Gender Discrimination and Common Property Resources: a Model

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1 August 2014

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August 01, 2014

Abstract

In an open economy with common property resources at the community level, marriage and migratory decisions crucially depend on inheritance rules on the commons. Motivated by the traditional management of the commons in the Italian Alps, we present a model that fits the evolution of property rights observed over six centuries. Women's rights over the commons were progressively eroded from the Middle Ages until 1800, when there was an almost universal adoption of a patrilineal inheritance system. Communities switched from an egalitarian system to a patrilineal inheritance system in an attempt to protect the per capita endowment of common resources from outside immigration. The model shows that inheritance rules have clear-cut implications for marriage strategies, migratory flows, and fertility rates.

Keywords: inheritance, commons, migration, institutions, property rights

JEL: D10, J12, J13, J16.

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1. Introduction

According to the United Nations, women have equal rights to own property in 115 out of 193 countries and equal inheritance rights in only 93 countries (less than 50%).[1] This paper examines gender discrimination in property rights in traditional societies and in particular in inheritance rights on common property resources.[2] So far, most scholars have primarily paid attention to inheritance rights in private assets rather than common property resources.[3] However, community members in traditional societies often rely on a share of common property resources for their survival, which makes these rights crucial (Jodha, 1992). In particular, when a family's subsistence depends on both private and collective assets, decisions to marry and have children are private but imply a public concern because they cause negative externalities regarding the collective assets. Because inheritance systems on the commons intervene in both decisions, they are important devices to reduce the negative effects of such externalities. We show that inheritance rights in these resources have deep implications for marriage strategies, migratory flows, and fertility rates.

The contribution of this paper is to present a formal model to examine the implications of two distinct inheritance systems on the commons, one with gender discrimination and the other with egalitarian rights. The establishment of this model closely follows the field evidence provided by Casari and Lisciandra (2014), who carried out an investigation into the management of the common property resources of hundreds of small alpine communities in northern Italy between the years 1200 and 1800. These communities belonged to the Prince-Bishopric of Trent, which is currently Trentino. Each community had the legal power to develop and enforce their own formal statutes. These documents aimed to limit the overexploitation of community resources, which mainly comprised pastures and forests (Casari, 2007; Casari and Lisciandra, 2011; Tagliapietra, 2011) that peasants relied on heavily for their survival due to the harsh environmental and climatic conditions in the region. The evidence shows a progressive erosion of women's property rights that was especially exemplified by the narrowing over time of inheritance rights granted to women.

Gender-biased inheritance systems typically take the form of a patrilineal system in which only sons can inherit the rights to exploit community resources and transmit them to future generations. According to the historical and institutional evidence, patrilineal systems emerged as a defensive measure to preserve the wealth of richer communities. Indeed, egalitarian inheritance systems, by promoting equal rights between men and women over the commons, caused migratory flows toward richer communities, which attracted men from poorer communities to marry more endowed women. The outcome, which occurred through the interactions of communities and individuals over the centuries, was eventually a convergence toward a gender-biased inheritance system. Initially, in 1348, the patrilineal system covered 24% of the region that held a known inheritance system, and by 1801, this percentage had increased to 97%.

In the wake of this historical and institutional evidence, the current analysis attempts to understand the underlying mechanisms of matching when potential partners are confronted with inheritance rights over the collective resources of their communities.[4] Under what conditions are egalitarian inheritance systems conducive to migratory pressures toward richer communities? Are patrilineal systems an effective defensive measure to protect common resources against overexploitation? We attempt to answer these questions through a theoretical model of matching that is purposefully adapted to consider inheritance over the commons and migratory dynamics.

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[1] UN Entity for Gender Equality and the Empowerment of Women (2011).

[2] For extensive surveys on gender discrimination in the inheritance systems of traditional societies, see, for example, Wedgwood (1939), Goody (1969), and Agarwal (1994).

[3] For the economic effects of gender discrimination on the inheritance of private assets, see, for example, Kennedy (1991), Kurushima (2004), Cooper and Bird (2012), and Kumar and Quisumbing (2012).

[4] For further historical evidence on marriage markets during the Middle Ages, see Botticini and Siow (2003), and for an extensive comparative analysis of marriage markets in traditional societies, see Botticini (2014).

We consider a two-sided matching model with no search costs and focus on the steady-state properties of a society where inheritance systems over the commons can take two forms: egalitarian or patrilineal. Endogenous population growth is set to zero, but each individual can freely choose both his or her spouse and in which community to live. Thus, population adjustments across communities can only occur through migratory flows. Every individual has the desire to get married and has identical preferences with regard to two assets: *1)* a mobile asset consisting of the personal traits of the spouse such as beauty, temperament, health, and private resources, and *2)* a fixed asset consisting of a share of the per capita collective wealth of the community in which one of the two partners is a member. The timing is very simple: individuals of the same generation meet, get married, and take up residence, and then a new generation substitutes for the older generation. The consequence of this system is that mate selection exhibits strategic behavior as individuals take into account the effects of their choice *vis-à-vis* others regarding which community to settle down in because their choices affect the per capita benefits derived from the commons.

The role of inheritance rules of the commons on partners' matching has not yet been investigated in the theoretical economics literature. The literature on matching theory is rather large, encompassing several subjects, and to our knowledge, no investigation has linked inheritance rules with the assignment mechanism in the marriage market, *a fortiori* this is also the case for the inheritance rules over the commons.

The model predicts that when all communities adopt an egalitarian inheritance system, there is a net migration toward the communities with the richest endowments of per capita collective wealth. The consequence is a convergence across communities of their per capita collective wealth. However, when all communities adopt a gender-biased inheritance system, no net migration can occur, hence inequalities in terms of per capita collective wealth are preserved. Finally, when the two types of inheritance systems coexist across communities, migrations occur only if egalitarian systems are applied in the richest communities. These results confirm that egalitarian inheritance systems are evolutionarily unstable, whereas patrilineal systems emerge as an attempt to limit the size of communities and protect their members' wealth.

The structure of the paper is as follows. Section 2 offers an overview of the literature on gender studies of property rights and matching. Regarding matching theory, we used only a few features of the previous theoretical literature due to the peculiar variables involved in mate selection. Section 3 describes the importance of inheritance systems to migratory flows and fertility rates and consequently to community size. Section 4 presents the theoretical model under three different scenarios: communities with only patrilineal inheritance systems for their collective resources, communities with only egalitarian inheritance systems, and communities with different inheritance systems that coexist. Finally, section 5 discusses the results and concludes.

2 .Literature review

This paper contributes to the literature on gender studies of property rights and the literature on matching theory. Gender scholars of property rights have debated at length about the gendered nature of access to and control of property rights. Boserup (1970) argues that the form in which agriculture was traditionally practiced in pre-industrial societies gave rise to gender roles, which eventually determined male control over the resources. In particular, the biology-based division of labor yielded cultural beliefs and norms on property rights that persist today, especially in less advanced societies. Alesina *et al.* (2013) provide evidence for this argument, namely that current differences in gender attitudes and female behavior are rooted in differences in traditional agricultural practices. Similarly, but with the opposite outcome, other examples show how women gained access to property rights because of their comparative advantages in work specialization. According to Agarwal (1994), the old female-biased system within the Garos ethnic group in northeastern India is explained by the fact that women played a major role in crop production and the gathering of forest produce. Similarly, Fleck and Hanssen (2009) find that the inheritance system for private land in ancient Sparta mirrored the labor specialization system. However, as Humphries (1987) notes, the need for human muscle power in pre-industrial societies became increasingly less important after the industrial revolution; thus, the biological argument in some circumstances could be less explanatory of the persisting, or even increasing, sexual segregation in production processes. Therefore, cultural beliefs could provide a better account of sexual disparities.[5]

Gender discrimination in property rights can be of two types: *de jure* and *de facto*. In particular, women's access to resources for their household's productive and reproductive activities is more prevalent than their control over such resources (Meinzen-Dick *et al*., 1997). In many traditional societies, women gain (*de facto*) access and use rights to land indirectly through their husbands or fathers. However, the actual (*de jure*) control of land by women is seen as a productivity-enhancing factor (Agarwal, 1994). According to Lastarria-Cornhiel (1997), securing land rights for women in traditional societies was and is still critical to promote long-term investment in land and thus to increase agricultural productivity and development. Geddes and Lueck (2002) provide theoretical support for this argument: women's inability to own and control property produces suboptimal effort, and this inefficiency increases with higher levels of capital. From this perspective, inheritance has crucial importance because it is still the most common way to acquire control over property, especially in Africa. Unfortunately, women's inheritance rights to land are commonly denied with the justification that the husband's family would eventually control the land (Lastarria-Cornhiel, *ibid.*).

Although the argument appears to be important, no theoretical model has analyzed the economic effects of discriminatory gender practices on inheritance systems. As outlined in the introduction, we attempt to fill this gap by providing an economic reason for gender discrimination in property rights during the Middle Ages. It is worth noting that the explanation we provide for gender discrimination is gender neutral. A matrilineal system in which property rights are allocated to women and intergenerationally through women would have served the same purposes as a patrilineal system, that is, preventing migratory flows toward rich communities and reducing the incentives for endogenous population growth. Though very rare, there are accounts of cases of matrilineal inheritance in Sumatra (Quisumbing and Otsuka, 2001; Quisumbing *et al.,* 2001), in central and southern Malawi, especially within the Chewa group (Hansen *et al.,* 2005; Takane, 2008), and within the old Garos ethnic group in India (Agarwal, 1994).[6]

This investigation is also related to another strand of literature referred to as matching models and marriage theories, which examines the problem of mate selection.[7] This subject commonly revolves around three main issues. *1)* An inherent problem of matching/marriage is the assignment mechanism among individuals, namely, how they meet and become mates. *2)* Individuals' utility can be transferable to their partner or not transferable. A transferable utility means that a unique output measure can be associated with each marriage such that utility can be redistributed among the partners to compensate for their actions or traits. With no transferable utilities, a partner's traits determine an outcome that cannot be modified to compensate partners with deficient traits. *3)* The

[5] Humphries (1990) and King (1991) also consider cases in which women were the primary exploiters of common resources through their customary activities (e.g., gathering, scavenging, gleaning, harvesting, processing) in eighteenth and nineteenth century England, but this relative advantage did not induce any remarkable turn in property rights entitlements.

[6] A matrilineal inheritance system should not be confused with the so-called uterine matrilineal system that exists, for instance, in Western Ghana, where land rights belong to males, but they are transferred through the female line (Lastarria-Cornhiel, 1997; Quisumbing *et al.,* 2001; La Ferrara, 2007).

[7] Comprehensive reviews on the theories of marriage can be found in Roth and Sotomayor (1990), Weiss (1997), and Browning *et al.* (2011).

existence of interdependent preferences between generations induces parents to care about the utility profiles of their offspring.

The first theoretical examination of mate selection in a marriage is that of Gale and Shapley (1962), who present an algorithm in which each individual has a preference ranking among all potential partners, with no transferable utility. Complete matching arises over a finite number of rounds. Each round allows one sex to send matching proposals to the opposite sex, which are temporarily accepted and put on hold according to individuals' preferences. This mechanism is repeated until no proposal is rejected. Convergence is ensured by the fact that no one can send more than one proposal to the same individual. One main concern of this and future investigations is the stability of matching, that is, two potential partners who eventually match with other individuals should not prefer each other to their spouses; otherwise, they would prefer to stay single. The market for marital partners is also analyzed as a linear programming assignment problem by Shapley and Shubik (1972) and Becker (1973, 1974a, 1974b), in which each potential couple can be ranked by each participant by pooling transferable resources and considering the rule of division of payoffs. Transferable utility is indeed a main ingredient of these types of models. For instance, when a rich individual who is not attractive marries a poor but attractive individual, the former compensates the latter for his/her deficiency.

These initial frameworks have expanded to include different issues such as the role of pre-match investments (Cole *et al.*, 2001; Peters and Siow, 2002; Peters, 2007; Nosaka, 2007), search frictions (Mortensen, 1988; Burdett and Coles, 1997, 1999; Shimer and Smith, 2000; Smith, 2006), household public goods (Lam, 1988), and risk pooling (Kotlikoff and Spivak, 1981; Rosenzweig and Stark, 1989). In particular, Mailath and Postlewaite (2004) develop a model in which individuals value their decisions about wealth, but indirectly they value some mobile asset (e.g., beauty, etc.) that has no direct impact on anyone's utility or wealth and that is not necessarily productive but has some degree of heritability. Assortative matching by wealth is contrasted by how much importance is placed on the mobile asset for matching decisions, which could eventually cause a redistribution of wealth because rich individuals who do not possess the attribute would marry poor individuals to transmit the attribute to their offspring.

We draw several elements from previous models of mate selection. However, the mating process in our model shows important differences because of the impact of individuals and couples' choices on the per capita share of the commons, which is eventually a decision variable. Unlike Gale and Shapley (*ibid.*), we are not interested in the survival of marriage assignments but rather in their formation. As in Mailath and Postlewaite (*ibid.*), redistribution occurs through the mobile asset, which is included in the utility functions. Further, individuals only care about their own utility levels, regardless of their offspring. This rationale is important to the origins of the tragedy of commons, as highlighted by Casari and Lisciandra (2014).[8] Further, in our analysis, individuals' mating choices and couples' settlement choices can have an impact on the utility functions of other individuals and couples. As shown below, mate selection is coupled with the choice of which community to settle down in with the partner. This choice eventually affects the per capita share of collective resources accessible to the couple. In other words, the choice of an individual affects the choice of other individuals in terms of mate selection and community settlement. Of course, this relationship also occurs in the opposite direction. The endogeneity of the per capita share of collective resources makes the analysis rather complex.

[8] Institutions tend to regulate the commons to reduce the negative effects of individuals' myopia or bounded rationality. Because marriage is a very personal act in one's life, as well as having children, and because these life events affect the commons, institutions intervene to regulate even these personal acts. As noted by Oström (1990), communities have developed institutions over the centuries to ensure the efficient allocation of common resources.

3. How inheritance systems affect community size

This section provides an explanation of the possible impact of inheritance systems on changes in communities' population. Consider a society comprising K communities that are endowed with collective wealth such as pastures and forests (W_k, with k=1,..,K). Individuals, men and women, belong to one of the communities and care about the per capita collective wealth of the community and about the personal traits of their spouses. The members of a community that have access and inheritance rights to the collective wealth are called insiders. In an egalitarian system, both men and women can inherit community membership, transmit it to their offspring, and establish their own families with full rights to access the collective resources. In a patrilineal system, only men have these rights. Individuals from other communities are considered outsiders and have no access to the collective wealth unless they marry an insider.

A simple example describes the possible impacts of different inheritance systems on the population of a community under scenarios of zero or positive population growth. One scenario considers a constant population over time, where each family has exactly two children, one son and one daughter (50% chance) or both of the same gender. An insider can marry another insider or an outsider; in the latter case, the new family decides which community they wish to settle down in. Because of such internal migrations, the population of a single community can vary, despite a stable population at the societal level. The extent of internal migrations depends on the type of inheritance system and the frequency of weddings with outsiders ("cross-weddings").

Consider a community of 100 families with relatively high per capita collective wealth and an egalitarian system. This "rich" community can attract spouses from poorer communities who want to settle there. If everyone in this community marries outsiders, the number of families in the next generation doubles (200). Hence, a community adopting an egalitarian system incurs the risk of halving its per capita collective wealth in a single generation.

With a patrilineal system, the "rich" community will not increase its population even when everyone marries an outsider. When deciding on place of residence, women from the "rich" community will prefer to move to their husband's community, where they have access to the common resources. Similarly, in a primogeniture system in which only one child can inherit access to the collective wealth, the number of families would remain constant at 100.[9] In another system, which Casari and Lisciandra (2014) call the "soft patrilineal system," only sons can inherit the right to access the collective resources, but if sons are lacking, then one daughter can inherit the right. This system yields results that fall between the others because the "rich" community can grow to 125 families in the next generation.

In the alternative scenario with positive population growth, the impact of the inheritance system is amplified. When each family has three children, the population of a community with an egalitarian system can potentially triple, from 100 to 300 (Table 1). This example illustrates the different incentives for migration in the various inheritance systems.

Table 1. Community size within a generation and inheritance systems

Inheritance system of a "rich" community	2 children per family	3 children per family
Egalitarian	+100%	+200%
Soft patrilineal	+25%	+62.5%
Patrilineal	+0%	+50%
Primogeniture	+0%	+0%

Notes: The population of a community that is "rich" in terms of per capita collective wealth can grow because of immigration. Within one generation, if everyone marries an outsider and settles down in the "rich" community, the population can double with two children per family or triple with three children per family.

[9] Specifically, a primogeniture system provides the right to inherit access to the collective wealth only to one son. If sons are lacking, one daughter can obtain the right to inherit the access.

The example described above refers to community population growth driven by migratory flows. However, inheritance systems on the commons also affect the level of endogenous population growth. If each family relies only on its own private resources, the incentive to have an additional child is lower than if families also rely on community resources because if a family's subsistence is exclusively based on its own private resources, the family bears the full cost of having an additional child. If the family also relies on community resources, the cost of an additional child falls to the community at large. This externality provides a higher incentive to have an additional child. Thus, parents' decision about their number of children is a private decision, but it becomes a matter of public concern within the community when families of insiders rely for their survival on the collective resources. Under an egalitarian inheritance system, "*everyone born has an equal right to the commons,*" which would "*lock the world into a tragic course of action*," in the words of Hardin (1968). Hence, the community is confronted with a tragedy of the commons relative to endogenous population growth. A primogeniture inheritance system for the collective resources removes the tragedy of the commons because additional children do not impose externalities on the use of the collective resources. A patrilineal system attenuates the tragedy of the commons due to population growth by decreasing individual incentives to have additional children.

Hence, population growth in a single community can occur based on a net positive immigration, as in the above example, and through endogenous growth due to fertility rates. The adopted inheritance system on the commons affects both the degree of net migration and the degree of endogenous population growth.

4. A theoretical model of inheritance systems over the commons

The following is a two-sided matching model with transferable utility among partners and no search costs. We study the steady-state properties of a society under two possible inheritance systems: an egalitarian system, where both men and women inherit access to the collective wealth of their community, and a patrilineal system, where only men inherit such access.[10] The right to access the collective wealth is family based, that is, at least one family member must be an insider. Each family that has access to the collective wealth, called an insider family, owns an equal share, regardless of the number of members originally holding the right. Outsider families do not have access to the collective wealth of the community. Population adjustments across communities can arise because each individual can freely choose both his or her spouse and the community in which to live. Although considerations of endogenous population growth are relevant, in this model we focus on a zero population growth scenario.

In the model, everyone has a desire to get married and has identical preferences, $U=U(p_i,w_k)$, with regard to the personal traits of the spouse (p_i) and the per capita collective wealth (w_k). An individual i has either a high (H) or a low (L) level of personal traits, which represent in a single dimension such diverse aspects as beauty, temperament, health, and private assets (i.e., land owned as private property, houses, dowry, cash, gold, cattle, etc.). Personal traits move with the owner (*mobile asset*) but not the share of collective wealth, which remains in the native community. Everyone prefers high levels of personal traits for their spouse and higher levels of per capita collective wealth, that is, $\partial U(.,.)/\partial w_k>0$, $\partial U(.,.)/\partial p_i>0$. *Ceteris paribus*, individuals prefer partners from their same community (*tie-breaking rule*).

What follows are the events within the model:

Matching:
1. Meeting: Individuals of the same generation meet
2. Wedding: Individuals choose a spouse of the opposite sex
3. Residence: Couples choose which community to live in

[10] Soft patrilineal and primogeniture systems are not considered for simplicity.

Renewal
4. Parents die
5. Children are born

These events occur in the following way. Matching unfolds sequentially into small sets of individuals, called batches. Individuals meet (1), wed (2), and make residence decisions with their partners (3) within their batch; renewal follows. Matching proceeds one batch after the other. All of the batches are equal in size (4K individuals), and each batch represents the society at large in terms of gender, personal traits, and community. For simplicity, we consider males rather than females making proposals first in each batch. If the females move first, the results do not change. Further, individuals from the richest community necessarily move first because the other individuals may marry them and move to the richest community. Thus, no specific order of marriage proposals is needed. The match (wedding) between a male (*M*) and a female (*F*) requires the consent of both partners. Matching within the batch ends when all of the individuals are married.

We assume that when matching, individuals are short-sighted in forecasting community populations. Namely, individuals cannot predict migration flows in subsequent batches. They choose their spouse and residence by strategically taking into account all of the choices of people in the same batch, but not the choices of people in subsequent batches. The model is balanced, meaning that the number of individuals in each community is a multiple of 4, and the initial population of each community has equal shares of genders and equal shares of personal traits by gender. The population is stable, as each married couple generates two children, one son and one daughter, one with low and the other with high personal traits, randomly. Eventually, within each community, children have an even distribution by gender and personal traits, regardless of the personal traits of the parents.

In a community, the endowment of collective wealth, W_k, is exploited in equal shares by N_k families ($w_k=W_k/N_k$). A family consists of a married couple with their children living together. Thus, the community population is $4N_k$. Communities are ordered from richer to poorer based on the initial level of per capita collective wealth. Society as a whole has a constant population of $4\sum_{k=1}^{K} N_k$ and a fixed collective wealth of $\sum_{k=1}^{K} W_k$.

4.1. Communities with only patrilineal systems

We now present the main theoretical prediction when all of the communities use patrilineal inheritance systems.[11]

Proposition 1. *Consider a random partition of families {N_1,..., N_K} and of collective wealth {W_1,..., W_K} across K communities. When all of the communities have a patrilineal inheritance system, there exists an equilibrium in which the communities' size remains the same and therefore also the inequalities across communities in per capita collective wealth.*

Proof. See the appendix.

In a patrilineal system, a man never moves into the woman's community because men would lose their right to a share of the commons in the original community without acquiring insider status in the woman's community. Even if there is a desire to move to communities with a higher w_k, under a patrilineal system the individuals will never become insiders in the destination community.[12] In a marriage decision within a patrilineal system, men only evaluate women's personal traits, whereas women take into account both personal traits and the share of the collective wealth of their potential spouse.

[11] We are able to prove the existence of a Nash equilibrium but not its uniqueness. We identify a specific equilibrium when applying a matching that takes place in batches. Other matching procedures may generate a different equilibrium.

[12] Note that if women move to another community and marry an insider, they will not individually be insiders but will belong to an insider family.

The results of Proposition 1 are remarkable because they are achieved under complete freedom in choice of residence. The drivers lie in the incentive structures of the patrilineal system: people move across communities, but net migration in each community is always zero. If women marry into another community, a simple balancing argument requires that cross-weddings always come in pairs. For instance, consider two communities, 1 and 2. For every woman from community 1 that marries a man from community 2, it must be that a man from community 1 necessarily marries a woman from community 2. Hence, the population of community 1 will remain constant because women move to their husband's community and men stay put, and so also for community 2. This result extends to societies with more than two communities.

Corollary 1. *Preference profiles with more weight placed on collective wealth than on personal traits induce cross-weddings but also "mix-weddings" between L-type males and H-type females. On the contrary, strong preferences for personal traits favor internal weddings and tend to keep women within their native communities.*

This corollary emerges from the proof of Proposition 1. The explanation is simple. As noted above, men only care about women's personal traits. In each batch, MH (H-type male) and FH (H-type female) from the richest community always match together. However, ML (L-type male) from the richest community definitely prefers to marry FH from a poorer community. However, this desire depends on women's preference profiles, which are assumed to be equal for every individual regarding how much weight they place on personal traits and collective wealth. If women prefer personal traits, FHs will stay in their community and marry a male with the same personal traits. If women prefer collective wealth, FHs will move to richer communities and marry local MLs.

4.2. Communities with only egalitarian systems

Compared with patrilineal societies, a society with only egalitarian systems may reach a quite different state in terms of net migrations and communities' size.

Proposition 2. *Consider a random partition of families $\{N_1,N_2\}$ and of collective wealth $\{W_1,W_2\}$ across two communities. If*

- *all of the communities have an egalitarian inheritance system;*
- *there is sufficiently high inequality in per capita collective wealth across communities;*
- *the richer community has a sufficiently large population;*
- *individuals have "intermediate" preferences (i.e., not too inclined toward collective wealth or, alternatively, personal traits);*

then there exists an equilibrium in which communities' sizes change, and inequalities in per capita collective wealth across communities decline.

Proof. See the appendix.

Under an egalitarian system, people move across communities, and net migrations can occur. In a patrilineal system, moving to the woman's community is never a profitable option. Instead, in an egalitarian system, couples from cross-weddings can choose to live in either the wife's community or the husband's community. They will choose the community with the highest per capita collective wealth. This opportunity breaks the balance that holds in a patrilineal system: cross-weddings always come in pairs, but the new families can all choose to live in the richer community. Hence, the population of the poorer communities declines, and the population of the richer communities increases. Consequently, the levels of per capita collective wealth across communities tend to converge.[13]

[13] Another variation of the model is to consider a fully myopic matching with respect to the consequences that individuals' matching choices have on migratory flows. In this case, we expect that convergence would occur more quickly than predicted by the proposed model.

Cross-weddings will occur between an L-type individual from a richer community and an H-type individual from a poorer community because in each batch, the H-type individuals from the richer community will marry each other. In their choice of partner, individuals are willing to make tradeoffs between personal traits and the per capita level of collective wealth of their potential partners. Moreover, an individual marrying an outsider takes on the responsibility of reducing the per capita collective wealth of his or her own community if the couple settles there. This result occurs because in the same community, other individuals of the opposite sex would lack potential partners, and they would consequently seek partners from other communities and bring them into their community.

Cross-weddings and, consequently, migration can occur only if a *double coincidence* of interests takes place. On the one hand, an FL and an ML from a richer community should not consider collective wealth to be very important relative to personal traits because otherwise they would marry each other and leave the size of the community unchanged. On the other hand, an FH and an MH from a poorer community should not consider personal traits as very important compared with collective wealth, thereby formulating their interest to move to the richer community by marrying a partner with low personal traits. For this reason, convergence requires individuals to have "intermediate" preferences, that is, not too inclined toward personal traits or per capita collective wealth.

A sufficiently high inequality in per capita collective wealth across communities is necessary to trigger convergence. On the one hand, an additional family claiming rights to collective resources does not seriously threaten inequality levels existing across communities. This would encourage an FL and an ML from the richer community to marry an H-type individual from the poorer community and settle in. On the other hand, a large gain in per capita collective wealth would more than compensate for a reduction in the utility levels incurred by an FH and an MH when giving up an H-type individual from the same community and marrying an L-type individual from the richer community. Preserving the wealth ranking among communities if an additional couple settles down in the richer community is also eased if the richer community is large enough. If the number of families holding rights to the collective wealth is high, an additional couple would not imply a serious reduction in per capita collective wealth.

To conclude, a net immigration into a community causes impoverishment in terms of per capita collective wealth. The magnitude of this impoverishment is wider for a small rather than for a large community. Marrying an outsider from a poorer community, who then moves to the richer community, can increase the population and cause a negative externality for all of the insiders, including the one individual who makes the choice.

Corollary 2. *Net migration is not affected by the ordering of marriage proposals.*

Proof. See the appendix.

The picture may become complicated when more than two communities with egalitarian inheritance systems are involved. We therefore present the case for K=3. However, for simplicity, assume a large difference in per capita collective wealth among the communities. In other words, assume that for a large enough *i*, the inequalities $W_1/(N_1+i)>W_2/(N_2-i)$ and $W_2/(N_2+i)>W_3/(N_3-i)$ hold. Thus, any net migration from one community to another does not affect the ranking among communities regarding per capita collective wealth. This result also means that any couple choosing a cross-wedding will always move to settle in a richer community, regardless of the choice of the remaining individuals within the same batch because further couples choosing the richer communities will not change the ranking. This assumption is rather painless, and it assumes that individuals are more myopic than in the previous situations because their choice of partner and residence does not take into account the possible externality on per capita collective wealth.

Proposition 3. *Consider a random partition of families {N_1,N_2,N_3} and of collective wealth {W_1,W_2, W_3} across three communities. If*

- *all of the communities have an egalitarian inheritance system;*
- *there is sufficiently high inequality in per capita collective wealth across the communities such that both $W_1/(N_1+i)>W_2/(N_2-i)$ and $W_2/(N_2+i)>W_3/(N_3-i)$ hold for a large enough i, with i being the net migration possibly occurring from the communities;*
- *the richer communities have a sufficiently large population;*
- *individuals have "intermediate" preferences (i.e., they are not too inclined toward collective wealth or, alternatively, personal traits);*

then there exists an equilibrium in which communities' sizes change, and inequalities in per capita collective wealth across communities decline.

Proof. See the appendix.

The analysis of the conditions that lead to net migration or a steady state confirms the results obtained for K=2. The extension of the proof for a larger set of communities follows the same procedure; however, the proof cannot be easily handled due to the increase in the number of payoffs and the enlargement of the game tree.

4.3. Communities with mixed inheritance systems

The following proposition presents the analysis when egalitarian and patrilineal inheritance systems coexist.

Proposition 4. *Consider a random partition of families {N_1,N_2} and of the collective wealth {W_1,W_2} between two communities, one with a patrilineal inheritance system and the other with an egalitarian inheritance system. If the community with a patrilineal system has higher per capita collective wealth, then Proposition 1 applies. Otherwise, Proposition 2 applies.*

Proof. See the appendix.

This Proposition shows that what matters for net migrations in a society with different inheritance systems is the system adopted in the community with the higher per capita collective wealth. We learned from Propositions 2 and 3 that net migrations are driven by inequalities in per capita collective wealth. However, if a rich community has a patrilineal system, women cannot attract men to their community from other communities, and, consequently, net migrations are zero. Conversely, if a rich community has an egalitarian system, it does not matter what system is in place in the poor community because nobody wants to settle there: women from rich and egalitarian communities attract men from poorer communities and become "devices" to achieve a wealthier life.

5. Conclusions

Through a model that fits the historical and institutional evidence, we show that gender discrimination in property rights could emerge for economic reasons. In an open economy where individuals can choose spouses and places of residence, we find that the types of inheritance rules for common property resources have clear-cut implications for marriage strategies, migratory flows, and fertility rates. In particular, we compare a patrilineal system with an egalitarian system.

We show that when marriage decisions are private, the presence of common property resources can affect the dynamics of migration and consequently community size. A key factor is the type of inheritance system that exists for these resources. In a society where all of the communities adopt patrilineal inheritance systems, men will focus exclusively on women's personal traits, whereas women will take into account both men's personal traits and the share of collective wealth they can obtain through marriage. In a society with egalitarian inheritance systems, men and women will evaluate both assets when choosing a spouse. Without changing residence, every individual marrying a person outside of his or her own community will reduce the per capita collective wealth of everyone living in that community. In societies where both egalitarian and patrilineal inheritance systems co-exist, what matters is the system adopted in the richest communities. The magnitude of migrations will also depend on individual preferences. We show that, *ceteris paribus* and regardless of the inheritance system, if preferences lean toward personal traits, then no cross-weddings will occur, and consequently, communities' sizes will remain unchanged. If individuals give more weight to per capita collective wealth, cross-weddings will occur only with communities having patrilineal systems or, with mixed systems, when then richest community has a patrilineal system. However, no net migration occurs. Intermediate-type preferences, that is, not too unbalanced toward personal traits or per capita collective wealth, will cause cross-weddings independently of the inheritance system.

More specifically, the model clarifies the conditions that can trigger net migration. *First*, the existence of egalitarian inheritance systems can trigger net migration. In the presence of mixed systems across communities, net migrations can only be induced when richer communities adopt egalitarian inheritance regulations. *Second*, the existence of the double coincidence of interests between individuals from richer communities who are poorly endowed in personal traits and potential partners from poorer communities who are highly endowed in personal traits can trigger net migration. On the one hand, individuals from richer communities who are poorly endowed in personal traits should find personal traits more important than a loss in the share of per capita collective wealth consequent to their action. On the other hand, the individuals from poorer communities who are highly endowed in personal traits should value the gain in wealth consequent to a marriage with a rich partner more than that partner's personal traits. *Third*, the existence of significant inequalities in per capita collective wealth across communities can potentially trigger migratory flows among them. Inequalities set the level of attractiveness of richer communities for high-quality individuals from poorer communities. *Fourth*, the richer communities should have a sufficiently large population to trigger net migration: richer individuals may be discouraged to engage in cross-weddings if it would eventually cause serious reductions in their communities' per capita collective wealth.

The decentralized decision of marriage and choice of partner along with the decision of where to settle down can be at odds with the general interest of a community to preserve its resource level. Consequently, communities can decide to adopt a patrilineal inheritance system to deter a local woman from marrying a foreign man and taking up residence in her community. Thus, an important implication of net migration occurring in traditional societies where egalitarian systems exist is the gradual replacement of this system with a patrilineal system, which is evolutionarily stable. In other words, if all communities are characterized by a patrilineal system, the transition of a community to an egalitarian system can be very costly in terms of per capita collective wealth, other than the case where the community is the poorest one. On the contrary, if all communities have an egalitarian system, a switch of a community to a patrilineal system would not imply any wealth reduction. Actually, if the community is relatively richer than the other communities, the switch would preserve its wealth. Therefore, a locked-in scenario occurs once all of the communities introduce a gender-biased inheritance system.[14] As shown by Casari and Lisciandra (2014), this scenario occurred during the Middle Ages in the Italian Alps, where communities autonomously, gradually and progressively replaced egalitarian inheritance systems with patrilineal systems, and no reversal occurrence arose until Napoleon's invasion in 1796, after which a centralized regime was implemented.

[14] Of course, a matrilineal system could have served the same purposes as a patrilineal system throughout the paper. Hence, all considerations regarding patrilineal systems readily apply to matrilineal systems.

The implications of the model are reinforced when endogenous population growth is possible. The decision to have children is private, but it has an impact on the community as a whole (Hardin, 1968) because of the negative externality of appropriating collective resources. In particular, an egalitarian inheritance system on the commons sets the highest incentive to appropriate common property resources through additional descendants, and therefore fertility rates are higher. Consequently, the inheritance system over collective resources plays a role in the control of community size through two channels: marriage decisions and fertility rates. Gender-biased inheritance systems would then limit both endogenous and exogenous population growth within a community. On the contrary, egalitarian inheritance systems could jeopardize communities' resources through demographic pressures, thereby providing an economic account, co-existing with cultural rationales, of the rise of gender-biased inheritance systems.

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APPENDIX

Proof of Proposition 1.

The proof is provided for the cases K=2 and K=3. The proof for K>3 follows along the same lines of the proofs provided for a smaller set of communities; however, the exposition is long and complex, and it is therefore not provided.

Case K=2.

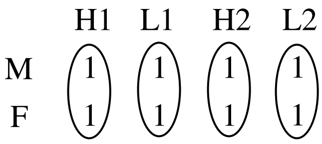
MH1 (H-quality male from community 1) would like to marry FH1 instead of FH2 because of the tie-breaking rule in favor of females from the same community when, *ceteris paribus*, the potential partners have the same personal traits. ML1 (L-type male from community 1) may attract H-quality females from the poorer community depending on the revealed preference profile (Table A1).

Table A1. Revealed preference profiles with a patrilineal system for K=2.

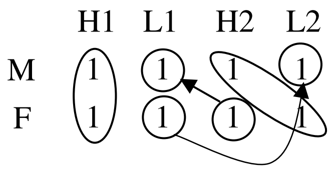
P1	P2
H1	H1
H2	L1
L1	H2
L2	L2

Notes: Payoffs are ordered from the most preferred on the top to the least preferred on the bottom. For instance, an individual with profile P1 prefers H2=(w_2,H), to wit, an H-type from community 2, to L1=(w_1,L), to wit, an L-type from community 1. The opposite is true for profile P2. The preference profile depends on W_k, N_k, and p_i.

For a given difference in per capita collective wealth between communities, when the preferences are quality oriented (i.e., P1), FH2 prefers to marry MH2. Therefore, no one moves across communities. As the graph below illustrates, H1s would marry each other, FH2 would remain in community 2 and marry MH2, ML1 would then marry FL1, and finally, ML2 would marry FL2.



When the preferences are wealth oriented (i.e., P2), FH2 has an incentive to move to community 1, and ML1 is happy to marry her rather than his potential partner in his community (i.e., FL1). Therefore, FL1 would necessarily marry ML2 because MH2 would prefer, *ceteris paribus*, an L-type female from his community. The direction of the arrow in the graph indicates the community where the couple will choose to live.



In both cases, neither community changes its size. Because personal traits are randomly assigned to children regardless of their parents' quality, individuals in the next batches will behave in exactly the same way as in this batch.

Case K=3.

When considering 12 individuals to match in each batch from three communities, there are five possible revealed preference profiles (Table A2).[15]

[15] If $w_1 = w_2$ or $w_2 = w_3$, there are two profiles, as shown in Table A1.

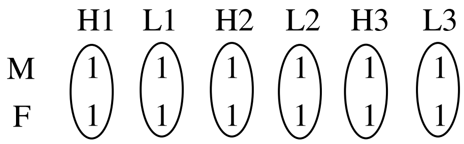
Table A2. Revealed preference profiles with a patrilineal system for K=3.

P1	P2	P3	P4	P5
H1	H1	H1	H1	H1
H2	H2	H2	L1	L1
H3	L1	L1	H2	H2
L1	H3	L2	H3	L2
L2	L2	H3	L2	H3
L3	L3	L3	L3	L3

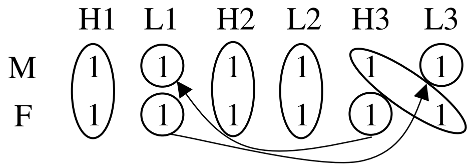
Notes: Payoffs are ordered from the most preferred on the top to the least preferred on the bottom. For instance, an individual with profile P1 prefers H3=(w_3,H), to wit, an H-type from community 3, to L1=(w_1,L), to wit, an L-type from community 1. The opposite is true for all of the other profiles. The preference profile depends on W_k, N_k, and p_i.

Let us distinguish the five cases according to the preference profiles.

P1. Individuals give the highest weight to personal traits over per capita collective wealth. Because H2 is preferred to L1, H3 is preferred to both L2 and L1, and FH2 and FH3 do not want to marry L-types from richer communities.

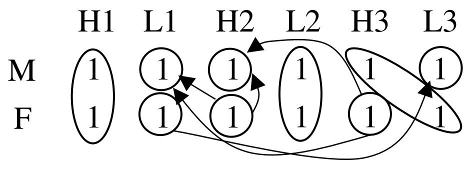


P2. Personal traits are still important, but not as important as in P1. H2 is still preferred to L1, and H3 is still preferred to L2, but L1 is now preferred to H3. Therefore, FH3 marries ML1, FH2 marries MH2 within her community, and FL2 marries ML2. Because FH3 marries ML1, MH3 marries FL3, and finally, FL1 necessarily marries ML3.



P3. Individuals have intermediate preferences: H2 is still preferred to L1, but L1 and L2 are now preferred to H3. There are no differences in the predicted outcome of migration and matching with respect to P2. In fact, FH2 still prefers MH2, and FH3 prefers both ML2 and ML1 to MH3; thus, she would choose ML1. Then, ML2 marries FL2, MH3 marries FL3, and finally, FL1 marries the remaining male, ML3.

P4. This revealed preference profile indicates preferences that are more inclined toward per capita collective wealth over personal traits: L1 is preferred to H2 and H3, although H3 is still preferred to L2. Therefore, FH2 (but also FH3) now prefers ML1. Consequently, ML1 can choose between FH2 and FH3. Over several batches, we may expect the ML1s to marry either FH2s or FH3s half of the times each and MH2s to marry the residual 50% of FH2s and FH3s. The remaining couples are ML2-FL2, MH3-FL3, and ML3-FL1.



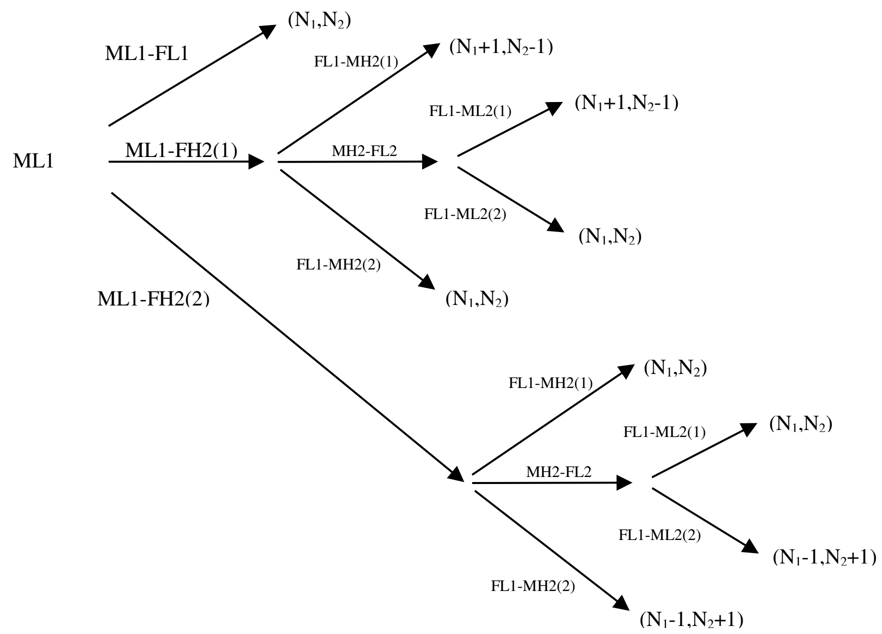
P5. Compared with the previous profiles, this profile is the most inclined toward per capita collective wealth: L1 is preferred to H2 and H3, and L2 is preferred to H3. There are no differences in the predicted outcome of migration and matching with respect to P4.

Community sizes remain the same in all five of the profiles. **End of Proof.**

Proof of Proposition 2.

H1s would prefer their own types (same personal traits and community but different gender) and to live in community 1.[16] Thus, matching choices would involve the remaining six individuals in the batch. The tree of the matching game is depicted in Figure A1. Note that ML1 has a priority in the marriage proposals because he is an insider in the richer community. The priority could also be given to FL1, but the results in terms of net migrations would not change.

Figure A1. Tree of a matching game of 2 communities with egalitarian systems.



Notes: This tree can be examined with reference to the first matching game, with $2N_1$ and $2N_2$ insider individuals in communities 1 and 2, respectively. Using several examples, we can elucidate the terminology. For instance, ML1-FH2(2) means ML1 marries FH2, and the couple chooses to live in community 2. Another specification, (N_1+1,N_2-1), is the number of couples living in communities 1 and 2, respectively, at the end of the entire game. We do not consider the options ML1-FL2(1) or ML1-FL2(2) because they are trivially less preferred by ML1.

Through backward induction, we can find the subgame perfect equilibria. Consider the subgame ML1-FH2(1) (i.e., ML1 marries FH2, and the couple decides to live in community 1). The payoffs for FL1 and MH2 are the following:

	FL1-MH2(1)	**FL1-ML2(1)**	**FL1-ML2(2)**	**FL1-MH2(2)**
FL1	$W_1/(N_1+1)$,H	$W_1/(N_1+1)$,L	W_2/N_2,L	W_2/N_2,H
MH2	$W_1/(N_1+1)$,L	$W_2/(N_2-1)$,L	W_2/N_2,L	W_2/N_2,L

There are three cases to be scrutinized. In the first case, there is a large difference in per capita collective wealth between communities; in the second case, the per capita collective wealth of the communities is rather close; in the third case, the per capita collective wealth of the communities is very close. Regarding notation, "$\succ$" represents a preference between payoffs.

1) A large difference between w_1 and w_2 (i.e., $W_1/(N_1+1)>W_2/(N_2-1)>W_2/N_2$)

FL1's ordering: $(W_1/(N_1+1),H)\succ(W_2/N_2,H)\succ(W_1/(N_1+1),L)\succ(W_2/N_2,L)$ or
$(W_1/(N_1+1),H)\succ(W_1/(N_1+1),L)\succ(W_2/N_2,H)\succ(W_2/N_2,L)$

MH2's ordering: $(W_1/(N_1+1),L)\succ(W_2/(N_2-1),L)\succ(W_2/N_2,L)$

Whatever FL1's ordering, both FL1 and MH2 prefer FL1-MH2(1).

[16] Apparently, this result cannot be taken for granted because MH1 may have an interest in marrying FH2 as long as the number of insider families in community 1, which in this case would only be known after the entire game is played, would be lower than that arising when MH1 marries FH1. However, it can be easily shown that this circumstance never arises.

2) A small difference between w_1 and w_2 (i.e., $W_2/(N_2-1)>W_1/(N_1+1)>W_2/N_2$)

FL1's ordering: $(W_1/(N_1+1),H)\succ(W_2/N_2,H)\succ(W_1/(N_1+1),L)\succ(W_2/N_2,L)$ or
$(W_1/(N_1+1),H)\succ(W_1/(N_1+1),L)\succ(W_2/N_2,H)\succ(W_2/N_2,L)$

MH2's ordering: $(W_2/(N_2-1),L)\succ(W_1/(N_1+1),L)\succ(W_2/N_2,L)$

FL1 prefers FL1-ML2(1) if MH2 marries FL2, which is actually in MH2's best interest. Thus, the subgame equilibrium is MH2-FL2, FL1-ML2(1).

3) A very small difference between w_1 and w_2 (i.e., $W_2/(N_2-1)>W_2/N_2>W_1/(N_1+1)$)

FL1's ordering: $(W_2/N_2,H)\succ(W_1/(N_1+1),H)\succ(W_2/N_2,L)\succ(W_1/(N_1+1),L)$ or
$(W_2/N_2,H)\succ(W_2/N_2,L)\succ(W_1/(N_1+1),H)\succ(W_1/(N_1+1),L)$

MH2's ordering: $(W_2/(N_2-1),L)\succ(W_2/N_2,L)\succ(W_1/(N_1+1),L)$

MH2 does not prefer to marry FL1. Thus, the best available option for FL1 is FL1-ML2(2), which is compatible with MH2 marrying FL2. The subgame equilibrium is MH2-FL2, FL1-ML2(2).

Now, consider the subgame ML1-FH2(2). The payoffs for FL1 and MH2 are the following:

	FL1-MH2(1)	FL1-ML2(1)	FL1-ML2(2)	FL1-MH2(2)
FL1	W_1/N_1,H	W_1/N_1,L	$W_2/(N_2+1)$,L	$W_2/(N_2+1)$,H
MH2	W_1/N_1,L	W_2/N_2,L	$W_2/(N_2+1)$,L	$W_2/(N_2+1)$,L

Because it is always verified that $W_1/N_1>W_2/N_2>W_2/(N_2+1)$,

FL1's ordering: $(W_1/N_1,H)\succ(W_2/(N_2+1),H)\succ(W_1/N_1,L)\succ(W_2/(N_2+1),L)$ or
$(W_1/N_1,H)\succ(W_1/N_1,L)\succ(W_2/(N_2+1),H)\succ(W_2/(N_2+1),L)$

MH2's ordering: $(W_1/N_1,L)\succ(W_2/N_2,L)\succ(W_2/(N_2+1),L)$

Whatever FL1's ordering, both FL1 and MH2 prefer FL1-MH2(1).

Now we solve the entire game by taking into account the three cases arising from the subgame ML1-FH2(1).

1) A large difference between w_1 and w_2 (i.e., $W_1/(N_1+1)>W_2/(N_2-1)>W_2/N_2$)

The payoffs for ML1 and FH2 are the following:

	ML1-FL1	ML1-FH2(1)	ML1-FH2(2)
ML1	W_1/N_1,L	$W_1/(N_1+1)$,H	W_2/N_2,H
FH2	W_2/N_2,H	$W_1/(N_1+1)$,L	W_2/N_2,L

For FH2, ML1-FH2(2) is dominated by the other two payoffs. Thus, this choice can be excluded, and the equilibrium conditions are the following:

if $(W_1/N_1,L)\succ(W_1/(N_1+1),H)$ and $(W_2/N_2,H)\succ(W_1/(N_1+1),L)$, then ML1-FL1, MH2-FH2;
if $(W_1/N_1,L)\prec(W_1/(N_1+1),H)$ and $(W_2/N_2,H)\succ(W_1/(N_1+1),L)$, then ML1-FL1, MH2-FH2;
if $(W_1/N_1,L)\succ(W_1/(N_1+1),H)$ and $(W_2/N_2,H)\prec(W_1/(N_1+1),L)$, then ML1-FL1, MH2-FH2;
if $(W_1/N_1,L)\prec(W_1/(N_1+1),H)$ and $(W_2/N_2,H)\prec(W_1/(N_1+1),L)$, then ML1-FH2(1), FL1-MH2(1).

In all circumstances, ML2 marries FL2.

2) A small difference between w_1 and w_2 (i.e., $W_2/(N_2-1)>W_1/(N_1+1)>W_2/N_2$)

This case replicates case 1 except for the following: if $(W_1/N_1,L)\prec(W_1/(N_1+1),H)$ and $(W_2/N_2,H)\prec(W_1/(N_1+1),L)$, then ML1-FH2(1), FL1-ML2(1), and MH2-FL2.

3) A very small difference between w_1 and w_2 (i.e., $W_2/(N_2-1)>W_2/N_2>W_1/(N_1+1)$)

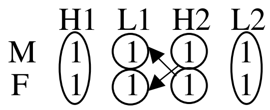
The payoffs for ML1 and FH2 are the following:

	ML1-FL1	ML1-FH2(1)	ML1-FH2(2)
ML1	W_1/N_1,L	W_1/N_1,H	W_2/N_2,H
FH2	W_2/N_2,H	W_1/N_1,L	W_2/N_2,L

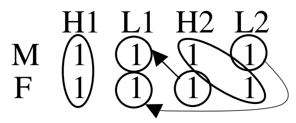
For FH2, ML1-FH2(2) is still dominated by the other two payoffs. Therefore, this choice can be excluded. For ML1, ML1-FH2(1) is preferred to ML1-FL1. Thus, the equilibrium conditions are:

If $(W_1/N_1,L) \succ (W_2/N_2,H)$, then ML1-FH2(1), MH2-FL2, FL1-ML2(2);
If $(W_1/N_1,L) \prec (W_2/N_2,H)$, then ML1-FL1, MH2-FH2.

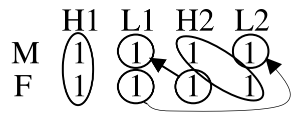
As expected, the subgame ML1-FH2(2) will never occur because FH2 will always be worse off. Further, even if there are two cross-weddings in the third case, a net migration will not occur because the cross-weddings balance each other. The only cases where a net migration takes place is when $W_1/(N_1+1)>W_2/N_2$, along with the conditions $(W_1/N_1,L) \prec (W_1/(N_1+1),H)$ and $(W_2/N_2,H) \prec (W_1/(N_1+1),L)$. We can finally depict four different equilibria in terms of matching:

α


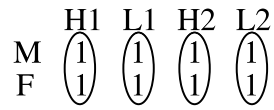
if $W_1/(N_1+1)>W_2/(N_2-1)>W_2/N_2$ and $(W_1/N_1,L) \prec (W_1/(N_1+1),H)$ and $(W_2/N_2,H) \prec (W_1/(N_1+1),L)$;

β


if $W_2/(N_2-1)>W_1/(N_1+1)>W_2/N_2$ and $(W_1/N_1,L) \prec (W_1/(N_1+1),H)$ and $(W_2/N_2,H) \prec (W_1/(N_1+1),L)$;

γ


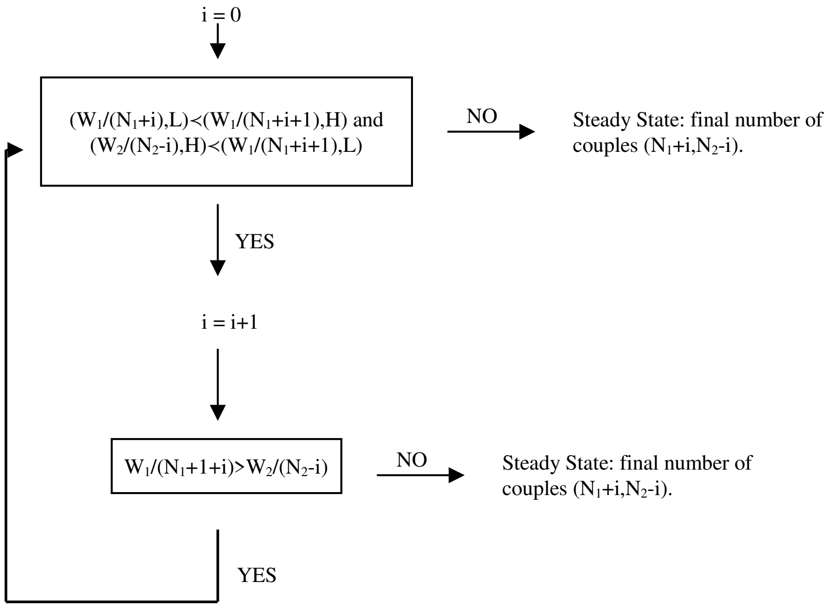
if $W_2/N_2>W_1/(N_1+1)$ and $(W_1/N_1,L) \succ (W_2/N_2,H)$;

δ


in all other circumstances.

The equilibria where a net migration from community 2 to community 1 occurs are α and β. Thus, two conditions must be satisfied. First, the per capita collective wealth between the two communities cannot be very close (i.e., $W_1/(N_1+1)>W_2/N_2$), meaning that there should be a sufficiently high inequality in per capita collective wealth across the communities. Second, there needs to be a *double coincidence* of interests in marrying each other for ML1 (i.e., $(W_1/N_1,L) \prec (W_1/(N_1+1),H)$) and FH2 (i.e., $(W_2/N_2,H) \prec (W_1/(N_1+1),L)$). If both conditions are satisfied as the batch is completed, insider families will increase by one unit in community 1 and decrease by one unit in community 2, causing a convergence of per capita collective wealth between the two communities. In the subsequent batch, individuals will take into account the number of insider families adjusted by the net migration. By generalizing the above procedure, the following diagram can apply (Figure A2):

Figure A2. Partners' choice in an egalitarian system for K=2.

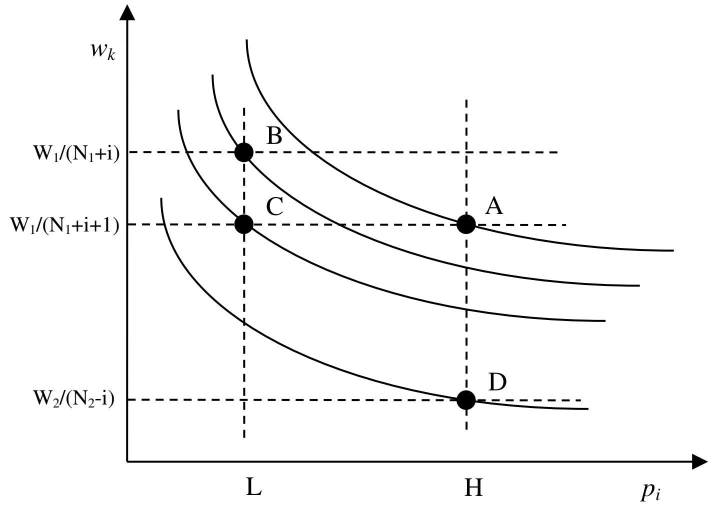


Notes: Counter *i* represents the net migration occurring from community 1 to community 2 before a generic batch starts. Specifically, *i* identifies the number of additional couples preferring to live in the richer community and consequently the number of couples moving out of the poorer community.

To this point in the analysis, we can easily observe that if equilibrium α arises, the next batch may show one of the following equilibria: α, β or a steady state (i.e., γ or δ). If equilibrium β arises, the next batch will necessarily show a steady state. If a steady state arises, the next batch will necessarily show a steady state. Of course, this holds *ceteris paribus*.

Assume that w_1 is higher than w_2 to such an extent that $W_1/(N+i+1)>W_2/(N-i)$, where $i\geq 0$ stands for the net migration occurring from community 1 to community 2 before a generic batch starts. Figure A3 describes individuals' preferences over four payoffs that can affect the equilibria: $A=(W_1/(N_1+i+1),H)$, $B=(W_1/(N_1+i),L)$, $C=(W_1/(N_1+i+1),L)$, and $D=(W_2/(N_2-i),H)$. We have shown that L1s compare the utilities over the payoffs A and B. Instead, H2s compare the payoffs C and D. In more detail, depending on the revealed preferences, A≻B means that L1s prefer to marry and take H-types from community 2 to community 1, even if there is a reduction in per capita collective wealth due to the cross-wedding and the consequent behavior of the other agents. If the revealed preferences indicate C≻D, then the H2s would prefer to marry L-types from the richer community and move there.

Figure A3. Map of relevant payoffs in an egalitarian system for K=2.



Notes: This map holds if $W_1/(N+i+1)>W_2/(N-i)$ for a generic $i\geq0$.

Following this line of reasoning, it helps to present the revealed preference profiles over the set of relevant payoffs that arise after playing a generic batch in Table A3.

Table A3. Revealed preference profiles with an egalitarian system for K=2.

P1	P2	P3	P4	P5
A	A	A	B	B
D	B	B	A	A
B	D	C	D	C
C	B	D	C	D

Notes: According to the preference profile, the payoffs are ranked from the most to the least preferred. Given our assumption, the following inequalities hold: A>D, A>C, and B>C. These profiles assume that $W_1/(N_1+i+1)>W_2/(N_2-i)$ for a generic $i\geq0$.

Each set of real preferences may underlie different revealed preference profiles depending on the distance between the levels of per capita collective wealth across the communities. For instance, the only profile that is compatible with a net migration from community 1 to community 2 is P3. This profile implies that A>B and C>D, which are the conditions that give rise to the equilibria α and β. All of the other profiles imply a steady state. The preferences revealed by P3 are neither too inclined toward personal traits, as in P1 and P2, nor too biased toward wealth, as in P4 and especially P5. P3 represents an intermediate type of preferences, which implies a double coincidence of interests for L1s and H2s to marry each other. Finally, observe that, *ceteris paribus*, (*i*) the higher that N_1 is, the higher is p(A>B) (probability that A>B),[17] and (*ii*) the higher that (w_1-w_2) is, the higher is p(C>D). Hence, if the richer community has a sufficiently large population, and there is a sufficiently high inequality in per capita collective wealth across the communities, then net migrations are more likely.[18] **End of Proof.**

Proof of Corollary 2.

Because the matching choice is reciprocal, no single individual moves first, but rather a potential couple. When ML1 moves first, he can choose between his potential partners FL1 and FH2.[19] In

[17] It holds that $W_1/N_1 - W_1/(N_1+1) > W_1/(N_1+1) - W_1/(N_1+2)$.

[18] Consider also that the higher that W_1 is, the lower is p(A>B), which makes a net migration less likely. Additionally, as *i* increases, p(A>B) rises, but also p(D>C) gets higher and higher, which implies that net migrations become less likely, and at some point, a stationary state will occur, as shown above.

[19] We have seen that trivially, ML1discards the choice of FL2.

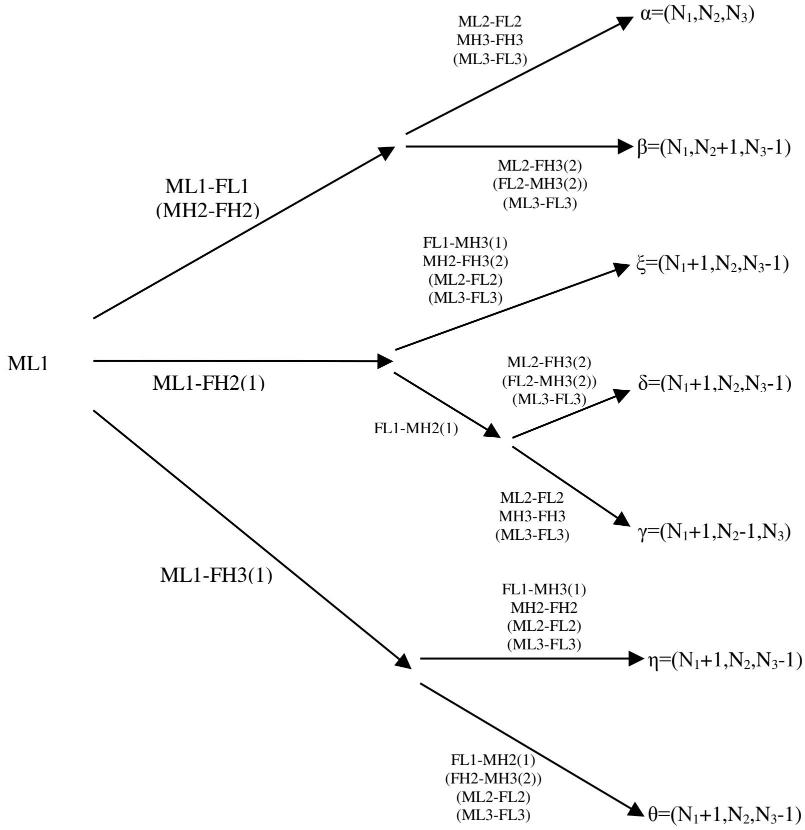
particular, if ML1 prefers FL1, the former is reciprocated by the latter because of the assumption of identical preferences; however, if ML1 prefers FH2, the latter may not prefer the former. Thus, this type of sequence gives the first move to both ML1 and FH2. In other words, FH2 may even move first if she definitely prefers MH2. Nonetheless, those who move first, either ML1 and FH2 or FL1 and MH2, have the choice of the best matching. In fact, ML1 and FH2 have the choice between marrying a partner from their community or marrying each other. They move according to their best alternatives by predicting the choices carried out by those playing after them, so they can only adjust their choice on the basis of the choices carried out by those players who moved first. In particular, in equilibria α and δ, there are no differences in terms of payoffs between ML1 and FL1 or MH2 and FH2, but this is not true in equilibria β and γ.

ML2 and FL2 will never move first because if they did, they would necessarily marry each other, whereas if they were to move later, one of them could get a better matching by marrying MH2 or FH2, as in equilibria β and γ. However, if the conditions for equilibria α or δ arise, ML2 and FL2 will necessarily marry each other, and whether they do so before or after the other players is irrelevant. Finally, no matter the choice of ordering for of choice of H1s, they will always marry each other. **End of Proof.**

Proof of Proposition 3.

In Figure A4, we show the tree for the entire game by taking into account that MH1 and FH1 necessarily prefer to marry each other. As for K=2, we assume that ML1 has the first-move option. Nonetheless, the same observations about the irrelevance of the choice of ordering in Corollary 2, which applies to the case of K=2, also applies to K=3.

Figure A4. Tree for the matching game of 3 communities with egalitarian systems.



Notes: This tree can be analyzed with reference to the first matching game with $2N_1$, $2N_2$, and $2N_3$ as insider individuals in community 1, community 2, and community 3, respectively. Using several examples, we can elucidate the terminology. For instance, ML1-FH3(1) means that ML1 marries FH3, and the couple chooses to live in community 1. Another specification, (N_1+1,N_2,N_3-1), represents the number of couples living in communities

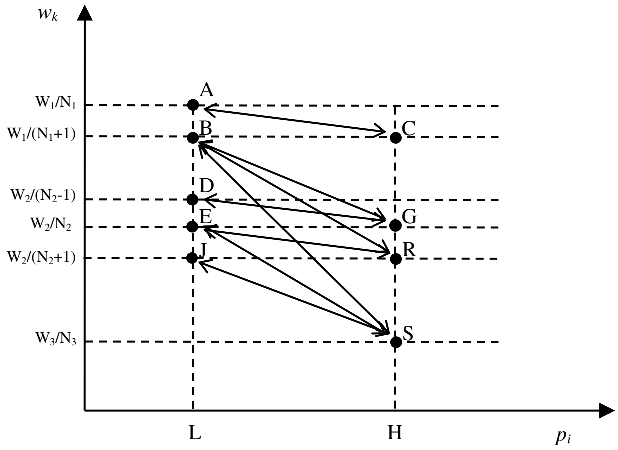
1, 2, and 3, respectively, at the end of the entire game. We do not consider the options ML1-FL2(1) or ML1-FL2(2) and ML2-FL3(2) or ML2-FL3(3) because they are trivially less preferred by ML1 and ML2. Matching under brackets (e.g., (ML2-FL2)) means that this matching will necessarily arise due to the matching choices of the players playing first.

From Figure A4, four different outcomes in terms of net migration among the three communities originate from seven different equilibria:

1. (N_1+1,N_2,N_3-1)
2. (N_1+1,N_2-1,N_3)
3. (N_1,N_2+1,N_3-1)
4. (N_1,N_2,N_3)

The last outcome is the steady state, whereas the first three outcomes allow for a net migration from a poorer community to a richer community at the end of the batch. The payoffs over which individuals express their preferences are depicted in Figure A5.

Figure A5. Map of the relevant payoffs in an egalitarian system with K=3.



Notes: The arrows between payoffs indicate the relevant comparisons carried out by individuals. The level of collective wealth $W_3/(N_3-1)$ is not included in the relevant payoffs for this map because it is not compared by the individuals who are relevant for the matching choices.

The map in Figure A5 is derived by solving the game in Figure A4 through a backward induction procedure. For the sake of simplicity, notice that Figures A4 and A5 and the analysis that follows depict potential outcomes of the first batch or later batches in which N_1, N_2, and N_3 include changes in population due to net migration if it occurred. Following the game tree in Figure A4, ML1 can choose between three types of matching: ML1-FL1, ML1-FH2(1), and ML1-FH3(1).

First consider the subgame ML1-FL1. As a consequence of the matching of ML1-FL1, MH2 and FH2 will necessarily prefer to match with each other. It is easy to check that the relevant comparisons for ML2 are between R and E and for FH3 are between J and S. Thus, the equilibria in this subgame are:

1) If R>E and J>S, then ML2 will marry FH3 and move to community 2 (equilibrium β);
2) If R<E or J<S, then there will only be weddings among partners of the same community, and no net migration between communities 2 and 3 takes place (equilibrium α).

Now consider the subgame ML1-FH2(1). FL1 can choose to match with MH2 or MH3. In the former case, ML2 and FH3 can match either with each other or with partners from their same community. As in any other matching choice, a cross-wedding needs a double coincidence of preferences, but this only arises if G>D and E>S (i.e., equilibrium δ).[20] Given the choice of this further node, the equilibria in this subgame will be:

1) if B<G, then the matching choices will be FL1-MH3(1) and MH2-FH3(2) and consequently ML2-FL2 and ML3-FL3 (equilibrium ξ);
2) if B>G, G>D, and E>S, then the matching choices will be FL1-MH2(1) and ML2-FH3(2) and consequently FL2-MH3(2) and ML3-FL3 (equilibrium δ);
3) if B>G and G<D or E<S, then the matching choice will be FL1-MH2(1), and the remaining matching choices are *no mix* and *no cross* (equilibrium γ).

Finally, consider the subgame ML1-FH3(1). In this case, the choice pertains to FL1 and MH2, who can either marry each other or not. The equilibria in this subgame will be:

1) if B>G, then the matching choice will be FL1-MH2(1) and consequently FH2-MH3(2), ML2-FL2, and ML3-FL3 (equilibrium θ);
2) if B<G, then the matching choices will be FL1-MH3(1) and MH2-FH2, and consequently the remaining matching choices are *no mix* and *no cross* (equilibrium η).

Now, we solve the entire game. In other words, we need to understand which choice will be carried out by ML1 and correspondingly by FH2 and FH3 in the primary node, given the equilibria in the subgames. We can distinguish between six possible comparisons among equilibria: α-γ-θ, β-γ-θ, α-δ-θ, β-δ-θ, α-ξ-η, β-ξ-η.[21] According to the preference profiles over the set of 9 relevant payoffs, as depicted in Figure A5, one of the seven equilibria will be reached. These profiles should follow several relevant conditions derived by our assumptions: C>B, G>E, R>J, A>B>D>E>J, and C>G>R>S. Given these assumptions, there are 76 different profiles for the revealed preferences over the 9 payoffs. Table A4 describes the conditions for the preferences that lead to each equilibrium and the corresponding outcome in terms of net migrations across communities.

Table A4. Equilibria and net migration outcomes according to the preference profiles.

<table>
<tr><th>Comparison Set</th><th colspan="3">Preference Conditions</th><th>Equilibrium</th><th>Net migration</th></tr>
<tr><td rowspan="2">α-γ-θ</td><td rowspan="2">R<E or J<S
G<D or E<S
B>G</td><td colspan="2">A>C</td><td>α</td><td>(N_1,N_2,N_3)</td></tr>
<tr><td colspan="2">C>A</td><td>γ or θ</td><td>(N_1+1,N_2-1,N_3) or (N_1+1,N_2,N_3-1)</td></tr>
<tr><td rowspan="2">β-γ-θ</td><td rowspan="2">R>E and J>S
G<D or E<S
B>G</td><td colspan="2">A>C</td><td>β</td><td>(N_1,N_2+1,N_3-1)</td></tr>
<tr><td colspan="2">C>A</td><td>γ or θ</td><td>(N_1+1,N_2-1,N_3) or (N_1+1,N_2,N_3-1)</td></tr>
<tr><td rowspan="2">α-δ-θ</td><td rowspan="2">R<E or J<S
G>D and E>S
B>G</td><td colspan="2">A>C</td><td>α</td><td>(N_1,N_2,N_3)</td></tr>
<tr><td colspan="2">C>A</td><td>δ or θ</td><td>(N_1+1,N_2,N_3-1)</td></tr>
<tr><td rowspan="2">β-δ-θ</td><td rowspan="2">R>E and J>S
G>D and E>S
B>G</td><td colspan="2">A>C</td><td>β</td><td>(N_1,N_2+1,N_3-1)</td></tr>
<tr><td colspan="2">C>A</td><td>δ or θ</td><td>(N_1+1,N_2,N_3-1)</td></tr>
<tr><td rowspan="3">α-ξ-η</td><td rowspan="3">R<E or J<S
B<G</td><td colspan="2">A>C</td><td rowspan="2">α</td><td rowspan="2">(N_1,N_2,N_3)</td></tr>
<tr><td rowspan="2">C>A</td><td>B<S</td></tr>
<tr><td>B>S</td><td>η</td><td>(N_1+1,N_2,N_3-1)</td></tr>
<tr><td rowspan="3">β-ξ-η</td><td rowspan="3">R>E and J>S
B<G</td><td colspan="2">A>C</td><td>β</td><td>(N_1,N_2+1,N_3-1)</td></tr>
<tr><td rowspan="2">C>A</td><td>B<R</td><td>η</td><td rowspan="2">(N_1+1,N_2,N_3-1)</td></tr>
<tr><td>B>R</td><td>ξ or η</td></tr>
</table>

[20] Note that unlike the subgame derived from the choice ML1-FL1, where no migration has already occurred before ML2 and FH3 decide whom to marry, in this subgame, MH2 and FH2 have already moved to community 1, thereby reducing the number of insider families in community 2 by one unit.

[21] No other comparison among equilibria is possible given the preferences over the payoffs.

The equilibria that lead to net migration are β, γ, θ, δ, ξ, and η, and there are 50 overall preference profiles leading to these equilibria. The remaining 26 preference profiles lead to the steady-state equilibrium α. In particular, the equilibrium α requires that A>C and that R>E and J>S should not hold contemporaneously. However, four of the profiles leading to the steady state satisfy the conditions C>A and B<S. These last profiles give weight, more than any of the other profiles, to personal traits. However, the profiles that are more oriented to collective wealth, such as A>C, D>G, E>R, and J>S, also lead to the steady state. This result shows that the preference profiles that lead to net migration are not too inclined toward wealth or personal traits.

In the subsequent batches, a net migration will evolve in a steady state in the following way. If the outcomes are (N_1+1,N_2,N_3-1) and (N_1+1,N_2-1,N_3) (i.e., equilibria γ, θ, δ, ξ, and η), the probability p(C>A) will be strengthened, as will the probabilities p(G>B) and p(S>B), which will eventually lead to the comparison set α-ξ-η and so to α. If the initial outcome is (N_1,N_2+1,N_3-1) (i.e., β), the probabilities p(B>G) and p(J>S) will increase, which will lead to the comparison sets α-γ-θ or α-δ-θ, and because p(A>C) remains unchanged, the final outcome will be the steady state.

Finally, consider the conditions leading to the steady state. If the probability p(A>C) decreases, or the joint probability p(R>E) and p(J>S) increases, then the probability for a net migration increases. The probability p(A>C) decreases if the difference $(W_1/N_1)-(W_1/(N_1+1))$ gets lower. In particular, this result occurs with a high N_1. Further, the joint probability p(R>E) and p(J>S) increases if the difference $(W_2/N_2-W_3/N_3)$ gets lower and N_2 gets higher. Hence, if the richer community has a sufficiently large population, and there is sufficiently high inequality in per capita collective wealth across the communities, then net migrations are more likely. **End of Proof.**

Proof of Proposition 4.

This proof is divided into two cases. The first case involves two communities in which the richer community in terms of per capita collective wealth has a patrilineal system, whereas the poorer community has an egalitarian system, and vice versa for the second case. The same observations in the previous propositions regarding matching and ordering also apply to this proposition.

Case 1. Following the matching game within a single batch, H1s marry each other, and ML1 would like to marry an H-type female, but one is only available from community 2. Their options in terms of matching and potential payoffs are described as follows:

	ML1-FL1	ML1-FH2(1)	ML1-FH2(2)
ML1	W_1/N_1,L	W_1/N_1,H	$W_2/(N_2+1)$,H
FH2	W_2/N_2,H	W_1/N_1,L	$W_2/(N_2+1)$,L

Note that when ML1 marries FH2 and the couple moves to community 1, MH2 will prefer, *ceteris paribus*, FL2 rather than FL1. The same consideration holds when the potential couple ML1-FH2 moves to community 2. However, FH2 will never choose to marry ML1 and move to community 2 because in this case, her payoff is always dominated. Thus, if $(W_1/N_1,L)>(W_2/N_2,H)$, then FH2 is happy to marry ML1 and move to community 1; otherwise, she will marry within her community. In both cases, there will never be a net migration from one community to another.

Case 2. The proof is the same as that where both communities have an egalitarian system, except for the node where ML1 moves to community 2 after marrying FH2. However, as shown in the proof for Proposition 2, this node will never be chosen by FH2. **End of Proof.**