Consequences of Social and Resource Heterogeneity in Endogenous Institutions

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Abstract

This paper examines the consequences of within-group societal and resource heterogeneity on private order institutions for the management of the commons. The hypothesis tested is that heterogeneity increases the costs of social contracting for defining and enforcing property rights, thereby affecting the process of institutional design and its stability. To test this hypothesis, I exploit the diversity exhibited by 159 self-governing communities that wrote and voted on community bylaws to manage their common resources in the Italian Alps during 1245-1801. Several proxies of institutional complexity are developed, based on a rich body of community bylaws: statistical analyses are conducted on a sample of 8,994 coded bylaws articles and data concerning 7,765 attendees in 260 legislative assemblies. The two measures of heterogeneity employed are the diversity of surnames in the group of those who vote and directly benefit from the legislation, and the diversity of communities in terms of natural resources. After controlling for group size, it is found that both surname and resource fractionalization had an impact on the design and stability of institutions. In larger groups a weaker stability of institutions is also found, as they struggled more to reach a wide consensus.

KEYWORDS: group size; heterogeneity; endogenous institutions; commons.
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1 INTRODUCTION

Crafting enforceable rules that enhance social welfare is challenging when multiple users have rivalrous and non-excludable access to a common-pool resource. In this paper, I examine the consequences of within-group societal and resource heterogeneity on private order institutions for the management of the commons in the Italian Alps during 1245-1801.

This study departs from the observation of a substantial disagreement of scholars concerning the role of heterogeneity in collective action, and the opportunity to observe the presence of sources of heterogeneity in every institutional context. In fact, the relation between how institutions for collective action are actually designed, and the role played by societal and resource heterogeneity remains controversial from both the theoretical and empirical standpoint (Ostrom, 1990; Poteete and Ostrom, 2004).

I contribute to the empirical side of this debate by underlining some interesting correlations regarding original data from a historical case, suggesting potential explanations for this controversial relationship. Starting from the observation and description of sources of heterogeneity in village assemblies in the Italian Alps adopting "Carte di Regola", and questioning whether it is possible to capture statistically significant correlations of these heterogeneities with the normative content of institutions, assuming that societies proceed to institutional changes when it is efficient to do so (Demsetz, 1967, 1968).

This paper combines a comparative analysis of institutions with the statistical analysis of individual- and community-level data from multiple historical and geographical sources (Diamond and Robinson, 2010; Greif, 2006, 1998), with the following purposes:

1. To provide evidence of existing correlations between heterogeneity and institutional outcomes, attempting to disentangle the potential endogeneity issues involving this relation (Leeson, 2005; Aoki, 2007) in two ways:

   (a) by studying two forms of heterogeneity exogenously determined with respect to institutional outcomes: societal heterogeneity is measured using a generic fractionalization index based on surnames, while resource heterogeneity is measured with a fractionalization index on land resource composition;

   (b) by capturing societal and resource heterogeneities during the setting-up phase of the institution (during the village assembly) separately from institutional features decided after the collective action, where these heterogeneities might have had an impact on the observed design of the resulting institution (after the village assembly);

2. To investigate the consequences of societal and resource heterogeneity on institutional outcomes within a context that provides comparable observations over a six century period. To this extent, the observations of the dataset used in this paper have numerous advantages:

   (a) they are taken at different times over the considered period;

   (b) they are all in a well delimited region with stable political characteristics;

   (c) they are located in an alpine area with heterogeneous natural characteristics (resource heterogeneity);

   (d) they are also comparable on the institutional side, having adopted similar institutions ("Carte di Regola") in the considered period. These institutions were based on the same collective action mechanisms, and are codified and thoroughly analysed.

3. To suggest the direction of the effect of social and resource heterogeneity on institutional design, based upon the analysis of the empirical evidence.

The structure of the paper is as follows. The remaining paragraphs of this first section provide a focused literature review on the problem of heterogeneity in institutions for collective action (subsection 1.1), state the ground hypothesis (subsection 1.2) and offer an overview of the historical setting of the "Carte di Regola" in the Italian Alps (subsection 1.3); section 2 outlines the methods adopted in the research design, data, empirical strategy and estimation; section 3 states the results of empirical analyses, while section 4 discusses the results before concluding.

1.1 *The terms of the problem*

The study of heterogeneity and of its consequences in collective action and institutions has a long scholarly tradition, being separately treated in two strands of research and predominantly dealing with the determinants of the provision of public goods.

The first strand of studies moved from the theoretical study of collective action (Olson, 1965; Oliver et al., 1985; Heckathorn, 1993), later inspiring literature on common-pool resources. The ground-breaking study by Ostrom (1990) on the governance of the commonly explicitly uses the expression "institutions for collective action", first raising the problems of size and heterogeneity in self-governing groups managing common-pool resources. There have been numerous contributions following this first study, which are only partially treated here.

A further stream of literature commenced with Tiebout (1956), and has been developed in the works of Alesina et al. (1999); Alesina and La Ferrara (2005). Such contributions inspired scholars interested in economic growth and the effects of inequality, fractionalization and inter-group conflicts on institutional and economic outcomes (Habyarimana et al., 2007; Vigdor, 2004; Easterly, 2001; Acemoglu et al., 2001; Alesina et al., 2003), and have been followed by a rich body of both theoretical and empirical papers, and - more recently - experiments (Smith, 2011).

The leading question in the study of common-pool resources (i.e. forest, pasture, water basins, the atmosphere, etc.) has shifted to research on the effects of the heterogeneity of appropriators on the likelihood of self-organisation and the type of rules designed (Ostrom, 2005).

Contributions in this strand of literature differ in their definition of group heterogeneity along a diversity of dimension: cultural background, interests and endowments. For instance, Vedeld (2000) focuses on resource heterogeneity, particularly forest coverage. Varughese and Ostrom (2001) highlight the terms of the institutional consequences for the presence of heterogeneity: when the interests of appropriators differ, it is particularly challenging to achieve a self-governing solution to common pool resource problems.

The problem is often raised of appropriators with more economic and political assets having similar interests to those with fewer, which may also differ substantially. Ostrom (2005) reviews a series of interesting case studies of interest dealing with economic inequality related to income, assets, stability of income streams, values, knowledge and skills, and location, in maintaining the resource. She also reviews studies dealing with forms of social heterogeneity (age, gender, ethnicity, status, residence), which often are mirrored in forms of political and economic heterogeneity at the base of a group's interests in shared resources (Poteete et al., 2010). Across all of the studies reviewed by Ostrom, heterogeneity sometimes has an impact on collective action, yet most rarely not. When it was present, heterogeneity had a highly variable impact.

Despite the case studies reported by Poteete et al. (2010) showing that institutional arrangements can mitigate the effects of heterogeneity, it is generally more regarded as an obstacle to collective action because it hinders individuals from reaching cooperative solutions (Libecap, 1995). This argument highlights a major concern within literature on heterogeneity Ostrom (2005), that the direction of causality still remains uncertain. This direction needs to disentangle the relationship between within-group heterogeneity and the design of endogenous institutions (Aoki, 2007), involving the question of whether heterogeneity causes some economic outcomes, or if it is caused by the outcome itself (Leeson, 2005). Here I attempt to disentangle endogeneity and investigate whether a relation from

heterogeneity to features of institutional design finds empirical support.

1.2 *The hypothesis*

The main *hypothesis* is that heterogeneity increases the costs of social contracting for the allocation of property rights (Libecap, 1989; Barzel, 1997; Coase, 1960), by decreasing the likelihood of social cooperation (Smith, 2011; Erlei, 2008) and hindering the process of aggregation of social preferences (Arrow, 1950; Brown, 1975) in the provision of public goods (Alesina et al., 1999; Vigdor, 2004; Habyarimana et al., 2007), consequently affecting the design and stability of institutions. Recent research in constitutional economics implicitly supports this hypothesis, finding that sources of societal heterogeneity might affect the structure of constitutions and normative content of the rules written and enforced legislative assemblies (Crowley, 2011). Three premises complementary to this hypothesis are suggested:

1. Contracting for property rights in heterogeneous societies entails more transaction costs than homogeneous ones;

2. Human "natural" characteristics determine the costs of collective action;

3. Institutions for property rights react to such costs in their evolution path with "institutional changes" (Acemoglu and Johnson, 2005; Demsetz, 1967; North, 1990).

1.3 *The historical setting*

I observe within-group heterogeneity and the institutions developed by village assemblies in the Bishopric of Trent during 1245-, within which it has been possible to study how sources of heterogeneity are related to changes in terms of design and internal functioning of the institution, as represented by the bylaws written and enforced by self-governing communities.

The Prince Bishopric was a Princedom of the Holy Roman Empire from 1027, lasting uninterruptedly until 1803. Jointly appointed for a lifetime term by the Emperor and the Pope, the Prince-Bishop allowed and approved the village communities' scattered in the Prince-Bishopric establishment of their own bylaws for the economic governance of communities, invoking exclusive jurisdiction over criminal and tax matters[1]. Since the

[1] A good historical introduction on the rural charters during the Bishopric of Trent (1027-1803) is provided in Nequirito (2002). For an overview of archival sources in the period after Napoleon, another good synthesis is offered by Nequirito (2004). A comprehensive history of the Bishopric is in Castagnetti and Varanini (2004); Bellabarba and Olmi (2000). A list of references on sources at village level is available upon request.

XII century (*Patti Gebardini*, year 1111), many upland communities in the Italian Alps have written their own bylaws, calling them "Carte di Regola" ("rural charters", or simply "*charters*"). The first recorded charter in the dataset dates back to t1202, and the last in 1807. Napoleon invaded Northern Italy in 1796, and abolished the charter system in 1807.

The normative content (hereinafter: "content") of the charters regulated the economic life of the community, and represents a case of emergence of private-order governance regimes for the management of natural resources (Casari, 2007). Given that communities might include one or more villages, a community charter could deploy effects on more villages.

Common resources were generally regulated and accessible only to the resident group, called "*Vicini*". The "*Vicini*" were the members of the community, which I will define as the *insiders*. The requirements for being part of the insider group, and the procedures for admittance to the insider group (membership rules), were carefully specified in the community bylaws. Such "contracts" were drafted and voted by the representatives of the insider group itself: the heads of the families, which compounded the "*Regola*", the legislative assembly of the community.

The residual portion of the community population was composed of "*Forestieri*" (*outsiders*), who were normally granted neither participation in the community governance, nor access and management of the commons (typically pasture and forest), unless the regulation allowed them to use or access rights by virtue of monetary payments (purchase of rights) or inheritance Casari and Lisciandra (2010). Despite not necessarily being a minority, outsiders were therefore passive subjects of the rules determined by the legislative assembly of the *insiders*.

Although the bulk of the rural charters are represented by practical resource management rules, the text of the rural charters describes the governance of the community and modes of participation to legislative assemblies in detail. Together with the provision decided, it sometimes reports the meeting's minutes: attendance was generally mandatory and absence subsequently punished, likewise uncooperative behaviour in assemblies (such as swearing, insulting or beating assembly participants, or simply carrying weapons during assemblies).

A description of the voting procedures was sometimes specified in the documents, which often also reported the assembly quorums and modes for representing resident village members who were unable to participate for a just cause.

2 METHODS

This section is divided into four subsections: research design (subsection 2.1), data description (subsection 2.2), testable conjectures (subsection 2.3) and estimation methods (subsection 2.4).

2.1 *Research design*

The research question is unpacked into three conceptual "blocks": institutions, heterogeneity and group/resource size (Figure 1), which will be employed to elaborate the model used in the empirical investigation of their correlations.

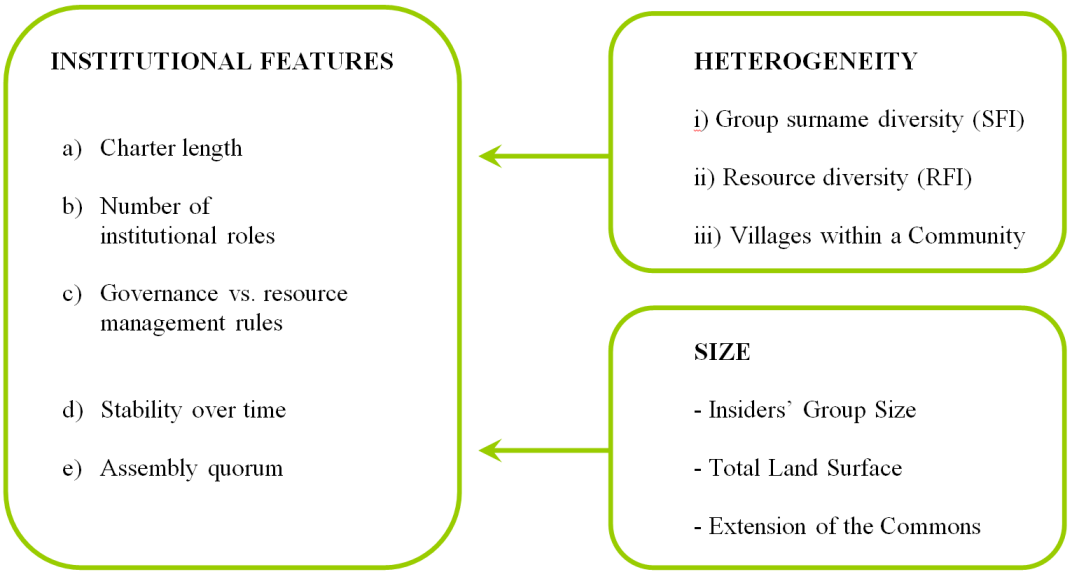
I first consider *institutions* as the outcome of collective action, and provide measures of this outcome. Measuring institutions is considered as opening a "black box" (Hansson, 2006; Acemoglu and Johnson, 2005). I define a set of key features to describe the institutions studied in this paper, which resulted from the face-to-face social interactions for the definition and allocation of property rights on common land in Trentino between the 13th and 19th centuries. These features will be used as dependent proxy variables in both statistical modelling and testing. These variables belong to two different moments. A first subset of variables arises from the process of collective decision, including variables that are determined *before* or *during* community assemblies: the *number of institutional roles* and the *assembly quorum*. The second subset deploys effects *after* the assembly, considering the normative content of the new institution in terms of structure and content. The indicators drawn from the text of institutions are: the *length* (number of articles written in a bylaws) and choice of *resource management* and *community governance rules*. Another important feature that can be derived from the timing of adoption is the *stability over time* of institutions, quantified as the number of years preceding the occurrence of the next institutional change.

Two remaining blocks identify factors that might exogenously influence the aforementioned institutional features.

I describe the existence of sources of *heterogeneity* within communities engaging in collective action. Two measures of heterogeneity are investigated: the diversity of surnames in the group of those who vote and directly benefit from the legislation, and the diversity of communities in terms of natural resources. Given that assemblies might count representatives from two or more villages, I also include the *number of villages* as a proxy for societal heterogeneity.

I eventually consider the *size of groups and resources*, focusing only on the size of the *insiders' group* as it is the one directly involved in the collective action of institutions. The

Figure 1: Possible factors influencing institutional features



Note. Graphical representation of the possible factors (on the right) influencing institutional features (on the left) tested in this paper.

total land surface and amount of *commons* are also considered.

The existence of correlations between diversity and institutional features is investigated through the formulation of a set of conjectures and their empirical testing.

2.2 *Data*

I exploit the societal and resource diversities exhibited by 159 self-governing communities that wrote and voted on community bylaws to manage their common resources in the Italian Alps during 1245-1801.[2] Statistical analyses are conducted on a sample of 8,994 coded bylaw articles and data concerning 7,765 attendees in 260 legislative assemblies. I describe the data for communities (subsubsection 2.2.1), institutional features (subsubsection 2.2.2) and heterogeneity (subsubsection 2.2.3). [3]

The information concerning institutions and assemblies comes from the detailed analysis of 260 archival documents in a subset of the complete dataset[4] of the rural charters

[2]A comprehensive guide to the archives of the area is offered by Casetti (1961), and presently in the online catalogues of the Provincia Autonoma di Trento

[3]The variables, described in detail at Table 2, are all contained within a unique dataset (unless otherwise indicated, see Table 1 for a description of the sources of each variable), and are grouped in four main categories: 1. communities, 2. assemblies, 3. institutions, 4. heterogeneity.

[4]This database has been developed by Marco Casari and Maurizio Lisciandra (quoted as: *Casari & Lisciandra*), who I gratefully acknowledge for sharing this dataset. See Table 1 for details on datasets and

($N_{tot} = 879$): I only select the documents containing detailed information on assembly attendance [5].

The unit of observation for the study of heterogeneity is the single *assembly* ($N_i = 260$), considered as an independent event, even when occurring in the same *community* at a different moment in time.

2.2.1 *Communities*

Among all the communities in the original dataset used by Casari ($N_{tot} = 452$), only those containing details on assembly participants are selected, $N_c = 159$. I provide the basic information concerning the context surrounding each assembly, and separate time invariant (mainly concerning the natural characteristics of the community) and time varying variables[6]. There were single-village and multi-village communities. For simplicity, I do not consider here the internal structure of communities, focusing on the highest organisation level (the community).

Settlements largely relied on dairy production and the production and trade of timber that could be employed in the building sector, mining industry or traded outside the region via rivers. Therefore, forest and pasture areas were crucially important in the economic life of communities, and were usually regulated under a common property regime by the rural charter. The economy emerging from the text of the charters relies heavily on agriculture, widespread and particularly organised at lower altitudes, where vineyards, plow land and fruit gardens were largely managed under a system of tradable private property rights.

Owing to the highly variable conditions of altitude, temperature and position, settlements were endowed with resources in differing proportions, with evidence of this heterogeneity reported in a tri-plot chart that uses the 1897 Land Register Data (published in 1903, Figure 2).

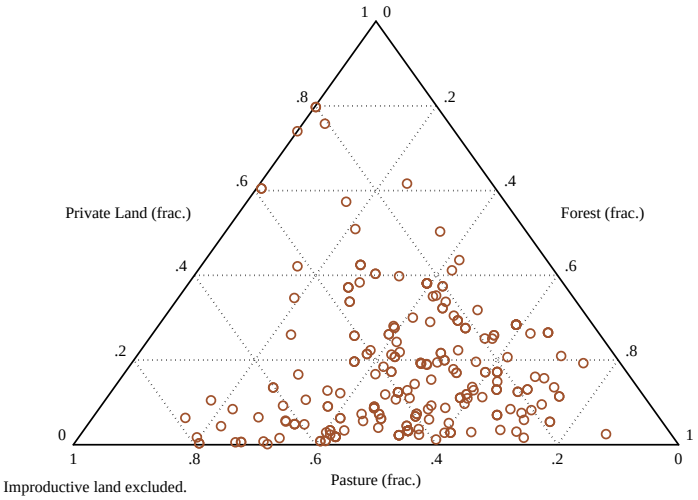
Community-level population estimates are obtained using data from the 1810 Napoleonic

original sources of data.

[5] The analyses conducted in this paper hold under the hypothesis that the subset of 260 documents is representative of the whole set of charters. Potential self-selection issues are addressed by assuming that the notary decided to write the list of attendants at random. I did not find direct evidence of notarial regulations in terms of setting forth provisions requiring the notary to write down the lists of attendance, and conversations with local historians and archival experts about their research in notarial deeds also confirmed this result, therefore perfect randomness in reporting the list of attendance can be assumed. The support consists of three facts: the dataset covers 1245-1801 (meaning that the dataset contains lists over the whole time period), it is possible to find both very long and very short lists (meaning that there were lists for both small and large meetings), and resource heterogeneity exists (meaning that lists were written in diverse natural settings, see Figure 2).

[6] See Table 3 for summary statistics of time-independent variables, and Table 4 for statistics of time-dependent variables.

Figure 2: Tri-plot: Heterogeneity in natural resources



Resources are represented as proportions of the total land surface.

Census, reported in Andreatta and Pace (1981), and the Italian Population trend in Bellettini (1987)[7]. The sample mean is rather low (530 individuals), and exhibits a high variation whose determinants are here not investigated.

Using assembly data on attendance, I estimated an *insider group size*: the assembly was participated in by all the heads of the families, and - using the assembly quorums - it was possible to obtain an estimate of the total number of individuals qualified to attend (the number of the families that should attend the assembly), and multiplied this number for a conventional average household size of five individuals[8]. By subtracting the insiders group size from the total community population, I obtained an indirect estimate of the number of outsiders for each of the communities in the year of the recorded assembly[9].

[7] I cross-checked the reliability of these estimates with point estimates by local historians and original sources when available, obtaining a high Spearman correlation coefficient (computation available upon request).

[8] Useful references on this point are Debiasi (1953); Seneca (1953); Chiocchetti (1983); Garbellotti (2006)

[9] However, this estimate suffers of a number of limitations. First, it is not a *direct* estimate, but rather calculated as a difference of two estimates: namely, population (backward estimate using the Italian population trend and each village population in 1810), and the insiders group (based on attendance at a limited number of assemblies, quorum and "indirectly estimated quorums", and the conventional household size). It is based on two different sources, and does not have a direct historical counter-factual: in fact, I have no point estimates or historical sources to check its reliability, as conducted with population. The consequences of these limitations intrinsic in the data might lead to measurement errors (i.e. this measure neglects unobservable internal migrations) and potential selection bias in the estimates. Nevertheless, this is the first attempt to measure the proportion of outsiders, and to my knowledge no alternative source studying phenomena related to internal migration in Trentino exist at present.

2.2.2 *Institutional features*

***Quorums* and institutional roles: data from assembly attendance.** Assemblies were usually held in the village's square, with the sound of the village bell tower ("*ad sonum campanae*") announcing that the assembly was summoned. Since the previous day, each participant was called to attendance with an explicit door-to-door convocation by a village officer. The documents often reported in their preamble a summary description of the assembly dynamics, which are essential sources to understand the functioning of the institution. The *preamble* often contains information concerning all the attendants: their name and surname, plus such details for their ancestors, their job in the village, the village of origin, and their role in the assembly. Assembly quorums were also reported[10]. Additionally, documents report the name and surname of the notaries who wrote the charter, and the witnesses (usually coming from other surrounding villages).

I constructed the *Assembly* dataset from direct observation of the preambles to the original documents sources, and found individual-level information concerning 7,765 attendees in 260 legislative assemblies deciding the assignment and enforcement of property rights on land in 159 communities, from 1245 until 1801.[11]

The individuals represented in the table can be divided into two classes: those with and without voting rights in the process of deliberation of the community charter. Those attendees without voting rights were the notary, witnesses and other non-attending village members.

The group of attendants was not huge: a smaller decision group faces a lower amount of transaction costs in collective action. In some cases the documents reported a quorum in fractional form (i.e. 1/2, 3/4, 8/9, etc.).

The number of villages represented in each assembly is reported for sake of completeness, and it does not have to be confounded with the number of villages in the community. In fact, assembly attendants, including witnesses and notaries, might come from different villages that are not necessarily part of the community's organisational structure.

Structure, content and stability of institutions. The description of the institutions decided by the legislative assemblies involves two distinct dimensions: the description of the content and the structure of the documents, and a broader description of these institutions. The latter dimension completes the former one by adding information on other measured

[10] *Quorums* measure the fraction of attendants qualified to cast a vote.

[11] Table 5 provides summary statistics of assemblies; Table 8 provides an illustration of how the individuals recorded in the dataset were distributed according to their role in the assembly.

institutional features and on the stability of the institutions [12].

Content and structure of the documents. The total of 8,994 bylaws articles representing the 260 documents reporting information on assemblies have been coded as follows[13]. Each numbered paragraph (*article*) has been assigned to one of the following categories (in parentheses: the number of coded articles for each category, plus the percentage of the grand total of 8,994):[14]

1. *Community Governance*
   - 1*a*. *Governance* (1,404 *articles*, 15.7%)
   - 1*b*. *Participation* (364 *articles*, 4.1%)
   - 1*c*. *Constraints on Outsiders* (957 *articles*, 10.6%)
2. *Resource Management* (5,689 *articles*, 63.2%)

The first macro-category identifies the rules decided by the assembly to govern the community, and not aimed directly to the management of collective action on resources. *Governance rules* describe the requirements and duration of assembly roles, defining the system of *checks-and-balances* necessary to elect and make accountable (and, occasionally even liable) those who were called to lead the institution for collective action in their capacity of community officers. *Participation rules* describe the requirements, periodicity and modes of participation to legislative assemblies of community members. Another set of rules describe the behaviour of the community towards the outsiders, termed *Constraints on Outsiders* because they generally imposed limitations on the action of outsiders, who were excluded from assembly participation. Therefore, this exclusion also entailed the impossibility of being an active part of the rule-making process [15]. The particular structure of

[12] Summary statistics about institutions at Table 7

[13] The details on categories (coding rules, examples, and the actual coding) are described in a codebook (in Italian), available upon request. Although the four categories are aimed at the description of the village polity and inspired by the famous dataset *Polity IV* (available at: www.systemicpeace.org/polity/polity4.htm), the analysis of the body of regulation and the development of the codebook for this specific case has largely benefited from an ongoing joint work with a research group on the regulation of institutions for collective action, guided by Tine de Moor and based in Utrecht since 2010 (see: www.collective-action.info/), in which the Author acts as an external collaborator. The accuracy of the codification has not yet been verified by other coders. The main difficulty is that some typeset compilations of statutes have been recently published (Giacomoni, 1991), yet most of the documents are written in ancient Italian, local dialects, or often in Latin. Therefore, inter-coder agreement statistics such as Krippendorff's alpha could not be computed.

[14] I omitted 580 articles (6.4%) belonging to the category *"Unknown content"*: no other category has been applied since these articles are in documents of which I know the length, but not the content.

[15] Such limitations were normally welfare detrimental for outsiders: for instance, limitations were imposed on the extension of village membership as a consequence of marriage with a village member, in the access and use of the commons as a consequence of inheritance rules when the offspring was born from a mixed marriage (the marriage of an outsider with an insider), or the required payment of a lump sum to be admitted to the village membership or use of the commons, or in being counterparts of resource trading with insiders.

the charters allowed the separating of this set of rules from another that focused directly on *Resource Management*. These rules defined the precise actions and precautions that had (or had not) to be undertaken by village members in order to coordinate the access and use of natural resources, mainly the commons (forest and pasture). The violation of each rule was normally backed by a monetary sanction (Casari, 2007), comprising at least the restoration of the damage, and often a component to deter future damages. This latter component was highly variable, and increased according to the action (i.e. grazing the cattle, cutting timber), condition of the tortfeasor (i.e. village member, foreigner, etc.), and timing of the offense (i.e. during the day or night, caused once or repeatedly). In this sense, sanctions were "graduated" (Ostrom, 1990, 2005).

Other institutional features and stability. Other institutional features are the *number of articles* contracted in the assembly (namely, the length of the document) the *number of roles* represented in the assembly, and the *years between the current assembly and the next institutional change*.

The length of the document is related to transaction costs: although the size could be decided by the notary writing the document, the number of provisions and themes are decided by the assembly. This decision of leaving contracts incomplete can be strategic, with the leaving of "gaps" in the social contract associated with the usual risks of contractual incompleteness in long-term contracts: the costs saved today in terms of a shorter contract might be much higher tomorrow in terms of enforcement and litigation costs[16]. The costs of border litigations were severe. Litigations between bordering villages persisted for decades, and therefore the length of the document can proxy the *ex-ante* investment in better-quality contractual enforcement. Reasonably, the communities with longer charters were those more complex to manage in terms of rule enforcement and the monitoring of resource use.

The number of assembly roles was not fixed, though the type of roles remained unaltered[17]. The number of roles in assemblies is another useful indicator, given that it represents the degree of government specialisation required for community governance. Communities where rule enforcement and resource monitoring was easier probably required a simpler governance organisation.

From the reconstruction of the time sequence of the documents, I computed a measure

[16]The issue of contract incompleteness has been widely explored and benefits from well-established reference literature. The main references for an economic treatment of the topic are the seminal contributions by Hart and Moore (1988) and Tirole (1999). From a Law & Economics perspective, a key reference is Ayres and Gertner (1989).

[17]See Table 8

of institutional stability represented by the number of years between the current assembly and next institutional change. The statistics in the table report separate estimates for the full sample ($N = 259$), although it was only possible to compute the distance from the next change for 63 of them. The remaining 196 estimates have set the year of next change set as 1807, when Napoleon abolished the charter regime (and they are therefore affected by right-censoring). The estimates can be further distinguished according to the type of change: complete replacement or modification. Intuitively, changing something that already existing entails lower transaction costs than writing and reaching an agreement on an entirely new institution.

2.2.3 *Heterogeneity*

I study *societal* and *resource* heterogeneity. The former is based on the surnames of assembly attendees, with the latter on the resource endowments of the community where the observed assembly takes place. Both are assumed to be exogenous.

To measure each source of heterogeneity, I compute a generic Hirschman-Herfindahl fractionalization index of the form

$$h_i = \sum \pi_k \cdot (1 - \pi_k) \tag{1}$$

where, in the case of surname fractionalization: h_i is the index of fractionalization of the insider group assembly i, k is one surname from the total surname set K_i in the insider group i, π_k is the probability of extracting the surname k from a random draw in K_i, and $(1 - \pi_k)$ is the probability of extracting a surname different from k from a random draw in K_i.

This index has been widely employed in literature (Alesina et al., 2003; Garcia-Montalvo and Reynald-Querol, 2002), and measures heterogeneity as the probability that two randomly extracted surnames are different[18]. I sinthetically describe each of the indexes and summarize their main properties.

[18]This index of heterogeneity has been preferred over other existing alternatives, because it focuses on generic within-group diversity. Other more sophisticated measures of heterogeneity also consider polarisation and the role of intra-group conflict, and also include intra-group distances in indexes: the fractionalization index reported here is a special case of the general polarisation index, with intra-group distances equal to 1. The mathematical treatment of the measurement of polarisation has been developed by Duclos et al. (2004); Esteban et al. (2012); Esteban and Ray (2011, 1994). Other indexes of statistical dispersion of population and resources, such as the Gini Coefficient, were considered unsuitable for this case: in fact, the Gini coefficient has been used to measure inequality, rather than resource or societal heterogeneities in probabilistic terms. For the same reasons, entropy measures have been disregarded. A summary of the basic measurements of social cohesion can be found in Banerjee et al. (2008). The kernel density estimates of the two indexes are available upon request, with summary statistics reported in table Table 6.

Surname fractionalization. One preliminary issue has been ascertaining an appropriate measure of societal heterogeneity. To solve this issue, an initial source of inspiration was the study by Ahlerup and Olsson (2012), who investigated the role of "genetic" fractionalization within countries' economic and political development. The authors discuss a *constructivist* and an *evolutionary* approach to studying the formation of ethnic diversity, providing empirical support for both the approaches. Other inputs came from findings in biological sciences and anthropology, in which surnames have long since been considered to contain information on the genetic traits of populations (King and Jobling, 2009; Jobling, 2001). Another reason leading to this choice was that surnames have been traditionally used to study population structure, in terms of historical contexts (Guglielmino et al., 1996; Bowden et al., 2008), and measuring migration (Colantonio et al., 2003a), the extinction of families (Watson and Galton, 1875), inbreeding rates (Darwin, 1875; Lasker, 1977), genetic isolation and distances between populations (Colantonio et al., 2003b; Sella et al., 2010).

Surname fractionalization has been measured at the assembly-level, using all of the attendants' surnames within the Assembly dataset (see section 2.2.2), and imputed to the whole group of insiders[19]. Given that the statistical distribution of the index is very asymmetric and does not allow for accurate analyses (the vast majority of the villages reported high values of SFI), I have decided to apply a transformation $x' = -ln(1-x)$ to the original index: being a monotone transformation, the effect achieved is to "stretch" the distribution of the index, previously included in the interval [0,1] with an asymmetric distribution, in the interval $[0,+\infty]$ with a normal distribution. When the $SFI \to 0$, the assembly (and therefore the community self-governed by the assembly) is regarded as highly homogeneous: the probability that two randomly extracted individuals have the same surname in the assembly tends to zero. This means that there are few families that have their preferences strongly represented in the assembly and that are likely to "dominate" (at least numerically) over the others.

Resource fractionalization. The investigation on the consequences of resource heterogeneity has represented one of the main research goals in the study of collective action (Baland and Platteau, 1996; Vedeld, 2000; Varughese and Ostrom, 2001; Poteete and Ostrom,

[19] Surnames have been distinguished from other individual identifiers (such as nicknames, job titles, etc.) in the lists of attendance, and translated to enable the within-assembly comparison of surnames with the aid of Cesarini Sforza (1914). In fact, Cesarini Sforza (1914) divides the origin of surnames into the following classes: 1. Women; 2. Arts, jobs, professions; 3. Physical qualities, body parts; 4. Moral qualities; 5. Objects; 6. Places; 7. Animals; 8. Plants; 9. Food; 10. Others. The goal was to distinguish real surnames from other individual attributes among the classes listed in the book. Efforts have been made to allow cross-assembly comparison with more sophisticates techniques, with the results reported in the *Appendix*.

2004; Naidu, 2005; Adhikari and Lovett, 2006; Nagendra, 2011), with this issue has often labelled as problematic (see subsection 1.1). I compute a fractionalization index to test the pure effect of "resource diversity" in each community where the assembly takes place, regardless of resource type. I used the same categories as in the land resources in Figure 2, but divided private land into vineyards and other private land (plow land and fruit gardens). Therefore, there are four categories considered for the index: 1) *vineyard*, 2) *other private land*, 3) *forest*, 4) *pasture* (meadows, grazing land, alp). Each resource category is a k in the resource set K_i, and a resource fractionalization index is also computed using Equation 1. A community is considered to be highly resource-homogeneous when the $RFI \rightarrow 0$: meaning that one type of resource prevails over the others because the probability of extracting two hectares of the same resource type from the pool of the community's total hectares tends to be 0. When there is resource homogeneity, I might expect even a lower level of transaction costs as the assembly can specialise in enforcement and monitoring activities. Conversely, the definition of property right on land entails higher levels of transaction costs when there are different types of resources to manage.

2.3 *Testable conjectures*

In this section, I conceptually structure the empirical problem, formulating some testable conjectures concerning the relation of a) institutional features (subsubsection 2.3.1), b) stability over time (subsubsection 2.3.2), and c) assembly quorums (subsubsection 2.3.3) with surname and resource fractionalization.

2.3.1 *Institutional features*

The impact of surname and resource fractionalization on the structure and content of regulation can be analysed under three dimensions: the length of the document ("*Length*"), the content of the documents ("*Content*"), and the number of roles in the legislative assemblies that vote and enforce the document ("*Roles*"). I briefly illustrate each dimension in the following paragraphs.

Length. The choice between long or short charters (namely, the degree of *contractual incompleteness*) may be strategic (Bernheim and Whinston, 1998), and might be a precise legislative choice when the internal organisation is structured on two or more levels. In such a case, the higher organisational level might opt for the adoption of a "framework" charter, whereas single villages might have a detailed charter. There might be three competing explanations for this choice, based on the grounds of efficiency:

1. *Short charters are more efficient*. This might be true when short documents are "framework" constitutions, providing the grounding principles of community governance. Short and "framework-oriented" charters might last longer: as due to their "generality" do not require frequent renegotiation or replacement. These charters are likely to be less complex, but also incomplete.

2. *Short charters are less efficient*. This is the final conclusion of the empirical analysis of American Constitutions by Hammons (1999), criticising what he called the *"Madisonian Hypothesis"*[20]. When short charters are of the "framework" type, they require a process of "gap filling". In this case, short charters tend to a situation of progressive "complexification" that is time-dependent [21]. The possibility of introducing modifications is a form of "constrained revision" that, as Chung (1991) argues, is aimed at correcting the inefficiencies deriving from contractual incompleteness when new information becomes available to consociates. This choice might also be strategic, as Crocker and Reynolds (1993) later found in the empirical study of pricing procedures used in Air Force engine procurement contracts, and thus even incomplete contracts can be efficient.

3. *Shorter charters entail less accountability to non-governing village members*. This "decentralisation" process is generally preferred over the risk of competition of the jurisdictions between the main-village and sub-village, consisting of the allocation of governing power at the local level under incomplete contracting. This choice entails higher risks of accountability for the governing board, and the problem is solved with a detailed piece of legislation for the local level : the local differentiation of the public good (charter) allows higher benefits[22] because it "*induces individuals to reveal the true preferences for levels and combinations of the public good provided by means of their location decision*" (Seabright, 1996). In the case of rural charters, the first problem is overcome with a periodical (usually yearly) role-rotation system in community appointments. The number of articles dealing with community governance can be a suitable measure of institutional content.

[20] The *"Madisonian Hypothesis"*, elaborated in Hammons (1999) states: "*The shorter the total length of the constitution and the smaller the number of statutory-type provisions as a percentage of the total document, the more durable the constitution will be*". The results of his study on American Constitutions reject this hypothesis.

[21] When the result of collective contracting in assembly is a modification of the charter, the complexity measured is that of the modification.

[22] Seabright (1996) argues that *"centralisation allows benefits from policy coordination but has costs in terms of diminished accountability, which can be precisely defined as the reduced probability that the welfare of a given region can determine the re-election of the government*".

If heterogeneity increases transaction costs, the "gap filling" process through public bargain requires more details to be specified in the resulting institutions of more heterogeneous societies, and fewer details in less heterogeneous societies. The following can be reasonably stated

Conjecture 1. *Communities where assemblies have a higher surname fractionalization write longer charters.*

I test this conjecture separately from

Conjecture 2. *Communities where assemblies have a higher resource fractionalization write longer charters.*

Institutional Roles. When population increases, the community government can specialise in monitoring and enforcement in order to benefit from the higher returns on scale in such activities that would otherwise be excessively expensive. Typical examples include the election of full-time monitoring officers, or full-time shepherds to graze the community herd. If surname heterogeneity has an impact on institutional features[23], governments that are larger in terms of insiders group size and resource endowments should be more heterogeneous and might require a higher degree of board specialisation (Doupé, 2011), and hence more assembly roles. Therefore, it is possible to state

Conjecture 3. *Communities where assemblies have a high surname fractionalization require more specialised governments.*

Structure and content. The content of the rules decided by the assembly is the written outcome of the institutional process, decided by the community members. The overall structure and balance of the regulation decided by the legislative assembly might contain important information about collective action on the commons. When the purpose of the institution is to find a solution to a collective action problem, such as this study's case of the rural charters, I would expect a great number of articles to contain rules on resource management. Accordingly, as a proportion of the total, resource management should represent the vast majority of rules. When the insider group is fractionalized, I would expect a great number of articles dealing with the structure and governance of the institution to coordinate

[23]To explain the impact of heterogeneity on government complexity (interpreted as the number of assembly roles required for the community governance), it is first necessary to understand how governance and heterogeneity are related with population. If from the one side resource heterogeneity depends on how villages set their borders and is uncorrelated with population, on the other side surname fractionalization, on a purely statistical basis, might be correlated with group size. See Figure 3.

the members' resource extraction (with particular regard to the commons, thereby avoiding the so called "Tragedy of the Commons" theorised by Hardin (1968) and completed by Ostrom (1990)). Therefore, it is possible to state

Conjecture 4. *The higher surname fractionalization in the assembly, the higher the number of community governance rules.*

If surname fractionalization correlates with both community governance rules and resource management, the issue is to disentangle which of the two effects is stronger. No prior expectations of the empirical results are put forward.

Given that, as argued above, managing a highly diverse environment under incomplete contracting also entails high costs, it is plausible to argue for the existence of a correlation between resource fractionalization and the choice of rules in the assembly.

Conjecture 5. *The higher resource fractionalization, the higher the number of rules dealing with resource management.*

Being uncertain which source matters the most in absolute terms, it is possible to state the following alternative

Conjecture 6. (jointly with 3). *The higher resource fractionalization, the more complex is the government required to manage resource diversity and - consequently - the higher the number of community governance rules.*

2.3.2 *Stability of institutions*

Determining whether forms of heterogeneity have an impact on the stability of institutions for collective action requires a clarification of what is meant by "stability".

"Stability" is a game theoretic concept referring to the emergence of cooperative solutions in infinitely repeated games with discounting Abreau et al. (1990); Myerson (1997). In this paper, I generally refer to "infinitely repeated games" as the families of games where the conditions for the "*Folk Theorems*" are fulfilled. In such games, individuals have previous knowledge on other players' behaviour, can obtain costly information and foresee future cooperation. (Fudenberg and Maskin, 1986; Casari, 2007).

Definition. Institution A is *less stable* than institution B when the forward duration of A is lower than the forward duration of B.

There might be several concurring explanations, one of such is that when heterogeneity increases, the discount factor also increases, and thus players might prefer not cooperate under the same set of incentives: the "institutional" game ends earlier. Another (preferable)

explanation is connected to the theory of voting: voters with heterogeneous preferences might form unstable coalitions (Arrow, 1950; Aumann and Dreze, 1963): this instability might have origins in external shocks (such as changes in relative prices), having asymmetric effects (i.e. having a different impact on a peasant than a craftsman, etc.). As a consequence, heterogeneous governments are likely to be politically unstable and require higher government consumption to mitigate social conflicts (Annett, 2001). Therefore, it is possible to state the following

Conjecture 7. *Heterogeneous legislative assemblies deliberate unstable (= less enduring) rules.*

2.3.3 *Assembly quorums*

The process of preference aggregation is typically simpler in smaller groups, because the chances are that individual preferences are less heterogeneous than in larger groups, on a purely statistical basis. Heterogeneity, making the aggregation of social preferences more difficult (Arrow, 1950; Brown, 1975), increases the costs of social contracting for the allocation of property rights.

The quorum provides a measure of the level of preference aggregation required to reach a collective decision, because it reports the level of consensus required to approve the collective decision. High quorums are usually placed to avoid cycles in voting that would lead to decisional deadlock, as stated by Arrow (1950) in the formulation of the "impossibility theorem", later developed in many studies on collective decision making and preferences aggregation includingBrown (1975); Matsatsinis et al. (2005); Erlei (2008); Choi (2008). In the statistics reported in section 2.2.2, I notice that this quorum above the simple majority (50 percent plus one vote) on average, and very close to a super-majority (75 percent), yet this figure does not account for the difference in quorums with other factors such as group size or heterogeneity. The vote of highly fractionalized groups might take longer to reach a decision that is approved by a smaller subgroup (lower quorum), but later overturned. Consistent with Conjecture 7, the following is stated

Conjecture 8. *Highly fractionalized legislative assemblies deliberate with lower quorums.*

2.4 *Estimation methods*

Models of heterogeneity. Several methods have been used in literature to estimate the impact of heterogeneity on economic outcomes[24]. The usual method of estimation takes

[24] An interesting overview on the different methodologies to the measurement of heterogeneity and econometric modelling is offered by Banerjee et al. (2008)

the form of

$$y_{ikt} = f(p_{it}, x_{it}) \tag{2}$$

where y_{ikt} is a measure of access or quality of public good k (in this case, the rural charter) in assembly$i$ at time t, p_{it} is a set of population characteristics of the community (including heterogeneity) in year t, while x_{jt} is a vector representing various geographical and historical features of the area in which the community is located (Banerjee et al., 2008).

An interesting improvement to this model has been applied by Crowley (2011), with the following model of heterogeneity and constitutional choice

$$y_{ik(t+1)} = \beta_0 + \beta_1 p_{it} + \beta_2 x_{it} + \varepsilon \tag{3}$$

In this model, the dependent variable represents some "constitutional characteristics" in the post-decision period, while p_{it} represents specifically heterogeneity in the pre-decision period, and vector x_{jt} represents additional characteristics always in the pre-decision period. The model in Equation 3 is explicitly targeted to capture the effect of pre-existing heterogeneity on institutional changes, and the use of a post-decision measure in the left-hand side and pre-decision regressors on the right-hand side (Crowley, 2011) discounts for the possibility of endogeneity being present in Equation 2.

The models employed in the empirical part adapt the model proposed in Equation 3, with two specifications according to the form of the dependent variable.

When the dependent variable is a cardinal number (0, 1, 2, ..., N), as in the case of "Length", I use an ordinary least square regression of this type:

$$y_{i(t+1)} = \beta_0 + \beta_1 SFI' + \beta_2 RFI_{it} + \beta_3 X_{it} + \varepsilon_{it} \tag{4}$$

where $y_{i(t+1)}$ is the *Institutions* dependent variable in assembly *i,* having values ranging in $\mathbb{N}$; $SFI'$is the *Adjusted Surname Fractionalization Index* $SFI' = -ln(1-SFI)_{it}$ explained at section 2.2.3; RFI_{it} is the *Resource Fractionalization Index* explained at section 2.2.3; X_{it} is a vector of controls; and ε_{it} is the error term, assumed to be normally distributed.

In some of the tests contained in this paper, dependent variables are often in fractional form (0.01, 0.5, ..., 1). This occurs with quorums and proportions of a particular rule type in the total document. In these cases, ordinary least square regression (OLS) would lead to satisfactory yet rather imprecise results, particularly when rule types have high frequencies towards the extremes (0 and 1). This empirical problem has been solved by using a fractional logit model proposed by Papke and Wooldridge (1996), which works on a logit transformation of the fractional dependent variable:

$$ln\left(\frac{y'}{1-y'}\right)_{i(t+1)} = \beta_0 + \beta_1 SFI'_{it} + \beta_2 RFI_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad (5)$$

where $y'_{i(t+1)}$ is the *Institutions (perc.)* dependent variable in assembly *i,* with values ranging in the interval $[0,1]$; and $SFI'$is the *Adjusted Surname Fractionalization Index*, log-transformed in $SFI' = -ln(1-SFI)$.

Dependent and independent variables. In terms of *dependent variables*, I include the length of the documents in terms of numbered paragraphs (articles) contracted in the assembly, the number of articles that deal with community governance, the number of articles that deal with resource management, the number of different roles represented in the assembly, the duration of the observed institutional change (number of years), and the assembly quorum. I also run regressions on fractional outcomes: the fraction of community governance rules, and the fraction of resource management rules.

Among the *independent variables*, apart from the two fractionalization indexes, I include: the insider group size, the number of villages represented in the assembly, the total land surface managed by the community in hectares, the distance from the closest local town, and a dummy that controls for commons endowments above the sample median. Documents are divided into two sets: complete charters, and changes (modifications) to complete charters. The two sets might differ in length, therefore I insert a dummy variable that controls for the type of document. In the complete versions I include the year of assembly among the regressors, together with 14 area dummies to control for area fixed effects.

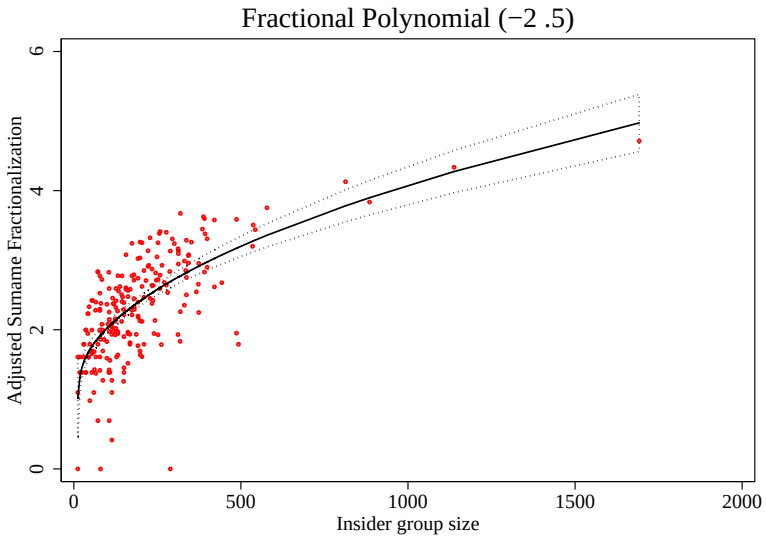
The results of exploratory data analysis[25] reveal a generally low cross-correlation among the regressors, with the exception of a high correlation detected between the log-transformed SFI and the insider group size ($\rho = 0.64$). A visual inspection reveals a non-linearly increasing relationship between surname fractionalization and the insider group size. Figure 3 visually reports the results of a fractional polynomial fit ($R^2 = 0.48, N = 226$).

I investigated the potential existence of multicollinearity by computing variance inflation factor (VIF) and Farrar-Glauber tests (χ^2 test, F-test, T-test). In VIF, tolerance is always above 0.50, with the mean VIF always below 2.00 (no multicollinearity detected). In the Farrar-Glauber tests, I can always reject the alternative hypothesis, namely the existence of multicollinearity[26].

[25] Table 12 is a cross-correlation table inclusive of all the regressors. The most important cross-correlations are reported in Table 9.

[26] Results of the multicollinearity diagnostic tests are not reported, and are available upon request.

Figure 3: Surname fractionalization and group size



3 RESULTS AND DISCUSSION

This section contains an exposition of the statistical tests of the conjectures concerning institutional features (subsection 3.1), the stability of institutions (subsection 3.2) and assembly quorums (subsection 3.3).

3.1 *Institutional features*

Length. Consistent with conjecture 1, the impact of surname fractionalization is strong and positively correlated with document length, also when controlling for time and area[27]. Another factor that exhibits a strong and positive correlation with institutional complexity and insiders' group size is the presence of representatives from more villages in the assembly (measured as the absolute number of villages represented in the assembly). Contrary to Conjecture 2, resource fractionalization has no significant impact on this index of institutional complexity. It is possible to state

Result 1. *The length of the charter increases significantly with the surname fractionalization of insiders.*

Institutional roles. Consistent with Conjecture 3, the impact of surname heterogeneity is strong and positively correlated with the number of the roles required to govern the

[27] See Table 13 for regression coefficients. The robustness of this result is checked for multicollinearity in the last two specifications of Table 13.

community, also when controlling for insiders' group size, time and area [28]. Moreover, a weak effect of resource fractionalization is present when simultaneously considering the two sources of heterogeneity and controlling for time. When considering the impact of surname fractionalization separately from group size, both are significant: surname fractionalization has a stronger effect on institutional complexity than group size.

Result 2. *A high number of formal organisational roles among insiders is significantly associated with surname fractionalization and (weakly) with resource fractionalization.*

Content. It has been found above that resource fractionalization does not correlate significantly with the length of the document. In order to refine this result and test Conjectures 4, 5, and 6, analyses are conducted separately on Community Governance and Resource Management rules[29].

Result 3. *The impact of surname fractionalization in the charter length varies depending on the focus on community governance vs. resource management, and is higher when the focus is on resource management.*

As a robustness check, T-tests have been conducted to detect significant differences in the average number of community governance articles (m) in institutions decided by assemblies where surname fractionalization was lower than those where it was higher[30]. Assemblies (n) where surname fractionalization is low produce on average less provisions on *community governance* than highly fractionalized assemblies[31]. I also carried out a similar test on surname fractionalization for *resource management rules*. Assemblies where surname fractionalization is low also produce on average less provisions on resource management than in highly fractionalized assemblies[32].

Result 3.1. *The average number of community governance and resource management rules is significantly higher when surname fractionalization is higher.*

I eventually repeated the same two tests, using resource fractionalization rather than surname fractionalization: the average number of community governance and resource

[28] Regression coefficients are reported in Table 14.

[29] Table 15 reports regression coefficients displaying that the effect of surname fractionalization being higher for resource management than community governance rules. A rough measurement of the impact: in models (1) and (3), the sample standard deviation for Log-transformed SFI is 0.755; in models (4) and (6) it is 0.751. If I multiply the beta coefficients for their sample standard deviations, I obtain that in model (1) and (4) $SFI_{resource\ management} > SFI_{community\ governance}$. The same is applies in (3) and (6).

[30] See Table 10 and Table 11 for the summary tables.

[31] Results of T-Tests on Community Governance Rules: $n_{low} = 77$, $n_{high} = 76$, $n_{high+low} = 153$, $t = -3.17$, $d.o.f = 151$, $H_a : (\mu(m_{low}) - \mu(m_{high}) < 0$ has $Pr(T < t) = 0.0009$.

[32] Results of T-Tests on Resource Management Rules: $n_{low} = 76$, $n_{high} = 74$, $n_{high+low} = 150$, $t = -2.74$, $d.o.f = 148$, $H_a : (\mu(m_{low}) - \mu(m_{high}) < 0$ has $Pr(T < t) = 0.0034$.

management rules does not significantly differ between assemblies where resource heterogeneity is low and those where it is high[33].

Result 3.2. *The average number community governance and resource management rules does not significantly change according to different levels of resource fractionalization.*

These results confirm Table 15 and are consistent with Conjectures 4, 5, yet inconsistent with Conjecture 6 [34].

3.2 *Stability of institutions*

Are some rules more stable than others? The stability of an institution has been defined as the number of years between the observed assembly and the next institutional change. A first analysis has been conducted on a sample of 47 documents including institutional changes before the end period (1807), of which it has been possible to compute a forward duration and the percentage of each type of rule of the total length of the document (*uncensored sample*). The goal was to understand how each type of rule decided by the assembly correlates with the number of years of forward duration of the institutions. I used the proportion of rules for each type as independent variables, and controlled for charter length and document type (whether a complete charter or a change to a charter). A higher proportion of governance rules on the total negatively correlates with the forward duration of the institution[35]. This indicates that governance rules require more frequent institutional changes or replacements. The opposite occurs with a higher proportion of resource management rules, which appear to require less frequent changes. In order to improve the estimates, I extended the sample and included the duration of the institutional changes that ended in 1807, when Napoleon forcefully abolished the charter regime (*censored sample*). The total sample has therefore been enlarged to 223 observations, of which it was possible to compute a forward duration and proportion of rule type of the total of the articles in the document, with the results substantially being the same[36] . These results are consistent with the findings in Paragraph section 3.1.

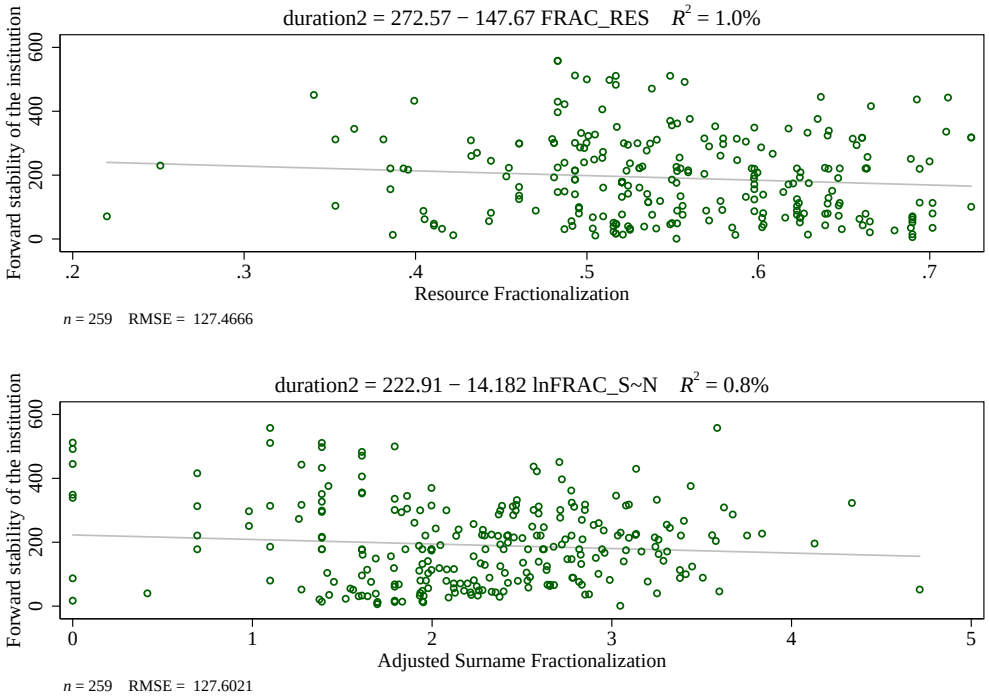
[33] Results of T-Tests on both Community Governance and Resource Management Rules are not reported, and are *all* not statistically significant.

[34] I also computed both fractional logit and ordinary least square regression estimates on fractional dependent variables (the proportion of community governance and resource management rules), obtaining similar results.

[35] Regression coefficients in Table 16.

[36] Regression coefficients in Table 17

Figure 4: Heterogeneity and stability of institutions



Does heterogeneity correlate with forward duration? This second type of analysis was conducted using a different model, both on the uncensored and censored samples[37]. Regression estimates exhibit a weak negative impact of heterogeneity on the forward duration of institutions, visually detectible in Figure 4: the results are not as robust as expected. Analyses on the censored sample brought a similar result [38]. It must be observed that although the real forward duration of institutions could not be computed for the last change due to the intervention of right-censoring, the results obtained are compatibly the best possible estimates, given the availability of historical data.

Result 4. *Resource heterogeneity has a negative impact on the stability of the organization. No significant impact of surname fractionalization was detected.*

This result is consistent with Conjecture 7, but has a validity limited to resource fractionalization.

[37] Regression coefficients are respectively in Table 18 and Table 19

[38] Regression coefficients in Table 19

3.3 *Assembly quorums*

In order to test Conjecture 8, 91 assembly quorums reported in the preambles to the documents were used as dependent variables. These quorums refer to the number of individuals that approved the rules (votes opposing the decisions are occasionally reported)[39]. The sole factor that significantly impacts the quorum is group size. This result is not consistent with Conjecture 8: the assembly quorum strongly depends on a group size effect, and not on the two measures of heterogeneity employed in this study.

Result 5. *Larger groups of insiders have lower deliberative quorum. Surname and resource heterogeneity have no significant impact.*

Again, these results are compatible with the hypothesis of increased transaction costs with group size stated in Cheung (1969), and with the previously discussed literature on social choice and preference aggregation (subsubsection 2.3.3).

4 CONCLUSION

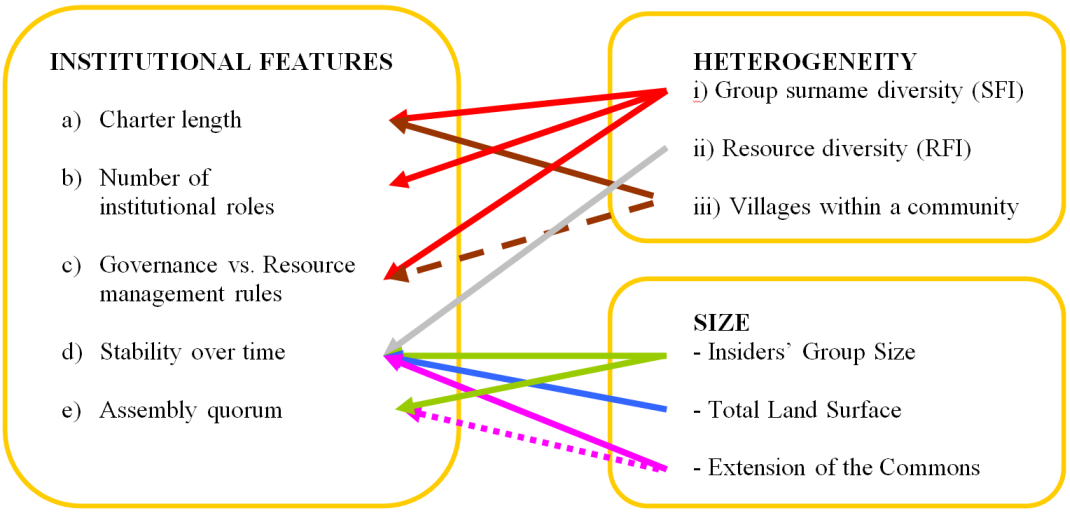
I examined how formal institutions for collective action reflect heterogeneities inherent in legislatures and resource endowments, with the aim of providing an answer to one among the myriads of theoretical and empirical problems in the study of institutions. A detailed analysis of a rich body of regulation produced by 159 upland communities in 260 community assemblies for the management of the commons in the Italian Alps during 1245-1801 was developed to study this issue. Three premises formed the basis of this research: contracting for property rights in heterogeneous societies entails more transaction costs than in homogeneous ones; human "natural" characteristics determine the costs of collective action; and institutions for property rights react to such costs in their evolution path.

I first investigated whether longer charters were written in communities where assemblies had a higher surname fractionalization or resource fractionalization. The answer is that the length of the charter increased significantly with the surname fractionalization of insiders (1). I would have also expected that communities where assemblies had a high surname fractionalization required more specialized governments, and found that a high number of formal organizational roles among insiders were significantly associated with surname fractionalization and (weakly) associated with resource fractionalization (2).

Regarding the content of the rules, I argued that a higher number of rules dealing with resource management should correlate with higher resource fractionalization. Furthermore,

[39] Table 20 reports the coefficients of the fractional logit model, and ordinary least square regression estimates report similar results.

Figure 5: Overview of the empirical correlations found in this study



Note. A summary of the empirical correlation found in the paper. A straight arrow indicates statistical significance at the 1% level (p<0.01), a dashed arrow significance at 5% (p<0.05), a dotted arrow significance at the 10% level (p<0.1).

more complex governments should be required to manage resource diversity: as a consequence, a higher number of community governance rules should be in place, and both the number of community governance rules and a high number of community roles should correlate positively with resource fractionalization. To a lesser extent, I would have expected that a high number of community governance rules should be enforced where surname fractionalization is higher. I found that the impact of surname fractionalization in the charter length varied, depending on the focus on community governance versus resource management, and was higher when focused on resource management (3). More specifically, the average number of community governance and resource management rules was significantly higher when surname fractionalization was higher. Additionally, I found that the average number of community governance and resource management rules did not significantly change according to different levels of resource fractionalization .

As to the stability of the institutions, I posited that heterogeneous legislative assemblies should deliberate unstable rules. I found empirical support for this conjecture, yet limited to resource fractionalization: in fact, surname fractionalization did not matter in determining the stability of institutions (4).

As to the consensus required in assemblies, I found that larger groups of insiders had lower deliberative quorum, with surname and resource heterogeneity having no significant impact (5).

In conclusion, I found support for the positive and significant impact of societal and

resource heterogeneity on institutional features, which can be explained using a transaction costs framework: the three starting premises of this study therefore received abundant empirical support, visually summarised in Figure 5.

Possible extensions of this research include the application of this methodology to similar cases, which would provide a useful support to the findings presented, and strengthen the external validity of this research. The techniques used to analyse the functioning of each specific type of rules in institutions, and the analysis of the determinants of specific types of rules, may provide policymakers and researchers alike with new tools to analyse the origins of social order and the direct consequences of laws on individual and social behaviour.

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TABLES

Table 1: The Dataset

Sources of data	
Variable Name	*Source*
Communities:	
Altitude	Casari (2007); Heterogeneity2 dataset. Google API.
Distance from closest local town	Casari (2007); Heterogeneity2 dataset. Google API.
Private Land	Author's estimate:: Heterogeneity2 dataset. Casari (2007); Consiglio (1903).
Pasture	Author's estimate: Heterogeneity2 dataset. Casari (2007); Consiglio (1903).
Forest	Heterogeneity2 dataset. Casari (2007); Consiglio (1903).
Total surface	Heterogeneity2 dataset. Casari (2007); Consiglio (1903).
Private Land (frac.)	Author's estimate: Heterogeneity2 dataset.
Pasture (frac.)	Author's estimate: Heterogeneity2 dataset.
Forest (frac.)	Author's estimate: Heterogeneity2 dataset.
Commons (frac.)	Author's estimate: Heterogeneity2 dataset.
Large commons endowment	Author's estimate: Heterogeneity2 dataset.
Insider Group Size	Author's estimate: Heterogeneity2, Assemblies. Casari & Lisciandra. Seneca (1953), Debiasi (1953)
Outsider Group Size	Author's estimate: Heterogeneity2 dataset.
Community population	Author's estimate: Heterogeneity2 dataset. Andreatta and Pace (1981); Bellettini (1987).
Insider Group Size (frac.)	Author's estimate: Heterogeneity2 dataset.
Outsider Group Size (frac.)	Author's estimate: Heterogeneity2 dataset.
Assemblies:	
Members with voting rights	Author's research: Assemblies dataset, Heterogeneity2 dataset.
Members without voting rights	Author's research: Assemblies dataset, Heterogeneity2 dataset.
Number of non members	Author's research: Assemblies dataset, Heterogeneity2 dataset.
Total attendants	Author's research: Assemblies dataset, Heterogeneity2 dataset.
Quorum	Author's research: Assemblies dataset, Heterogeneity2 dataset.
Villages within a community	Author's estimate: Assemblies dataset; Heterogeneity2 dataset.
Institutions:	
Governance	Author's research: *Polity v7* dataset, Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Participation	Author's research: *Polity v7* dataset, Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Constraints on outsiders	Author's research: *Polity v7* dataset, Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Resource Management	Author's research: *Polity v7* dataset, Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Community Governance	Author's research: Heterogeneity2 dataset, Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Governance (frac.)	Author's research: Heterogeneity2 dataset, Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Participation (frac.)	Author's research: Heterogeneity2 dataset, Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Constraints on outsiders (frac.)	Author's research: Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Resource Management (frac.)	Author's research: Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Community Governance (frac.)	Author's research: Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Year of the assembly	Author's research: Heterogeneity2 dataset.. Casari & Lisciandra; Casetti (1961).
Document Length	Author's research: Institutions dataset, Heterogeneity2 dataset.
Number of roles in each assembly	Author's research: Institutions dataset, Heterogeneity2 dataset.
Forward stability of the institution (All)	Author's estimate: Heterogeneity2 dataset. Casari (2007); Casari & Lisciandra.
Forward stability of the institution (Until Next Change)	Author's estimate: Heterogeneity2 dataset. Casari (2007); Casari & Lisciandra.
Forward stability of the institution (Right-Censored at 1807)	Author's estimate: Heterogeneity2 dataset. Casari (2007); Casari & Lisciandra.
Charter amendment	Author's research: Heterogeneity2 dataset. Casari & Lisciandra; Casetti (1961).
Heterogeneity:	
Surname Fractionalization	Author's research: Assemblies dataset, Heterogeneity2 dataset.
Adjusted Surname Fractionalization	Assemblies dataset; Author's research: Heterogeneity2 dataset.
Resource Fractionalization	Author's research: Heterogeneity2 dataset. Casari (2007); Consiglio (1903).

Table 2: The Dataset

Variable Description	
Variable Name	*Description*
Communities:	
Altitude	Altitude in meters above the sea level.
Distance from closest local town	Linear distance in kilometers from the closest urban center of relevant size in the district.
Private Land	Surface of the community represented by plow land, vineyard, fruit garden. Measured in hectares (Ha).
Pasture	Surface of the community represented by meadow, grazing land, and alp. Measured in hectares (Ha).
Forest	Surface of the community represented by forest. Measured in hectares (Ha).
Total surface	Total surface of the community including private land, pasture, forest, waste land and houses (Ha).
Private Land (frac.)	Fraction of the total community surface represented by private land.
Pasture (frac.)	Fraction of the total community surface represented by pasture land.
Forest (frac.)	Fraction of the total community surface represented by forest land.
Commons (frac.)	Fraction of the total community surface represented by commons (forest and pasture).
Large commons endowment	Dummy. =1 if the surface devoted to commons is above the median of the sample (=260), =0 otherwise.
Insider Group Size	Number of full members or associated with full members. Source: charters, assembly quorums and average household size.
Outsider Group Size	Number of foreigners living in the village. Obtained by subtracting insiders from the total community population.
Community population	Population estimate from the Napoleonic Census scaled backwards using the Italian population trend 1200-1800.
Insider Group Size (frac.)	Fraction of full members residents in the community.
Outsider Group Size (frac.)	Fraction of foreigners living in the village.
Assemblies:	
Members with voting rights	Number of attending members qualified to cast a vote in the assembly (A).
Members without voting rights	Number of qualified members not attending the assembly (B).
Number of non members	Number of attendees not entitled to cast a vote, and having other assembly roles (C).
Total attendants	Total number of individuals attending the meeting (A+B+C).
Quorum	Number of members attending the assembly out of the total qualified members (from documents).
Villages within a community	Number of villages represented in the assembly.
Institutions:	
Governance	Number of articles in the document describing checks-and-balances. See *codebook*.
Participation	Number of articles in the document describing participating behavior and procedures in assemblies. See *codebook*.
Constraints on outsiders	Number of articles in the document describing rules protecting insiders and community resources from outsiders' action.
Resource Management	Macro-category. Number of articles in the document describing rules resource management.See *codebook*.
Community Governance	Macro-category. Sum of: Governance, Participation and Constraints on outsiders.
Governance (frac.)	Fraction of governance rules out of the total number of articles in the document.
Participation (frac.)	Fraction of participation rules out of the total number of articles in the document.
Constraints on outsiders (frac.)	Fraction of outsider-defensive rules out of the total number of articles in the document.
Resource Management (frac.)	Fraction of resource management rules out of the total number of articles in the document.
Community Governance (frac.)	Fraction of community governance rules out of the total number of articles in the document.
Year of the assembly	Year of the document reporting the observed assembly.
Document Length	Number of articles in the document (*contracted* or *cumulative*). An article is a numbered paragraph.
Number of roles in each assembly	Number of different community roles in assembly. I include also non-active roles.
Forward stability of the institution (All)	Years between the observed assembly and the *next* complete charter.
Forward stability of the institution (Until Next Change)	Subsample. Years between the observed assembly and the next complete charter (*until the last*).
Forward stability of the institution (Right-Censored at 1807)	Subsample. Years between the last observed assembly and the abolition of the charter system (*censored at 1807*).
Charter amendment	Dummy. =1 if the document is a modification or other document, =0 if the document is a complete charter.
Heterogeneity:	
Surname Fractionalization	Probability that two members randomly chosen among the total assembly attendants have a different surname.
Adjusted Surname Fractionalization	Log-transformation of the SFI in -ln(1-SFI).
Resource Fractionalization	Probability that two hectares randomly chosen in the total surface belong to a different land type category.

Table 3: Summary Statistics: Communities (Time independent variables).

Variable	Mean	Std. Dev.	Min.	Max.	N
Altitude	638.415	267.398	73	1579	159
Distance from closest local town	5.799	5.415	0	25	159
Private Land	177.741	230.847	6.5	1979.6	159
Pasture	536.561	806.085	3.7	5722.7	159
Forest	794.732	930.867	0.02	5054.6	159
Total surface	1738.251	2145.148	39.655	15796.1	159
Private Land (frac.)	0.18	0.157	0.001	0.797	159
Pasture (frac.)	0.274	0.154	0.034	0.765	159
Forest (frac.)	0.461	0.164	0	0.868	159
Commons (frac.)	0.735	0.177	0.069	0.981	159
Large commons endowment	0.421	0.495	0	1	159

Table 4: Summary Statistics: Communities (time dependent variables).

Variable	Mean	Std. Dev.	Min.	Max.	N
Insider group size	200.018	178.643	12	1692	226
Outsider group size	381.031	696.723	1	5989	192
Community population	530.112	688.945	35	6061	250
Insider group size (frac.)	0.561	0.304	0.012	1	226
Outsider group size (frac.)	0.439	0.304	0	0.988	226

Table 5: Summary Statistics: Assemblies.

Variable	Mean	Std. Dev.	Min.	Max.	N
Members with voting rights	33.062	29.535	2	281	226
Members without voting rights	4.402	5.44	1	28	87
Number of non members	3.467	1.814	1	11	182
Total attendants	29.865	29.453	1	295	260
Quorum	0.71	0.118	0.5	1	91
Villages within a community	1.573	1.888	1	18	260

Table 6: Summary Statistics: Heterogeneity.

Variable	Mean	Std. Dev.	Min.	Max.	N
Surname Fractionalization	0.847	0.178	0	0.991	260
Adjusted Surname Fractionalization	2.244	0.810	0	4.713	260
Resource Fractionalization	0.553	0.086	0.22	0.724	260

Table 7: Summary Statistics: Institutions

Variable	Mean	Std. Dev.	Min.	Max.	N
Governance	6.185	7.655	0	54	227
Participation	1.604	2.098	0	10	227
Constraints on outsiders	4.216	5.032	0	30	227
Resource Management	25.511	23.694	0	125	223
Community Governance	12.004	11.861	0	73	227
Governance (frac.)	0.156	0.181	0	1	223
Participation (frac.)	0.048	0.103	0	1	223
Constraints on outsiders (frac.)	0.149	0.199	0	1	223
Resource Management (frac.)	0.647	0.253	0	1	223
Community Governance (frac.)	0.353	0.253	0	1	223
Year of the assembly	1607.525	128.911	1249	1801	259
Document Length	37.165	32.533	1	151	242
Number of roles in each assembly	3.469	1.58	1	7	260
Forward stability of the institution	190.958	127.857	1	558	259
Forward stability of the institution (Until Next Change)	137.778	88.019	1	376	63
Forward stability of the institution (Right-Censored at 1807)	208.051	134.009	6	558	196
Charter amendment	0.354	0.479	0	1	260

Table 8: Assembly Roles in 1245-1801

Roles	**No.**	**%**
Accountant	1	0.01%
Assistant Consul	4	0.05%
Assistant Head of the Community	12	0.15%
Assistant Officer	1	0.01%
Capitain	2	0.03%
Community member	6,211	79.99%
Consul	116	1.49%
Counsellor	102	1.31%
Elected representative	103	1.33%
Head of the community	198	2.55%
Juror	217	2.79%
Knight	2	0.03%
Mayor	82	1.06%
Notary	135	1.74%
Officer	168	2.16%
Outsider	1	0.01%
Priest	1	0.01%
Representative	17	0.22%
Representative of the Emperor	3	0.04%
Secretary	5	0.06%
Witness	384	4.95%
Total attendants	*7,765*	*100.00%*

Source: assemblies.dta

Table 9: Cross-correlation table

Variables		1	2	3	4
Adjusted Surname Fractionalization	1	1.000			
Resource Fractionalization	2	-0.073	1.000		
Insider group size	3	0.642	-0.042	1.000	
Total productive surface	4	0.141	-0.205	0.296	1.000

Table 10: Content and Surname Fractionalization

Type of rules	Genetic Fractionalization							
	Low		Medium		High		Total	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Community Governance (n=227)	8.94	(1.11)	12.43	(1.64)	14.33	(1.30)	11.79	(0.79)
Resource Management (n=223)	19.71	(2.72)	24.80	(3.88)	29.37	(3.52)	24.52	(1.96)

Source: heterogeneity2.dta

Table 11: Content and Resource Fractionalization

Type of rules	Resource Fractionalization							
	Low		Medium		High		Total	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Community Governance (n=227)	12.16	(1.46)	11.93	(1.49)	11.33	(1.16)	11.79	(0.79)
Resource Management (n=223)	25.27	(3.42)	23.15	(3.82)	24.80	(2.95)	24.52	(1.96)

Source: heterogeneity2.dta

Table 12: Cross-correlation table

Variables		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Resource Management	1.00																	
Community Governance	0.57	1.00																
Quorum	-0.02	-0.16	1.00															
Forward stability of the institution	0.09	-0.25	0.11	1.00														
Adjusted Surname Fractionalization	0.23	0.21	-0.09	-0.09	1.00													
Resource Fractionalization	-0.04	-0.07	-0.13	-0.10	-0.07	1.00												
Number of roles in each assembly	0.09	0.28	-0.21	-0.41	0.44	0.11	1.00											
Document Length	0.95	0.79	0.03	-0.02	0.25	-0.05	0.14	1.00										
Insider group size	0.14	0.11	-0.23	-0.08	0.64	-0.04	0.26	0.16	1.00									
Outsider group size (frac.)	-0.01	-0.10	0.17	0.09	-0.12	-0.01	-0.08	-0.08	-0.17	1.00								
Community population	0.01	-0.07	0.10	-0.01	0.25	-0.01	0.08	-0.04	0.41	0.44	1.00							
Villages within a community	-0.01	-0.02	-0.04	0.01	0.36	0.01	0.16	-0.00	0.47	0.04	0.61	1.00						
Charter amendment	-0.47	-0.46	0.04	-0.20	-0.06	0.09	0.05	-0.54	-0.03	0.15	0.10	-0.11	1.00					
Total productive surface	0.11	-0.12	-0.02	0.24	0.14	-0.20	-0.10	0.03	0.30	0.45	0.57	0.32	-0.01	1.00				
Large commons endowment	0.06	-0.10	0.13	0.22	0.15	-0.27	-0.08	-0.00	0.24	0.39	0.37	0.26	0.05	0.70	1.00			
Year of the assembly	-0.07	0.28	-0.10	-0.81	0.08	0.08	0.51	0.03	0.00	-0.11	-0.08	-0.12	0.23	-0.34	-0.29	1.00		
Distance from closest local town	0.12	-0.03	0.15	0.28	0.02	-0.13	-0.13	0.12	0.03	-0.18	-0.13	-0.05	-0.14	0.04	0.05	-0.18	1.00	

Table 13: Complexity of Institutions: Document length

	(1)	(2)	(3)	(4)
Adjusted Surname Fractionalization	11.30***	10.77***		11.04***
	(2.794)	(2.904)		(2.496)
Resource Fractionalization	20.25	10.19	11.21	10.32
	(20.519)	(25.871)	(26.115)	(25.895)
Insider group size	0.0106	0.00216	0.0270**	
	(0.016)	(0.012)	(0.011)	
Villages within a community	-3.299***	-3.049***	-2.539**	-3.008***
	(1.106)	(1.029)	(1.081)	(0.989)
Total productive surface	0.000844	0.00134	0.000841	0.00138
	(0.002)	(0.002)	(0.002)	(0.002)
Charter amendment	-38.92***	-42.06***	-43.11***	-42.07***
	(3.797)	(3.925)	(3.972)	(3.914)
Large commons endowment	-0.280	2.673	5.410	2.646
	(4.921)	(4.866)	(5.109)	(4.863)
Distance from closest local town	0.146	0.144	0.0449	0.146
	(0.446)	(0.415)	(0.412)	(0.415)
Constant	13.96	-71.12**	-64.89*	-71.94**
	(14.109)	(35.460)	(37.473)	(35.977)
Observations	222	222	222	222
R^2	0.37	0.45	0.42	0.45
Time Trend	NO	YES	YES	YES
Area Fixed Effects	NO	YES	YES	YES

OLS, robust unclustered standard errors in parentheses.
Dependent: number of articles in the document.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Complexity of Institutions: Number of Assembly Roles

	(1)	(2)	(3)	(4)
Adjusted Surname Fractionalization	0.803***	0.817***		0.815***
	(0.153)	(0.133)		(0.120)
Resource Fractionalization	1.185	1.606	1.661	1.605
	(1.122)	(1.343)	(1.447)	(1.336)
Insider group size	0.000441	-0.0000145	0.00191***	
	(0.001)	(0.001)	(0.001)	
Villages within a community	0.0261	0.0346	0.0743	0.0343
	(0.058)	(0.054)	(0.052)	(0.051)
Total productive surface	-0.000100	0.0000189	-0.0000218	0.0000187
	(0.000)	(0.000)	(0.000)	(0.000)
Charter amendment	0.267	-0.130	-0.190	-0.130
	(0.203)	(0.196)	(0.203)	(0.196)
Large commons endowment	-0.213	0.0550	0.264	0.0553
	(0.264)	(0.266)	(0.267)	(0.266)
Distance from closest local town	-0.0308*	-0.00727	-0.0123	-0.00728
	(0.017)	(0.019)	(0.019)	(0.019)
Constant	1.275*	-7.767***	-6.829***	-7.765***
	(0.734)	(1.339)	(1.396)	(1.339)
Observations	226	226	226	226
R^2	0.21	0.45	0.37	0.45
Time Trend	NO	YES	YES	YES
Area Fixed Effects	NO	YES	YES	YES

OLS, robust unclustered standard errors in parentheses.
Dependent: number of roles in the assembly.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 15: Content of regulation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Adjusted Surname Fractionalization	3.757***		3.806***	7.178***		7.422***	0.0421
	(1.193)		(0.998)	(2.153)		(1.945)	(0.031)
Resource Fractionalization	-11.82	-12.21	-11.79	23.75	23.55	23.91	-0.113
	(10.205)	(10.336)	(10.163)	(21.795)	(21.944)	(21.841)	(0.268)
Insider group size	0.000391	0.00910**		0.00200	0.0183**		-0.0000597
	(0.005)	(0.005)		(0.009)	(0.009)		(0.000)
Villages within a community	-0.850*	-0.649	-0.842*	-2.104**	-1.734**	-2.066**	-0.00362
	(0.442)	(0.459)	(0.430)	(0.825)	(0.845)	(0.803)	(0.009)
Total productive surface	-0.000625	-0.000835	-0.000618	0.00207	0.00171	0.00211	-0.0000145
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Charter amendment	-14.53***	-14.76***	-14.53***	-25.89***	-26.58***	-25.89***	-0.0150
	(1.515)	(1.572)	(1.508)	(3.098)	(3.082)	(3.085)	(0.053)
Large commons endowment	1.021	1.984	1.017	-0.149	1.727	-0.167	-0.0333
	(1.956)	(2.058)	(1.950)	(3.686)	(3.781)	(3.680)	(0.047)
Distance from closest local town	-0.0180	-0.0368	-0.0176	0.111	0.0581	0.112	-0.00127
	(0.141)	(0.142)	(0.142)	(0.386)	(0.386)	(0.386)	(0.004)
Constant	-34.28***	-29.37**	-34.36***	-31.29	-25.97	-32.14	-0.627
	(11.195)	(12.061)	(11.429)	(29.345)	(30.546)	(30.116)	(0.381)
Observations	206	206	206	205	205	205	205
R^2	0.46	0.43	0.46	0.39	0.37	0.39	0.21
Time Trend	YES	YES	YES	YES	YES	YES	YES
Area Fixed Effects	YES	YES	YES	YES	YES	YES	YES

OLS, robust unclustered standard errors in parentheses.
In specification (1),(2) and (3), the dependent variable is the number of community governance rules.
In specification (4),(5), and (6) the dependent variable is the number of resource management rules.
In specification (7), the dependent variable is the fraction of community governance rules.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Forward stability of the institution (uncensored observations)

	(1)	(2)	(3)	(4)
Governance (frac.)	-322.9***			
	(75.152)			
Participation (frac.)		-740.4**		
		(324.877)		
Constraints on outsiders (frac.)			-0.102	
			(125.750)	
Resource Management (frac.)				270.9***
				(82.019)
Document Length	0.712*	0.476	0.440	0.384
	(0.353)	(0.422)	(0.473)	(0.399)
Charter amendment	59.57*	37.11	50.99	18.78
	(30.768)	(43.344)	(45.001)	(29.308)
Constant	-576.8***	-513.0***	-372.0**	-866.9***
	(176.666)	(183.596)	(172.393)	(261.102)
Observations	42	42	42	42
R^2	0.36	0.26	0.17	0.37
Time Trend	YES	YES	YES	YES

OLS, robust unclustered standard errors in parentheses.
Dependent: forward duration (in years).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 17: Forward stability of the institution (including censored at 1807)

	(1)	(2)	(3)	(4)
Governance (frac.)	84.95			
	(113.584)			
Participation (frac.)		201.7		
		(217.247)		
Constraints on outsiders (frac.)			-44.26	
			(96.026)	
Resource Management (frac.)				-54.73
				(85.569)
Document Length	-0.767	-0.713	-0.817	-0.688
	(0.577)	(0.583)	(0.590)	(0.607)
Charter amendment	136.4**	138.1**	131.0*	137.7**
	(68.411)	(68.757)	(67.311)	(66.445)
Constant	1646.7***	1655.2***	1600.5***	1725.3***
	(268.249)	(274.672)	(278.776)	(280.901)
Sigma				
Constant	209.3***	209.3***	208.6***	209.8***
	(22.522)	(22.618)	(22.695)	(22.867)
Observations	223	223	223	223
Uncensored observations	42	42	42	42
Right-censored observations	181	181	181	181
Log-likelihood	-337.1	-337.1	-337.3	-337.2
Time Trend	YES	YES	YES	YES

Censored-normal regression, robust unclustered standard errors in parentheses.
Dependent: forward duration (in years).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 18: Forward stability of the institution (uncensored observations)

	(1)	(2)	(3)	(4)	(5)
Adjusted Surname Fractionalization	-3.454		-4.144	5.300	0.446
	(13.665)		(13.176)	(23.101)	(38.126)
Resource Fractionalization		-373.2*	-374.4*	-130.5	162.9
		(187.784)	(187.829)	(330.920)	(316.020)
Insider group size				-0.0504	-0.0422
				(0.062)	(0.073)
Villages within a community				-1.253	-2.151
				(3.878)	(5.675)
Total productive surface				-0.00294	0.0226
				(0.009)	(0.017)
Charter amendment				54.01**	56.92
				(25.418)	(41.117)
Large commons endowment				27.86	24.03
				(49.371)	(63.641)
Distance from closest local town				4.301	3.850
				(3.329)	(3.318)
Constant	145.7***	338.6***	348.8***	163.3	-625.2*
	(36.075)	(102.952)	(104.022)	(211.086)	(352.978)
Observations	63	63	63	50	50
R^2	0.00	0.08	0.08	0.18	0.44
Time Trend	NO	NO	NO	NO	YES
Area Fixed Effects	NO	NO	NO	NO	YES

OLS, robust unclustered standard errors in parentheses.
Dependent: forward duration (in years).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 19: Forward stability of the institution (including censored at 1807)

	(1)	(2)	(3)	(4)	(5)
Adjusted Surname Fractionalization	-26.09			4.378	-3.177
	(24.895)			(38.280)	(4.219)
Resource Fractionalization		114.9		-21.69	-529.3***
		(222.079)		(266.682)	(19.071)
Insider group size			-0.218**	-0.253	-0.102***
			(0.085)	(0.170)	(0.023)
Villages within a community				9.942	1.980
				(12.037)	(1.819)
Total productive surface				0.00288	-0.0254***
				(0.019)	(0.003)
Charter amendment				77.65	129.9***
				(50.761)	(7.407)
Large commons endowment				-70.97	-21.78**
				(60.209)	(10.508)
Distance from closest local town				10.30***	11.76***
				(3.814)	(0.851)
Constant	463.5***	344.7***	467.9***	421.8**	3260.0***
	(64.733)	(123.555)	(40.400)	(175.542)	(11.001)
Sigma					
Constant	223.1***	226.4***	230.8***	225.2***	146.5***
	(16.771)	(16.882)	(18.950)	(18.810)	(3.337)
Observations	259	259	226	226	226
Uncensored observations	63	63	50	50	50
Right-censored observations	196	196	176	176	176
Log-likelihood	-504.0	-504.5	-404.5	-399.7	-362.1
Time Trend	NO	NO	NO	NO	YES
Area Fixed Effects	NO	NO	NO	NO	YES

Censored-normal regression, robust unclustered standard errors in parentheses.
Dependent: forward duration (in years).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 20: Quorums in Assemblies

	(1)	(2)	(3)	(4)	(5)	(6)
Adjusted Surname Fractionalization	-0.0808			0.0120		-0.123
	(0.118)			(0.154)		(0.136)
Insider group size		-0.00112**		-0.00162*	-0.00159**	
		(0.000)		(0.001)	(0.001)	
Resource Fractionalization			-0.883	-0.434	-0.435	-0.544
			(0.722)	(0.964)	(0.964)	(1.004)
Villages within a community				0.0436	0.0439	0.00647
				(0.036)	(0.036)	(0.027)
Total productive surface				-0.0000608	-0.0000609	-0.000107
				(0.000)	(0.000)	(0.000)
Charter amendment				0.0585	0.0589	0.155
				(0.126)	(0.125)	(0.131)
Large commons endowment				0.310*	0.313*	0.347**
				(0.169)	(0.178)	(0.170)
Distance from closest local town				0.000405	0.000258	0.00840
				(0.015)	(0.015)	(0.014)
Constant	1.080***	1.114***	1.383***	1.405	1.422	2.035
	(0.296)	(0.139)	(0.409)	(1.680)	(1.601)	(1.612)
Observations	91	90	91	90	90	91
Log-likelihood	-37.82	-37.26	-37.79	-36.43	-36.43	-36.97
Time Trend	NO	NO	NO	YES	YES	YES
Area Fixed Effects	NO	NO	NO	YES	YES	YES

Fractional logit. Robust unclustered standard errors in parentheses.
Dependent: quorum in assemblies.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$