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Property Rights, Marriage, and Fertility in the Italian Alps, 1790–1820[☆]

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ABSTRACT

Does property rights allocation on the commons affect marriage strategies and fertility? We focus on the role played by patrilineal vs. egalitarian inheritance systems. Our approach combines a theoretical model and an empirical study that exploits an institutional shock at the turn of the 19th century, which made inheritance on the common property-resources egalitarian for everyone. We report that – as predicted by the model – communities with patrilineal inheritance rights on the commons exhibit higher levels of endogamy and consanguinity and lower fertility than those with egalitarian inheritance rights.

1. Introduction

When the subsistence of a society depends on both private and collective assets, decisions to marry and have children may cause the depletion of collective assets in the long run through an uncontrolled population growth (Dasgupta, 2000). Inheritance systems on the commons affect both decisions and may play a crucial role in the equilibrium of a social-ecological system.

This study proposes a theoretical model to frame these issues within the context of common property resources (CPRs) and shows empirically that inheritance rights on these resources had deep implications for marriage strategies and biological welfare. We exploit an exogenous shock that led to a regime change, in order to empirically disentangle the effects of an egalitarian versus patrilineal inheritance system on endogamy, consanguinity, and fertility. In our empirical setting, the regime change only affected inheritance of CPRs. We can thus isolate the effect of inheritance rules on CPRs from that of inheritance rules on private property. This feature is unique, because large-scale reforms usually affect a country's property rights system in a non-distinctive manner.

Most scholars have studied inheritance rights on private assets rather than on CPRs (Cole and Wolf, 1974), which can have consequences for economic inequality, marriage opportunities, children health and nutritional outcomes (Kennedy, 1991; Wegge, 1999; Cooper and Bird, 2012). Inheritance systems of CPRs, however, are quite distinct from those concerning privately owned land, because they are more directly tied to solving the "tragedy of the commons" (Gordon, 1954). Designing a private inheritance system is not an effective instrument with which to prevent the tragedy of the commons, while, for instance, a switch from an egalitarian to a

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patrilineal inheritance system of CPRs can contribute to solving it (Casari and Lisciandra, 2016). In traditional societies, the survival of an entire community may hinge on the good management of its CPRs, and a change in the inheritance rules of CPRs may shape both marriage strategies and individuals' welfare (O' Grady and Tagliapietra, 2017). The extent of these effects has not yet been studied, and the present article is an attempt to remedy this gap in the literature. To our knowledge, only Alfani and Munno (2012) have explored the effects on endogamy levels of a change in the inheritance system of CPRs.

For centuries, hundreds of small communities in the Trentino region in the Italian Alps self-governed their CPRs (Casari, 2007; Casari and Tagliapietra, 2018). The type of governance observed in Trentino on the CPRs resembles that described by Ostrom (1990) for community management through long-enduring institutions. Resource users locally set rules to regulate access to and the harvesting of CPRs, including inheritance rules, and codified them in formal documents called 'charters' . Casari and Lisciandra (2011) have traced the evolution over the centuries of the inheritance system of CPRs and show that some communities relied on an egalitarian inheritance system, where members could transmit their property rights on local commons to all sons and daughters, while other communities followed a patrilineal inheritance system that granted the transmission of CPRs rights to all sons but not to the daughters.[1] The patrilineal system slowly emerged in the region as a strategy used by community members to protect the CPRs from immigration (Casari and Lisciandra, 2016). At the turn of the 19th century, after Napoleon's invasion, France and Austria enacted some major institutional changes that replaced this ancient and long-enduring system for the management of the commons with a centralized and egalitarian-based institutional arrangement.

Our investigation builds on this historical evidence and compares theoretically and empirically the patrilineal and egalitarian inheritance systems. The two systems differentially affected endogamy and consanguinity according to a precise theoretical mechanism: the egalitarian system allowed foreign men to gain access to CPRs by marrying local women. This mechanism relied on the higher incentive of migrating to communities with an egalitarian inheritance system. Based on the legal equality between descendants of both sexes, egalitarian inheritance systems also encouraged the appropriation of CPRs more than any other system, which increased incentives to have children. The empirical analysis relies on marriage-level data from 52 parishes for the years 1790–1820. This empirical setting offers the opportunity to observe comparable units (parishes) that differed in their environmental and geographical characteristics and in their inheritance rules on CPRs, within a region that maintained identical institutional conditions for centuries. Changes are assessed during a pre-post reform period of observation of thirty years, nearly a generation.

We present three main results. First, before the regime change, communities with a patrilineal system recorded higher endogamy and consanguinity levels than communities with an egalitarian system. The patrilineal system exhibited a tendency towards reproductive isolation, which may have led to lower genetic variability and a risk of genetic drift (Cavalli-Sforza et al., 2004). Second, before the regime change, communities with a patrilineal system also recorded lower fertility levels than communities with an egalitarian system. Third, after every community was forced to switch to a universal egalitarian inheritance system, one can observe a convergence in the endogamy, consanguinity, and fertility levels of both types of communities. In particular, the communities that had previously been under a patrilineal inheritance system shifted toward the levels of those communities that had previously been under an egalitarian inheritance system. These three results are in line with the predictions of the theoretical model.

The rest of the paper is structured as follows. Section 2 describes the environmental and institutional setting with a focus on changes in inheritance systems of CPRs. Section 3 contains a theoretical framework that formulates predictions on endogamy and fertility. Section 4 illustrates the data set and the main empirical patterns of marriage and fertility. Section 5 applies an econometric technique, a *Difference-in-Differences* framework, to explore the effects of the institutional change on endogamous relations, consanguinity, and fertility. To further develop the analysis of the empirical role played by CPRs, we also present a triple-differences model in which we exploit the variation across parishes in terms of per-capita value of common land. The final section states the conclusions.

2. Institutions for the management of the commons

2.1. Before the regime change

We study the Bishopric of Trento in the Italian Alps at the turn of the 19th century. The area comprised more than 300 villages with a median population of 394 (Census 1810), and largely overlaps with today's Trentino region. The local Bishop, who resided in the city of Trento, was also a Prince of the Holy Roman Empire. As such, he was jointly appointed by the Roman Pope and the Holy Roman Emperor (Cole and Wolf, 1974). This meant that he was at the same time both the ecclesiastical and temporal ruler of the region from 1027 until 1802.

Only a small portion of the region's total land was suitable for agriculture, and the population relied heavily on large tracts of forest and pasture for survival. Using a sample of 37 villages in the Theresian land registers (1780), Casari and Lisciandra (2016) estimated that common land represented 72.4% of grazing land, alp, and forest; 25.5% of low altitude meadows; 13.6% of plowland; 1.5% of orchards and gardens; 0.2% of vineyards. Forests provided community members with firewood, wild game, mushrooms, and large quantities of raw material. Pasture areas were instead a source of food for livestock, which provided meat and dairy products. The climate varied considerably with season and altitude. The activities connected with pasturage were often carried out collectively through appointed herdsman. Log rafting was widely practiced to transport timber.

[1] For Japan, Kurushima (2004) describes how women were gradually excluded from positions of power in medieval times. He does so by examining marriage patterns and inheritance of private assets (instead of common property resources).

From the institutional standpoint, villages were allowed to self-govern their economic lives under a regime of substantial communal autonomy. In the 13th century, communities began writing their own community charters (*carte di regola*). Enactment of the charters required a double approval: the first to be granted in a community gathering (*regola*) by all the heads of the households with membership rights; the second granted by the Prince-Bishop. A charter prescribed a rather detailed system of governance involving peer-monitoring, coordination, and monetary punishment (Casari and Plott, 2004). Document length ranged from a few to hundreds of chapters (Casari and Tagliapietra, 2018). In this way, through community self-enforcement, the charters allowed the sustainable management of natural resources for nearly eight centuries. At the end of the 18th century, more than 80% of the communities were under a charter regime, while the rest of the communities relied on informal norms (Casari and Lisciandra, 2016).

Self-governance institutions for the management of CPRs were widespread in Europe and also elsewhere during the pre-modern period until the liberal reforms of the 18th-19th centuries (De Moor et al., 2002; Demélas and Vivier, 2003; Ostrom, 1990). The management of CPRs in Trentino closely resembled the systems that applied also in other regions of the Alps, such as Cadore, but it differed from the CPRs in the Italian plains, because in Trentino the type of resources shared in common were forest and alpine pastures rather than arable land or irrigation systems (Alfani, 2011).[2] The archival documentation available in Trentino is another feature that sets this case apart from other situations such as the commons in England. In Trentino, users put appropriation and governance rules in writing, while in England they remained oral, and we have learned about them only indirectly through judicial rolls describing the settlement of controversies. Among the cases studied in the academic literature, the one closest to Trentino is most likely the village of Törbel in the Swiss Alps (Netting, 1981).

In the charter regime of Trentino, only certain individuals (“insiders”) could be considered as full-fledged members of the community. Full membership in a community carried an entitlement to the right to participate and cast a vote in the assembly, the right to access and use CPRs according to the rules and quotas determined in the charter, and the right to transmit all these privileges to offspring through inheritance. Note that the family was the unit of reference for membership rights. Therefore, all families having at least one insider as a member were entitled to a share of CPRs and could cast a single vote in the assembly. Individuals without membership rights were considered “outsiders”. In general, in each village some residents were outsiders, and they were generally employed in the trade and craft sector. In some circumstances, outsiders could access and use the CPRs, but only by paying a fee.

Membership could be acquired in three ways: inheritance, purchase, or marriage (Casari and Lisciandra, 2011). Over time, an increasing number of communities explicitly regulated in their charters the transfer of membership through inheritance. While ‘membership through marriage’ entailed its acquisition by absorption from a spouse, the ‘membership through inheritance’ mechanism affected the transmission to one’s offspring through the descent system, which could be either patrilineal or egalitarian. Unlike the patrilineal inheritance system, the egalitarian one was based on a bilateral descent, which allowed membership transmission through both the male and the female lines. This system still discriminated against residents descending from non-original families.[3]

From the 16th century onwards, apparent in Trentino was a gradual shift from egalitarian to patrilineal inheritance systems of CPRs as a protective measure to preserve members’ entitlement to CPRs, thereby discouraging the immigration of male outsiders.[4] According to Casari and Lisciandra (2016), the customary system was egalitarian, although often not explicitly coded, and about 30% of the 289 communities with a charter had formally stated their switch to a patrilineal system by the end of the 18th century.

2.2. The regime change

At the turn of the 19th century, an exogenous shock caused the removal of the charter system and the associated inheritance regulations. The historical events occurred in a quick succession: in 1796 Napoleon invaded Trentino and in the following twenty years a sequence of five different foreign powers ruled the region: the French (and Italian) Republic (1797–1802), the Austrian Empire (1802–1806), the Kingdom of Bavaria (1806–1810), the Kingdom of Italy under the French imperial sovereignty (1810–1814), and once again the Austrian Empire after the Congress of Vienna, which took place in 1814–15.

The French invasion triggered many legal and institutional events that eventually led to the centralization of government and the secularization of the Bishopric (1802),[5] the abolition of the charter system (1805),[6] the dissolution of the old inheritance rules and customs (1807),[7] and finally their replacement with the rule-of-law of the new French and later Austrian codifications, the Code Napoleon (1810) and the *Allgemeines Bürgerliches GesetzBuch* or ABGB (1816), respectively. Both civil codes, inspired by the classic liberal legal tradition, introduced the principle of universal succession (1811 ABGB, §§727–730). The new family and succession laws

[2] While the types of resources in the community of Nonantola differed with respect to the Trentino case, the type of governance institution (*partecipanza agraria*) as well as the logic of the inheritance system of the CPRs was similar. Nonantola’s common land was essentially arable land, which was partitioned into small parcels. Every decade or so, the family of each community member received a parcel for its exclusive use through a random allocation scheme (Alfani, 2015).

[3] A residual system, used only by a few communities at the German border, was the *Erbhof* (related to the *Geschlossener Hof*), which was a variant of the primogeniture system according to which community membership was transmitted to only one child.

[4] Alfani (2015) reports that an analogous solution was adopted also in the *partecipanza agraria* of Nonantola, Northern Italy.

[5] The Peace of Lunéville (9 February 1801) and the ensuing treaty determined the secularization and annexation of the semi-independent Bishoprics of Trento and Brixen to Austria.

[6] Austrian Government Circular (5 January 1805), which deprived the charters of any enforcement power and the village members’ gatherings of any power of making decision because it considered them “illicit plebeian gangs”.

[7] Provision of the Kingdom of Bavaria (4 January 1807). This law definitively abolished all the previous communal authorities, whose jurisdictional powers were transferred to the new district authorities.

relied on a marriage-based system that fostered the protection of legitimate filiation of both genders and protection of the patrimony within the nuclear family.

The French reform brought about a change of the inheritance system in the entire region. All the communities modified their inheritance rules in light of the new universal egalitarian regime regulated by the French and Austrian codifications. The Napoleonic *Code Civil* entered into force in Trentino on 1 July 1810 (Decreto vicereale n. 106, 15 June 1810), but was short-lived and exerted some influence mostly on the ensuing local forest regulation (1811).[8] After the dissolution of Napoleon's empire in 1814, Austria implemented in the region the ABGB, which had come into force in the rest of the empire earlier in 1811.

The new civil codes placed more emphasis on individual property and use rights. Conversely, under the charter regime, the individual could enjoy property rights (access, use, and management) inasmuch as he/she was a member of an insider family. Under the new legal system, the pre-existing institutions for the management of CPRs came to occupy a 'grey zone', fluctuating between a private and a State property status (Bonan, 2016). The old access and rights of use of CPRs were generally interpreted as private rights of a "community entity" (*universitas civium*) regulated by new centralized administrative laws (1811 ABGB, §§286–288). Thus, CPRs access rights became individual rights to which former insiders and former outsiders living in the community were entitled in their capacity as residents of a municipality (Grossi, 1981). As a result, the old distinction between insiders and outsiders was doomed to disappear. The rights of accessing and using CPRs were regulated by the 1819 municipal law, which required the user's residence within the community boundary (1823 RLPTV, vol. 6, §§756–778).[9] However, Bonan (2016) shows that, when put into practice, the municipal law implicitly perpetuated the distinction between outsiders and insiders throughout the 19th century, given that "after the municipal reform some family groups, although having the citizenship rights, [...] could not benefit from the use of common resources". Outsiders repeatedly tried to appeal against insiders and mayors, but to no avail.[10]

The 1819 municipal regulation did not provide for the inheritance rules on the CPRs, so that the main legal reference, also as regards the inheritance of CPRs access and the rights of use, remained the 1811 ABGB. Accordingly, the individual rights on CPRs became part of the bundle of rights transferable *mortis causa* through the egalitarian inheritance system (1811 ABGB, §§737–761). Thus, the universal egalitarian system fully removed the gender bias existing in some communities that adopted the patrilineal inheritance system before the regime change and became closer to the egalitarian customary law practiced in the past by the remaining communities.

3. Theoretical framework

This section puts forwards theoretical considerations in order to compare different inheritance systems in terms of expected endogamy and fertility levels. By regulating the access to a community's CPRs, the inheritance system could affect marriage strategies and reproductive decisions. Here we offer predictions concerning the differential impact of the two inheritance systems, namely egalitarian and patrilineal, on endogamy and fertility.[11] We consider a marriage to be endogamous if both spouses belonged to the same community (parish).

Consider a set of communities under decentralized decision-making, in which each community owns its local CPRs and is free to adopt its own inheritance system for the CPRs. The choice is between a patrilineal and an egalitarian inheritance system; we will refer to a community as either a "patrilineal community" or an "egalitarian community" . In the latter, both men and women can inherit community membership, transmit it to their offspring, and establish their own families with full access rights to CPRs. In a patrilineal community, instead, only men are insiders and, as such, enjoy inalienable rights. Outsiders can have access to CPRs only by marrying an insider. In the following theoretical and empirical analysis, we assume that inheritance of private assets is the same across all communities and does not change over time. As will be evident in Sections 4 and 5, the interpretation of the empirical findings relies on this assumption, and for this reason an extensive discussion is conducted in Appendix A.

The access right to the CPRs is family-based, meaning that at least one family member must be an insider. Each insider family has the right to access one unit of CPRs, regardless of the number of family members holding access rights to CPRs.

3.1. Effects of inheritance systems on endogamy

Consider a society comprising K communities. Each community is equally divided between men and women, and both are free to choose their marriage partner and place of residence. A family consists of a married couple with their children living together. Everyone wants to get married and has identical preferences concerning potential spouses. An individual has a payoff $U = U(w_k - c, p_i)$ from marrying a partner i which depends on the per capita CPRs (w_k) accessible to the members of community k, the search costs (c) to reach the place of residence of the potential partner, and the personal traits (p_i) of the spouse. The endowment of CPRs of community k (W_k) is divided into equal shares by the N_k families, and per capita CPRs is then $w_k = W_k/N_k$. For notational

[8] With the *Decreto relativo all'amministrazione, direzione, custodia e sorveglianza dei boschi del Regno* (27 May 1811), the management of pasture and forest was transferred to the regional government (§§ 28, 30).

[9] *Regolamento delle Comuni, e dei loro Capi nel Tirolo e Vorarlberg*, 26 October 1819.

[10] According to Giordani (2008), the promise of the Austrian government to return to the ancient institutional status exacerbated the existing uncertainty about who was an insider and who was an outsider, with the former insiders acting as such against the "outsider" resident citizens. The various disputes arising in the Valley of Fiemme, and lasting until the outbreak of World War I, are eloquent evidence of this state of uncertainty.

[11] The considerations on endogamy in this section also apply to consanguinity.

purposes, a community that has higher per capita CPRs than another community is considered richer. Search costs c are considered as a lump sum deducted from the achievable per capita CPRs.

An individual i has either a high (H) or a low (L) level of personal traits with equal probability. Personal traits are a one-dimensional representation of diverse individual features such as beauty, temperament, health, and private assets (i.e. private land, houses, monetary wealth, human capital, animals, etc.).

Preferences are increasing over both w_k and p_i, that is, $\partial U(.,.)/\partial w_k > 0$, $\partial U(.,.)/\partial p_i > 0$, and decreasing over c, $\partial U(.,.)/\partial c < 0$. A major difference between w_k and p_i is that personal traits are mobile (they follow their owner) while access rights are not (CPRs remain in the native community).[12] We assume that access to any CPRs always provides a higher utility than no access, regardless of the per capita share and the partner's personal traits, i.e. $U(w_k,p_i) > U(0,p_j)\ \forall i \neq j$. This assumption implies that no one prefers to shift from an insider status to an outsider one. Finally, ceteris paribus, individuals prefer partners from their same community (tie-breaking rule), and if this is not possible, then – as a rule of thumb – they opt for a partner from a richer community.

We describe the marrying behavior of individuals using a two-sided matching model between partners of the same generation in the presence of search costs. Matching occurs according to the "deferred acceptance algorithm" (Gale and Shapley, 1962; Roth, 1984; Bjerk, 2009). Matching unfolds sequentially into sets (generations) of two-period-lived agents that were born in the same period. The configuration of a generation must comply with some requirements in terms of gender, personal traits, and community of birth. More precisely, each generation in each community has the same number of individuals, the same number of men and women, and each gender has the same number of H and L individuals.[13]

Within a generation, all men make marriage proposals to women; a proposal also includes the indication of a place of residence. For the sake of simplicity, consider only two communities (i.e., $K=2$). The strategy space of a man is $S=\{1,2,\ldots,m/2\}\times\{1,2\}$, that is, men make a marriage proposal to a woman belonging to their generation which consists of m individuals, and indicates a place of residence in one of the two communities. Although we consider men as first movers, the final outcome does not change if those who make proposals are women. Consider the first round of proposals. Each man proposes to the woman at the top of his preference list. Each woman who receives multiple proposals chooses her most preferred proposer and rejects all the others. If there is only one proposal, she accepts. All rejected men from the first round move to the second round and, scrolling down their preference list, make a proposal to a new woman. Women who have received a proposal only in the second round behave exactly like the women in the first round. Women who have received proposals also in the previous round reject the proposals if they are weakly preferred, while they accept a proposal if strictly preferable to the choice they made in the previous round. This process is repeated until all the proposals made by each man within the same generation have been accepted. At this stage, any matching is stable because couples are not encouraged to change their partners and place of residence. Marriages and residence changes will only occur at the end of the process. Once married, the generational renewal follows: spouses' parents die and children are born. The birth rate is assumed to be the same across communities.

There are some elements of bounded rationality built into the model. Partner selection coupled with the choice of place of residence may eventually affect the per capita share of CPRs accessible to other couples and those of future generations. We assume that while making their proposals, individuals take into account only the per capita CPRs existing at the beginning of the first round. The knowledge of the per capita CPRs of each community will be updated once all marriages within a generation take place.

Suppose that $w_1 > w_2$ and, initially, $c=0$. The possible payoffs in the matching decision are: $A=(w_1,H)$; $B=(w_2,H)$; $C=(w_1,L)$; $D=(w_2,L)$. A is always the most preferred and D the least preferred. When ranking the other potential partners, the issue is whether the personal traits prevail over per capita CPRs in the individuals' preferences (B≻C), or vice versa (C≻B). There exist two revealed preference profiles: either A≻B≻C≻D (*P1*) or A≻C≻B≻D (*P2*). If $c>0$, a move to another community becomes less attractive. Compared to the case without search costs, this may cause a divergence in revealed preference profiles between individuals from different communities. Individuals from the richer community could eventually reveal profile *P2* while individuals from the poorer community could reveal profile *P1*.[14]

We focus on preference profiles where (*a*) players value per-capita CPRs over personal traits, that is, where CPRs are crucial for families' survival, (*b*) per-capita CPRs are unequally distributed across communities, (*c*) search costs are positive but do not produce differences in revealed preference profiles among individuals from different communities. This situation typically reveals *P2*-like preferences, that is, revealed preferences leaning towards per capita CPRs rather than personal traits.

What we have described this far allows formulation of a prediction that concerns the effects of the inheritance system on endogamy rates. We postpone the proof to Appendix B.[15] The endogamy rates are evaluated within the parish of marital residence.

Prediction 1 (Endogamy). *On average, endogamy rates are higher in patrilineal communities than in egalitarian communities. The wealthier egalitarian communities are than patrilineal communities, the greater is the difference in endogamy rates.*

As a corollary, one can also show that, under some circumstances, no migration occurs among communities, regardless of their inheritance system. This applies when at least one of the following conditions holds: (*1*) individuals value personal traits more than per-capita CPRs, or (*2*) per-capita CPRs are sufficiently similar across communities, or (*3*) search costs are sufficiently high. Under

[12] Note that unlike CPRs, individual land can be considered a mobile asset because it can be sold and the money earned thereby follows the owner.

[13] Hence, a generation has a minimum size of four individuals and is balanced in terms of gender and personal traits.

[14] An example described in Appendix B illustrates this situation.

[15] We identify a specific equilibrium when applying a matching that takes place according to the deferred acceptance algorithm (Gale and Shapley, 1962). Other matching procedures may generate a different equilibrium.

these circumstances, all marriages will be endogamous. In other words, egalitarian communities will never exhibit on average higher endogamy rates than patrilineal communities.

3.2. *Effects of inheritance systems on fertility*

In a Malthusian economy, parents' decisions about the number of their offspring are private but become a matter of public concern within the community when families of insiders heavily rely on CPRs for their survival. Under an egalitarian inheritance system, in Hardin's (1968) words, «everyone born has an equal right to the commons,» which would «lock the world into a tragic course of action». *Ceteris paribus*, this system sets the highest incentive to appropriate CPRs through additional descendants and therefore displays higher levels of fertility. This can be considered a demographic free-rider problem (Dasgupta, 2000). In a patrilineal inheritance system, where only men would have access to the CPRs, the tragedy of the commons would be mitigated by the decrease of individual incentives to have additional children. Accordingly, we can formulate the following (the proof is in Appendix B):

Prediction 2 (Fertility). *An egalitarian community displays fertility levels higher than those of a patrilineal one.*

This prediction holds when comparing communities with the same number of insider families. In the long run, however, the number of insiders may increase more in egalitarian than patrilineal communities because of the combined effect of higher fertility (Prediction 2) and the lower endogamy rates (Prediction 1). As a consequence, the per capita share of CPRs in egalitarian communities may decline. Hence, the incentives for demographic free-riding will decline as well, and fertility may drop. As described in the proof, egalitarian communities would show free-riding incentives lower than those of patrilineal communities only when the number of insiders is much higher than in patrilineal communities (i.e., at least twice as high).

4. Patterns of marriage and fertility in Trentino

This Section presents the dataset and describes the main regularities concerning endogamy, consanguinity, and fertility. The regime change brought about by Napoleon's conquests was exogenous and accomplished two goals. The first goal was a switch from decentralized to centralized rules of access and management of CPRs. The second one was the shift from a patrilineal inheritance system for a group of communities—or, a customary egalitarian inheritance system for another group—to a universal egalitarian inheritance system that implemented the transmission of membership through bilateral descent for all communities.

As described in Section 2, the patrilineal system discriminated against women residents, residents descending from non-original families, and all non-residents in their ability to access CPRs. Customary egalitarian systems excluded residents descending from non-original families and all non-residents from inheritance; women, however, were not excluded from inheritance. In principle, the universal egalitarian system only discriminated against non-residents. But, in 1820 (the post-reform year), the part of the latter system that prevented the discrimination against residents descending from non-original families was not fully in force. In practical terms, the universal egalitarian system can be still considered very similar to the older customary egalitarian one in force before the regime change. Hence in this natural experiment, the transition to a universal egalitarian system is comparable to the assignment of a "placebo" to the egalitarian group.

4.1. *Dataset*

The dataset was built by drawing on the marriage and birth records in the Catholic Church registers of 52 parishes (sources and procedures in Appendix C, dataset in Casari et al., 2018). Fig. 1 maps their geographical distribution in the present-day province of Trento. The selected parishes are a random sample of the 227 parishes in the Bishopric of Trento with complete coverage of register data used in O' Grady and Tagliapietra (2017). Even though ecclesiastical and community borders did not always overlap, generally a community included only one parish. Communities without a parish were included and counted in the nearest parish. To capture the effect of the regime change while excluding potential noise in proximity of the institutional change, we fix the regime change threshold year at 1805 and select 1790 and 1820 (i.e. 15 years before and after the abolition of the charter system) as benchmark years for our comparisons. Data for the response variables (i.e. endogamy, consanguinity, fertility) come from 104 marriage registers (N = 1,069 marriage records) and 100 birth registers (N = 4,456 birth records), for a total of 204 parish registers.

We used parish registers to build proxies for the response variables. Parish marriage registers are one source of information for endogamy and consanguinity.[16] The typical marriage record reports for each marriage the date, the names and surnames of the spouses, their village of origin, and the grant of dispensations for consanguinity.[17] These registers were compiled by priests and

[16] One limitation of marriage registers is that one cannot observe individuals who marry outside the region of study. In our case, marriage registers make it possible to track inter-community migrations in the Bishopric, or immigration at best. Despite the scarcity of migration records before the mid-1800s, historians agree on the marginal role of emigration from Trentino until the 1870s. Ascolani (2010) details that emigration before the mid-1800s was fundamentally seasonal, and served the purpose of guaranteeing to the peasant population an additional source of income. In Trentino, a law on migration was non-existent before 1832. The official records of the Austrian Empire report the migration of a few hundred people until 1848, with more people immigrating than emigrating. However, this source does not account for unreported emigrations.

[17] The Catholic Church discouraged consanguineous marriages, which required a special dispensation from the Bishop. Before 1917 Canon Law provisions forbade consanguineous unions between first cousins, second- and third-cousin unions. From the 11th to the 13th centuries a dispensation was required also for fourth- to sixth-cousin marriages (Bittles and Black, 2010).

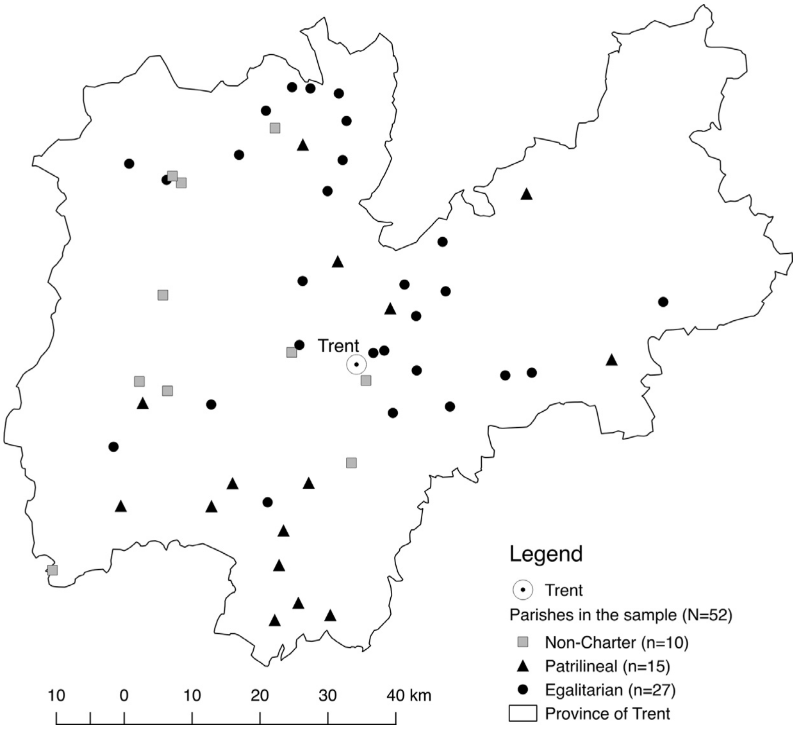

Fig. 1. Study Region and Treatment Groups.
Notes: The map shows the 52 parishes divided by groups. A list is in Appendix C. The region is located at N46.60–45.60, E11.97–10.41 and roughly corresponds to the present-day Province of Trento.
Source: Sources: Authors' elaboration on parish register data.

stored in the Archive of the Archdiocese of Trento for a period spanning from the late sixteenth century to 1913.[18] The Council of Trento mandated priests to keep records of baptisms, burials, and marriages in their parishes, and with the *Matriktpatent* of 20 February 1784 Emperor Joseph II declared church registers to be official state records and obliged priests to pass on the information to the government.

Before the abolition of the charter system in 1805, communities could adopt a charter regime for the management of commons (Casari, 2007). The dataset compiled by Casari and Lisciandra (2016) provides information about the inheritance system adopted in each community until the abolition of the charter system. Using this data set, we determined whether a parish was under a charter regime. In our sample, 42 parishes adopted a charter, while the remaining 10 were under a non-charter regime. 15 charter parishes adopted a formal patrilineal system. The remaining 27 did not adopt a formal inheritance system for the transmission of membership rights, thereby applying the customary egalitarian system (Casari and Lisciandra 2016).

Table 1 contains the summary statistics of the response variables and divides parishes into three groups: Patrilineal, Egalitarian, Non-Charter parishes. In 1826, the total population of the 52 parishes was 56,910. The Patrilineal group consisted of 25,195 parishioners; the Egalitarian group had 25,345 parishioners; the Non-Charter group had 6,370 parishioners.[19]

In Table 1 marriages are allocated to one of four categories depending on the spouses' community of origin. Parish records indicate the community of origin of each spouse. In line with Gueresi et al., (2001), we assumed that this indication identifies the spouses' place of residence at the time of marriage. A 'residential marriage' occurred if both spouses had their origins in the parish of the marriage. A 'non-residential marriage', instead, occurred when for both spouses the parish of origin was different from that of marriage. When it was only the husband that came from outside the parish of marriage, we termed this union a 'wife-residential marriage' . Finally, when it was only the wife that came from outside the parish, we called the union 'husband-residential marriage' . We used this information to build the proxies for endogamy and consanguinity.

[18] The Council of Trento, Session XXIV, required each parish to keep baptism and marriage registers since the year 1563. In practice, marriage registers have been found to begin from the late 1570s throughout Italy, while registers of baptism are earlier and often even pre-date the Council of Trent. The instructions for the compilation of the registers are stated in the *Rituale Romanum*, §§ 91-97 (1614). The *Rituale Romanum* also required the keeping of registers of burials alongside those of baptisms and marriages. Here we use baptisms as a proxy for births.

[19] The sample in this study represents approximately 20% of the total population of Trentino in 1835, which was 290,000 according to Cole and Wolf (1974).

Table 1
Descriptive Statistics, 1790–1820.

	Year 1790 (before the regime change)			**Year 1820** (after the regime change)		
	Egalitarian	Patrilineal	Non-charter	Egalitarian	Patrilineal	Non-charter
Marriage Frequencies						
(A) Residential marriage	0.519	0.811	0.738	0.563	0.667	0.733
	(0.073)	(0.082)	(0.127)	(0.075)	(0.070)	(0.115)
(B) Non-residential marriage	0.137	0.095	0.017	0.130	0.084	0.050
	(0.042)	(0.060)	(0.017)	(0.048)	(0.035)	(0.050)
(C) Wife-residential marriage	0.217	0.083	0.225	0.211	0.179	0.182
	(0.055)	(0.045)	(0.131)	(0.057)	(0.048)	(0.086)
(D) Husband-residential marriage	0.127	0.011	0.020	0.096	0.069	0.035
	(0.043)	(0.008)	(0.020)	(0.030)	(0.026)	(0.018)
Marriage records	261 (54%)	168 (35%)	52 (11%)	278 (47%)	260 (44%)	50 (9%)
Number of parishes	27	15	10	27	15	10
Sociobiological outcomes						
Endogamy [A/(A + C + D)]	0.583	0.835	0.755	0.626	0.713	0.733
	(0.077)	(0.080)	(0.129)	(0.070)	(0.061)	(0.115)
Consanguinity (% Dispensations)	0.136	0.191	0.356	0.036	0.082	0.288
	(0.047)	(0.077)	(0.120)	(0.015)	(0.038)	(0.118)
Birth rate (Baptisms records) (*)	51.024	32.633	30.521	51.818	44.568	37.652
	(8.165)	(2.179)	(6.010)	(6.642)	(6.316)	(4.902)
Number of parishes	27	15	10	27	15	10

Notes: The table reports parish-level mean shares and standard errors for each year. (*) birth rates in 1790 reported 1 missing value in egalitarian, patrilineal, and non-charter parishes, respectively (N = 49), while in 1820 there was 1 missing value in non-charter parishes (N = 51). Mean frequencies and outcomes are reported in decimal form.
Sources: Authors' elaboration on parish register data.

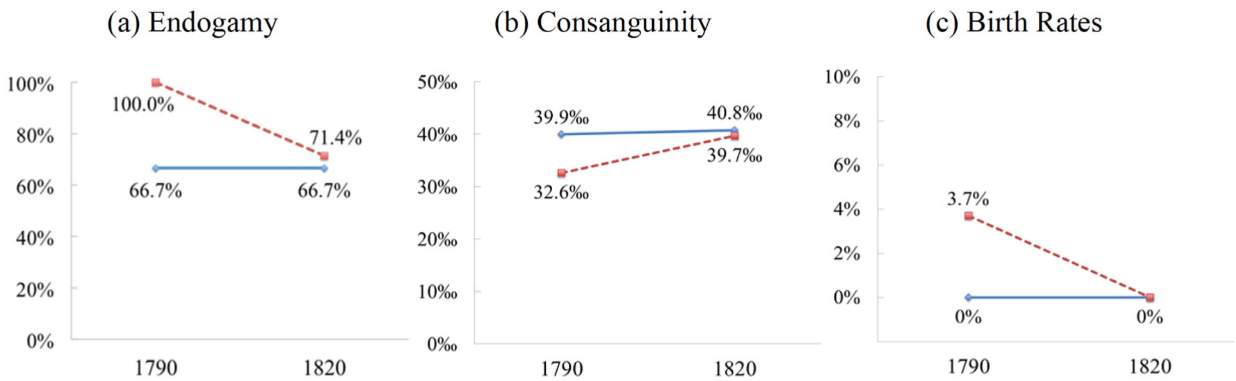

Fig. 2. Convergence after the Regime Change
Notes: Median values for *egalitarian* (solid line) and *patrilineal* (dashed line) parishes.
Source: Sources: Authors' elaboration on parish register data.

The proxy for endogamy is the ratio between the number of residential marriages and all marriages except non-residential ones. The proxy for consanguinity is the percentage of marriage dispensations granted in the parish, which provides an even clearer index of community closure than the endogamy rates do. For the purpose of this study, we considered birth rates as a proxy for fertility. Birth rates were computed as total baptisms in the parish divided by total parish population.

The dataset also includes the walking distance between the spouses' communities of origin and a set of environmental and geographical controls for each parish. We reconstructed the parish surface area using the 1897 cadastral data, and the 1780 cadastral data to estimate the average per hectare value by land type (Casari and Lisciandra, 2016). We collected estimates of the average soil elevation and terrain slope, the distance from Trento, and the parish population for the year 1826 from the Diocesan Registers of the Clergy (O' Grady and Tagliapietra, 2017).

4.2. Descriptive evidence

Here we outline the main patterns of marriages and births using descriptive statistics. The evidence in Table 1 and Fig. 2 supports our theoretical predictions. We expected to find three stark differences between egalitarian and patrilineal inheritance systems. *First*, before the regime change, patrilineal communities should display higher levels of endogamy and lower levels of fertility than egalitar-

Table 2
Changes in Outcomes, 1790–1820 (Sign Tests).

(a) Patrilineal ($N = 15$)			
Sign test	$M(y_{1820}) < M(y_{1790})$	$M(y_{1820}) > M(y_{1790})$	$M(y_{1820}) \neq M(y_{1790})$
Endogamy	0.033	0.994	0.065
Consanguinity	0.055	0.989	0.109
Birth rate (*)	0.998	0.011	0.023
(b) Egalitarian ($N = 27$)			
Sign test	$M(y_{1820}) < M(y_{1790})$	$M(y_{1820}) > M(y_{1790})$	$M(y_{1820}) \neq M(y_{1790})$
Endogamy	0.808	0.332	0.664
Consanguinity	0.059	0.982	0.119
Birth rate (*)	0.986	0.038	0.076

Notes: The statistics test the null hypothesis that the distribution of a random variable $D = (x_{i,1820} - x_{i,1790})$, where *i* is the parish, has zero median. The table reports the *p*-values of tests on the alternative hypotheses against the null (equality of medians). Panels a and b report sign tests carried out on paired observations of parish outcomes in 1790 and 1820. (*) Due to missing values, tests on birth rates are carried out on 14 patrilineal parishes and 26 egalitarian parishes.
Sources: Authors' elaboration on parish register data.

ian communities (cross-sectional difference). *Second*, in the transition between 1790 and 1820, patrilineal communities should reduce endogamy and increase fertility (longitudinal difference). *Third*, in the transition between 1790 and 1820, egalitarian communities should display no change in the levels of endogamy and fertility ascribable to the regime change (longitudinal difference). Consanguinity should exhibit a similar pattern to endogamy because both measures reveal the degree of group openness or, conversely, closure to cross-marriages with outsiders.

A cursory analysis of total averages reported in Table 1 reveals that in 1790 (i.e. before the regime change) patrilineal communities had, on average, higher endogamy and consanguinity rates and lower birth rates than egalitarian communities (83.5% vs. 58.3%, 19.1% vs. 13.6%, 32.6‰ vs. 51.0‰, respectively). In 1820, the former patrilineal communities show a decline in both endogamy and consanguinity rates (83.5% vs. 71.3%, 19.1% vs. 8.2%, respectively) and an increase in birth rates (32.6‰ vs. 44.6‰). In the transition to a universal egalitarian system, the endogamy and birth rates of the egalitarian group remain substantially unchanged (58.3% vs. 62.6%, 51.0‰ vs. 51.8‰, respectively), while average consanguinity rates show a decline (13.6% vs. 3.6%).

An even clearer picture of the differences between types of communities before and after the regime change is provided by Fig. 2, which shows the trend by plotting group medians in the two years 1790 and 1820. Viewed together, our statistics show a convergence of endogamy, consanguinity, and birth rates between the two types of communities after the regime change. With the shift to a universal egalitarian system, endogamy and consanguinity in patrilineal communities decreased and got closer to the rates of the customary egalitarian communities. In the egalitarian communities, the rates remained substantially unvaried, which indicates that the change affected especially patrilineal communities. Likewise, while patrilineal communities were subject to a remarkable increase in birth rates, customary egalitarian communities did not experience any significant change.

We performed a set of non-parametric tests (*sign tests*) on paired pre-post parish observations within the same group (Table 2). These tests on the patrilineal communities showed a significant decrease in endogamy and consanguinity (p-values 0.033 and 0.055, respectively) as well as a significant increase in birth rates (p-value 0.011). For the egalitarian communities, we cannot reject the null hypothesis of identical outcomes, except for birth rates (p-value 0.076). While the patrilineal results are in line with theoretical expectations, the results of the egalitarian communities are less compelling and this may be due to other unobserved factors.

5. Empirical analysis

This section presents an econometric analysis conducted to quantify the effect of the inheritance system of CPRs on the socio-biological parish-level outcomes. Our empirical strategy employs a *Difference-in-Differences* (DD) framework that exploits a two-period panel data set before and after the regime change (1790 vs. 1820) to estimate the magnitude of the effects with a number of control covariates.

The available historical evidence suggests that all communities in Trentino remained under an egalitarian inheritance system for *private land* in the decades before and after the regime change. Moreover, the documental evidence suggests that changes in private and CPRs inheritance systems were substantially orthogonal. Specifically, the control group remained under an egalitarian inheritance system both for CPRs and private land *before* and *after* the regime change. That is, for them the regime change worked as a *placebo*. Hence, we argue that in our case the "parallel trend assumption" holds. Appendix A provides specific and contextual elements about both the origin and development of property rights that corroborate the interpretation that the inheritance system for private land during the *Ancien Régime* was egalitarian, in line with Casari and Lisciandra (2016).

Pre-treatment conditions, such as the adoption of a charter and the inheritance systems, are predetermined. Our sample of 52 parishes is random with respect to pre-treatment conditions. The adoption of a charter was endogenous, and we considered such choice the requirement to take part in the empirical analysis. The 10 non-charter parishes attracted in the sample lack the participation requirement and, therefore, we will not take them into account for the analysis.

5.1. Estimation method

Consider the cut-off time $t = 1805$ of the exogenous regime change, a baseline time $t_0 = 1790$ before, and a follow-up time $t_1 = 1820$ after the reform. Consider also a population of N parishes. In t_0, the *i-th* parish is assigned to the control group ($Patrilineal_i = 0$) if it was under an egalitarian inheritance system, while it is included in the treatment group ($Patrilineal_i = 1$) if it adopted a patrilineal inheritance system. Consider that each parish i has a set of M_i marriages and B_i births, so that all the marriages and births can be assigned to the group to which the parish belongs. Hence, we can use the single marriage in M_i or the single birth in B_i as units of observation in the econometric analyses. However, since we miss individual covariates from birth registers, we carry out the empirical analysis for fertility at the parish level.

At time t, an exogenous regime change switches all the parishes to the universal egalitarian inheritance system, so that an outcome Y_{it} – either endogamy, consanguinity, or fertility – varies between a pair of before-after periods. The average effect of the regime change on the treated group can be modeled as:

$$DD = \left(\bar{Y}_1^1 - \bar{Y}_1^0\right) - \left(\bar{Y}_0^1 - \bar{Y}_0^0\right) \tag{1}$$

Where $\bar{Y}_0^1 = \sum_i Y_{i0}^1$. The average effect is defined as the difference in the average outcome variable between parishes in treated ($\bar{Y}^1$) and control ($\bar{Y}^0$) groups, after ($\bar{Y}_1$) and before ($\bar{Y}_0$) the regime change. In order to infer a causal relationship from the model, the critical assumption is that the differential change in the outcome between the two periods is exclusively due to the inheritance reform. The estimating equation Y_{it} takes the following form:

$$Y_{it} = \beta_0 + \beta_1 d_t + \beta_2 Patrilineal_i + \beta_3 \left(Patrilineal_i \times d_t\right) + \beta_4 X_i + e_{it} \tag{2}$$

In this equation, d_t is a binary variable taking value *0* for the baseline period (1790) and *1* for the follow-up period (1820); X_i is a set of time-invariant control covariates - specific to each parish - added to account for observed heterogeneity, such as logarithm of parish population in 1826, terrain slope and elevation, the estimates of per-capita value of total and common land, and a control dummy for 11 parishes located in the *Welsch confinen*, which underwent institutional reforms earlier than 1790 (O' Grady and Tagliapietra, 2017).[20]

We then compute the mean outcomes Y_{it} in Eq. 1 from the interaction of the estimated coefficients in Eq. 2. More specifically, the coefficient β_1 reveals the differential change in the outcome for the control group across the two periods, while the effects of the inheritance system appear from β_2, which is the difference between the mean outcomes of treated and control in the baseline period, and β_3, which is the differential mean response to the regime change between treated and control (i.e. the DD parameter). If the inheritance reform had an effect, β_3 should be statistically different from zero. Also the combination $\beta_2 + \beta_3$ should indicate the difference between the mean outcomes of treated and control in the follow-up period.

Since parishes differ as to the per-capita value of common land, we can exploit this source of cross-sectional variation to further specify our analysis and compare the effects of the regime change between parishes having higher and lower per-capita values of their CPRs. If the main driver of the effects on the socio-biological outcomes is the change in inheritance rules of CPRs, we should see larger effects in parishes with a higher per-capita value of common land. Conceptually, the DD described earlier Eqs. 1 and (2) estimates the heterogeneous treatment effect. In this approach, d_t (that is, the "reform") is the treatment, and we want to estimate how the treatment influences the outcomes differentially in the two "groups" described by the variable $Patrilineal_i$ (patrilineal and egalitarian). The DDD estimator would be an extension of this approach that adds a layer of heterogeneous treatment effect for *high-commons* or *low-commons* settings.[21] Therefore:

$$DDD = \left[\left(\bar{Y}_1^1 - \bar{Y}_1^0\right) - \left(\bar{Y}_0^1 - \bar{Y}_0^0\right)\right]_{Commons=1} - \left[\left(\bar{Y}_1^1 - \bar{Y}_1^0\right) - \left(\bar{Y}_0^1 - \bar{Y}_0^0\right)\right]_{Commons=0} \tag{3}$$

Where *Commons* is a dummy that equals 1 if the per-capita value of common land is above the median (high commons), and 0 otherwise (low commons). The new econometric specification takes the following form:

$$\begin{aligned} Y_{it} = {} & \beta_0 + \beta_1 d_t + \beta_2 Patrilineal_i + \beta_3 Commons_i + \beta_4 \left(d_t \times Patrilineal_i\right) + \\ & \beta_5 \left(d_t \times Commons_i\right) + \beta_6 \left(Patrilineal_i \times Commons_i\right) + \\ & \beta_7 \left(d_t \times Patrilineal_i \times Commons_i\right) + \beta_8 X_i + e_{it} \end{aligned} \tag{4}$$

β_1 is the differential change in the outcome for the control group and low-commons parishes across the two periods, β_2 is the difference in the outcome between treated and control low-commons parishes in the baseline period, β_3 is the difference in the outcome between high-commons and low-commons parishes in the baseline period for the control group, β_4 is the DD effect in

[20] The Welsch confines were territories in the former Bishopric of Trento directly ruled by the House of Habsburg. The Theresian administrative reforms started in 1754 gradually centralized Habsburg lands. The empire was divided into provinces, and the province of Tyrol and Vorarlberg (with capital in Innsbruck) comprised 6 districts, and the Welsch Confines (with Rovereto as capital town) were one of these districts. Despite the centralizing reforms, the Welsch communities remained autonomous in practice during the period examined here (O'Grady and Tagliapietra, 2017). Of the 11 parishes in the Welsch confines, 2 were under a patrilineal inheritance system.

[21] The DDD approach assumes that no shock occurred during the policy intervention that differentially affected the outcome of only the high-commons parishes in the patrilineal group.

low-commons parishes, $\beta_4 + \beta_7$ is the DD effect in high-commons parishes, while $(\beta_4 + \beta_7) - \beta_4 = \beta_7$ is the DDD coefficient, which measures the average effect of the regime change in high-commons parishes compared to low-commons parishes (represented in Eq. 4 as a triple interaction). Finally, β_5 is the DD effect high- vs. low-commons parishes for the control group and, more importantly, β_6 measures the difference between high- and low-commons parishes in the comparison between treated and control groups before the regime change. In other words, β_6 is the cross-sectional DD before the regime change between high- and low-commons parishes.

We employ these specifications to estimate the effect of the regime change on endogamy, consanguinity, and fertility. To study the impact of the regime change on migration patterns and community isolation, we also perform a DD and DDD analysis of marriage distances measured by the walking distance between the spouses' parishes of origin reported in the marriage registers. Marriage distance has been widely employed in genetics to study the impact of migration on population closure (Boyce et al., 1967; Fix, 1974). More specifically, Perry (1969) used the kilometric distance between the spouses' residences retrieved from parish registers to study migration patterns. Perry measured parish isolation using the percentage of intra-parochial marriages and, indeed, the marriage distance. In our case, the distance between the places of origin of the spouses is interpreted as a proxy for migration patterns, and we use it as an outcome to test the robustness of our results on endogamy and consanguinity.

Our sample is composed as follows. The 42 parishes with an ascertained inheritance system have a total of 590 marriages.[22] This figure is the result of a sampling procedure from the original 967 marriages. The treatment group consists of 15 parishes (328 marriages, 167 in 1790 and 161 in 1820), while the control group consists of 27 (262 marriages, 118 in 1790 and 144 in 1820). Among the 42 parishes, we lack two birth registers for the year 1790, one from a patrilineal parish and another from an egalitarian parish.

5.2. Findings on endogamy and consanguinity

The evidence of the DD and DDD studies that we will illustrate shortly is in line with the descriptive findings presented in Section 4 and the theoretical predictions in Section 3. Thus, centralization achieved the result of homogenizing behavioral and biological patterns of the patrilineal communities with those of the egalitarian communities. In what follows, we discuss results about endogamy and consanguinity and then in Section 5.3 we will discuss results about fertility.

The DD analysis in Table 3 studies the differential impact caused by the regime change on egalitarian and patrilineal communities, and provides information about the magnitude of the change and its statistical significance. Table 4 extends the analysis by exploiting the per-capita value of common land as a cross-sectional source of heterogeneity in a DDD design.

In the baseline (1790) period, the difference between patrilineal and egalitarian communities is positive and statistically significant for both endogamy and consanguinity (0.223 and 0.044, respectively). Such evidence is compatible with the hypothesis that the formalization of a patrilineal system into the local charters served the purpose of closing the community to outsiders. The effects of the type of inheritance system in the follow-up period (1820) are estimated by a combination of $\beta_2 + \beta_3$ in Table 3. The coefficient for endogamy is 0.0775 (s.e. = 0.059, p-value = 0.194) and for consanguinity is 0.00092 (s.e. = 0.0148, p-value = 0.951). Note that after the regime change, no statistically significant differences are detected between patrilineal and egalitarian communities for both endogamy and consanguinity. The DD coefficient in Table 3 shows a clear convergence for consanguinity (−0.043), which points towards a reduction of consanguinity rates that is higher in patrilineal communities than in the egalitarian communities. Also the DD coefficient for endogamy (−0.145) is statistically significant, and shows the expected sign.

We comment also on the impact of the regime change on marriage distance (Table 3, col. 4). In the pre-reform period (1790) there was a negative and statistically significant difference in marriage distance between patrilineal and egalitarian parishes (−5.550), suggesting that the marriage distance in egalitarian parishes was higher. This may reflect that patrilineal parishes privileged endogamous marriages before the regime change. In the follow-up period (1820) the difference in marriage distance between the two groups decreases (1.406) and is not statistically significant (s.e. = 2.949, p-value = 0.634). The overall effect of the reform is described by a positive and significant DD coefficient (6.955), which indicates that the patrilineal parishes experienced increased immigration. Interestingly, the decrease in the average distance in egalitarian parishes (4.024, p-value = 0.046) is almost identical to the increase in patrilineal ones (4.042, p-value = 0.110). This evidence supports the hypothesis of a regional rebalancing in migratory patterns through marriages in the aftermath of the regime change. More importantly, in line with the theoretical prediction and the empirical evidence, patrilineal communities exhibited higher levels of isolation than egalitarian communities before the regime change; after the regime change, however, the two types of communities converged..

Table 4 provides further insights into the results by exploiting the information of an additional layer of analysis. If changes in inheritance rules of CPRs were the main driver of the socio-biological outcomes, we would expect larger effects in communities with a higher per-capita value of common land. We recall that the coefficient β_6 represents the DD effect between high- and low-commons communities in the baseline, while β_7 is the overall DDD effect between high- and low-commons communities due to the regime change. In Table 4, the parameter β_6 has the expected sign and is statistically significant for both endogamy and consanguinity (i.e. 0.224 and 0.192, respectively). This result implies that the difference in endogamy and consanguinity rates in the baseline between high-commons patrilineal communities and high-commons egalitarian communities is larger than the same difference concerning low-commons communities. The DDD estimate β_7 is negative for both endogamy and consanguinity (−0.101 and −0.191, respectively),

[22] Since endogamy is defined as the number of marriages between insiders divided by the number of marriages in which at least one spouse (either husband of wife) is an insider. The denominator excludes couples where both spouses are outsiders (N=89), and this rule generates missing values whenever both spouses are outsiders.

Table 3
Effects of the Inheritance Reform (DD estimates).

Dependent variables:	(1) Endogamy	(2) Consanguinity	(3) Fertility	(4) Marriage distance
d_t (0 = year 1790, 1 = year 1820) [β_1]	−0.042	−0.036***	1.393	−1.556
	(0.055)	(0.012)	(9.381)	(2.337)
Patrilineal$_i$ (0 = Egal., 1 = Patr.) [β_2]	0.223***	0.044*	−18.837**	−5.550*
	(0.066)	(0.024)	(7.742)	(2.930)
$d_t \times$ *Patrilineal$_i$* (= DD) [β_3]	−0.145*	−0.043**	10.394	6.955*
	(0.076)	(0.020)	(11.657)	(3.932)
Log parish population	0.023	−0.015	−11.703**	−0.821
	(0.026)	(0.010)	(5.120)	(1.279)
Distance from Trento (km)	0.023	−0.015	0.335**	−0.012
	(0.026)	(0.010)	(0.147)	(0.050)
Average slope (%)	0.004**	−0.002***	−0.589*	0.007
	(0.002)	(0.001)	(0.305)	(0.121)
Log elevation (m)	0.029	0.049***	−9.975	−3.906*
	(0.045)	(0.013)	(7.477)	(2.175)
Total land value (per capita)	−0.002	−0.005	1.102	−1.809
	(0.026)	(0.008)	(3.305)	(1.234)
Common land value (per capita)	0.046	0.026	−4.852	3.077
	(0.056)	(0.019)	(6.213)	(2.662)
Welsch confine parish (yes/no)	0.042	−0.050***	−8.504	0.059
	(0.058)	(0.014)	(8.430)	(2.443)
Missing value (1 = yes, 0 = no)	0.118***		12.125	
	(0.040)		(9.745)	
Constant	0.119	−0.052	205.661***	44.289**
	(0.420)	(0.142)	(76.651)	(18.336)
Obs. (Total)	590	590	84	590
Obs. (Year 1790)	285	285	42	285
Obs. (Year 1820)	305	305	42	305
R^2	0.09	0.21	0.28	0.025

Notes: Regression coefficients obtained from estimating Eq. 2. Estimates are computed through ordinary least squares (OLS) regressions. Specifications (1, 2, and 4) are based on marriage-level data. We coped with sampling in parishes having more than 12 marriages by applying sampling weights to the dependent variable. The sampling weight for each observation was computed as the inverse of the selection probability (sampled/total marriages). Robust standard errors are reported in parentheses. Specification (3) are based on parish-level data, 27 egalitarian and 15 patrilineal parishes (42 per period). In specification (1) endogamy has 89 missing values, while in specification (3) fertility has 2 missing values: we imputed the mean value of the variable to the missing values and controlled for the bias introduced by the missing values using a dummy variable. Statistical significance is indicated as: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

and statistically significant for consanguinity. In line with our expectations, this means that the net effect of the regime change between patrilineal and egalitarian is higher in high-commons communities than in low-commons communities. In other words, endogamy and consanguinity rates decreased relatively more in patrilineal high-commons communities than in patrilineal low-commons communities compared to the respective egalitarian groups of communities ($DD_{high}^{endogamy} = -0.200$ vs. $DD_{low}^{endogamy} = -0.098$, $DD_{high}^{consanguinity} = -0.205$ vs. $DD_{low}^{consanguinity} = -0.015$).

When analyzing the changes in marriage distances through a DDD specification (Table 4), we found further support for our theoretical predictions. We note that in the baseline estimate β_6, the difference in marriage distances between patrilineal and egalitarian large-commons parishes is larger than the same difference in low-commons parishes (−9.020), which again suggests that patrilineal large-commons parishes were more closed to immigration, and that the size of commons was a major driver of immigration before the regime change. The overall effect of the reform, measured by the β_7 coefficient is positive (5.726), though not statistically significant it points toward a large effect on marriage distances in high-commons parishes rather than low-commons communities.

The empirical evidence so far presented corroborates Prediction 1. The exogenous change brought by a universal egalitarian inheritance system, where also women received and transmitted membership rights, opened former patrilineal communities to migration marriages for both males and females, and led to a higher reduction of endogamy rates and dispensations than egalitarian communities.

Studies in human biology have investigated the possible links between reproductive isolation of societies and their biological health. For instance, higher rates of consanguinity have been linked to homozygosity, a type of blood disease (Cavalli-Sforza et al., 2004; Bittles and Black, 2010), and small chest size, which is a biometric index of poor genetic health (Olivier and Devigne, 1980). While high consanguinity rates can be genetically undesirable, they nevertheless remain present in many small-scale societies, even when discouraged (Bittles and Black, 2010). For the observed levels of consanguinity of Trentino, however, the risks of negative health effects were likely to be limited, or entirely negligible.

Table 4
Effects of the Inheritance Reform (DDD estimates).

Dependent variables:	(1) Endogamy	(2) Consanguinity	(3) Fertility	(4) Marriage distance
d_t (0 = year 1790, 1 = year 1820) [β_1]	−0.106	−0.028**	−1.989	0.074
	(0.068)	(0.011)	(14.410)	(2.793)
Patrilineal$_i$ (0 = Egal., 1 = Patr.) [β_2]	0.119	−0.007	−22.931**	−2.815
	(0.084)	(0.022)	(11.209)	(3.510)
Commons$_i$ (yes/no) [β_3]	−0.018	0.130***	7.227	6.184
	(0.089)	(0.029)	(15.537)	(4.489)
$d_t \times$ *Patrilineal$_i$* [β_4]	−0.098	−0.015	18.211	5.586
	(0.090)	(0.016)	(17.399)	(4.587)
$d_t \times$ *Commons$_i$* [β_5]	0.242**	−0.052*	6.696	−7.179
	(0.107)	(0.029)	(18.780)	(4.418)
Patrilineal$_i$ $\times$ *Commons$_i$* [β_6]	0.224**	0.192**	8.696	−9.020**
	(0.101)	(0.077)	(15.181)	(4.404)
$d_t \times$ *Patrilineal$_i$* $\times$ *Commons$_i$* (= DDD) [β_7]	−0.101	−0.191**	−20.853	5.726
	(0.134)	(0.083)	(23.652)	(6.656)
Log parish population	0.046*	0.003	−10.754*	−0.968
	(0.027)	(0.008)	(5.647)	(1.337)
Distance from Trento (km)	0.046*	0.003	0.343**	−0.017
	(0.027)	(0.008)	(0.153)	(0.056)
Average slope (%)	0.007***	−0.000	−0.616*	−0.026
	(0.002)	(0.001)	(0.312)	(0.124)
Log elevation (m)	−0.022	0.026*	−11.110	−3.113
	(0.049)	(0.015)	(7.833)	(2.277)
Total land value (per capita)	0.001	−0.009	0.333	−2.203*
	(0.026)	(0.008)	(3.628)	(1.303)
Common land value (per capita)	−0.018	−0.007	−5.405	3.699
	(0.055)	(0.019)	(6.464)	(3.145)
Welsch confine parish (yes/no)	0.016	−0.053***	−9.163	1.200
	(0.058)	(0.016)	(8.968)	(2.564)
Missing value (1 = yes, 0 = no)	0.133***		7.861	
	(0.040)		(9.288)	
Constant	0.256	−0.074	210.500**	40.384**
	(0.412)	(0.141)	(81.439)	(18.683)
Obs. (Total)	590	590	84	590
Obs. (Year 1790)	285	285	42	285
Obs. (Year 1820)	305	305	42	305
R^2	0.11	0.34	0.29	0.031

Notes: Regression coefficients obtained from estimating Eq. 4. Estimates are computed through ordinary least squares (OLS) regression. Specifications (1, 2, and 4) are based on marriage-level data. We coped with sampling in parishes with more than 12 marriages by applying sampling weights to the dependent variable. The sampling weight for each observation is computed as the inverse of the selection probability (sampled/total marriages). Specification (3) is based on parish-level data, 27 egalitarian and 15 patrilineal parishes (42 per period). In specification (1) endogamy has 89 missing values, while in specification (3) fertility has 2 missing values: we imputed the mean value of the variable to the missing values and controlled for the bias introduced by missing values using a dummy variable. Robust standard errors are reported in parentheses. Statistical significance is indicated as: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

There exist other studies on endogamy rates in Trentino that are based on parish registers (Gueresi et al., 2000, 2001). They have a different geographical focus, because they are limited to single valleys, and scrutinized in periods of time different from that of the current study. Our original contribution is to relate demographic outcomes to the institutional changes as occurred after Napoleon's invasion, rather than geographic characteristics and population sizes.

The investigation by Alfani and Munno (2012) is instead related to the present study and further corroborates our theoretical predictions and empirical evidence. Alfani and Munno show the impact of restrictions in CPRs inheritance rights on endogamy levels in the Northern Italian village of Nonantola, outside Trentino. In 1584, the village switched to a patrilineal system, and from that year onward, women who married an outsider lost all their rights on the commons. The average endogamy rate within this group of initial settlers changed from about 25% in 1574–80 to 45% in 1587–99, showing a clear effect of the institutional change on marriage patterns.[23] We have generalized this case study by building a dataset comprising several communities and strengthened the findings by providing information about endogamy levels in the counterfactual situation of no changes occurring to the inheritance system. We have also extended the empirical test to consanguinity and fertility rates.

[23] Nonantola was larger than most Trentino villages, with 3,253 inhabitants in 1672.

5.3. Findings on fertility

In the Baseline (1790) period, patrilineal communities exhibit a fertility rate lower than that of egalitarian communities, in line with Prediction 2. The support for this statement is provided by the baseline parameter estimated in Table 3 (−18.837), which is negative and statistically significant. The follow-up parameter is negative (−8.442) and not statistically significant (s.e. = 9.070, p-value = 0.355). This shows a convergence of fertility levels of patrilineal communities toward fertility levels of egalitarian communities. With the regime change, the estimate shows a positive DD parameter (10.394), although it is not statistically significant. These results reinforce the descriptive evidence already shown in Table 1 and Fig. 2. In principle, when breaking down low- vs. high-commons communities, we would expect different signs for the DD effect between high- and low-commons communities in the baseline (8.696) and for the DDD parameter (−20.853). However, these parameters are not statistically significant and result in a non-statistical difference between high- and low-commons communities. The differential effect between these two groups is more nuanced for fertility because the main driver would probably remain the inheritance system on the CPRs (i.e. egalitarian vs. patrilineal) rather than the per-capita value of the CPRs.

The empirical evidence corroborates the interpretation that a more egalitarian inheritance system sets a higher incentive to appropriate CPRs than does a patrilineal inheritance system. This makes the demographic free-rider problem more severe for egalitarian communities. As mentioned in the theoretical section, the expected long-run demographic growth in egalitarian communities and the immigration marriages towards egalitarian communities could push fertility in these communities toward lower levels. However, the net effect between all contrasting forces suggests that the demographic free-rider problem on the CPRs is more important than the opposing effects.

In accordance with this empirical evidence, Lee (1990) observes that CPRs suffer from two tragedies. For a given population size, the first tragedy has to do with the mismanagement of CPRs, which causes their overuse and degradation. This situation can be resolved by altering the institutional arrangement (Ostrom, 1990). Once this is done, a second problem persists: the appropriation rush deriving from reproductive behavior. In other words, each additional birth produces costs that are borne by all the other members of the same community by reducing the value of their birthrights (Hardin, 1968). In Trentino, the charter adoption was a way to address the former issue, and the gradual switch toward a patrilineal inheritance system of CPRs was a way to address the latter one. While attractive from the point of view of fairness and equality, the regime change following Napoleon's invasion removed these safeguards that protected communities against the two tragedies. Unless replaced by alternative, appropriate measures, the communities faced the danger of deforestation and mismanagement of the local commons, accompanied by an increased demographic pressure on the resources.

So far, we have assumed that fertility and consanguinity are independent. However, Helgasson et al., (2008) and Bailey et al., (2014) suggest that consanguinity and fertility can be related; more specifically, that consanguinity may have a positive effect on fertility. The reasons may include earlier age at marriage and the advantages associated with the preservation of land and wealth within the family. This position challenges the conventional wisdom that higher consanguinity adversely affects fertility due to genetic reasons, through an increased rate of miscarriage, infant mortality, and morbidity in general. Helgasson et al., (2008) show a positive association between consanguinity and fertility in pre-industrial Iceland and argue for a biological rather than socioeconomic explanation. Bailey et al., (2014) find that in non-forager societies, children's survival is positively associated with the relatedness of parents. A possible explanation is that spousal relatedness is positively associated with a higher socioeconomic status, given that, in non-forager societies, close-kin marriages are often employed as an "asset-protection" strategy. Both studies observe that children born from first and second cousins had lower rates of survival and reproduction.

The dataset of this paper does not allow us to make any claim concerning the interplay between fertility and consanguinity. We have not recorded the female age at marriage, the social status of spouses; and the dataset does not make it possible to track the number of children. In Trentino, the Catholic Church closely monitored and regulated consanguineous unions. Marriages between first, second and third cousins required a special permission and were discouraged. Marriage registers in Trentino do not provide information on the degree of relatedness of consanguineous spouses when reporting the dispensation. Moreover, our dataset covers a sampled population with a limited time span.

6. Conclusions

Inheritance institutions regulate the intergenerational transmission of property rights, but they may also shape social and biological characteristics of societies. In this article we have studied the transmission of community membership status across generations, which carried with it the right to access and harvest common property resources. Most studies on inheritance systems focus on the transmission of private assets. This paper fills a gap in the literature by showing the impact of the rules concerning the intergenerational transmission of common land on the welfare and biology of a society.

We have focused on a sample of communities in the Italian Alps at the turn of the 19th century, when an exogenous shock radically changed their institutions. Before this regime change, each community owned vast tracts of forest and pasture in common and overcame the social dilemma of the excessive harvesting common resources through local self-governing institutions that emerged and evolved over the centuries. These institutions were decentralized because users of the CPRs decided how to design them. The autonomy of users was so wide that it included the ability to locally craft the inheritance system of the CPRs that best suited them. We observe some variety because some communities followed a customary egalitarian inheritance system while others adopted a patrilineal system. This study contributes to identifying the effects of an egalitarian vs. patrilineal system on a selection of socio-biological dimensions such as endogamy, consanguinity, and fertility.

We have exploited the institutional shock that these communities experienced following the Napoleonic conquest in 1796 of the region under study (Trentino) in order empirically to disentangle the effect of the inheritance system of the CPRs. There was a forced transition to a universal egalitarian inheritance system initially disciplined by the Napoleon civil code and, from 1814 onwards, by the Austro-Hungarian civil code. While this regime change ensured a *de-facto* continuity for customary egalitarian communities, it generated an abrupt change for patrilineal communities. This offered a unique opportunity to study the consequences of the regime change empirically.

Casari and Lisciandra (2016) have already shown that a patrilineal system gradually emerged in Trentino between the 15th and the 18th centuries as a mean to protect the community's assets from outsiders who married into the community in order to acquire membership rights. Discouraging marriages outside the community may have brought economic advantages but also led to higher endogamy and consanguinity rates. Moreover, at the regional level, the communities were locked into a patrilineal system. In Trentino, communities rich in CPRs gradually adopted a patrilineal inheritance system, and, once the process was completed, nobody had an incentive to switch back to an egalitarian inheritance system. This course of action would have exposed egalitarian communities to a considerable reduction in per-capita CPRs, because men from all over the region would have flocked to those communities to marry their women. Only an aggregate exogenous shock – as occurred after the Napoleon invasion – could have unlocked the situation and restored property rights for women. Besides fairness considerations, the centralized adoption of an egalitarian inheritance system could have been globally optimal. Such a system could provide individuals with an insurance against shocks hitting communities asymmetrically, through the possibility to emigrate to another community. It is difficult, though, to assess whether the regime change improved the welfare of the region as a whole (O' Grady and Tagliapietra, 2017).

This paper has proposed a theoretical framework that suits the specificities of the setting in which marriage strategies take the potential access to CPRs of the spouses into account, and it has then performed an empirical test of the predictions. We report three main findings. First, before the regime change, patrilineal communities were associated with higher endogamy and consanguinity than egalitarian communities were. Second, before the regime change, patrilineal communities exhibited lower fertility than egalitarian communities. Third, after the regime change, former patrilineal communities converged toward egalitarian communities in terms of endogamy, consanguinity, and fertility. In brief, the empirical results on consanguinity strongly support our theoretical claims, while the results on endogamy are sometimes not statistically significant but always coherent with the model. Our empirical findings on fertility are less robust: the results of the DD analysis generally follow our theoretical predictions, while the results of the DDD analysis are less supportive of our theoretical claims. Further support for our findings comes from an empirical analysis of migration patterns and parish isolation using marriage distance data.

This study has some limitations, which offer opportunities for further research. Due to data limitations, we have treated consanguinity and fertility as two independent outcomes but the two dimensions may be intertwined. It is possible that higher consanguinity causes higher (or lower) fertility; this relationship may also depend on taking a short-run versus a long-run perspective, but it can clearly affect the interpretation of our findings. Marriage registers do not offer information about the degree of relatedness of consanguineous spouses in reporting the dispensation, and many limitations of the dataset prevent some analyses that would have helped in establishing a causal link.

A larger amount of micro-data and a longer time-frame would be helpful to strengthen the robustness of the results concerning the relationship between inheritance institutions and socio-biological variables. Nevertheless, this historical study can still offer insights to policymakers and development agencies. Many CPRs-dependent societies today continue their struggle for survival, and this study shows how externally imposed reforms can influence marriage patterns and population dynamics. Inheritance laws that intervene in the customary land tenure systems can ultimately affect the welfare and the biology of populations.

Abbreviations

RLPTV: Raccolta delle Leggi Provinciali pel Tirolo e Vorarlberg
ABGB: Allgemeines Bürgerliches GesetzBuch (1811)
ADT: Archivio Diocesano di Trento

Archives

Birth and Marriage Registers: ADT (Archivio Diocesano di Trento), Registri dei nati; Registri dei matrimoni. Microfilms, 250 coils.
Diocesan Registers of the Clergy: ADT (Archivio Diocesano di Trento), Prospetti del clero, sec. XVIII-XX. 7 vol, 17 envelopes.

Appendix

A. *Inheritance System of Private Property*

While the evidence that Napoleonic reform implemented an egalitarian inheritance system on private property is unequivocal (Zimmermann, 2015), the situation during the *Ancien Régime* emerges from a joint assessment of the customary law, a few cases of communities that formally codified it, and the formal laws of the Bishopric. In line with Casari and Lisciandra (2016), five items of historical evidence support the argument that the inheritance system for private land during the *Ancien Régime* was egalitarian.

First, from the year 1111 until at least the year 1583 the eleven communities in the valley of Fiemme applied an egalitarian inheritance system on private land. This is one of the few cases for medieval Trentino where there is such an explicit mention (Sartori-Montecroce 2002, p. 278).

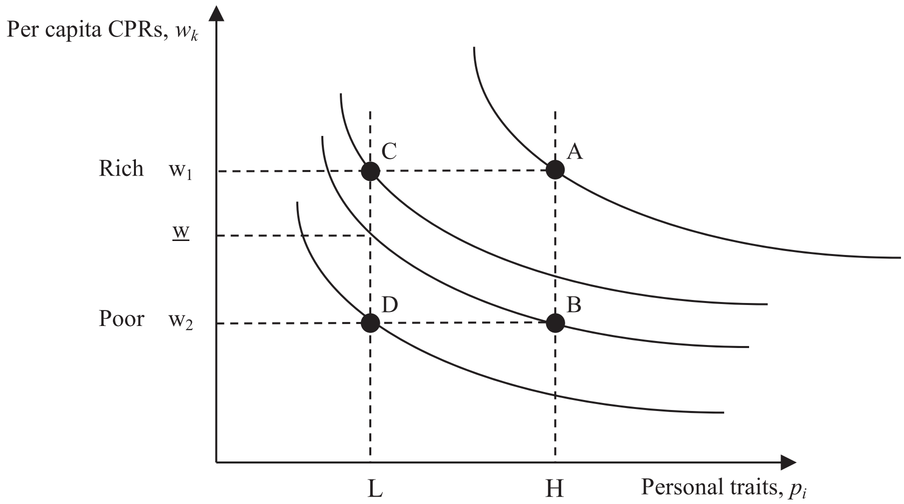

Fig. B.1. Preferences over Possible Partners: An Example
Notes: $K = 2$, $c = 0$, and preference profile *P2*.

Second, the regulations established by the 1425 Statute of Trento legislated a substantially egalitarian inheritance regime for private goods and private land, where both sons and daughters had claims. This item of legislation was enacted for the capital town but also applied to all communities in the Bishopric of Trento for those aspects not regulated by the local charters.

Third, while inheritance rules for private land were regulated by the 1425 Statute of Trento, inheritance rules for common land were never mentioned. This differential legal treatment suggests, as a possibility, that the former was a general customary rule for all communities that found explicit mention in the statute of the capital town, while the latter was left to the decentralized decision of each community. Hence, it opens the door to a possible differential evolution over time of inheritance rules of private vs. common land.

Fourth, Fiemme communities explicitly stated that, in the year 1583, inheritance systems for private vs. common land were different: whereas the former remained egalitarian, the latter switched from egalitarian to patrilineal. Therefore, we have a documented case showing that the two systems could diverge, both in principle and in practice.

Fifth, the historical origins of the customary inheritance systems on private land was inspired by the ancient Roman law, which was largely egalitarian. All Trentino communities shared this same legal history. Before the Napoleonic conquest, in the absence of specific regulations issued by the Bishop, the region was under customary law, as was the majority of the European continent. The customary law was inspired by the ancient legal institutions of the late Roman empire. According to Justinian's *Novellae* 118 and 127.1, the default custom for intestate succession was that both male and female offspring inherited all of the deceased's private goods (Zimmermann, 2015). The region was also a Bishopric of the Catholic Church, which was ruled under canon law. Canon law provisions concerning inheritance are contained in the part devoted to the sacrament of matrimony of the *Decretum Gratiani*, which largely incorporated the Roman legal tradition, thus including inheritance law provisions. The *Decretum Gratiani* was the most comprehensive legal treatise of medieval times: published around the year 1150 with the name *Concordia discordiantium canonum*, it remained in force until the year 1917 and served as a model for the development of the modern Western law of marriage, property, and inheritance. Also, the inheritance system endorsed by canon law was egalitarian and based on bilateral descent.

B. *Theoretical Proofs*

An Example of the Preferences over Possible Partners

Fig. B.1 illustrates preference profile *P2* without search costs, in which per capita CPRs prevail over personal traits (C>B). Preferences are not lexicographic but sensitive to the difference in per capita CPRs between the two communities, $w_1 - w_2$. Consider $\underline{w}$, which is the per capita CPRs that would make it indifferent between having an L-type partner along with the access to $\underline{w}$ and payoff B. If w_2 gets close enough to w_1, because of a net migration from the poor to the rich community, to such an extent that $w_1 < \underline{w}$, then the preference profile will change to *P1* (i.e. B>C). A net migration into the rich community lowers its per capita CPRs ($w_1 = W_1/N_1$), increases w_2, and can eventually shift the position of relative advantage of payoff C over B. This is why preference profiles are revealed: they may change in accordance with the difference in per capita collective wealth across communities. Hence, for a given distance between w_1 and w_2, preference profile *P1* (i.e. A>B>C>D) leans more towards personal traits, while preference profile *P2* (i.e. A>C>B>D) leans more towards CPRs. Alternatively, for a given set of preferences, large differences in the distribution of per capita CPRs are likely to reveal profiles as *P2*, while small differences in the distribution of per capita CPRs are likely to reveal profiles as *P1*.

Note that by introducing search costs (i.e., $c > 0$), individuals from different communities may not reveal the same preference profiles. On the one hand, individuals from the richer community would see a lower intercept on the vertical axis for payoffs B and D.

For these individuals, preference profile *P2* would then be strengthened (since $w_1 > w_2 > w_2\text{-}c$). On the other hand, individuals from the poorer community would see a lower intercept for payoffs C and A. For these individuals, preference profile *P1* would then be strengthened.[24] This may cause a divergence of preferences such that individuals from the richer community have preference profile *P2* and individuals from the poorer community have preference profile *P1*.

Proof of Prediction 1 (endogamy)

The following proof considers any matching that occurs across two communities according to all possible combinations: (1) both communities are egalitarian; (2) both communities are patrilineal; (3) the richer community is egalitarian while the poorer one is patrilineal; (4) the richer community is patrilineal while the poorer one is egalitarian.

The notation is as follows. For the sake of parsimony, from now onwards, search costs are dropped from notation. We define an allocation as the distribution of per capita CPRs across communities (w_1^n, w_2^n) occurring at the end of the matching process of the *n-th* generation, in which each matching is stable. We describe a match between an H-quality male from community *1* and an H-quality female from community *2*, both taking residence in community *1*, as $\{MH_1, FH_2\}_1$, where the subscripts to each individual refer to the community of origin, while the subscript to the brace indicates the community where the couple takes residence.

The following proof is provided for preference profile *P2*. Search costs are allowed to be positive but do not produce any divergence in revealed preference profiles across individuals from different communities.

(1) Both communities are egalitarian. Consider the allocation (w_1^1, w_2^1) at period 1 such that $w_1^1 > w_2^1$. The following stable matching occurs: $\{MH_1, FH_1\}_1$; $\{ML_1, FH_2\}_1$; $\{MH_2, FL_1\}_1$; $\{ML_2, FL_2\}_2$. The endogamy rate is lower in the richer community than in the poorer community: *33%* vs. *100%*. A net migration occurs from the poorer to the richer community. This migration will continue through generations until individuals are indifferent between matching with an L-type individual and the couple has access to collective wealth in community *1* (i.e. (w_1,L)) and matching with an H-type individual and the couple has access to collective wealth in community *2* (i.e. (w_2,H)). As long as net migration takes place, then for a generic generation *n*, the inequality $(w_1^n\text{-}w_2^n) > (w_1^{n+1}\text{-}w_2^{n+1})$ holds. At some point, this will make $(w_1^{n+i}\text{-}w_2^{n+i})$ small enough such that $(w_1^{n+i},L) \nsucc (w_2^{n+i},H)$, and the revealed preference profile would switch to *P1*. At this point, the equality $(w_1^{n+i}\text{-}w_2^{n+i}) = \{(w_1^{n+i}\text{-}w_2^{n+i})\}_{i \to \infty}$ holds. *Ceteris paribus*, the following generations will follow the same matching strategies such that no migration occurs over time.

(2) Both communities are patrilineal. Consider the allocation (w_1^1, w_2^1) at period 1 such that $w_1^1 > w_2^1$. The following stable matching occurs: $\{MH_1, FH_1\}_1$; $\{ML_1, FH_2\}_1$; $\{MH_2, FL_2\}_2$; $\{ML_2, FL_1\}_2$. The endogamy rate is *50%* in both communities. Since no net migration occurs after the first generation, no change occurs in the relative distance in terms of CPRs for a generic generation *n* (i.e. $(w_1^n\text{-}w_2^n) = (w_1^1\text{-}w_2^1)$). Thus, the subsequent generations will follow the same matching strategies. As a consequence, no net migration occurs over time.

(3) The richer community is egalitarian while the poorer one is patrilineal. Matching outcomes will be as follows: $\{MH_1, FH_1\}_1$; $\{ML_1, FH_2\}_1$; $\{MH_2, FL_1\}_1$; $\{ML_2, FL_2\}_2$. The endogamy rate is lower in the egalitarian community than in the patrilineal community: *33%* vs. *100%*. After the first generation, a net migration occurs from the patrilineal community to the egalitarian community. This migration will continue through generations until individuals are indifferent between matching with an L-type individual and the couple has access to collective wealth in community 1 (i.e. (w_1,L)) and matching with an H-type individual, and the couple has access to collective wealth in community *2* (i.e. (w_2,H)). As long as net migration takes place, then for a generic generation *n*, the inequality $(w_1^n\text{-}w_2^n) > (w_1^{n+1}\text{-}w_2^{n+1})$ holds. At some point, this will make $(w_1^{n+i}\text{-}w_2^{n+i})$ small enough such that $(w_1^{n+i},L) \nsucc (w_2^{n+i},H)$, and the revealed preference profile would switch to *P1*. At this point, the equality $(w_1^{n+i}\text{-}w_2^{n+i}) = \{(w_1^{n+i}\text{-}w_2^{n+i})\}_{i \to \infty}$ holds. *Ceteris paribus*, the following generations will follow the same matching strategies such that no migration occurs over time.

(4) The richer community is patrilineal while the poorer is egalitarian. Matching outcomes will be as follows: $\{MH_1, FH_1\}_1$; $\{ML_1, FH_2\}_1$; $\{MH_2, FL_2\}_2$; $\{ML_2, FL_1\}_2$. The endogamy rate is the same in both communities: *50%*. Since no net migration occurs after the first generation, no change occurs in the relative distance in terms of CPRs for a generic generation *n* (i.e. $(w_1^n\text{-}w_2^n) = (w_1^1\text{-}w_2^1)$). Thus, the subsequent generations will follow the same matching strategies. As a consequence, no net migration occurs over time.

If we assume an equal distribution across matching situations and the persistence of preference profile *P2*, the average endogamy rate per egalitarian community is *54%*, while the rate per patrilineal community is *62.5%*. This difference can even increase if matching occurs more frequently between poorer patrilineal communities and richer egalitarian communities.

Finally, it is easy to show that if all individuals reveal preference profiles as *P1* or search costs are high enough to cause a divergence in revealed preferences profiles across individuals from different communities, then no migration occurs and, as a result, the endogamy rate is *100%* in every community, regardless of the inheritance system.[25]

Proof of Prediction 2 (fertility).

Consider the following example. For a given private asset, suppose there are N_P insider families that have access to a patrilineal community's CPRs and N_E insider families that have access to an egalitarian community's CPRs.

[24] If *c* is high enough such that $w_2 > w_1\text{-}c$ it may even occur that individuals from the poorer communities reveal *P2* preference profiles. However, if $w_2 > w_1\text{-}c$ it is easy to show that any preference profile (i.e., either *P1* or *P2*) would result in the same matching decisions.

[25] A detailed proof can be provided upon request.

In a patrilineal community, male children are the only ones who are entitled to be insiders and have access to the CPRs once they have settled down and started a new family. Thus, the expected share of the community's CPRs appropriated by an additional child is $\frac{1}{2(N_P+1)}$.[26]

In an egalitarian community, both male and female children are entitled to membership rights. Thus, the expected share of the community's CPRs appropriated by an additional child is $\frac{1}{N_E+1}$.

If $N_P = N_E$, then we can observe that $\frac{1}{N_E+1} > \frac{1}{2(N_P+1)}$. Provided that parents discount their children's future welfare, they would have higher incentives to give birth to an additional child in an egalitarian community rather than in a patrilineal community. Over time this incentive may decrease as long as the difference $(N_E - N_P)$ increases. Families in patrilineal communities would have higher incentives to give birth to an additional child than families in egalitarian communities only if $N_E > 2N_P + 1$.

C. Data Appendix

Parishes. Table C.1 provides the complete list of the parishes in this study. We georeferenced the parish centers, and Fig. 1 shows their distribution in the present-day province of Trento, which roughly corresponds to the territory of the former Bishopric. The data used to create the treatment groups are described below (see Inheritance Systems).

Parish Archives. For each of the parishes listed in Table C.1, we collected birth and marriage records for the years 1790 and 1820. The details of the Archives are provided in the References. The data on birth registers are from O' Grady and Tagliapietra (2017). Below we provide details about the number of marriages and births for each year.

Marriage records amounted to 481 in 1790 and 588 in 1820 (Gross total of 1,069 marriage records from 104 marriage registers). We collected all the records for 40/52 parishes in 1790 (77%), and for 34/52 parishes in 1820 (65%). For 12 parishes in 1790 and 18 parishes in 1820, we either sampled 12 marriage records or used a reduced number due to record illegibility. The percentage of data coverage in these parishes is detailed as follows. For 1790: Ala (42.86%); Baselga di Pine (52.17%); Besenello (70.59%); Borgo Valsugana (54.54%); Civezzano (85.71%); Levico (42.86%); Mezzolombardo (92.30%); Mori (54.54%); Pergine Valsugana (18.75%); Riva del Garda (44.44%); Tione (60%); Tregiovo (80%). For 1820: Ala (36.36%); Arco (29.27%); Baselga di Pine (60%); Borgo Valsugana (60%); Cavalese (92.31%); Cembra (70.59%); Civezzano (66.67%); Cles (80%); Grauno (83.33%); Levico (54.54%); Mezzolombardo (57.14%); Mori (42.85714%); Pergine Valsugana (14.81%); Pieve di Bono (54.54%); Pieve Tesino (80%); Riva del Garda (38.71%); Tione (44.44%); Villazzano (85.71%). In total, data sampled is approximately 69% of the total 1790 records, and 60% of the 1820 records.

Birth records amounted to 2,028 in 1790 and 2,428 in 1820 (Gross total of 4,456 birth records from 100 birth registers). Of the original 52 parishes, we lack 4 birth registers: Cavedago 1790, Ronchi di Ala 1790, Villazzano 1790, and Villazzano 1820.

Charter Adoption. To determine if and when a village adopted a charter, we referred to the charters data set, a list of documents compiled by Casari and Lisciandra (2016, Data Appendix, p. 589). This dataset has 878 entries, which include data about 480 charters, and 398 additional chapters to charters and other documents. The documents cover 301 villages in total, with entry dates spanning from 1202 to 1796. Casari and Lisciandra (2016) report that by the year 1801 the charter system had been adopted by 82% of the villages. In this study, 42 out of 52 communities (80%) had experienced the charter system prior to the inheritance reform. Other studies using this data set are Casari (2007), O' Grady and Tagliapietra (2017).

Inheritance Systems. The dataset compiled by Casari and Lisciandra (2016) provides information about the inheritance system adopted in each community until the abolition of the charter system. All communities that formalized an inheritance system in their charter adopted a patrilineal inheritance system, while all other communities were considered under the customary inheritance law. The dataset provides information about the adoption of formal (patrilineal) inheritance systems in 15 communities (Table C.2), while 27 did not formalize any inheritance system whatsoever.

Geographical and Environmental Variables. Table C.3 provides summary statistics of the covariates for the empirical analysis.

Parish population, used also in O' Grady and Tagliapietra (2017), was collected from the ecclesiastical population census of the year 1826 and reported in the Diocesan Registers of the Clergy stored in the ADT. Log *Population* is the logarithm of this variable.

Distance from Trento (km), used also in O' Grady and Tagliapietra (2017), is the travel distance in kilometers between parish centers and Buonconsiglio Castle in Trento. The distance is measured in terms of minimum hiking time between the two points. Travel distances are calculated in ArcGIS using the path distance function which incorporates elevation data to measure distance over a three-dimensional surface.

Elevation and Slope, used also in O' Grady and Tagliapietra (2017), are derived from the Shuttle Radar Topography Mission (SRTM). *Average elevation* represents the average pixel value within the community boundaries. Log *elevation* is the logarithm of average elevation. *Average slope* is calculated by first converting the elevation DEM into a slope raster corresponding to the average change in elevation across neighboring cells divided by the average distance between cell centers. The slope raster pixels are then averaged within community boundaries.

Total and common land value (per capita) employs the 1897 Cadastral Registers data to estimate the per capita average value of the parish surface considering all types of resources. The per hectare value of each land type was computed in Casari and Lisciandra (2016) for a sample of 37 villages using the Theresian Cadastral Land Registers (1780). The total parish surface was reconstructed using the 1897 Cadastral Registers data (Consiglio Provinciale d' Agricultura pel Tirolo, 1903). If a community did not have a parish

[26] Notice that the probability to have a male child is 50%=$\frac{1}{2}$.

Table C.1
Parish List.

Parish name	Latitude	Longitude	Decanate	Treatment group
Arco	45.931	10.913	Arco	Patrilineal
Vò Sinistro	45.737	10.917	Avio	Patrilineal
Corne	45.804	10.936	Brentonico	Patrilineal
Cavalese	46.248	11.475	Cavalese	Patrilineal
Cles	46.347	10.986	Cles	Patrilineal
Albiano	46.142	11.185	Trento	Patrilineal
Riva del Garda	45.893	10.823	Riva	Patrilineal
Tiarno di Sopra	45.86	10.656	Riva	Patrilineal
Ala	45.736	11.062	Rovereto	Patrilineal
Mori	45.847	10.969	Rovereto	Patrilineal
Ronchi di Ala	45.736	11.062	Rovereto	Patrilineal
Villa Lagarina	45.925	11.038	Rovereto	Patrilineal
Pieve Tesino	46.158	11.576	Strigno	Patrilineal
Tione	46.006	10.702	Tione	Patrilineal
Mezzolombardo	46.206	11.091	Mezzolombardo	Patrilineal
Ronzo Chienis	45.898	10.956	Arco	Egalitarian
Pieve di Bono	46.05	10.844	Banale	Egalitarian
Borgo Valsugana	46.015	11.435	Borgo	Egalitarian
Levico	45.997	11.33	Borgo	Egalitarian
Roncegno	46.056	11.387	Borgo	Egalitarian
Covelo	46.114	11.009	Calavino	Egalitarian
Vigolo Vattaro	46.002	11.184	Calceranica	Egalitarian
Cembra	46.188	11.213	Cembra	Egalitarian
Grauno	46.245	11.302	Cembra	Egalitarian
Arsio-Brez	46.456	11.088	Cles	Egalitarian
Marcena di Rumo	46.456	10.989	Cles	Egalitarian
Romeno	46.395	11.116	Cles	Egalitarian
Smarano	46.351	11.128	Cles	Egalitarian
Torra	46.302	11.076	Cles	Egalitarian
Tregiovo	46.412	11.051	Cles	Egalitarian
Lardaro	45.98	10.642	Condino	Egalitarian
Baselga di Pine	46.158	11.296	Trento	Egalitarian
Bedollo	46.158	11.296	Trento	Egalitarian
Civezzano	46.101	11.181	Trento	Egalitarian
Villa Montagna	46.092	11.157	Trento	Egalitarian
Bresimo	46.423	10.924	Malé	Egalitarian
Malé	46.338	10.918	Malé	Egalitarian
Castello di Pellizzano	46.343	10.773	Ossana	Egalitarian
Celledizzo	46.364	10.711	Ossana	Egalitarian
Pergine Valsugana	46.054	11.282	Pergine	Egalitarian
Ronco	46.204	11.737	Primiero	Egalitarian
Cavedago	46.184	11.009	Mezzolombardo	Egalitarian
Saone	46.03	10.773	Banale	Non-Charter
Ciago	46.114	10.994	Calavino	Non-Charter
Baitoni	45.849	10.573	Condino	Non-Charter
Villazzano	46.046	11.163	Trento	Non-Charter
Bozzana	46.385	10.979	Malé	Non-Charter
Mezzana	46.311	10.806	Ossana	Non-Charter
Ortisé-Menas	46.339	10.792	Ossana	Non-Charter
Besenello	45.943	11.121	Rovereto	Non-Charter
Carisolo	46.204	10.731	Tione	Non-Charter
Verdesina	46.062	10.676	Tione	Non-Charter
Trento	46.711	11.1269	Trento	

Sources: Authors' elaboration on GIS and archival data (ADT).

church, for the purpose of our study we joined bordering communities to fit the ecclesiastical parish borders. The variable *total land value (per capita)* is equal to the sum of the surfaces of each land type in the village multiplied by their per hectare value. The variable *common land value (per capita)* is equal to the surface of collective ownership by land type multiplied by their per hectare value. The proportions of each land type owned as common land were estimated by Casari and Lisciandra (2016) for a sample of 37 villages using the Theresian land registers (1780). The averages of such proportions are: 25.5% for low altitude meadows; 72.4% for grazing land, alps, and forest; 13.6% for plowland; 1.5% for fruit and gardens; 0.2% for vineyards. Both total land value and common land value are finally divided by parish population in the year 1826. Land values are expressed in the local currency (*carantani*).

Walking distance between spouses (km) represents the walking distance between the place of residence of husband and wife, as reported in the marriage record. We manually georeferenced each place of residence using Google Maps, and obtained latitude and

Table C.2
Year of Adoption of Patrilineal Inheritance.

Community	Year
Ala	1619
Albiano	1761
Arco	1635
Cavalese	1584 (*), 1773
Cles	1641
Corne	1619
Mezzolombardo	1727
Mori	1619
Pieve Tesino	1289
Riva del Garda	1484
Ronchi di Ala	1619
Tiarno di Sopra	1587
Tione	1757
Villa Lagarina	1544
Vo Sinistro	1619

Notes: (*) The Community of Cavalese adopted a weaker form of the patrilineal system prior to switching to a complete form of this system.

Table C.3
Descriptive Statistics of Parish Characteristics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Parish Population (1826)	42	1203.33	1050.89	145	3663
Log Population	42	6.678	0.962	4.977	8.206
Distance from Trento (km)	42	43.949	23.429	5.167	94.056
Average slope (%)	42	35.070	14.414	9.880	61.580
Log elevation (m)	42	6.604	0.630	4.527	7.486
Total land value (per capita)	42	5.669	2.628	1.815	13.363
Common land value (per capita)	42	1.828	1.406	0.161	6.730
Welsch confine parish (yes/no)	42	0.262	0.445	0	1

longitude in decimal form. We then used the R package gmapsdistance (Version: 3.3, Date: 2017-10-21) to obtain the distance between two points using walking routes from Google Maps. Distances are reported in kilometers.

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