From Polygyny to Serial Monogamy: A Unified Theory of Marriage Institutions

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Marriage institutions have changed over time, evolving from polygyny to monogamy, and then to serial monogamy (as defined by divorce and remarriage). We propose a unified theory of such institutional changes, where the dynamics of income distribution are the driving force. We characterize the marriagemarket equilibrium in each of the three alternative regimes, and determine which one emerges as a political equilibrium, depending on the state of the economy. In a two-class society, a rise in the share of rich males drives the change from polygyny to monogamy. The introduction of serial monogamy follows from a further rise in the proportion of either rich females or rich males. Monogamy eases the transition to serial monogamy, since it promotes social mobility.

Key words: Marriage, Polygyny, Monogamy, Divorce, Human capital, Political economy

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1. INTRODUCTION

Mating and marriage institutions have dramatically changed over the history of mankind, and this evolution has attracted the attention of intellectuals since the classical contributions of Westermarck (1925) and Russell (1929). It is still unclear whether primitive human communities started off as monogamous or polygamous.¹ As soon as economic motives became of some importance, however, most powerful and wealthy men aimed to have as many wives as possible and enjoy large reproductive success. The early prevalence of polygynous mating is attested by genetic analysis (Hammer *et al.*, 2008).² Polygynous mating eventually evolved into polygynous

^{1.} For example, population geneticists like Hammer *et al.* (2008) claim that humans, and their primate forefathers, were originally at least mildly polygynous, while the anthropologist Todd (2011) argues that, at origin, the human family was nuclear, with the parental couple as an elementary particle.

^{2.} This type of evidence, based on the observation of a female-biased sex ratio in six populations from the Human Genome Diversity Panel, is further discussed by Emery, Felsenstein, and Akey (2010).

marriage, which has long been the dominating marriage institution, and still characterizes most contemporaneous traditional societies.³

At some point, polygyny has been replaced by monogamy in Western societies. When this exactly occurred is still subject to debate, as will be further discussed in Section 2.1. However, after the medieval spread of Christianity, and in particular after the Fourth Lateran Council in 1215, it became virtually impossible for men to simultaneously father different children from multiple women, and remarriage was only possible after widowhood. The enforcement of (strict) monogamy is confirmed by the deterioration of the status of illegitimate children (Brundage, 1987; Boswell, 1988).

More recently, however, the introduction of divorce and the possibility of remarriage has driven a transition from monogamy to serial monogamy, an institutional setting in which men can have children with different women (and vice versa), but not simultaneously. Typically, divorce laws appear in the second half of the 19th century (1857 in England, 1875 in Germany). Serial monogamy essentially started off as an inter-temporal version of polygyny, in which divorce was usually initiated by men. With the gradual instatement of no-fault and unilateral divorce, and the progressive extension of the right to divorce to women, serial monogamy has become an inter-temporal kind of polygamy.⁴

There are multiple theories of the emergence of monogamy, trying to explain why it replaced polygyny. The problem was first studied by sociologists, anthropologists, and historians. Alexander (1979) and Betzig (1986) see monogamy as a choice made by the ruling elite, in order to "regulate the reproductive striving of individuals and sub-groups within societies. in the interest of preserving unity", or elicit cooperation from others whose services were both essential and irreplaceable. This view goes under the name of male compromise theory, since male interests are regarded as the driving force in the transition to monogamy. Being based on the emergence of economic specialization and the division of labour, it points to the Industrial Revolution as the time when polygyny died out.⁵ MacDonald (1995) proposes instead an evolutionary theory of socially imposed monogamy, where mechanisms of social control (democracy, the Church) played a key role in banning reproductive relationships outside of legitimate, monogamous marriage. In this framework, the interests (and the political participation) of women and unskilled men may have been important. Henrich et al. (2012) link the emergence of monogamous marriage to inter-group competition, since monogamy reduces intra-sexual competition and enhances parental investment in children, which is a key to achieve success in competition between communities. Kanazawa and Still (1999) also depart from the male compromise literature, suggesting that monogamy may indeed have been a *female choice*: if resource inequality among men is low, women prefer to marry monogamously. The only attempt to propose a comprehensive interpretation of polygyny, monogamy, and serial monogamy is due to Marlowe (2000). He claims that when males provide all the income but some have much more than others, richer males achieve polygyny, whereas ecologically imposed monogamy prevails in case of moderate inequality. When males provide an intermediate level of investment with little variation, females are not excessively dependent on males and serial monogamy may arise.

3. In Murdoch's ethnographic atlas, out of 1231 societies, 186 were monogamous, 453 had occasional polygyny, 588 had more frequent polygyny, while 4 practiced polyandry (Gould *et al.*, 2008).

4. For the sake of completeness, it might be useful to recall that polygamy is a more general definition encompassing both polygyny (one man marrying multiple wives) and polyandry (one woman marrying multiple husbands). Models of polyandry do exist (Korn, 2000), and show that polyandry may arise under very special conditions. As confirmed by Marlowe (2000), polyandry—which, different from polygyny, does not allow the polygamous spouse to increase the number of her offspring by having multiple mates—occurs in a tiny minority of human societies.

5. More generally, Betzig (1986) speculates that polygyny, being a typical feature of despotism, has been ruled out by democracy, which in turns correlates with economic development and specialization.

Economists have formalized three different theories of the emergence of monogamy. Consistent with the Beckerian view, according to which male inequality in wealth naturally produces inequality in the number of wives (see also Grossbard-Shechtman, 1980), Lagerlöf (2005) explains the decline in polygyny by a decrease in male inequality, reproducing in this respect the female choice argument proposed by Kanazawa and Still (1999). Starting from the observation that monogamy also characterizes highly unequal societies, Gould et al. (2008) suggest an alternative explanation based on male choice: monogamy is a consequence of a rise in the value of quality, rather than quantity, of children. If the mother's human capital affects the human capital of her children, and men value children's quality, they may prefer one wife of high quality (high human capital) over several wives of low quality. This theory is compatible with the view that, in the West, the switch to an industrial economy marked the passage from polygyny to monogamy. Finally, Lagerlöf (2010) explains the rise of "socially imposed" monogamy through the *male compromise* theory, seeing monogamy as a choice made by the ruling elite to avoid the threat of rebellion by lower-status men. This model is compatible with monogamy arising in the Middle Ages, well before the establishment of democracy. Let us highlight that the first two theories (Lagerlöf, 2005; Gould et al., 2008) deal with the decline of the prevalence of polygyny, but are not theories of institutional change, whereas the third one (Lagerlöf, 2010) models institutional restrictions imposed on the number of wives that each male can take.

But why did Western societies shift from polygyny to monogamy, without considering the option of serial monogamy? In fact, serial monogamy may be seen as an intermediate passage, since it allows multiple mating (over a lifetime), but prevents the richest men from monopolizing the reproductive life of multiple women. As highlighted by Käär *et al.* (1998), serial monogamy seems to have been an important male reproductive strategy in historical populations: through remarriage, men can extend their reproductive lifespan beyond that of their spouses. So, why did the system that we have in modern societies today—serial monogamy involving a high marital break-up rate—come after monogamy, instead of deriving directly from polygyny? Existing theories of divorce and remarriage—such as Chiappori and Weiss (2006), and Barham *et al.* (2009)—are quite silent on this point. Furthermore, a theory of the emergence of divorce laws is still lacking.⁶

In this article, we provide a unified theory of marriage institutions which considers the two transitions as a part of the same dynamic process of social change, thus imposing additional discipline on the analysis. The term "unified" refers to Galor (2011)'s Unified Growth Theory, in the sense that our theory encompasses in a single analytical framework the whole process of transformation of marriage institutions, where transitions between regimes are endogenous and do not require the intervention of external shocks.

The evolution of marriage institutions is explained within a politico-economic set-up: in every period, individual preferences are aggregated into a social objective that determines the institutional framework regulating marriage. To represent social preferences, we use voting theory, with possibly different political weights for men and women, and for rich and poor individuals. Polygyny, monogamy, and serial monogamy are mutually exclusive: only one of these three regimes can emerge as a political equilibrium. Since the (majority) voting process serves as a device to aggregate conflicting preferences, our approach reconciles the female choice, male choice and male compromise theories on the emergence of monogamy. It also provides the first political-economy model of divorce laws.

Before describing the core mechanism of our model, it may be useful to clarify that monogamy replaced polygyny well before the transition to universal suffrage. It might then seem

^{6.} A first attempt to provide a theory of divorce laws has been made by Hiller and Recoules (2013).

inappropriate to use a political-economy model to describe public decision-making for periods in which there was no formal voting, or some social groups (women, for instance) were denied political participation. However, as will be discussed more extensively in Section 4, there is convincing evidence that the interests of women and lower-status men had some kind of political representation even in the absence of (formal) voting rights. It can also be argued that women's interests have been defended by men, namely fathers, who were altruistic towards their daughters (as put forward by Doepke and Tertilt (2009) to explain why the legal rights of women improved well before their enfranchisement) or had important stakes in their daughters' marriage.⁷ One may also consider that the male compromise theories of monogamy, such as Lagerlöf (2010), Betzig (1986), and Alexander (1979), implicitly recognize that, although lacking formal voting rights, lower-status males retain some political power (justified by the threat of revolution, the property of production factors, etc.).

In the model, since all agents involved in the marriage market have some kind of political representation, the prevailing marriage institution necessarily depends on the size of interest groups. We consider four groups: rich and poor males, and rich and poor females. Income has here a broad definition: by rich we mean persons having either physical assets (land, capital) or human assets (education, network) on top of embodied capital (strength, genes). A key role in defining political preferences (and thus, coalitions) is played by the expected outcomes on the marriage market. Under monogamy, people can marry only once in their lifetime and raise children only inside that marriage. Under polygyny, a male can be married to multiple females simultaneously, and have children with every wife. Under serial monogamy, both males and females can have more than one spouse in their lifetime, although not simultaneously. We further assume that resources are equally split between spouses (which, together with a jealousy cost, makes females adverse to polygyny) and divorce is costly, but allows spouses to break an unhappy marriage.

The transition between regimes is generated endogenously by human capital accumulation and social mobility, which drive the evolution of the four groups. As mentioned above, each regime is associated with a different outcome on the marriage market, and possibly different family types. Family structures are key for social mobility, as we assume that the probability to become rich depends on parental resources (time and income) devoted to education. Therefore, at any given time the prevailing marriage institution and marriage pattern depend on group sizes. In turn, marriage patterns determine the size of the four groups in the next period, thus driving changes in marriage outcomes and institutions.

Our theory helps us understand historical evidence. In a society with few rich males and virtually no rich females, polygyny is supported by rich males, who can naturally monopolize a larger number of partners, and poor females, who prefer to be the *n*-th wife of a rich male rather than marrying a poor male monogamously. Under polygyny, rich males have many children. Given that the father spends a small fraction of his resources—that are crucial for the intergenerational transmission of skills—on each child, the proportion of rich individuals increases very slowly over time. This description may correspond to the *de facto* polygynous Western European society from 500 to 1000 CE.⁸ The polygyny regime does not imply that polygyny is widespread, but rather that it is allowed (or at least tolerated) by institutions. Eventually, however, the number of rich males increases enough, and poor females prefer to marry monogamously. The latter form a coalition with poor males to support monogamy as a socially imposed regime. This transition

^{7.} Edlund and Lagerlöf (2006) show that, in preindustrial societies, marriages were largely decided by parents whose utility depended on the marriage outcome of their children.

^{8.} Charlemagne is a good example of this period. As reported by Settipani (1993), he had over his life six official spouses (fathering 14 children) and 4 concubines (fathering 5 children).

may take place when a new class of rich men appears, as in the case of the Urban Revolution in Europe (1000–1300). Monogamy is more conducive to human capital accumulation, since fathers can devote more resources to the education of each of their children.⁹ As a consequence, more females and/or more males have access to higher income (as it happened in Western Europe around 1850), and serial monogamy prevails. In fact, serial monogamy can be supported by the rich, who can afford the cost of divorce and benefit from the possibility of breaking an "unhappy" marriage. But it may also be supported by poor females if there are enough rich males, so that the probability of remarrying a rich male is sufficiently high.

Our results are established assuming that income is pooled and shared exogenously between spouses, but still hold if we allow for equilibrium transfers. Our theory is also robust to the introduction of a complementary mechanism of institutional change, namely time-varying political weights. If the relative political power of the poor is initially very low but increases along the development path, followed by that of females, the economy can still move out of the polygyny regime, transit through strict monogamy, and end up allowing divorce.

From a technical point of view, our model contributes to the literature on marriage and family economics along two additional directions. First, we supply a politico-economic explanation of divorce laws, which is still missing. Secondly, we offer a more complete characterization of the equilibrium of a polygynous marriage market, allowing for different levels of heterogeneity among males and females. In this respect, we go beyond Lagerlöf (2010), Gould *et al.* (2008), and Siow (2006), who assume that either all females are identical or the proportion of high-type individuals is the same among males and females.

2. MARRIAGE INSTITUTIONS, INCOME, AND INEQUALITY: FACTS

In this section, we first present an overview of the historical evolution of marriage institutions, restricting our attention to Western Europe, from 500 CE onwards. We then provide some information on the level and distribution of income over that period, stressing the importance of the Urban Revolution (1000–1300) and the Industrial Revolution (1800–).

2.1. Changes in marriage institutions

It is not easy to establish exactly when the transition from polygyny to monogamy occurred, and the very dichotomy opposing polygyny to monogamy is perhaps insufficient to capture the complex evolution of marriage arrangements and mating practices (Scheidel, 2009b).¹⁰ Three alternative views trace monogamy back to (i) ancient Greece and Rome, (ii) the Middle Ages, and (iii) the Industrial Revolution, respectively. Much of the debate concentrates on the fact that, both in ancient Rome and in the Middle Ages, some men *married* monogamously but *mated* polygynously.

It is in fact well known that, in ancient Rome, members of the aristocracy often fathered children with their slaves. These children were brought up with, and in the style of, legitimate children, freed young, and given wealth, position, and paternal affection (Betzig, 1992).¹¹

^{9.} The idea that monogamy is better than polygyny for human capital accumulation also charcterizes the analysis developed by Edlund and Lagerlöf (2012).

^{10.} The disagreement on the timing of this transition has generated conflicting theories about the mechanisms that might have driven the decline of polygyny and the emergence of monogamy.

^{11.} The Roman example is very controversial and interesting. Initially, the ancient law of Rome reserved the possibility of divorce only to men, and only conditional to serious marital faults, such as adultery and infertility. Divorce on grounds of sterility appears to have been first allowed in 235 BCE (Aulus Gellius, Attic Nights 17.21.44). Later on, as

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As explained by Scheidel (2009a), the "Greeks and Romans established a paradigm that eventually attained global dominance. What can be observed is a historical trajectory from polygamous to formally monogamous but effectively often polygynous arrangements and on to more substantively and comprehensively monogamous conventions. [...] Their system readily accommodated multiple sexual relations for married men (though not for women), most notably through sexual access to slaves." MacDonald (1995) reports that a steady deterioration in the status of bastards occurred under the Christian Roman emperors, and continued as a result of Christian influence during the early Middle Ages, when social controls on the possibility of illegitimate children inheriting property became increasingly effective. This is important, since Henrich *et al.* (2012) identify the exclusion of bastards from inheritance as the key defining factor of monogamy. In addition to direct ecclesiastical influence, a variety of penalties arising from the secular authorities and public opinion applied to illegitimate birth, leading to an increased mortality of illegitimate children. Stone (1977) highlights that by the 13th century the Church had managed to take control of marriage law and get bastards legally excluded from property inheritance.¹²

Therefore, if we relate polygyny to the possibility of fathering children from multiple women simultaneously, it seems safe to affirm that Europe—that was inhabited by polygynous societies before the Greek–Roman age and remained polygynous in the pre-Christian era—had become monogamous after the spread of Christianity. Figure 1 lists some important landmarks for marriage institutions in Europe.¹³ As reported by Henrich *et al.* (2012), European aristocracies, which derived from clan-based tribal societies, were highly polygynous in the 5th century. However, after Saint Augustine, the Church fought a long battle against illegitimacy, bigyny, and concubinage, culminating with two major Councils—the Fourth Lateran Council in 1215 and the Council of Trent in 1563—which defined the rules still prevailing today. As summarized by MacDonald (1995), "there has been a remarkable continuity within a varied set of institutions that have uniformly penalized polygyny and channeled non-monogamous sexuality into non-reproductive outlets (or suppressed it altogether). Despite […] vast changes in political and economic structures, Western family institutions deriving ultimately from Roman civilization have clearly sought and with considerable success to impose monogamy on all classes of society". And for some centuries, both polygyny and divorce were banned almost everywhere in Europe.

However, Europe is nowadays completely serial-monogamous, with unilateral divorce laws adopted almost everywhere and gender differences removed. After the switch from polygyny to monogamy, Europe has thus completed, over the last two centuries, a further transition from monogamy to serial monogamy, leading to the currently high divorce rates that are often regarded as a feature of the "second demographic transition" popularized by Lesthaeghe and Neidert (2006). Unlike monogamy, it is relatively easy to establish when serial monogamy was initiated (see Phillips, 1988, 1991).

In this respect, Scotland was an isolated front runner, first recognizing divorce for adultery in the 1560s.¹⁴ In England, by 1857 the Matrimonial Causes Act made divorce available to ordinary people through a Court of Law.¹⁵ Eventually, in 1923 women were allowed to

- 12. Bastards disappeared from wills altogether during the Puritan era in England.
- 13. For Christianity, we use Denisart (1786) and the references therein. For Judaism, see Sherwin (1990).
- 14. MacDonald (1995) reports, however, an average of only 19 divorces per year from 1836 to 1841.
- 15. The fear that legalized divorce would result in large-scale serial monogamy continued to inspire arguments over divorce up to the 20th century. This fear was apparently groundless: according to Phillips (1988), in England the divorce rate remained below 0.1/1000 until 1914, and below 1/1000 until 1943.

Rome entered the classical age, the privilege of initiating divorce was extended to wives. Eventually, divorce was heavily restricted by Constantine in 331 CE and by the Theodosian Code. Therefore, *de jure* (serial) monogamy coexisted with *de facto* polygyny.







FIGURE 1 European marriage institutions: timeline

divorce on the same terms as men. In France, divorce became legal in the aftermath of the Revolution (1792), was banned again in 1816, and progressively reinstated starting from 1884. In Germany, an imperial divorce law was passed as part of the 1875 Personal Status Act. In 1916, Sweden became the first Scandinavian country with a liberal-for-that-time divorce law, and the other Scandinavian countries followed with similar laws within a few years. After the 1917 Revolution, the Soviet Union entered an era of very informal and easy divorce, but during Stalin's regime, family law was radically revised, and divorce became expensive and difficult to obtain. Eventually, a new liberalization occurred after 1968. More recently, divorce has been introduced by referendums in Italy (1974) and Ireland (1997), and reinstated in Spain (1981). At the time these countries were introducing divorce, other European countries were making it even easier to obtain (no-fault and unilateral divorce).¹⁶

16. After the referendum held in Malta on 28 May 2011, there remain only two countries where divorce is illegal: the Philippines and the Holy See (Vatican City).

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Concerning the U.S., where marriage is subject to state laws, divorce was first legalized by Maryland in 1701 and has become progressively more widespread and easier (the progressive introduction of no-fault and unilateral divorce is detailed by Drewianka, 2008).

To summarize, if one has to give a symbolic date for the end of the polygyny era, we would propose the Fourth Lateran Council in 1215. As an ending date of the strict monogamy regime, we would take the German Personal Status Act of 1875.

2.2. Income and social classes: the Urban Revolution and the Industrial Revolution

As far as income is concerned, estimates of GDP per capita during the last millennium describe three phases: (i) three to four centuries of progress from the 10th to the 14th century; (ii) a period of very slow growth, lasting for about five centuries; and finally (iii) recent modern growth in the 19th and 20th centuries.

The first phase, which saw a rise in population, a commercial revolution, growth of industry, and progress in urbanization (Malanima, 2009, p. 278), is of special interest to us as it corresponds to the final installment of strict monogamy. In particular, historical evidence suggests that the share of rich people in the total population increased over 1000-1300 CE, through the emergence of new upper classes in cities, and in relation with trade and technical progress. The rise of cities took place all over Western Europe. From van Zanden (2009) we learn that, between the 9th and the 13th centuries, the urbanization rate-defined as the share of the population living in cities with more than 10,000 inhabitants—rose from 2.9% to 5.6% in France, from 0% to 15% in Belgium, from 0% to 4.4% in the Netherlands, from 3.5% to 4.7% in Germany, and from 4.3% to 13.2% in Italy. Urbanization led to the emergence of a new class of wealthy people, enriched by new types of occupations. Cipolla (1993) notices that between the 10th and the 13th centuries the economic trend was upwards partly because of the reorganization of property. "The town came into play as an element of innovation, a place to seek one's fortune. The town was a dynamic world [...] where people hoped they would find opportunities for economic and social advancement, and where there would be ample reward for initiative, daring, and hard work. [...] With the appearance of the medieval city and the emergence of the urban bourgeoisie, a new Europe was born."

Before 1000 CE, Western European cities were very small, and exclusively religious or military centres (Pirenne, 1925). Only the members of a tiny elite—lords and bishops—could afford multiple wives and/or concubines. With the Urban Revolution, this becomes less and less true, as an increasing number of bourgeois become wealthy enough to do so, at least potentially.¹⁷ This brought about more competition for (multiple) wives, reduced the incidence of polygyny, and eventually led to its dismissal.¹⁸

The elite before 1000 CE, being made up of lords and bishops, roughly corresponded to the 3% of nobles in the population. The rise of bourgeoisie could have driven the share of wealthy persons to no less than 10% of the population. These figures are provided by Malanima (2009), who estimates the high society (made up of nobles, rich landowners, professional men, important tradesmen) to be 10% of the European population on average over 1500–1700, the

^{17.} Details on how opportunities for making trade profits were exploited by skilled merchants, leading to the appearance of "nouveaux riches", are given by Pirenne (1925).

^{18.} The hypothesis that urbanization paved the way to the emergence of (strict) monogamy is also supported by Anderson (2007), according to whom the return of the dowry in medieval Europe (which corresponds to the enforcement of monogamy) took place in "a period of economic expansion coinciding with the introduction of heavier plow agriculture technology. In turn, this technology led to greater productivity, more surplus for trade, growth in commerce, and a rise of towns" (Quale, 1988).

nobility accounting for 3% of total population. Consistent with this estimation, Vauban, engineer and general under Louis XIV, classified the French population as follows: 10% rich, 50% very poor, 30% near beggars, 10% beggars (Cipolla, 1993, p. 9). Note also that, according to Malanima (2009), the *ancien régime* society can be schematically depicted as a two-class society, respectively made up of gentlemen and those who were not gentlemen. We will stick to this two-class structure when formalizing our theory.

Economic historians disagree on whether, between the end of the Urban Revolution and the beginning of the Industrial Revolution, there was a slow increase in income per capita or, instead, a stagnation in standards of living and real wages. Anyhow, around 1800 CE, income per capita started increasing in Western Europe (see Bolt and van Zanden, 2014) and never stopped growing. Among the multiple mechanisms involved in this take-off, the rise in education led progressively parts of the population out of poverty. According to Morris (2013), the proportion of men endowed with full skills (*i.e.* able to read and write connected prose, and use some advanced mathematical techniques) rose from 10% in 1700 to 40% in 1900, for the most advanced Western economies. Initially concentrated on improving men's skills, education spread finally to women, giving them financial independence and, ultimately, emancipation. The educated guess of Morris (2013) locates female literacy between 1% and 2% of males' literacy in the West, before 1700. Then it rose to 10% in 1700, 50% in 1800, 90% in 1900. As far as specific countries are concerned, Diebold and Perrin (2013) show that the female-to-male enrolment in primary schools in France went from 58% in 1835 to 90% in 1935. We suggest that this process of human capital accumulation may explain the transition to serial monogamy that started in the second half of the 19th century.

3. THE MODEL

We now introduce our unifying approach to marriage institutions. We first analyse the equilibrium at time t defined, for a given distribution of income, by a political equilibrium, *i.e.* a marriage institution resulting from the aggregation of individual preferences (Section 4), and—within that institution—a marriage-market equilibrium (Section 3.2). The inter-temporal equilibrium is a sequence of time t equilibria equilibria that, given initial conditions, satisfies the dynamic equations describing the time evolution of income distribution (Section 5). Let us now describe our model and characterize the equilibrium configuration of the marriage market, under polygyny, monogamy, and serial monogamy.

3.1. Modelling choices

Time is discrete. Every individual lives for two periods: childhood and adulthood. Adulthood is in turn made of two subperiods, thus allowing us to deal with divorce and remarriage. There are two genders, male and female. In each subperiod, a female can be married or not. If married, she gives birth to one child. This implies that if all women are married for both subperiods, every woman has two children (one boy and one girl), and the population is constant. In each subperiod, males can be married or not, to one or two females.

Agents are also characterized by their income level, and can be rich or poor. We normalize the income of rich individuals to 1, whereas that of the poor is set equal to $\omega < 1$.¹⁹ The time spent rearing children does not affect lifecycle income. At any *t*, the state of the economy is described by the proportion of rich males and females, denoted by μ_t and ϕ_t , respectively.

19. Our results also hold if the income of poor females is assumed to be lower than that of poor males, as in the working paper version of this article (available upon request).

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In our model, income should be regarded as lifecycle income, covering three broad classes of wealth: (i) physical (strength, practical skills); (ii) material (land, livestock, household goods, and—at later stages of development—physical capital); and (iii) human (social ties, ritual knowledge, and later on, education). Poor people may have some physical, but little material and human wealth. Rich people have either material wealth, or high human capital, or both. The degree to which these types of wealth can be passed from one generation to the next may vary, but is positive. This is important for the dynamics of the income distribution.

Definition 1. (Marriage) A marriage is a relationship between persons of different sexes, which: (i) partners freely choose to join; (ii) involves one and only one male and one or two females; (iii) implies that resources are pooled and shared equally among the members of the household; and (iv) allows every female to have one child per subperiod.

The assumption that resources are pooled and distributed to the spouses according to an exogenous sharing rule implies that, for our model, we make use of a Gale–Shapley notion of marriage-market equilibrium. An alternative formulation, based on endogenous equilibrium transfers, will be discussed in Section 6 and analysed in Appendix B.

Utility depends on life-time consumption c and marriage relationships in each period. It is separable in its two arguments. The utility derived from life-time consumption is v(c), where $v(\cdot)$ is increasing and concave. Divorce allows partners to remarry in the following period, but entrains (i) a cost d that must be paid by divorcees, and (ii) a social cost s that concerns everyone, regardless of his/her marital status (married, divorced, or single).²⁰

In each period, the utility from relationships depends on the number, exclusiveness, and quality of simultaneous relationships in which the individual is involved. The number of relationships can be 0 (single), 1 (monogamy), or 2 (polygyny). Utility is also increasing and concave in the number of relationships, for a given quality of the relationship, which can be g > 0 in the case of a happy (good) marriage, or b < g if the marriage deteriorates and becomes unhappy (bad). Marriages are always happy in the first subperiod, but they may turn bad in the second subperiod, with probability $p \in (0, 1)$. Therefore, remarriages are always happy. If the relationship is not exclusive, *i.e.* if there are other persons of the same sex involved in the marriage, a jealousy cost *m* must be accounted for. In our framework, the jealousy cost only applies to women in polygynous households.²¹

Total utility is the sum of consumption and relationship utility, over the two subperiods. For example, the expected utility of a lasting monogamous marriage is:

$$v(c) + g + (1-p)g + pb.$$

20. The existence of economy-wide costs of divorce is supported by several studies. Ananat and Michaels (2008) say that divorce increases inequality and poverty (something that even people who do not divorce may not like). Schramm (2006) quantifies the cost of legal procedures and courts, the welfare state transfers to children of divorced parents, the productivity loss of divorced workers, etc. as the main components of the social burden imposed by divorce. As far as the children of divorced parents are concerned, negative effects—which could translate into costs for the society as a whole—have been detected by Ross and Mirowsky (1999) (lower socioeconomic status and problems in interpersonal relationships), Gruber (2004) (lower education and higher odds of adult suicide), Gilman *et al.* (2003) (onset of major depression in adulthood), Jonsson *et al.* (2000) (worse health and emotional experiences) and Stevenson (2007) (less education). One limitation, common to these studies, is the absence of a control group. Finally, the parameter *s* can also account for some (religious) aversion to divorce.

21. Westermarck (1925, vol. V, pp. 86-89), provides many examples of jealousy between co-wives and its limit.

To simplify notation, we define the expected *relationship* utility of a lasting monogamous marriage as:

$$u_p = g + (1-p)g + pb = (2-p)g + pb > 0.$$

If one man has two wives to whom he remains married for both periods, his relationship utility becomes $(1+z)u_p$, with 0 < z < 1 accounting for the decreasing marginal utility of simultaneous relationships.²² Finally, we assume the relationship utility of singles to be 0.

Let us stress that in our model agents are free to marry whom they prefer (no parental consent), and transfers are possible only between spouses. This means that we do not consider situations in which, for instance, women are forced into polygyny by their fathers, who extract material benefits from their daughters' marriage.

Our theory of marriage institutions is developed within a simplified $2 \times 2 \times 2$ framework: two wives, two subperiods, and two income types. In Appendix 5, available as Supplementary Material, we discuss whether our analysis can be generalized along each of these three dimensions.

3.2. Marriage-market equilibrium

To simplify the analysis, we make the following Assumption that seems very realistic, at least until the very recent past.

Assumption 1. At time t, the proportion of rich males is larger than the proportion of rich females, i.e. $\mu_t > \phi_t$.

When dealing with the dynamics, μ_t and ϕ_t will become endogenous, and we will have to check that $\mu_t > \phi_t$ holds at any t. We now provide a definition of the equilibrium in the marriage market, which is valid for all the three marriage institutions we consider.

Definition 2. (Marriage-market equilibrium) An equilibrium in the marriage market is such that no individual prefers to be single than to keep his/her current assignment, and no pair of individuals of opposite sex prefers to marry each other than to keep their current assignment.

This definition is consistent with the "stable marriage assignment" property (Gale and Shapley, 1962). Although similar definitions are used in the context of monogamy, this one extends to polygynous marriages: for an assignment to be an equilibrium we require that no woman could increase her utility by being accepted in a marriage (be it polygynous or monogamous) other than her own.

In the literature on marriage and mating, it is often assumed that nobody wants to remain single in equilibrium, consistent with the fact that the proportion of ever married persons has historically been very high.²³ The following Lemma gives the conditions under which voluntary singleness cannot be an equilibrium outcome in our model.²⁴

Lemma 1. Voluntary singleness cannot be an equilibrium outcome if

$$u_p > \max\left\{m, v(2) - v(1+\omega) + g, v\left(\frac{3\omega+1}{2}\right) - v(2\omega) + g\right\}.$$
(1)

22. For Westermarck (1925, vol. V, p. 74), "A further cause of polygyny is man's taste for variety. The sexual instinct is dulled by long familiarity and stimulated by novelty."

23. A notable exception is Saint-Paul (2009), whose model interprets the emergence of widespread singleness as a by-product of increasing inequality.

24. Under polygyny, singleness is involuntary.

Proof See Appendix A.1.

Condition (1) requires the expected relationship utility u_p to be large enough, so as to compensate for negative aspects of marriage, such as the jealousy cost (in case of females joining polygynous households), or the income loss incurred by marrying low-type partners (which may also justify strategic singleness in the first subperiod if divorce is available).

We now consider the three possible institutions in turn, starting with polygyny.

3.3. Polygyny

For simplicity, in our characterization of polygyny we constrain the maximum number of wives per husband to two, thus focusing on bigyny (the possibility of marrying more than two wives will be dealt with in Appendix 5, available as Supplementary Material). Polygyny is defined as follows.

Definition 3. (**Polygyny**) *Polygyny is a constitution such that marriages satisfy the following characteristics:* (P1) *each male is allowed to marry up to two females at the same time;* (P2) *partners remain together for the two subperiods.*

Definition 3 stipulates that, in polygynous marriages, the (three) spouses remain together for both subperiods, even if the relationship turns bad. In many polygynous societies though, marriage breakup is possible. It is, however, a quite asymmetric kind of divorce, since the husband has often the option to repudiate his wives, or easier access to divorce.²⁵ In our model, we do not introduce symmetric divorce in polygyny, for the sake of realism. We do not introduce repudiation (or asymmetric divorce) either, for simplicity.

From the male point of view, a polygynous marriage is comparable to multiple monogamous marriages. In particular, marrying bigamously allows a man to father four children, instead of the two he could raise inside a monogamous marriage. We recall, however, that a polygynous man faces a decreasing marginal utility of simultaneous relationships.

A priori three types of polygynous households are possible: mixed households with one rich and one poor wife, and households composed exclusively of either low- or high-status females. In equilibrium, however, we have the following.

Lemma 2. There is no polygynous household including both rich and poor females, and only rich males may have polygynous households.

Proof See Appendix A.2.

Depending on the share of rich males in the population, there can be different equilibrium assignments. In particular, as soon as $\mu_t > 1/2$, not all rich males can marry polygynously. In any case, polygyny is a prerogative of rich men, a result derived by Grossbard-Shechtman (1980), among others, and empirically validated by Grossbard-Shechtman (1986). The following Proposition characterizes the possible marriage-market equilibria under polygyny.

^{25.} When polygynous societies allow for divorce, the latter is inherently asymmetric. In most Muslim countries a husband may divorce his wife easily, whereas the inverse is not true. Moreover, the father alone remains in charge of the financial support of the children, who are under his exclusive custody after reaching a certain age. In Ancient Rome, that we consider as *de facto* polygynous, access to divorce was also asymmetric, the children were regarded as the property of the father, and there was no such thing as joint marital property. In both cases, divorce only gives more flexibility to polygyny from the male viewpoint.

Proposition 1. Suppose polygyny is the constitution, the jealousy cost m satisfies

$$m < \min\left\{v(2) - v(1+\omega), v\left(\frac{2+4\omega}{3}\right) - v(2\omega)\right\},\tag{2}$$

and preferences satisfy

$$zu_p > v(2) - v\left(\frac{2+4\omega}{3}\right). \tag{3}$$

If $\mu_t < 1/2$, in equilibrium we have $\phi_t/2$ rich polygynous households, $\mu_t - \phi_t/2$ poor polygynous households, $1-2\mu_t$ poor couples, and μ_t poor single males.

If $1/2 \le \mu_t < (1+\phi_t)/2$, we have $(1-2\mu_t+\phi_t)/2$ rich polygynous households, $2\mu_t - 1$ rich couples, $(1-\phi_t)/2$ poor polygynous households, and $1-\mu_t$ poor single males.

If $\mu_t \ge (1+\phi_t)/2$, we have ϕ_t rich couples, $1-\mu_t$ poor polygynous households, $2\mu_t - 1 - \phi_t$ rich/poor couples, and $1-\mu_t$ poor single males.

Proof See Appendix A.3.

Condition (2) requires that both rich females and poor females prefer a polygynous marriage with a rich male to a monogamous marriage with a poor male. Condition (3) requires men to like polygyny enough, so that they prefer two poor wives to one rich. In other terms, the utility value of an additional relationship is large enough to compensate the income loss implied by sharing resources with two poor wives. Taken together, conditions (2) and (3) ensure that polygyny can arise as a marriage equilibrium.

Figure 2 provides a graphical description of the equilibrium, if $\mu_t < 1/2$. The bars represent, for each gender, the distribution of agents by income group, whose utility is also displayed.

The actual incidence of polygyny is variable. When $\mu_t < 1/2$, a rise in μ_t leads to more polygynous households. The number of polygynous households is maximized at $\mu_t = 1/2$ and, as μ_t increases above 1/2, the number of rich polygynous households diminishes and some of them are transformed into rich couples. When $\mu_t = (1 + \phi_t)/2$, all rich polygynous households have disappeared. If μ_t increases further, poor polygynous households are progressively transmuted into rich/poor couples. Note that the intensity of polygyny depends only on μ_t and ϕ_t , different from Lagerlöf (2005), where it also depends on the productivity gap between rich and poor males.

When either conditions (2) or (3) does not hold, other equilibrium configurations are possible. Appendix 1, available as Supplementary Material, details three of these cases. To avoid discussing a large number of cases, depending on different conditions, we assume from now on that conditions (2) and (3) hold.

To characterize the political equilibria, we need to determine the expected utility of the four groups, for each marriage regime. To this purpose, we denote *ex ante* utilities as W_{ij}^k where k = M, P, S is the marriage institution (monogamy, polygyny, serial monogamy), i = r, p the income level, and j = m, f gender. *Ex ante* utilities under polygyny (W_{ij}^P) are given by:

$$W_{rm}^{P}(\mu_{t},\phi_{t}) = \begin{cases} \frac{\phi_{t}}{2\mu_{t}}v(2) + \left(1 - \frac{\phi_{t}}{2\mu_{t}}\right)v\left(\frac{2+4\omega}{3}\right) + (1+z)u_{p} & \text{if } \mu_{t} < \frac{1}{2} \\ \frac{1 - 2\mu_{t} + \phi_{t}}{2\mu_{t}}v(2) + \frac{2\mu_{t} - 1}{\mu_{t}}(v(2) - zu_{p}) & \\ + \frac{1 - \phi_{t}}{2\mu_{t}}v\left(\frac{2+4\omega}{3}\right) + (1+z)u_{p} & \text{if } \frac{1}{2} \le \mu_{t} < \frac{1+\phi_{t}}{2} \\ \frac{\phi_{t}}{\mu_{t}}(v(2) + u_{p}) + \frac{1 - \mu_{t}}{\mu_{t}}\left(v\left(\frac{2+4\omega}{3}\right) + (1+z)u_{p}\right) & \\ + \frac{2\mu_{t} - 1 - \phi_{t}}{\mu_{t}}\left(v(1+\omega) + u_{p}\right) & \text{otherwise,} \end{cases}$$



FIGURE 2 Polygyny: Equilibrium with $\mu_t < 1/2$



3.4. Monogamy

Definition 4. (Monogamy) Monogamy is a constitution such that marriages satisfy the following characteristics: (M1) each person is allowed to marry at most one person of the opposite sex; (M2) partners remain together for the two subperiods.



Monogamy: equilibrium

Proposition 2. Assume that monogamy is the constitution, assumption 1 and condition (1) hold. In equilibrium, we have (i) ϕ_t marriages between rich persons; (ii) $1 - \mu_t$ marriages between poor persons; and (iii) ($\mu_t - \phi_t$) marriages between rich males and poor females.

Proof Rich men always agree to marry rich females and vice versa, as $u_p > 0$. Since by Assumption 1 there are more rich males than rich females, a marriage pattern involving marriages between rich females and poor males is not an equilibrium. In fact, rich females would be better off if married to a rich male. Therefore (i) holds. Poor persons always accept any marriage proposal, so that (ii) holds. By condition (1), rich males accept to marry poor females. Therefore (iii) holds.

The equilibrium is represented in Figure 3. The associated *ex ante* levels of utility, for each of the four groups involved in the marriage game, are given by:

$$\begin{split} W^{M}_{rm}(\mu_{t},\phi_{t}) &= u_{p} + \frac{\phi_{t}}{\mu_{t}} v(2) + \frac{\mu_{t} - \phi_{t}}{\mu_{t}} v(1+\omega), \\ W^{M}_{pm}(\mu_{t},\phi_{t}) &= u_{p} + v(2\omega), \\ W^{M}_{rf}(\mu_{t},\phi_{t}) &= u_{p} + v(2), \\ W^{M}_{pf}(\mu_{t},\phi_{t}) &= u_{p} + \frac{1 - \mu_{t}}{1 - \phi_{t}} v(2\omega) + \frac{\mu_{t} - \phi_{t}}{1 - \phi_{t}} v(1+\omega). \end{split}$$

Since everybody expects the same u_p , utility differentials across groups derive from the consumption associated with different outcomes on the marriage market. In this framework, only the utility of poor females and rich males is subject to uncertainty, and depends on the state of the economy (μ_t, ϕ_t).

3.5. Serial Monogamy

Definition 5. (Serial Monogamy) Serial monogamy is a constitution such that marriages satisfy the following characteristics: (S1) each person is allowed to marry at most one partner of the opposite sex for every subperiod; (S2) a marriage can end in divorce at the end of the first subperiod if one of the spouses so wishes (unilateral divorce); and (S3) for divorced agents, it is possible to marry a new partner at the beginning of the second subperiod.

Proposition 3. Assume that serial monogamy is the constitution, and the divorce cost d satisfies

$$v(2\omega) - v\left(\frac{3\omega + 1}{2} - d\right) > g - b > v(2) - v(2 - d).$$
(4)

Then we have in equilibrium: (i) $(1-p)\phi_t$ lasting marriages between rich persons; (ii) $p\phi_t$ marriages between rich persons ending in divorce; (iii) $p\phi_t$ remarriages between rich persons; and (iv) $1-\mu_t$ lasting marriages between poor persons. Let us also define:

$$\overline{v}_t = \frac{\phi_t}{\mu_t} v \left(\frac{3+\omega}{2} - d\right) + \frac{\mu_t - \phi_t}{\mu_t} v (1+\omega-d) + g - b,$$

$$\underline{v}_t = \frac{p\phi_t}{p\phi_t + \mu_t - \phi_t} v \left(\frac{3+\omega}{2} - d\right) + \frac{\mu_t - \phi_t}{p\phi_t + \mu_t - \phi_t} v (1+\omega-d).$$

- (a) If $v(1+\omega) > \overline{v}_t$, we have (v) $\mu_t \phi_t$ lasting marriages between rich males and poor females.
- (b) If $\underline{v}_t < v(1+\omega) < \overline{v}_t$, we have $(v') p(\mu_t \phi_t)$ marriages between rich males and poor females ending in divorce, $(vi') p(\mu_t \phi_t)$ remarriages between rich males and poor females, $(vii') (1-p)(\mu_t \phi_t)$ lasting marriages between rich males and poor females.
- (c) If $v(1+\omega) < \underline{v}_t$, we have $(v^n) \mu_t \phi_t$ marriages between rich males and poor females ending in divorce, $(vi^n) \mu_t \phi_t$ remarriages between rich males and poor females.

Proof See Appendix A.4.

The condition on *d*—which implies that unhappy rich couples would always divorce, whereas unhappy poor ones would not—is instrumental to reducing the number of possible cases. It is well documented, however, that at the time of its introduction, the rich were more favourable to divorce than the poor. In particular, the results of the referendums held in Ireland and Italy suggest that serial monogamy may be a bourgeois institution. In both countries high-income, educated, and urban voters voted in favour of divorce more than low-income, less educated, and rural ones, as reported by Marradi (1976) and Darcy and Laver (1990).²⁶

^{26.} In today's U.S., the incidence of divorce is higher among low-income, less educated families (see Stevenson and Wolfers, 2007). Our model, however, is not sophisticated enough to reproduce this empirical relationship. In particular, it cannot disentangle the effect of higher education that, being correlated with income, decreases the relative cost of divorce, but translates also into later marriage, more patience, and better mate selection, all factors that reduce the likelihood of divorce.



Serial monogamy: equilibrium (case (*b*))

Before computing *ex ante* utilities, let us stress that the existence of a social cost of divorce *s* will be important for the poor to rank monogamy higher than serial monogamy, for some state of the economy (see Section 4.1). The parameter *s* is the simplest way of modelling a social cost of divorce. As an alternative, in Appendix 4 available as Supplementary Material, we consider a contractual failure arising endogenously from within the couple. The idea is that the option of divorce makes people invest less in the quality of their marriage, thus creating a negative externality. Introducing endogenous marriage quality makes the model less tractable, but we show that it generates a mechanism similar to a social cost.

The equilibrium is represented in Figure 4, for case (b). As under monogamy, the expected utility of poor males and rich females does not depend on the state of the economy. On the contrary, for the two other groups, expected utility is a function of (μ_t, ϕ_t) through the probabilities of finding a match of a given type, in a fashion which in turn depends on whether case (a), (b), or (c) arises in equilibrium. *Ex ante* utilities, which are all continuous in (μ_t, ϕ_t) over $(0, 1) \times (0, 1)$, are given by:

$$W_{rm}^{S}(\mu_{t},\phi_{t}) = -s + 2g + \frac{\phi_{t}}{\mu_{t}}(1-p)v(2)$$

$$\begin{cases} v(2-d) & \text{if } (a) \\ \phi & (3+\alpha) \end{cases}$$

$$+\frac{\phi_t}{\mu_t}p \times \left\{\frac{\frac{\phi_t}{\mu_t}v(2-d) + \frac{\mu_t - \phi_t}{\mu_t}v\left(\frac{3+\omega}{2} - d\right)\right\}$$
 if (b)

$$\left(\frac{p\phi_t}{p\phi_t + \mu_t - \phi_t}v(2-d) + \frac{\mu_t - \phi_t}{p\phi_t + \mu_t - \phi_t}v\left(\frac{s+\omega}{2} - d\right)\right)$$
 if (c)

$$v(1+\omega) + u_p - 2g$$
 if (a)

$$-\frac{\mu_t - \phi_t}{\mu_t} \times \begin{cases} (1-p)v(1+\omega) + p\left(\frac{\mu_t - \phi_t}{\mu_t}v\left(\frac{3+\omega}{2} - d\right) + \frac{\phi_t}{\mu_t}v(1+\omega-d)\right) & \text{if }(b) \end{cases}$$

$$\left(\frac{p\phi_t}{p\phi_t + \mu_t - \phi_t}v\left(\frac{3+\omega}{2} - d\right) + \frac{\mu_t - \phi_t}{p\phi_t + \mu_t - \phi_t}v(1+\omega-d)\right)$$
 if (c)

$$W_{pm}^{S}(\mu_{t},\phi_{t}) = -s + v(2\omega) + u_{p},$$

$$W_{rf}^{S}(\mu_{t},\phi_{t}) = -s + (1-p)v(2) + pv(2-d) + 2g,$$

$$W_{pf}^{S}(\mu_{t},\phi_{t}) = -s + \frac{1-\mu_{t}}{1-\phi_{t}} \left(v(2\omega) + u_{p}\right)$$

$$(v(1+\omega) + v, w) = v(1+\omega) + v,$$

$$if (a)$$

$$+\frac{\mu_t - \phi_t}{1 - \phi_t} \times \begin{cases} v(1 + \omega) + u_p & \text{if } (a) \\ pv(1 + \omega - d) + (1 - p)v(1 + \omega) + 2g & \text{if } (b) \end{cases}$$

4. POLITICAL EQUILIBRIUM

We now analyse how marriage institutions are determined, as a political equilibrium. In a first step (Section 4.1), we establish how the four different groups rank the three alternative arrangements (\mathbf{P} , \mathbf{M} , and \mathbf{S}), by comparing the values of their indirect utility functions. Then, in Section 4.2 we determine the outcome of the voting process.

The formation of coalitions involving different groups of males and females has been crucial to define marriage institutions in pre-industrial societies, even in the absence of formal political structures. In this respect, Low (1992) emphasizes that "in some societies politics and reproduction are overtly interwoven" and "the line between 'coalitions' and 'politics' is not always clear". According to MacDonald (1995)'s analysis of the medieval "socially imposed monogamy", there is evidence of three facts: (i) political activity of lower status men; (ii) political activity of women and their relatives; and (iii) the emergence of the Church as a powerful collectivist institution trying to impose monogamy on the ruling secular elite.

Historians agree that socially imposed monogamy in Western Europe originated as a result of conflict in which the ecclesiastical authorities attempted to combat the power of the secular aristocracy, mainly through the regulation of reproductive behaviour. Women have, at times, directly supported institutions favourable to monogamy, and this influence may also have, occurred during antiquity. According to Brown (1988), female support may have been a crucial factor in the success of the early Christian Church, which featured monogamy, chastity, and sexual decorum as prominent aspects of its public image (see also MacDonald, 1990). Henrich et al. (2012) underline that as monogamy was gradually being imposed in Europe, the main line of resistance came from the nobility, whereas lower classes, who were economically limited to monogamous marriage anyways, were rapidly adopting Christianity. The idea that the political interests of women and poor men could have been represented by the Church is further confirmed by Stone (1990), who stresses that parishes were responsible for taxing the wealthiest third of the population to support the indigent. He also suggests that (i) after the decline of ecclesiastical control in England, women-fearing that divorce would result in desertion and economic loss—acted as an interest group favouring the maintenance of anti-divorce customs; and (ii) in England, the fear that legalizing divorce would result in large-scale serial monogamy

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by promiscuous (and richer) males did not disappear from the public debate until the 19th century.²⁷

4.1. Political preferences by group

Knowing expected utilities, and the equilibrium assignments on the marriage market, we can establish how the four groups of voters rank the alternative marriage institutions. From the analysis developed in the previous section, we obtain the following result.

Lemma 3. When $(\mu_t, \phi_t) \to (0, 0)$, $W_{pf}^P \to W_{pf}^M$ and $W_{pm}^P \to W_{pm}^M$. When $(\mu_t, \phi_t) \to (1, 1)$, $W_{rf}^P \to W_{rf}^M$ and $W_{rm}^P \to W_{rm}^M$. In both cases, polygyny tends to coincide with monogamy.

Proof See Appendix A.5.

The above Lemma reflects that, if there is absolute equality among both males and females, everybody marries monogamously even if polygyny is not banned by law.²⁸ We now consider the four groups and establish their preference orderings, which in Figure 5 are represented in the space of admissible values of $\{\mu_t, \phi_t\}$. Recall that, for the time being, we consider μ_t and ϕ_t as exogenous. Both variables will become endogenous in the next section, and evolve over time within the region defined by $0 < \phi_t < \mu_t < 1$. Note also that whether a given group of agents prefers serial monogamy to alternative regimes depends, in general, on *p*, the probability that a marriage goes bad.

Lemma 4. (Rich females) Rich females prefer monogamy to polygyny, unless $\mu_t > (1+\phi_t)/2$, in which case they are indifferent between polygyny and monogamy.

There is a threshold \hat{p} , solving $W_{rf}^M = W_{rf}^S$, such that rich women prefer serial monogamy to monogamy for any state of the economy if and only if $p > \hat{p}$, with

$$\hat{p} = \frac{s}{v(2-d) - v(2) + (g-b)} > 0.$$
(5)

27. Stone (1990) also points out, however, that working-class wives, although opposed to divorce, presumably had little or no influence on the political process.

28. Tertilt (2005) provides a model with polygyny in equilibrium without income heterogeneity; since men can marry younger women, polygyny may emerge even in the absence of income differences among men. Different from her model, however, we abstract from age heterogeneity and spousal age gap.

Proof This result follows from the comparison of expected utilities W_{rf}^P , W_{rf}^M and W_{rf}^S . condition (4) ensures that $\hat{p} > 0$.

The very existence of a jealousy cost implies that rich females prefer monogamy to polygyny, unless polygyny is not practiced even if allowed, *i.e.* when $\mu_t > (1 + \phi_t)/2$ holds, and we are in the region delimited by a straight line joining (1/2,0) to (1,1) in the { μ_t, ϕ_t } plan. Moreover, for divorce to become an attractive option for rich females, the probability of their marriage going bad must be sufficiently high.

Lemma 5. (Rich males) Let (a), (b), and (c) be the three cases described in Proposition 3. (A) Rich males always prefer polygyny to monogamy; (B) there exists a threshold $\tilde{p}(\mu_t, \phi_t)$, solving $W_{rm}^S = W_{rm}^M$,

$$\int \frac{\mu_t s}{\phi_t (g-b+v(2-d)-v(2))} \quad if(a)$$

$$\tilde{p}(\mu_t, \phi_t) = \begin{cases} \frac{s\mu_t^2}{\phi_t^2 v(2-d) + \mu_t(\mu_t(g-b) - \phi_t v(2)) + (\mu_t - \phi_t)((\mu_t - \phi_t)v(1+\omega - d) + 2\phi_t v(\frac{3+\omega}{2} - d) - \mu_t v(1+\omega))} & \text{if }(b) \end{cases}$$

$$\frac{H - \sqrt{H^2 - 4(\mu_t - \phi_t)\phi_t J(\mu_t s + (\mu_t - \phi_t)(v(1 + \omega) - v(1 + \omega - d))))}}{2\phi_t J} \quad if(c)$$

where:

$$H = (\mu_t - \phi_t)(\mu_t(g-b) - \phi_t\left(v(2) + v(1+\omega) - 2v\left(\frac{3+\omega}{2} - d\right)\right) - \mu_t\phi_t s,$$

$$J = \phi_t(v(2) - v(2-d)) - \mu_t(g-b),$$

such that rich males prefer serial monogamy to monogamy for any state of the economy if and only if $p > \tilde{p}(\mu_t, \phi_t)$; (C) there exists a threshold function $\mu^{\diamond}(\phi_t)$, solving $W_{rm}^P = W_{rm}^S$, such that rich males prefer serial monogamy to polygyny if and only if $p > \hat{p}$ and $\mu_t > \mu^{\diamond}(\phi_t)$.

Proof See Appendix A.6.

The rationale for this result is the following. If the possibility of having an unhappy marriage is not too close to zero, rich males' least preferred arrangement is monogamy, since it limits their ability to take advantage of their higher status (which can allow them to have multiple wives, simultaneously or over time).²⁹ Rich males also prefer polygyny to serial monogamy, as long as their relative scarcity ensures them a strong position on the marriage market.

Lemmas 4 and 5 both require p to be large enough for rich people to rank serial monogamy above other regimes. Both requirements can be encompassed by the following sufficient condition on p:

$$p > \bar{p} \quad \text{where} \quad \bar{p} = \max\left\{\hat{p}, \max_{\mu \in (0,1), \phi \in (0,\mu)} \tilde{p}(\mu,\phi)\right\}.$$
(6)

 $\max_{\mu \in (0,1), \phi \in (0,\mu)} \tilde{p}(\mu,\phi)$ is the largest value that the function $\tilde{p}(\cdot)$ takes on the set of admissible values of μ and ϕ .³⁰ Unlike the threshold $\tilde{p}(\mu_t,\phi_t)$ of Lemma 5, condition (6) does not depend on the state of the economy as described by μ_t and ϕ_t , which will evolve endogenously in Section 5.

^{29.} Schoellman and Tertilt (2006) quantify the cost born by males if monogamy is enforced in a polygynous society and find it to be large, typically larger than the gain accruing to females.

^{30.} In our dynamic simulations, we will chose a parametrization such that $1 > p > \overline{p}$.

Lemma 6. (Poor females) Let (a), (b), and (c) be the three cases described in Proposition 3. *There exist*

$$\hat{\mu}(\phi_t) = \min\left\{ \frac{\phi_t v(1+\omega) - v(2\omega) + (1-\phi_t) \left(v\left(\frac{2+4\omega}{3}\right) - m \right)}{v(1+\omega) - v(2\omega)}, \frac{\phi_t \left(m + v(1+\omega) - v\left(\frac{2+4\omega}{3}\right) \right)}{2m + v(1+\omega) + v(2\omega) - 2v\left(\frac{2+4\omega}{3}\right)} \right\},$$

and

$$\tilde{\mu}(\phi_t) = \begin{cases} \phi_t + \frac{(1-\phi_t)s}{p((g-b) - (v(1+\omega) - v(1+\omega-d)))} & \text{if }(b) \\ \phi_t + \frac{(1-\phi_t)s}{p(g-b) - (v(1+\omega) - v(1+\omega-d))} & \text{if }(c). \end{cases}$$

such that the most preferred regime by poor females is, in case (a): polygyny, if $0 < \mu_t < \hat{\mu}(\phi_t)$, and monogamy, if $\hat{\mu}(\phi_t) < \mu_t$. In cases (b) or (c): polygyny, if $0 < \mu_t < \hat{\mu}(\phi_t)$, monogamy, if $\hat{\mu}(\phi_t) < \mu_t < \tilde{\mu}(\phi_t)$, and serial monogamy if $\tilde{\mu}(\phi_t) < \mu_t < 1$.

There also exists a function $\mu(\phi_t)$, solving $W_{pf}^P = W_{pf}^S$, such that poor females rank serial monogamy higher than polygyny if $\mu_t > \mu(\phi_t)$.

Proof This result follows from the comparison of expected utilities W_{pf}^P , W_{pf}^M and W_{pf}^S . Note that $\mathring{\mu}(\phi_t)$ solves $W_{pf}^P = W_{pf}^S$, while $\hat{\mu}(\phi_t)$ and $\tilde{\mu}(\phi_t)$ solve $W_{pf}^P = W_{pf}^M$ and $W_{pf}^M = W_{pf}^S$, respectively. In case (a), poor women never prefer **S** to **M** because they never want to divorce $(W_{pf}^M > W_{pf}^S)$. \parallel

We can identify conditions such that: $\phi_t < \hat{\mu}(\phi_t) < \hat{\mu}(\phi_t) < 1$ for all values of $\phi_t < \mu_t$, and the preferences of poor females are thus correctly summarized by the third panel of Figure 5. A priori we cannot exclude that the two functions $\hat{\mu}(\phi_t)$ and $\tilde{\mu}(\phi_t)$ intersect. First, consider that for any ϕ_t , condition (2) on the jealousy cost ensures that $\phi_t < \hat{\mu}(\phi_t)$. Moreover, $\hat{\mu}(\phi_t) < \tilde{\mu}(\phi_t) < 1$ if the following condition on (g-b) holds:

$$\frac{v(1+\omega)-v(1+\omega-d)+s}{p} < (g-b)$$

$$< v(1+\omega)-v(1+\omega-d) + \frac{s}{p} \left(1 + \frac{m+v(1+\omega)-v\left(\frac{2+4\omega}{3}\right)}{v\left(\frac{2+4\omega}{3}\right)-m-v(2\omega)}\right).$$
(7)

In particular, the first inequality implies that $\tilde{\mu}(\phi_t) < 1$, whereas the second one ensures that $\hat{\mu}(\phi_t) < \tilde{\mu}(\phi_t)$ for any ϕ_t .

When there are few rich males, poor females prefer polygyny, as polygyny increases their chance to be the (second) wife of a rich man, which makes them better off than being the only wife of a poor man. When the number of rich males increases, poor females prefer monogamy as their chance of having a monogamous marriage with a rich man is higher. But they do not want to allow for divorce, as the probability of finding only a poor man as second husband is too high. Finally, if the number of rich men increases further, there is a high probability that poor females will be married to rich males. When the number of such men is large enough, poor women benefit

from divorce, since it allows them to get rid of a bad match, and they are certain to remarry a rich husband in the second subperiod.³¹

However, note that, if $v(1+\omega)-v(1+\omega-d)+s/p > (g-b)$, serial monogamy will never be poor females' most preferred regime (since $\tilde{\mu}(\phi_t) > 1$), and their preferences would switch only once, from polygyny to serial monogamy as soon as $\mu_t > \hat{\mu}(\phi_t)$. In particular, any decrease in (g-b), or increase in s/p, induces a counterclockwise rotation of $\tilde{\mu}(\phi_t)$, which may eventually drive it to the right of the vertical line $\mu_t = 1$.

Lemma 7. (Poor males) Poor males prefer strict monogamy to the two other regimes for any state of the economy. There also exists a threshold value $\bar{\mu} = s/(u_p + s)$ such that poor males prefer polygyny to serial monogamy if and only if $\mu_t < \bar{\mu} < 1/2$.

Proof It suffices to compare expected utilities W_{pm}^P , W_{pm}^M , and W_{pm}^S .

Obviously, poor males prefer monogamy to polygyny since the latter would entrain the risk of remaining single. They also prefer monogamy to serial monogamy since condition (4) implies that they would never divorce (they are too poor to pay the cost of divorce), but would nonetheless bear the social cost of divorce. If poor males had to choose between serial monogamy and polygyny, they would prefer the latter for low values of μ_t , *i.e.* when the probability of remaining single is not very high.

Concerning the choice between polygyny and monogamy, our model generates the straight implication that rich and poor men have conflicting preferences. Interestingly enough, Anderson and Tollison (1998) claim that the opposition of a majority of (lower- and middle-class) men, who would have incurred some welfare loss under polygyny, played a key role in the U.S. Congress decision to ban Mormon polygyny in 1882.³²

4.2. Aggregating individual preferences

We choose to aggregate individual preferences through a political mechanism: at every *t* the marriage regime is chosen by majority voting. We assume that voters are self-interested, and should, therefore, not care about the future consequences of their choice. All adults, regardless of their gender and status, participate in the elections. We allow, however, the different groups to have different weights in the voting process (*i.e.* different degrees of political power). These weights are exogenous, and we denote by $\chi \in (0, 1)$ the relative political power of females, whereas $\theta \in (0, 1)$ accounts for the relative weight of "poor" votes. Therefore, the relative weight of a rich male is 1, whereas a poor male, a rich female, and a poor female weigh θ , χ , and $\theta \chi$, respectively. Such a modification of the standard majority-voting set-up is not uncommon (see, for instance, Bourguignon and Verdier, 2000), and allows for a more realistic analysis, in a historical perspective. We shall now characterize the political equilibrium. We start by considering the case of identical political power ($\chi = \theta = 1$), and then turn to the more general case.

4.2.1. Equal political power. We consider separately two different situations, corresponding to $\mu_t + \phi_t < 1$ and $\mu_t + \phi_t > 1$, respectively. In the first case, rich males and females

^{31.} Note that serial monogamy is not just an inter-temporal version of polygyny, whereby some men can mate with multiple women through divorce and remarriage, but also benefits women who can get rid of a bad match. This echoes the results in Borgerhoff Mulder (2009).

^{32.} These same authors explain that (some) women might have benefited from polygyny, and in fact the Mormons actively supported the enfranchisement of women.



FIGURE 6 Political equilibria with equal weights (left) and with $\theta < 1$ and $\chi < 1$ (right)

cannot form a majority, although they can in the second case. If the poor are the majority $(\mu_t + \phi_t < 1)$, the following proposition completely describes the voting outcome of our economy.

Proposition 4. If $\chi = \theta = 1$ and $\mu_t + \phi_t < 1$, the political equilibrium is: polygyny if $0 < \mu_t < \hat{\mu}(\phi_t)$, monogamy if $\hat{\mu}(\phi_t) < \mu_t < \tilde{\mu}(\phi_t)$, and serial monogamy if $\hat{\mu}(\phi_t) < \mu_t < 1 - \phi_t$.

Proof When $0 < \mu_t < \hat{\mu}(\phi_t)$, **P** is the political equilibrium since it is the most preferred institution of both rich males and poor females, who together account for more than half of the votes. When $\hat{\mu}(\phi_t) < \mu_t < \tilde{\mu}(\phi_t)$, **M** arises as an equilibrium since it is the best option for all poor persons (males and females), who are the majority. If $\tilde{\mu}(\phi_t) < \mu_t < 1 - \phi_t$, poor females' best option is **S**, which emerges as a Condorcet winner because rich females also support **S** against any other alternative, whereas poor or rich males prefer it to **P** and **M**, respectively.

The situation is depicted in Figure 6, where the kinked lines $\hat{\mu}(\phi_t)$ and $\tilde{\mu}(\phi_t)$ correspond to the expressions given by Lemma 6, and we assume that condition (7) holds. When the poor are the majority, poor females are the pivotal group, and we can have a transition from **P** to **M** and then to **S** by increasing the number of rich males, given a constant low number of rich females.

When the rich are the majority $(\mu_t + \phi_t > 1)$, the situation is less clear and a Condorcet winner might not exist, because of circularities in political preferences. However, we can establish a few interesting results when the probability *p* is not too low.

Lemma 8. Assume (6) and $\mu_t + \phi_t > 1$. Then, monogamy cannot be the political equilibrium.

Proof Since rich females and rich males both prefer serial monogamy to strict monogamy (due to Lemmas 4 and 5), the latter cannot be a Condorcet winner.

Proposition 5. Assume (6) and $\mu_t + \phi_t > 1$. Then, the political equilibrium is: polygyny, if $1 - \phi_t < \mu_t < \min\{\hat{\mu}(\phi_t), \mu^{\diamond}(\phi_t)\}$, and serial monogamy, if $\min\{\hat{\mu}(\phi_t), \hat{\mu}(\phi_t)\} < \mu_t < 1$. A Condorcet winner does not exist if $\hat{\mu}(\phi_t) < \mu_t < \hat{\mu}(\phi_t)$.

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Proof When the rich are a majority, we already know that **M** cannot be a Condorcet winner; in particular, it would be defeated by **S** in a pairwise contest. We also know that rich females always prefer **S** to **P**. Therefore, a sufficient condition for serial monogamy to be the political equilibrium is that it is rich males' most preferred regime (*i.e.* $\mu_t > \mu^{\diamond}(\phi_t)$, see Lemma 5). Serial monogamy can also emerge if $\mu_t > \hat{\mu}(\phi_t)$: in such a case, even if rich males prefer **P** to **S**, the latter would be supported (against **P**) by a majority comprising poor males, rich females and poor females (by Lemma 6). However, if poor females prefer **P** over **S** ($\mu_t < \hat{\mu}(\phi_t)$), a Condorcet winner does not exist, since in a pairwise contest **P** defeats **S**, **S** defeats **M**, but **M** prevails over **P**. Finally, polygyny is the political equilibrium if it is the best possible outcome for both rich males ($\mu_t < \mu^{\diamond}(\phi_t)$) and poor females (which happens for $\mu_t < \hat{\mu}(\phi_t)$), since poor females and rich males together account for more than one half of the total population.

Condition (6) ensures that the probability that a marriage turns bad is not too low, and there is an incentive to set up a (costly) institution with divorce.

Proposition 5 implies that, as soon as the rich become the majority, monogamy is replaced by serial monogamy. Therefore, if the economy is located in the intermediate region of the left panel of Figure 6, where monogamy prevails, the transition to serial monogamy need not be driven by an increase in the number of rich men, but may also result from an increase in the proportion of rich women. In such a case, the economy would move from below to above the diagonal.

We can also show that serial monogamy will ultimately prevail if everybody becomes rich and *p* is sufficiently large.

Proposition 6. Assume (6). For $(\mu_t, \phi_t) \rightarrow (1, 1)$, serial monogamy is the political equilibrium.

Proof As (μ_t, ϕ_t) approaches (1, 1) everybody is rich. Rich females prefer serial monogamy to any other regime. Rich males may prefer **S** to **P** if μ_t is sufficiently high. If we replace $(\mu_t, \phi_t) = (1, 1)$ in $W_{rm}^P(\mu_t, \phi_t)$ and $W_{rm}^S(\mu_t, \phi_t)$, we find that the latter is higher, if $p > \hat{p}$. It follows that serial monogamy is the political equilibrium (by unanimity).

Since we are particularly interested in the transition from **P** to **M**, and from **M** to **S**, it is useful to summarize how the main parameters of the model affect the position of $\hat{\mu}(\phi_t)$ and $\tilde{\mu}(\phi_t)$, and thus the size of the **P**, **M**, and **S** regions in the left panel of Figure 6. Recall, however, that the transition from **M** to **S** can also take place when the rich become the majority, *i.e.* as soon as $\mu_t + \phi_t > 1$.

Lemma 9. The threshold $\hat{\mu}(\phi_t)$ is decreasing in *m* and ω . If condition (7) holds, the threshold $\tilde{\mu}(\phi_t)$ is increasing in *s* and *d*, decreasing in *p*, (g-b) and ω .

Proof The results of the above lemma follow from the partial derivatives of $\hat{\mu}(\phi_t)$ and $\tilde{\mu}(\phi_t)$ with respect to the relevant parameters.

We can see that the kinked line $\hat{\mu}(\phi_t)$ becomes closer to the diagonal, thus making the **P** region shrink, if the jealousy cost or the income of the poor increases. Concerning $\tilde{\mu}(\phi_t)$, it becomes closer to $\mu_t = 1$, thus making the **S** region shrink, if the divorce costs (*d* and *s*) increase, if the probability that a marriage goes bad decreases, if the relationship-utility gain from remarriage (*g*-*b*) decreases and if the relative income of the poor decreases.

Finally, it is worth noting that condition (6) is sufficient, but not necessary, for Lemma 8, and Propositions 5 and 6 to hold. The (state-dependent) necessary condition is $p > \max\{\hat{p}, \tilde{p}(\mu_t, \phi_t)\}$.

4.2.2. Unequal political power. When political weights are not equal ($\theta < 1$ and $\chi < 1$), for the rich to account for the majority of votes we need $\mu_t + \chi \phi_t > \theta(1 - \mu_t) + \chi \theta(1 - \phi_t)$, which can also be written as $\mu_t + \chi \phi_t > \theta(1 + \chi)/(1 + \theta)$. We consider this case after the alternative one, in which $\mu_t + \chi \phi_t < \theta(1 + \chi)/(1 + \theta)$, so that poor males and females can form a successful coalition.

It is also useful to define

$$\check{\mu}(\phi_t) = \frac{\theta + ((1+\theta)\phi_t - \theta)\chi}{1+\theta}$$

such that, if $\mu_t < \check{\mu}(\phi_t)$, poor males and rich females can form a winning coalition, and

$$\check{\mu}(\phi_t) = \frac{\theta + \chi(\theta + (1 - \theta)\phi_t)}{1 + \theta}$$

such that, if $\mu_t > \check{\mu}(\phi_t)$, rich males alone hold more than one-half of total votes and can impose their preferred regime onto the rest of the economy. One possible location of these upward-sloping functions is depicted in the right panel of Figure 6, which summarizes the resulting political outcomes.

When $\mu_t + \chi \phi_t < \theta(1+\chi)/(1+\theta)$, so that the poor have the majority of votes, the following proposition completely describes the political equilibrium.

Proposition 7. If $\mu_t + \chi \phi_t < \theta(1+\chi)/(1+\theta)$, the equilibrium regime is monogamy if $0 < \mu_t < \check{\mu}(\phi_t)$ or $\hat{\mu}(\phi_t) < \mu_t < \tilde{\mu}(\phi_t)$, polygyny if $\check{\mu}(\phi_t) < \mu_t < \hat{\mu}(\phi_t)$, and serial monogamy if $\tilde{\mu}(\phi_t) < \mu_t < 1-\phi_t$.

Proof If $\mu_t + \chi \phi_t < \theta(1+\chi)/(1+\theta)$, the rich cannot form a winning coalition. With respect to the corresponding case with equal political power (*i.e.* $\mu_t + \phi_t < 1$, Proposition 4), one difference arises: as long as $0 < \mu_t < \check{\mu}(\phi_t)$, the votes of rich males and poor females are not sufficient to impose **P**; instead, **M** emerges as an equilibrium, since in a pairwise contest it would defeat both **P** (for rich females and poor males, $\mathbf{M} > \mathbf{P}$) and **S** (for the poor, $\mathbf{M} > \mathbf{S}$). As soon as $\mu_t > \check{\mu}(\phi_t)$, the reasoning developed in Proposition 4 can be applied. Being the most preferred regime of rich males and poor females, **P** is the Condorcet winner if $\check{\mu}(\phi_t) < \mu_t < \hat{\mu}(\phi_t)$. **M** is the political equilibrium if $\hat{\mu}(\phi_t) < \mu_t < \tilde{\mu}(\phi_t)$, as all the poor prefer it to any other regime. Finally, **S** prevails if $\tilde{\mu}(\phi_t) < \mu_t < 1 - \phi_t$, since it is the best option for all females (and poor or rich males would also prefer it to **P** and **M**, respectively).

With differential political power, monogamy can thus be the equilibrium regime for very low values of μ_t and/or ϕ_t . This is an interesting result, since some scholars (*e.g.* Todd, 2011) believe that the human family started off nuclear, with the parental couple as its core.

We can now describe the possible voting outcomes when the rich have the majority of votes.

Proposition 8. If $\mu_t + \chi \phi_t \ge \theta(1+\chi)/(1+\theta)$ and (6) holds, the equilibrium regime is: polygyny, if $1-\phi_t < \mu_t < \min\{\hat{\mu}(\phi_t), \mu^{\diamond}(\phi_t)\}\$ or $\check{\mu}(\phi_t) < \mu_t < \mu^{\diamond}(\phi_t)$, and serial monogamy, if $\min\{\hat{\mu}(\phi_t), \hat{\mu}(\phi_t)\} < \mu_t < \check{\mu}(\phi_t)\$ or $\mu^{\diamond}(\phi_t) < \mu_t < 1$. A Condorcet winner does not exist if $\hat{\mu}(\phi_t) < \mu_t < \mathring{\mu}(\phi_t) < \check{\mu}(\phi_t)$.

Proof With respect to Proposition 5, we need to consider that polygyny might eventually be the Condorcet winner if rich males prefer **P** to any other regime, and they are numerous enough to be a majority, given their relative political weight. For this to happen we need μ_t to be smaller than $\mu^{\diamond}(\phi_t)$ (so that rich males prefer **P** to **S**), but larger than $\breve{\mu}(\phi_t)$ (so that rich males alone hold more than one-half of total votes).

Recall also that the transition from **M** to **S** can occur as soon as the rich have the majority of (weighted) votes, *i.e.* when the economy moves past the downward-sloping threshold

$$\mu(\phi_t) = 1 - \frac{1 - (\theta(1 - \phi_t) + \phi_t)\chi}{1 + \theta}$$

Such function, which plays the same role as $\mu(\phi_t) = 1 - \phi_t$ in the case with equal political weights, is closer to the origin of the axes—thus suggesting that the economy can switch to **S** earlier—if the relative weight of the poor θ is low.

The institutional transitions highlighted in this section can be summarized as follows.

Proposition 9. (Institutional transitions) Assume that political power is equally distributed, and the share of rich individuals is low, so that **P** is the constitution. A large enough increase in the number of rich males can drive a transition from **P** to **M**. Either a further increase in the number of rich males, or an increasing number of rich females, may spur the transition from **M** to **S**. When political power is distributed unequally, the above may also be true, provided that the initial share of rich individuals is not too low.

The transitions described by the above proposition are coherent with the key facts presented in Section 2. The installment of strict monogamy corresponds to the Urban Revolution that led to a significant increase in the number of wealthy males. The emergence of serial monogamy in the second half of the 19th century comes together with a large rise in female education (the female-to-male literacy ratio exceeds 50% for the first time in history), but is not incompatible with a further rise in the proportion of rich men only.

Although we have abstracted from the possibility of polyandry, one can easily figure out when this would be the preferred regime in our framework of analysis, as there is nothing specific to each gender. Polyandry, defined as one female being allowed to marry two males simultaneously, could then be a political equilibrium if the share of rich females is larger than the share of rich males (a situation that has almost never occurred over the course of human history).³³

So far, we have studied how an exogenous state of the economy (μ_t, ϕ_t) at time t maps into a specific marriage regime, through a politico-economic mechanism. We now want to analyse how the pair (μ_t, ϕ_t) changes over time and, in particular, how its dynamic behaviour is influenced by marriage institutions.

5. INTER-TEMPORAL EQUILIBRIUM

5.1. Dynamics of marriage and social mobility

We now make the state of the economy at t+1 (μ_{t+1}, ϕ_{t+1}) depend on the prevailing marriage institution, and the specific marriage-market equilibrium at time t. In such a way, we introduce in our economy a dynamic interplay between income distribution and marriage institutions along the development path. In this respect, the dynamic part of our theory relates to Fernández and Rogerson (2001), who link growth and social mobility to marital sorting, but restrict their analysis to a monogamous marriage market.

33. However, since in some advanced societies women seem to be overtaking men in terms of human capital accumulation, whether polyandry could be a future possible outcome remains an open question. A recent example of such a possible trend can be found in the affidavits filled by Canadian polyamorous families with British Columbia supreme court at http://polyadvocacy.ca/evidence-filed-with-bc-supreme-court, which describes some arrangements close to polyandry.

	Family type	Paternal time per child	Income per child	Probability to become rich							
				Boys	Girls						
1	Rich polygynous households	1/2	3/2	π_1^μ	π_1^{ϕ}						
2	Poor polygynous households	1/2	$(1+2\omega)/2$	π_2^{μ}	π^{ϕ}_2						
3	Rich couples	1	2	π^{μ}_{3}	π^{ϕ}_{3}						
4	Rich/poor couples	1	$1+\omega$	π_4^{μ}	π_4^{ϕ}						
5	Poor couples	1	2ω	π_5^{μ}	π_5^{ϕ}						
6	Divorcing rich couples	1	2-d	π_6^{μ}	π_6^{ϕ}						
7 8	Divorcing rich/poor couples Poor single males	1	$1 + \omega - d$	π_7^{μ}	π_7^{ϕ}						

TABLE 1 Different family types

We assume that social mobility, *i.e.* the probability that each child at time t has of becoming a rich adult in t + 1, depends on parental resources (time, income) that children belonging to the same household have access to. In fact, parental resources are crucial to socialize, educate, and transfer assets and knowledge to the children. In turn, parental resources per child depend on marriage institutions, and the implied marriage-market outcome.

There can be eight possible types of families, among which seven have children, as reported in Table 1. We start by computing, for each type of family, the fraction of paternal time and income per child, and define the implied probability to become rich, for boys and girls belonging to the same type of family. This amounts to set the 14 parameters (*i.e.* π_{κ}^{ι} , for $\iota = \phi, \mu$ and $\kappa = 1, ..., 7$), listed in the last two columns of Table 1, which fully characterize the social mobility pattern of our model.

Emphasizing the role of paternal resources per child implies that, keeping fixed the characteristics of the father, children raised in polygynous households may have a lower probability of becoming rich, since men who marry multiple wives father more children. Indeed, the fact that polygyny might be harmful for child outcomes seems to be confirmed by several empirical studies. For instance, in contemporary Africa, children raised in polygynous households have poorer nutrition (Sellen, 1999; Hadley, 2005) and face higher mortality rates (Defo, 1996; Strassmann, 1997; Omariba and Boyle, 2007), a result similar to that obtained by Heath and Hadley (1998) for the 19th-century Mormons in Northern America.

The dynamic function mapping (μ_t, ϕ_t) into (μ_{t+1}, ϕ_{t+1}) depends on the marriage regime in place at time *t*, and the resulting equilibrium marriage pattern. In particular, in the **P** and **S** regimes, social mobility depends on which of the three alternative cases is relevant. The dynamic function is, therefore, a piecewise function with switches between seven different domains. The first equation of the dynamic system is given by:

$$\mu_{t+1} = \begin{cases} \phi_t \pi_1^{\mu} + (2\mu_t - \phi_t) \pi_2^{\mu} + (1 - 2\mu_t) \pi_5^{\mu} & \text{if } \mathbf{P} \text{ and } \mu_t < 1/2 \\ (1 - 2\mu_t + \phi_t) \pi_1^{\mu} + (2\mu_t - 1) \pi_3^{\mu} + (1 - \phi_t) \pi_2^{\mu} & \text{if } \mathbf{P} \text{ and } \frac{1}{2} \le \mu_t < \frac{1 + \phi_t}{2} \\ \phi_t \pi_3^{\mu} + 2(1 - \mu_t) \pi_2^{\mu} + (2\mu_t - 1 - \phi_t) \pi_4^{\mu} & \text{if } \mathbf{P} \text{ and } \mu_t \ge \frac{1 + \phi_t}{2} \\ \phi_t \pi_3^{\mu} + (\mu_t - \phi_t) \pi_4^{\mu} + (1 - \mu_t) \pi_5^{\mu} & \text{if } \mathbf{M} \\ \phi_t [p \pi_3^{\mu} + (1 - p) \pi_6^{\mu}] + (\mu_t - \phi_t) \pi_4^{\mu} + (1 - \mu_t) \pi_5^{\mu} & \text{if } \mathbf{S} \text{ and } (a) \\ \phi_t [p \pi_3^{\mu} + (1 - p) \pi_6^{\mu}] + (\mu_t - \phi_t) [p \pi_4^{\mu} + (1 - \mu_t) \pi_5^{\mu} & \text{if } \mathbf{S} \text{ and } (b) \\ \phi_t [p \pi_3^{\mu} + (1 - p) \pi_6^{\mu}] + (\mu_t - \phi_t) \pi_7^{\mu} + (1 - \mu_t) \pi_5^{\mu} & \text{if } \mathbf{S} \text{ and } (c) \end{cases}$$

The second equation is similar, with ϕ_{t+1} instead of μ_{t+1} and π^{ϕ} instead of π^{μ} .

Parameters for the numerical example										
$v(\cdot)$	$\ln(\cdot)$	р	0.333	π_1^{μ}	1	π_1^{ϕ}	1	π_6^{μ}	1	
ω	0.15	z	0.3	π_2^{μ}	0.5	π_2^{ϕ}	0	π_6^{ϕ}	0.99	
g	2	m	0.55	$\pi_3^{\overline{\mu}}$	1	$\pi_3^{\overline{\phi}}$	1	π_7^{μ}	0.9	
b	1	d	0.65	$\pi^{\mu}_{\scriptscriptstyle A}$	0.99	π_{4}^{ϕ}	0.03	π_7^{ϕ}	0.025	
		S	0.04	π_5^{μ}	0.07	π_5^{ϕ}	0.015	,		

TABLE 2 arameters for the numerical examp

We are not going to provide a general characterization of the dynamics, but rather display one parametric example that highlights some important properties of our model. To build this example, we first assume that consumption utility is described by a logarithmic function $v(y) = \ln(y)$. Table 2 lists the whole set of parameter values, which meet the parametric restrictions upon which our Propositions (in Sections 3 and 4) are based. The threshold \bar{p} , defined in condition (6), is equal to 0.236. Hence, our parametrization implies that condition (6) holds, thus ensuring that individual preferences are correctly summarized by Figure 5.

As mentioned above, the parameter values that we have chosen to describe social mobility imply that the probability that a given child has of becoming rich depends upon both paternal time and the lifetime income of her family, divided by the number of children living in the same household.³⁴ As a consequence, polygyny hampers overall social mobility, as the resources of single males cannot be transferred to the next generation, as well as divorce, which subtracts resources from divorced parents.

Notice that our parametrization implies full inter-generational persistence at the top of the social ladder: the children of rich polygynous households $(\pi_1^{\mu}, \pi_1^{\phi})$ and rich couples $(\pi_3^{\mu}, \pi_3^{\phi})$ are certain to be rich when adult. As far as other household types are concerned, we assume that a girl has always a lower probability than her brother of becoming rich, which ensures that Assumption 1 holds all along the dynamic path of our model economy. Divorce has a cost in terms of social mobility, especially for girls: $\pi_6^{\phi} < \pi_3^{\phi}$ and $\pi_7^{\phi} < \pi_4^{\phi}$. It is better, however, for children to be raised in a divorcing rich/poor couple than in a poor polygynous household, $\pi_7^{\mu} > \pi_2^{\mu}$ and $\pi_7^{\phi} > \pi_2^{\phi}$, as they can spend more time with their father. Our parametrization also implies that a boy has a very low probability (*i.e.* ≤ 0.1) to become rich, only if none of his parents is rich (π_5^{μ}) . On the contrary, it suffices that one of her parents is poor, for a girl to have very low chances to become rich $(\pi_2^{\phi}, \pi_4^{\phi}, \pi_5^{\phi} \text{ and } \pi_7^{\phi})$.

The difference between boys and girls reflected by our parameter values may have several justifications. For instance, the sociological literature shows that gender segregation in occupations is a key determinant of the gender-biased distribution of social class destinations, even in the absence of gender differences in educational attainment (see Gundert and Mayer (2012), for a European example). At earlier stages of development, as documented by the World Bank (2012), there is evidence of strong biases in favour of boys, as far as education, health, assets, and the transmission of wealth are concerned. In particular, consistent with our parametrization, the education gender gap (within countries) is often a \cup -shaped function of family income. Note also that Tertilt (2006) reports evidence of a large and persistent gender gap in literacy for polygynous countries, a fact that justifies the very low probabilities assigned to girls raised in poor polygynous

^{34.} Alternatively, the parameters describing intergenerational social mobility may be generated by a function having paternal time and resources per child as arguments. The values listed in Table 2 are compatible with a function monotonically non-decreasing in its two arguments, since for instance $\pi_3^t > \pi_2^t$, for $\iota = \phi, \mu$.



Dynamics with $\chi = \theta = 1$: **P** (light grey), **M** (grey), **S** (darker grey)

households and poor couples (*i.e.* the two most common family types under polygyny, according to Figure 2).

We are now ready to characterize the dynamic behaviour of our model, depending on political weights. We start our analysis with the case of equal weights.

5.2. Dynamics with $\chi = \theta = 1$

Once we set the other parameter values as in Table 2, assuming that $\chi = \theta = 1$, we can draw the different regions in the $\{\mu_t, \phi_t\}$ space. The left panel of Figure 7 shows the **P**, **M**, and **S** regions that correspond to those in the left panel of Figure 6. If the rich are a majority ($\mu_t + \phi_t > 1$), there is a very thin region in which a Condorcet winner fails to exist.

In the middle panel of Figure 7, the arrows indicate the direction of change $(\mu_t \mapsto \mu_{t+1}, \phi_t \mapsto$ ϕ_{t+1}) as a function of (μ_t, ϕ_t) . In the **P** regime (*i.e.* when polygyny is the political equilibrium), the arrows point to the right, indicating that the share of rich males increases over time, whereas the share of rich females remains about constant. Under polygyny, household resources have to be divided among a large number of children, and this hampers the social mobility of females. In the M regime, the arrows point to the northeast. In fact, monogamy favours the social mobility of females, since daughters from rich/rich couples are almost certain to become rich, whereas daughters from a rich/poor couple still have a probability of 3% of becoming rich. The S regime is less conducive to (male) social mobility than the M regime, since the divorce $\cot d$ is subtracted from parental resources. The arrows show that, for our numerical example, the steady state is located in the serial monogamy regime.

The result that polygyny is detrimental to the accumulation of productive resources can also be found in Tertilt (2005, 2006) and Edlund and Lagerlöf (2012). According to Tertilt (2005, 2006), shifting to, and/or enforcing, monogamy increases savings and output per capita. Edlund and Lagerlöf (2012) highlight the intergenerational conflict inherent to polygyny, where young and old(er) men compete for (possibly multiple) wives. The young men who remain unmarried do not have children, and therefore do not contribute to the inter-generational transmission of human capital, thus slowing down the growth process. The positive effect of monogamy on poor females' social mobility is also consistent with the idea that the enforcement of monogamy brought about by Christianity hastened progress towards a better status of women in the great bulk of the population (Russell, 1929).

Starting from initial conditions $\mu_0 = 0.03$ and $\phi_0 = 0.029$, we draw the dynamic path of (μ_t, ϕ_t) on the right panel of Figure 7. We take $\mu_0 = 0.03$ so as to be consistent with the historical



evidence of Section 2.2, according to which the (male) elite accounted for about 3% of total (male) population, at the onset of the Urban Revolution (about 1000 CE). The economy starts off in the polygyny regime. As the share of rich males increases, the marriage regime eventually switches to monogamy. Monogamy promotes the social mobility of females, so that the proportion of rich individuals increases for both genders. When the rich become a majority, divorce is introduced and serial monogamy emerges as a political equilibrium. The dynamics asymptotically converge to a steady state with high shares of rich males and females. The simulated time paths of μ_t and ϕ_t , as well as the dynamics of family types, are reported in Appendix 2, available as Supplementary Material.

Let us now highlight that the first subset of parameters (left part of Table 2) essentially determines the frontiers between the regimes arising as political equilibria. As the theoretical analysis of Section 4 indicates, the shape of these frontiers is robust to the specific parameter values, provided that they satisfy the conditions, such as condition (7), specified in our main propositions. In particular, **M** emerges as an intermediate regime. The second subset of parameters (right part of Table 2) does not affect the frontiers between regimes, but influences the dynamics of the model and are key to determine in which regime the steady state is located. For example, if the poor have very little social mobility, the **P** regime is likely to be a steady state. Appendix 2, available as Supplementary Material, develops a more detailed robustness analysis.

5.3. Dynamics with $\chi = \theta = 0$, and progressive enfranchisement

In contrast with the previous example with $\chi = \theta = 1$, we now consider the case in which $\chi = \theta = 0$, *i.e.* political power is concentrated in the hands of rich males, whereas poor and females do not have any political representation, not even mediated by institutions such as the Church. The map of equilibrium regimes thus reproduces rich males' preferences, as described by the second panel of Figure 5. Figure 8 shows the voting outcome, under the same parameter values as Table 2. Here, **P** prevails for a broad range of (μ_t, ϕ_t) values. On the same chart, we also report arrows

indicating the direction of change $(\mu_t \mapsto \mu_{t+1}, \phi_t \mapsto \phi_{t+1})$ as a function of (μ_t, ϕ_t) . Starting from the same initial conditions as in the $\chi = \theta = 1$ case, the first phase of the dynamics is identical, with the share of rich males increasing over time. However, as the poor and the females have no say on marriage institutions, we do not observe the switch from **P** to **M**. Polygyny continues to prevail despite the (changing) preferences of females. The dynamics converge to a point where the shares of rich males and rich females are about 55% and 10%, respectively.

Our theoretical framework (and the results of Section 4) can also be used to analyse the consequences of progressive enfranchisement (of lower-status men, and—later on—women) for the evolution of marriage institutions. This analysis if provided in Appendix 3, available as Supplementary Material. We show there that our model is compatible with the idea that the two transitions, from \mathbf{P} to \mathbf{M} , and from \mathbf{M} to \mathbf{S} , could have been sparked by the progressive increase of political power, first of poor males and, more recently, of women.

6. ENDOGENOUS TRANSFERS

Our model is based on the assumption that, within a couple, resources are shared according to an exogenous rule. This implies that agents with the same characteristics may attain different levels of utility at equilibrium. For instance, only a fraction of poor women marries up in equilibrium, while others have a poor husband, and these (identical) women are not indifferent between the two outcomes. If endogenous transfers were allowed, women in the worse situation could pay rich men to be their husband, and at equilibrium identical women would all derive the same utility. One could, therefore, wonder whether our main findings are preserved with equilibrium transfers.

To address this issue, in Appendix B we let the distribution of consumption between spouses be determined at equilibrium—together with a stable assignment on the marriage market—by means of the Becker-Shapley-Shubik algorithm (as defined by Browning, Chiappori, and Weiss, 2014), which maximizes total marriage output.

Dealing with endogenous transfers implies several modelling difficulties. In particular, market-clearing transfers and marriage patterns are often undetermined, especially under monogamy and serial monogamy. Such indeterminacy complicates the characterization of the political equilibrium and prevents us from studying the dynamics of group sizes.³⁵

We can show, however, that most results of the main model still hold once we recast our analysis to allow for equilibrium transfers. In particular, (i) the equilibrium marriage patterns described in Section 3 can also be supported by market-clearing transfers, and (ii) although some groups rank differently the three alternative marriage regimes, the transition $\mathbf{P} \to \mathbf{M} \to \mathbf{S}$ can still be driven by increases in μ_t and/or in ϕ_t .

As far as political preferences are concerned, Appendix B shows that individual preferences over S versus M are not affected by endogenous transfers, whereas the way agents rank P is. Under polygyny, for instance, women are in short supply and can then extract a bigger rent from marriage. Therefore, P is always the most preferred regime of poor females, whereas rich females always prefer P to M. Conversely, under polygyny rich men pay a higher price for wives (because of increased competition), and their position deteriorates as their relative number increases. When $\mu_t > 1/2$, not all rich men can be polygynous and their utility is pinned down by that of those who marry only one wife. Therefore P, which can still be the best option for rich males if they are a minority, becomes their least preferred regime as soon as $\mu_t > 1/2$. As far as poor males are concerned, they prefer M to S, and S to P for any state of the economy.

35. With a balanced sex ratio, as shown by Anderson (2003, 2007) among others, there is a whole range of possible values for the equilibrium price, which may be a bride price or a dowry.

As shown in Appendix B, for $0 < \mu_t < 1/2$, **P** can emerge as a political equilibrium, supported by a coalition formed by poor females and rich males (assuming equal political weights). For $1/2 < \mu_t < 1 - \phi_t$, only **M** can be a Condorcet winner. As soon as $\mu_t > 1 - \phi_t$, **S** becomes the political equilibrium; the preferences of the rich, who are now the majority, are key for the last regime switch.

Similar to the benchmark model, with endogenous transfers the whole transition $\mathbf{P} \rightarrow \mathbf{M} \rightarrow \mathbf{S}$ can be driven by increases in μ_t and/or in ϕ_t . An important difference, however, concerns the emergence of monogamy, which—different from Section 4—no longer relies on the pivotal role of poor females, and must rather be explained by a change in rich males' preferences. This is due to the traditional Beckerian argument, according to which polygyny redistributes utility away from men towards women, through market-clearing transfers.

The framework with equilibrium transfers may not be, however, the most appropriate to deal with our specific research question, although we in principle agree with Becker (1993), according to whom "models that assume a rigid division of income greatly underestimate human ingenuity and experience in making the terms of marriage flexible and responsive to market conditions" (p. 129). In fact, social norms and traditions often regulate within-family allocations and limit the scope for market-clearing transfers. This could have been the case, for instance, of the Western European society before 1200 CE, when polygyny was practiced, but not regulated by enforceable marriage contracts. More in general, as argued by Legros and Newman (2007), there may exist rigidities that prevent partners from costlessly dividing the gains from a match, due to limited insurance possibilities, incentive or enforcement problems. Such rigidities may also characterize the marriage market. If this is the case, the best possible model of the marriage market would combine elements of the two approaches (endogenous and exogenous transfers).

7. CONCLUSION

Marriage institutions have greatly changed over time, evolving from polygyny to monogamy, and then to serial monogamy (as defined by divorce and remarriage). We propose a unified theory of such institutional changes, where social-class dynamics are the driving force.

Using a politico-economic framework, we show that a rise in the share of rich males can explain the first regime change from polygyny to monogamy. This shift occurs because, when the number of rich males is high enough, poor females have a chance of marrying monogamously, and stop supporting polygyny. The introduction of serial monogamy follows from a further enrichment of the society, through a rise in either the share of rich males, or the proportion of rich females. The prevailing marriage institution is key in determining social mobility, since children's human capital depends on their parents' marriage decisions. Without ruling out the option of divorce and remarriage, our theory reconciles the female choice and the male compromise theories of monogamy, since both female and male preferences concur to determine the marriage regime chosen by the society at a given time.

We link the first transition to the Urban Revolution (1000–1300 CE), which in Europe saw cities develop, and the elite, initially composed by lords and bishops, expand to include rich merchants and successful entrepreneurs. The second transition is related to the spread of education (to women), which acted as one of the main engine of the growth take-off.

We conclude by stressing three original implications of our set-up. First, polygyny may emerge as a political equilibrium in a democracy, provided that the share of rich males and rich females are either low or close enough. In such a case, polygyny is the only way poor females can aspire to marry a rich husband. Hence, polygyny may well survive democratization, provided that the distribution of income changes slowly. Secondly, monogamy arises as an intermediate regime and makes the transition towards serial monogamy faster. In fact, unlike polygyny, monogamy allows using all the human resources of the economy to educate children, and therefore, promotes female social mobility. This mechanism characterizes monogamy as a precondition for serial monogamy, and explains why a direct transition from polygyny to its inter-temporal version did not occur.

Finally, we provide the first political economic model of the introduction of divorce laws. Serial monogamy is not just an inter-temporal version of polygyny, whereby some males mate with more than a single female through repeated divorce and remarriage, but also benefits females who can get rid of a bad match. As divorce is costly, serial monogamy is likely to arise when the rich are numerous enough.

APPENDIX A

A. PROOFS

A.1. Proof of Lemma 1

Let us first rule out singleness as an alternative to lasting marriages. In the case of monogamy, rich persons prefer a marriage with a poor person to singleness if

$$u_p > v(2) - v(1+\omega).$$
 (A.1)

If the above condition holds, a rich person would agree to marry a poor person: by doing so, he trades the relationship utility gain u_p against the individual consumption-utility loss $v(2) - v(1 + \omega)$. This would hold in particular, if the utility gain from a relationship that has turned bad is still large (*e.g.* if it is very important to have children). Poor males and poor females also agree to marry each other, as $u_p > 0$.

Since male utility is increasing in the number of relationships, condition (A.1) is also sufficient to rule out male singleness under polygyny, For women, we need to impose a condition on the jealousy cost *m*. The worst-case marriage for a rich female would be a polygynous marriage, in which she shares a poor husband with a poor female. As we will see later, such a configuration cannot arise in equilibrium: rich females always have a rich husband, possibly shared with another rich female. The condition for a rich female to prefer a marriage arrangement of this kind to remaining single is $u_p > m$, which also implies that poor females never choose to remain single since, unlike rich females, they always benefit from income pooling.

Consider now the possibility of divorce. In general, this makes singleness less attractive, because divorce allows individuals to replace an unhappy marriage with a new one. However, divorce may also justify strategic singleness. For instance, a rich male matched with a poor partner in the first subperiod may want to stay single and wait until the second subperiod for a match with a wealthier (*i.e.* divorced rich) person. Such a strategy would avoid him paying the cost of divorce. For a rich male to prefer marrying a poor female to being single for one subperiod, and then marrying a rich wife (which is the best possible case) we need:

$$u_p + v(1+\omega) > g + v(2).$$
 (A.2)

Inequality (A.2) implies (A.1).

Poor males and rich females cannot improve over the equilibrium assignment. Poor females, instead, may find a rich male in the second subperiod. For them to prefer marrying a poor male to being single for one subperiod, and then marry a rich husband we need

$$u_p + v(2\omega) > g + v\left(\frac{3\omega + 1}{2}\right). \tag{A.3}$$

Gathering conditions (A.1) to (A.3), we obtain condition (1).

A.2. Proof of Lemma 2

The first part of the Lemma can be proved by contradiction. Suppose there are (at least two) mixed polygynous households. Then, the husband has an incentive to replace his poor wife with a rich one. His rich wife would also be better off, since she would enjoy a more favourable resource pooling. Any other rich female involved in similar mixed polygynous households would be ready to serve as replacement. It is then possible to find a pair of individuals of opposite sexes who would prefer to marry each other than keep their current assignment, which would violate Definition 2. This means that, under polygyny, there might be at most one mixed polygynous household, which is of measure zero in our continuous setting.

That only rich males may be polygynous can also be proved by contradiction. First suppose that one poor male has two rich wives. By Assumption 1, this means that there is a rich male who is either single or married with poor wives. This rich man, and the two wives of the poor male, would all improve their utility by forming a rich polygynous household. Suppose instead that one poor male is married to two poor females. This implies that there is at least one single male in the economy. Regardless of his income, marrying this man would always increase the utility of the wives of the polygynous poor male. Hence, the current assignment would not satisfy Definition 2.

A.3. Proof of Proposition 1

Let us consider the three possible cases mentioned in the proposition, one at a time. Recall that, at equilibrium, no two persons of opposite sex should have an incentive to break their marriages to form a new one together.

Suppose $\mu_t < 1/2$: in such a case, every rich man can potentially marry two wives. If this is the case, mixed polygynous households—involving one rich and one poor wife—cannot arise in equilibrium, since a rich woman, who is part of a mixed polygynous household, would have an incentive to replace a poor wife of another mixed polygynous household (so as to form a rich polygynous household), and the husband and the other rich wife would agree to accept her in their household (Lemma 2). Moreover, no rich female (and *a fortiori*, no poor woman) can convince a rich man to form a monogamous marriage, since by condition (3) rich men prefer two poor wives to one rich wife, and their relative scarcity ($\mu_t < 1/2$) allows them to get two wives. Condition (2) further ensures that all rich men have polygynous households, since both types of women would rather be the second wife of a rich man than the only wife of a poor man. The remaining $1-2\mu_t$ poor women (who are not part of rich polygynous households) marry a poor husband, monogamously. Residually, there must be μ_t poor single males at equilibrium.

Suppose instead $1/2 \le \mu_t < (1 + \phi_t)/2$: in such a case, although rich men monopolize all available women, there are not enough women for all rich men to marry polygynously. As a consequence, and in contrast with the previous case, some rich women manage to marry monogamously. In particular, if the second part of condition (2) holds, all poor women are available to marry a rich husband polygynously. Given Lemma 2, this means that $(1 - \phi_t)/2$ poor polygynous households are formed at equilibrium. The remaining rich men can form either rich polygynous households or rich couples $((1 - 2\mu_t + \phi_t)/2 \text{ and } 2\mu_t - 1$, respectively). Thus, given conditions (3) and (2), and Lemma 2, this equilibrium is Gale–Shapley stable.

Finally, if $\mu_t \ge (1 + \phi_t)/2$, rich men are still numerous enough to monopolize all women, but the relative scarcity of rich females allows all these women to marry monogamously. By consequence, we have ϕ_t rich couples. The remaining $\mu_t - \phi_t$ rich men are now less than half of the population of poor females. This implies that some of these women $(2\mu_t - 1 - \phi_t)$ end up being the only wife of a rich husband, whereas the remaining $2(1 - \mu_t)$ join poor polygynous households. As in the previous case, there are μ_t poor single males at equilibrium.

A.4. Proof of Proposition 3

If condition (1) holds, nobody wants to remain single. In particular, with only poor females left on the market, rich males do not prefer to wait and remain single.

Following the same arguments as in the proof of Proposition 2, serial monogamy coincides with monogamy for the first subperiod.

Condition (4) implies that unhappy rich females always divorce, whereas unhappy poor females married to poor males never divorce. In fact g-b, *i.e.* the relationship utility gain from remarriage, is larger (smaller) than the consumption utility loss implied by the divorce cost, for rich (poor) couples.

Therefore, for rich females married to rich males, it is always worthwhile to pay the cost of divorce *d*, if their marriage is unhappy. On the contrary, if their marriage is happy, they have no gain from divorce. All this is *a fortiori* true for their rich husbands, who face the additional risk of marrying down in the second subperiod. Hence, (*i*), (*ii*), and (*iii*) hold.

For poor females married to poor males, divorce is too costly to be optimal, even if they are unhappy and they are certain to marry a rich male in the second subperiod. This is *a fortiori* true for poor males, who have no hope of finding a rich partner after divorce. Hence, no marriage between poor persons will end up in divorce, and *(iv)* holds.

As far as marriages between rich males and poor females are concerned, there are three possibilities, since (rich) husbands face different incentives depending on the state of the economy (μ_t, ϕ_t) . In case (a), rich males do not divorce even if their marriage is unhappy, as the probability of remarrying up is not high enough to compensate for the cost of divorce. Since $v(1+\omega) > \overline{v}_t$ implies $v(1+\omega) > v(1+\omega-d)+g-b$, their poor wives do not want to divorce either. In case (b), *d* is sufficiently low to justify the break up of an unhappy marriage, but high enough to prevent rich males from ending a happy marriage in quest of a richer partner. Under case (c), rich males always divorce from a poor partner.

A.5. Proof of Lemma 3

Consider first $(\mu_t, \phi_t) \rightarrow (0, 0)$. In such a case,

$$\lim_{\mu_t \to 0, \phi_t \to 0} W_{pf}^P = \lim_{\mu_t \to 0, \phi_t \to 0} W_{pf}^M = \lim_{\mu_t \to 0, \phi_t \to 0} W_{pm}^P = \lim_{\mu_t \to 0, \phi_t \to 0} W_{pm}^M = u_p + v(2\omega)$$

If instead $(\mu_t, \phi_t) \rightarrow (1, 1)$, we have

$$\lim_{t_t \to 1, \phi_t \to 1} W_{rf}^P = \lim_{\mu_t \to 1, \phi_t \to 1} W_{rf}^M = \lim_{\mu_t \to 1, \phi_t \to 1} W_{rm}^P = \lim_{\mu_t \to 1, \phi_t \to 1} W_{rm}^M = u_p + \nu(2).$$

A.6. Proof of Lemma 5

(A): Condition (3) implies that rich men always prefer **P** to **M**.

(B): The expression for \tilde{p} can be obtained by solving $W_{rm}^{S} = W_{rm}^{M}$. As soon as the probability of their marriage going bad is sufficiently high $(p < \tilde{p}(\mu_t, \phi_t))$, rich men expect a higher utility when the option of divorce is available.

(C): Consider the two extreme situations $(\mu_t, \phi_t) \to (0, 0)$ and $(\mu_t, \phi_t) \to (1, 1)$. First, when there is only one rich man (and no rich women, by Assumption 1), **S** coincides with **M**, as there is *de facto* no remarriage possibility for the rich. Hence, as a rich man prefers **P** to **M**, he also prefers **P** to **S**. Secondly, if $(\mu_t, \phi_t) \to (1, 1)$, we have that $\lim_{\mu_t \to 1, \phi_t \to 1} W_{rm}^S > \lim_{\mu_t \to 1, \phi_t \to 1} W_{rm}^B$ if $p > \tilde{p}(1, 1)$, as **P** and **M** coincide. It can be checked that $\tilde{p}(1, 1) = s/(v(2-d) - v(2) + (g-b)) = \hat{p}(\hat{p})$ was first defined in equation 5). Therefore, if $p > \hat{p}$, it is possible to identify a threshold function $\mu^{\diamond}(\phi_t)$, such that rich men prefer **S** over **P** for values of μ_t and ϕ_t belonging to the region between $\mu_t = \mu^{\diamond}(\phi_t)$, $\mu_t = 1$, and $\mu_t = \phi_t$.

B. THE MODEL WITH EQUILIBRIUM TRANSFERS

If transfers between spouses are endogenous, the equilibrium assignment on the marriage market can be determined by means of the Becker–Shapley–Shubik algorithm (as defined by Browning, Chiappori, and Weiss, 2014). We first study the equilibrium of the marriage market under each of the three alternative regimes, starting with monogamy, as it will make easier to understand the more complex cases of polygyny and serial monogamy. We then draw implications for (the aggregation of) individual preferences and the dynamics.

B.1. Marriage-market equilibrium

Consistent with our basic model, we assume that there is no public good produced within the household, and thus the only reason that justifies marriage is the possibility to enjoy the relationship utility, which does not depend on individual traits (*i.e.* income).³⁶

Participants into the marriage market prefer to marry if, and only if, their utility from marriage exceeds their utility from remaining single. Therefore, if this is necessary to get married, they are ready to make a transfer to their spouse. Let τ be a payment going from the husband to the wife. Transfers can be as high as τ_{ij}^k , *i.e.* the transfer that, under regime k=M,P,S, would make a person of gender j=m,f, from income group i=r,p, exactly indifferent between marrying and staying single (at equilibrium, those who remain single have at least as high a utility as they could attain by marrying).

B.1.1. Monogamy. Under monogamy, the maximum transfer τ_{rm}^M that rich males would be ready to make is given by the value of τ which solves $u_p + v(2-\tau) = v(2)$. Similarly, in the case of poor males, τ_{pm}^M can be determined solving $u_p + v(2\omega - \tau) = v(2\omega)$. If we consider females, τ_{rf}^M and τ_{pf}^M solve $u_p + v(2+\tau) = v(2)$ and $u_p + v(2\omega + \tau) = v(2\omega)$, respectively. Note that $\tau_{rf}^M < 0 < \tau_{pm}^M < \tau_{rm}^M$, $\tau_{rf}^M = -\tau_{rm}^M$ and $\tau_{pf}^M = -\tau_{pm}^M$.

The equilibrium transfer τ^{M*} , *i.e.* the price that clears the marriage market, depends on the relative number of men and women on the market.³⁷ If we assume, as in the model without transfers, that there are as many females

36. Introducing complementarity in traits would induce assortative matching on the marriage market.

37. The marriage market can be described in terms of demand and supply curves for wives. Recalling that the size of both groups (females and males) is normalized to 1, we have that for $\tau > \tau_{mn}^{M}$, the demand for wives is equal to 0. It jumps to μ_t for $\tau_{pm}^M < \tau \le \tau_m^M$ since, as soon as $\tau = \tau_{mn}^M$, rich males are ready to make a transfer to their prospective wives. The demand for wives then reaches 1 when the price of a wife becomes accessible also for poor men, *i.e.* if $\tau < \tau_{pm}^M$. On the contrary, the supply of wives is 0 if $\tau < \tau_{rf}^M$, since no woman is rich enough to pay such high prices for a husband. It amounts to ϕ_t for $\tau_{rf}^M \le \tau < \tau_{pf}^M$, because for those values of the transfer only rich females could afford a husband. The supply of wives eventually becomes equal to 1, as soon as $\tau > \tau_{pf}^M$: at that point all females would be available as potential wives.

as males, indeterminacy arises.³⁸ We can only say that $\tau_{pf}^M \le \tau^{M*} \le \tau_{pm}^{M.39}$ As a consequence, we can claim the following.

Proposition 10. Under monogamy, the marriage pattern arising in the benchmark model (Proposition 2) is an equilibrium with endogenous transfers.

Proof Due to the irrelevance of individual traits (income) for the marriage outcome (u_p) , the indeterminacy problem applies not only to the equilibrium transfer but also to the equilibrium marriage pattern (who marries whom). As a consequence, the assignment arising in the baseline model is also a possible equilibrium when the sharing rule is endogenous.

For the assignment described in Proposition 2 to be the only possible equilibrium with endogenous transfers, we need the marriage surplus function $(u_p, \text{ in our case})$ to be super modular, *i.e.* $u_p^{rr} + u_p^{pr} \ge u_p^{rp} + u_p^{pr}$. We may, for instance, assume that p, the probability that a marriage deteriorates, is a function of the respective incomes of the two spouses, so that $u_p^{rr} > u_p^{rp} = u_p^{pr} \ge u_p^{pr} \ge u_p^{pp}$. Maximizing the surplus of marriage leads to positive assortative matching, with ϕ_t rich/rich, $\mu_t - \phi_t$ rich/poor, and $1 - \mu$ poor/poor marriages. It is not possible, however, to overcome the indeterminacy of equilibrium transfers.⁴⁰

B.1.2. Polygyny. Assuming that polygyny (up to two wives, as in the benchmark model) is allowed, polygynous marriages can occur only if rich men are willing to pay for a second wife more than poor males for a first wife. For this to be the case, we need $\tau_{2,rm}^{P} > \tau_{1,pm}^{P}$. We have added the subscripts 1 and 2 because, under polygyny, monogamous and polygynous marriages do not necessarily imply the same transfer. In particular, $\tau_{2,rm}^{P}$ is the value of τ which solves

$$(1+z)u_p + v(2-2\tau) = u_p + v(2-\tau_{1,rm}^P), \tag{B.1}$$

where $\tau_{1,rm}^P$ in turn solves $u_p + v(2-\tau) = v(2)$. By $\tau_{1,rm}^P$ we denote the bride price that would make rich males indifferent between remaining single and marrying monogamously. In equation (B.1) we have assumed that the two wives involved in a polygynous marriage receive the same transfer, as a consequence of their anonymity and interchangeability.⁴¹ Given $\tau_{1,rm}^P$, the transfer $\tau_{2,rm}^P$ (to be paid to both wives) would make rich males indifferent between a polygamous and a monogamous marriage.

As far as poor males are concerned, $\tau_{1,pm}^P$ is the solution to $u_p + v(2\omega - \tau) = v(2\omega)$. Note that $\tau_{1,rm}^P = \tau_{rm}^M$ and $\tau_{1,pm}^P = \tau_{pm}^M$.⁴² As far as wives are concerned, those who will be part of a polygynous household will not cost the same as those who

38. If instead of a balanced sex ratio, we assume that there are more males than females, some (poor) males risk to remain single, and are then ready to transfer the whole surplus they obtain from marriage to their wives, so that $\tau^{M*} = \tau_{pm}^{M}$. Symmetrically, if females outnumber males, the latter would be on the short side of the market and obtain a positive transfer, such that $\tau^{M*} = \tau_{pf}^{M}$ (with u_p super modular, $\tau^{M*,pp}$ is equal to $\tau_{pf}^{M'}(\tau_{pm}^{M'})$ if females are more (less) numerous than males). The literature has identified the cases of a negative and a positive transfer with a dowry and a bride price, respectively.

39. Anderson (2003, 2007) also shows that with a balanced sex ratio, there is a whole range of admissible values for the equilibrium transfer, which may be negative or positive.

40. Suppose that $\tau^{M*,pp}$ is the equilibrium τ for marriages involving two poor persons. Since poor females must be indifferent, at equilibrium, between a rich and a poor husband, the equilibrium transfer for a rich/poor marriage (denoted by $\tau^{M*,rp}$) is the value of τ which solves $v(2\omega+\tau)+u_p^{rp}=v(2\omega+\tau^{M*,pp})+u_p^{pp}$. Moreover, since rich males must be indifferent between a rich and a poor wife, the equilibrium transfer for a rich-rich marriage ($\tau^{M*,rp}$) is given by the value of τ which solves $v(2-\tau)+u_p^{rp}=v(2-\tau)+u_p^{rr}$. It is then clear that, once we know $\tau^{M*,pp}$, all the other equilibrium prices ($\tau^{M*,rp}$) and $\tau^{M*,rp}$) can be computed. With a balanced sex ratio, however, $\tau^{M*,pp}$ can take any value comprised between $\tau_{pf}^{M'}$ and $\tau_{pm}^{M'}$, *i.e.* the transfers that would make poor females and poor males, respectively, indifferent between staying single and marrying a poor partner. In fact, $\tau_{pf}^{M'}$ and $\tau_{pm}^{M'}$ can be obtained as solutions to $v(2\omega+\tau)+u_p^{pp}=v(2\omega)$ and $v(2\omega-\tau)+u_p^{pp}=v(2\omega)$, respectively.

41. According to Anderson (2007), there is evidence suggesting that, in polygynous marriages, brideprice amounts do not vary with the rank of the wife.

42. The demand function for wives behaves as follows. It is equal to 0 when the price of wives is prohibitively high, even for rich males, *i.e.* $\tau > \tau_{1,rm}^{P}$. It is equal to μ for $\tau_{2,rm}^{P} < \tau \le \tau_{1,rm}^{P}$, since only rich men can pay, for one wife only. For $\tau_{1,pm}^{P} < \tau \le \tau_{2,rm}^{P}$, the demand for wives becomes 2μ because rich males can afford a second wife, whereas poor males would still prefer to remain single, rather than paying the full price of a wife. The demand for wives is instead equal to $1 + \mu$ for $\tau_{2,pm}^{P} < \tau \le \tau_{1,pm}^{P}$, and finally becomes 2 if $\tau \le \tau_{2,pm}^{P}$.

are going to marry monogamously. In fact, females who accept to join polygynous households need to be compensated for the jealousy cost *m*, so that they are indifferent between marrying monogamously and being part of a polygynous household. Formally, $\tau_{2,rf}^{p}$ and $\tau_{2,of}^{p}$ must solve

$$u_p + v(2 + \tau_{1,rf}^P) = u_p - m + v(2 + \tau)$$

and

$$u_p + v(2\omega + \tau_{1\,rf}^P) = u_p - m + v(2\omega + \tau),$$

respectively. Since singleness is always a viable outside option, $\tau_{1,rf}^{P} = \tau_{rf}^{M}$ and $\tau_{1,pf}^{P} = \tau_{pf}^{M}$.⁴³ At equilibrium, the number of women who want to marry must equal the total demand for wives. Any equilibrium

At equilibrium, the number of women who want to marry must equal the total demand for wives. Any equilibrium assignment is supported by a pair of prices $(\tau_1^{P*}, \tau_2^{P*})$, such that individuals of the same type (*i.e.* same gender and same income level) attain the same utility, regardless of their marital status. Obviously, females belonging to the same household must receive the same transfer and everybody must be at least indifferent between marrying and staying single.

Females are now necessarily in short supply on the marriage market. Two types of marriage patterns are possible. If $\mu < 1/2$: all rich males take two wives, $1-2\mu$ poor males take only one wife, μ poor males remain single. If instead $\mu > 1/2$: $1-\mu$ rich males take two wives, $2\mu - 1$ rich males take one wife, all poor males remain single. We can then claim the following.

Proposition 11. When polygyny is the constitution and $\tau_{2,rm}^P > \tau_{1,pm}^P$, the marriage pattern arising in the benchmark model (Proposition 1) is an equilibrium assignment with endogenous transfers.

Proof We first prove by contradiction that there is no equilibrium where both types of females are involved in both monogamous and polygynous marriages. If it was the case, the equilibrium vector of transfers $(\tau_1^{P*}, \tau_2^{P*})$ would be determined as a solution of a system composed by the following three equations:

$$\begin{cases} u_p + v(2\omega - \tau_1^P) = v(2\omega) & \text{if } \mu_t < 1/2, \\ (1+z)u_p + v(2-2\tau_2^P) = u_p + v(2-\tau_1^P) & \text{if } \mu_t \ge 1/2 \end{cases}$$
(B.2)

$$(1+z)u_p + v(2-2t_2) = u_p + v(2-t_1)$$
 If $\mu_t \ge 1/2$

$$u_p + v(2 + \tau_1^P) = u_p - m + v(2 + \tau_2^P), \tag{B.3}$$

$$u_p + v(2\omega + \tau_1^P) = u_p - m + v(2\omega + \tau_2^P).$$
 (B.4)

The first part of equation (B.2) ensures that poor males are indifferent between marrying (one wife) and remaining single; it allows us to determine τ_1^{P*} in the case $\mu_t < 1/2$. When $\mu_t \ge 1/2$, the second part of equation (B.2) imposes that rich males (the only who can be polygynous) are indifferent between marrying one or two wives. Equations (B.3) and (B.4) imply that females of the same type (rich and poor, respectively) reach the same utility level, be they married polygynously or monogamously. Equations (B.3) and (B.4) cannot hold simultaneously, implying that a marriage pattern in which both poor and rich females are part of both monogamous and polygynous households cannot be an equilibrium.

Hence, we are left with four possible configurations: (i) rich females marry monogamously and poor females marry polygynously; (ii) poor females marry monogamously and rich females marry polygynously; and (iii) rich females marry monogamously and poor females marry both monogamously and polygynously; and (iv) poor females marry monogamously and rich females marry both monogamously and polygynously; and (iv) poor females marry monogamously and rich females marry monogamously.

Configuration (i) is possible in a knife-edge case where $\mu_t = (1 - \phi_t)/2$. Configuration (ii) is impossible because $\mu_t > \phi_t$. The interesting cases are (iii) and (iv). In such cases, the indifference condition (B.3) or (B.4) needs not hold for the type of women who can only marry monogamously, and should just prefer marriage over singleness.

If $\mu_t < 1/2$, we can determine the vector of equilibrium transfers which supports the same allocation described in Proposition 1. Once we obtain τ_1^{P*} as a solution to the first part of equation (B.2), we can replace $\tau_1^P = \tau_1^{P*}$ in equation (B.4), solve it for τ_2^P , and find τ_2^{P*} .

If $\mu > 1/2$, poor males never marry since $\tau_{2,rm}^P > \tau_{1,pm}^P$, as in the benchmark model. Configurations (i) and (ii) are now both impossible since μ_t is larger than 1/2. Case (iii) reproduces the equilibrium assignment of the benchmark when $\mu_t \ge (1+\phi_t)/2$ (with $2\phi_t$ rich couples, $1-\mu_t$ poor polygynous households, $2\mu_t - 1 - \phi_t$ rich/poor couples, and $1-\mu_t$ poor single males), while case (iv) reproduces the marriage pattern of the benchmark when $1/2 \le \mu_t \le (1+\phi_t)/2$ (with $(1-2\mu_t+\phi_t)/2$ rich polygynous households, $2\mu_t - 1$ rich couples, $(1-\phi_t)/2$ poor polygynous households, and $1-\mu_t$ poor single males). Solving the system composed by equations (B.2)–(B.4), we can find the vector of equilibrium transfers compatible with case (iv).

43. The supply of wives involved in a monogamous marriage behaves as described in the previous section. In particular, the supply of wives is 0 if $\tau < \tau_{1,rf}^{P}$, ϕ_t for $\tau_{1,rf}^{P} \le \tau < \tau_{1,rf}^{P}$, and 1 if $\tau > \tau_{1,rf}^{P}$.

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B.1.3. Serial monogamy. Dealing with endogenous transfers in a set-up where people can divorce and remarry requires a series of assumptions and modelling choices. One needs to specify, for instance, the share of the initial transfer that will be paid back in case of divorce. The problem of strategic singleness must also be addressed. Agents may in fact choose to remain single in the first subperiod, and enter the marriage market only in the second one. They may also decide not to remarry after divorce. Finally, one needs to choose whether women are anonymous or, instead, a poor male is willing to pay more for a poor wife, who is less likely to divorce.

Specifying a full-fledged model of divorce and remarriage with equilibrium transfers would probably deserve a paper in itself. Here, we can sketch some characteristics that such a model necessarily displays. First, as equilibrium transfers do not depend on the spouses' income, the willingness to divorce does not depend either on the income of the partner, or on the chance to marry up in the second subperiod. This stands in contrast with the benchmark model, since μ_t and ϕ_t no longer matter to determine the divorce choice of poor females. Secondly, divorce remains a superior good, benefiting the rich more than the poor. Thirdly, if we assume, as we did in the model without transfers, that there are as many females as males, indeterminacy arises, and we can only say that the equilibrium transfer satisfies $\tau_{pf}^S \le \tau^{S*} \le \tau_{pm}^S$, where τ_{pf}^S , and τ_{pm}^S depend on the specifics of the model.

Let us take a simple case to illustrate the point. Assume that half of the equilibrium transfer determined on the (lifetime) marriage market and paid at the beginning of the first period can be returned, in case of divorce, at the beginning of the second period. This money can then be used to "pursue" a new wife or husband on the secondary market, which involves only divorced people.⁴⁴ Let us also abstract from strategic singleness.

To ensure that all individual behaviours are time consistent, we suppose for simplicity that people can stipulate from the beginning not to divorce, and marriage contracts are fully enforced. In that case, the transfer paid is denoted by τ_I^{S*} . If instead spouses leave their marriage open to the possibility of divorce, the transfer is denoted by τ_I^{S*} . The equilibrium vector of transfers is $(\tau_I^{S*}, \tau_{II}^{S*})$. This modelization implies that the transfer received after remarriage is fixed by contract. A divorced woman, for instance, returns to her first husband $\tau_{II}^{S*}/2$ at the beginning of the second subperiod, but receives the same amount of money from her second husband, so that her lifetime transfer is τ_{II}^{S*} . A man who subscribes a marriage contract open to divorce, paying τ_{II}^{S*} to his wife at the beginning of the first subperiod, automatically buys the right to remarry if his marriage turns bad.

Consider now rich males. At the beginning of the first subperiod, the price they would be ready to pay for a wife (to whom they can remain married or not for both subperiods) is denoted by τ_{rm}^{S} and is the value of τ which solves:

$$2g + (1-p)v(2-\tau) + pv(2-\tau-d) = u_p + v(2-\tau_I^{S*}),$$

where τ_I^{S*} is the perfectly anticipated transfer in the market with no divorce option. If they remarry, agents know that their lifetime relationship utility is $2g (> u_p)$. However, if their marriage goes bad, they must bear the cost of divorce d, which decreases their consumption. In other words, through the option of divorce, agents trade-off some additional relationship utility against a reduction in consumption utility.

For the other types, τ_{rf}^S , τ_{pf}^S and τ_{pm}^S are determined as solutions of the following equations:

$$2g + (1-p)v(2+\tau) + pv(2+\tau-d) = u_p + v(2+\tau_I^{S*}),$$

$$2g + (1-p)v(2\omega+\tau) + pv(2\omega+\tau-d) = u_p + v(2\omega+\tau_I^{S*}),$$

$$2g + (1-p)v(2\omega-\tau) + pv(2\omega-\tau-d) = u_p + v(2\omega-\tau_I^{S*}).$$

These equations reflect the idea that the outside option, with respect to a marriage open to divorce, is not singleness but a marriage without the possibility of divorce.

There exists a threshold \bar{d} such that, if the divorce cost d is below \bar{d} , everybody—even the poor—chooses to have the option of divorce. τ_{pm}^S and τ_{pf}^S are computed assuming $\tau_I^{S*} = \tau^{M*}$, *i.e.* agents know that if they opt for a marriage without the possibility of divorce they would end up on a marriage-market equivalent to the one we have characterized for the strict monogamy regime. This threshold plays the same role as that in condition (4).

When $d < \bar{d}$, we have $\tau_{ff}^{S} < \tau_{pf}^{S} < 0 < \tau_{pm}^{S} < \tau_{rff}^{S} = -\tau_{rm}^{S}$ and $\tau_{pf}^{S} = -\tau_{pm}^{S}$. The rest of the argument follows closely the one developed for monogamy. If we assume, as in the model without transfers, that there are as many females as males, we can only say that $\tau_{pf}^{S} < \tau_{ln}^{S} < \tau_{pm}^{S}$. Here, for given bounds τ_{pm}^{S} , the equilibrium price is indeterminate, but the bounds themselves are also indeterminate given the characteristics of the marriage market without the possibility of divorce. Obviously, the marriage pattern is also undetermined.

Let us now consider $d > \overline{d}$, the most interesting case for our analysis. The marriage market is segmented into two. $1 - \mu_t$ poor couples agree not to divorce and implement a transfer τ_t^{S*} . The μ_t rich males can pay for the option of divorce

44. As reported by Goode (1970) and Becker (1993), Muslim law prescribes that the bride price must be forfeited, at least partially, when a wife is divorced without cause, whereas in other societies the husband is obliged to return (part of) his wife's dowry, if he initiated divorce.

a transfer τ_{II}^{S*} (> τ_{I}^{S*}), such that poor females are indifferent between the two types of marriage: $\tau_{II}^{S*} = \tau_{pf}^{S}$ (here, we also abstract from cases with *d* so high that no one would ever like to divorce). We can then claim what follows.

Proposition 12. When serial monogamy is the constitution and $d > \overline{d}$, where \overline{d} solves $\tau_{pm}^S = \tau_{pf}^S = 0$, the marriage pattern arising in the benchmark model under case (b) of Proposition 3 is also an equilibrium assignment with endogenous transfers.

Proof As explained above, poor couples do not divorce. In fact, poor males cannot convince poor females (and *vice versa*) to accept a marriage open to divorce, because $\tau_{pm}^S < 0$ and $\tau_{pf}^S > 0$. Other couples divorce only if their marriage goes bad after one period. Indeed, the only reason people may want to divorce is to get rid of a bad match. Different from the benchmark, here there is no gain related to remarrying up, because the same transfer applies to all marriage, regardless of the identity of the spouses. As a consequence we have $1 - \mu_t$ lasting marriages between poor persons, $(1-p)\phi_t$ lasting marriages between rich persons, $p\phi_t$ marriages between rich persons ending in divorce, $p\phi_t$ remarriages between rich males and poor females, $p(\mu_t - \phi_t)$ marriages between rich males and poor females.

Finally, if the marriage surplus function u_p is super modular and $d > \bar{d}$, the marriage pattern described by case (b) of Proposition 3 is the only equilibrium with endogenous transfers.

B.2. Political equilibrium and dynamics

We can already highlight two major differences with respect to the model presented in the main text. First, with endogenous transfers, indeterminacy prevails for monogamy and serial monogamy, as long as we keep the same assumptions as in the benchmark (balanced sex ratio, relationship utility independent of individual income). Secondly, changes in state variables μ_t and ϕ_t do not affect the preference ordering of the individuals, except in the case of polygyny, where the equilibrium outcome depends on whether μ_t is above or below 1/2. This comes as a consequence of identical individuals having, under endogenous transfers, the same utility regardless of the identity of their spouse (rich or poor) and the type of marriage they are involved in (monogamous or polygamous, in regime **P**). The probability to end up in a given marriage, which depends on μ_t and ϕ_t , is now irrelevant.

B.2.1. Preferences by group. Let us now describe the preference orderings of the different groups, restricting our attention to the case $d > \bar{d}$, which ensures comparability with the basic model.

Rich males prefer **S** to **M** for any state of the economy because otherwise they would not accept a marriage contract open to the possibility of divorce, which is more expensive $(\tau_{L}^{T*} > \tau_{I}^{S*} = \tau^{M*})$. Whether they rank higher **P** or **S** depends on the state of the economy. If $\mu_t < 1/2$, all rich men can have two wives, and thus prefer **P** to **S** if τ_{L}^{T*} , the *a priori* undetermined equilibrium transfer under serial monogamy, is such that $(1+z)u_p + v(2-2\tau_2^P) > 2g + (1-p)v(2-\tau_{L}^{T*}) + pv(2-\tau_{L}^{T*} - d)$. We assume this condition, which involves parameters such as p, d, g, b and z, to hold, so that rich males' preferences are summarized by **P** > **S** > **M** when $\mu_t < 1/2$. If instead $\mu_t > 1/2$, not all rich men can have two wives under polygyny, and their utility is thus pinned down by that of those who manage to have only one wife. Since τ_1^{P*} is higher than or at least equal to τ^{M*} —because, under polygyny, women are in short supply, and the equilibrium transfer is given by the maximum transfer that poor males would be ready to pay for a wife—rich males prefer **M** to **P**. A fortiori, they also prefer **S** to **P**. Therefore, when $\mu_t > 1/2$, the preference ordering of rich men is $\mathbf{S} > \mathbf{M} > \mathbf{P}$.

Rich females, as in the basic model, always prefer S to M, for the same reasons as rich males, and P to M, because under polygyny they are in short supply and command a higher price, net of the jealousy cost. Whether rich females prefer P or S depends on parameters, but is irrelevant for the political equilibrium, as will become clear later on.

Poor males always prefer M to S, due to the social cost of divorce. They also prefer S to P because in P they receive the same utility as they would have as singles, though under S the undetermined equilibrium transfer is such that their utility is larger than or equal to their utility as singles. Therefore, for poor males: M > S > P, for any μ_t .

Poor females always prefer **M** to **S** for the same reason as poor males. In addition, they always prefer **P** to **M** as, in regime **P**, they obtain with certainty at least the maximum utility they could get under **M** (which is determined by the willingness to pay of poor males). To sum up, poor females' preferences imply $\mathbf{P} > \mathbf{M} > \mathbf{S}$, for any state of the economy.

Compared to Section 4 (Figure 5), individual preferences over \mathbf{S} versus \mathbf{M} are not affected by endogenous transfers, whereas the way agents rank \mathbf{P} is. In fact, under polygyny, being on the short side of the market allows females to extract a bigger rent from marriage. Let us now proceed to the aggregation of individual preferences.

B.2.2. Aggregating individual preferences. For $0 < \mu_t < 1/2$, **P** is the political equilibrium. In fact, in a pairwise comparison, **P** prevails over any other alternative, since it is always supported by a coalition of rich males



FIGURE 9

Political Equilibria with with $\chi = \theta = 1$ and endogenous transfers

and poor females, *i.e.* the two social classes that are commonly believed to benefit from polygyny, at early stages of development, and also support \mathbf{P} in the benchmark model.

For $1/2 < \mu_t < 1 - \phi_t$, only **M** can be an equilibrium . In fact, **S** is defeated by **M** since the poor, who are the majority, prefer **M** to **S**. Moreover, if the society has to chose between **P** and **M**, all males support **M** against all females, who would rather prefer **P** (in line with the Beckerian argument that polygyny redistributes utility from males to females, when not all men who would pay for a second wife can have one). If men have slightly more political power or if indifference in broken in their favour, **M** prevails over **P** and emerges as a Condorcet winner.

Finally, for $\mu_t > 1 - \phi_t$, **S** is the political equilibrium. In fact, all rich persons, who are now the majority, prefer **S** to **M**. Moreover, all males (and rich females, for some configuration of the parameters) rank **S** higher than **P**.

Figure 9 illustrates the political outcome of the model with equilibrium transfers as a function of (μ_t, ϕ_t) , and can be compared with Figure 6.

B.2.3. Institutional transitions. Similar to the benchmark model, the whole transition $\mathbf{P} \rightarrow \mathbf{M} \rightarrow \mathbf{S}$ can be driven by increases in μ_t and/or in ϕ_t (although the frontiers between regimes are different), and can be now generated by any parametrization such that rich males' best option is \mathbf{P} for $\mu_t < 1/2$.

Note that, as in the benchmark model, polygyny is supported by a coalition of poor females and rich males, whereas serial monogamy is likely to emerge as a bourgeois institution, supported by a coalition of the rich. The main difference concerns the transition to monogamy, which—different from the benchmark model—no longer relies on the pivotal role of poor females. In fact, if transfers are endogenous and $\mu_t > 1/2$, polygyny becomes so expensive for rich man (and profitable to women) that they join poor men and support monogamy.

The transition $\mathbf{P} \to \mathbf{M} \to \mathbf{S}$ is also compatible with a process of progressive enfranchisement. If μ_t is low, and all the power is detained by rich males, polygyny prevails; if more power is given to poor males (not to females), the political equilibrium switches to monogamy, and such institutional change can be accompanied by a rise in the proportion of rich males, provided that $\mu_t < 1/2$; if monogamy generates more social mobility, μ_t and/or ϕ_t will (further) increase, and the economy will endogenously shift to serial monogamy (the power of females can also increase along the transition, but is not key to explain it).

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Supplementary Data

Supplementary materials are available at Review of Economic Studies online.

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