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Differences between Sons and Daughters in the Intergenerational Transmission of Wealth

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Abstract

Persistent interest lies in gender inequality, especially with regard to the favoring of sons over daughters. Economists are concerned with how privilege is transmitted across generations, and anthropologists have long studied sex-biased inheritance norms. There has, however, been no focused cross-cultural investigation of how parent-offspring correlations in wealth vary by offspring sex. We estimate these correlations for 38 wealth measures, including somatic and network wealth, from 15 populations ranging from hunter-gatherers to small-scale farmers. Although small sample sizes limit our statistical power, we find no evidence of ubiquitous male bias. Rather we find wide variation in signatures of sex bias, with evidence of both son and daughter-biased investment. Further, we introduce a model that helps pinpoint the conditions under which simple parent-offspring wealth correlations can reveal information about sex-biased parental investment. Our findings are relevant to the study of female-biased kinship by revealing just how little normative descriptors of kinship systems, such as patrilineal inheritance, capture intergenerational correlations in wealth, and how variable parent-son and parent-daughter correlations can be.

Key Words: wealth transmission, parental investment, son bias

1. Introduction

Matriliny, often erroneously associated with notions of matriarchy (see Introduction to this Special Issue [see Introduction to Special Issue 1]), conjures up expectations of gender equality, or at least muted sex-biases [2-6], when compared to patriliny. In matrilineal societies women are key to the determination of descent and typically have greater support from their kin relative to women in patrilineal societies. Furthermore, matrilineal inheritance describes a range of normative patterns of intergenerational wealth transmission in which women, as sisters and daughters, play key mediating roles. Such practices include a man giving wealth to his sisters' sons, as in many African Bantu examples [e.g., 7], grandparents investing in grandchildren born to their daughters [8], or parents bestowing inheritances directly on their daughters, as in many other southern African populations [9, see also 10].

In reality, normative patterns of intergenerational wealth transmission are unlikely to capture the full set of influences whereby privilege in one generation is passed to that of the next, even less so the implied gendered inequalities therein, insofar as the patterning, causality and implied mechanisms in son preference are highly variable globally [e.g., 5, 11, 12]. Wealth transmitted across generations can have strong effects on wellbeing of the offspring generation [13], a phenomenon popularly recognized as a child of the wealthy being born with a "silver spoon" in their mouth. Furthermore, such wealth transmission is implicated in complex dynamics of gender inequality [14]. Accordingly, we take a close look here at how parental wealth correlates with that of sons and daughters. To avoid some of the ambiguous metrics associated with the study of matriliny [1], we offer an empirical lens through which to analyze a key relationship (parent-offspring) in any kinship system, here with a focus on the relevance of offspring sex to the intergenerational transmission of wealth and privilege.

To place our work in the context of this Special Issue we stress that we are addressing neither descent (social identity based on filiation), nor post-marital residence, nor the collective ownership of property rights associated with descent groups. Rather we examine the intergenerational transmission of material, somatic, and network wealth from parents to their sons and daughters. This question aligns closely with the interest of evolutionary biologists in how parental quality is transmitted across generations to affect reproductive value [15] and the interest of economists in the persistence of inequality [16, 17].

We present our argument as follows. First, we briefly review how gender differentials have been studied by comparative social scientists, paying particular attention to intersections with gender-biased intergenerational norms of matrilineal and patrilineal inheritance, and the importance of individual-level data (2). We then turn to the methods (3) and results (4) of our study that examines how parental wealth is associated with the wealth of their sons and daughters across a sample of 15 populations. In the Discussion (5), we explore the generality of our results and consider the implications of our findings for the understanding of matrilineal kinship. We also present a model (detailed in Electronic Supplementary Material) that addresses the limitations of making inferences about sex-biased parental investment from parent-offspring wealth correlations.

2. Sex differences, parental investment, norms and individual-level data

Male-biased differentials in wealth and power have long engaged socially-inclined philosophers [18], political scientists [19], and comparative social scientists [20]. The phenomenon is widespread, illustrated by the fact that post-marital residence [21, 22] and property inheritance [23] are predominantly patrilocal and patrilineal. Such systems allow for men to form coalitions with their kin rather than women with their kin [24]. South and Southeast Asia offer classic examples of male biased sex ratios, son-biased inheritance norms and discrimination against daughters [25]. Such institutional tendencies have led, for example, to an identification of the "missing women" across many parts of the Middle East, North Africa, India, China and other parts of Asia [26, 27]. Gendered inequalities in rights, employment, education, autonomy and access to resources are of course widely recognized across the globe [e.g., 5], persist in (sometimes) subtle but clear patterns in industrialized contemporary populations [e.g., in the USA, 28], and are shaped by a diverse set of ecological, historical, institutional, evolutionary, and developmental influences [14]. These include the existence of private property [19], differential contributions to subsistence [29-31], psycho-cultural factors reflecting socialization [32, 33], marital strategizing [34], taboos and culturally transmitted proscriptions [35], regional politics [2, 36], colonial policies [37], and both biological [38] and a broader range of ecological constraints and opportunities [39]. Pursuing some of these ideas economists have in recent years begun to study how gender-biased inheritance and postmarital residence patterns, specifically patriliny and patri-virilocality, affect women's wellbeing [6, 40].

An important mechanism contributing to gender inequality is sex-biased parental investment, particularly in the form of intergenerational wealth transmission. There is a widespread and strongly-supported claim that sons in many human societies are typically preferred as inheritors over daughters [e.g., 41]. Indeed, given that the features of mammalian reproductive biology typically favor more competition among males than females over access to mates [e.g., 42] it is generally expected that parents will invest more heavily in their surviving sons than their surviving daughters. In humans, this has been studied from both macro and micro perspectives.

From the macro-perspective sociocultural anthropologists, as the natural historians of our species, have for well over a century recognized the importance of sex-biased intergenerational transmission of property [e.g., 43]. Quantitative support for such biases (and their patterning) relies mainly on analyses that use cross-cultural codes capturing the norms and/or institutions that shape gender inequalities, such as matrilineal versus patrilineal inheritance [44, 45] or matrilocal versus patrilocal post-marital residence [46, 47], rather than actual patterns of behaviour or residence. Informative as such analyses can be [see 48, and 49] normative descriptors of populations can obscure many of the choices and strategies of individuals, as suggested by the unexpectedly poor fit of Y chromosome data with normative residential patterns [50]. The persistent critique of studies based on normative codes is that it is often unclear how far the coded variable state reflects a unique institutional solution and/or how seriously it is followed. Ideally studies based on these codes should be supplemented by studies using individual-level measures.

At the micro-level evolutionary anthropologists have examined preferential parental investment by sex using either individual investment behaviour or individual outcomes [51-59]. Strangely, empirical evidence for sex differences in parent-offspring similarity, or the extent to which parents transmit their traits to their offspring, is rarely the focus of investigation, or is simply assumed to be the consequence of parental allocations. This is surprising, insofar as a fundamental assumption underlying tests for adaptive variation in parental investment turns on how effective parents can be in transmitting their traits to their offspring of each sex [15, 51, 60].

Economists have addressed intergenerational wealth transmission using individual-level data [e.g., 16], with the specific goal of revealing the transmission of inequality rather than the patterning parental investment *per se*. They ask whether all children have an equal chance for a successful life, or whether children's fates are limited by the same opportunities (or constraints) as their parents. To answer such questions individual-level data are used to estimate intergenerational elasticities (child's adult log measures of human capital on parent's adult log measures of human capital). Such studies show, for example, how high parent-offspring similarities (elasticities) in education play a key role in contributing to income inequality in developed [61] and developing nations [62]. These studies nevertheless focus primarily on income and education differentials [e.g., 63], and mainly in (developed) nations with reliable panel data [64]. Furthermore, they typically look only at men [e.g., 65]. This is in part because women's labor force participation can be a poor indicator of her economic status (if only poor women work), and in part because often only few women are educated or earn incomes.

Chadwick and Solon [66] broke the mold with a sophisticated analysis of income elasticities for sons and daughters, using panel data on income for the US. They found somewhat higher elasticities for sons (0.55) than daughters (0.35-0.49), and showed that much of the daughters' elasticity was attributable to assortative marriage—daughters of the rich marrying into rich families [see also 12]. More recent studies show smaller differences in gender-specific income elasticities – e.g., in Spain (0.39 versus 0.40 for income) [67] and Japan (0.39 versus 0.34 for income, for daughters and sons respectively) [68]. Perhaps unsurprisingly from an anthropological perspective, these more detailed quantitative surveys of sex differences in intergenerational transmission suggest that customary norms regarding property transfers are not the whole story: irrespective of the formal institutions of lineality, parents appear to strategize, bargain with one another, and make compensatory allocations that often run counter to expectations regarding son/daughter preferences based simply on inheritance or postmarital residential norms [11, 69, 70, see also 71].

Here we study a key set of relationships within any kinship system – between parents and sons and parents and daughters – to identify gender differences in the extent to which offspring resemble their parents with respect to different kinds of wealth. In so doing we move away from normative accounts of gender-biased inheritance systems. Rather we present individual-based data on parent-offspring wealth correlations for 38 wealth measures from 15 populations around the world, representing different modes of economic production. As in Borgerhoff Mulder et al. [13], we examine a range of wealth variables that capture holistic indicators of well-being, and include material assets, physical health, skills and social capital, greatly expanding the previous focus among economists on income and education.

While we start from the assumption that sex-biased parental investment can be detected from parent-offspring wealth correlations, we recognize that inferring parental discrimination *per se* from such data can be problematic [51, 72]. Accordingly, we include a model in the Electronic Supplementary Materials that identifies the condition under which this inference might be accurate, as reported in the Discussion. The logic of our approach can be illustrated with the following example: suppose that parents of all wealth levels invest most of their resources in daughters. The rich, having more wealth to invest, will produce daughters who are much wealthier than the daughters of the poor. This creates a strong correlation between a daughter's wealth and that of her parents. In contrast, because relatively little is invested in sons, regardless of parent wealth, the sons of wealthy parents will tend to be only slightly more wealthy than the sons of poor parents. Son's wealth will therefore be only weakly correlated with parent wealth. The general result is that the sex in which parents invest more heavily will be the sex with a larger parent-offspring correlation. This logic does assume that other mechanisms leading to parent-offspring wealth correlations (e.g., genetic and cultural transmission for wealth productivity [16]) will not upend the influence of direct parental investment, an assumption we return to in the Discussion in connection with our model.

We find that parent-offspring correlations show wide variation in parental investment behaviour across different populations, thereby failing to support the common expectation that son preference is more common than daughter preference. We estimate that roughly 40% of the datasets show little evidence of sex-biased investment as indicated by parent-offspring wealth correlations. The remaining datasets fall about equally into son-biased vs. daughter-biased categories, although material wealth measures are more often son-biased in our sample.

3. Methods

(a) Data.

The data represent a convenience sample of 15 populations assembled to test a model for the relationship between inequality and intergenerational transmission [13, 73]. Two of our populations are settled foragers (Lamalera, Ust Avam), four horticulturalists (Chewa, Gambia, Pimbwe, Tsimane), two pastoralists (Datoga, Himba) and seven agriculturalists (Bangladesh, Bengaluru, Kipsigis, Krummhörn, Maya, Mosuo, Poland). Only adults (age ≥ 18) were used. For somatic wealth, our measures include education (in years), height, reproductive success (RS, measured as the number of offspring surviving to age 5), weight, and ethnographically appropriate measures of productive skill or knowledge. For relational wealth, our measures are cattle partners and social network size. And for material wealth, our measures include boat shares, household wealth, house quality, income, land, and livestock. These variables (listed in Table 1) were chosen on the basis of availability in the original data set, with the data collectors' endorsements that they are useful measures of well-being or success in the population. For some material wealth variables (especially land and livestock), males are often the primary owners and inheritors. In such cases, we assigned to women the wealth of their husbands. We recognize that this assignment is somewhat artificial; for example, that a husband and wife live on the same amount of land does not imply equal control over it.

We use standardized wealth scores to compare an individual's wealth relative to others of his or her same age and sex. This allows for comparisons across societies and also to examine the extent to which the relative fates of sons and the relative fates of daughters are determined by that of their parents. In other words, we are comparing not the wealth of males to females, but rather the extent to which the relative fates of sons, and the relative fates of daughters, are determined by that of their parents. Accordingly, whether our wealth measures have different practical meanings between the sexes is irrelevant so long as the values assigned to women reflect some measure of advantage relative to other women, and similarly men relative to other men.

Table 1 includes the standardized difference between male and female mean wealth. A value of 1 implies that males tend to have one standard deviation more wealth than females; -1 would imply the opposite. This provides a rough measure of gender inequality with respect to the variable in question. Again, we caution against a simple interpretation of these values because of the complex causes underlying them. First, basic biological constraints may drive the differences, as is likely the case for weight; that sons are larger than daughters is not necessarily evidence that sons are healthier or better nourished. Second, even material wealth measures as shown do not necessarily reflect actual differential advantage in the population. For example, although men and women had access to the same amount of land in Krummhörn, men were the inheritors and had much more control over its use [74]. Third, in some cases, the wealth variable is necessarily shared between the father and mother (e.g., some land or RS datasets). If every chunk of wealth is owned jointly by one man and one woman, then a sex difference in mean wealth can only be due to an unequal sex ratio (a point first recognized by Fisher [75] in his theory of the evolution of sex ratios); the less common sex will necessarily have more wealth as measured here, regardless of its actual control of resources. Because of these problems, we do not further discuss mean wealth differences.

(b) Statistical Inference.

Our goal is to estimate the correlation between parent wealth and offspring wealth. Because our data contain individuals of varying ages and because age often strongly predicts wealth, we compute deviations from age-specific (and sex-specific) distributions. An individual i's relative wealth deviation, D_i, is his or her standardized deviation of wealth W_i relative to other individuals of the same age, a_i, and sex, s_i:

$$D_i = \frac{W_i - \mu(a_i,s_i)}{\sigma(a_i,s_i)} \quad [1]$$

μ and σ are functions specifying the mean and standard deviation, respectively, for each age and sex. Their functional forms for each population were chosen via Bayesian information criteria (BIC). We then used Hamiltonian Monte Carlo (RStan) to infer posterior estimates of D for every individual. Further statistical details can be found in the Electronic Supplementary Materials.

The parent-offspring wealth correlation, ρ, is the correlation between offspring D on mid-parent D. The mid-parent D, or D_{mp}, is the mean D of an individual's two parents; we use mid-parent wealth under the assumption that both parents play a role in investment. We compute ρ separately for sons and daughters, yielding ρ_s and ρ_d, respectively. We refer to the difference between son and daughter correlations as Δ_ρ. That is

$$\Delta_\rho = \rho_s - \rho_d \quad [2]$$

To understand the use of D, the wealth deviations, consider the following example: suppose men and women tend to acquire more wealth (of unspecified kind) as they age. Comparing a young woman to an old woman, we will likely find that the latter is more wealthy. But suppose the young woman has acquired more wealth than is common for women of her age, while the old woman has less than average. Then the young woman's wealth deviation, D, will be positive and larger than that of the older woman's, whose D will be negative. The young woman will be counted as wealthier in this analysis.

For all datasets, we checked whether the parent wealth distribution deviated from that of the offspring distribution, even when controlling for age. For reproductive success (RS), this will clearly tend to be true, because parents necessarily have at least one offspring, but their children may not. We identified such cases by comparing models with and without a generation effect via BIC. For such cases, each individual's deviation is taken with respect to his or her own generation rather than with respect to the full sample from that population.

For some datasets, only information for one parent is available, making the mid-parent D impossible to calculate. For such datasets, we simply use the D of the one available parent. The ρ produced by this method tends to differ from the ρ produced by the mid-parent method, but the precise effect depends on the details of transmission. For example, under simple quantitative genetics, single-parent-offspring correlations tend to be of smaller magnitude than those with both parents, but the effect is moderated by assortative mating. Although we cannot calculate the expected error, we expect single-parent correlations to be of the same sign as the true mid-parent correlation. We feel that these datasets are therefore appropriate to include. We note these populations in the Electronic Supplementary Materials, but do not separate them from other populations in our figures.

4. Results

(a) Parent-son and parent-daughter wealth correlations

Statistical estimates of the parent-offspring wealth correlations for sons (ρ_s) and daughters (ρ_d), and their differences (Δ_ρ) are summarized in Table 2. The estimates of ρ_s and ρ_d are also plotted (along with 90% confidence intervals) in Figure 2, with populations sorted by mean correlation across both sexes. The plots show that many of our estimates are not very precise; only about one half (39 of 74) have standard errors less than 0.1. For most of the populations, then, we are moderately uncertain about where ρ_s and ρ_d lie.

Taking sons and daughters together, we can be 90% confident that wealth is positively transmittable ($\rho > 0$) for just over half of the estimates (42 of 74). Weight shows consistent positive parent-offspring correlation, probably due in large part to genetic transmission. Land, too, is consistently positive, and education is also positive for most datasets.

Few correlations show strong evidence of being negative. This is as expected, because a negative ρ would imply that wealthy parents tend to have poor offspring. Only one is below 0 with 90% confidence: Chewa male RS. Visual inspection of Figure 2 suggests that RS tends to be overrepresented among low correlations (on the second panel). This observation weakly supports the common prediction that selection should rapidly deplete heritable variation in fitness [76], leading to low parent-offspring correlations in RS. Increased competition for parental investment in larger families may also account for the low RS correlations.

(b) Estimates of sex differences in intergenerational transmission

Figure 3 shows plots of Δ_ρ, the difference between parent-son and parent-daughter wealth correlations, with 90% confidence intervals. Because these estimates compound the uncertainty in both male and female ρ, their errors are greater. We are therefore unable to precisely identify Δ_ρ for most datasets. For example, only twelve estimates, about a third of the total, have a standard error less than 0.1.

Nonetheless, in some cases we can be quite certain that $\Delta_\rho > 0$, and, for others, $\Delta_\rho < 0$. We are 90% confident that $\Delta_\rho > 0$ for Ust Avam education, Kipsigis land and livestock, Pimbwe household wealth, Krummhörn land, Bangladesh land, Gambia RS, and Poland education (Figure 3). We are 90% confident that $\Delta_\rho < 0$ for Lamalera RS, Chewa RS, Gambia height and weight, Maya height, Mosuo RS, and Bangladesh education. The fact that a difference exists does not imply that the difference is very large, however. For example, while we can be sure that parent-offspring education correlations are greater for sons than daughters in Poland, the absolute difference in correlation is probably < 0.05.

Although most confidence intervals overlap zero, we caution against embracing the null hypothesis ($\Delta_\rho = 0$); most estimates that overlap zero also allow for the possibility of moderate to large Δ_ρ. Increased precision would require larger samples. To demonstrate this, we ask the question: for which datasets can we be confident that the difference is quite small say, $-0.1 < \Delta_\rho < 0.1$ with 90% confidence? In fact, there are only two: Poland education and Bengaluru education which, incidentally, are among our largest samples. Our inability to identify populations with small Δ_ρ is due to our wide confidence intervals, not because the evidence points away from it, as we reveal below.

Do particular wealth types or production systems show a tendency toward son or daughter bias? The data do suggest a few possibilities. First, five of the ten material wealth measures (land, livestock, household wealth, income, and boat shares) are convincingly son-biased, while none are clearly daughter-biased. Mechanistically, this may arise from male-biased norms of property transmission; furthermore, this pattern would be expected evolutionarily if sons can use inherited resources to enhance fitness more effectively than daughters (see discussion). Second, the populations with matrilineal norms (Chewa and Mosuo) appear to show a slight tendency toward female bias. These populations together account for only five wealth measures, however, so this pattern must be viewed with caution. No pattern emerges with respect to marriage patterns: the most polygynous populations (Chewa, Datoga, Gambia, and Kipsigis) show both son-biased and daughter-biased correlations.

(c) Characterizing the Extent of Sex Bias

Although our estimates for each dataset are imprecise, we can nevertheless characterize the distribution of Δ_ρ for the whole group of datasets using the computed posterior probabilities. We can ask, for example, how many datasets are expected to be strongly son-biased, or how many show little bias in either direction. Table 3 shows how many datasets are expected to show little sex bias ($-0.1 < \Delta_\rho < 0.1$), son bias ($\Delta_\rho > 0.1$), and daughter bias ($\Delta_\rho < -0.1$). These numbers are calculated by independently drawing estimates from the distributions depicted in Figure 3 and counting the amount that fall into each category. The choice of 0.1 as the cutoff is arbitrary.

Table 3 shows that roughly 15 datasets (39% of the total) are expected to have little sex-biased parental investment, although we have confidently identified only two. The rest will have some notable bias, with about equal numbers daughter biased and male biased. Note that these calculations were done using a prior that assigned equal prior probability to every value of Δ_ρ in the interval (-1,1). If extreme values of Δ_ρ are *a priori* unlikely, then this would increase the number of datasets in the “little bias” category.

5. Discussion

We have estimated sex differences in parent-offspring correlations for a wide range of small-scale societies. Despite the imprecision of most estimates, we conclude that there is substantial variation in correlations across populations, and, in many cases, across sex. Some datasets show strong evidence for much higher parent-offspring correlation in one sex than the other; other populations likely have very small differences, although we cannot identify most of them.

Our analysis does not support the hypothesis that son-preference among parents is more predominant than daughter-preference. This is perhaps surprising, given common perceptions, and given that some of our wealth variables are explicitly inherited only by sons (in contrast, we have no wealth measure that is only inherited by daughters). This does not mean that sons and daughters are everywhere treated equally; our data clearly refute that claim. Rather, we find that many populations appear to show no sex-biased parental investment and, among those that do, they are just as likely to favor daughters as sons.

In this discussion we address first the conditions under which parent-offspring correlations reveal patterns of sex-biased investment. We then interpret in more detail the patterning we find in our data before drawing conclusions about some aspects of female-biased kinship, and adding a few more general conclusions.

(a) Inferring preferences for sex-biased inheritance from parent-offspring correlations

As noted in the Introduction, the sex with the larger parent-offspring correlation in wealth will, all other things being equal, be the sex in which parents invest more heavily. But all other things are never equal, such that offspring wealth may correlate with parental wealth for many other reasons apart from direct parental investment, including genetic and cultural transmission for wealth productivity [16]. To address this problem, we consider a model (detailed in Electronic Supplementary Material) that includes two pathways of wealth inheritance: (1) direct parental investment and (2) indirect transmission via the inheritance of genetic and cultural capability for wealth production. In short our model of wealth transmission helps us derive the conditions under which offspring-parent correlations can be used to infer sex-biased investment. These conditions include that: (1) the ability to acquire wealth is equally heritable in males and females (whether through genetic or cultural inheritance), (2) the effect of direct parental investment on offspring wealth is the same for sons and daughters relative to each sex's wealth standard deviation, and (3) parent wealth is not correlated with a particular investment strategy. Although we are unable to assess whether all three conditions hold in each of the datasets considered here, the model is useful in identifying circumstances that could unlink the parent-offspring correlation from the investment strategy, for instance if wealthy parents invest more in sons than do poor parents (Condition 3). We are not aware of any previous attempt to identify these conditions formally.

(b) Interpreting the pattern of sex-biased parental behaviour

Research of economists in the Philippines [12, 77] and Ghana [70] corroborates our finding that gender equality in parental investment may be a great deal more common than normative rules would imply. These studies show relatively egalitarian treatment of sons and daughters, as estimated from intergenerational correlations/elasticities for a variety of different kinds of capital, including health, education, land and productivity. It is important, however, to point out that apparent gender equality may be obscuring more nuanced dynamics. For example, material capital may be more effectively transmitted to sons, and human capital to daughters [as shown in the Philippines, 12], and compensatory strategies may occur over the lifetime to make up for initial biases [11]. As such global patterns are likely to be highly variable, and meta-analyses of individual-level data are needed to determine the effects of institutional norms, such as inheritance laws, political systems, or religious values not only parent-offspring correlations but the varying pathways entailed. Furthermore, only with a larger data set and data collected specifically for the purpose, could we test more focused hypotheses, for example, that sons are favored more in polygynous than monogamous populations. To date this hypothesis is supported quantitatively only with data based on normative (or institutional) codings for inheritance and marital customs [e.g., 44]; there is no evidence of such a pattern in the current data set.

For the unbiased datasets, we reemphasize that equal parent-offspring correlations do not imply that men and women have equal control of wealth. Systemic sexism can produce gender inequality even if parents invest in sons and daughters equally. Strictly speaking, our results show only that, for such populations, the daughters of rich families are just as likely to stay rich (relative to other women) in adulthood as are their brothers (and vice versa for the poor) – in other words “silver spoon” effects exist equally for girls as they do for boys.

Some datasets do show evidence of strong sex-biased investment as inferred from our data. In some cases, we can readily hypothesize mechanisms underlying such inequality. For example, Kipsigis males, but not females, inherit land and livestock directly from their fathers. It is not surprising, then, that males more resemble their fathers than do females with respect to the land and livestock. Inheritance systems do not, however, dictate such patterns. After all, patriliny also characterizes the Datoga, for whom the correlation sex difference appears to be small. This likely reflects a pattern of assortative mating (see below). Clearly, then, *post hoc* explanations should be treated with skepticism. More population-specific information is needed to explain any particular statistic.

The observed tendency toward son bias for material wealth is consistent with adaptationist logic. Theory predicts that parents will invest more in the sex in which such investments more strongly augment fitness [78]. A common finding among human behavioural ecologists [e.g., 79, 80-83] is that material resources do indeed more strongly affect male than female reproductive success, largely through the ability to acquire mates. We would therefore expect the observed pattern of male bias in material wealth [44], but not necessarily in other wealth types.

We note that the form of parental investment need not be the same for both sexes. For example, we have detected only a small son bias in Krummhörn parental investment for land. The small effect size is, at first glance, surprising, because males are the sole inheritors of land. The discrepancy probably arises because of assortative mating: rich farmers marry their daughters to rich farmers. The result is that the daughters of wealthy parents are only slightly less likely than their brothers to remain wealthy in adulthood. Similarly, Bevis and Barrett [12] found, using detailed data from the Philippines, that sons' incomes resemble parents' incomes mostly as a result of the bequests of land, whereas daughters inherit from their parents a more diffuse set of skills in income generation, probably mediated by education, culturally transmitted skills and values, nutrition, health, and genetics (see also [84] for a similar decomposition of intergenerational effects). An understanding of such pathways, rather than simple statistical correlations, is key to designing appropriate policy interventions whether, for example, to allocate resources to reforming inheritance laws or making education freely available.

One potential problem with our analysis is that each wealth measure is only correlated with the same wealth measure in the parents. For example, we only correlated offspring education with parent education. Suppose, however, that an offspring's education is determined largely by his/her parents' income, or some composite measure of wealth composed of multiple quantities? If so, then our single-variable analyses are inappropriate. Precisely identifying the complex pathways by which humans transmit wealth across generations will require more detailed data than that which we present here.

This is also important from an applied perspective. There are a diverse set of mechanisms posited to be responsible for intergeneration wealth transmission [85], and these vary both between populations and (most likely) at different wealth strata within populations [86]. Furthermore, the pathways may be complex and non-intuitive. For example, reforms to improve the inheritance rights of women in India have led to a significant increase in the education of women but an unanticipated decrease in the education attainment of their children, reflecting educated women's clearer perception of the opportunity costs associated with education, particularly for their sons [87]. As rates of inequality within developing nations escalate [88] better understanding of these pathways will be critical to resolving debates over how the vicious cycles whereby poverty breeds poverty might best be broken [as reviewed in 89].

(c) Implications for female-biased kinship

The parent-offspring relationship is central to any kinship system. This includes matrilineal systems, in so far as emphasis is placed either on the parent-daughter tie, or on the grandparent-maternal granddaughter tie (even though in the latter it is sons who invest in their sisters' children rather than daughters in their own children). Our convenience sample of populations is insufficiently variable with respect to inheritance rules to allow us to test systematically how parent-offspring wealth correlations might differ by inheritance norms. As noted above there are weak indications of a daughter-bias in the only two populations with a matrilineal inheritance norm (Chewa and Mosuo), but there is, rather surprisingly, no clear signal of higher absolute correlations for daughters than for sons in these matrilineal populations. The extent to which inheritance norms (both patrilineal and matrilineal) shape offspring outcomes is not straightforward, and the norms themselves do not describe well the diverse mechanisms whereby advantage or disadvantage are perpetuated across generations.

Cultural practices associated with female-biased kinship organization, such as inheritance rules, post-marital residence norms and marriage payments, have long been recognized by anthropologists as influencing social outcomes, with support from correlational cross-cultural data [90]. Engels [19] proposed that gender inequality emerged with the intensification of agriculture, and the consequential establishment of private property (monopolized by men), leading to the replacement of matrilineal with patrilineal descent. More regionally focused studies link gender inequality to virilocality as a result of lower parental investment in the out-marrying sex (e.g., [2] for northern India) and the limited social support a woman enjoys once she has left her natal household (e.g., [91] for many parts of south and east Asia). This is intriguingly consistent with recent work in non-humans showing that sex differences in dominance may be related to social support networks [92]. Economists too are pursuing this investigation into the specific consequences for women's wellbeing contingent on lineality, or at least indicators associated with lineality [40]. For example, contemporary women's advantageous political status is linked to a history of no plough agriculture [93], and high juvenile female survival to favourable female earnings relative to males [94].

That said, direct positive outcomes associated with female biased kinship are not inevitable. A recent comparison of matrilineal and patrilineal societies within both the Solomon Islands and the global Standard Cross Cultural Sample finds very little evidence that matrilineal inheritance translates into real economic or political power in either sample [95]. In short, this body of literature, together with the results of the study reported here, suggests that understanding the links between normative patterns (or institutions) and social outcomes will require careful analysis of individual level data to determine who exactly gains and loses from an institutional shift such as that from male to female-biased kinship.

In summary, with respect to female-biased kinship systems, we find no support for the hypothesis that son-preference among parents is more predominant than daughter-preference, at least insofar as we can infer such preferences from our data. This suggests that despite the predominance of patriliny and patrilocality as norms in the ethnographic record, the parent-daughter relationship central to female-biased kinship organization bears much closer scrutiny, as indeed indicated in some specific ethnographic contexts within our sample. Maternal kin are critical to offspring survival in resource-stressed (as compared to wealthy) patrilineal Kipsigis households [96], and Himba women make frequent visits to their maternal kin despite patrilocal residence [97]. More generally, a focus on the sex-specific ways in which parental quality is transmitted across generations would appear to be a key step in determining both the adaptive value of varying parental strategies [15] and the persistence of inequality [16, 17].

(d) Concluding remarks

We end with a methodological and a more general coda. First an ideal study of sex-biased parental investment would investigate parents' actual behaviour, i.e., how many resources they devote to sons vs. daughters over the period of dependence, and how this affects their offspring's subsequent wealth status (broadly defined as here). In the absence of such direct behavioural data, we follow economists in comparing the parent-offspring wealth correlations of each sex to explore sex differences in the "silver spoon" effect. As our model shows, such correlations are affected by many things other than direct parental investment, issues that should be kept in consideration in all studies of parental investment that examine outcomes rather than actions.

Second, gender inequality is still pervasive. Differentials in income, education and autonomy persist globally [5, 98, 99]. Secondary sex ratios are still rising in some parts of India and China [100] prompting questions of why parents appear to favor sons over daughters [101]. Anthropologists working in communities where such inequalities persist despite or indeed because of rapid social change need to document these dynamics. Examining the extent to which this inequality persists across generations is a key first step in this pursuit.

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Author contributions

MBM and RB wrote the paper, with substantial contributions from MCT; RB constructed the model and analysed the data; MBM, MCT, BAB, HC, MG, KLK, SLM, DAN, BS, RS, MKS, and EV contributed data to the population analyses and participated in development of the paper's intergenerational focus and methodological approach in conjunction with a larger project.

References

[1] Mattison, S. M., Shenk, M., Thompson, M. E., Borgerhoff Mulder, M. & Fortunato, L. 2019 Introduction to the Special Issue: The Evolution of Female-Biased Kinship in Humans and Other Mammals. *Philosophical Transactions of the Royal Society B: Biological Sciences*.
[2] Dyson, T. & Moore, M. 1983 On kinship structure, female autonomy, and demographic behavior in India. *Population & Development Review* **9**, 35-60. (DOI:10.2307/1972894).
[3] Harrell, S. 1997 *Human Families*. New York, Routledge.
[4] Leonetti, D. L., Nath, D. C. & Hemam, N. S. 2007 In-law conflict: Women's reproductive lives and the roles of their mothers and husbands among the Matrilineal Khasi. *Current Anthropology* **48**, 861-890. (DOI:10.1086/520976).
[5] Jayachandran, S. 2015 The Roots of Gender Inequality in Developing Countries. *Annual Review of Economics* **7**, 63-88. (DOI:10.1146/annurev-economics-080614-115404).
[6] Giuliano, P. 2017 Gender: A historical perspective. In *The Oxford Handbook of Women and the Economy* (eds. S. Averett, L. Argys & S. Hoffman). New York, Oxford University Press.
[7] Richards, A. I. 1950 Some types of family structure amongst the central Bantu. *African Systems of Kinship and Marriage*, 207-251.
[8] Holden, C. J., Sear, R. & Mace, R. 2003 Matriliny as daughter-biased investment. *Evolution and Human Behavior* **24**, 99-112. (DOI:10.1016/S1090-5138(02)00122-8).
[9] Davison, J. 1997 *Gender, lineage, and ethnicity in Southern Africa*. Boulder, Colorado, Westview Press.
[10] Sear, R. 2008 Kin and child survival in rural Malawi : Are matrilineal kin always beneficial in a matrilineal society? *Human Nature* **19**, 277-293. (DOI:10.1007/s12110-008-9042-4).
[11] Levine, D. & Kevane, M. 2003 Are Investments in Daughters Lower when Daughters Move Away? Evidence from Indonesia. *World Development* **31**, 1065-1084.
[12] Bevis, L. E. M. & Barrett, C. B. 2015 Decomposing Intergenerational Income Elasticity: The Gender-differentiated Contribution of Capital Transmission in Rural Philippines. *World Development* **74**, 233-252. (DOI:10.1016/j.worlddev.2015.04.010).
[13] Borgerhoff Mulder, M., Bowles, S., Hertz, T., Bell, A., Beise, J., Clark, G., Fazzio, L., Gurven, M., Hill, K., Hooper, P. L., et al. 2009 Intergenerational wealth transmission and the dynamics of inequality in small-scale societies. *Science* **326**, 682-688. (DOI:10.1126/science.1178336).
[14] Borgerhoff Mulder, M. & Bliege Bird, R. 2009 Special Issue: Gendered Inequalities in Evolutionary Perspective. *Human Nature* **20(2)**.
[15] Leimar, O. 1996 Life-history analysis of the Trivers and Willard sex-ratio problem. *Behavioral Ecology* **7**, 316-325. (DOI:10.1093/beheco/7.3.316).
[16] Bowles, S. & Gintis, H. 2002 The inheritance of inequality. *Journal of Economic Perspectives* **16**, 3-30. (DOI:10.1257/089533002760278686).
[17] Clark, G. 2014 *The son also rises : surnames and the history of social mobility*, Princeton : Princeton University Press.
[18] Mill, J. S. 1869 *The subjection of women*. London, Longmans, Green, Reader, and Dyer.
[19] Engels, F. 1902 *The Origin of the Family, Private Property and the State*. New York, Charles H. Kerr.
[20] Simmons, L. 1937 Statistical correlations in the science of society. *Studies in the Science of Society*, 493-517.
[21] Divale, W. T. & Harris, M. 1976 Population, Warfare, and the Male Supremacist Complex. *American Anthropologist* **78**, 521-538. (DOI:10.1525/aa.1976.78.3.02a00020).
[22] Sanday, P. R. 1973 Toward a Theory on the Status of Women. *Toward a Theory of the Status of Women*.
[23] Hrdy, S. B. & Judge, D. S. 1993 Darwin and the puzzle of primogeniture - An essay on biases in parental investment after death. *Human Nature* **4**, 1-45. (DOI:10.1007/BF02734088).
[24] Paige, K. & Paige, J. M. 1981 *The politics of reproductive ritual*. Berkeley, University of California Press; xii, 380 p. p.
[25] Shenk, M. K., Towner, M. C., Starkweather, K., Atkisson, C. J. & Alam, N. 2014 The Evolutionary Demography of Sex Ratios in Rural Bangladesh. In *Applied Evolutionary Anthropology* (eds. M. A. Gibson & D. W. Lawson), pp. 141-173, Springer New York.

[26] Sen, A. 1990 Gender and Cooperative Conflicts. In *Persistent Inequalities* (ed. T. Irene). New York, Oxford University Press.
[27] Brooks, R. 2012 "Asia's Missing Women" as a problem in applied evolutionary psychology. *Evolutionary Psychology* **10**, 910-925.
[28] Dahl, G. B. & Moretti, E. 2008 The demand for sons. *Review of Economic Studies* **75**, 1085-1120. (DOI:10.1111/j.1467-937X.2008.00514.x).
[29] Boserup, E. 1965 *The conditions of agricultural growth*. London, London, G. Allen & Unwin.
[30] Burton, M. L. & White, D. R. 1984 Sexual Division of Labor in Agriculture. *American Anthropologist* **86**, 568-583. (DOI:10.1525/aa.1984.86.3.02a00020).
[31] Ember, M. & Ember, C. R. 1983. *Marriage, Family, and Kinship: Comparative Studies of Social Organization*.
[32] Whiting, B. B. & Whiting, J. W. M. 1975 *Children of six cultures: A psycho-cultural analysis*. Cambridge, Harvard University Press.
[33] Wood, W. & Eagly, A. H. 2002 A cross-cultural analysis of the behavior of women and men: Implications for the origins of sex differences. *Psychological Bulletin* **128**, 699-727. (DOI:10.1037/0033-2909.128.5.699).
[34] Fortunato, L. & Archetti, M. 2010 Evolution of monogamous marriage by maximization of inclusive fitness. *Journal of Evolutionary Biology* **23**, 149-156. (DOI:10.1111/j.1420-9101.2009.01884.x).
[35] Brightman, R. 1996 The sexual division of foraging labor: Biology, taboo, and gender politics. *Comparative Studies in Society and History* **38**, 687-729.
[36] Collier, J. F. 1988 *Marriage and inequality in classless societies*. Stanford, Calif., Stanford, Calif. : Stanford University Press.
[37] Talle, A. 1988 Women at a loss: changes in Maasai pastoralism and their effects on gender relations. (Stockholm Studies in Social Anthropology (Sweden).
[38] Brown, J. K. 1970 A Note on the Division of Labor by Sex. *American Anthropologist* **72**, 1073-1078.
[39] Kuhn, S. L. & Stiner, M. C. 2006 What's a mother to do? The division of labor among Neandertals and modern humans in Eurasia. *Current Anthropology* **47**, 953-980. (DOI:10.1086/507197).
[40] Lowes, S. 2018 Matrilineal Kinship and Spousal Cooperation: Evidence from the Matrilineal Belt. *Unpublished manuscript*.
[41] Hrdy, S. B. & Judge, D. S. 1993 Darwin and the puzzle of primogeniture: an essay on biases in parental investment after death. *Human Nature-an Interdisciplinary Biosocial Perspective* **4**, 1-45. (DOI:10.1007/bf02734088).
[42] Clutton-Brock, T. 2007 Sexual selection in males and females. *Science* **318**, 1882-1885. (DOI:10.1126/science.1133311).
[43] McLennan, J. F. 1865 *Primitive marriage An inquiry into the origin of the form of capture in marriage ceremonies*. Edinburgh, Edinburgh, A. and C. Black.
[44] Hartung, J. 1982 Polygyny and the inheritance of wealth. *Current Anthropology* **5**, 77-95.
[45] Hartung, J. 1985 Matrilineal inheritance: New theory and analysis. *Behavioral and Brain Sciences* **8**, 661-670. (DOI:10.1017/S0140525X00045520).
[46] Ember, M. & Ember, C. R. 1971 The conditions favoring matrilocal versus patrilocal residence. *American Anthropologist* **84**, 645-649.
[47] Korotayev, A. 2003 Form of marriage, sexual division of labor, and postmarital residence in cross-cultural perspective: A reconsideration. *Journal of Anthropological Research* **59**, 69-89. (DOI:10.1086/jar.59.1.3631445).
[48] Opie, C., Shultz, S., Atkinson, Q. D., Currie, T. & Mace, R. 2014 Phylogenetic reconstruction of Bantu kinship challenges Main Sequence Theory of human social evolution. *Proceedings of the National Academy of Sciences of the United States of America* **111**, 17414-17419. (DOI:10.1073/pnas.1415744111).
[49] Moravec, J. C., Atkinson, Q., Bowern, C., Greenhill, S. J., Jordan, F. M., Ross, R. M., Gray, R., Marsland, S. & Cox, M. P. 2018 Post-marital residence patterns show lineage-specific evolution. *Evolution and Human Behavior* **39**, 594-601. (DOI:10.1016/j.evolhumbehav.2018.06.002).
[50] Ly, G., Alard, B., Laurent, R., Lafosse, S., Toupance, B., Monidarin, C., Diffloth, G., Bourdier, F., Evrard, O., Pavard, S., et al. 2018 Residence rule flexibility and descent groups dynamics shape uniparental genetic diversities in South East Asia. *American Journal of Physical Anthropology* **165**, 480-491. (DOI:10.1002/ajpa.23374).
[51] Borgerhoff Mulder, M. 1998 Brothers and sisters: How sibling interactions affect optimal parental allocations. *Human Nature* **9**, 119-162.

[52] Cronk, L. 1991 Preferential parental investment in daughters over sons. *Human Nature* **2**, 387-417. (DOI:10.1007/BF02692198).
[53] Winterhalder, B. & Smith, E. A. 2000 Analyzing adaptive strategies: Human behavioral ecology at twenty-five. *Evolutionary anthropology* **9**, 51-72.
[54] Godoy, R., Reyes-García, V., McDade, T., Tanner, S., Leonard, W. R., Huanca, T., Vadez, V. & Patel, K. 2006 Why do mothers favor girls and fathers, boys? A hypothesis and a test of investment disparity. *Human Nature* **17**, 169-189. (DOI:10.1007/s12110-006-1016-9).
[55] Lawson, D. W. & Mace, R. 2009 Trade-offs in modern parenting: a longitudinal study of sibling competition for parental care. *Evolution and Human Behavior* **30**, 170-183. (DOI:10.1016/j.evolhumbehav.2008.12.001).
[56] Ross, C. T., Borgerhoff Mulder, M., Winterhalder, B., Uehara, R., Headland, J. & Headland, T. 2016 Evidence for quantity–quality trade-offs, sex-specific parental investment, and variance compensation in colonized Agta foragers undergoing demographic transition. *Evolution and Human Behavior* **37**, 350-365. (DOI:10.1016/j.evolhumbehav.2016.02.005).
[57] Neill, D. B. 2011 Urbanization and Daughter-Biased Parental Investment in Fiji. *Human Nature* **22**, 139-155. (DOI:10.1007/s12110-011-9110-z).
[58] Judge, D. S. & Hrdy, S. B. 1992 Allocation of accumulated resources among close kin: Inheritance in Sacramento, California, 1890-1984. *Ethology and Sociobiology* **13**, 495-522. (DOI:10.1016/0162-3095(92)90014-U).
[59] Rickard, I. J. 2008 Offspring are lighter at birth and smaller in adulthood when born after a brother versus a sister in humans. *Evolution and Human Behavior* **29**, 196-200. (DOI:10.1016/j.evolhumbehav.2008.01.006).
[60] Lazarus, J. 2002 Human sex ratios: adaptations and mechanisms, problems and prospects. *Sex ratios: concepts and research methods* **1**, 287-311.
[61] Piraino, P. 2007 Comparable estimates of intergenerational income mobility in Italy. *B.E. Journal of Economic Analysis and Policy* **7**. (DOI:10.2202/1935-1682.1711).
[62] Asadullah, M. N. 2012 Intergenerational Wealth Mobility in Rural Bangladesh. *Journal of Development Studies* **48**, 1193-1208. (DOI:10.1080/00220388.2011.646988).
[63] Hertz, T., Selcuk, S., Jayasundera, T., Smiths, N., Piraino, P. & Verashchagina, A. 2007 The inheritance of educational inequality: International comparisons and fifty-year trends. *B.E. Journal of Economic Analysis and Policy* **7**.
[64] Solon, G. 2002 Cross-country differences in intergenerational earnings mobility. *Journal of Economic Perspectives* **16**, 59-66. (DOI:10.1257/089533002760278712).
[65] Corak, M. 2006 Do Poor Children Become Poor Adults? Lessons from a Cross-Country Comparison of Generational Earnings Mobility. In *Research on Economic Inequality* (pp. 143-188.
[66] Chadwick, L. & Solon, G. 2002 Intergenerational income mobility among daughters. *American Economic Review* **92**, 335-344. (DOI:10.1257/000282802760015766).
[67] Cervini-Plá, M. 2015 Intergenerational Earnings and Income Mobility in Spain. *Review of Income and Wealth* **61**, 812-828. (DOI:10.1111/roiw.12130).
[68] Lefranc, A., Ojima, F. & Yoshida, T. 2014 Intergenerational earnings mobility in Japan among sons and daughters: Levels and trends. *Journal of Population Economics* **27**, 91-134. (DOI:10.1007/s00148-012-0464-2).
[69] Quisumbing, A. R. 1994 Intergenerational transfers in Philippine rice villages. Gender differences in traditional inheritance customs. *Journal of Development Economics* **43**, 167-195. (DOI:10.1016/0304-3878(94)90003-5).
[70] Quisumbing, A. R., Payongayong, E. M. & Otsuka, K. 2004 Are wealth transfers biased against girls? Gender differences in land inheritance and schooling investment in Ghana's Western Region. *IFPRI Food Consumption and Nutrition Division Discussion Paper 186, Washington, DC*.
[71] Grogan, L. 2007 Patrilocality and human capital accumulation: Evidence from Central Asia. *Economics of Transition* **15**, 685-705. (DOI:10.1111/j.1468-0351.2007.00305.x).
[72] Behrman, J. R. 1997 Intrahousehold distribution and the family. In *Handbook of Population and Family Economics* (eds. M. R. Rosenzweig & O. Stark). North Holland, Elsevier Science.
[73] Smith, Eric A., Bowles, S., Hertz, T., Borgerhoff Mulder, M., Shenk, Mary K. & Gurven, M. 2010 Intergenerational Wealth Transmission and Inequality in Premodern Societies: Reply. *Current Anthropology* **51**, 119-126. (DOI:10.1086/650152).

[74] Voland, E. 1988 Differential infant and child mortality in evolutionary perspective: data from late 17th to 19th century Ostfriesland (Germany). In *Human Reproductive Behaviour: a Darwinian Perspective* (eds. L. Betzig, M. Borgerhoff Mulder & P. Turke), pp. 253-262. Cambridge, Cambridge Univesity Press.
[75] Fisher, R. A. 1958 *The Genetic Theory of Natural Selection*. New York, Dover.
[76] Mousseau, T. A. & Roff, D. A. 1987 Natural selection and the heritability of fitness components. *Heredity* **59**, 181-197. (DOI:10.1038/hdy.1987.113).
[77] Estudillo, J. P., Quisumbing, A. R. & Otosuka, K. 2001 Gender differences in land inheritance, schooling and lifetime income: Evidence from the rural Philippines. *Journal of Development Studies* **37**, 23-48. (DOI:10.1080/00220380412331322031).
[78] Clutton-Brock, T. 1991 *The evolution of parental care*. Princeton, Princeton University Press.
[79] Flinn, M. V. 1986 Correlates of reproductive success in a Caribbean village. *Human Ecology* **14**, 225-243. (DOI:10.1007/BF00889239).
[80] Mace, R. 1996 Biased parental investment and reproductive success in Gabbra pastoralists. *Behavioral Ecology and Sociobiology* **38**, 75-81. (DOI:10.1007/s002650050219).
[81] Borgerhoff Mulder, M. 1988 Reproductive success in three Kipsigis cohorts. *Reproductive Success*, 419-435.
[82] Hopcroft, R. L. 2006 Sex, status, and reproductive success in the contemporary United States. *Evolution and Human Behavior* **27**, 104-120. (DOI:10.1016/j.evolhumbehav.2005.07.004).
[83] Stulp, G., Sear, R. & Barrett, L. 2016 The Reproductive Ecology of Industrial Societies, Part I: Why Measuring Fertility Matters. *Human Nature* **27**, 422-444. (DOI:10.1007/s12110-016-9269-4).
[84] Kleinjans, K. 2010 Family background and gender differences in educational expectations. *Economics Letters* **107**, 125-127.
[85] Roemer, J. E. 2004 Equal Opportunity and Intergenerational Mobility: Going Beyond Intergenerational Income Transition Matrices. In *Generational Income Mobility in North America and Europe* (ed. M. Corak). ambridge, Cambridge University Press.
[86] Corak, M. 2013 Income inequality, equality of opportunity, and intergenerational mobility. *Journal of Economic Perspectives* **27**, 79-102. (DOI:10.1257/jep.27.3.79).
[87] Bose, N. & Das, S. 2017 Women's Inheritance Rights, Household Allocation, and Gender Bias. *American Economic Review* **107**, 150-153.
[88] Hvistendahl, M. 2014 While emerging economies boom, equality goes bust. *Science* **344**, 832.
[89] Behrman, J. R., Schott, W., Mani, S., Crookston, B. T., Dearden, K., Duc, L. T., Fernald, L. C. H. & Stein, A. D. 2017 Intergenerational Transmission of Poverty and Inequality: Parental Resources and Schooling Attainment and Children's Human Capital in Ethiopia, India, Peru, and Vietnam. **65**, 657-697. (DOI:10.1086/691971).
[90] Naroll, R. 1970 What Have We Learned from Cross-Cultural Surveys?1. *American Anthropologist* **72**, 1227-1288. (DOI:10.1525/aa.1970.72.6.02a00030).
[91] Skinner, G. W. 1997 Family systems and demographic processes. In *Anthropological demography: toward a new synthesis* (eds. D. I. Kertzer & T. Fricke), pp. 53-95. Chicago, The University of Chicago Press.
[92] Vullioud, C., Davidian, E., Wachter, B., Rousset, F., Courtiol, A. & Höner, O. P. 2018 Social support drives female dominance in the spotted hyaena. *Nature Ecology and Evolution*. (DOI:10.1038/s41559-018-0718-9).
[93] Alesina, A., Giuliano, P. & Nunn, N. 2013 On the origins of gender roles: Women and the plough. *Quarterly Journal of Economics* **128**, 469-530. (DOI:10.1093/qje/qjt005).
[94] Qian, N. 2008 Missing women and the price of tea in China: The effect of sex-specific earnings on sex imbalance. *Quarterly Journal of Economics* **123**, 1251-1285. (DOI:10.1162/qjec.2008.123.3.1251).
[95] BenYishay, A., Grosjean, P. & Vecci, J. 2017 The fish is the friend of matriliny: Reef density and matrilineal inheritance. *Journal of Development Economics* **127**, 234-249. (DOI:10.1016/j.jdeveco.2017.03.005).
[96] Borgerhoff Mulder, M. 2007 Hamilton's rule and kin competition: the Kipsigis case. *Evolution and Human Behavior* **28**, 299-312. (DOI:10.1016/j.evolhumbehav.2007.05.009).
[97] Scelza, B. A. 2011 Female Mobility and Postmarital Kin Access in a Patrilocal Society. *Human Nature-an Interdisciplinary Biosocial Perspective* **22**, 377-393. (DOI:10.1007/s12110-011-9125-5).
[98] Seabright, P. 2012 *The war of the sexes : how conflict and cooperation have shaped men and women from prehistory to the present*. Princeton, Princeton : Princeton University Press.
[99] Jerrim, J. & Macmillan, L. 2015 Income inequality, intergenerational mobility, and the great gatsby curve: Is education the key? *Social Forces* **94**, 505-533. (DOI:10.1093/sf/sov075).

[100] Hesketh, T. & Xing, Z. W. 2006 Abnormal sex ratios in human populations: Causes and consequences. *Proceedings of the National Academy of Sciences of the United States of America* **103**, 13271-13275. (DOI:10.1073/pnas.0602203103).
[101] Almond, D., Edlund, L. & Milligan, K. 2013 Son Preference and the Persistence of Culture: Evidence from South and East Asian Immigrants to Canada. *Population and Development Review* **39**, 75-95. (DOI:10.1111/j.1728-4457.2013.00574.x).

Figure and Table Captions

Table 1: Summary of wealth datasets. “Stan. diff.” is the standardized difference: it is the difference between the son and daughter means, divided by the standard deviation. *Shared incomes and land holdings were recorded for Bangladesh married pairs; the sample means are therefore the same. **Krummhörn data are from historical records from which ages are unavailable.

Table 2: Estimates of parent-offspring correlations for each sex and the differences between them. SE is the standard error of the estimate.

Table 3: Estimated number of datasets that show little bias, son bias, and daughter bias.

Figure 1: Plots of ρ_s and ρ_d estimated for land ownership in Bangladesh. The steeper slope for sons (in blue) is consistent with son-biased parental investment. D_s, D_d, and D_{mp} are standardized wealth deviations of sons, daughters, and midparents, respectively; see the section “Statistical Inference” for an exact definition.

Figure 2: Parent-son and parent-daughter correlations, with 90% confidence intervals. The datasets are sorted according to the mean correlation across both sexes. “HH wealth” refers to household wealth; “Network” refers to a measure of social network wealth.

Figure 3: Difference between son and daughter correlations ($\Delta\rho$), with 90% CI. Numbers along vertical axes are the posterior probability that $\rho_s > \rho_d$ for (a) and $\rho_s < \rho_d$ for (b), for each dataset. “HH wealth” refers to household wealth; “Network” refers to a measure of social network wealth.

Population	Wealth type	N sons	N daughters	Stan. diff.	Mean age
Bangladesh	Education	596	516	0.21	27.8
	Income	298	584	0*	42.6
	Land	283	436	0*	50.4
Bengaluru	Education	263	299	0.23	34.3
	Network wealth	162	183	0.22	33
	RS	291	355	-0.12	33.9
Chewa	Education	147	98	0.35	23.5
	Land	33	118	0.04	30.7
	RS	35	132	-0.58	30.7
Datoga	Livestock	95	40	-0.22	30.9
	RS	95	40	-0.43	30.9
Gambia	Height	390	427	1.24	24.1
	RS	87	220	0.34	32
	Weight	390	427	0.59	24.1
Himba	RS	54	92	0.21	39.4
Kipsigis	Cattle partners	61	41	0.3	44.3
	Land	161	109	-0.44	42.3
	Livestock	161	109	0.27	42.3
	RS	160	108	0.46	42.4
Krummhörn	Land	708	744	-0.01	NA**
Lamalera	Boat shares	64	55	-0.14	36.7
	House quality	53	40	-0.31	36.3
	RS	64	55	-0.08	36.7
Maya	Education	106	103	0.6	32.1
	Height	63	78	1.57	33.8
	RS	99	88	-0.14	32.4
	Weight	61	74	0.61	33.8
Mosuo	Education	141	156	0.11	28.1
	RS	134	146	-0.32	28.3
Pimbwe	Farm skill	61	71	-0.04	33.7
	Household wealth	77	92	-0.03	32.7
	RS	226	215	-0.26	29.7
Poland	Education	5781	7274	-0.35	47.3
Tsimane	Knowledge	41	68	-0.37	24.6
	RS	435	406	-0.22	30.2
	Weight	110	107	0.86	26.6
Ust Avam	Education	55	45	-0.5	22.6
	RS	77	54	-0.44	25.1

Table 1: Summary of wealth datasets. "Stan. diff." is the standardized difference: it is the difference between the son and daughter means, divided by the standard deviation. *Shared incomes and land holdings were recorded for Bangladesh married pairs; the sample means are therefore the same. **Krummhörn data are from historical records from which ages are unavailable.

Population	Wealth type	ρ_s	SE	ρ_d	SE	$\Delta\rho$	SE
Bangladesh	Education	0.47	0.03	0.54	0.03	-0.07	0.05
	Income	0.29	0.05	0.22	0.04	0.07	0.07
	Land	0.52	0.04	0.37	0.04	0.14	0.06
Bengaluru	Education	0.67	0.03	0.71	0.03	-0.04	0.04
	Network wealth	0.12	0.07	0.12	0.07	0	0.1
	RS	0.21	0.06	0.12	0.06	0.1	0.08
Chewa	Education	0.28	0.07	0.24	0.09	0.04	0.11
	Land	-0.14	0.25	0.06	0.1	-0.2	0.27
	RS	-0.41	0.16	0.08	0.09	-0.49	0.19
Datoga	Livestock	0.54	0.08	0.54	0.12	-0.01	0.13
	RS	0.18	0.13	0.2	0.17	-0.02	0.21
Gambia	Height	0.435	0.04	0.56	0.03	-0.12	0.05
	RS	0.15	0.07	-0.03	0.05	0.18	0.09
	Weight	0.37	0.04	0.44	0.04	-0.08	0.06
Himba	RS	0.15	0.13	0.19	0.11	-0.04	0.17
Kipsigis	Cattle partners	-0.02	0.15	0.16	0.21	-0.18	0.25
	Land	0.63	0.06	0.16	0.11	0.47	0.12
	Livestock	0.46	0.07	0.09	0.1	0.37	0.12
	RS	0.06	0.11	0.03	0.13	0.03	0.17
Krummhorn	Land	0.6	0.02	0.52	0.03	0.08	0.03
Lamalera	Boat shares	0.15	0.15	0.12	0.14	0.03	0.2
	House quality	0.14	0.14	0.12	0.16	0.03	0.21
	RS	-0.14	0.13	0.42	0.11	-0.56	0.18
Maya	Education	0.12	0.12	0.3	0.1	-0.18	0.15
	Height	0.4	0.1	0.63	0.07	-0.23	0.11
	RS	0.07	0.12	-0.01	0.11	0.07	0.16
	Weight	0.25	0.13	0.23	0.11	0.02	0.16
Mosuo	Education	0.26	0.09	0.3	0.07	-0.05	0.11
	RS	-0.13	0.11	0.06	0.07	-0.2	0.13
Pimbwe	Farm skill	0.08	0.14	0.21	0.12	-0.13	0.18
	Household wealth	0.33	0.1	-0.08	0.11	0.41	0.15
	RS	-0.04	0.06	0.04	0.07	-0.07	0.09
Poland	Education	0.3	0.01	0.28	0.01	0.02	0.02
Tsimane	Knowledge	0.03	0.15	-0.02	0.14	0.05	0.2
	RS	0.05	0.05	0.09	0.05	-0.04	0.07
	Weight	0.35	0.09	0.22	0.1	0.13	0.13
Ust Avam	Education	0.53	0.12	-0.15	0.18	0.68	0.22
	RS	-0.15	0.15	-0.14	0.12	-0.01	0.19

Table 2: Estimates of parent-offspring correlations for each sex and the differences between them. SE is the standard error of the estimate.

	Definition	N	90% CI
Little bias	$\lvert\Delta\rho\rvert < 0.1$	15	11-19
Son bias	$\Delta\rho > 0.1$	11	8-14
Daughter bias	$\Delta\rho < -0.1$	11	7-14

Table 3: Estimated number of datasets that show little bias, son bias, and daughter bias.

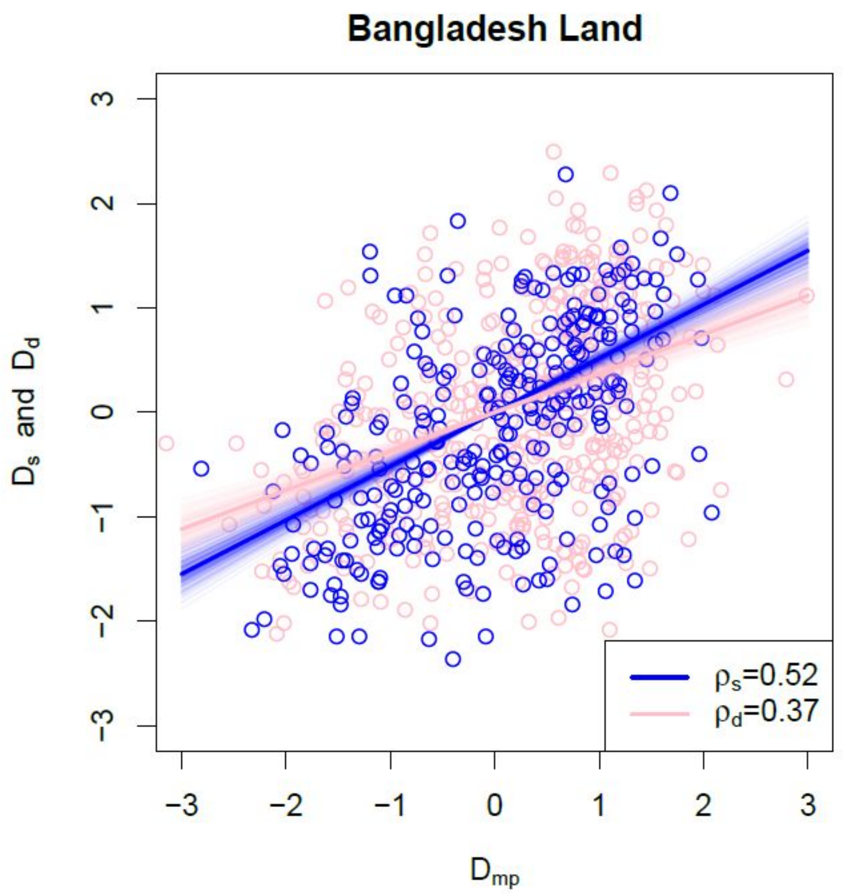


Figure 1: Plots of ρ_s and ρ_d estimated for land ownership in Bangladesh. The steeper slope for sons (in blue) is consistent with son-biased parental investment. D_s, D_d, and D_{mp} are standardized wealth deviations of sons, daughters, and midparents, respectively; see the section "Statistical Inference" for an exact definition.

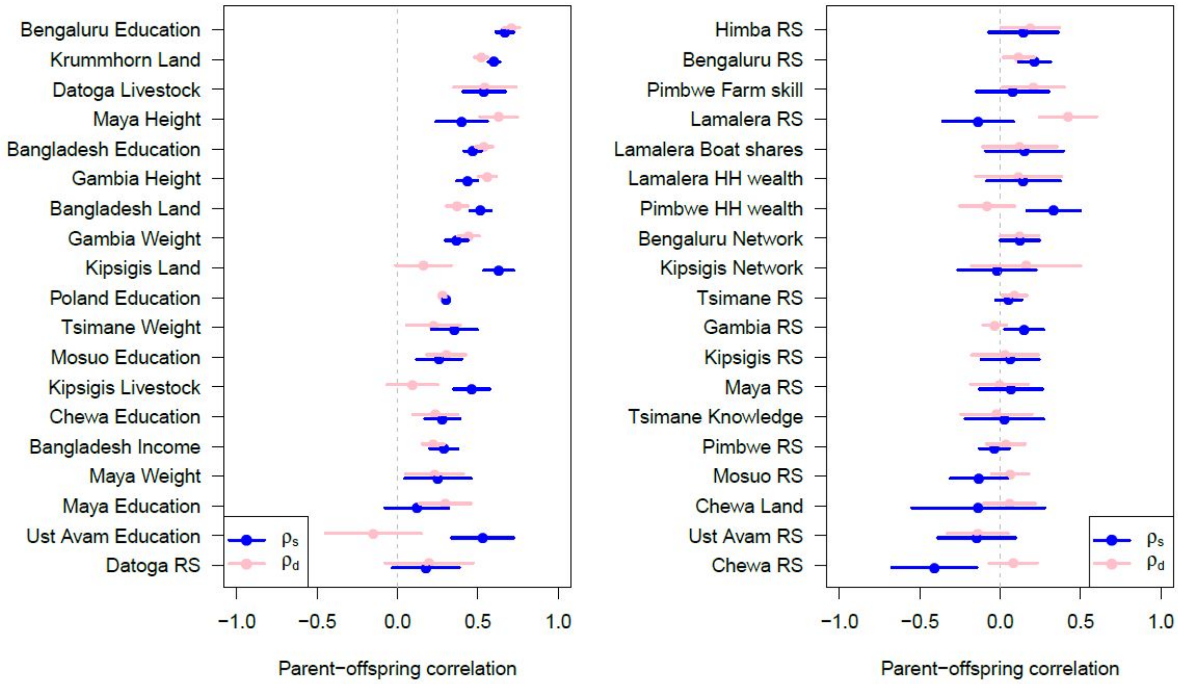
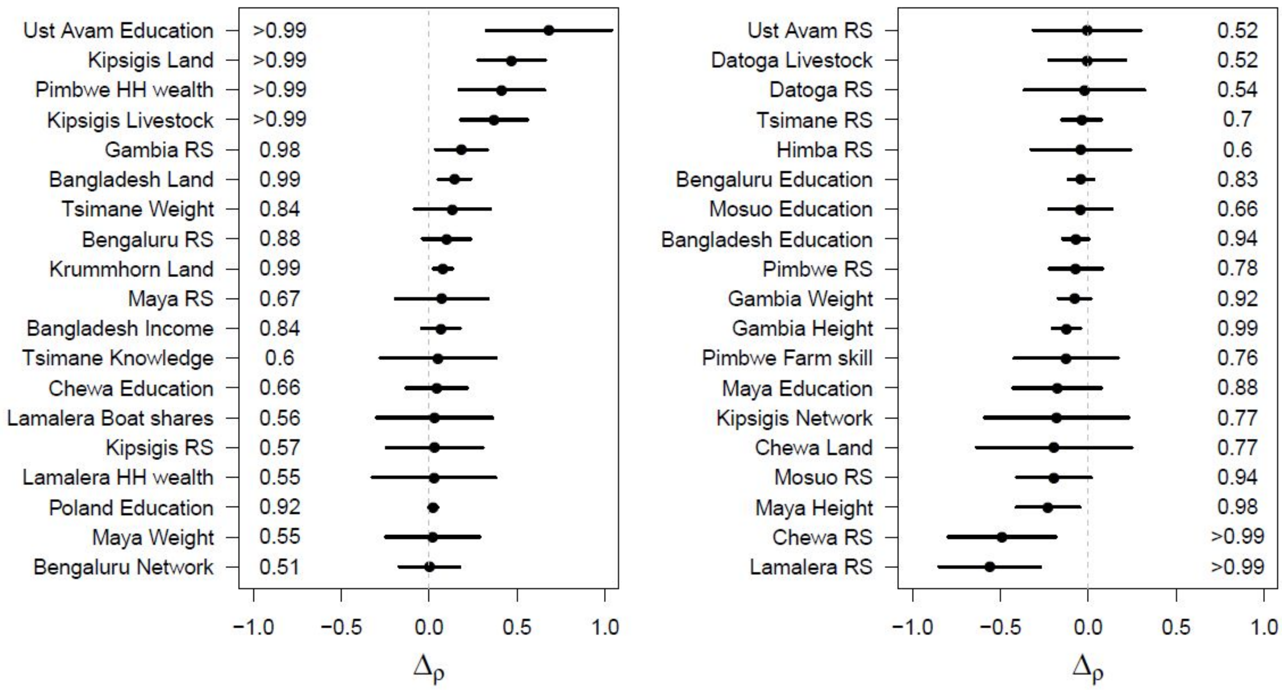


Figure 2: Parent-son and parent-daughter correlations, with 90% confidence intervals. The datasets are sorted according to the mean correlation across both sexes. “HH wealth” refers to household wealth; “Network” refers to a measure of social network wealth.



(a) Son-biased correlations (b) Daughter-biased correlations

Figure 3: Difference between son and daughter correlations ($\Delta\rho$), with 90% CI. Numbers along vertical axes are the posterior probability that $\rho_s > \rho_d$ for (a) and $\rho_s < \rho_d$ for (b), for each dataset. “HH wealth” refers to household wealth; “Network” refers to a measure of social network wealth.