Productive Efficiency and the Scope for Cooperation in Polygynous Households

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Within households, altruism, shared public goods, and repeated interactions help facilitate the efficient allocation of resources. Yet many papers have documented inefficiencies in intrahousehold allocation (see, for example, Udry 1996, Duflo and Udry 2004, and Dubois and Ligon 2010). This is not necessarily surprising. While family members typically have good information about each other, asymmetries may still arise, and incentives are not always aligned. And, ironically, the same factors that promote cooperation may make renegotiation inevitable, pre-empting the use of harsh trigger strategies that could otherwise sustain a cooperative equilibrium.

In this paper, we explore the incentives for cooperation among household members. We find suggestive evidence that altruism, in the form of shared public goods, can inhibit cooperation, while selfish preferences can encourage it. One possible explanation is that altruism places lower bounds on the utility attained in a non-cooperative equilibrium. This also means that the gains to cooperation will be larger for individuals who are not altruistically linked and, therefore, would not otherwise be engaged in any mutually beneficial behavior. While our findings are based on polygynous households (one man with multiple wives) in Burkina Faso, the notion that altruism, broadly defined, both aids and inhibits cooperation could be applied to many contexts, including inter-generational transfers, political coalitions, and trade agreements.

Cooperation within Households

A growing body of empirical evidence suggests that many households fail to achieve efficiency, in consumption as well as production. While efficiency does not necessarily signal cooperation, an inefficient outcome does indicate that individuals are not cooperating. Using data from Burkina Faso and Ghana, Udry (1996) and Goldstein and Udry (2008), respectively, find that, among plots planted with the same crop in the same year within a given household, female-controlled plots achieve significantly lower yields than male-controlled plots, even after controlling for plot characteristics, suggesting a lack of cooperation in the allocation of farm inputs. Rangel and Thomas (2005) and Goldstein and Udry (2008) show that these differentials are largely due to differences in the length of fallow across men's and women's plots, which is also indicative of an inefficient allocation of resources within the household. Households in West Africa are often organized along separate production spheres with men and women controlling and cultivating separate plots, so non-cooperative outcomes are not entirely surprising (Lundberg and Pollack 1993), and intrahousehold dynamics in Burkina Faso are

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admittedly complex. Although norms vary by ethnic group, married Burkinabé women often have access to private plots under their own control (Kevane and Gray (1999)). This access does not relieve women of their responsibility to contribute labor to household fields for joint production, which typically takes precedence over female's work in their own fields (Dey-Abbas 1997). While the household head is usually assumed to be responsible for providing staple foods and covering expenditures on medical care and school fees, in practice, females often have to supply their own millet or cover expenses (Thorsen 2002). Bargaining dynamics are driven not only by individual characteristics but also by the institutions framing their relationships, including polygyny. A single household often includes multiple mother-child pairs, and households are typically part of a larger compound (Thorson 2002). Each husband/wife pair is viewed as a separate entity (Boye *et al.* 1991), and co-wives occupy various positions of power in the household, with the first wife typically holding more power than the co-wives.

Much of the anthropological literature suggests that co-wife relationships within polygnous households are characterized by conflict. Jankowiak, Sudakov, and Wilreker (2005) find this to be true in almost all of the 69 polygynous cultures they reviewed. Despite this near-universal trait, they note the tendency for co-wives to cooperate to achieve pragmatic goals, particularly if females are not as reliant on their husbands for material or emotional support. This scenario was suggested earlier by Becker (1981), who applied his Rotten Kid Theorem to suggest that cooperative behavior could occur in productive activities in polygamous households, while conflict might still occur over distribution. Given that women in Burkina Faso are found to work significantly more hours per day than male household members (Saito 1994), cooperation by co-wives could be an important method of managing demands on time and energy. Indeed, in rural areas of the Sahel, polygyny can serve to reduce a co-wife's daily responsibilities by allowing women to engage in labor-sharing activities (Boye *et al.* 1991). Members of the same household often exchange goods or services through involved agreements driven by local norms, customs, and biological factors (Saito 1994).

To fix ideas, consider a polygynous household consisting of a husband and two wives. Each person operates some land for agricultural production and, although everyone has access to the same production technology, the optimal use of labor varies with plot characteristics (*e.g.*, soil types may affect the optimal timing of labor inputs). For simplicity, assume that each wife can choose to cooperate with either her husband or her co-wife, but not both, and cooperating with either person generates the same quantity of total output. This ensures that any differences in the gains to cooperation are not the result of differences in production processes between men and women. Instead, differences in the gains to cooperation arise because the husband shares a public good with each wife, whereas co-wives do not share any public goods. Thus, in the absence of a cooperative arrangement, the husband and wife will both continue to contribute to the public good, provided the couple is not at a corner solution. In contrast, when co-wives fail to maintain a cooperative arrangement, neither receives any benefit from the actions of the other. Moreover, the presence of shared public goods casts doubt on the credibility of harsh trigger strategies, particularly since household members can, and do, frequently renegotiate contracts. Altruism, therefore, both increases the payoff to noncooperation in the stage game and reduces the capacity to punish the other player in future periods if he/she reneges on a cooperative agreement.

If there is a cost associated with arranging and/or enforcing cooperative agreements, this asymmetry between couples and co-wives in shared public goods can lead to an equilibrium in which co-wives cooperate with each other but not with their husband (see Akresh, Chen and Moore 2011 for a more thorough description of the game and equilibria). Because the husband will continue to contribute to the public good in the noncooperative equilibrium, the gains to cooperation for the husband-wife pair are lower than the gains to cooperating with a co-wife, and may be insufficient to cover the cost of cooperation. Similarly, if the wife reneges on a cooperative agreement with a co-wife, the co-wife can punish her harshly in the future, whereas the husband will have more difficulty committing to a punishment that reduces his own utility (via the public good). Thus, even when the gains to cooperation exceed the cost, cooperative agreements still may not be incentive-compatible.

Table 1. Yield, Area and Primary Crop, by Plot, Household Type and Cultivator

	Monogamous			Polygynous		
	Head	Wife	Other	Head	Wife	Other
Yield (1000 FCFA)	94.16	82.61	120.53	83.70	77.60	97.14
	(432.72)	(375.69)	(346.33)	(283.09)	(208.59)	(287.60)
Area (Hectare)	0.75	0.07	0.27	0.79	0.10	0.23
	(1.22)	(0.13)	(0.42)	(1.19)	(0.14)	(0.37)
Observations	1841	832	1415	2398	2083	1831
Percentage of Plots Planted with a Given Primary Crop						
Millet	27.59	7.33	12.51	19.35	10.8	10.7
White Sorghum	18.85	8.05	20.78	22.35	22.95	21.68
Red Sorghum	7.5	4.57	8.2	10.34	5.86	7.21
Maize	19.45	1.32	6.86	17.89	2.35	5.9
Groundnuts	4.89	20.67	9.19	6.3	17.81	13.22
Okra	1.14	21.03	4.81	0.33	13.92	6.77
Cotton	7.17	0.96	17.31	10.38	0.91	13.98
Earthpeas/Fonio	2.77	31.37	12.51	1.09	18.1	11.57
Others	10.64	4.68	7.83	11.97	7.3	8.94

Note: Standard deviations in parentheses. Data drawn from 1981-85 ICRISAT. Burkina Faso survey.

Evidence: Farm Yields in Burkina Faso

Data are drawn from the 1981–85 International Crops Research Institute for the Semi-arid Tropics (ICRISAT) Burkina Faso household survey (see Matlon 1988 and Udry 1996 for detailed descriptions of the data). Roughly half (50.7 percent) of the households in this sample are polygynous, defined as the household head having two or more wives. Of these households, 56 percent have two wives, 33 percent have three wives, and the remaining 11 percent report 4 or 5 wives. For the purposes of this study, polygyny is defined by the number of wives listed in the household roster, which may, in principle, differ from the number of women married to the household head. Yields are similar but slightly lower in polygynous households, even though the average plot size is slightly larger for household heads and wives (table 1). However, the percentage of plots planted with a given primary crop is quite different across household types. In particular, wives in polygynous households have more plots devoted to millet and sorghum (staple crops) and fewer plots devoted to okra and earthpeas/fonio (cash crops).

Following Udry (1996), we estimate plot yield as a function of plot characteristics (area, soil type, toposequence, location) and cultivator characteristics (gender, relation to household head – head, wife or other), conditional on a household-crop-year fixed effect. That is, we examine the deviation of plot yield from mean yield as a function of the deviation of plot characteristics from mean plot characteristics within a group of plots planted to the same crop by members of the same household in a given calendar year. Yield Q for plot i, planted with crop c, in year t, in household h can be expressed as:

$$Q_{htci} = \boldsymbol{X}_{htci}\beta + \gamma_G G_{htci} + \gamma_{OC} OC_{htci} + (\gamma_G^P G_{htci} + \gamma_{OP}^P OC_{htci}) Poly_{ht} + \lambda_{htc} + \varepsilon_{htci}$$

where $\boldsymbol{X}$ is a vector of plot characteristics, G is gender of the plot cultivator (1 = female), OC is an indicator equal to one if the cultivator is neither the household head nor a wife of the head. Cultivator characteristics (gender, relationship to household head) are also allowed to differ for polygynous households via an interaction with an indicator for polygyny ($Poly$).

Jacoby (1995) and Tertilt (2005) show that it would be incorrect to assume that monogamous and polygynous households do not differ significantly in unobserved characteristics. For example, polygynous households are likely to be wealthier and have access to better production technologies and/or risk-coping mechanisms. Therefore, we include a household-crop-year fixed effect (λ) in all specifications, in order to account for differences across monogamous and polygynous households that are fixed across cultivators for a specific crop within a given growing season. In column 1 of table 2, we replicate Udry's specification, with the addition of data from 1984–85. The coefficient on gender is negative and statistically significant, although roughly twice as large as Udry's result. This may be related to plot selection in the ICRISAT survey[1] or intertemporal variation in intrahousehold allocation (Akresh (2008) shows these results are not necessarily generalizable across Burkina Faso or over time, and they may mask important dynamics within households), but the qualitative finding does not appear to be driven by either of these factors. Differentiating other cultivators (column 2) also does not change the finding of lower yields on female-controlled plots, nor does it affect the magnitude of the point estimate.

We cannot test directly for yield differences among co-wives because the data only record the relationship of the cultivator to the household head and not his/her identity. However, greater cooperation among co-wives will reduce the yield differential between household heads and their wives in polygynous households (γ_G^P), while (weakly) increasing the differential between heads and other cultivators (γ_{OC}^P). That is, if co-wives cooperate with each other but not their husband, their yields will be higher relative to the husband, and the husband's yields will be lower or unchanged relative to other cultivators in the same polygynous household. This is evident in column 3 of table 2, in which we see a positive significant coefficient on γ_G^P and a positive, but not statistically significant, coefficient on γ_{OC}^P. The yield differential between husbands and wives is approximately 60 percent smaller in polygynous households but remains sizable in magnitude, equal to about half of average yields on wives' plots. Limiting the estimation to plots controlled by the household head and his wife (wives) yields similar results (column 4), suggesting that the coefficients on gender and gender interacted with polygyny are not driven by the behavior of other female cultivators. Limiting the estimation to plots controlled by the head and other cultivators also yields similar results (column 5), although the point estimates are larger. Surprisingly, polygyny appears to be at least as good for other female cultivators in the household as it is for wives.

The household-crop-year fixed effects account for any factors that affect yields uniformly for all cultivators of the same crop in the same household in the same year. However, they cannot control for factors that differentially affect men and women across monogamous and polygynous households, even when planting the same crop in the same year. In table 3, we explore this possibility with a variety of robustness checks. First, polygynous households may utilize a different production technology that is particularly well-suited for women's plots. We allow for this possibility by interacting all plot characteristics with the indicator for polygyny. The estimates (column 1) are slightly more precise and qualitatively unchanged, but larger in magnitude. However, for polygynous households, the total effect of cultivator characteristics on yields (*e.g.*, $\gamma_G + \gamma_G^P$) remains roughly the same as when the interactions with plot characteristics are omitted (column 3, table 2). Alternatively, the results may be driven by selection on the propensity for cooperation (*e.g.*, households that are better able to coordinate resource allocation decisions might also be more likely to take on an additional wife). In this case, we should observe more pronounced effects among polygynous households with more wives. But, when we split polygynous households by the number of wives (columns 2 and 3), the point estimates for gender and gender interacted with polygyny are nearly identical.[2]

In contrast, when the analysis is limited to cereal crops (column 4), we find that the effect of cultivator characteristics does not differ significantly across monogamous and polygynous households.[3] This suggests that some of the differences observed across these households are due to differences in crop choice, with polygynous households adopting a very different cropping strategy. Wives in polygynous households devote a greater share of their plots to cereal crops, particularly sorghum, and there seem to be stronger social norms governing the pooling of resources for cereal production

[1] In 1981–83, ICRISAT collected detailed information only for a selected sub-sample of plots that included all plots planted with cereals, cotton, or root crops, but only one plot under the household head's management and one plot of his senior wife for legume or minor garden crops. In 1984–85, summary information was collected for all plots (Matlon 1988).

[2] Further limiting the sample of polygynous households to those with three or more wives also yields nearly identical results (results not shown).

[3] Conversely, limiting the estimation to non-cereal crops produces much larger coefficients on gender and gender interacted with polygyny (results not shown).

Table 2. Fixed Effects Estimates of the Effect of Cultivator Characteristics on Plot Yield

	All Members (1)	All Members (2)	All Members (3)	Only Head and Wives (4)	Only Head and Others (5)
Gender (1 = female)	−59.84**	−62.44**	−109.41**	−97.13**	−155.66**
	(10.19)	(10.24)	(18.01)	(23.13)	(33.46)
Other Cultivator		−21.40**	−29.19*		−56.78**
		(8.72)	(16.38)		(25.27)
Gender*Polygynous			65.14**	57.51**	113.93**
			(20.24)	(25.44)	(39.41)
Other*Polygynous			14.72		33.22
			(18.88)		(29.46)
Observations	9428	9428	9428	7154	6507
Plot Characteristics[a]	Yes	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses. * significant at 10%, ** significant at 5%. All regressions include household-crop-year fixed effects. Dependent variable is value of plot output/hectare (1000 FCFA).
[a] Includes plot size by decile, soil type, toposequence, location.

Table 3. Robustness Checks, Fixed Effects Estimates of Plot Yield

	Fully Interacted (1)[b]	Polygynous =2 Wives (2)	Polygynous >2 Wives (3)[c]	Only Cereal Crops (4)	Vertical Household (5)[d]
Gender (1 = female)	−125.21**	−96.99**	−92.14**	−32.51**	−20.04
	(19.07)	(20.93)	(21.17)	(15.49)	(12.29)
Other Cultivator	−50.12**	−16.78	−15.20	−37.01**	−17.42
	(16.93)	(18.85)	(19.00)	(14.96)	(12.04)
Gender*Polygynous	92.26**	52.49**	60.87**	−9.72	−8.78
	(22.56)	(25.70)	(26.32)	(17.10)	(14.42)
Other*Polygynous	40.69**	4.02	0.24	23.99	1.45
	(19.73)	(24.27)	(24.74)	(17.52)	(15.25)
Observations	9428	6182	5769	5819	5850
Plot Characteristics[a]	Yes	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses. * significant at 10%, ** significant at 5%. All regressions include household-crop-year fixed effects. Dependent variable is value of plot output/hectare (1000 FCFA).
[a] Includes plot size by decile, soil type, toposequence, location.
[b] All plot characteristics interacted with indicator for polygyny.
[c] Includes only monogamous households and polygynous households with 2 or more wives.
[d] Excludes households in which the other cultivator may be a brother of the head.

(*e.g.*, via the "common" plots controlled by the household head). The cost of cooperation may, therefore, be lower for plots with cereals as the primary crop. Consistent with this, the coefficient on gender, not interacted with polygyny, is also much smaller for cereal crops. Alternatively, there could be specialization among wives in polygynous households, with only one wife planting cereal crops, which would limit the scope for cooperation among co-wives.

Lastly, monogamous and polygynous households may differ in their structure and/or composition, which may, in turn, affect the incentives for cooperation. For example, 48 percent of polygynous households that include an "other" cultivator appear to be horizontally-extended (*i.e.*, household head co-resides with his brother), versus only 32 percent of monogamous households. In column 5 of table 3, we limit the estimation to (1) households with no other cultivators, and (2) vertically-extended households (households that do not include a brother of the household head). The relationship of other cultivators to the household head (primarily sons, daughters, and daughters-in-law) should be more homogenous in this sub-sample, with the head acting more as a patriarch. None of the same yield differentials are evident in this sub-sample; the coefficients are not statistically significant and are much smaller in magnitude compared to column 1. There may be less overt conflict among members of a vertically-extended household, or perhaps the head is better able to mitigate conflicts given his position within the family. The head and his wife (wives) are also likely to be older in vertically-extended households, and the cost of spousal cooperation may decline with age and/or length of marriage.

Directions for Future Research

In this paper, we provide preliminary evidence that wives in polygynous households are more likely to coordinate agricultural production with their co-wives than with their husbands. The difference in plot yields between household heads and wives is smaller in polygynous households, indicating more efficient production either among co-wives or among the household head and his wives. The difference in yields between the head and other cultivators suggests that it is the former; other cultivators are found to have the same or higher yields in polygynous households, relative to the household head. In contrast, if polygyny facilitates cooperation among husbands and wives, we should observe a larger yield differential between heads and other cultivators. These results are robust to allowing for different technologies in monogamous and polygynous households and do not appear to be driven by selection on the propensity for cooperation.

One possible explanation is that altruism and/or shared public goods ensure a minimum level of exchange between spouses, resulting in greater gains to cooperation among co-wives than among husbands and wives. Alternatively, women might have stronger preferences (lower costs) for cooperation, such that differences in the gains to cooperation across husband-wife and co-wife pairs are driven by gender rather than altruism. It could also be the case that the household head is able to act as a low-cost enforcement mechanism for cooperative agreements of which he is not a part. That is, the husband can serve as a third-party to resolve disputes between co-wives and other cultivators, but no other household members have sufficient status to mediate agreements between the head and his wives. The presence of other cultivators in the household allows us to distinguish among these hypotheses and better understand the incentives and scope for cooperation within households (see Akresh, Chen and Moore 2011).

Not surprisingly, intrahousehold dynamics also appear to be driven by factors other than the interaction between husbands, wives and co-wives – specifically, crop choice and household structure (*e.g.*, vertically vs. horizontally extended). Future research will explore these dimensions in greater detail to determine how they relate to the degree of cooperation within households. The role of household size must also be explored, to determine whether the results presented here are simply indicative of a specific form of economies of scale (*e.g.*, the scope for cooperation increases with household size, which is positively correlated with polygyny). However, the consistently negative and statistically significant effect of "other cultivator" on plot yields suggests that additional cultivators do not improve efficiency irrespective of their relationship to the household head. And, perhaps most importantly, we need to understand if and how opportunities for cooperation affect dynamic efficiency. When households are able to achieve a more efficient allocation of farm inputs, do they experience higher growth rates of consumption and/or investment? Does a lack of cooperation push households and/or individuals towards sub-optimal investments (*e.g.*, small, divisible inputs versus larger assets that require sharing)?

This paper raises the question of whether altruism may, in fact, deter cooperative behavior by making the threat of punishment and/or non-cooperation less salient. We believe that this has the potential to explain a variety of economic interactions, at both the micro and macro level. We hope that this exercise will also provide a new direction for modeling the intrahousehold allocation of resources when there are more than two decision-makers. Given the prevalence of extended households in developing countries and the recent resurgence of this phenomenon in developed countries, this may prove to be a very useful, and more accurate, way to conceptualize household bargaining and decision-making.

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