the common resource could have been punished with a denial of credit, with the refusal to rent a privately owned field, or the rejection of a marriage proposal. An advantage of social sanction is that the punishment was targeted to the individual free rider. On the other hand, inflicting individual punishments requires knowledge of individual actions and hence monitoring was still necessary to avoid a high rate of ‘undeserved’ punishments. Unless legal regulations, there was no need to build costly institutions.

Despite the advantages, the community adopted formal sanctions where community officials were in charge of punishing the individual defector through a monetary fine. A social sanction, in fact, entails a loss for both the agent who inflicts it as well as for the targeted agent. At the societal level social sanctions bring destruction of resources. As have already been mentioned, a legal sanction instead is often voluntarily paid (under the threat of violence by higher authorities) and is mostly a transfer of resources within the community. Its aim is to be costly for the targeted agent, but at the community level there is no destruction of resources besides collecting costs.³⁹

To sum up, formal sanctioning institutions exhibit advantages and disadvantages in comparison with informal sanctioning institutions. The advantages are that the punishment is not a deadweight loss for the group and is directed only toward the free rider instead of the whole

group. The disadvantages of formal regulations include the need to build additional formal institutions to prosecute insiders and to monitor individual actions of insiders. Social sanctions have been briefly discussed. In the specific conditions of the Northern Italian communities formal sanctioning institutions for insiders were chosen probably because they were more efficient than informal cooperation. Still, we need to explain how those institutions came to place.

7. SECOND ORDER SOCIAL DILEMMA: WHO BUILDS THE INSTITUTIONS?

We know for a fact that the Trentino communities – instead of relying on informal cooperation among their members - adopted formal sanctioning institutions for insiders. If they made this choice because it was more efficient, we still have to explain how those institutions were established. The point in question is that formal institutions are similar in nature to public goods, they supply valuable services to the whole group but they are costly to provide and each member of the group has too little incentives to contribute to them. As a result, a beneficial institution might never be created. A possible way around it is the one chosen by the Trentino communities.

Compliance with the regulations benefited everybody because it promoted efficient use of the common resource. Regulations were enacted through a formal sanctioning system toward insiders. In the Northern Italian villages, the community officials exacted a monetary payment when an insider appropriated timber or grazed on the commons in violation of a Charter rule. Inducing compliance with the regulations, on the other hand, constituted another social dilemma. Crafting, updating, and enforcing formal regulations involved costly activities and it was not in the best self-interest of any individual to voluntarily bear those costs. In other words, regulations solved the social dilemma of the use of a common resource but generated a second-order social dilemma of institution building.

Before discussing how the new dilemma was solved, we have to consider the costs associated with formal regulations of insiders. There were at least three types of costs: first, appropriated usage rules and prosecution procedures had to be negotiated in meetings among villagers, recorded by a notary, and then submitted to the political authority for approval. Participation at the community meetings was time consuming and the discussions frequently raised animosities.⁴⁰ Some villagers would have preferred to avoid them. Second, once the legal rules and procedures were agreed upon, additional efforts needed to be devoted to information-gathering activities in order to monitor the individual actions of insiders. That could have taken

the form of additional guards, constraints on actions – such as a no going out at night in the woods rule -, and additional monitoring efforts by ordinary *vicini*. Third, enforcing regulations entailed other significant costs. A transgressor sometimes had to be brought in front of the governor and an estimation of the damage that was done to the resource assessed. Sometimes dedicated officials (*stimadori*) were in charge of suggesting a fair compensation to be paid on top of the penalty indicated in the Charter. The convicted transgressor could then appeal to the community assembly and after that to the Prince courts. These activities of determining the amount of punishment and actually exacting the payment were costly. For instance, the office of governor (*regolano*) was oftentimes taken on unwillingly by a *vicino* because it was more of a burden than a form of employment. The option of relinquishing the office after being elected was frequently considered unacceptable. To avoid an uneven distribution of efforts among the insiders, some communities rotated the office among all the *vicini* while others set limits to the number of consecutive terms in office.⁴¹

To sum up, formal regulations were costly to provide but the *vicini* did not have the individual incentive to voluntarily provide efforts to build and run them. As mentioned, there is evidence in at least two instances - participation in assemblies and acceptance of some offices - that the *vicini* were quite reluctant to contribute to the village institutions.

This second order social dilemma of providing formal institutions was surmounted through informal cooperation. According to the theory of repeated games, provided that some conditions are met, an optimal level of contributions to the creation of formal institutions could be sustained. In this case there was no difficulty in observing individual actions because everybody knew who was participating to meetings, involved in court actions, or holding offices. Eventual free riding could have been punished with social sanctions or other means. The community of Romallo provides an example: it explicitly used ostracism. A *vicino* that refused to perform the required tasks was deprived of his status of insider and considered an outsider. As such he would have to pay rent for using the communal resources.⁴²

The role of informal cooperation here helps to resolve the paradox that we began with: namely, that although the Trentino communities met the conditions needed for informal cooperation, they apparently turned to formal regulations to manage the commons. The paradox was only apparent. The seemingly redundant institutions, in fact, served different purposes. The formal regulations aimed at limiting the appropriation of resources from the common forests and

pastures, while the informal cooperation supported the provision of such effective formal institutions. The paradox is thus resolved.

In a sense, both the informal and especially formal institutions can be thought as social capital (Coleman, 1990, chapter 12). They were part of a set of valuable assets in the form of community organizations, social networks, customary coordination cues that were useful for the efficient conduct of economic activities. Such social capital is subjected to depletion and needs constant replenishment in order to allow the same level of efficiency. A portion of this capital was inherited from previous generations. A member of the community benefited not only for the availability of a physical capital in the form of communal forests and pastures but also from the social capital that protected the property rights and made possible the efficient use of the resources. It might well be that in a context where the central state was weak the former without the latter was worthless.⁴³

In conclusion, the contributions to institution building activities from insiders were provided thanks to the repeated nature of the interaction among insiders. The Folk theorem helped here but it did not directly solve the social dilemma of limiting the use of the communal resources. Rather, its role was only indirect in that it supported the creation and maintenance of the formal institutions, which prevented the ‘tragedy of the commons’.

8. CONCLUSIONS

This paper discusses the interrelations between formal and informal institutions in solving a well-known social dilemma, the management of a common property resource. The issue is examined in reference to the alpine communities of the Trentino, a region of Northern Italy. Formal institutions existed side by side with the sort of repeated interaction that would breed informal cooperation generating a paradoxical redundancy of institutions.

The contribution of the paper is a game theoretical and property rights examination of the emergence of this pre-modern institutional framework. Other studies have highlighted the complementarities between formal and informal institutions to facilitate private enforcement of rules (Hay and Shleifer, 1998) and trade (Greif, 1998b; Clay, 1997; Greif, Milgrom, and Weingast, 1994; Greif, 1993; Milgrom, North, and Weingast, 1990). Here the focus is the relative advantages and disadvantages of one over the other and on the conditions that make self-governance possible.

One might think that the rural communities of Northern Italy in the period from the 13th to the 19th century offered the ideal situation for observing the Folk theorem in action: the villages were small and isolated in a mountain area, the villagers interacted with one another, and remained in the same village for generations. Upon closer inspection, however, it becomes unclear whether the Folk theorem actually applies. In fact, whether the standard Folk theorem operated turns out to depend on the presence of formal institutions purposively created to make it work. Property rights were aimed at excluding outsiders from the use of the commons and promoting a long-term interaction among the users (Rubinstein, 1979; Green and Porter, 1984; Fudenberg and Maskin, 1986; Abreu, Pearce and Stacchetti, 1986, 1990; Kandori, 1992a, 1992b; Fudenberg, Levin, and Maskin, 1994). The two goals were achieved by prosecuting trespassing (Section 4) and by an elaborate set of membership rules (Sections 3 and 4). In particular, as leaving the community meant renouncing the benefits of the common resource, villagers had an incentive to stay.

Despite having created the conditions to support informal cooperation, the rural communities adopted formal institutions to manage the commons, where users that exceeded the individual quotas or violated the time or place restrictions were subjected to a monetary fine. Here the formal institutions were legal constraints to behavior that could be enforced in court. The rural Charters established self-governing formal institutions, which means that the insiders chose themselves the set of rules and were responsible of the enforcement of those rules.

Limiting the overuse of the common forests and pastures with formal institutions and not with informal cooperation was probably more efficient. Both alternatives were available and the communities relied on the former one. This paper however does not present empirical data to support the superiority of formal regulation in the management of the commons over informal regulations. Moreover, I expect the arrangement that can deliver a higher income stream to the owners of the resource to vary according to conditions such as wage level and distance from roads. The test of this prediction is left for future research. There are tradeoffs between developing formal regulations versus relying on informal cooperation.

Formal regulations have the advantage of a more efficient sanctioning system but require the development of additional formal institutions that are costly to create and maintain (Section 6). With informal cooperation, there were significant deadweight losses due to the recurrent collective punishment of the users because of imperfect monitoring. In order to sustain cooperation, the users must know the cooperation level of the others, so that they could decide whether to keep cooperating or to switch to punishing. As the users had only a noisy signal about

the cooperation level, there would be periodic overuse of the resource that would harm both free riders and cooperators. A formal sanctioning system, instead, targets only the free riders and the punishment is mostly a transfer of resources within the community and not a deadweight loss. Exacting monetary fines involved some effort but most of the money would flow to either the community officials or treasure.

On the other hand, creating and maintaining additional formal institutions was costly. The users had to agree upon a set of regulations, engage in extra monitoring activity, and run the court system. Those activities absorbed real resources and such costs should be taken into account when comparing efficiencies of different arrangements. The rural Charters constituted a legal innovation that decreased transaction costs of defining property rights and enacting formal regulations. They allowed a decentralization of jurisdictional powers from the expensive state courts to village officers. Under certain conditions, the cost of building formal institutions was less than the gain in efficiency associated with it.

The choice of formal regulations for the management of the commons raises two related questions. On one side, stating their superiority in terms of efficiency does not explain how formal institutions were established. Since the formal regulations were self-governing the users themselves had to bear the costs of creating and maintaining them. Formal institutions are similar in nature to public goods, as they supply valuable services to the whole group but they are costly to provide and each member of the group has too little incentives to contribute to them. As a result, a beneficial institution might never be created. On the other side, there is the paradox of redundancy because formal institutions existed side by side with the sort of repeated interaction that would support informal cooperation.

The paradox is resolved considering the two layers of social dilemmas. There was a first-order social dilemma concerning the efficient use of the commons. This dilemma was surmounted through formal regulations of insiders. In turn, that arrangement generated a second order social dilemma of provision of such formal institutions. This second-order dilemma was solved thanks to the repeated interaction among insiders that supported informal cooperation. In other words, there was no redundancy of institutions. The theory of repeated games did not help directly with the first-order social dilemma but it did indirectly with the problem of provision of formal regulations. Self-governance was possible because there was a sustainable way to promote institution-building efforts.

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APPENDIX

TECHNOLOGY OF A RENEWABLE RESOURCE

The purpose of this section is to describe the model of a renewable resource that is presented in section 2 of the paper.

The production function is a relation between the quantity of input (level of effort in exploiting the resource) and the quantity of output (amount of resource obtained in harvesting). The derivation of the production function involves three steps. The first step is to model the growth of a renewable resource, the second step is to introduce a harvesting technology, and the third is to consider prices.

The biologic dynamic of a renewable resource over time can be described with the logistic equation $\frac{dx}{dt} = rx \left(1 - \frac{x}{K}\right)$ that is widely employed in the literature (Gordon, 1954; Clark, 1990; Baland and Platteau, 1996). The evolution of the population x over time t is a quadratic function of x itself. The parameter K is the maximum size of the population level (or resource stock) that is usually called the carrying capacity. Loosely speaking, the parameter r measures the growth rate, that is, the time needed to reach K . the dynamic of a resource according to a logistic equation. Figure 3 shows an example of this function for forest growth.

< *Figure 3 about here* >

So far the model describes the dynamic of a biological resource not subjected to harvesting activity. The next step is to model the harvest function. Assume that the marginal return of one unit of effort Q is proportional to the population level x : $S = nx$, where S stands for the physical amount of the harvest. In other words, the higher the stock of the resource, the more productive the harvesting activity will be. The production function is obtained by solving the zero-growth condition $\frac{dx}{dt} = S$ in the equilibrium population level x^* : $S = Qx^* = QK - Q^2 \frac{K}{r}$. In general, there is also the solution $x^{**}=0$, when the resource is totally depleted and the harvest is zero. The zero-growth condition implies that, in a given period of time, the natural growth of the resource must be equal to the quantity of resource harvested. The stock level x^* is the steady state equilibrium and $S = Qx^*$ is the perpetual constant flow of harvest that the resource yields in equilibrium.

From the graph, we can see that “at any population below a certain level K , a surplus production exists that can be harvested in perpetuity without altering the stock level. If the surplus is not harvested, on the other hand, corresponding increase occurs in the stock level, which ultimately approaches the environmental carrying capacity K , where the surplus is reduced to zero.” (Clarke, 1990, p.1) The maximum surplus that can be obtained in perpetuity is called MSY (Maximum Sustainable Yield) and is reached at $x = \frac{K}{2}$.

The last step is the introduction of prices. Let c be the cost of one unit of effort and p the selling price v of one unit of harvest. The sustainable level of revenues from the application of Q units

of effort to the resource is $Y = \nu S$ or $Y = aQ - bQ^2$, where $a = Kv$ and $b = \frac{Kv}{r}$ (see figure 2A).

There is an assumption that every unit of effort has the same return, namely $\frac{Y}{Q}$.

To sum up, the assumptions about technology are:

- (1) Resource dynamic is logistic
- (2) Harvesting efficiency is linear in the population level
- (3) Marginal cost of one unit of effort is constant
- (4) Earnings are divided in proportion of harvesting efforts

ANALOGY WITH OLIGOPOLY

The problem faced by appropriators of a renewable resource is formally equivalent to the problem that firms face when they decide the amount of goods they want to sell in a market. The unregulated common ownership solution (tragedy of the commons or NE in Figure 2) is the Cournot equilibrium of an oligopoly when the competition in on quantity and entrance of new firms is blocked. The reinterpretation of the parameters is straightforward: q_i is the quantity sold by firm i in a market with a linear demand function $Y = a - bQ$ and a constant returns to scale technology. The socially optimal case corresponds to a monopoly and the open access case is like a market with perfect competition. While the formal analysis of the two problems is exactly the same, the welfare evaluation of the different regimes is opposite. In the case of a monopoly, the solution is not socially optimal because the firm does not consider the consumer surplus, while in the case of a renewable resource the rent - the new label for firm profits - is the only welfare consequence to consider and so its maximization leads to the socially optimal solution. In the new setting, a zero-profit outcome means complete rent dissipation.

PROTECTION FROM TRESPASSING

This section presents a model of property rights enforcement toward outsiders. The goal is to show that under some reasonable conditions some trespassing occurs in equilibrium.

Detecting and convicting trespassers were costly activities. We could assume that the trial involved a constant cost while the cost of monitoring the land was increasing with the degree of its completeness. Under the assumptions that as the enforcement of property rights becomes complete its cost goes to infinity, a partial enforcement was socially optimal and that might explain why outsiders still attempted to trespass.

Consider the following three assumptions: (i) outsiders' actions were detectable at a cost, (ii) monitoring cost was increasing in the probability to detect the trespassing action and moreover (iii) as the probability p_0 to observe the action approaches one, monitoring costs m_0 go to infinity.

We can model this concept with the function $m_0(p_0) = \frac{p_0}{1-p_0}$, where $p_0 \in [0,1)$.

The interaction between the potential trespassers and the community is modeled as a game where the community has the powers to levy fines on trespassers when they are caught. A trespassing action involved harvesting a given amount of resources d that is subtracted to the community profits. As explained, monitoring was costly, but no extra deadweight loss is in this model for the activity of collecting the fine. A decision based on a cost-benefit analyses would have considered the loss of resource caused by trespassing, the revenues from the fines, as well as the monitoring costs:

$$\max_{\{p_0\}} \{-d \cdot M(p_0) + f \cdot p_0 \cdot M(p_0) - m_0(p_0)\}$$

Where M is the expected number of trespasser attempts, $M = \pi^*/(d + f \cdot p_0)$ and π^* is the actual rent enjoyed by the insiders from the common resource. The number of trespassing attempts in equilibrium M^* is a proxy for the degree of enforcement of the property rights toward outsiders. Under some quite reasonable conditions ($f > d/2 \cdot \pi^*$ and $f + d > 0$) there exist only one acceptable solution $0 < p_0^* < 1$ while the other solution is too big, $p_0^* > 1$. The solutions are both equal to 1 in the degenerate case when $f + d = 0$, which is not possible since by assumption $d > 0$ and $f \geq 0$.

The enforcement could be improved by increasing the expected sanction of trespassing $f \cdot p_0$, which could be done either by boosting monitoring activity or increasing the nominal sanction f . I call the enforcement complete when there is no expected attempt to trespass, $M^* < 1$. Given a level of punishment f , the optimal monitoring policy in general involves some positive effort but not detecting every single trespassing, $0 < p_0^* < 1$. The punishment ceiling f^* is binding when the amount f^* defined by $M(f^*, p_0^*(f^*)) = 1$ is such that $f^* > f$.

As Barzel puts it: "If it is assumed that for any asset each of these costs is rising and that both the full protection and the full transfer of rights are prohibitively costly, then it follows that rights are never complete, because people will never find it worthwhile to gain the entire potential of "their" assets" (Barzel, 1997, p.2).

MONITORING INSIDERS

The costs to monitor insiders m_i could be thought as similar to the one for outsiders, m_o . Consider the following three assumptions about the cost of the joint activity of monitoring outsiders and insiders, m ,

(i) It exhibits economies of scale because the guards that are on the common land to patrol for trespassers can detect violations by insiders at a low additional cost, $m(p_o, p_i) < m_o(p_o) + m_i(p_i)$, for any $p_o, p_i > 0$;

(ii) The function m should reduce to the elementary functions m_o and m_i when one of the target groups, either insiders or outsiders, is not monitored, $m(p_o, 0) = m_o(p_o)$ and $m(0, p_i) = m_i(p_i)$;

(iii) The joint activity should be still more expensive than one single component carried out independently, $m(p_o, p_i) > m_o(p_o)$ and $m(p_o, p_i) > m_i(p_i)$, for any $p_o, p_i > 0$.

An example is the cost function $m(p_o, p_i) = m_i(p_i) + (1 - s \cdot p_i) m_o(p_o)$, where $0 < s < 1/2$ satisfies

properties (i) through (iii), or more specifically the function is $m(p_o, p_i) = \frac{p_i}{1 - p_i} + (1 - s \cdot p_i) \frac{p_o}{1 - p_o}$.

Property (i) is obvious since $(1 - s \cdot p_i) < 1$. The two properties (ii) can be easily verified by substituting $p_i = 0$ or $p_o = 0$. The first of properties (iii) is verified when $m(p_o, p_i) - m_o(p_o) > 0$, which reduces to $x > 1 - (1 - s) / s \cdot p_o$, which is true when $s < 1/2$. The second of properties (iii) is verified when $m(p_o, p_i) - m_i(p_i) > 0$, which reduces to $x < 1 / s$, which is true when $s < 1$.

TABLES AND FIGURES

Table 1: ORGANIZATIONAL FEATURES OF FORMAL INSTITUTIONS

(SUB-SAMPLE: rural Charters from Valley of Non, 1581-1644)

	<i>Feature</i>	<i>Number of doc. (tot. of 23)</i>	<i>% of relevant doc.</i>	<i>Relevant documents</i>
	TRESPASSING AND IMMIGRATION			
1	• Monetary sanction imposed on outsiders who trespassed on the common land	23	100%	All (= 23)
2	• Non-member residents had to pay an annual fee to use the common land	10	43%	All
3	• Explicit consent of village members (<i>vicini</i>) was required to use the common land	5	22%	All
	OBSERVABILITY OF INDIVIDUAL ACTIONS			
4	• Higher sanction for violations at night	12	52%	All
5	• Higher sanction for violations committed by outsiders	16	70%	All
6	• Guards for vineyards	15	100%	Where vineyards were mentioned
7	• Prohibition against harvesting grapes before a publicly announced day	13	87%	Where vineyards were mentioned
8	• Guards for high mountain meadows and forests	15	-	
9	• Prohibition against mowing hay before a publicly announced day	12	80%	(10)
	OTHERS			
10	• Participation at meetings was compulsory for all village members	19	83%	All
11	• A share of the monetary sanctions had to be given to the Prince or to the Landlord	8	35%	All
12	• Only witnesses with a good reputation can be accepted in the village court	9	39%	All

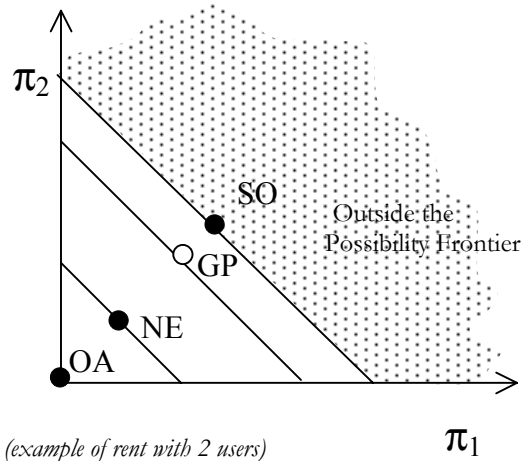
Notes: The 23 Charters analyzed are all the documents published in *Giacomoni (1991)* concerning the Valley of Non (current administrative district of the Val di Non) in the years 1560-1660 with the exclusion of 3 Charters that were in Latin (*Sarnonico and Ronzone, 1586; Mechel, 1587; Bresimo, 1603*). Subsequent modifications to the original Charters up to the year 1800 have not been counted in the table. That would add 3 to line (2), 2 to (3), and 1 to (8) and (9)

Figure 1: ITALY DURING THE RENAISSANCE



Notes: the Principality of Trento was a mountain area on the Italian side of the Alps part of the Carolingian Empire. It was located North of the Republic of Venice. The current Trentino region covers a surface of 1,465 square miles and in 1754 had a population of 206,000 scattered in more than 300 villages (Cole and Wolf, 1974; Provincia Autonoma di Trento, 1995). Source of the map: Adapted from Muir's Historical Atlas: (1911), <http://www.fordham.edu/halsall/sbookmap.html> (checked on Oct 2000)

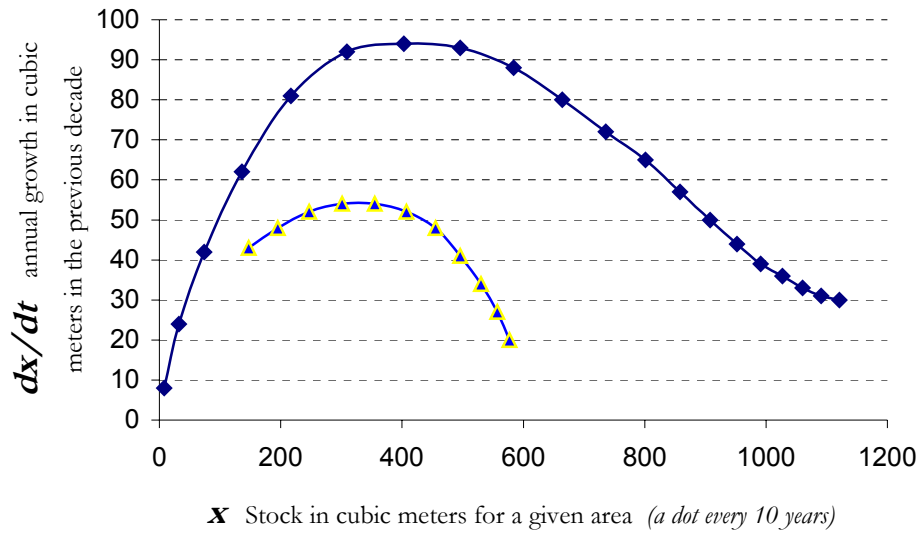
Figure 2: POSSIBLE RENT LEVELS FROM THE USE OF A COMMON RESOURCE



Notes: Total rent $\Pi = \pi_1 + \pi_2$ (example of rent with 2 users)
 SO = Social Optimum, NE = Nash Equilibrium, GP = Green-Porter, OA = Open Access.
 The dots show a symmetric outcome for each rent level.

Figure 3: EXAMPLE OF BIOLOGICAL DYNAMIC OF A RENEWABLE RESOURCE:

FOREST GROWTH



Note: the empirical data for red fir (upper line) comes from Trentino and for beech (lower line) from another region of Italy. The maximum sustainable yield (MSY) for the fir is at 70 years. ISAF.A (82)

¹ The oldest know of such Charters dates back to 1202 and was drawn by the villagers of Civezzano, a small village nearby the administrative center of Trento. Most of the documents here quoted are from Giacomoni(1991), which copied 190 rural Charters of the Trentino area from the parchments that were found in the Biblioteca Comunale of Trento, Archivio di Stato of Trento, Archivio della Curia Arcivescovile of Trento, Biblioteca Civica of Rovereto, Ferdinandeum Museum of Innsbruck, Castel Bragher and several village archives. Nequirito (1988) surveyed the literature that published the text of Charters. Many Charters have not been published yet and new ones are discovered every year. For documents relative to some other regions in the Alps, see Batl (1951), Cortesi (1983), and Pototshing (1953).

² The reference is to the villages of Romeno, Don, and Amblar. Regulation of the gate is mention in the 1459 rural Charter (chapter 24: *Item che la chiave della porta di Vallavena sia tenuta et conservata nella sacrestia della chiesa di santa Maria di Romeno*).

³ Allen (1998) defines property rights as “one’s ability, without penalty, to exercise a choice over a good, a service, or person” and transaction costs as “the costs of establishing and maintaining property rights”. See also Barzel (1997) and the classical article of Demsetz (1967). Besides trespassing, legal disputes over community borderlines were very common as it is testified by the incredible number of documents on the matter that can still be found in the archives.

⁴ Libretto di Amministrazione (1589): “*per una codanza fatta per aver menado entro legna da le giare del nos*”, which literarily means “for a penalty inflicted for having removed firewood from the bank of the river Nos”. For the rural Charters of Mezzolombardo see Devigili (1979).

⁵ On the best of my knowledge at least three-quarters of the Trentino villages have had a Charter by 1803 (284 villages out of 377). The count is approximate for two reasons: First, I took as total the number of villages the land register units in which the province of Trento was divided in 1897; secondly, I have counted only the Charters that I have collected but some Charters might have been lost or not found by me. Both factors suggest that the actual ratio is above 75%.

⁶ The exact data are 48% and 31%. Source: 1897 land register data reported in Consiglio Provinciale d’Agricoltura, 1903.

⁷ The data are from the *Catasti Teresiani of 1780-90*, manuscripted books recording ownership rights (*Archivio di Stato di Trento*). Goio(1978) reports the summary statistics for the village of Levico and Varesco (1981) for Predazzo. A more systematic study of the extent of common ownership could be carried on. In 1897 more than 76% of the forest in the region was municipal or State ownership. After 1803, both political and economic shocks reduced the extent of communal ownership. Part of the village estates were divided in individual plots or sold after the end of the Principality of Trento. An increasing population and more generally and increasing logging activity reduced the extension of the village forests (Perini, 1852, Monteleone, 1964).

⁸ $E(Q^{NE}(N)) = (4N)/((N+1)^2)$

⁹ It is a similar logic to the supply side of a market where there is free entry. If for any reason the outsiders have a discount rate lower than the insiders (for instance because of their temporary stay), the ‘tragedy of the commons’ is even more serious.

¹⁰ The situation could however have been improved employing information-gathering institutions.

¹¹ In the discussion, a publicly observed signal is assumed. Cooperation is more problematic with private signals. A villager sampled the status of the common land in a given number of locations while doing his daily activities and did not usually cover the whole land and count every tree in order to find out the exact quantity of the leftover timber or grass. The signal was thus a random variable, which yielded different draws to different villagers because the sampled areas were in general different. This individual heterogeneity in the signal could easily make implicit cooperation unravel. If communication is allowed, however, the information will likely be aggregated into a public signal (Kandori and Matsushima, 1998; Compte, 1998).

¹² There is a perfect formal symmetry between firms competing on quantity in an oligopolistic market and users exploiting a common resource. See appendix for a more extensive explanation.

¹³ Some Charters report at the opening the list of the heads of the families present at the meeting. Women usually moved to the man’s village when they got married. The last name was transmitted through male lineage and only the pater familia was entitled with the right to use the common land.

¹⁴ From Statuti et Ordini della Spet. Comunità di Nago e Torbole (1683): Nago and Torbole, 1647: “*Cittadini, che non habitaranno non possono goder beni comuni?*” (c.73: They cannot bring timber outside the village borders; they can use the common land only if they still have individually owned land in the village). “*Cittadini, che partono dal commune, et ritornano, che non possono goder beni comuni, se non pasato un anno?*” (c.74). There is probably a relationship between the location of these two communities nearby the Garda lake – the biggest in Italy - and the very detailed regulations contained in their Charter for people who where leaving the community, temporary or definitely.

See also Tres, 1551 (the 1599 modifications regulates the *vicino* status) and Casez, 1632, c.45

¹⁵ See Dossi (1913) and Dossi (1927)

¹⁶ Meadow assignments can be found in Pradibondo 1221, Condino 1340-3, Storo 1347, Nago-Torbole 1533, Caderzone 1591 (Papaleoni, 1891, Papaleoni, 1892, Valenti, 1911, Dossi, 1927). Forest assignments can be found in Storo 1347, Nago-Torbole 1541. Many other rural Charters mentioned temporary assignments of meadows (*sort*) (Mortaso, 1558, c.119-125), though sometimes the wording is ambiguous. Individual assignments were in fact family assignments. The individual assignments of common land has been interpreted as an early form of individual ownership (Papaleoni, 1892) but it remained in many ways closer to common than to individual ownership.

¹⁷ A qualified majority of at least 2/3 was required to sell the common land in Cles 1641, c.5 and in Cis 1587, c.80. Some authors interpret the absolute prohibition to sell the common land as a pivotal aspect of the traditional land management of the Trentino communities (Andreatta and Pace, 1981). In this paper we argue that this statement is not empirically correct and that it is not a requirement from a theoretical point of view to ensure a long-term relationship among users. Absolute inalienability and indivisibility of the commons were not cornerstones of the historical form of common ownership in Trentino, although selling the commons was sometimes subjected to the authorization of the feudal authorities (Cagnò 1587, c. 3, modification of 1693). An interesting discussion about the role of tradability of property rights in the commons can be found in Seabright (1993).

¹⁸ Example of *forestieri* were the residents of neighboring villages, seasonal workers living in the village, occasional travelers. Similar systems were adopted in other regions of Europe (Popkin, 1979).

¹⁹ We are more likely to observe explicit immigration regulations where the per capita endowment of common forest and pasture was highest. Some rural Charters do not mention rules to accept newcomers and the reason might well have to do with the fact that nobody ever wanted to move into those “poor” communities See lines 4 and 5 of table 1 for the frequency of immigration regulations. I did not test this conjecture.

²⁰ For an example of male inheritance of the right to use the commons see Tres 1551 (and modification of 1599, chapter 102 and 103). The *vicini* were men representing their families. In particular circumstances the family could be represented by a woman (in particular, the widow, if her male children were still too young). For a more detailed discussion on the recognition of the peculiar nature of these historical forms of collective properties in the Alps, see Grossi (1982) and Capuzzo (1985).

²¹ A letter from the governor (*Scario*) to the Prince dated 16 November 1583: “*Et perché da uno tempo in qua molti forestieri se maridano in done de Fiemme solamente per haver detta vicinanza, et questi tali forestieri continuamente hanno fato e fano assai desordeni et dani in li boschi de essa Comunità ...*” (Delugan and Visani, 1988, p.54).

²² Cles 1641 (modification 1719, c.2, “*attestati autentici della sua buona vita et costum?*”). In addition from requiring the prospective member to give good references about his reputation, Nago and Torbole required some form of real warranty in case of mis-behavior. For instance, see Nago and Torbole 1647, modified in 1670, c. 72: outsiders cannot stay in the village for more than 3 days unless they own a piece of land or a house (*stabili*) worth at least 200 fiorini. No outlaw could be accepted (*banditi or ricercati*). For a description of the situation in the Fiemme Valley see Ciresa and Salvotti (1978) and Delugan and Visani (1988).

²³ Cis, 1587 (all but 3 dissenters), Cles, 1641, Tres, 1551 (unanimity required in 1599)

²⁴ See the modification to Cis, 1587, chapter 80: “*... alienare beni comunali o ricevere alcuno forestiero per vicino se meno di 3 vicini son contrari?*”

²⁵ For example Cles, 1641, c.57: “*Che li forestieri habitanti nella comunità di Cles siino colettati dalla regola per l'bonesto in loro arbitrio, considerando la loro qualità et animali che tengono sopra li comuni, et in più concorrono ad ogni cosa ordinaria et straordinaria come li vicini,...*”. See also Tres, 1551 and following modifications.

²⁶ The oldest know of such Charters dates back to 1202 and was drawn by the small village of Civezzano, nearby the administrative center of Trento.

²⁷ For example, the 1677-78 administration booklet of the community of Coredo lists at least ten fines extolled from outsiders, oftentimes for cutting trees in the village forest as is reported in the *Libri de Conti della Honoranda Comunità di Coredo*: “*ricevuto per condane fatte alli sottoscritti come forestieri?*” (1677-78). This despite the fact that trespassers had to refund the market value of whatever they harvested and in addition pay a penalty. There are other reports of fines where it is not specified if the payment came from insiders or outsiders: “*per due larici taliati nel ingazato, e venduti a Sfruz?*” (1672-73), “*per haver tagliato un pez dent in sas nella sorte?*” (1673-74), “*per il valor di legni menati dal monte con buoi forestieri senza licenza?*” (1677-78).

²⁸ Raising the level of the fine has two additional effects, a beneficial and a detrimental ones. The benefit comes from the extra incentive in detecting trespasser (an increase in *p*). The extra cost is due to the increasing effort necessary to collect the fine from the trespasser, since he could for instance appeal to the landlord and Prince courts.

²⁹ For the text of the *Moderatio Betta* see for instance Salter e Malgolo, 1586. For a comment on the *Moderatio Betta* see Welber (1992).

³⁰ This rule was almost always there if there were vineyards in the village (see table 1). For an example see Tassullo, Rallo, Pavillo and Sanzenone, 1586, c.30, 52, 60. One reason was to collect the *decima* (tax on the harvest) but fear of thefts

were relevant as Sanzeno (villa), 1586, c.27 makes clear: in case somebody needs to harvest a day before” *che ogn’uno sia obligato lasciar da vendemar appresso li suoi confinanti: che non debba integralmente vendemare in un luogo, havendo confinanti, et questo si apparerà alli regolani; et che quello il quale vendemerà sia obligato avisar li decimani che vengino pigliar la sua decima*”.

³¹ For an example Vigolo Vattaro, 1496, c.22

³² For references from rural Charters, see for instance Malosco 1593, c.25, 26 and Tres 1551, c.53, 54, and 55.

Monteleone (1964), pages 34-37, provides clear evidence for the years 1810s when the rural Charters were abolished. He writes about the thefts in the vegetable gardens: “*L’istituzione dell’orto nel Trentino era ritenuta particolarmente rischiosa per la facilità e la frequenza dei furti che sconsigliavano l’agricoltore non solo dal dargli il desiderabile respiro superficiale ma anche dall’erigerlo in aperta campagna e distante dagli abitati.*” and again about fear of thefts on fruit trees: “*Un altro ramo redditizio della produzione era costituito dal frutteto, la cui diffusione, in generale notevole, trovava però una limitazione comprensibile in non poche regioni caratterizzate da alti indici di delinquenza, che inibiva col timore dei furti l’iniziativa del contadino*”. Another colourful example is the theft of the wooden supports from the vineyards: “*... il timore dei furti, a tal punto incruditi negli ultimi anni, da convincere il contadino di non poche regioni che pali e tronconi sarebbero rubati, se non il primo, certamente il secondo inverno seguente*”.

³³ For two among many: Salter and Malgolo, 1586, c.26 (fines doubled at night); Sanzeno (villa), 1586, c.13 (fines doubled for outsiders), c.6 (differential treatment of outsiders from insiders: need to leave timber in the village for three days).

³⁴ Pieve di Sanzeno, 1586, ch.23: “*Item per tor via molti abusi et cative usanze et cativi costumi che per alcuni che per il passato si ha fatto, si statuisse che niuno della pieve non debba, né anco forestiero ardisca, di stare di notte, né di di festa, eccetto che il gazaro, uno over più, in la montagna predetta ed massime nel tempo della segagion ed mentre è ancor il fieno nelli prati: sotto penna de lire cinque per cadauna persona; ed se fosse rubato fieno ad alcuno over legnami over anco taiato legnami (...) che si imputi tal furto ed contrafacion a quello over quelli che si trovarono esser stati la note over il giorno di festa sul monte*”, see Cagnò, 1587, c.43 for a more generic rule against working during holidays.

³⁵ There were also guards for the vineyards (*saltari delle vigne*). Vineyards were nearly all in individual hands but there still was a need to enforce the property rights toward trespassers. This activity was organized collectively and regulated in the rural Charters (see table 1). Switching from village to individual ownership would does not exempt from the need for external enforcement of property rights.

³⁶ The 1350 tax register for the Valley of Non, a district that represents less than one fifth of the area, mentions 38 villages of a size variable between 5 to 59 families (*foce*). Under the generous assumption of 5 people per family on average, the biggest village had less than 300 inhabitants (Bezzi, 1964). There was no requirement to own land individually in order to participate to the meetings. In order to modify a Charter usually a qualified majority of the people needs to be present.

³⁷ Oral communication by Marco Boscolo, June 2000.

³⁸ The fact that we do not often observe formal regulations also in oligopolistic markets is because cartels are illegal contracts. In order to overcome the unavailability of the otherwise convenient way of enforcing the agreement through courts, the oligopolistic firms use Folk-theorem type strategies.

³⁹ In addition to this economic reason there are probably sociological and anthropological aspects that deals with the risk of social disruption due to unlimited revenge (Girard, 1972). The risk is higher when there is not a well-defined norm for how much punishment should be considered enough.

⁴⁰ Bringing weapons to the meetings, even a knife or a farming tool, was prohibited. Sometimes the guard (*Saltaro*) could bring the *roncola*, a special cutting tool used for chopping wood. Many charters explicitly punish the use of insulting words during meetings.

⁴¹ Seio, 1616, c.1: The refusal to take on the governor office when elected is punished. *Vicini* are appointed guards by rotation. See also Casez, 1632, c.5. The Charter of Romallo, 1598, c.81 mentions the need in general of the *vicini* to perform their duties, “*fare tutte le foncioni ordinarie et straordinarie*”.

⁴² Romallo, 1598, c.46 “*... et se alcuno vicino dicessero e non volessero far per fuogo, sia astretto et sottoposto a perdere e rinunciare la sua parte di commun et sia obligato pagar l’affitto come forestiero*”.

⁴³ The service provided by the community organization were valuable. Since insiders contributed to building the social capital they were asked to pay less than outsiders for such services. An example are the payments requested to outsiders for the services of protection of property rights in Vion, 1620, c.45, “*Item hanno statuito et ordinato che se alcun forestiero che haverà o possederà beni nelle pertinenze di Vion sia tenuto ong’anno dar al saltaro, qual haverà avuto custodire delli suoi beni, una quarta di segalla.*” See also Pieve di Vigo di Ton, 1644, c.2 (outsiders pay more than insiders for the services of the guard). Another example is about the service of damage estimation from village officers Sanzeno (villa), 1586 (modification 1694, c.5) “*Che li regolani per stimare danni habbino per loro mercede carentani sei a ciascheduno di loro, et il medemo al saltaro denuntiante; et se il pretendente l’estimo del danno fosse forestiere, haverano li regolani et saltaro il dopio*”