

# Childless Aristocrats. Fertility, Inheritance, and Persistent Inequality in Britain (1650–1882)\*

Paula Gobbi<sup>†</sup>

Marc Goñi<sup>‡</sup>

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## Abstract

This paper studies the interaction between inheritance schemes, fertility, and inequality over the very long run. While a high fertility in the elite is typically associated with lower wealth concentration, we show that this is not necessarily true for the extensive margin of fertility. We study the case of Britain, where inheritance was governed by marriage settlements, a *de facto* entailment of the land that had to be renewed every generation. Using genealogical evidence for 20,000 peers and peers' offspring between 1650 and 1882, we show that families signing a settlement were 12.5 percentage points more likely to have children, thus ensuring dynasty continuation. To establish causality we use variation within lineage and estimate an instrumental variables model exploiting the birth order of the heir. We then propose a model to highlight the mechanisms behind this reduced form effect. The model provides three sets of results: first, we rationalize the existence and the persistence of inheritance schemes that tie the hands of future generations with inter-generational hyperbolic discounting. Second, we argue that settlements can affect fertility choices on the extensive margin due to inter-generational preferences: a household who is subject to a settlement—and thus cannot break the family estate—is more likely to produce an heir in order to enjoy the utility of passing him a large inheritance. Third, the model rationalizes a positive relation between the extensive margin of fertility and inequality: settlements contributed to inequality not only by entailing the land, but also by ensuring the survival of dynasties at the top of the distribution. We argue that this is important to understand the pattern of persistent inequality in landownership in England since the Norman conquest.

*Keywords:* Childlessness, Inheritance, Inequality, Settlement, Inter-generational discounting.

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<sup>†</sup>National Fund for Scientific Research (Belgium) and IRES, Université catholique de Louvain and CEPR

<sup>‡</sup>Department of Economics, University of Vienna

*The rich get richer and the poor get - children!*—F. Scott Fitzgerald, *The Great Gatsby*

## 1 Introduction

Inequality is highly persistent. [Clark et al. \(2014\)](#) argues that “movement on the social ladder has changed little over the last 8 centuries.” Neither the Protestant Reformation, the Industrial Revolution, nor the rise of the welfare state in the twentieth century seem to have had much effect on social mobility, particularly at the top of the wealth distribution—the richest families have always been the same.<sup>1</sup> Why is inequality so persistent? One important factor is inheritance. For example, the increase in top inequality in the second half of the twentieth century ([Piketty and Saez 2006](#)) is associated with an increase in the percentage of national income accounted by bequests ([Piketty 2011](#)).

However, inheritance *per se* cannot explain everything. One important factor mediating the effect of inheritance on inequality is demographics. Typically, economists have argued that a fertility and inequality are negatively associated ([Deaton and Paxson 1997](#); [Kremer and Chen 2002](#); [de la Croix and Doepke 2003](#)). With low fertility, bequests are divided among less children and thus family wealth remains concentrated in a few hands. But other effects might be at place. A high fertility ensured the continuity of a family lineage, and therefore that wealth could remain in one family. The relation between fertility and inequality, hence, might be different in the intensive margin—the decision of how many children to have—and extensive margin—the decision whether to have children or not. A second limitation in the way economists deal with inheritance is related to inter-generational discounting: the classic overlapping generations model of bequests assumes exponential discounting across generations ([Barro 1974](#)). That is, it assumes that preferences are time consistent across generations. This is hard to reconcile with many inheritance schemes that tie the hands of proprietors, such as trusts, fee tails (United States), entails

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<sup>1</sup>The persistence of inequality is particularly striking when it comes to landownership. After the Norman conquest of England in 1066, one-third of the land was given to Norman noblemen (Domesday book). Around 1880, fewer than 5,000 landowners—many of them, descendants of these Norman noblemen—owned more than 50 percent of all land ([Cannadine 1990](#)). Nowadays, less than 1 percent of the population still owns 70 percent of the land ([Cahill 2002](#)).

(Scotland), *majorat* (France), *mayorazgo* (Spain), or *ordynacja* (Poland).

In this paper, we analyze a unique historical setting and show that the relation between top-inequality and the extensive margin of fertility can be positive, especially in the presence of inheritance schemes that tie the hands of proprietors. In nineteenth century Britain, around 50 families “held the lion’s share of land, wealth, and political power in the world’s greatest empire” (Cannadine 1990). These were the British peerage. Their position at the top of the distribution, however, was not always guaranteed. Around 1600, between 30 and 40 percent of all married women in the peerage were childless. This was of course a threat for the continuity of noble family lineages and therefore the maintenance of land and wealth within these families. We show that the introduction of settlements—a *de facto* entailment of the land that restricted the heir’s freedom to sell parts of the family estate—crucially moved the peerage to a higher fertility regime. By 1850, childlessness rates among peers’ daughters decreased to 10 percent, the level for the general population (de la Croix, Schneider, and Weisdorf 2017). Settlements, thus, contributed to the persistence of inequality not only by entailing the land, but also by ensuring the survival of dynasties at the top of the distribution.

To estimate the effect of settlements on childlessness, we exploit the demographic aspect of settlements. Most settlements were signed upon the marriage of the eldest son, whom limited his interest in the estate to that of a life-tenant, ensuring that the family estate would descend unbroken to the heir born of this marriage (Habakkuk 1950). For the marriage settlement to operate as a *de facto* entailment, the settlement had to be renewed by each generation at the time of the marriage of the heir. Thus, it was crucial for the father to survive to the marriage of his eldest son (Bonfield 1979). Linking demographic information across generations for about 1,500 peers and their offspring from 1650 to 1882, we find that heirs marrying before their fathers’ dead—that is, heirs subject to a settlement—were 15 percentage points less likely to be childless. To establish causality, we exploit exogenous variation in the probability of a heir marrying after the father’s death coming from the birth order of the heir. All the effects are identified based on variation among members of the same family, capturing the genetic similarities of these related individuals, as well as their cultural and socio-economic proximity. Furthermore, the results are robust to the inclusion of controls over spouses’ age at marriage, socio-economic status, and socio-economic

and demographic conditions during their lifetime, as partly captured by birth year and marriage decade fixed effects.

The second main contribution of this paper is to show that imperfect altruism<sup>2</sup> across generations can (1) rationalize the widespread use of settlements in the nobility and (2) explain its effects on fertility. We develop a simple model of household decisions where three generations of the same dynasty decide sequentially over consumption and fertility. These decisions affect future generations as they reduce the amount of family wealth that is passed down in the form of bequests. We depart from the classic bequests models by assuming that individuals have quasi-hyperbolic discount function towards future generations and that altruism is higher towards direct descendants than towards distant relatives. The first assumption implies that individuals are present-biased as they value their current consumption over that of the next generations. At the same time, they do not value their children’s well-being significantly more than that of the future generations, namely their grandsons. As preferences are not consistent across generations, fathers have an incentive to restrict their son’s freedom to manage the family estate with a settlement. In other words, hyperbolic discounting across generations—as opposed to the exponential discounts typically assumed—rationalizes the existence of settlements and, more generally, of inheritance rules that tie the hands of proprietors. To our knowledge, we are the first to explain inheritance schemes with hyperbolic discounting preferences.

Furthermore, our model suggests that inter-generational altruism can explain why settlements reduced the rate of childlessness. The idea is that a household head who, being subject to a settlement, cannot sell parts of the family estate, may decide to have children, as he prefers the large inheritance to go to their offspring rather than to a distant relative. Formally, we model settlements as a commitment device that allows the father to decide all bequests of future generations. In this model, the father can influence the fertility decisions of his son by settling a larger endowment for the third generation, namely the grandson. As a result, the family dynasty is less likely to die out than in a benchmark model where every generation decides the

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<sup>2</sup>Phelps and Pollak (1968) define perfect altruism as the situation when “each generation’s preference for their own consumption relative to the next generation’s consumption is no different from their preference for any future generation’s consumption relative to the succeeding generation” (p. 185). Here we will use imperfect altruism to refer to time discounts that are not consistent across generations; i.e., when, say, the father values the well-being of his grandson relatively more than what his son will do.

bequests of the next generation (i.e., a model without settlements). This effect is stronger the more hyperbolic the discount function is, suggesting that this particular time-preference may explain the reduced-form effect of settlements on fertility that we document in the empirical analysis.

This paper relates to several strands of the literature. First, we challenge the common wisdom that fertility and inequality are negatively associated. [Deaton and Paxson \(1997\)](#) conclude that lower rates of population growth can contribute to wealth concentration by increasing within cohort inequality in settings as diverse as in the USA, Britain, Taiwan, or Thailand. Similarly, [Kremer and Chen \(2002\)](#) and [de la Croix and Doepke \(2003\)](#) find that inequality is associated with fertility differentials between the rich and the poor. We show that on the extensive margin—i.e., on the decision whether to have children or not—the relationship between fertility and inequality can be the opposite. High fertility ensures the continuation of a family lineage and, hence, that wealth remains concentrated in their hands. This is particularly relevant for the top of the wealth distribution. The literature on demographic economics has already shown that childlessness—the opposite of the extensive margin of fertility—can respond differently to economic changes than the intensive margin of fertility. [Aaronson, Lange, and Mazumder \(2014\)](#) show that the Rosenwald Rural Schools Initiative decreased the intensive margin of fertility (number of children) but increased motherhood rates. Similarly, [Baudin, de la Croix, and Gobbi \(2015\)](#) show that motherhood rates and completed fertility can show a negative relationship for low-educated women. [Brée and de la Croix \(2016\)](#) show that an increase in materialism, women’s empowerment, and the returns to education can explain the increase in childlessness in Rouen between 1640 and 1792. Finally, [de la Croix, Schneider, and Weisdorf \(2017\)](#) show that, once the extensive margin of fertility is accounted for, the middle-classes had higher reproductive success than the upper-classes in early-modern England.

Second, our paper also contributes to the study of time preferences. In particular, hyperbolic discounting has been used widely to explain savings decisions ([Laibson, Repetto, and Tobacman 1998](#); [Diamond and Köszegi 2003](#)), addictive behavior ([Gruber and Köszegi 2001](#)), or fertility ([Wrede 2011](#); [Wigniolle 2013](#)) *of individuals*. Our contribution is to apply the idea of hyperbolic discounting *across generations*, in line with the seminal paper by [Phelps and Pollak \(1968\)](#). We argue that, in opposition to exponential discounting, hyperbolic discounting across generations is consistent with

many inheritance schemes that “tied the hands” of proprietors. Furthermore, we show that models of bequests assuming exponential discounting are not only inconsistent with such inheritance rules, but also that this type of discounting may ignore important effects of inheritance on the extensive margin of fertility.

Our results also shed new light on the dynamics of inequality over the very long run. Using historical tax records, [Piketty and Saez \(2006\)](#) find that income inequality has increased dramatically over the last decades. This trend is especially significant for English-speaking countries like the United States or the United Kingdom. [Miles \(1993\)](#), [Mitch \(1993\)](#), and [Long and Ferrie \(2013\)](#) suggest that this is not a new phenomena. Already by the nineteenth century rates of occupational mobility were low in Britain. Similarly, [Clark and Cummins \(2015\)](#) analyze a sample of people with rare surnames, showing that social mobility has changed little since the middle ages, despite changes such as the Industrial revolution, the extension of the franchise, or the provision of public education. We argue that the interaction between inheritance schemes and fertility behavior settled the conditions for the persistence of wealth inequality over the long-run. Settlements contributed to the persistence of inequality not only by entailing the land, but also by ensuring the survival of dynasties at the top of the distribution.

Finally, this paper is important because it adds to our understanding of elites. When sufficiently powerful, elites may support policies that are pernicious to economic growth ([Acemoglu 2008](#)). A crucial factor explaining the persistence of elites is the intergenerational transmission of wealth. [Bertocchi \(2006\)](#) shows that primogeniture reinforced the concentration of landownership, consolidating aristocratic political systems. We add to this literature by showing how the interaction between inheritance schemes and demographic helped to consolidate the wealth and power of the British peerage. This paper is not the first to study the persistence of British peerage. [Allen \(2009\)](#) suggests that the aristocratic lifestyle was, in fact, a commitment device to ensure control over public offices. [Goni \(2016\)](#) emphasizes the role of marriage and the meeting technology embedded in the London Season. [Marcassa, Pouyet, and Trégouët \(2017\)](#) show that stringent dowry rules matter to explain the degree of assortativeness among the English and German nobilities. Two sets of studies are most related to our work. On the one hand, [Habakkuk \(1950\)](#), [Bonfield \(1979\)](#), and [English and Saville \(1983\)](#) describe marriage settlements and discuss whether they contributed or

not towards landownership concentration. On the other hand, [Hollingsworth \(1964\)](#) provided detailed descriptive statistics on the demography of the British peerage.

The article proceeds as follows. Section 2 portrays marriage settlements in the British nobility and describes the data. Section 3 describes historical trends in childlessness and presents reduced form estimates on the effect of settlements. In Section 4, we develop a model for the reproduction choices of British peers that highlights the mechanisms behind the reduced-form effect of settlements on childlessness, and that rationalizes the existence of settlements. Finally, Section 5 concludes.

## 2 Institutional Setting and Data

### 2.1 Marriage settlements

How did settlements came into being? Before 1650, settlements were exclusively used to settle a provision for the wife in case she became a widow. In detail, one could not use settlements to entail the land because they were easy to break. A landowner who had settled his land, for example, could easily sell parts of the family estate because nobody was there to defend the interest of his under-aged or even unborn son, who was the beneficiary, that is, the one supposed to receive the estate untouched ([Habakkuk 1994](#): p. 7).

This changed during the interregnum period with the introduction of the figure of the *trustee*, who was precisely in charge of defending the interest of this under-aged or unborn son. Why were *trustees*, and more generally, settlements developed during the Interregnum period? After the Civil War, both Royalist and Parliamentarist landowners were afraid of expropriation in case events turned the tide in favor of the opposing side. Settlements ensured their family estates would not be lost. Note that when a landowner signed a settlement, the beneficiary of his estate was no longer him but his heir, most likely an under-aged kid or even an unborn son who had obviously not taken sides in the war, and thus who could not be expropriated ([Habakkuk 1994](#): p. 12).

Although the threat of expropriation eventually disappeared after 1650, settlements

became widely used by the aristocracy both to entail the land and to fix a provision for the widow and for the younger children of the couple. Quoting [Habakkuk \(1950\)](#),

“[...] about one-half of the land of England was held under strict settlement in the mid-eighteenth century”.

([Bonfield 1983](#)) finds that most settlements during the period 1660-1740 were of the form of the strict settlement (Table 1).

The standard settlement worked in the following way: Settlements were typically signed upon the marriage of the eldest son. With the settlement, he limited his interest in the estate to that of a life-tenant, ensuring that the family estate would descend unbroken to the heir born of this marriage ([Habakkuk 1950](#)). In order to convince his son to make such a sacrifice, the father usually transferred him an income to support his household until he inherited the estate. Although settlements were only valid for a generation, *de facto* they operated as a permanent entailment of the land, as settlement were renewed by each generation. For the marriage settlement to operate in this fashion, however, it was crucial for the father to survive to the marriage of his eldest son ([Bonfield 1979](#)). In the empirical analysis we will exploit this demographic aspect of settlements to identify its effects on fertility.

In the negotiation of settlements, the wife’s family also had an interest, particularly regarding the allowances settled for her in case she became a wife, and for the younger children of the couple. This tension is illustrated by the following example:

In 1673 Sir Henry Finch [gentry], negotiating for a bride for his eldest son, was pressed by her guardian to execute such a settlement as shall leave the young man but a tenant for life”. He resisted, and pointed out that ”most settlements in England which make the young man tenant for life, proceed rather from his father than from the wife’s friends ([Habakkuk 1994](#): p. 14).

Allowances toke the form of charges on the estate ([Habakkuk 1994](#): p. 17). This practice gained weight overtime, and by the end of the eighteenth century it had become common ([Habakkuk 1994](#): p. 16). Although we recognize the importance



of allowances in the negotiation of settlements, we abstract from this motivation and focus on settlements as a legal instrument to entail the land and ensure the continuity and the integrity of family estates.

Importantly, settlements were prevalent in England, but not in Scotland. There, land could be entailed *ad perpetuum*. What frustrated the attempts to introduce a similar form of permanent entailment in England is not clear. Habakkuk (1994: p. 18) suggests that the reasons may be purely legal and not related to any specific demographic aspect of these countries. In detail, he suggests that the strong bias of English Common Law judges for the free alienability of land prevented the establishment of such permanent entails in England. In the empirical analysis, we will exploit this divergence between England and Scotland as a robustness check: Since the wives of Scottish peers were not subject to settlements, we should not observe any effect of our proxy—that is, marrying after inheritance—on fertility.

Settlements came to an end with the Settled Land Act in 1882. In the midst of a great debate in Britain about landownership concentration (Bateman 1883), Parliament established that settlements could not prevent the life tenant to sell parts of the land. To be able to sell the land, the life-tenant was required to obtain the best possible price from the sell, and to settle the profits from the sell—that is, the money had to pass down untouched to the next generation.

## 2.2 Data

Our demographic data on the British peerage is from Hollingsworth (1964). In this subsection, we describe the original sources used by Hollingsworth to collect this information, as well as the process of matching parents to offspring that we undertook for this project.

### Demographic data on the British peerage

The Hollingsworth (1964) genealogical database on the British peerage is constructed with information from various Peerage records, the family histories of the aristocracy of Britain and Ireland.<sup>3</sup> For the sake of illustration, Figure 1 shows the entry for

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<sup>3</sup>The principal sources used by Hollingsworth were Cokayne’s *Complete Peerage* (1913), Collins’ *Peerage of England* (all editions from 1710 to 1812), Lodge’s *Peerage of Ireland* (1754 and 1789),

Charles Lyttelton, 8th Viscount Cobham from Cokayne’s *Complete Peerage*. The entry contains abundant genealogical material. In detail, the entry states that he was born in 1842 and married at age 35 to Mary Susan Caroline Cavendish, who was 11 years younger. They had seven children together. Charles George Lyttelton died aged 79 and was succeeded to the barony by his eldest son, John.

Hollingsworth collected all of this genealogical material for all peers who died between 1603 and 1938 (primary universe) and their offspring (secondary universe). The [Hollingsworth \(2001\)](#) database is the end product of digitizing the original 30,000 handwritten original index sheets by the Cambridge Group for the History of Population and Social Structure. In its current form, the data comprise approximately 26,000 individuals.

Each entry provides the date of birth, marriage, and death of each individual, as well as a variable indicating its accuracy. It also provides information on social status, title, whether he/she was heir-apparent at age 15, and the status of the highest-ranked parent.<sup>4</sup> If the individual married, we also know the spouses’ date of birth, date of death, and social status. The entry also lists the name and the date of birth of the children born to this marriage. For individuals that married more than once, or individuals that had illegitimate children, we also know how many children they had in total. Figure 2 illustrates how a digitized entry looks like.

## Matching parents to children

Unfortunately, the entries from the [Hollingsworth \(2001\)](#) dataset are not linked across generations. To resolve this issue, we manually matched each entry database to their father’s entry. For individuals whose father could not be found in the database we tried to match them with their mothers.

In detail, we first match non-heirs (i.e., peers’ daughters and younger sons) to their parents. To do so, we exploit a particularity of the [Hollingsworth \(2001\)](#) database.

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Douglas’ *Scots Peerage* (1904-14), Burke’s, Lodge’s and Debrett’s *Peerages* (different editions between 1825 and 1961), and Burke’s *Extinct Peerage* (1866 and 1883). See [Hollingsworth \(1964\)](#), appendix I for details on the method of compilation of the data.

<sup>4</sup>Social status is presented in five categories: (1) duke, earl, or marquis, (2) baron or viscount, (3) baronet, (4) knight, and (5) commoner. The entries state whether a title is an English, Scottish, or Irish peerage.

An entry corresponding to an heir is typically identified with a reference number which is a multiple of 20 or 50. The reference number of the entries corresponding to her daughters and younger sons (if any) are typically consecutive numbers of the father’s reference number. Thus, we match a entry C (children) to entry P (parent) if entry P is identified with a reference number that is a multiple of 10 and entry C is identified with a consecutive reference number.

The matching of heirs is less trivial. In the first iteration, we match entries C and P if entry P corresponds to a male, and the surname, name, date of birth, and accuracy in entry C coincides with the surname of the individual and the name, date of birth, and accuracy of any of the children listed in entry P. We then restrict the sample to unmatched individuals, and repeat the procedure considering female P entries only. For the remaining unmatched individuals, we consider a similar matching procedure based on birth date and accuracy (iteration 2), first name and birth date (iteration 3), and unique birth dates—that is, restricting the sample to individuals born on a date where no other peer or peer’s offspring was born—(iteration 4). At each iteration, we check double matches manually using information from [thepeerage.com](http://thepeerage.com), an online genealogical survey of the peerage of Britain.

The validity of the matching is essential to the credibility of this exercise. For this reason, we perform several manual checks. First, we use [thepeerage.com](http://thepeerage.com) to check manually if individuals matched to their mother do not have siblings who were matched to their father. Second, we calculate the distance between father’s and children’s surnames for individuals matched in iterations 2 to 4. To do so, we use the Levenshtein distance algorithm, which measures the minimum number of single-character edits required to change one surname into the other. We then use [thepeerage.com](http://thepeerage.com) to check manually the matches with a Levenshtein distance above 1.

Using this procedure, we match 98.25 percent of the 26,499 entries in the dataset to their parents. Only 2.22 percent of them are matches to the mother.

Table 2 presents descriptive statistics for the universe of peers and peers’ offspring in the Hollingsworth dataset. On average, 26.3 percent of married peers and peers’ sons remained childless. Those who were not had, on average, 4.7 children. Women married earlier than men (23 versus 29 years old) and lived longer (51 versus 47 years). For the sample of matched parents who had children, we can also compute the

proportion whose last offspring was a girl. Around 50 percent of their last children was a girl, indicating that on average parents did not stop having children after they had a son. Regarding socio-economic status, 18% of the individuals in the whole sample are heirs to a peerage, half of them from an English peerage. Finally, 23.6 percent of the individuals in the database married after the heir of the family inherited, that is, married with the estate not being re-settled. In the next section, we will use this proxy for marriage settlements to gauge their impact on childlessness and completed fertility.

## 3 The effect of settlements on fertility

### 3.1 Historical trends

Compared to the general population, the British aristocracy had more children but considerably lower motherhood rates. Figure 3 plots the average fertility of mothers (left panel) and childlessness rates (right panel), for all peers' daughters first-marrying between ages 15 and 35 in 1600–1959 together with estimates for the general population.<sup>5</sup> The number of children born to aristocratic mothers reflects general trends in fertility. On average, mothers had between 4 and 5 children before the 1800s. The peerage experienced a demographic transition around 1810, eighty years earlier than the general population. This is consistent with the fertility of the wealthy (Clark and Cummins 2009).

In contrast, marital childlessness rates among the aristocrats were astonishingly high. For example, around 1600 between 30 and 40 percent of all married women in the aristocracy were childless. In the general population, the corresponding rate was only around 10 percent. The rate of childlessness in the peerage was also high in comparison to other European nobilities. Table 3 shows that peers consistently display higher childlessness than the nobility of Hesse-Kassel (Germany) and, before 1700, than *ducs et pairs*—the highest ranked nobles in France.<sup>6</sup> Admittedly, peers had children out

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<sup>5</sup>Estimates for the general population are from de la Croix, Schneider, and Weisdorf (2017), Galor (2011), Anderson (1998) and Wrigley and Schoeld (1997).

<sup>6</sup>These comparisons have to be taken with grain of salt. First, because Lévy and Henry (1960) and Pedlow (1982) have few observations. Second, because Lévy and Henry (1960) considers a

of wedlock. Therefore, our childlessness rates might be an overestimate. However, illegitimate children did not inherit and therefore are not relevant for our analysis.<sup>7</sup>

The high rates of childlessness in the peerage around 1600 were of course a major threat for the continuity of noble family lineages and therefore, a threat to the maintenance of wealth within these families. Around 1650, however, we observe a declining trend in childlessness in the aristocracy. By 1850, childlessness rates among peers' daughters decreased to 10 percent, the level for the general population (de la Croix, Schneider, and Weisdorf 2017). This declining trend coincides with the introduction of a particular inheritance scheme: settlements. In the next section we show that settlements crucially moved the British nobility to a higher fertility regime, and hence ensured the continuity of a family lineage and the concentration of wealth in their hands.

## 3.2 OLS estimates

Here we show that marriage settlements reduced childless rates in the British peerage. Ideally, we would like to compare fertility outcomes in families that are subject to a marriage settlement to the outcomes of similar families who have not signed it. Unfortunately, we do not know who signed a marriage settlement and who did not. To resolve this issue, we exploit the demographic aspect of marriage settlements. Most settlements were signed upon the marriage of the eldest son, whom limited his interest in the estate to that of a life-tenant and committed to provide an allowance for his siblings (Habakkuk 1950). In order to convince his son to make such a sacrifice, the father transfers him an income to support his household until he inherits the estate. For the marriage settlement to operate in this fashion, thus, it is crucial for the father to survive to the marriage of his eldest son (Bonfield 1979). We use the fact that a father survived until his heir's wedding as a proxy for the presence of a marriage

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sample of women marrying before 20, whose marriage did not break because one spouse died before reaching 45 years of age. For comparability, we report results from a comparable sample. This sample, however, may not be ideal, as we are probably selecting women who married close relatives, which could also affect childlessness rates (Goñi 2014).

<sup>7</sup>Hollingsworth's dataset still provides some information on the number of illegitimate children. In the sample, for instance, James O'Hara, 2nd Baron Tyrawley and 1st Baron Kilmaine did not have any children with his wife, but had seven illegitimate children including the Irish actress George Anne Bellamy.

settlement. Formally, we estimate the effect of marriage settlements on childlessness as follows:

$$\chi_{i,j,b,d} = \beta m_{i,j,b,d} + \mu_j + \mu_b + \mu_d + \mathbf{X}'_{i,j,b,d} \gamma + \epsilon_{i,j,b,d} \quad (1)$$

where  $\chi$  equals one if individual  $i$  did not have any children and zero otherwise. Our proxy for marriage settlements,  $m$ , indicates if  $i$ 's father died before the wedding of his heir.<sup>8</sup> The coefficient  $\beta$  captures the association between marriage settlements and childlessness. We account for wide range of confounding factors that may also affect fertility. Following [Galor and Klemp \(2014\)](#), we include family fixed effects,  $\mu_j$ . That is, we identify the effect of marriage settlements on childlessness using variation in fertility among members of the same lineage. This will capture any genetic, cultural, religious, or socio-economic predisposition towards childlessness among these genetically related individuals. In addition, childlessness rates may be affected by the socio-economic and demographic conditions during one's lifetime. To capture this lifecycle effects, we include birth year fixed effects,  $\mu_b$ , and marriage decade fixed effects,  $\mu_d$ . Finally, the vector  $\mathbf{X}$  includes a set of covariates that may also affect the probability of having children: social status of the spouses, wife's age at marriage, spouses' age at death, history of stillbirth in the husband's family, and the number of siblings for which the heir of the family has to provide for.<sup>9</sup>

Table 4 presents the baseline results of estimating equation 1 using OLS. For heir's wives, there is a strong, significant association between the probability of being childless and marriage settlements. In detail, for heir's wives marrying after inheritance (i.e., no marriage settlement was signed) is associated to an increase in the probability of being childless by 5 to 8 percentage points (columns 1 to 4). Results are robust to the inclusion of covariates that may also affect childlessness, like the social status of spouses, the wife's age at marriage, or the ratio of stillbirths to live births in the husbands family (columns 2 and 3). The precision of the model increases when we include family fixed effects to control for unobserved heterogeneity in terms of genetic preconditions, culture, or social-economic position, as well as when we con-

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<sup>8</sup>Note that if individual  $i$  is the heir himself, then  $m = 1$  when the father died before his own wedding. If  $i$  is not the heir of the family, then  $m = 1$  when the father died before the marriage of  $i$ 's eldest brother.

<sup>9</sup>Our baseline results are robust to using non-linear econometric models such as probit or logic (results are available upon request). However, our preferred specification is a linear probability model as it is more flexible in dealing with fixed effects—which in our case are crucial to control for genetic, cultural, or religious unobserved factors affecting fertility at the family level.

trol for life-cycle conditions by including birth year and marriage decade fixed effects (column 4).

While childlessness seems to be affected by inheritance laws, the historical trends suggest that the total number of births—that is, the intensive margin of fertility—is not. Both heir and non-heir wives present a comparable record for the number of births, with a demographic transition preceding 80 years that of the general population. Table 5 confirms that the total number of births was not affected by marriage settlements beyond the effects over childlessness. In detail, the table presents results of poisson regressions<sup>10</sup> of equation (1)’s form, with the number of births as dependent variable. To fully explain away the effect of marriage settlements on childlessness, we restrict the sample to couples having at least one children.

Results suggest that an heir signing a marriage settlement did not produce less children than an heir who did so, conditional on having at least one child. In detail, our proxy for marriage settlements—i.e., marrying after the heir inherits—is not significantly associated with the number of live births. The estimated coefficient is not only insignificant, but also small in magnitude. In a poisson regression, the coefficients may be interpreted as semi-elasticities. A coefficient of -0.042 (column 1) indicates that an heir marrying after his father’s death and, thus, not signing a settlement, is expected to give birth to around 4.2 percent less children than what he would have if he entered a marriage settlement. Given that, conditional on not being childless, the average number of births of an heir’s wife is 5.7, this effect is equivalent to having 0.24 less children.

This result is robust to the inclusion of covariates that may also affect fertility, like the social status of spouses, the wife’s age at marriage, or the ratio of stillbirths to live births in the husbands family (columns 2 and 3). Including family, birth year, or marriage decade fixed effects also does not alter results (column 4). Finally, the effect is not statistically different for comparable women who were not directly exposed to marriage settlements: non-heirs’ wives (column 5) and wives of Scottish peers (column 6), where entails were perpetual, i.e., they did not had to be renewed upon the heir’s marriage (Habakkuk 1994: 6).

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<sup>10</sup>Poisson regressions are the standard form of regression analysis used to model count data like the number of live births.

Altogether, the evidence indicates a strong correlation between marriage settlements and childlessness, but not with the number of births. In other words, marriage settlements seem to be associated with the extensive margin of fertility, while the effect on the intensive margin seems to be negligible. In the next subsection, we use exogenous variation in our proxy for marriage settlements, that is, marrying after inheritance, to estimate the causal effect of this legal instrument on childlessness rates.

### 3.3 IV estimates

In this subsection, we estimate the causal effect of marriage settlements on childlessness using an instrumental variables approach. Whether a family signed a marriage settlement depends on many factors, some of which might be endogenous to childlessness. In particular, it could be that individuals with certain characteristics that are correlated to childlessness may choose not to sign a settlement by delaying marriage until their father dies. Here we exploit exogenous variation in our proxy for marriage settlements—the probability of marrying before or after inheritance—coming from the birth order of heirs. Formally, our proxy for marriage settlements indicating whether the father died before the heir’s wedding,  $m_{i,d}$ , is treated as an endogenous variable and modeled as:

$$m_{i,d} = \sum_{n=2}^{15} \beta_n \mathbb{I}(r_{i,d} = n) + \beta_z Z_{i,d} + \mu_d + \mathbf{X}_{i,d}' \gamma + \epsilon_{i,d} , \quad (2)$$

where  $r_{i,d}$  is the birth order of individual  $i$ .  $\mathbb{I}$  is equal to one when  $r_{i,d} = n$  and zero otherwise.  $Z$  is the age at death of  $i$ ’s father, which obviously affects  $m$  without regard to  $i$ ’s birth order. As in equation (1),  $\mu_d$  are marriage decade fixed effects; and  $\mathbf{X}$  is a vector of covariates including social status of the spouses, wife’s age at marriage, spouses’ age at death, history of stillbirth in the husband’s family, and the total number of siblings of the heir.

The causal effect of marriage settlements on childlessness is captured by coefficient  $\beta$  in:

$$\chi_{i,j,b,d} = \beta \hat{m}_{i,j,b,d} + \mu_j + \mu_b + \mu_d + \mathbf{X}_{i,j,b,d}' \gamma + \epsilon_{i,j,b,d} . \quad (3)$$

where  $\hat{m}_{i,j,b,d}$  is the value of  $m_{i,j,b,d}$  estimated from Equation (2), and  $\mu_j$  and  $\mu_b$  are,



respectively, family and birth year fixed effects.

Note that we use a triangular IV model in which not all the covariates used in the first-stage are included in the second-stage. In detail, we include father’s age at death in the first-stage but do not consider it to affect childlessness in the second-stage. The implicit assumption is that father’s age at death does not have a direct effect on childlessness other through affecting the probability of signing a marriage settlement. This assumption would be violated, for example, if an early age at death of the father reflects poor health conditions that are transmitted intergenerationally and also affect fertility. To account for that, we include family fixed effects and the history of stillbirths in the family in the second stage. Moreover, we present evidence suggesting that neither father’s age at death nor our instrument violate the exclusion restriction; i.e., they only affect childlessness through marriage settlements. In detail, we estimate the IV model for a comparable group of women who were not exposed to marriage settlements (because they married a non-heir or a Scottish peer) and show that the estimated effects converge to zero. To fit the resulting triangular IV model described here, we estimate the recursive equation system (2) and (3) by maximum likelihood.

Table 6 presents the first-stage results. Relative to first-born heirs, later-born heirs have a larger probability to marry after their father’s death. For example, a second-born heir is 4 percentage points more likely to marry after his father’s death, a third-born heir 10 percentage points, and a seventh-born heir, 17 percentage points. The remaining covariates have expected signs. As the father lives longer, the probability of the heir marrying after inheritance and thus not signing a marriage settlement decreases. In detail, every additional year of life of the father reduces the probability of the heir marrying after his death by 2 percentage points. The probability of marrying after inheritance also decreases with the husband’s social status and increases with wife’s age at marriage. Finally, the F-test is large enough to eliminate concerns about weak instruments.

Table 7 presents the OLS and IV estimates for the effect of marriage settlements on childlessness. Results suggest that, an heir marrying after his father’s death and, thus, not signing a marriage settlement, was significantly more likely to be childless. The magnitude of the effect is strong. In detail, our IV estimates suggest that not signing a marriage settlement increases by 15.1 percentage points the probability of

being childless. Given that the average childlessness rate for heirs equals 17.6%, not signing a marriage settlement accounts for 86% of the childlessness rate among British heirs.

Note that here we find that the bias affecting the OLS results is an attenuation bias. One possible explanation for this might be that if the father dies before the marriage of the heir, he is less likely to influence the choice of the bride of the heir. In other words, the heir might enjoy more freedom when choosing his wife. If such marriages tend to have more children (e.g., because they are love matches rather than socially convenient marriages), this could explain the attenuation bias in our OLS specifications, corrected by the instrumental variables approach described here.

Control variables have the expected signs. Heirs from larger families and those who live longer are less likely to be childless. Marrying an older wife also significantly increases the probability of not having children, although the magnitude of the effect is much lower. In detail, to match the estimated effect of marriage settlements on childlessness one would have to marry a wife aged ten years older (assuming that the effect of age on childlessness is linear).

As with every IV approach, the identifying assumption is that the instruments are relevant and that the exclusion restriction is satisfied. The birth order of heirs is relevant for our proxy of marriage settlements: in families where the heir is born after one or two daughters, the father is older and thus the likelihood that he dies before the heirs' wedding is larger than if the heir is his first-born child. Birth order is certainly exogenous to future choices regarding childlessness or strategically delaying marriage to avoid signing a settlement. Therefore, the instrument also satisfies the exclusion restriction: birth order may affect childlessness only through affecting the probability of the father surviving to the marriage of his eldest son, and thus, signing a marriage settlement.

To confirm the validity of the exclusion restriction, we estimate the instrumental variables system in Equations (2) and (3) with a comparable sample of women who should not be affected by marriage settlements because (a) they did not marry an heir, or because (b) they married a Scottish heir. Unlike marriage settlements in England and Ireland, Scottish entails were perpetual, i.e., they did not had to be renewed upon the heir's marriage ([Habakkuk 1994: 6](#)). If the exclusion restriction is

satisfied—that is, if the birth order of the heir only affects childlessness through our proxy for marriage settlements—we should find no effect for these populations.

Table 8 presents the results of this robustness check. The effect of marrying after inheritance on childlessness is much smaller and not significantly different from zero for peers’ daughters who did not marry heirs (col. 2).<sup>11</sup> In other words, for those who did not inherit the land, our proxy rightly indicates that marriage settlements did not affect their choice of having children. A Wald test confirms that the estimated coefficients are significantly different from the baseline effect for the sample of heir’s wives (col. 1).

We find similar results when we compare those who married English or Irish peers (col. 3) to those that married Scottish peers (col. 4), and thus, who had not to renew entailments every generation. Not signing a settlement increases the probability of being childless by 16 percentage points in the case of women who married English or Irish peers; in the case of wives of Scottish peers the coefficient is not significantly different from zero. The Wald test rejects that the effect is the same for wives of English or Irish peers and for wives of Scottish peers. Note that, compared to the results in columns (1) and (2), the Wald test is weaker. This may be the result of the measurement error: on the one hand, there are fewer Scottish peers, so the regression is estimated with fewer observations. On the other hand, Scottish peers typically held land and titles in England too, so many of them might have been subject to marriage settlements.

Altogether, the evidence indicates that marriage settlements played a crucial role in the probability of being childless. First-born heirs were exogenously more likely to marry before their father died, that is, they were more likely to sign a marriage settlement. Instead, heirs born after several daughters were more likely to inherit before their wedding and, thus, did not have to limit their interest in the estate to that of a life-tenant and did not have to commit to provide an allowance for their siblings. The empirical results suggest that this triggered high rates of childlessness.

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<sup>11</sup>Note that in this case the instrument is the birth order of the family heir, that is, the birth order of the husband’s older brother.

### 3.4 Robustness

This sub-section shows that our results are robust to alternative specifications of our proxy for settlements. So far, we have assumed that a family failed to renew the settlement if the family head died before the wedding of his heir. This proxy hinges on settlements being signed between the family head and his heir on the wedding day of the latter. Although there is ample evidence that this was the case in most families, [Habakkuk \(1950\)](#) also suggests that a significant amount of settlements were signed when the heir turned 21 (then the age of majority). In fact, Habakkuk suggests that this may even be a purest form of settlement, as

the father might find it advantageous to bargain with his eldest son before a marriage was in immediate prospect to avoid the pressure of the bride's family. ([Habakkuk 1950](#): p. 26).

In other words, settlements signed at the majority age of the heir may only reflect the motivation of settlements as an entail of the family estates, while settlements signed at the marriage of the heir may also reflect the interests of the bride's family bargaining for larger family provisions.

Here, we show that our results are robust to assuming that settlements were signed at majority age of the heir. In detail, [Table 9](#) presents our main results using an alternative proxy for settlements assuming that an heir did not sign a settlement with his father if the latter died before his 21st birthday.<sup>12</sup> As with the benchmark proxy, we find that not signing a settlement increases the probability to be childless. The magnitude of the IV coefficient (column 2) is not significantly different to that of [Table 7](#).

Note that here we find that the bias affecting the OLS results is an attenuation bias, as in [Table 7](#). Again, one possible explanation for this might be that if the father dies before the marriage of the heir or before the heir turns 21, he is less likely to influence the choice of the bride of the heir. If, in these situations, the heir chooses a

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<sup>12</sup>First-stage results for this alternative proxy are reported in [Table 10](#). Note that, as in the benchmark specification, first-born heirs are more likely to turn 21 before their father's death than later born heirs. F-stats are large enough to rule out concerns about weak instruments in this alternative specification too.

wife and has more children with her (e.g., because they are love matches rather than socially convenient marriages), this could explain the attenuation bias in our OLS specifications.

Furthermore, as in Table 8, our results suggest that women who were not exposed to settlements because they married a non-heir or a Scottish heir were not more prone to be childless if the family head died before the heir turned 21. Finally, column 5 suggests that our alternative proxy for not signing a settlement is not associated with the intensive margin of fertility, that is, the number of births by mothers.

Importantly, as settlements signed at the majority of the heir are not influenced by the interest of the bride’s family as much as settlements signed at the marriage of the heir, these results suggest that the effect of settlements on childlessness is explained by the motivation to entail of land with this legal instrument, and not by the bride’s family interest in setting provisions for the widow or the children of the couple.

## 4 A model of fertility and bequests

This section presents a simple theoretical framework with two main objectives: first, to highlight the mechanisms behind the reduced-form effect of settlements on fertility documented in Section 3. Second, the model rationalizes the existence of settlements, or, more generally, of inheritance rules that tie the hands of proprietors.

### 4.1 Setup

We assume a three-period sequential move game played by three generations  $i = \{1, 2, 3\}$  of the same dynasty. For simplicity, one can think of these as the father, the son, and the grandson. Each generation makes decisions regarding consumption,  $x_i$ , and fertility,  $n_i = \{0, 1\}$ . We model fertility as a binary choice and assume that there is no uncertainty regarding having an heir.<sup>13</sup> If a generation decides not to

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<sup>13</sup>Alternatively, Li and Pantano (2014) propose a dynamic framework of fertility choices in order to account for sex selection. From our sample, sex selection does not seem to be an issue among the British Nobility. An important concern is that families might stop having children once they conceive an heir. This does not seem to happen as on average 49% of last births within families are

have children, we assume that the dynasty dies out after this generation. A positive fertility has a cost  $q$  in terms of consumption goods.

The three generations belong to a dynasty endowed with wealth  $K$ . Think, for example, of landholdings. This endowment is used to subsidize the consumption and the cost of raising children of every generation. Therefore, the consumption of generation  $i$  today affects future generations by reducing their endowments.

The decisions of each generation, thus, crucially depend on how the dynasty wealth  $K$  is passed down from one generation to the next. This, in turn, depends on the degree of altruism towards future generations and on inheritance rules. We depart from the classic bequests models by assuming hyperbolic discounting towards future generations. This means that individuals are present biased as they value their consumption  $x_i$  over that of the next generations  $x_{i+1}$ . At the same time, they do not value their children's well-being significantly more than that of the future generations, namely their grandsons.

As for inheritance rules, we will consider two models: a the benchmark case where each generation decides the bequests to the next generation, and a model with commitment where the first generation decides the bequests of the following two generations. The latter case is meant to represent settlements, which ensured the father some control over the inheritance that his grandson would receive.

## 4.2 Model without commitment

Consider a model in which each generation decides over consumption, fertility, and the bequests for the next generation. Generation 1 derives utility from his consumption but also from the consumption of the following two generations in case the dynasty continues. We assume that the dynasty becomes extinct if any generation decides not to have children, and otherwise it dies out after generation 3.

Formally, the utility of generation 1 is

$$v_1(x_1, x_2, x_3, n_1, n_2) = u(x_1) + n_1 \cdot [\beta\delta u(x_2) + n_2 \cdot \beta\delta^2 u(x_3)], \quad (4)$$

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girls (see Table 2 for details).

where  $x_i$  and  $n_i = \{0, 1\}$  are the consumption and fertility of generation  $i \in \{1, 2, 3\}$ .

We assume that generation 1 has a quasi-hyperbolic discount function towards future generations. This discount function has two components: First,  $\delta \in [0, 1]$  is the discount rate for future generations. In other words, generation 1 is present-biased, that is, he values his consumption more than that of the next two generations. At the same time, he uses an additional discount factor  $\beta$  to discount all the future consumptions compared to his own. This additional discount factor therefore captures his dynastic preferences.

Consider Figure 4. For low values of  $\beta$ , generation 1 has a strong dynastic preference, in the sense that he values the consumption of his grandson and his son similarly. For high values of  $\beta$ , the discount function tends to the exponential discount function, implying that an individual values the consumption of his grandson much less than that of his son.

Hyperbolic discounting is important in this model because it provides the rationale for settlements. Under exponential discounting ( $\beta = 1$ ) generation 1's preference for his own consumption  $x_1$  relative to his son's consumption  $x_2$  is no different from his son's preference for his own consumption  $x_2$  relative to the succeeding generation's consumption  $x_3$ . In other words, preferences are time consistent across generations. This is hard to reconcile with inheritance schemes that tied the hands of proprietors, such as entails or settlements. In contrast, under hyperbolic discounting ( $\beta < 1$ ) individuals value the well-being of their grandchildren relatively more than their son will do, and hence, they have an incentive to restrict their son's freedom to manage the family estate with a settlement.

Generation 1 is subject to the following budget constraint. He needs to allocate the family wealth,  $K$ , to his own consumption, the cost  $q$  of having children if he decides to do so, and the bequests to the next generation,  $k_2$ . Formally,

$$K = x_1 + qn_1 + k_2. \tag{5}$$

Generation 2, the son, faces a similar problem. He derives utility from his consumption,  $x_2$ , and from the consumption of generation 3 in case he decides to have children.

His utility is therefore represented as

$$v_2(x_2, x_3, n_2) = u(x_2) + n_2 \cdot \beta \delta u(x_3). \quad (6)$$

His budget constraint is also similar to that of generation 1. He needs to allocate the bequest he receives from his father,  $k_2$ , to his own consumption, the cost  $q$  of having children if he decides to do so, and the bequests to the next generation,  $k_3$ . Formally,

$$k_2 = x_2 + qn_2 + k_3. \quad (7)$$

Finally, generation 3—the grandson—faces a trivial problem. The dynasty will die out after him, so he only values his own consumption:

$$v_3 = u(x_3). \quad (8)$$

As there is no intrinsic utility from having children, he will just decide to consume all his endowment, that is, the bequests he receives from previous generations,  $k_3$ .

Since we have a sequential move game with perfect information and finite time, we use subgame perfect equilibrium (SPE) as the solution concept.

**Definition 1 (SPE without commitment)** *The SPE of the sequential game in which each generation decides over the bequests for the next generation is a strategy profile  $\{k_2, k_3, x_1, x_2, x_3, n_1, n_2, n_3\}$  where  $\{k_2, x_1, n_1\}$  maximize  $v_1$  subject to (5),  $\{k_3, x_2, n_2\}$  maximize  $v_2$  subject to (7), and  $\{x_3, n_3\}$  maximize  $v_3$  subject to  $x_3 = k_3$ .*

We solve the model described in (4)-(8) by backward induction. Proposition 1 summarizes the optimal decisions regarding consumption and bequests conditional on fertility choices. Hereafter, we assume log-utility for simplicity; i.e.  $u(x_i) = \ln x_i$ .

**Proposition 1 (Consumption and bequests without commitment)** *Suppose that each generation decides over the bequests for the next generation. In any SPE:*

- (a) *If  $n_1 = 0$ , generation 1 consumes all the dynasty wealth,  $x_1 = K$ .*



- (b) If  $n_1 = 1$  and  $n_2 = 0$ , generation 1 consumes  $x_1^* := \frac{K - q}{1 + \beta\delta}$ , generation 2 consumes  $x_2^* := \frac{\beta\delta(K - q)}{1 + \beta\delta}$ , and generation 1 gives a bequest  $k_2^* := x_2^*$ .
- (c) If  $n_1 = 1$  and  $n_2 = 1$ , generation 1 consumes  $x_1^{**} := \frac{K - 2q}{1 + \beta\delta + \beta\delta^2}$ , generation 2 consumes  $x_2^{**} := \frac{1 + \delta}{1 + \beta\delta} \frac{\beta\delta(K - 2q)}{1 + \beta\delta + \beta\delta^2}$ , generation 3 consumes  $x_3^{**} := \frac{\beta(1 + \delta)}{1 + \beta\delta} \frac{\beta\delta^2(K - 2q)}{1 + \beta\delta + \beta\delta^2}$ , and generations 1 and 2 give a bequest  $k_2^{**} := K - x_1^{**} - q$  and  $k_3^{**} := x_3^{**}$  respectively.

Proof: See Appendix [A.1](#). ■

Given these optimal levels of consumption  $K, x_1^*, x_2^*, x_1^{**}$ , and  $x_2^{**}$ , we derive the optimal fertility choices for each generation by comparing the indirect utilities of having children and being childless. Proposition 2 characterizes these fertility decisions.

**Proposition 2 (Fertility without commitment)** *Suppose each generation decides over the bequests for the next generation. In any SPE:*

- (a) Generation 3 never has children,  $n_3 = 0$ .
- (b) Generation 2 has children,  $n_2 = 1$ , if and only if:

$$f(k_2, q, \beta, \delta) := v_2 \left( x_2 = \frac{k_2 - q}{1 + \beta\delta}, x_3 = \frac{\beta\delta(k_2 - q)}{1 + \beta\delta}, n_2 = 1 \right) - v_2(x_2 = k_2, x_3 = 0, n_2 = 0) > 0,$$

where  $f_{k_2} > 0$  and  $f_q < 0$ .

- (c) Generation 1 has children,  $n_1 = 1$ , if and only if:

$$g(K, q, \beta, \delta) := v_1(x_1^*, x_2^*, x_3 = 0, n_1 = 1, n_2 = 0) - v_1(x_1 = K, x_2 = 0, x_3 = 0, n_1 = 0, n_2 = 0) > 0 \quad \text{when } f(k_2^*, q, \beta, \delta) < 0,$$

or

$$h(K, q, \beta, \delta) := v_1(x_1^{**}, x_2^{**}, x_3^{**}, n_1 = 1, n_2 = 1) - v_1(x_1 = K, x_2 = 0, x_3 = 0, n_1 = 0, n_2 = 0) > 0 \quad \text{when } f(k_2^{**}, q, \beta, \delta) > 0$$

where  $g_K, h_K > 0$  and  $g_q, h_q < 0$ .

Proof: See Appendix A.2. ■

Each generation will have children if and only if his indirect utility of doing so exceeds the indirect utility of being childless. The gains of having children for generation 2 are captured by the function  $f$ , where  $x_2 = \frac{k_2 - q}{1 + \beta\delta}$  and  $k_3 = x_3 = \frac{\beta\delta(k_2 - q)}{1 + \beta\delta}$  are the optimal consumption and bequest decisions when he has children, and  $x_2 = k_2$  and  $k_3 = 0$  when he is childless.<sup>14</sup> Importantly,  $f$  depends positively on his wealth,  $k_2$ . That is, the larger the bequest  $k_2$  that generation 2 receives from his father, the more likely he is to have children. Obviously, childlessness is more attractive the larger the costs of raising children  $q$ .

In addition to wealth and the cost  $q$ , the gains from having children for generation 1 also depend on whether he anticipates to have a grandson or not. Specifically, function  $g$  captures the difference in indirect utilities from having children or not when the dynasty dies out after generation 2; i.e., when  $f < 0$ . Function  $h$  is for the case in which the dynasty continues until generation 3; i.e., when  $f > 0$ . Note that generation 1 can influence the fertility decision of his son, that is, can influence the continuation of the dynasty, by leaving a larger bequest  $k_2$  to the next generation.

Proposition 3 describes the conditions for the three possible SPE without commitment; i.e., a high-fertility SPE in which generations 1 and 2 have children, a low-fertility SPE in which only generation 1 has children, and a no-fertility SPE in which generation 1 is childless.

**Proposition 3 (SPE without commitment)** *Suppose each generation decides over the bequests for the next generation. Then,*

- (i) *A high-fertility strategy  $\{k_2^{**}, k_3^{**}, x_1^{**}, x_2^{**}, x_3^{**}, n_1=1, n_2=1, n_3=0\}$  is the SPE if:*
  - (a)  $f(k_2^{**}, q, \beta, \delta) > 0$ ;  $h(K, q, \beta, \delta) > 0$ ; and
  - (b)  $v_1(x_1^{**}, x_2^{**}, x_3^{**}, n_1=1, n_2=1) > v_1(x_1^*, x_2^*, x_3=0, n_1=1, n_2=0)$  when  $f(k_2^*, q, \beta, \delta) < 0$  and  $f(k_2^{**}, q, \beta, \delta) > 0$ .

- (ii) *A low-fertility strategy  $\{k_2^*, k_3=0, x_1^*, x_2^*, x_3=0, n_1=1, n_2=0, n_3=0\}$  is the SPE if:*

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<sup>14</sup>To define  $f$  we characterize the indirect utility of being childless as  $v_2(x_2 = k_2, x_3 = 0, n_2 = 0)$ . This is a slight abuse of notation, as  $n_2 = 0$  implies that the third generation does not exist. Hence,  $x_3$  is not zero but undefined. Since the utility carried by future generations is multiplied by  $n_i$  this is inconsequential. The same applies for the indirect utility of being childless of generation 1.

- (a)  $f(k_2^*, q, \beta, \delta) < 0$ ;  $g(K, q, \beta, \delta) > 0$ , and
- (b)  $v_1(x_1^{**}, x_2^{**}, x_3^{**}, n_1=1, n_2=1) < v_1(x_1^*, x_2^*, x_3=0, n_1=1, n_2=0)$  when  
 $f(k_2^*, q, \beta, \delta) < 0$  and  $f(k_2^{**}, q, \beta, \delta) > 0$ .
- (iii) A no-fertility strategy  $\{k_2=k_3=0, x_1=K, x_2=x_3=0, n_1=n_2=n_3=0\}$  is the SPE if  
 $g(K, q, \beta, \delta) < 0$  and  $h(K, q, \beta, \delta) < 0$ .

Proof: See Appendix [A.3](#). ■

For each SPE, condition (a) guarantees that generation 1 and generation 2 take the optimal fertility decisions for a given  $k_1, k_2, x_1, x_2, x_3$ . Condition (b) ensures that generation 1 internalizes optimally that he can influence the fertility choices of the second generation. Specifically, note that for some parameter values, both  $f(k_2^*, q, \beta, \delta) < 0$  and  $f(k_2^{**}, q, \beta, \delta) > 0$  are satisfied. In other words, generation 1 can choose between an SPE in which he gives a low bequest  $k_2^*$  and generation 2 is childless and an SPE in which he gives a high bequest  $k_2^{**}$  and generation 2 has children. Condition (b) guarantees that generation 1 chooses his preferred SPE when these two are feasible.

Propositions 2 and 3 suggest that intergenerational discounting plays a crucial role in fertility choices. Figure 5 illustrates how the two discount factors,  $\beta$  and  $\delta$ , affect fertility for a given endowment  $K$  and cost of having children  $q$ . Remember that  $\delta$  captures the traditional discount factor, while  $\beta$  captures dynastic preferences. For low values of  $\beta$  and  $\delta$ , that is, when individuals are highly present-biased, generation 1 will prefer to consume all the dynasty wealth  $K$  and not have children. That is, the dynasty will die out in the first generation. For high discounts, the opposite holds. Individuals value the consumption of future generations more, so both generation 1 and 2 decide to have children. For intermediate discounts, only generation 1 will have children.

Next, we solve a model in which generation 1 makes all the decisions regarding bequests, and show that this commitment device can be used to increase the fertility of generation 2.

### 4.3 Model with commitment

Consider a model where generation 1, the father, sets all bequests for future generations, namely  $k_2$  and  $k_3$ . This commitment device closely resembles the strict settlement, which ensured the family head (e.g., the father) control over the inheritance that the next generation's heir (e.g., the grandson) would receive.

Each generation still decides over fertility and consumption but, in contrast to the previous model, here generation 1 sets all bequests. Therefore, the constraints of generations 1 and 2 are now

$$K = x_1 + qn_1 + k_2 + k_3 \quad (9)$$

and

$$k_2 = x_2 + qn_2. \quad (10)$$

The decision problem of each generation is now characterized by equations (4), (6), (8), (9) and (10). Definition 2 characterizes the SPE of this game.

**Definition 2 (SPE with commitment)** *The SPE of the sequential game in which generation 1 decides over the bequests for the following two generations is a strategy profile  $\{k_2, k_3, x_1, x_2, x_3, n_1, n_2, n_3\}$  where  $\{k_2, k_3, x_1, n_1\}$  maximize  $v_1$  subject to (9),  $\{x_2, n_2\}$  maximize  $v_2$  subject to (10), and  $\{x_3, n_3\}$  maximize  $v_3$  subject to  $x_3 = k_3$ .*

Proposition 4 summarizes the optimal decisions regarding consumption and bequests in this setting.

**Proposition 4 (Consumption and bequests with commitment)** *Suppose generation 1 decides over the bequests for the following two generations. In any SPE:*

- (i) *If  $n_1 = 0$ , generation 1 consumes all the dynasty wealth,  $x_1 = K$ .*
- (ii) *If  $n_1 = 1$  and  $n_2 = 0$ , generations 1 and 2 consume  $x_1^*$  and  $x_2^*$  and generation 1 gives a bequest  $k_2 = x_2^*$  as in the model without commitment.*
- (iii) *If  $n_1 = 1$  and  $n_2 = 1$ , generation 1 consumes  $x_{1c}^{**} := \frac{1}{1 + \beta\delta + \beta\delta^2}(K - 2q)$ , generation 2 consumes  $x_{2c}^{**} := \frac{\beta\delta}{1 + \beta\delta + \beta\delta^2}(K - 2q)$ , generation 3 consumes  $x_{3c}^{**} :=$*

$\frac{\beta\delta^2}{1 + \beta\delta + \beta\delta^2}(K - 2q)$ , and generation 1 chooses  $k_{2c}^{**} := x_{2c}^{**} + q$  and  $k_{3c}^{**} := x_{3c}^{**}$  as bequests.

Proof: See Appendix [A.4](#). ■

Proposition 4 suggests that the consumption and bequest decisions when  $\{n_1 = 0\}$  and when  $\{n_1 = 1, n_2 = 0\}$  are identical to the decisions from the model without commitment. In other words, the commitment device that allows generation 1 to set all bequests is only relevant when the dynasty does not die out,  $n_1 = n_2 = 1$ . In the latter case, note that  $x_{2c}^{**} < x_2^{**}$  and  $x_{3c}^{**} > x_3^{**}$ . That is, generation 1 redistributes consumption from generation 2 to generation 3 by settling a larger bequest  $k_3$  than the one generation 2 would have left in the model without commitment. Proposition 5 characterizes how this redistribution of family wealth affects fertility decisions.

**Proposition 5 (Fertility with commitment)** *Suppose that generation 1 decides over the bequests for the following two generations. In any SPE:*

(i) *Generation 3 never has children,  $n_3 = 0$ .*

(ii) *Generation 2 has children,  $n_2 = 1$ , if and only if:*

$$\mathcal{F}(k_2, k_3, q, \beta, \delta) := v_2(x_2=k_2 - q, x_3=k_3, n_2=1) - v_2(x_2=k_2, x_3=0, n_2=0) > 0,$$

where  $\mathcal{F}_{k_2} > 0$ ,  $\mathcal{F}_{k_3} > 0$ , and  $\mathcal{F}_q < 0$ .

(iii) *Generation 1 has children,  $n_1 = 1$ , if and only if:*

$$g(K, q, \beta, \delta) := v_1(x_1^*, x_2^*, x_3=0, n_1=1, n_2=0) - v_1(x_1=K, x_2=x_3=0, n_1=n_2=0) > 0$$

or

$$\mathcal{H}(K, q, \beta, \delta) := v_1(x_{1c}^{**}, x_{2c}^{**}, x_{3c}^{**}, n_1=1, n_2=1) - v_1(x_1=K, x_2=x_3=0, n_1=n_2=0) > 0 \text{ when } \mathcal{F}(k_{2c}^{**}, k_{3c}^{**}, q, \beta, \delta) > 0,$$

where  $g_K, \mathcal{H}_K > 0$ , and  $g_q, \mathcal{H}_q < 0$ .

Proof: See Appendix [A.5](#). ■

The fertility choices for generation 2 change significantly when the generation 1 sets all bequests. The gains of having children are captured by the function  $\mathcal{F}$  in the model with commitment. Note that  $\mathcal{F}$  not only depends on generation 2's endowment,  $k_2$ , but also on the endowment that generation 1 settled for generation 3,  $k_3$ . For example, when generation 1 sets  $k_3 = 0$ , generation 2 will always prefer to be childless. Therefore, in the model with commitment generation 1 can influence the fertility choices of his son through two channels: by giving him a higher endowment, but also by settling more wealth for the third generation.

Proposition 6 describes the conditions for the three possible SPE with commitment; i.e., a high-fertility SPE in which generations 1 and 2 have children, a low-fertility SPE in which only generation 1 has children, and a no-fertility SPE in which generations 1 is childless.

**Proposition 6 (SPE with commitment)** *Suppose that generation 1 decides over the bequests for the following two generations. Then,*

- (i) *A high-fertility strategy  $\{k_{2c}^{**}, k_{3c}^{**}, x_{1c}^{**}, x_{2c}^{**}, x_{3c}^{**}, n_1=1, n_2=1, n_3=0\}$  is the SPE if:*
  - (a)  $\mathcal{F}(k_{2c}^{**}, k_{3c}^{**}, q, \beta, \delta) > 0$ ;  $\mathcal{H}(K, q, \beta, \delta) > 0$ ; and
  - (b)  $v_1(x_{1c}^{**}, x_{2c}^{**}, x_{3c}^{**}, n_1=1, n_2=1) > v_1(x_1^*, x_2^*, x_3=0, n_1=1, n_2=0)$ ,
- (ii) *A low-fertility strategy  $\{k_2^*, k_3=0, x_1^*, x_2^*, x_3=0, n_1=1, n_2=0, n_3=0\}$  is the SPE if:*
  - (a)  $g(K, q, \beta, \delta) > 0$ , and
  - (b)  $v_1(x_{1c}^{**}, x_{2c}^{**}, x_{3c}^{**}, n_1=1, n_2=1) < v_1(x_1^*, x_2^*, x_3=0, n_1=1, n_2=0)$  when  $\mathcal{F}(k_{2c}^{**}, k_{3c}^{**}, q, \beta, \delta) > 0$ ,
- (iii) *A no-fertility strategy  $\{k_2=k_3=0, x_1=K, x_2=x_3=0, n_1=n_2=n_3=0\}$  is the SPE if  $g(K, q, \beta, \delta) < 0$  and  $\mathcal{H}(K, q, \beta, \delta) < 0$ .*

Proof: See Appendix A.6. ■

As before, for each SPE condition (a) guarantees that generation 1 and generation 2 take the optimal fertility decisions for a given  $k_1$ ,  $k_2$ ,  $x_1$ ,  $x_2$ ,  $x_3$ . Condition (b) ensures that generation 1 internalizes optimally that he can influence the fertility choices of the second generation. That is, that generation 1 chooses his preferred

SPE when both the high-fertility SPE and the low-fertility SPE are feasible; i.e., when  $\mathcal{F}(k_{2c}^{**}, k_{3c}^{**}, q, \beta, \delta) > 0$ .

Propositions 5 and 6 highlight the importance of settlements for fertility decisions. Now generation 1 can affect the fertility choices of generation 2 not only by giving him a higher bequest  $k_2$ , but also by settling a larger  $k_3$  for generation 3. This additional channel is particularly important when the dynasty exhibits hyperbolic discounting. Figure 6 illustrates how the two discount factors,  $\beta$  and  $\delta$ , affect the SPE in the two models, with and without commitment. In both cases, higher discounts are associated with high fertility; low discounts with no fertility. But when generation 1 sets all bequests the region where both the first and second generation have children is larger. In detail, the orange region is where the second generation does not have children in the model without commitment, but has children in the model with commitment. Proposition 7 generalizes this result.

**Proposition 7 (The effect of settlements on fertility)** *Generation 2 is childless in the model without commitment and has children in the model with commitment if the conditions for the low-fertility SPE in Proposition 3 and the conditions for the high-fertility SPE in Proposition 6 are satisfied.*

Proof: See Appendix A.7. ■

Proposition 7 reproduces our empirical finding: individuals who signed a settlement with their father were more likely to have children than individuals who were not subject to a settlement. Importantly, this happens in the parameter region where discounting is more hyperbolic. Here generation 1, the father, is more eager for the dynasty not to die out in the next generation. Without commitment, he can only influence his son to give him grandchildren by giving him a large endowment  $k_2$ . In contrast, with commitment he can also *force* him to have children by allocating a higher portion of the inheritance to his yet-to-be-born grandson. This is why the region where generation 2 has children is larger under commitment. This stylized model, therefore, suggests that hyperbolic discounting across generations can explain the effect of settlements in reducing childlessness.

Proposition 8 derives the welfare implications of the model with commitment compared to the benchmark case where each generation decides the bequests of the following generation.

**Proposition 8 (Welfare)** *In the parameter region defined in Proposition 7, commitment is welfare improving in comparison to the benchmark model in which each generation decides over the bequest of the next generation. Specifically, all generations are better off; i.e.,  $v_3(x_{3c}^{**}) > v_3(x_3 = 0)$ ,  $v_2(x_{2c}^{**}, x_{3c}^{**}, n_2=1) > v_2(x_2^*, x_3=0, n_2=0)$ , and  $v_1(x_{1c}^{**}, x_{2c}^{**}, x_{3c}^{**}, n_1=1, n_2=1) > v_1(x_1^*, x_2^*, x_3=0, n_1=1, n_2=0)$ .*

Proof: See Appendix A.8. ■

In other words, commitment is welfare improving for dynasties with hyperbolic discounting. On the one hand, generation 1 will always prefer an arrangement in which he can decide the bequests of the following two generations, as this allows him to solve the problem of inter-generational time inconsistency. In the model with commitment he can settle a larger bequest to generation 3, while in the model without commitment generation 2 would choose a smaller bequest. On the other hand, generation 2 *ex ante* prefers the model with commitment as this guarantees that a larger share of the family wealth  $K$  will trickle down from generation 1; i.e.,  $k_{2c}^{**} + k_{3c}^{**} > k_2^*$ . Finally, generation 3 obviously prefers the model with commitment as this guarantees him a larger bequest.

This result provides a rational for the widespread use of settlements in the aristocracy. On the one hand, the aristocracy is likely to have strong dynastic preferences. That is, it is likely to exhibit hyperbolic discounting across generations, and hence, improve its welfare with a commitment device that gives the family head (e.g., the father) some control over the inheritance that the next generation's heir (e.g., the grandson) will receive.<sup>15</sup> On the other hand, the fact that both generation 1 and generation 2 benefit, *ex ante*, from such a commitment explains why both the family head and the heir would accept signing a settlement upon the marriage of the latter.<sup>16</sup>

In sum, this stylized model provides two sets of interesting results. First, it shows that hyperbolic discounting across generations can explain why settlements reduced childlessness and moved the aristocracy to a high fertility regime. Second, hyper-

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<sup>15</sup>From a societal point of view, however, the welfare implications are not clear as this mechanism can contribute to higher inequality.

<sup>16</sup>Admittedly, according to this model signing a settlement should occur before the heirs marriage, as this reduces the probability that the father dies before the wedding and, hence, that the settlement is not signed. Although our empirical results are robust to this possibility, it is certainly true that not all settlements were signed when the heir turned 21. This is explained by the interest of the bride's family in fixing allowances for the bride and the younger children of the marriage. In this paper, we have abstracted from the use of settlements as a device to fix family provisions.



bolic discounting provides a rational for the widespread use of settlements, and more generally, of inheritance rules that tie the hands of proprietors (e.g., entail and trust).

## 5 Conclusion

From 1650 to 1882, British peers could not freely dispose of their estates. Upon their marriage, peer heirs signed a settlement with their father in which they committed to pass down the family estate, unbroken, to the next generation. In this paper we show that such arrangements were crucial in reducing the high rates of childlessness in the British aristocracy. This ensured the continuation of family lineages and, thus, that wealth would remain concentrated in their hands. Using demographic evidence from about 1,500 wives of heirs to a peerage between 1650 and 1882, we show that heirs marrying after their fathers' death—that is, heirs that were subject to a settlement—were 15 percentage points more likely to have children. We address endogeneity concerns in the relation between our proxy for settlements and fertility. First, we show that results are robust to the inclusion of covariates that may also affect childlessness. Second, we estimate all the effects using variation within a lineage. That should capture any genetic, cultural, religious, or socio-economic predisposition towards childlessness. Finally, we estimate an instrumental variables model that uses exogenous variation in the probability of heirs marrying before the fathers' death—that is, our proxy for signing a settlement—coming from the birth order of the heir.

In the second part of the paper, we develop a model of household decisions where three generations of the same dynasty decide sequentially over consumption and fertility. We depart from the classic bequests models by assuming that individuals have quasi-hyperbolic discount function towards future generations and that altruism is higher towards direct descendants than towards distant relatives. As preferences are not consistent across generations, fathers have an incentive to restrict their son's freedom to manage the family estate with a settlement. We then model settlements as a commitment device that allows the father to decide all bequests of future generations. In this model with commitment, we show that the father can influence the fertility decisions of his son by settling a larger endowment for the third generation, namely the grandson. As a result, the family dynasty is less likely to die out than in a model

where every generation decides the bequests of the next generation. This effect is stronger for more hyperbolic discount functions, suggesting that this particular time-preference may explain the reduced-form effect of settlements on fertility that we document in the empirical analysis.

These results have two sets of implications: first, we argue that the benchmark model of bequests assuming exponential discounting ([Barro 1974](#)) is inconsistent with many inheritance rules that tie the hands of proprietors, and that this type of discounting may ignore important effects of such inheritance rules on fertility. Second, while economists typically think of fertility and inequality to be negatively related ([Deaton and Paxson 1997](#); [Kremer and Chen 2002](#); [de la Croix and Doepke 2003](#)), our results suggest that this relation may be the opposite on the extensive margin of fertility. Settlements contributed to inequality not only by entailing the land, but also by ensuring the survival of noble dynasties at the top of the distribution.

## References

- Aaronson, Daniel, Fabian Lange, and Bhashkar Mazumder. 2014. “Fertility Transitions along the Extensive and Intensive Margins.” *American Economic Review* 104 (1): 3701–3724.
- Acemoglu, Daron. 2008. “Oligarchic Versus Democratic Societies.” *Journal of the European Economic Association* 6 (1): 1–44 (03).
- Allen, Douglas W. 2009. “A Theory of the Pre-Modern British Aristocracy.” *Explorations in Economic History* 46 (3): pp. 299–313.
- Anderson, Michael. 1998. “Highly Restricted Fertility: Very Small Families in the British Fertility Decline.” *Population Studies* 52 (2): 177–199 (July).
- Barro, Robert J. 1974. “Are Government Bonds Net Wealth?” *Journal of Political Economy* 82 (6): 1095–1117.
- Bateman, John. 1883. *The Great Landowners of Great Britain and Ireland*. London: Harrison and Sons.
- Baudin, Thomas, David de la Croix, and Paula Gobbi. 2015. “Fertility and childlessness in the United States.” *American Economic Review* 105 (6): 1852–1882.

- Bertocchi, Graziella. 2006. "The Law of Primogeniture and the Transition from Landed Aristocracy to Industrial Democracy." *Journal of Economic Growth* 11 (1): 43–70.
- Bonfield, Lloyd. 1979. "Marriage Settlements and the 'Rise of Great Estates': The Demographic Aspect." *The Economic History Review* 32 (4): 483–493.
- . 1983. *Marriage Settlements 1601-1740. The Adoption of the Strict Settlement*. Edited by D. E. C. Yale. Cambridge University Press.
- Brée, Sandra, and David de la Croix. 2016, July. "Key Forces Behind the Decline of Fertility: Lessons from Childlessness in Rouen before the Industrial Revolution." Unpublished.
- Cahill, Kevin. 2002. *Who Owns Britain and Ireland*. Edinburgh: Canongate Books.
- Cannadine, David. 1990. *The Decline and Fall of the British Aristocracy*. New Haven: Yale University Press.
- Clark, Gregory, and Neil Cummins. 2009. "Urbanization, Mortality, and Fertility in Malthusian England." *The American Economic Review* 99 (2): 242–247 (May). Papers and Proceedings of the One Hundred Twenty-First Meeting of the American Economic Association.
- . 2015. "Intergenerational Wealth Mobility in England, 1858–2012: Surnames and Social Mobility." *Economic Journal* 125 (582): 61–85.
- Clark, Gregory, Neil Cummins, Yu Hao, Daniel Diaz Vidal, Tatsuya Ishii, Zach Landes, Daniel Marcin, Firas Abu-Sneneh, Wilfred Chow, Kuk Mo Jung, Ariel M. Marek, and Kevin M. Williams. 2014. *The Son also Rises: Surnames and the History of Social Mobility*. Princeton: Princeton University Press.
- Deaton, Angus, and Christina Paxson. 1997. "The effects of economic and population growth on national saving and inequality." *Demography* 34 (1): 97–114.
- de la Croix, David, and Matthias Doepke. 2003. "Inequality and Growth: Why Differential Fertility Matters." *American Economic Review* 93 (4): 1091–1113 (September).
- de la Croix, David, Eric Schneider, and Jacob Weisdorf. 2017. "Decessit sine prole - Childlessness, Celibacy, and Survival of the Richest [with ]." Unpublished.

- Diamond, P., and B. Köszegi. 2003. "Quasi-hyperbolic discounting and retirement." *Journal of Public Economics* 87 (9-10): 1839-72 (September).
- English, B., and J. Saville. 1983. *Strict Settlement: A Guide for Historians*. Hull : University of Hull Press.
- Galor, Oded. 2011. *Unified Growth Theory*. Edited by Princeton University Press.
- Galor, Oded, and Marc Klemp. 2014, September. "The Biocultural Origins of Human Capital Formation." Working paper 20474, National Bureau of Economic Research.
- Goñi, Marc. 2014, July. "Kissing cousins. Estimating the causal effect of consanguinity on fertility using evidence from the London Season." Unpublished.
- Goni, Marc. 2016. "Assortative Matching and Persistent Inequality. Evidence from the world's most exclusive marriage market." Manuscript, University of Vienna.
- Gruber, J., and B. Köszegi. 2001. "Is addiction "rational"? Theory and evidence." *Quarterly Journal of Economics* 116 (4): 1261-304 (November).
- Habakkuk, H. J. 1950. "Marriage Settlements in the Eighteenth Century." *Transactions of the Royal Historical Society*.
- . 1994. *Marriage, Debt, and the Estates System: English Landownership, 1650-1950*. Oxford: Clarendon Press.
- Hollingsworth, T. H. 1964. "The Demography of the British Peerage." *Population Studies*, vol. Supplement.
- . 2001. "Hollingsworth Genealogical Data on the British Peerage". Database. Re-digitised from handwritten original index sheets and archived by the Cambridge Group for the History of Population and Social Structure.
- Kremer, Michael, and Daniel L. Chen. 2002. "Income Distribution Dynamics with Endogenous Fertility." *Journal of Economic Growth* 7 (3): 227-258 (Sep).
- Laibson, D. I., A. Repetto, and J. Tobacman. 1998. "Self control and saving for retirement." *Brookings Papers on Economic Activity* 1 (1): 91-172.
- Lévy, Claude, and Louis Henry. 1960. "Ducs et pairs sous l'Ancien Régime. Caractéristiques démographiques d'une caste." *Population (French Edition)* 15 (5): 807-830.

- Li, Qi, and Juan Pantano. 2014. "The demographic consequences of sex-selection technology." *Unpublished*.
- Long, Jason, and Joseph Ferrie. 2013. "Intergenerational Occupational Mobility in Great Britain and the United States since 1850." *American Economic Review* 103 (4): pp. 1109–37.
- Marcassa, Stefania, Jérôme Pouyet, and Thomas Trégouët. 2017. "Marriage Strategy Among European Nobility." *Unpublished*.
- Miles, A. 1993. "How Open Was Nineteenth-Century British Society? Social Mobility and Equality of Opportunity, 1839–1914." In *Building European Society: Occupational Change and Social Mobility in Europe, 1840–1940*, edited by Andrew Miles and David Vincent. Manchester: Manchester University Press.
- Mitch, David F. 1993. "Inequalities Which Every One May Remove: Occupational Recruitment, Endogamy, and the Homogeneity of Social Origins in Victorian England." In *Building European Society: Occupational Change and Social Mobility in Europe, 1840–1940*, edited by Andrew Miles and David Vincent. Manchester: Manchester University Press.
- Pedlow, Gregory W. 1982. "Marriage, Family Size, and Inheritance Among Hessian Nobles, 1650–1900." *Journal of Family History* 7 (4): 333–352.
- Phelps, E. S., and R. A. Pollak. 1968. "On Second-Best National Saving and Game-Equilibrium Growth." *The Review of Economic Studies* 35 (2): 185–199.
- Piketty, Thomas. 2011. "On the Long-Run Evolution of Inheritance: France 1820–2050 \*." *The Quarterly Journal of Economics* 126 (3): 1071.
- Piketty, Thomas, and Emmanuel Saez. 2006. "The Evolution of Top Incomes: A Historical and International Perspective." *American Economic Review* 96 (2): 200–205.
- Wigniolle, Bertrand. 2013. "Fertility in the absence of self-control." *Mathematical Social Sciences* 66 (1): 71–86 (July).
- Wrede, M. 2011. "Hyperbolic discounting and fertility." *Journal of Population Economics* 24 (3): 1053–1070.
- Wrigley, Edward Anthony, R S Davies James Oeppen, and Roger Schoeld. 1997. *English Population History from Family Reconstitution: 1580–1837*. Cambridge: Cambridge University Press.

## 6 Figures and Tables

Figure 1: Charles Lyttelton, 8th Viscount Cobham, Cokayne's *Complete Peerage* (1913).

**VIL 1876. 5. CHARLES GEORGE (LYTTELTON), LORD LYTTELTON, BARON OF FRANKLEY [1794] also BARON WESTCOTE OF BALLYMORE in the peerage of Ireland [1776] also a Baronet [1618], s. and h., by 1st wife, b. 27 Oct. 1842; ed. at Eton and at Trin. Coll., Cambridge; M.P. for East Worcestershire, 1868-74: *suc. to the peerage*, 18 April 1876; Land Commr., 1881-89; *suc.* as VISCOUNT COBHAM AND BARON COBHAM, on the death, 26 March 1889, of his distant cousin (the Duke of Buckingham and Chandos, Viscount Cobham. &c.). under the *spec. rem.* in the creation of that dignity. 23 May 1718. He m. 19 Oct. 1878, Mary Susan Caroline, 2d da. of William George (CAVENDISH), 2d BARON CHESHAM, by Henrietta Frances. da. of the Rt. Hon. William Saunders Sebright LASCELLES. She was b. 19 March 1853.**

Figure 2: James Hamilton, 1st Earl of Abercorn, Hollingsworth database.

**Hollingsworth's Peerage Data**

Ref No:

**New Record**

Ref No: 
 Child: 
 Parent: 
 Rank: 
 Title:

Surname: 
 Comment:

First Names:

Highest titles succeeded to.

Father	Mother	Self	Illegitimate: Males	Created:
Succ. Heir Cr.	Succ. Heir Cr.	Succ. Heir Cr.	Females	Violent Death
<input type="text" value="1"/> <input type="text" value="1"/> <input type="text" value="8"/>	<input type="text" value="1"/> <input type="text" value="1"/> <input type="text" value="1"/>	<input type="text" value="1"/> <input type="text" value="8"/> <input type="text" value="5"/>	<input type="text" value="0"/>	<input type="text" value="10 July 160"/>

Sex/Death:  Sole Heirship: ☒

Died:  Notes:

Birth	Day	Month	Year	Acc	After	Before	Comment
<input type="text" value="12"/>	<input type="text" value="5"/>	<input type="text" value="1575"/>	<input type="text" value="y"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Death	Day	Month	Year	Acc	After	Before	Comment
<input type="text" value="23"/>	<input type="text" value="0"/>	<input type="text" value="1618"/>	<input type="text" value="y"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

N of Marriages:  No of this Marriage:

Children:  This Marriage, Live:

All Marriages, STILL:  All Marriages, LIVE:

Spouse	First Names	Surname	Comment	Child	Parent	Rank	Title	Address
Spouse	Merion		eld. dau.					
Widow/er of								
Spouse's Father	Thomas	Boyd				6B	Boyd	Kilmarnock
Spouse's Mother	Marqueret or Mariar							
Mat. GrFather	Matthew	Campbell				Sir		London

Parent Spouse

Origin  Heir

Marriage	Spouse's Birth	Spouse's Death	Divorce
Day <input type="text" value="12"/>	<input type="text" value="1"/>	<input type="text" value="26"/>	<input type="text"/>
Month <input type="text" value="x"/>	<input type="text" value="1"/>	<input type="text" value="5"/>	<input type="text"/>
Year <input type="text" value="1599"/>	<input type="text" value="1579"/>	<input type="text" value="1632"/>	<input type="text"/>
Acc. <input type="text" value="6"/>	<input type="text" value="7"/>	<input type="text" value="y"/>	<input type="text"/>
After <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Before <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Comment <input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Notes:

Children Set No:  Average accuracy of birth dates

Num	Name	Remarks	Da	Montl	Yee	Surviva	Accura	Ref Nc
1	Anne		19	9	1599	1	5	0
2	James	2E	22	x	1601	0	5	0
3	Claude	2B Strabane	21	2	1602	0	5	0
4	William		16	6	1603	0	5	0
5	George		9	x	1605	0	5	0
6	Margaret		28	4	1606	1	6	0
7	Lucy		11	x	1608	1	6	0
8	Isabel		20	6	1609	1	6	0
9	Archibald		24	2	1611	0	6	0
*	0				0			0

Record: 1 of 9
No Filter
Search

Figure 3: Childlessness rates and average births of mothers, by marriage decade.

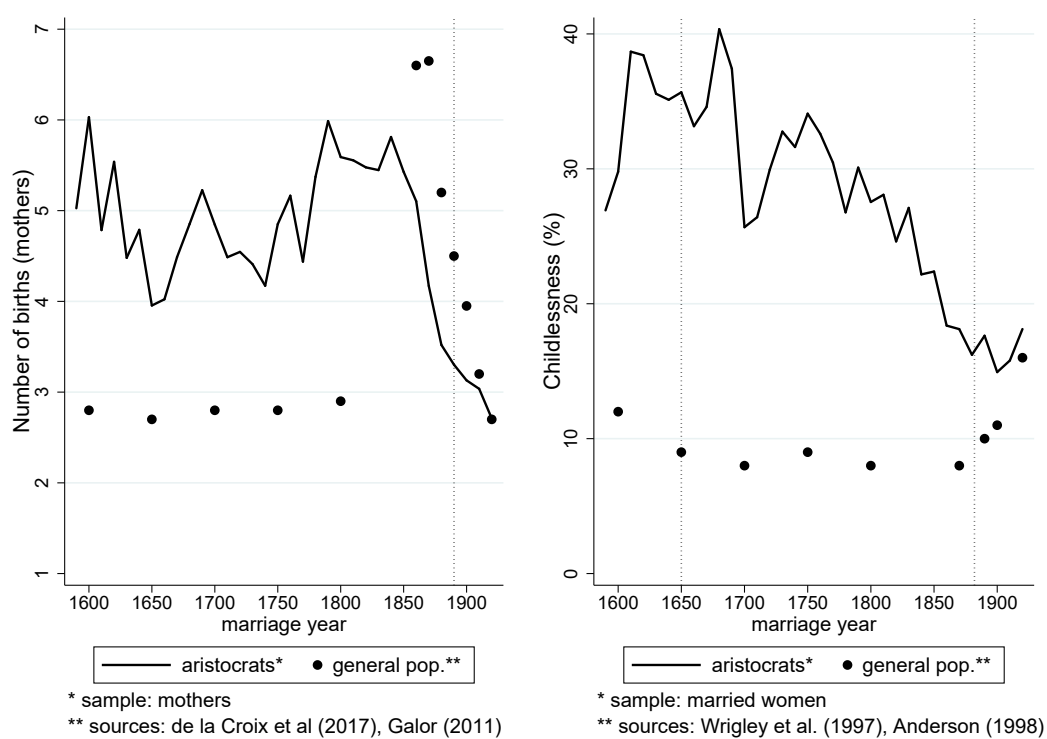




Figure 4: Quasi-hyperbolic discrete discount function

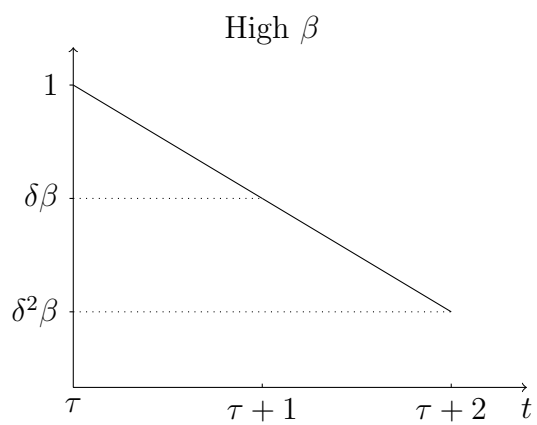
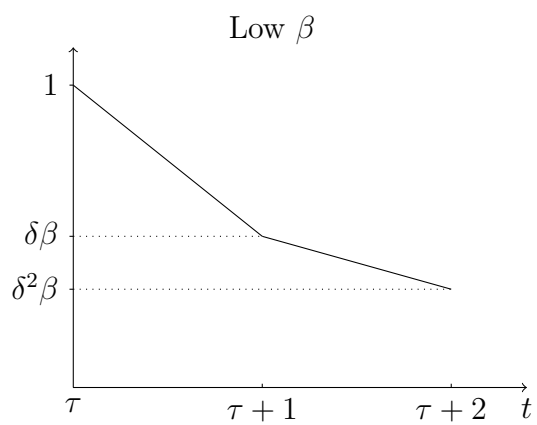
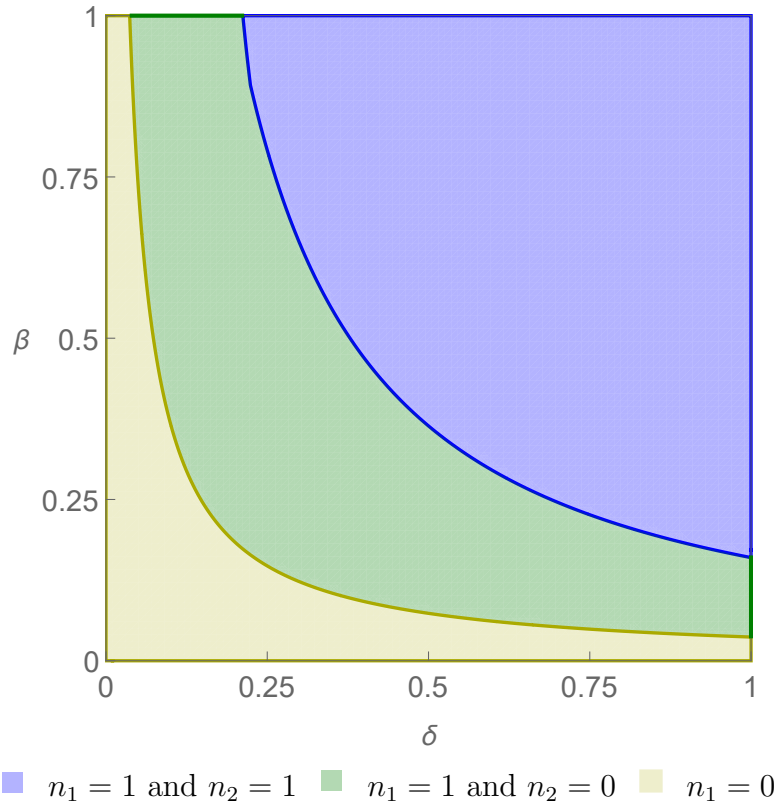
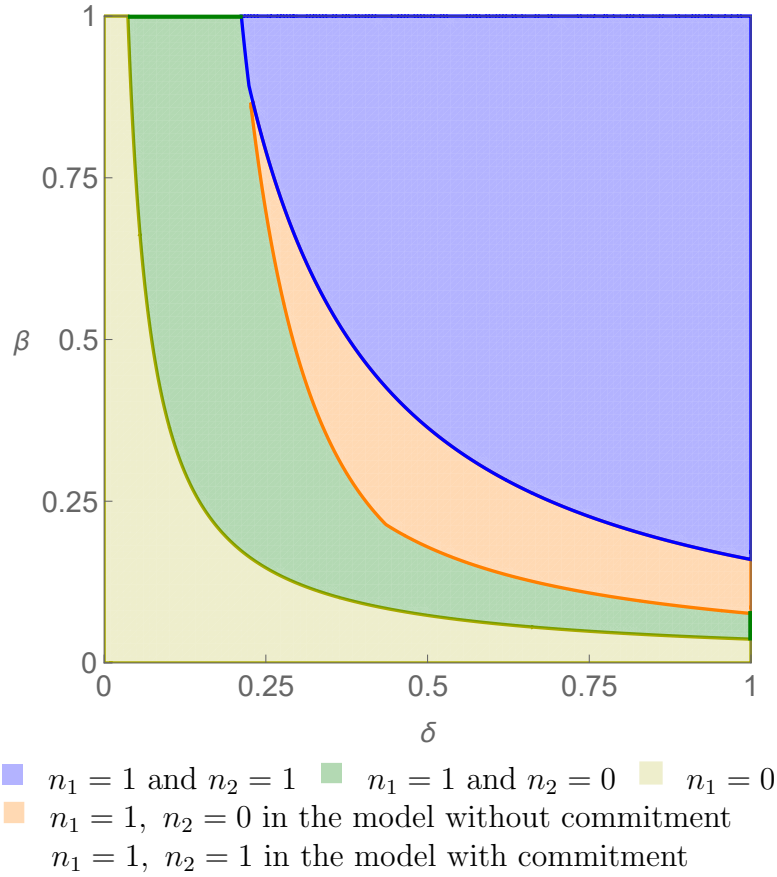


Figure 5: Discount factors and fertility without commitment



*Notes:* Family wealth  $K$  is fixed to 100 and the cost of raising children  $q$  to 1.

Figure 6: Discount factors and fertility. Model with vs. without commitment



*Notes:* Family wealth  $K$  is fixed to 100 and the cost of raising children  $q$  to 1.

	Strict settlement		Other forms	
	N	%	N	%
1660-80	26	63.4	15	36.6
1681-1700	29	78.4	8	21.6
1701-20	25	80.6	6	19.4
1721-40	25	75.8	8	24.2
Totals	105	73.9	37	26.1

*Source:* [Bonfield \(1983, p.86\)](#)

Table 1: The employment of settlements (1660-1740)

	mean	se	min	max	N	sample
A. Fertility variables						
% childless	0.249	0.004	0	1	9,632	all
All live births	3.903	0.038	0	31	9,632	all
All live births (if > 0)	5.196	0.041	1	31	7,234	parents
Stillbirths	0.128	0.013	0	9	1,503	all
B. Other demographic variables						
Age at first marriage (wom)	23.446	0.084	2	71	5,170	women
Age at first marriage (men)	28.686	0.109	8	74	4,838	men
Age at death (wom)	59.966	0.269	13	104	5,144	women
Age at death (men)	61.414	0.240	16	98	4,812	men
Age difference	0.587	0.093	-40	56	9,940	all
Number of marriages	1.159	0.004	1	4	10,129	all
Last child is a girl	0.535	0.009	0	1	2,778	matched parents
C. Socioeconomic status variables						
Baron offspring (non-heir)	0.392	0.005	0	1	10,129	all
Duke offspring (non-heir)	0.439	0.005	0	1	10,129	all
Baron heir	0.079	0.003	0	1	10,129	all
Duke heir	0.090	0.003	0	1	10,129	all
Heir	0.282	0.005	0	1	10,129	all
English peerage	0.481	0.005	0	1	10,129	all
Scottish peerage	0.210	0.004	0	1	10,129	all
Irish peerage	0.308	0.005	0	1	10,129	all
Marrying a commoner	0.671	0.003	0	1	10,129	all
Marrying after inheritance	0.251	0.005	0	1	8,582	all

*Notes:* The sample are all peers who married between 1650 and 1882 and their offspring. Marrying after inheritance indicates that the heir married after his father's death. It is our proxy for not having signed a marriage settlement.

Table 2: Summary statistics for the Hollingsworth's dataset

Childlessness

	1650-99	1700-49	1750-99	1800-49	1850-99
<a href="#">Lévy and Henry (1960)</a> <sup>a</sup> <i>ducs et pairs de France</i>	9% (N=34)	21% (N=24)	35% (N=20)	-	-
<a href="#">Pedlow (1982)</a> <sup>b</sup> nobility of Hesse-Kassel	5% (N=39)	14% (N=51)	9% (N=56)	8% (N=121)	8% (N=84)
Hollingsworth (1964) <sup>a</sup> (dukes only)	12% (N=122)	18% (N=115)	17% (N=138)	12% (N=146)	8% (N=166)
Hollingsworth (1964) <sup>a</sup> (all peers)	14% (N=218)	18% (N=192)	16% (N=217)	12% (N=281)	9% (N=308)

*Notes:* The sample are: *a*) women marrying before 20 years old for whom the marriage did not break because either she or the spouse died before 45 years old; *b*) for whom the marriage did not break because either she or the spouse died before 45 years old.

Table 3: Comparison with other nobilities

Dep. variable: Childlessness

	(1)	(2)	(3)	(4)
No settlement [i.e., marrying after inheritance]	0.050*** (0.019)	0.053*** (0.019)	0.036** (0.018)	0.084** (0.036)
Husband's siblings (#)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.004 (0.005)
Father-in-law is a duke		0.022 (0.019)	0.022 (0.018)	-0.047 (0.051)
Father-in-law is a baron		ref.	ref.	ref.
Wife's age at marriage			0.014*** (0.002)	0.013*** (0.004)
Wife's age at death			0.000 (0.000)	-0.000 (0.001)
Husband's age at death			-0.003*** (0.001)	-0.004*** (0.001)
Still to live births (fam)			0.175 (0.311)	1.624*** (0.613)
Wife's social status	NO	YES	YES	YES
Family FE	NO	NO	NO	YES
Birth year FE	NO	NO	NO	YES
Marriage decade FE	NO	NO	NO	YES
Observations	1,526	1,525	1,505	1,505
% correctly predicted	81.2	81.2	82.8	90.8

*Notes:* Sample is all peer heirs' wives who married between 1650 and 1882. Marrying after inheritance indicates that the heir married after his father's death. It is our proxy for not having signed a marriage settlement. Wife's social status includes indicators for her father's social position (commoner, knight, baronet, baron, or duke); Father-in-law status considers the same categories; Still to live births indicated the history of stillbirths relative to the total number of children born in the husband's family; % correctly predicted shows the percent of childless individuals for whom the predicted childlessness rate is higher than 0.5; Standard errors clustered by family in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 4: Baseline OLS results

Dep. variable: All live births (if > 0)

	heirs' wives				non-heirs' wives	peers of scotland
	(1)	(2)	(3)	(4)	(5)	(6)
No settlement [i.e., marrying after inheritance]	-0.042 (0.036)	-0.042 (0.035)	-0.012 (0.033)	-0.024 (0.043)	0.073 (0.087)	-0.000 (0.134)
Number of siblings	0.011** (0.005)	0.011** (0.004)	0.010** (0.004)	-0.012* (0.006)	0.000 (0.009)	0.024* (0.013)
Father-in-law is a duke		0.046 (0.037)	0.028 (0.035)	0.037 (0.082)		0.641*** (0.222)
Wife's age at marriage			-0.032*** (0.005)	-0.024*** (0.006)		-0.027* (0.015)
Wife's age at death			0.000 (0.001)	0.002** (0.001)	0.005*** (0.002)	0.011*** (0.003)
Husband's age at death			0.012*** (0.001)	0.013*** (0.002)	0.009*** (0.002)	0.018*** (0.004)
Still to live births (fam)			-0.379** (0.193)	-10.406 (7.524)	-0.784 (10.565)	43.645* (25.512)
Wife's social status	NO	YES	YES	YES	YES	YES
Father-in-law status	-	-	-	-	YES	-
Family FE	NO	NO	NO	YES	YES	YES
Birth year FE	NO	NO	NO	YES	YES	YES
Marriage decade FE	NO	NO	NO	YES	YES	YES
Observations	1,264	1,263	1,261	1,261	854	311

*Notes:* Sample is all peer heirs' wives who married between 1650 and 1882 in columns (1)–(4), all peer daughters' marrying non-heirs between 1650 and 1882 in column (5), and all Scottish heirs' wives who married between 1650 and 1882 in column (6). In all columns, the sample is restricted to women having at least one child; Marrying after inheritance indicates that the heir married after his father's death. It is our proxy for not having signed a marriage settlement; Wife's social status includes indicators for her father's social position (commoner, knight, baronet, baron, or duke); Father-in-law status considers the same categories. Standard errors clustered by family in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 5: Poisson regressions for the number of children



Dep. Var.: Marrying after inheritance

	coef	se
Birth order of the heir		
1st	reference	
2nd	0.040	(0.025)
3rd	0.101***	(0.029)
4th	0.119***	(0.036)
5th	0.127***	(0.043)
6th	0.152***	(0.055)
7th	0.168**	(0.077)
8th	0.119	(0.085)
9th	0.155	(0.098)
10th	0.045	(0.093)
11th	-0.104	(0.263)
12th	0.141	(0.213)
13th	-0.220	(0.262)
15th	-0.421	(0.367)
Father-in-law age at death	-0.021***	(0.001)
Number of siblings	-0.006**	(0.003)
Father-in-law is a duke	-0.042**	(0.020)
Father-in-law is a baron	reference	
Wife's age at marriage	0.009***	(0.002)
Wife's age at death	0.001**	(0.001)
Husband's age at death	0.001	(0.001)
Still to live births (fam)	0.554**	(0.261)
Wife's social status	YES	
Marriage decade FE	YES	
Observations	1,530	
% correctly predicted	74.9	
F test	39.18	

*Notes:* Sample is all peers who married between 1650 and 1882; Marrying after inheritance indicates that the heir married after his father's death. It is our proxy for not having signed a marriage settlement; Wife's social status includes indicators for her father's social position (commoner, knight, baronet, baron, or duke); Father-in-law status considers the same categories; Still to live births indicated the history of stillbirths relative to the total number of children born in the husband's family; % correctly predicted shows the percent of individuals who married after inheritance for whom the predicted value is higher than 0.5; Standard errors clustered by family in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Dep. Var.: Childlessness

	OLS	IV
No settlement [i.e., marrying after inheritance]	0.084** (0.036)	0.151*** (0.036)
Number of siblings	-0.004 (0.005)	-0.002 (0.004)
Father-in-law is a duke	-0.047 (0.051)	-0.045 (0.036)
Wife's age at marriage	0.013*** (0.004)	0.012*** (0.003)
Wife's age at death	-0.000 (0.001)	-0.000 (0.001)
Husband's age at death	-0.004*** (0.001)	-0.004*** (0.001)
Still to live births (family)	1.624*** (0.613)	1.645*** (0.424)
Wife's social status	YES	YES
Family FE	YES	YES
Birth year FE	YES	YES
Marriage decade FE	YES	YES
Observations	1,505	1,530
% correctly predicted	90.8	91.0

*Notes:* Sample is all peer heirs' wives who married between 1650 and 1882; Marrying after inheritance indicates that the heir married after his father's death. It is our proxy for not having signed a marriage settlement; Wife's social status includes indicators for her father's social position (commoner, knight, baronet, baron, or duke); Father-in-law status considers the same categories; Still to live births indicated the history of stillbirths relative to the total number of children born in the husband's family; % correctly predicted shows the percent of childless individuals for whom the predicted childlessness rate is higher than 0.5; Standard errors clustered by family in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table 7: Second-stage

Dep. Var.: Childlessness

	(1)	(2)	(3)	(4)
	benchmark	non-heirs	England and Ireland	Scotland
No settlement [i.e., marrying after inheritance]	0.151*** (0.036)	-0.035 (0.056)	0.161*** (0.054)	-0.011 (0.084)
Ho:	-	$\beta(1) = \beta(2)$	-	$\beta(3) = \beta(4)$
prob > chi2	-	8.06***	-	2.98*
Controls	YES	YES	YES	YES
Family FE	YES	YES	YES	YES
Birth year FE	YES	YES	YES	YES
Marriage decade FE	YES	YES	YES	YES
Father-in-law status	-	YES	-	-
Observations	1,530	1,565	1,165	365
% correctly predicted	90.99	53.66	89.16	54.44
F-stat from first stage	39.18	36.96	30.51	12.16

*Notes:* Sample is all peer heirs' wives who married between 1650 and 1882 in column (1), all peers' daughters marrying non-heirs between 1650 and 1882 in column (2), all English and Irish peers heirs' wives who married between 1650 and 1882 in column (3), and all Scottish heirs' wives who married between 1650 and 1882 in column (4); Marrying after inheritance indicates that the heir married after his father's death. It is our proxy for not having signed a marriage settlement; Controls are the number of siblings of the husband, age at marriage of the wife, age at death of both spouses, the history of stillbirths relative to the total number of children born in the husband's family, and wives social status, defined as indicators for her father's social position (commoner, knight, baronet, baron, or duke); Father-in-law status considers the same categories; % correctly predicted shows the percent of childless individuals for whom the predicted childlessness rate is higher than 0.5; Standard errors clustered by family in parentheses;

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 8: Test for the exclusion restriction – Second-stage (1650-1882)

Dep. Var.:	Childlessness				All live births (if > 0)
	(1)	(2)	(3)	(4)	(5)
	heir's wives OLS	wives IV	non-heirs IV	Scotland IV	heir's wives Poisson
No settlement	0.080**	0.153***	-0.049	-0.029	-0.014
[i.e., inheritance before majority]	(0.031)	(0.038)	(0.056)	(0.052)	(0.040)
Controls	YES	YES	YES	YES	YES
Family FE	YES	YES	YES	YES	YES
Birth year FE	YES	YES	YES	YES	YES
Marriage decade FE	YES	YES	YES	YES	YES
Father-in-law status	-	YES	-	-	-
Observations	1,700	1,727	1,714	433	1,418
% correctly predicted	89.83	89.83	57.46	63.12	-
F-stat from first stage	-	48.27	48.66	15.21	-

*Notes:* Sample is all peer heirs' wives who married between 1650 and 1882 in columns (1) and (2), and all peer heirs' wives who married between 1650 and 1882 and had at least one birth in column (5). For columns (3) and (4) the sample is restricted to women who were not exposed to settlements because they married a non-heir (col. 3) or a Scottish heirs (col. 4) between 1650 and 1882. Inheritance before majority indicates that the father died before the heir was 21. It is our second proxy for not having signed a marriage settlement; Controls are the number of siblings of the husband, age at marriage of the wife, age at death of both spouses, the history of stillbirths relative to the total number of children born in the husband's family, and wife's social status, defined as indicators for her father's social position (commoner, knight, baronet, baron, or duke); Father-in-law status considers the same categories; % correctly predicted shows the percent of childless individuals for whom the predicted childlessness rate is higher than 0.5; Standard errors clustered by family in parentheses;

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 9: Robustness: inheritance before majority as a proxy for not signing a settlement

Dep. Var.: inheritance before majority

	coef	se
Birth order of the heir		
1st	reference	
2nd	0.040*	(0.022)
3rd	0.089***	(0.025)
4th	0.113***	(0.030)
5th	0.124***	(0.035)
6th	0.162***	(0.043)
7th	0.151***	(0.058)
8th	0.125*	(0.066)
9th	0.119	(0.075)
10th	0.131*	(0.078)
11th	0.089	(0.153)
12th	0.394**	(0.195)
13th	0.032	(0.169)
15th	-0.285	(0.335)
Father-in-law age at death	-0.020***	(0.001)
Number of siblings	-0.012***	(0.002)
Father-in-law is a duke	-0.007	(0.017)
Father-in-law is a baron	reference	
Wife's age at marriage	-0.002	(0.002)
Wife's age at death	0.000	(0.000)
Husband's age at death	-0.000	(0.001)
Still to live births (fam)	0.231	(0.224)
Wife's social status	YES	
Marriage decade FE	YES	
Observations	1,727	
% correctly predicted	87.67	
F test	48.27	

*Notes:* Sample is all peers who married between 1650 and 1882; Inheritance before majority indicates that the father died before the heir was 21. It is our second proxy for not having signed a marriage settlement; Wife's social status includes indicators for her father's social position (commoner, knight, baronet, baron, or duke); Father-in-law status considers the same categories; Still to live births indicated the history of stillbirths relative to the total number of children born in the husband's family; % correctly predicted shows the percent of individuals who married after inheritance for whom the predicted value is higher than 0.5; Standard errors clustered by family in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

## A Appendix

This appendix shows that Proposition 1 to 5 hold if the cost of raising children  $q$  is not too large. Formally, we assume  $K > 2q$  which guarantees that the consumption of the next generations will not be negative. This assumption is a byproduct of the log-specification of the utility function. Results, therefore, do not hinge on it.

### A.1 Proof of Proposition 1

We solve for the optimal levels of consumption and bequests by backward induction. Generation 3 chooses the level of consumption that maximizes (8) subject to  $x_3 = k_3$ , where  $k_3$  follows from the choices of generation 2.

Generation 2 chooses consumption,  $x_2$ , and bequests,  $k_3$ , to maximize (6) subject to (7), given the level of bequests chosen by generation 1,  $k_2$ . The optimal choices depend on whether generation 2 has children or not. If  $n_2 = 0$ , the optimal solutions are  $x_2 = x_2^* := k_2$  and  $k_3 = 0$ . If  $n_2 = 1$ , the optimal solutions are

$$x_2 = x_2^{**} := \frac{1}{1 + \beta\delta}(k_2 - q), \quad \text{and} \quad k_3 = x_3^{**} := \frac{\beta\delta}{1 + \beta\delta}(k_2 - q).$$

Generation 1 chooses consumption,  $x_1$ , and the bequests,  $k_2$ , to maximize (4) subject to (5). If  $n_1 = 0$ , the optimal solutions are  $x_1 = K$  and  $k_2 = 0$ . If  $n_2 = 0$  and  $n_1 = 1$ , the optimal solutions are

$$x_1 = x_1^* := \frac{1}{1 + \beta\delta}(K - q), \quad \text{and} \quad k_2 = k_2^* := \frac{\beta\delta}{1 + \beta\delta}(K - q).$$

If  $n_2 = 1$  and  $n_1 = 1$ , the optimal solutions are

$$x_1 = x_1^{**} := \frac{1}{1 + \beta\delta + \beta\delta^2}(K - 2q), \quad \text{and} \quad k_2 = k_2^{**} := K - q - \frac{1}{1 + \beta\delta + \beta\delta^2}(K - 2q).$$

Replacing  $k_2^*$  in  $x_2^*$ , and  $k_2^{**}$  in  $x_2^{**}$  and  $x_3^*$ , Proposition 1 summarizes the optimal conditions detailed above.

## A.2 Proof of Proposition 2

Generation 3 is always childless,  $n_3 = 0$ , as  $\ln(k_3) > \ln(k_3 - q)$ .

For generation 2,  $f$  is the difference between the indirect utility when  $n_2 = 1$  and the indirect utility when  $n_2 = 0$ .

$$f(k_2, q, \beta, \delta) = \ln\left(\frac{k_2 - q}{1 + \beta\delta}\right) + \beta\delta \ln\left(\frac{\beta\delta(k_2 - q)}{1 + \beta\delta}\right) - \ln(k_2).$$

The partial derivatives are  $f_{k_2} = \frac{\beta\delta k_2 + q}{(k_2 - q)k_2} > 0$  and  $f_q = -\frac{1 + \beta\delta}{k_2 - q} < 0$ .

For generation 1,  $g$  is the difference between the indirect utility when  $n_1 = 1$ ,  $n_2 = 0$  and the indirect utility when  $n_1 = 0$ . Given the optimal solution on consumptions given in Proposition 1,  $x_1^*$  and  $x_2^*$ ,

$$g(K, q, \beta, \delta) = \ln\left(\frac{K - q}{1 + \beta\delta}\right) + \beta\delta \ln\left(\frac{\beta\delta(K - q)}{1 + \beta\delta}\right) - \ln(K).$$

The partial derivatives are  $g_K = \frac{\beta\delta K + q}{(K - q)K} > 0$  and  $g_q = -\frac{1 + \beta\delta}{K - q} < 0$ .

For generation 1,  $h$  is the difference between the indirect utility when  $n_1 = 1$ ,  $n_2 = 1$  and the indirect utility when  $n_1 = 0$ . Given the optimal solution on consumptions given in Proposition 1,  $x_1^{**}$ ,  $x_2^{**}$  and  $x_3^{**}$ ,

$$\begin{aligned} h(K, q, \beta, \delta) = & \ln\left(\frac{1}{1 + \beta\delta + \beta\delta^2}(K - 2q)\right) + \delta\beta \ln\left(\frac{1 + \delta}{1 + \beta\delta} \frac{\beta\delta}{1 + \beta\delta + \beta\delta^2}(K - 2q)\right) \\ & + \beta\delta^2 \ln\left(\frac{\beta(1 + \delta)}{1 + \beta\delta} \frac{\beta\delta^2}{1 + \beta\delta + \beta\delta^2}(K - 2q)\right) - \ln(K). \end{aligned}$$

The partial derivatives are  $h_K = \frac{(\beta\delta + \beta\delta^2)K + 2q}{(K - 2q)K} > 0$  and  $h_q = -2 \frac{1 + \beta\delta + \beta\delta^2}{K - 2q} < 0$ .

## A.3 Proof of Proposition 3

From Proposition 2, the functions  $g$  and  $h$ , compare the indirect utilities of generation 1 when  $n_1 = 1$  and when  $n_1 = 0$  at the optimal levels of  $x_1$ ,  $x_2$ , and  $x_3$  given in

Proposition 1. The function  $f$ , compares the indirect utilities of generation 2 when  $n_2 = 1$  and when  $n_2 = 0$  at the optimal level of  $k_2$  given in Proposition 1. The sign of these functions gives the SPE.

## A.4 Proof of Proposition 4

We solve for the optimal levels of consumption and bequests by backward induction. Generation 3 chooses the level of consumption that maximizes (8) subject to  $x_3 = k_3$ , where  $k_3$  is given by the choices of generation 1.

Generation 2 chooses the level of consumption that maximizes (6) subject to (10). If  $n_2 = 0$ , the optimal solution is  $x_2 = x_{2c}^* := k_2$ . If  $n_2 = 1$ , the optimal solution is  $x_2 = x_{2c}^{**} := k_2 - q$ .

Generation 1 chooses consumption,  $x_1$ , and bequests,  $k_2$  and  $k_3$  to maximize (4) subject to (9). If  $n_1 = 0$ , the optimal solutions are  $x_1 = K$  and  $k_2 = k_3 = 0$ . If  $n_2 = 0$  and  $n_1 = 1$ , the optimal solutions are

$$x_1 = x_1^* := \frac{1}{1 + \beta\delta}(K - q), \quad k_2 = k_2^* := \frac{\beta\delta}{1 + \beta\delta}(K - q), \quad \text{and} \quad k_3 = k_3^* := 0.$$

If  $n_2 = 1$  and  $n_1 = 1$ , the optimal solutions are

$$x_1 = x_{1c}^{**} := \frac{1}{1 + \beta\delta + \beta\delta^2}(K - 2q), \quad k_2 = k_{2c}^{**} := q + \frac{\beta\delta}{1 + \beta\delta + \beta\delta^2}(K - 2q),$$

$$\text{and} \quad k_3 = k_{3c}^{**} := \frac{\beta\delta^2}{1 + \beta\delta + \beta\delta^2}(K - 2q).$$

Replacing  $k_2^*$  and  $k_3^*$  in  $x_2^*$ ,  $k_{2c}^{**}$  in  $x_{2c}^{**}$ , and  $k_{3c}^{**}$  in  $x_{3c}^{**}$ , Proposition 4 summarizes the optimal conditions detailed above.

## A.5 Proof of Proposition 5

Generation 3 is childless,  $n_3 = 0$ , as  $\ln(k_3) > \ln(k_3 - q)$ .

For generation 2,  $\mathcal{F}$  is the difference between the indirect utility when  $n_2 = 1$  and



the indirect utility when  $n_2 = 0$ .

$$\mathcal{F}(k_2, k_3, q, \beta, \delta) = \ln(k_2 - q) + \beta\delta \ln(k_3) - \ln(k_2).$$

The partial derivatives are  $\mathcal{F}_{k_2} = \frac{1}{k_2 - q} - \frac{1}{k_2} > 0$ ,  $\mathcal{F}_{k_3} = \frac{\beta\delta}{k_3} > 0$ , and  $\mathcal{F}_q = \frac{-1}{k_2 - q} < 0$ .

For generation 1,  $g$  is the difference between the indirect utility when  $n_1 = 1$ ,  $n_2 = 0$  and the indirect utility when  $n_1 = 0$ . Note that this function is equivalent to the one defined in the model without commitment. Hence, Proof A.2 shows that  $h_K > 0$ ,  $h_q < 0$ ,  $h_\beta > 0$ , and  $h_\delta > 0$ .

For generation 1,  $\mathcal{H}$  is the difference between the indirect utility when  $n_1 = 1$ ,  $n_2 = 1$  and the indirect utility when  $n_1 = 0$ .

$$\begin{aligned} \mathcal{H}(K, q, \beta, \delta) = & \ln\left(\frac{1}{1 + \beta\delta + \beta\delta^2}(K - 2q)\right) + \beta\delta \ln\left(\frac{\beta\delta}{1 + \beta\delta + \beta\delta^2}(K - 2q)\right) \\ & + \beta\delta^2 \ln\left(\frac{\beta\delta^2}{1 + \beta\delta + \beta\delta^2}(K - 2q)\right) - \ln(K). \end{aligned}$$

The partial derivatives are  $\mathcal{H}_K = \frac{(\beta\delta + \beta\delta^2)K + 2q}{(K - 2q)K} > 0$ , and  $\mathcal{H}_q = -2\frac{1 + \beta\delta + \beta\delta^2}{K - 2q} < 0$ .

## A.6 Proof of Proposition 6

From Proposition 5, the functions  $g$  and  $\mathcal{H}$  compare the indirect utilities of generation 1 when  $n_1 = 1$  and when  $n_1 = 0$  at the optimal levels of  $x_1$ ,  $x_2$ , and  $x_3$  given in Proposition 4. The function  $\mathcal{F}$ , compares the indirect utilities of generation 2 when  $n_2 = 1$  and when  $n_2 = 0$  at the optimal level of  $k_2$  given in Proposition 4. The sign of these functions gives the SPE.

## A.7 Proof of Proposition 7

This is implied by Propositions 3 and 6.

## A.8 Proof of Proposition 8

Generation 1 is better off in the model with commitment as the condition

$$v_1(x_{1c}^{**}, x_{2c}^{**}, x_{3c}^{**}, n_1 = 1, n_2 = 1) > v_1(x_1^*, x_2^*, x_3 = 0, n_1 = 1, n_2 = 0) \quad (11)$$

defines the region characterized in Proposition 7. Note that condition (11) can be rewritten as:

$$\frac{1 + \beta\delta}{\delta} \ln \left( \frac{(K - 2q)(1 + \beta\delta)}{(1 + \beta\delta + \beta\delta^2)(K - q)} \right) + \beta\delta \ln \left( \frac{\beta\delta^2(K - 2q)}{1 + \beta\delta + \beta\delta^2} \right) > 0. \quad (12)$$

Generation 2 is better off in the model with commitment in the region characterized in Proposition 7 if and only if

$$v_2(x_{2c}^{**}, x_{3c}^{**}, n_2 = 1) > v_2(x_2^*, x_3 = 0, n_2 = 0)$$

which holds if and only if

$$\ln \left( \frac{(K - 2q)(1 + \beta\delta)}{(1 + \beta\delta + \beta\delta^2)(K - q)} \right) + \beta\delta \ln \left( \frac{\beta\delta^2(K - 2q)}{1 + \beta\delta + \beta\delta^2} \right) > 0. \quad (13)$$

Inequality (12) implies that inequality (13) is satisfied.