# The lion's share. An experimental analysis of polygamy in Northern Nigeria.

**by**

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**Abstract:**

Using samples of polygamous and non-polygamous households from villages in rural areas south of Kano, Northern Nigeria we test basic theories of household behaviour. Husbands and wives play two variants of a voluntary contributions game in which endowments are private knowledge, but contributions are public. In one variant, the common pool is split equally. In the other treatment the husband allocates the pool (and wives are forewarned of this). Most partners keep back at least half of their endowment from the common pool, but we find no evidence that polygynous households are less efficient than their monogamous counterparts. We also reject a strong form of Bergstrom's model of polygyny in which all wives receive an equal allocation. In our case, senior wives often receive more from their husbands, no matter what their contribution. Thus the return to contributions is higher for senior wives compared to their junior counterparts. When they control the allocation, polygynous men receive a higher payoff than their monogamous counterparts. We speculate on the implications of this pattern of investment and reward for the sustainability of polygynous institutions.

Keywords: Polygyny, Polygamy, Experiment, Household, Nigeria

**Introduction.**[*]

Across many countries around the world, polygamy is a familiar and apparently robust social institution. Its most typical form is polygyny, where a husband has two or more wives and in this form it is found commonly in more than 50 countries world-wide.[i] Though widespread and seemingly integral to the culture of many societies, the empirical investigation of polygyny has attracted very little attention from economists. In this paper we add to the small pool of data, by reporting an experiment with polygynous couples in the northern Nigerian state of Kano. Given the lack of data on economic behaviour amongst polygynous families, we concentrate on some simple questions. As with monogamous families, the most straightforward questions to consider with polygyny are household efficiency and intra-household allocation. Are monogamous households more efficient than polygamous? In polygynous households, which wife receives the greater share of incomes? How are resources allocated? These questions provide a starting point for our design which employs two versions of a one-shot voluntary contribution game: one with a fixed rule of allocating the communal pool and one in which the husband must make the allocation. The experiment is part of a much wider programme that investigates patterns of conjugality in several countries. As such it runs in parallel with near identical experiments on monogamous couples in the same location. In addition we run a follow-up household survey 1-2 months later, in which wives and husbands are interviewed. In this way we tie our experimental results to more traditional forms of household data

To offer a quick preview of our results, broadly speaking we find that both types of households in our sample are equally inefficient in their decisions. In terms of payoffs, senior wives in polygyny fare no worse that wives in monogamous households, but polygynous husbands do better than their monogamous counterparts. Most clearly, second wives are disadvantaged compared to their co-spouses when men control the allocation of resources.

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**Background.**

Table 1 provides some summary statistics about the incidence of polygyny in sub-Saharan Africa - the part of the world where incidence is highest - over the last 25 years. The percentages of women in polygynous marriages vary significantly across countries, but are generally higher in the west of Africa. In several countries, over one third of married women share their husband with one or more wives and while the percentage doing so has declined over the period, the trend is gentle in most countries and absent in some.

**Table 1. Polygyny in sub-Saharan Africa**[ii]

| % Wives with one or more co-wives | | | | | | | |
|---|---|---|---|---|---|---|---|
| Country | | Year | | Country | | Year | |
| **Benin** | **1996** | **2001** | **2006** | **Mali** | **1987** | **2001** | **2006** |
| | 49.4 | 45.4 | 42.6 | | 45 | 42.4 | 39.2 |
| **Burkina Faso** | **1993** | **1998-99** | **2003** | **Mauretania** | | | **2001** |
| | 50.9 | 54.6 | 48.4 | | | | 11.2 |
| **Burundi** | **1987** | | | **Mozambique** | | **1997** | **2003** |
| | 11.6 | | | | | 27.3 | 24.2 |
| **Cameroon** | **1991** | **1998** | **2004** | **Namibia** | **1992** | **2000** | **2005** |
| | 38.2 | 32.7 | 30 | | 24.2 | 12.4 | 5.5 |
| **Chad** | | **1998** | **2003** | **Niger** | **1992** | **2001** | **2006** |
| | | 39.1 | 39 | | 36 | 37.6 | 35.7 |
| **Cote d'Ivoire** | **1994** | **1998** | | **Nigeria** | **1990** | **2003** | **2008** |
| | 36.4 | 34.8 | | | 40.8 | 35.7 | 32.7 |
| **Eritrea** | | **1995** | **2002** | **Rwanda** | **1992** | **1999** | **2005** |
| | | 6.9 | 9.3 | | 14.2 | 12.1 | 11 |
| **Ethiopia** | | | **2000** | **Senegal** | **1987** | **1997** | **2005** |
| | | | 13.6 | | 46.5 | 46 | 39.5 |
| **Gabon** | | | **2000** | **Sierra Leone** | | | **2008** |
| | | | 21.1 | | | | 37.3 |
| **Ghana** | **1988** | **2000** | **2008** | **South Africa** | | **1998** | |
| | 32.6 | 22.5 | 18.6 | | | 6.8 | |
| **Guinea** | | **1999** | **2005** | **Sudan** | **1989** | | |
| | | 53.3 | 53 | | 20.1 | | |
| **Kenya** | **1988** | **2003** | **2008** | **Swaziland** | | | **2007** |
| | 23.4 | 16.4 | 13.3 | | | | 18.3 |
| **Liberia** | | **1986** | **2007** | **Tanzania** | | **1992** | **1997** |
| | | 38 | 16.3 | | | 26.9 | 28 |
| **Madagascar** | **1992** | **2003** | **2007** | **Togo** | **1988** | **1998** | |
| | 5.9 | 3.1 | 3.1 | | 52.3 | 42.8 | |
| **Malawi** | | **1992** | **2000** | **Uganda** | **1988** | **2001** | **2006** |
| | | 20.4 | 17 | | 34.1 | 32.2 | 28.1 |
| | | | | **Zambia** | **1992** | **2001** | **2007** |
| | | | | | 17.6 | 15.8 | 14.4 |

Source DHS surveys various years. The data includes the most recent and the earliest data for each country.

Nigeria is therefore one of a significant number of countries where polygyny is common and apparently stable in the sense that it has shown but a slow and erratic tendency to decline in the modern era. According to the 2008 Demographic and Health Survey,[iii] 41.9% of married women in the largely Muslim North-west region of Nigeria (where our study is located) reported having one or more co-wives. Conversely, 27.1% of married husbands reported two or more wives in the same region. For husbands, this compares to 24.2% reported for same region in a 1999 survey and a national average of 18.7% in 2008. For wives in north-west Nigeria, 37.2% reported one or more co-wives in 1999, and 32.7% nationally report one or more co-wives in 2008. Polygyny is more common in rural areas by about six percentage points, more common amongst individuals with lower education levels and common at all wealth levels. In the vast majority of polygynous marriages, 2 wives are married to one man, but 2.6% of married men in 2008 reported having 3 or more wives.

We focus on the Hausa people, the largest ethnic group in the north of Nigeria who also live in large numbers in neighbouring countries such as Niger. Hausa are Muslims and practice female seclusion as a cultural norm for married women (Hill, 1969). Married women do not generally go out in daylight except for occasions such as marriage ceremonies or to seek medical help (Calloway, 1984, Robson 2004). Among the Hausa, the reality of female seclusion varies with the nature of the settlement and the prosperity of the family. In general, it is more complete in urban areas and amongst higher income families (Calloway, 1984). In dispersed settlements away from the main towns there can be relatively little seclusion. Although seclusion limits their physical mobility, women have a significant degree of economic autonomy. They engage in various small scale enterprises and many are highly active producers and traders of craft and food products. In this regard, children act as intermediaries with girls to the fore, hawking goods, passing messages and learning the skills of the marketplace. In Robson, 2004, girls spend twice as much time per week on trading as they do on domestic work and four times as much time as boys do.

What money wives earn is usually for themselves, accounts are kept strictly separately from their partners and spent according to their own priorities. “In Kano [the main city of the region], a woman's trade is so individual that a husband will actually buy prepared food from his wife for his meals.” Calloway, 1984, p. 440. Meanwhile men are responsible for providing normal consumption goods, housing and investing in agriculture. Divorce is relatively common and frequently initiated by women (in 86% of cases according to Solivetti, 1994). Jackson, 1993, reports a lifetime average of 2.3 marriages per woman amongst Hausa, while Calloway concludes that around 50% of women will at some stage in their lives go through the process of divorce, emphasizing that remarriage is the overwhelming norm for pre-menopausal women and occurs rapidly because most women who would otherwise face social isolation. Overwhelmingly in our survey, both men and women state that, upon divorce men and women typically retain their own property, including livestock, tools, cash and housing. Older boys and girls usually go with fathers, while younger children, especially girls, are more likely to go with mothers.

Population density is relatively high and most farming is intensive. Crops include wheat, rice, millet, sorghum, maize, cowpeas and groundnuts. There is some livestock farming and vegetables. The practice of seclusion means that while they engage heavily in agricultural processing activities for their own profit, married Hausa women play little role in cultivation, which is carried out largely by men with the aid of children (Hill, 1969; Jackson, 1985).[iv] Hausa is a patrilineal society and one patrilocal extended family normally occupies a single compound with separate dwellings for each wife.

**Theory Background.**

Although polygyny is common, interest in it from an economic perspective has been intermittent and economic theories about it are correspondingly rare. In Becker's pioneering, discussion, differences in male productivity are given as one possible reason for polygyny. Total output maybe higher when more than one female is matched with some males, compared to a situation where only monogamy matches are allowed. Given such efficiency and a competitive marriage market, polygyny may result. A complete dynamic model is provided by Telfit, 2005 (see also Lagerloef, 2005 and Gould et al 2008) who formalises and then calibrates a growth model in which the form of the marital contract drives rates of savings and hence the process of economic development. In this model there are diseconomies of scale in child rearing for individual women. When polygyny is allowed and fertility is sufficiently high, men use their children as a savings vehicle (with the investment recouped through a bride price) and this lowers physical investment and therefore the capital stock compared to an economy where only monogamy is possible. High fertility is central to this story as it means that all men can potentially marry provided the age gap at marriage between men and women is sufficiently large.

One assumption of the dynamic model is constant returns for the production of children as a function of number of wives. In Becker's 1981 analysis he raised the possibility of diminishing returns because one input (the husband) is fixed. Significant diseconomies in polygyny might also arise through the constant rivalry between wives regularly described in qualitative interviews with polygynous families, Solivetti, 1994 or Strassmann, 1997, or simply through free-riding in the provision of household public goods. In one of the few empirical investigations of polygamy, Kazianga and Klonner, 2009, use evidence of child mortality in Mali, to argue against the efficiency of polygyny. Meanwhile, Mammen, 2004, considers a similar data set for Cote d'Ivoire, and concludes that, "This evidence is consistent with the notion that co-wives compete for resources from the husband and invest only in their own children, which may result in inefficient investments in the household's children." P. 28. Against this, there may be some significant economies of scale in marriage size, such as through the division of labour. After all, in standard economic models of the marriage market it is this division that drives the efficiency advantages of marriage over singlehood, and it would seem quite reasonable to suppose that there are continued gains from greater household size. For the purposes of designing an experiment, and in the absence of a detailed theory of the polygynous household and a body of evidence on its efficiency, it seems reasonable to take as a starting point the assumption that households types are of equal efficiency:

Efficiency H0: In their decisions, polygynous and monogamous households are of equal efficiency.

Perhaps the most complete microeconomic model of polygyny is provided in Bergstrom's (1994) well-known but unpublished paper. Bergstrom's primary focus is on the intra-household allocation process. He supposes that for women there are first increasing then decreasing returns to scale in the production of children, f (see Figure 1) from the investment of resources, r. Given a low enough turning point in the production function, it is then optimal for a husband who cares only about his own consumption and the number of his surviving children to marry more than one wife and then allocate resources equally to the spouses when child productivity is symmetric.

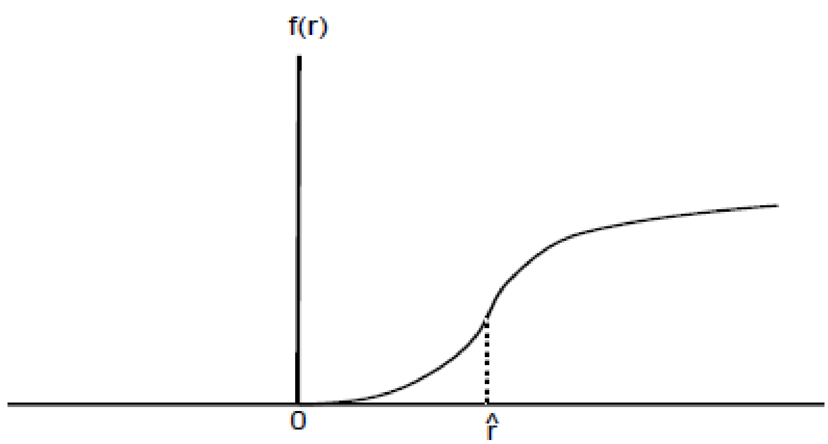


**Figure 1. Bergstrom's model of the family.**

Formally, consider a husband with income Y who must divide it between his own consumption and investments, $r_1$ and $r_2$ in the production of children from his two families. He maximizes the payoff function,

$$u(Y - r_1 - r_2) + f(r_1) + f(r_2)$$

Where u(.) is his utility from personal consumption. The first order conditions yield:

$$f'(r_1) = f'(r_2)$$

Where ‘ indicates a first derivative. If all functions are concave (or as above, have low enough turning points), then at the maximum $r_1 = r_2$. That is, the husband allocates equal funds to the two families and produces equal numbers of children, $f(r_1)=f(r_2)$. Thus our basic null hypothesis about allocation is,

Allocation H0: A polygynous husband will allocate funds equally between wives.

Alternatively, we might imagine the allocation of incremental resources ΔY, given existing numbers of children $f(r_1)$ and $f(r_2)$ which may or may not be equal. In this context, the optimal solution is to allocate relatively more to the family where the marginal productivity of resources is highest. If f is concave this means allocating marginal resources (more) towards the family with the fewest number of children. This produces an alternative hypothesis:

Allocation H1: A polygynous husband will allocate relatively more funds to the wife who has fewer children.

We view the null and alternative as a useful organising device in what follows, but it comes from a deliberately simple and naïve model (Bergstrom describes it as ‘a crude caricature of the reality of polygamous marriage markets’ which is probably overstating the point). As the author, says, though, “Because the structure is simple and easily understood, it should be quite possible to test it in applications” (p. 18 Bergstrom, 1994) and that is the spirit in which we use it.

It is worth considering briefly how in reality, two types of ways allocation may differ from the equalising principles behind H0 and H1. First, the model is ex ante, whereas in practice the husband will usually have posterior information on his wives’ fertility and on the probabilities of children passing safely to adulthood. This may mean tilting allocation of resources towards the wife who has a higher future chance of producing offspring. Meanwhile, the needs and demands of children will depend on their age profile. Smaller children are more likely than older children to suffer serious and prolonged harm from under-provision of nourishment (Maluccio et al, 2009), but at the same time their total needs are smaller.

Secondly, the allocation of resources might depend on the bargaining power of wives. We noted earlier that divorce was common in our target site and it is often initiated by women. Whether this gives relatively more power to senior or junior wives is unclear. Women only usually retain custody of young children, suggesting that it is older women who have most to lose from divorce, but divorce can be emotionally and financially disruptive when the bonds between partners are more numerous, making more salient the fear of divorce for a husband in a longer-established family. The overall effects of these forces is unclear, but Izugbara and

Ezeh, 2010, quote the view that "… in polygynous marriages in Islamic northern Nigeria, husbands allocate resources to their wives based on the number of children they have; the wife with the most children attracts the greatest proportion of his resources." P. 200

These models relate allocations to demographic factors and measures of bargaining power. Alternatively, allocation in the household may be rule based, either because of social norms or because simple rules can reduce the transaction costs of repeated negotiation over resources. Solivetti, 1994, attests that local interpretation of Koranic law in northern Nigeria favours equal treatment of wives while Ware, 1979 reporting on polygyny elsewhere in Nigeria finds a perceived norm of preferential treatment for senior wives in the opinions of her married subjects.

**Design**.

To test efficiency and to examine male allocation within polygyny, we have two relevant treatments. In treatment 1, each subject, i, separately and privately receives an endowment of $E_i$ = 400 Nairas. Each person then chooses an investment, $x_i$ from the set {0, 100, 200, 300, 400}. The investments of the n players are summed and multiplied by 1.5 and then each player receives a fraction 1/n of the total.

The first treatment can be thought of as a benchmark. In the second treatment each subject separately and privately receives the same 400 Nairas as in treatment 1 and makes an investment decision from the same choice set. The investments are summed and multiplied in the same manner, but then the husband chooses how much to allocate to each person in the household. The husband's decision is made using the strategy method – i.e after he has made his investment decision, he must propose a binding allocation of payouts for each possible investment by his wife. For monogamous couples, this means 5 conditional allocations. For polygynous couples we would need 25 conditional allocations. Under the circumstances of the experiment, this was logistically impossible, so we selected a subset of 5 possible investment combinations. If one of these combinations matched the actual pattern of investment, then the conditional allocation was binding. If it did not match we asked the husband to make an actual allocation once the true investment pattern was revealed to him.

There is an issue in voluntary contribution games about the best way to compare games with different numbers of players. Consider a game where rewards are linear in investments. Endowment is E(n), and the multiplier for contributions is m(n). Thus if no-one contributes, per person payoffs are A(n) = E(n) and if everyone contributes all of her or his endowment the per person payoff is B(n) = E(n).m(n). Meanwhile the private marginal return on investment is C(n) = m(n)/n. It follows that B = nAC, so that not all of A, B and C can be independent of n. If C and B are constant then the per person payoff when no one contributes must fall inversely with n. Similarly if A and C are constant then B must be proportional too n. We took the view that it was most important that, if everyone were completely selfish each person would end up with the same payoff independently of household size and secondly if the household were unitary, payoff per person would be independent of household size. This dictates that we keep constant the endowment per person across conjugal types and we keep constant m (=1.5). So, the private marginal return to individual investment is 0.5 in a 3 person game, compared to 0.75 in the two person game.[v]

The private endowment $E_i$ was known only to individual i., whereas the common account and the final allocation from that account was common knowledge. We told participants that,

> The exact amount will vary between people, but you will receive something between 0 and 400 Nairas. [Show the envelope.] Your husband will receive a similar envelope and he will receive an amount of money between 0 and 400 Nairas. He does not know how much you have in your envelope and you won't be told how much he has in his envelope. (Instruction for a wife in the monogamy case).[vi]

This practice of asymmetric information is designed to mimic the typical household situation, in line with Iversen et al, 2006. Asymmetric information about individual resources and spending is a familiar part of household behaviour in many cultures, including the Hausa (Calloway, 1984). Our follow-up survey (see below) amongst participants confirms this. It is worthwhile stressing that in this experiment the total surplus maximizer has no incentive to withhold contributions, even with asymmetric information, but of course players with different motives may wish to hide some or all of their endowment from their partner. Here this could be achieved by not placing some of the endowment in the common pool, but because there are other motives for not investing which apply even if endowments are common knowledge, we cannot interpret all failures to invest as evidence of deceit.[vii] The clearest evidence of attempts to conceal resources is provided where the potential investor also controls the allocation (i.e. the husband in treatment 2).

The experiments took place on five consecutive days in July 2009. The locations were five villages (i.e. one village per day) around 1-2 hour's drive south along sealed roads from the edge of Kano, the third largest city in Nigeria. The villages had been pre-selected in the month leading up to the main fieldwork using local informants and prior visits by members of the research team. The major selection criteria were size (we needed to recruit 80 couples from each place), rural location and separation from the other sites (to limit the possibility of cross-contamination). The actual experimenters were 12 (6 female and 6 male) local researchers recruited through the advice of local partners from Bayero University, Kano. Most of them had some background in Sociology or Economics. Some of them had experience with the implementation of household surveys. All of them had very good English.

The experimenters received five days of training. The first day of training was used for explaining the principles of how to run experiments (what to do and what not to do with examples) and presenting all the treatments to be played in Nigeria. On days 2 and 3 experimenters practised in Hausa (and sometimes in English so that the team leaders could understand). On day 4 we ran a pilot using a small sample of subjects. The fifth day of training was used to give individual and collective feedback on the pilot, to explain the logistics for the game days and to distribute the material needed for the first 5 game days. The experiments used scripts translated into Hausa and then back-translated into English. Each experimenter was also used to compare the English and the Hausa versions of 2 or 3 treatments. Discrepancies were corrected by the experimenters during training in the Hausa version. The schedule for the 5 game days was as follows: 4 treatments in the morning and 4 treatments in the afternoon[viii] (including one polygamous treatment in the morning and one in the afternoon). In each location 16 polygamous couples and 16 monogamous couples took part in the relevant treatments. In four of the five locations, no suitable public building was available for the experiments, so maize plantations were used instead with people sitting on the ground. On the second day a village school was used.

Secrecy about endowments was ensured by calling one household at a time and separating each person, with the husband going to one location with one researcher and each of the wives going separately to another location with other researchers. Each spouse removed from their envelope what they wanted to keep for themselves, with the remainder left for the common account. A helper collected their envelopes and recorded the decisions.

**Results.**

Tables 2 and 3 set out some background information from the accompanying survey.[ix]

**Table 2. Background information on households.**

| | Household size | Children | Age of wife at marriage | Age of husband at marriage | Current Age of husband | Husband's Income (Naira per year) |
|---|---|---|---|---|---|---|
| Monogamy | 5.9 | 3.2 | 16 | 26 | 36.7 | 126,014 |
| Polygyny | 10.7 | 5.1 | | | 42.0 | 203,717 |
| First marriage | 6.5 | 3.4 | 15 | 23 | | |
| Second marriage | 4.1 | 1.8 | 18 | 32 | | |

Note: all variables are means. Income figures exclude household where husbands reported no income.

We see that the typical polygynous family is larger than its currently[x] monogamous counterpart, has a higher income, the husband is older and as measured by the number of radios, wealthier.[xi] In our monogamous sample, around 20% of male subjects and 10% of female subjects report having been married before. With spousal death (usually a wife) accounting for 30% of cases in which marriages ended, it suggests that our sample has relatively low divorce rates compared to the standard view of the region (e.g. in Jackson, 1993 or Calloway, 1984). There is some evidence of a bimodal shape in the second wife ages: only 30 out of 220 monogamous marriages involve a wife who married at age 20 or over; only 7 (out of 80) first marriages had the same status, whereas 23 out of 78 second marriages involved women who were at least aged 20. This would accord with Last (1984) view of a mixed motive for second marriages, at least some of which were not for the purpose of producing children.

When we asked polygynous spouses about cooperation and allocation practices differences emerged between husbands and wives, as documented in Table 3. Largely, spouses reported equal allocation of time and money to wives, but with some favouring of first wives in decision-making. First wives were less likely to claim a major say in decisions, compared to second wives' perceptions of the first wives' role. Conversely, first wives granted second wives a greater say in decision-making than second wives claimed was the reality.

**Table 3. Perceptions of household practices.**

| Wives' say in major household decisions (%) | First wife has more say | Both wives have about the same | Second wife has more say | Neither wife is involved | Other, specify | |
|---|---|---|---|---|---|---|
| Husband | 40.0 | 43.8 | 8.8 | 6.8 | 1.3 | |
| First Wife | 24.1 | 50.6 | 20.3 | 5.1 | 0 | |
| Second wife | 34.6 | 52.6 | 6.4 | 6.4 | 0 | |
| **How husband splits time spent with wives (%)** | **All with first wife** | **Mostly with first wife** | **Equal time** | **Mostly with second wife** | **All with second wife** | |
| Husband | 10.0 | 6.3 | 83.8 | 0.0 | 0.0 | |
| First Wife | 1.3 | 5.1 | 84.8 | 8.9 | 0.0 | |
| Second wife | 1.3 | 2.6 | 96.2 | 0.0 | 0.0 | |
| **How husband splits money between wives (%)** | **All to first wife** | **75% to first wife** | **Half to each wife** | **25% to first wife** | **None to first wife** | **Other, specify** |
| Husband | 10 | 11.3 | 73.8 | 0 | 0 | 5 |
| First Wife | 2.5 | 8.9 | 84.8 | 3.8 | 0 | 0 |
| Second wife | 0 | 10.3 | 82.1 | 7.7 | 0 | 0 |

We also asked questions about cooperation, both generally and specifically. Answers were largely consistent between household partners: about 90% agreed that the wives cooperated most of the time, with the remainder stated that the wives cooperated sometimes (the remaining alternatives were rarely and never). For specific tasks, namely for childrearing, cooking, buying provisions and agriculture the percentages stating that wives cooperated most of the time were lower, but still always the majority response by all three spouses.

Meanwhile, around 65% of husbands stated that they would not hide any part of a windfall from their wives. The percentage was very similar for women, across family types, but second wives were slightly more likely to state that they would hide all of a windfall (20.5%) compared to first wives (15%) and wives in monogamy (15%).

Table 4 sets out the mean investment levels in the common pool across the experiment at both the household and individual level. [xii] A basic feature is that, across all types of spouses in the different treatments and marriages, subjects rarely invest all of their endowments. Thirteen out of 80 men invest all their endowment in treatment 1 and 11 place everything in the common pool in treatment 2. For women, the corresponding numbers are just one and two. In fact, the majority of subjects invest half or less of their endowments and as a result the mean rate of investment across the whole experiment is less than 50%.[xiii] A second basic feature of this data is the lack of variation across treatments at the level of the household and the lack of variation across household types, though it appears that the sign of treatment effects differs between marital groups. Median tests accept the null hypotheses that rates of household investment are the same across treatments within marital groups and across marital groups within treatments. The smallest p-value is 0.105 for a test of the effect of treatment within polygynous households. Husbands invest more than wives, but there is no significant difference between the behaviour of first and second wives in polygyny and no significant difference between wives in polygyny and monogamy.

**Table 4. Mean investment levels as a fraction of endowment.**

| | | Treatment 1 | Treatment 2 | Median test, treatments p-value |
|---|---|---|---|---|
| Overall | | | | |
| | Monogamy | 0.459 | 0.503 | *0.311* |
| | Polygyny | 0.500 | 0.469 | *0.106* |
| Husbands | | | | |
| | Monogamy | 0.486 | 0.565 | *0.069* |
| | Polygyny | 0.594 | 0.513 | *0.043* |
| | Median test, husbands p-value | *0.043* | *0.069* | |
| Wives | | | | |
| | Monogamy | 0.431 | 0.444 | *0.644* |
| | Polygyny | 0.453 | 0.447 | *0.412* |
| | Polygyny, Wife 1 | 0.475 | 0.425 | *0.085* |
| | Polygyny, Wife 2 | 0.431 | 0.469 | *0.644* |
| | Paired test, husbands and wives, monogamy | *0.202* | *0.041* | |
| | Paired test, husbands and 1st wives, polygyny | *0.022* | *0.026* | |
| | Paired test, husbands and 2nd wives, polygyny | *0.018* | *0.222* | |
| | Paired test, wives, polygyny | *0.300* | *0.478* | |

Notes: All non-paired tests are tests of medians. Paired tests are signed rank tests. Results are reported as p-values, two sided.

Table 5 shows mean payoffs, that is rewards including any part of the endowment that is kept back by the spouse from the common pool. Recall that if all subjects invest no endowment, then the payoff is 400 Nairas per person, while if all endowments are given to the common pool and distributed equally, the result is 600 Naira per person. Overall mean rewards cluster around the 500 Nairas per person mark, and per person payoffs vary little with treatment and household type. However, disaggregated rewards are more sensitive to treatment and family type. In treatment 1, polygynous husbands invest more than their monogamous counterparts and more than their wives. The equal split rule enacted for this treatment means that the rewards of their higher investment are shared around the family. As a result, the payoffs for polygynous wives are significantly higher than husbands' payoffs in treatment 1. In treatment 2, polygynous husbands invest less than in treatment 1 and less than monogamous men. They also claim more from the eventual allocation. As a result, polygynous men earn significantly more than monogamous men and more than their wives. However, first wives in polygynous households do no worse than women in monogamy: it is second wives whose earnings are significantly lower when men control the allocation.

**Table 5. Payoffs (Nairas).**

| | Treatment 1 | Treatment 2 | Median test, treatments. p-values |
|---|---|---|---|
| Overall (per person) | | | |
| Monogamy | 491.9 | 500.7 | |
| Polygyny | 500.0 | 496.3 | |
| Husbands | | | |
| Monogamy | 480.6 | 518.8 | *0.037* |
| Polygyny | 462.5 | 572.5 | *0.000* |
| Median test, p-value, husbands | *0.372* | *0.044* | |
| Wives | | | |
| Monogamy | 503.1 | 482.5 | *0.222* |
| Polygyny, Wife 1 | 510.0 | 481.3 | *0.027* |
| Polygyny, Wife 2 | 527.5 | 435.0 | *0.073* |
| Paired test, husbands and wives, monogamy | *0.202* | *0.240* | |
| Paired test, husbands and 1st wives, polygyny | *0.020* | *0.002* | |
| Paired test, husbands and 2nd wives, polygyny | *0.014* | *0.000* | |
| Paired test, wives, polygyny | *0.302* | *0.042* | |
| Wives in monogamy versus first wives in polygyny | *0.820* | *0.780* | |

Notes: All non-paired tests are tests of medians. Paired tests are signed rank tests. Results are reported as p-values for a two sided alternative hypothesis.

Table 6 sets out the patterns of allocation in polygynous and monogamous households in treatment 2. In each cell in the section of the matrix dealing with polygyny, there are three entries, representing the allocation to the husband, to the first wife and to the second wife respectively. With the monogamy column the first of the two entries is for the man and the second is for the wife. For polygynous families the rows and columns represents the first and second wife's investment. For monogamy the rows show the wife's conjectured investment level. Some basic patterns are apparent: in all cells, men take the lion's share of the proceeds. As investment levels rise, rewards rise for all parties with some sharing of the rewards of greater investment. On the whole, first and second wives earn closely related amounts. Yet, whatever the level of investment, it is notable that mean allocations to second wives are always lowest. This is particularly stark in the case where the second wife's investment is four times that of the first. In fact in only one household did the second wife actually get allocated more than the first in any actual allocation.[xiv] In the conditional allocations, there were 13 cases of higher allocations to second wives (4 from the same household), compared to 62 cases of higher allocations to first wives and 125 equal shares.

Thus the naïve null and alternative hypotheses are both basically wrong – there is neither equal allocation of resources between families nor are there greater transfers to wives with fewer children. [xv]

**Table 6. Mean Conditional allocations by husbands in treatment 2 (Naira).**

| Polygyny | | | | | Monogamy | | |
|---|---|---|---|---|---|---|---|
| Wife 1's investment | Wife 2's investment | Husband | Wife 1 | Wife 2 | Wife's investment | Husband | Wife |
| 100 | 100 | 267.5 | 178.1 | 161.9 | 0 | 206.3 | 131.3 |
| 100 | 400 | 472.5 | 292.6 | 291.4 | 100 | 272.0 | 215.5 |
| 400 | 100 | 490.0 | 308.1 | 256.9 | 200 | 363.8 | 272.5 |
| 300 | 300 | 548.8 | 337.5 | 317.5 | 300 | 441.3 | 346.3 |
| 400 | 400 | 627.5 | 435.6 | 424.4 | 400 | 516.0 | 422.5 |

Still considering treatment 2, for each wife we take the difference between her conditional allocation when she invests 100 and when she invests 400. In the case of polygyny, the other wife's conditional investment is held constant at 100 Nairas. The results are reported in Table 7, where we see that the marginal return to wives is lower under polygyny. According to this table, wife 1 obtains a higher return than wife 2 from wife 2's marginal investment.

| Table 7. Marginal returns. | | | |
|---|---|---|---|
| | N | Wife 1's investment | Wife 2's investment |
| | | Polygyny | |
| Return to wife 1 | 40 | 0.433 | 0.432 |
| Return to wife 2 | 40 | 0.317 | 0.382 |
| Return to husband | 40 | 0.742 | 0.683 |
| | | Monogamy: | |
| Return to wife | 40 | 0.690 | - |
| Return to husband | 40 | 0.810 | - |

Note: table shows mean marginal return from investment of 1 more Naira. Thus within each household, the sum of returns to spouses equals 1.50.

Table 8 shows the actual returns on investment for partners in the husband-controlled allocation. In other words for each woman we divide her actual allocation by her investment and then average across households. In a few cases, there is no investment, so this is omitted from the relevant sub-sample. For polygynous households we break the sub-sample down further, according to whether the first wife's investment was higher than the second wife's investment etc. A number of features are readily apparent from this table. First, male returns are higher than females for polygynous households. For monogamous households the male and female figures are almost the same. Secondly, within polygynous households, the returns to wife 1 are higher than returns for wife 2. However, this pattern of returns depends critically on relative investment levels. Recall the earlier statement that first wives are rarely allocated less, but that typically both wives are allocated similar amounts by the husband. In this situation, the wife who invests more than her co-wife faces reduced returns. Table 8 shows this by breaking down the polygynous households according to which wife invested more. We can see that when the first wife invests less she does particularly well, relatively. Conversely, when a wife invests more her returns are attenuated by the equalising nature of male allocation.

| Table 8. Returns on actual investment | | | | | | |
|---|---|---|---|---|---|---|
| | | | Polygynous | | | Monogamous |
| | $\Delta I > 0$ | $\Delta I \geq 0$ | $\Delta I = 0$ | $\Delta I < 0$ | All | |
| Wife 1 | 1.0 | 1.39 | 1.57 | 2.36 (9) | 1.62(38) | 1.62 |
| Wife 2 | 1.75(8) | 1.46(28) | 1.34 | 0.87 | 1.29(39) | - |
| Husband | 2.05 | 1.88 | 1.79 | 2.52 | 2.02 | 1.61(37) |
| N | 9 | 29 | 20 | 11 | 40 | 40 |

$\Delta I$ = wife 1's investment – wife 2's investment. In each column, the sub-sample size is usually equal to the value of N; exceptions are shown in parentheses and represent cases where the wife or husband made no investment.

**Regresssion.**

We relate behaviour in the experiment to the results of the survey in two parts. In the first part we consider the investment decisions across all treatments and groups. Table 9 reports the results. In the second part, reported in subsequent tables, we concentrate on allocation behaviour in the polygynous households who faced treatment 2.

In Table 9, in all cases the dependent variable is the fraction of endowment invested. Since this value is censored at zero and 1, the models estimated are tobit. Arguably, with a categorical dependent variable another type of model might be more appropriate. Yet, we do not get qualitatively different results if we use OLS or ordered logit.

For the equation with controls, we try a large number of variables, very few of which have any explanatory power. The equations shown are representative, in that they induce the few variables that have significant explanatory power across many specifications, along with some (insignificant) variables that might be expected to be correlated with investment. It is notable that men without formal education invest less, compared to men with some formal education. For male investment intentions, the other significant variables are female clothing share and male age. Female clothing share is often used as a measure of female bargaining power (e.g. Lundberg et al, 1988). Here men invest more when more clothing expenditure is on adult women.

For women there is a similar paucity of significant explanatory controls. Higher male income is associated with higher levels of female investment, whereas when wives perceive their husbands to have more leisure, they are less likely to invest. Apart from the constant, there are no variables that are significant in both men and women’s equations.

**Table 9. Tobit Models of Investment.**

| | Men's investment | | | Female investment | |
|---|---|---|---|---|---|
| | Basic | With controls | | Basic | With controls |
| Constant | 0.501 | 0.359 | Constant | 0.431 | 0.437 |
| | (0.000) | (0.000) | | (0.000) | (0.000) |
| Polygyny | 0.117 | 0.107 | Polygyny | 0.023 | 0.015 |
| | (0.098) | (0.135) | | (0.577) | (0.706) |
| Male control | 0.078 | 0.060 | Male control | 0.015 | 0.032 |
| | (0.270) | (0.375) | | (0.727) | (0.464) |
| Polygny x Male control | -0.170 | -0.141 | Polygny x Male control | -0.019 | -0.053 |
| | (0.090) | (0.142) | | (0.742) | (0.341) |
| Number of children | | 0.012 | Number of Children | | 0.008 |
| | | (0.214) | | | (0.325) |
| Male Age | | 1.001 | Male Age | | -0.050 |
| | | (0.094) | | | (0.449) |
| Husband's income | | 0.085 | Husband's income | | 0.262 |
| | | (0.449) | | | (0.000) |
| Male has no formal education | | -0.122 | Female has no formal education | | -0.025 |
| | | (0.015) | | | (0.396) |
| Wife owns land | | -0.062 | Wife owns land | | -0.049 |
| | | (0.787) | | | (0.558) |
| Female clothing share | | 0.376 | Female Age | | -0.600 |
| | | (0.008) | | | (0.579) |
| | | | Male has more leisure | | -0.061 |
| | | | | | (0.082) |
| | | | Female Income | | -0.242 |
| | | | | | (0.284) |
| Observations | 160 | 153 | | 240 | 220 |
| Invest nothing | 6 | 6 | | 7 | 6 |
| Invest all | 24 | 21 | | 12 | 11 |
| LR chi-squared value | 3.32 | 22.88 | F-statistic | 0.11 | 2.36 |
| Prob | 0.33 | 0.01 | Prob. | 0.94 | 0.009 |

Notes.

1. A p-value for a two-tailed test that the coefficient is equal to zero is in parentheses under the estimated coefficient.
2. Female clothing share is the share of total clothing expenditure spent on adult females.
3. The LR chi-squared value is for a test that the equation has a whole has no explanatory power. The corresponding p-value is entered beneath it.
4. For the female equations, errors are clustered at the household level.
5. The F-statistic and the associated probability below it is for the null hypothesis that the equation has no explanatory power.
6. To make the coefficients easier to display, the income coefficients have been multiplied by 1,000,000. Meanwhile, the wife owns land and age coefficients are multiplied by 1,000.

We now turn to the allocation data. For polygynous households in treatment 2, let $y_i$ i = h, w1, w2, be the allocation to the husband, senior wife and junior wife respectively. We are interested in estimating equations of the form:

$$y_h = X\beta + \varepsilon_h$$
$$y_{w1} = X\alpha + \varepsilon_{w1}$$
$$y_{w2} = X\gamma + \varepsilon_{w2}$$

Where X is a matrix of explanatory variables that can include features of the marriage, and household characteristics as well as investment levels of the 3 partners. The symbols α, β and γ represent parameter vectors and $\varepsilon_i$s are error terms. A feature of the allocation data from treatment 2 is that about 40% (15/40) of polygynous husbands give equal shares to wives on all occasions. Figure 2 illustrates this point, showing the relative allocations of money, ($y_{w1}$ - $y_{w2}$), by polygynous husbands in all cases where wives had invested different amounts. There is a sharp spike in the data at zero, a feature amplified if the data from all the allocation decisions is included. The sharp difference in behaviour between husbands suggests an underlying population that contains a mix of two types: equal splitters – defined as males who always set $y_{w1} = y_{w2}$ in our experiment - and husbands who tend to favour the first wife, but more generally, relate relative allocations ($y_{w1}$ - $y_{w2}$) to investment levels and other factors. Our ungainly label for this type is 'non-equal splitters'.

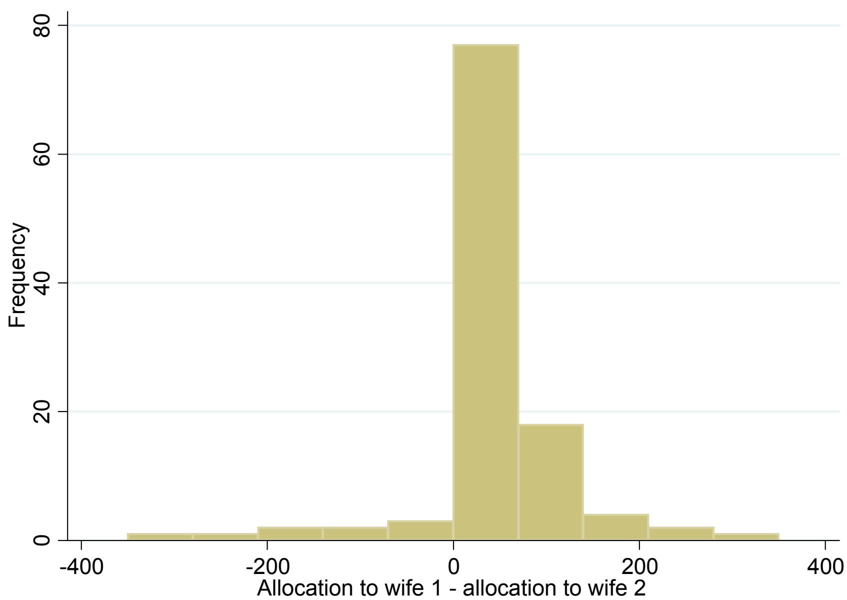


**Figure 2. Allocation to Wives in Treatment 2**

Table 10 first reports a probit model which investigates the factors correlated with whether husbands are equal splitters. The explanatory power of this model is limited (it correctly predicts 79.5% of outcomes), but it suggests that households where husbands perceive leisure to be equally distributed are more likely to be equal splitting.[xvi] Interpreting the impact of age and years of marriage is more complex because the correlation between age and years of first marriage is 0.9, while the correlation between age and years of second marriage is 0.49. Suppose we add 1 year to age and to both the years married variables, then the probability of equal splitting increases. Alternatively if we keep the age of the husband constant, but raise the gap between the lengths of marriages by one year, the probability of equal splitting goes down. That is the more senior the first wife is, compared to the junior wife, the lower the probability the husband splits resources equally.

In polygyny, the husband must split the allocation between 3 partners, but given total investment, two allocation decisions (e.g. to husband and first wife), must determine the third. In fact for husbands who always split their wives' allocation equally, there is only one decision: how much to keep for himself. This second equation is estimated and presented in the final column in Table 10.

**Table 10 Equal splitters**

| | **Probit, equal splitter =1** | **Husband's allocation to self, Random effects one way panel** |
|---|---|---|
| Constant | -6.230 | 216.968 |
| | (0.012) | (0.375) |
| Male investment | | 0.082 |
| | | (0.824) |
| Wife 1 investment | | 0.628 |
| | | (0.000) |
| Wife 2 investment | | 0.595 |
| | | (0.000) |
| Husband income x 1000 | 0.00011 | 0.014 |
| | (0.082) | (0.809) |
| No. children, 1$^{st}$ | | 7.879 |
| | | (0.752) |
| No. children, 2$^{nd}$ | | 16.548 |
| | | (0.256) |
| Years married, 1$^{st}$ | -0.231 | 5.466 |
| | (0.025) | (0.472) |
| Years married, 2$^{nd}$ | 0.177 | -0.220 |
| | (0.025) | (0.108) |
| Male age | 0.171 | -5.596 |
| | (0.036) | (0.488) |
| One or both wives have land in own name | 0.650 | |
| | (0.263) | |
| "Spouses have same leisure time" | 1.557 | |
| | (0.066) | |
| N | 38 | 101 |
| No. groups | - | 15 |

Notes. ***Equal splitter*** = 1 if husband always gives wives equal shares of the allocation, 0 otherwise. P-values for 2-tailed t-test in parentheses. Independent variables based on husband's answers. As a reference point, mean reported income for husbands is 96,000Naira.

For non-equal splitters, we concentrate on the relative treatment of the wives and so estimate the following pair of equations:

$$y_{w1} = X\alpha + \varepsilon_{w1}$$
$$y_{w2} = X\gamma + \varepsilon_{w2}$$

Since it is possible that the error terms in the equations are correlated, we use a seemingly unrelated (SUR) one-way random effects model for an unbalanced panel (Biorn, 2004).[xvii]

**Table 11. One-way random effect estimation on polygynous husband's allocation**

| | No controls | With controls |
|---|---|---|
| **Husband's allocation to first wife, $y_{w1}$** | | |
| Constant | 62.619 | -26.025 |
| | (0.006) | (0.799) |
| Male investment | 0.120 | 0.191 |
| | (0.206) | (0.169) |
| Wife 1 investment | 0.529 | 0.539 |
| | (0.000) | (0.000) |
| Wife 2 investment | 0.386 | 0.381 |
| | (0.000) | (0.000) |
| Husband income x 1000 | | 0.056 |
| | | (0.081) |
| No. children, 1st | | 5.374 |
| | | (0.372) |
| No. children, 2nd | | 0.777 |
| | | (0.953) |
| Years married, 1st | | -3.635 |
| | | (0.400) |
| Years married, 2nd | | 1.077 |
| | | (0.786) |
| Male age | | 2.556 |
| | | (0.485) |
| **Equation 2. Husband's allocation to second wife ($y_{w2}$)** | | |
| Constant | -6.325 | -157.925 |
| | (0.725) | (0.032) |
| Male investment | 0.308 | 0.246 |
| | (0.000) | (0.019) |
| Wife 1 investment | 0.338 | 0.332 |
| | (0.000) | (0.000) |
| Wife 2 investment | 0.581 | 0.610 |
| | (0.000) | (0.000) |
| Husband income x 1000 | | 0.068 |
| | | (0.004) |
| No. children, 1st | | -2.736 |
| | | (0.539) |
| No. children, 2nd | | 8.772 |
| | | (0.349) |
| Years married, 1st | | -6.808 |
| | | (0.029) |
| Years married, 2nd | | 1.861 |
| | | (0.516) |
| Male age | | 6.341 |
| | | (0.016) |
| Chi-squared | 45.5 | 69.9 |
| Independence test probability | 0.000 | 0.000 |

| | | |
|---|---|---|
| N | 129 | 129 |
| No. groups | 23 | 23 |

Numbers in parentheses are p-values for two-sided t-tests of the null hypothesis that a coefficient is zero. Chi-squared value reported is for a Breusch-Pagan test of independence between the equations (1 d.f.). The p-value for this test is reported in the subsequent row.

We can see that adding the controls makes little difference to the coefficients on the investment variables. The allocation to the wives is sensitive to their own investment, but also to the investment of their co-wives. The coefficient on own investment is relatively higher, compared to the parameter value for the co-wife and the coefficients are symmetric, suggesting that at the margin the husbands do not favour one wife over the other. It is also noticeable that the coefficients on investments are small, given that the sum of marginal returns to a person's investment must add up to 1.5. In other words the econometric results reflect the fact that husbands take the major share of any marginal investment.

If we concentrate on the final column in this table we see that the major difference in the treatment of the wives is in the constant term. Essentially, second wives start 130 Naira behind first wives in the allocation. Both wives receive more generous treatment if the husband is richer, but there is no significant effect of the number of children on the allocation. When men are married to the first wives longer then the second wives receive less money. However first wives do not benefit – the money is kept by the husband. Against this, older men are more generous to second wives.

If we compare the behaviour of equal splltters and non-equal splitters, we see that in both Tables the husband's allocated earnings are closely related to investment values. The coefficients on male investment differ sharply between household types, whereas those for female investment are the more or less the same.[xviii] We tried different sets of variables for the different equations, but this conclusion was not altered. To sum up, across the two equations, there is a series of cumulative factors in the husband's allocation rule that favour the first wife over the second. Differences in the number of children are not the immediate cause of this asymmetry, but none of these points should obscure the fact that is the husband who is most favoured in the allocation.

**Conclusions.**

Polygynous households are a significant building block of many societies, yet evidence of their economic functioning is scarce. We have run an experiment with polygynous and monogamous households in the north of Nigeria and gathered survey data on their economic and marital circumstances. In both types of families, spouses rarely invested all their endowments into a common fund. In fact the most common decisions were to invest half of the endowment or just one quarter. As a result, mean levels of investment were low (and low compared to most other locations in which we have run similar experiments). A key feature of the data though, is the similarity of behaviour by spouses in monogamous and polygynous families: as measured by the percentage of total endowment invested into a common pool, there is no efficiency loss with polygamy and no efficiency gain either.

Compared to the situation where the common pool is split evenly amongst participants, male control of the allocation yields higher male investment in monogamy, but lower investment under polygyny. For polygynous women investment is lower in the male control treatment. With polygyny, the allocation of investment made by men favours first wives over their juniors, but above all it favours men, who are the only partners who consistently earn a rate of return above the 1.5 multiple offered by the experimenters to the household as a whole. Though our results are confined to two treatments, it is worth noting that in the other treatments faced by monogamous couples there are no substantial differences to the behaviour we observe in this sub-sample. In other words, there is nothing to suggest that are results on efficiency are due only to the treatments. In keeping with much of the survey-based evidence on intra-household allocation in West Africa, our results are therefore incompatible with simple models that assume household efficiency.

Our experimental results on polygyny are also incompatible with theories in which there is always equal allocation to the wives. Instead, we have evidence of a mixture of households. In some families, rules of equal splitting seem to be followed, though even here, the lower investment made by senior wives mean they have a higher average rate of return. Amongst families where equal splitting rules are not followed, senior wives have a higher marginal and average rate of return. This evidence of a mix of households may help reconcile the fragments of geographically scattered yet contradictory evidence on intra-household resource allocation that are available for polygyny. For instance in an early study of Hausa, Barkow, 1972, writes, “A gift to one wife means a gift to all wives and the gifts must be of equal value” p. 322, whereas Leroy et al, 2007, conclude that children of first wives in northern Ghana fare better nutritionally, than their half-siblings. Meanwhile in results that come closest to mirroring ours, Gibson and Maice, 2006, find that controlling for age and other variables, first wives have a higher body mass index (BMI) compared to monogamous women and second wives (who rank last) amongst agro-pastoralists in rural Ethiopia.

There is no evidence in our results that the advantage from seniority is motivated by the higher number of children in first marriages. On this point, it is worth noting the positive correlation between seniority and numbers of children and the relatively small numbers of children in second families in our sample. It is theoretically possible that a larger sample would establish a clear relationship between number of children and the total allocation to each household. All we can say is that our data suggests an advantage to first wives that goes beyond that conferred by the number of children she has. Furthermore, our household survey evidence suggests that many households are aware of seniority rules.

What is the value of a seniority rule? We obviously cannot answer that with our experiment, but a number of quite different theories might be consistent with the practice. In the theory of labour markets (Kuhn, 1989 for instance) seniority rules may be price-discriminating devices used by trade unions with some market power to extract rents from employers. In this context higher payments to senior wives would be indicative of collective power on the part of wives. In other theories of human capital, age related seniority rules are incentive devices to keep workers loyal to a firm in a situation where shirking is possible (Lazear, 1984). Higher payments to the senior wife may play a similar role in polygynous households, with husbands keeping younger wives loyal to the marriage by offering higher earnings with age. These analogies work best when there is "promotion" and "retirement" for wives. Barkow, 1972, argues that being divorced is particularly common for post-menopausal Hausa women, at which point men may sometimes select another junior wife, but we have no evidence for or against this in our survey.

[i] This is a conservative figure drawn from various sources including, UN Population Division, 2000, Tertilt, 2005 and Demographic and Health Surveys. In approximately 30 countries, the percentage of married men with two or more wives exceeds 10%. In other 25 or so, the percentage is below 10% but above 5%. In some cases, the data is over 20 years old and therefore may be inaccurate.

[ii] For most countries there is evidence of a slow rate of decline in the incidence of polygyny. A cursory look at the data suggests that this is associated with urbanisation (rates of polygyny are significantly lower in urban communities) and female education (more highly educated women are less likely to be in polygynous households).

[iii] 2008 Demographic and Health Surveys (http://www.measuredhs.com/statcompiler); The sample size is 5336 men for the figures given here.

[iv] Scattered through rural areas south of Kano there are also villages for Maguzawa, a non-Islamic group who do not practice wife seclusion and who were sampled for our examination of monogamous couples. Maguzawa women may sometimes be hired by Hausa households for agricultural work.

[v] Thus this game mimics a household in which economies of scale are limited, as if for instance the investment goes towards a collective food budget. If the game were supposed to mimic contributions to a pure household public good such as a communal light source or radio, then it would be more appropriate to allow C to be constant.

[vi] In fact though endowments varied across the various treatments in our experiment they did not vary within treatments.

[vii] For the monogamous couples, we have some parallel treatments which are identical except all endowments and investments are revealed to both partners. In these comparisons there are no treatment effects, either for men or for women. The lack of an effect from changes in information is in line with our research in other countries, with Mani, 2008 for northern India and with Munro et al, 2006 for the UK, but it is in contrast to Ashraf, 2009 who does find an impact on male behaviour from altering the information set for Philippine couples.

[viii] It is worth repeating that there were other treatments on monogamous couples. Within monogamous couples, assignment to treatment was random. For the polygamous couples we alternated treatments (morning and afternoon).

[ix] Six of the first polygynous marriages were levirate and 1 of the second marriages.

[x] Of course some monogamous families may become polygynous at a later date. Since this is not uncommon men and women may anticipate it in their decision-making.

[xi] We have fairly detailed information on ownership of a variety of assets, along with values. Some types (e.g. cars) are too infrequently held to be useful indicators of household wealth

and some valuations (particularly for land holdings) are not credible. Typically though, measures of wealth are higher with polygynous households; patterns of radio ownership can be seen as a metonymy for this aspect of our data.

[xii] Only two male subjects out of 160 and seven women out of 240 fail our checks of understanding.

[xiii] It's worth making a brief comparison to Iversen et al, 2006 and results from other locations, such as North and South India and Ethiopia for the same games. The overall investment levels here are lower than elsewhere. In some locations in Uganda, for instance, Iversen et al, obtain investment rates of 80%, with the majority of subjects investing all their endowments. At other sites there are also responses to treatment, though as with this location, small aggregate household responses tend to hide larger, but offsetting changes in men and women's behaviour.

[xiv] Contrast this with the women interviewed in Calloway, 1984, who "… assert that men are not impartial, and that often disproportionate resources go to support younger wives and their children." P. 404.

[xv] Senior wives have more children, so there is an obvious implicit rejection of the hypothesis that the family with fewer children receives more, but the hypotheses can be rejected explicitly. In only 3 households does the husband have more children with the second wife. So reanalysing the data on the basis of relative household size does not change the conclusion.

[xvi] In ¾ of cases husbands and wives separately state that wives have more leisure time.

[xvii] There is also the issue of the potential endogeneity of male investment. Using the equation for husband's allocation to self and the independent variables from Table 9 as instruments we run a Hausman test, accepting the null hypothesis of no endogeneity with a p-value of 0.933.

[xviii] We cannot perform significance tests on the difference between the corresponding coefficients for the two households. However, as a check we ignore the second equation and just pool the data on male allocation, estimating a model which allows different coefficients for the two household types. We find a significant difference between the coefficients for male investment for the two types of household. The coefficients on wives' investment do not differ between types.

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Appendix. Instructions for the Male control treatment.

## Instructions for Participants

**[General introduction: To be read at the beginning of ALL investment treatments and sessions. Prior to the experiment you will need to make or buy coloured cards for each participant. Say Blue for men and Yellow and Red for women. On entering the venue each man receives a Blue card. Within each household one wife gets Yellow and one wife gets Red. The allocation is random.**

Welcome. Thank you for taking the time to come today. [Introduce EXPERIMENTERS and the assistants.] You can ask any of us questions during today's programme.

We have invited you here because we want to learn about how married couples in this area take decisions. We will ask you to make decisions about money. Whatever money you win today will be yours to keep.

What you need to do will be explained fully in a few minutes. But first we want to make a couple of things clear.

- First of all, this is not our money. We belong to a research organization, and this money has been given to us for research.

- Second, this is a study about how *you* make decisions. Therefore you should not talk with others. This is very important. Please be sure to obey this rule because it is possible for one person to spoil the activity for everyone. I'm afraid that if we find you talking with others, we will have to send you home, and you will not be able to earn any money here today. Of course, if you have questions, you can ask one of us.

- Third, the study has two parts: today's exercise is one, but we will also visit you in your homes in the coming weeks to ask both the husband and the wives a number of questions.

- Finally, make sure that you listen carefully to us. You will be able to make a good amount of money here today, and it is important that the instructions are clear for you so that you can follow them.

- Does everyone in the room have a coloured card (check)?

Would wives with red cards now please go with [Thea] and wives with yellow cards please go with [Thelma] and husbands with [Theo]? The task will then be explained to you. [**<u>You need to be careful that each room now contains only 1 person from each household</u>**]

**[Instructions for each wife]**

In a moment I will give you an envelope containing money. The exact amount will vary between people, but you will receive something between 0 and 400 nairas. [Show the envelope.] Your husband will receive a similar envelope and he will also receive an amount of money between 0 and 400 Nairas. He doesn't know how much you have in your envelope and you won't be told how much he has in his envelope. The other wife (**sister**?) will also receive a similar envelope with some amount of money between 0 and 400 Nairas. Again she won't know how much you have or how much your husband has. None of you will know what the others have.

You have to decide how much money to take out of the envelope and how much to leave in. Any money you take out of the envelope is yours to keep. Your husband and **sister wife** will be making the same decision with their envelopes. You can only take nothing, 100, 200, 300 or 400 Nairas out of the envelope. Other amounts are not allowed. So please remember: you can only take nothing, 100, 200, 300 or 400 Nairas out.

After you have made your decision and your husband and your sister have made their decisions we will bring you together again. We will put all the money that you and you all have left in your envelopes into one envelope. We call it, the common envelope. To whatever is in the common envelope we will add another half again. So, if there are 200 Nairas in the common envelope we will add another 100 Nairas to make the total 300. If there are 800 Nairas in the common envelope we will add another 400 Nairas to make a total of 1200 Nairas and so on.

Each of you will know the total amount of money in the common envelope.

<u>After that your husband will decide how to split the money in the common envelope. He has to decide how much to give to you, how much to give to your sister and how much to keep for herself. In a moment we will give you some time to think about how much money you want to leave in your envelope.</u>

Let me ask some questions to check whether you understood the instructions.

1. If you have 400 Nairas in your envelope and you take out 200 Nairas how much will be left in the envelope? [record the answer, correct participant if necessary]
2. If you each put 200 Nairas into the common envelope how much will there be in total (before we add anything)?
3. How much we will add if there is 400 Nairas in the common envelope?

[Record each answer, correct participant if necessary]

**[Responses to common questions: to be used only when subjects ask]**

1. If you are asked whether the husband and wives will have the same amounts in their envelopes, answer: possibly, possibly not.
2. If you are asked what 'what should I do', you should say that it is 'your decision and I am not allowed to offer advice'
3. If you are asked precise arithmetical questions then answer them precisely. E.g if I put in 400 Nairas and my husband and sister puts in nothing how much will you add to the total?' Answer: 200 Nairas.

**[Once the experimenter is sure that the participant has understood the activity, give him/her some time to make his/her decision in private. DON'T FORGET TO KEEP RECORD OF THIS DECISION. <u>YOU NEED TO TRANSFER THIS INFORMATION TO THE EXPERIMENTER WORKING WITH THE HUSBAND.</u>]**

1. If your husband had 400 Nairas in his envelope, how much do you think he would take out?

Thank you. We will now rejoin your husband and sister and put the money from your two envelopes into the common envelope.

**[Bring husband and wives together & resolve the game.]**

**[Experimenter looks up the allocation decision and executes it. Subjects are given their money and thanked**]

**[Instructions for husbands]**

In a moment I will give you an envelope containing money. The exact amount will vary between people, but you will receive something between 0 and 400 Nairas. [Show the envelope.] Your wives will each receive a similar envelope and they will each receive an amount of money between 0 and 400 Nairas. They don't know how much you have in your envelope and you won't be told how much they have in their envelopes. None of you will know what the others have.

You have to decide how much money to take out of the envelope and how much to leave in. Any money you take out of the envelope is yours to keep. Your wives will be making the same decision with their envelope. You can only take nothing, 100, 200, 300 or 400 Nairas out of the envelope. Other amounts are not allowed. So please remember: you can only take nothing, 100, 200, 300 or 400 Nairas out.

After you have made your decision and your wives have made their decisions we will bring you together again. We will put all the money that you and your wives have left in your envelopes into one envelope. We call it, the common envelope. To whatever is in the common envelope we will add another half again. So, if there are 200 Nairas in the common envelope we will add another 100 Nairas to make the total 300. If there are 320 Nairas in the common envelope we will add another 400 Nairas to make a total of 480 Nairas and so on.

All of you will know the total amount of money in the common envelope and who put it in.

<u>After that you will decide how to split the money in the common envelope. You have to decide how much to give to each of your wives and how much to keep for yourself.</u>

<u>In a moment we will give you some time to think about how much money you want to leave in your envelope. After you have made your decision, we will ask you some questions about how you want to divide the money in the common envelope between yourself and your wives.</u>

Let me ask some questions to check whether you understood the instructions.

1. If you have 400 Nairas in your envelope and you take out 200 Nairas how much will be left in the envelope? [record the answer, correct participant if necessary]
2. If you each put 200 Nairas into the common envelope how much will there be in total (before we add anything)?
3. How much we will add if there is 400 Nairas in the common envelope?

[Record each answer, correct participant if necessary]

**[Responses to common questions: to be used only when subjects ask]**

1. If you are asked whether the spouses will have the same amounts in their envelopes, answer: possibly, possibly not.

2. If you are asked what 'what should I do', you should say that it is 'your decision and I am not allowed to offer advice'
3. If you are asked precise arithmetical questions then answer them precisely. E.g if I put in 400 Nairas and my wives puts in nothing how much will you add to the total?' Answer: 200 Nairas.

**[Once the experimenter is sure that the participant has understood the activity, give him/her some time to make his/her decision in private. DON'T FORGET TO KEEP RECORD OF THIS DECISION.]**

**[Continuation of instructions for husbands. You need to quietly receive the actual amounts left in their envelopes by the Red and Yellow wives. Put these amounts into the question below,.]**

You have left [Y] Nairas in the envelope. In a few minutes we will put all the money into one envelope, the common envelope.

**[For the questions which follow, read off the amounts from these tables.**

| **Amount added to common pool** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Y↓ | Wives→ | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 |
| 0 | | 0 | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| 100 | | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 |
| 200 | | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 |
| 300 | | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 |
| 400 | | 200 | 100 | 300 | 140 | 400 | 450 | 500 | 550 | 600 |

| **Total amount in the common pool** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Y↓ | Wives→ | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 |
| 0 | | 0 | 150 | 300 | 450 | 600 | 750 | 900 | 1050 | 1200 |
| 100 | | 150 | 300 | 450 | 600 | 750 | 900 | 1050 | 1200 | 1350 |
| 200 | | 300 | 450 | 600 | 750 | 900 | 1050 | 1200 | 1350 | 1500 |
| 300 | | 450 | 600 | 750 | 900 | 1050 | 1200 | 1350 | 1500 | 1650 |
| 400 | | 600 | 750 | 900 | 1050 | 1200 | 1350 | 1500 | 1650 | 1800 |

1. Your wife with the Red card has left RED Nairas in her envelope. Your wife with the Yellow card has left YELLOW Nairas in her envelope. We add [read off first table] Nairas to the [Total] Nairas that are already in the common envelope. There will then be [read off second table] Nairas in the common envelope.

**[Making the decision.]**

You now have to decide how to split the money. You cannot change your mind later on.

1. Your wife with the Red card has left RED Nairas in her envelope. Your wife with the Yellow card has left YELLOW Nairas in her envelope so that there is [read off second table] Nairas in the common envelope. How do you want to split the money? How much for you [write down]; and how much for your wife with the Red card and how much for you wife with the Yellow card. [Write down & check sums]?

**[Review and change as is necessary]**

Thank you. We will now rejoin your wife and put the money from your two envelopes into the common envelope.

[Bring husband and wives together & resolve the game.]
[Experimenter looks up the allocation decision and executes it. Subjects are given their money and thanked]