Let's Talk About the Money: Spousal Communication, Expenditures, and Farm Production

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A burgeoning body of literature highlights asymmetric information among household members. However, little is known about the source of the asymmetry and its effect on efficiency. Using a unique survey of Ghanaian households, we examine the accuracy of spousal cross reports and the effect of discrepancies on farm production. We find that information problems pertain to scale (the quantity of resources) and scope (the distribution of resources), as well as allocation decisions on the margin (Engel curves). Moreover, we find that information asymmetries lead to inefficiency in production, and the effect is equivalent to about 15% of the variation across households.

Key words: Asymmetric information, intra-household allocation, Engel curve.

JEL codes: D13, D82, O12.

A spate of recent studies has documented imperfect information among household members. These information problems have been found to affect allocation within the household, shifting resources towards goods preferred by the individual with superior information (e.g., Ashraf 2009 and Chen 2013). Information asymmetries have potential implications not only for development programs (e.g., the transparency of program eligibility/benefits) but also for more organic elements of the development process (e.g., migration and women's employment), to the extent that the flow of information among household members may affect and/or be affected by economic growth and transition.

However, we do not yet know whether, and to what degree, productivity (optimal investments in new technology over time) and efficiency (optimal allocation of resources) are affected by information asymmetries, nor whether asymmetries have differing effects on productivity and efficiency. For example, if imperfect information (e.g., about production shocks) limits the scope for insurance among household members, incentives to invest in risky new technologies may also be distorted, resulting in lower productivity in the long run. Similarly, if household members are unable to perfectly observe each other's actions, their incentives to work may be reduced, resulting in an inefficient use of household labor. Alternatively, asymmetric information may simply induce a reallocation—information disparities may reinforce specialization in household production, prompt inter-temporal substitution, etc.—that has little or no effect on Pareto optimality, despite changing the distribution of resources among parties.

This gap in the literature is largely the result of data limitations. Field and lab experiments can create variations in access to information, which can then be used to assess how individual choices are affected. However, unless subjects are followed after the experiment has concluded, we often cannot ascertain the ultimate effect of those choices, or what other (compensating) choices may be made in the interim. In contrast, survey data typically require that we examine allocation patterns to infer asymmetric information, making it difficult to then identify causation

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in the opposite direction. In this article, we utilize a unique dataset that includes cross reports of spouses' income and expenditures. This provides us with clear measures of imperfect information and allows us to assess both its source and its impact on farm production and efficiency.

Our descriptive analysis reveals large discrepancies in income, expenditure, and budget shares for specific categories of goods. These discrepancies pertain to both scale (the quantity of resources) and scope (the allocation of resources) and vary widely by gender and across goods. Moreover, husbands and wives have inaccurate perceptions of not only their spouses' absolute spending but also their spouses' spending behaviors on the margin, as evidenced by our estimation of Engel curves using both actual and perceived expenditures. These discrepancies are indicative of imperfect information among spouses and are found to have a significant negative effect on agricultural output and profit, equivalent to about 50% of the sample mean for men.

Our results suggest that an exogenous change in information quality, even when it is minimal, can have very large effects on efficiency. We find that, controlling for household fixed effects, individuals respond strongly to known information problems—that is, to situations in which they recognize a systematic inability to fully observe their spouses' expenditure/income, resulting in under- rather than overestimation. And, while individuals are responsive to the strategic behavior underlying these known information problems, they are also aware that discrepancies in expenditure/income are largely caused by inattention and are, therefore, very noisy. Consequently, the quality of information (magnitude of the discrepancy) has a small but statistically significant effect.

Conversely, discrepancies due purely to recall error are not strongly correlated with farm outcomes, despite the fact that recall error appears to account for a large portion of observed discrepancies. In other words, although spouses in our sample may have poor recall of each other's expenditure/income, these estimating errors are treated as noise and have little effect on the household's ability to optimize. Hence, with regard to the effect of asymmetric information on farm production, there appear to be two important distinctions: (1) between known (systematic) and unknown (random) information problems and (2) between the underlying strategic and incidental sources of asymmetric information. More generally, our findings indicate that information asymmetries are not all created equal, and increasing farm production will require reducing the scope for strategic behavior rather than simply improving attentiveness.

In the following section, we provide a brief discussion of the socio-cultural context of our study, followed by a description of the data. We then present a descriptive analysis of asymmetric information among spouses. Next, we conduct an empirical analysis of the effect of information discrepancies on farm outcomes. The final section includes a discussion and possible directions for future research.

Cultural Context

The data used for this study are drawn from Ghana, where the norms surrounding both production and consumption tend to increase the scope of asymmetric information among spouses. In farm households, plots are not managed collectively but rather by individual household members. Husbands and wives both engage in farm production but rarely own, manage, or inherit property together. In fact, husbands are twice as likely to own property with their kin as with their wives (Oppong 1974). The cultivator of a plot is responsible for its expenses and makes decisions regarding the type, timing, and amount of inputs used during production. And, with the exception of certain communal crops, which are under the control of the husband for redistribution within the household, cultivators are the residual claimants and retain control of both output and revenue (Baden et al. 1994; Goldstein and Udry 1999a, 1999b, 2008). Nonetheless, household members often provide labor on each other's plots, though typically only at certain stages of the production process (Abbas 1993; Chao 1999; Lloyd and Gage-Brandon 1993). In fact, there is a stark division of labor by gender, with men generally responsible for initial land clearing and women largely responsible for sowing, weeding, harvesting, and transporting output.

There is also very little coordination on the consumption side; husbands and wives do not pool resources but rather have separate income and expenditure streams (Abu 1983;

Clark 1999; Goldstein 2004; Leach 1991). Due to marriage insecurity, both husbands and wives have little incentive to pool income: and wives' incomes are considered neither supplementary to nor part of the family income (Vercruijsse, Vercruijsse-Dopheide, and Boakye 1974). Men are expected to contribute "chop money" for food and to pay children's school fees, while women are responsible for childrearing, cooking, and cleaning (Baden et al. 1994; Bukh 1979; Chao 1999). Women also contribute to food, medical, and farm expenditures, although it is not solely their responsibility.

Data

Data used in this study are drawn from a household survey conducted between November 1996 and October 1998 in collaboration with the Institute of Statistical, Social, and Economic Research at the University of Ghana. The original purpose of the survey was to study land resource management and technology adoption. Consequently, the study area was identified as the forest-savanna transition zone of southern Ghana, where the farming system was undergoing a stark transition from intercropped maize and cassava production for domestic consumption to intensive pineapple production for export (Goldstein and Udry 1999a). Four village clusters in the Akwapim South District of the Eastern Region were selected for enumeration based on their participation in fruit and vegetable production, as well as the heterogeneity of environmental and market conditions that exist among them. Sixty married couples (or triples) were randomly selected from each village, except for Village 3, where all eligible households were selected.

Since little data exist that combine elements of household economics and soil fertility, the surveyors opted for an iterative survey design (Udry 2003) in which each respondent was interviewed 15 times over the course of two years, with interviews being held roughly six weeks apart. Although it was time intensive, this design allowed for short recall periods and created a panel data structure. The design also permitted additions to the survey instruments as the cultural context became clearer. Questionnaires regarding plot activities (e.g., input application, land maintenance, etc.), farm outcomes (e.g., harvests and sales), and credit were administered in every round, while other modules were administered on a rotating basis (Goldstein and Udry 1999a; Udry 2003). These modules cover a vast range of topics, including socio-demographic characteristics, farm and non-farm income, financial assets, expenditures, and property rights, among others. Due to its wide scope, the survey has also been used to study technology adoption (Conley and Udry 2001, 2010; Goldstein and Udry 1999a), property rights (Goldstein and Udry 2008), and household consumption patterns (Collins 2013; Goldstein 1999; Udry and Woo 2007).

The survey is unique in that spouses were asked to provide cross reports of each other's income and expenditure. Cross reports of income are available for both farm and non-farm businesses and cross reports of expenditure are available by category (e.g., clothing, education, housing, etc.). All interviews were conducted with same-sex interviewers, in private, to ensure that respondents would be comfortable speculating on their spouses' activities and resources (Goldstein and Udry 1999a). As expenditure and income questionnaires were completed in different rounds and utilized different reference periods, the data must be matched to conduct the analysis.[1]

Own and cross reports of expenditure are available from three rounds (4, 8, and 12). Respondents were permitted to select the most convenient reporting period for expenditures, so all values are standardized to represent average monthly expenditure. Own reports of farm sales are available for each round; hence, we form two periods of data by aggregating reports from rounds 2 through 8 and from rounds 10 through 12. We then standardize to obtain average monthly sales. Cross reporting of farm sales did not begin until round 6, but spouses were asked to aggregate across rounds up to that point (i.e., across rounds 2 through 6). To form two periods of data comparable to the own reports of farm sales, we aggregate across rounds 6 through 8 and across rounds 10 through 12; again, we standardize to obtain average monthly values.

Measures of plot-level productivity are compiled from the plot activity questionnaires conducted in each round. Output is

[1] See the online supplementary appendix for a full description of how the data set was constructed.

valued at prevailing market prices and combined across crops, and profit is calculated as total output value net of input and hired labor costs (both cash and in-kind). We again form two periods of data by aggregating across rounds 2 through 8 and 10 through 12. Because these two periods coincide approximately with the region's major and minor cropping seasons, respectively, and the reference periods are consistent across subjects and rounds, we do not standardize productivity measures to average monthly values. Finally, we link the production, income, and expenditure data for each individual by period and then match each individual to his/her spouse's cross reports.

To our knowledge, this is the only large-scale survey in existence that combines cross reports of income and expenditure with detailed production data. These cross reports allow us to measure the extent of asymmetric information between spouses, which we then relate to efficiency in farm production. Though economic development (e.g., deepening financial markets, more sophisticated modes of transaction, etc.) may, over time, reduce the monetary cost of acquiring information about spousal income and expenditure, development also increases the time cost of acquiring that information by increasing wages; thus, the net effect on asymmetric information is unclear. Moreover, while development may alter the ways in which spouses share or conceal information, it does not fundamentally alter the incentives or scope for strategic behavior to exploit informational advantages.[2] There is also evidence that imperfect information among household members remains highly salient in Ghana (Castilla and Walker 2013; Mazzucato 2009) and many other countries (e.g., Ambler 2013; Ashraf et al. 2013; Chen 2014). Thus, although the dataset we utilize is now quite old, it remains valuable for studying asymmetric information; and the results, if not directly applicable to the present day, can be utilized to inform future research.

[2] To provide an analogy, consider the principal-agent problem of inducing effort from hired workers. The technology for monitoring (e.g., from time-punch cards to blocked web addresses) and the specific mechanisms designed to address this problem (e.g., from sharecropping to stock options) have changed dramatically, but the issue of asymmetric information and the problems of inefficient effort and sub-optimal output remain relevant over time and across a wide variety of contexts.

Comparing Cross Reports

To assess the potential sources of asymmetric information, we begin with a descriptive analysis utilizing several different types of cross reports. We then estimate Engel curves to examine asymmetric information regarding expenditure patterns on the margin.

Descriptive Analysis

We first examine cross reports of total expenditure and gross farm revenue. We aggregate expenditures on specific goods to obtain a measure of total expenditure for each individual, as well as a cross report from his/her spouse. To create a measure of the discrepancy between reports, we calculate the absolute difference between the own and cross reports and then scale it by the value of the own report. For example, in table 1 we see that wives' reports of their husbands' total expenditure differ from husbands' own reports by 78.7%, on average.[3] In comparison, husbands' reports of their wives' total expenditure differ from wives' own reports by 76.3%, on average. Spouses display roughly the same degree of accuracy, although husbands are slightly more likely to underestimate their wives' total expenditure. However, since respondents were asked to estimate their spouses' expenditure by category rather than in total, some of this inaccuracy may result from the lack of any sort of "adding up" constraint.

Discrepancies in farm income are even greater than for expenditure, with estimates diverging from the true values by over 100% on average, although the discrepancies are somewhat more evenly split between positive and negative. The magnitude of these discrepancies is surprising, particularly given that wives are often tasked with selling output from their husbands' plots. However, it should be noted that the reports here refer to gross revenue, not output quantity or value. Thus, some of the estimation error may reflect imperfect information about the disposition of output (e.g., own consumption versus market sale) rather than the resources available to one's spouse.

[3] At the sample mean, this would imply that for a husband reporting an expenditure of 254,138 GHS, his wife reports his expenditure as 54,131 Ghana cedi (GHS).

Table 1. Average Expenditure and Farm Income

Self-Reported	Total Expenditure	Gross Farm Income
Husband (GHS)	254,138	953,625
	(278027)	(2756448)
Observations	258	258
Wife (GHS)	152,192	37,198
	(88239)	(73700)
Observations	110	110
Wife's Report on Husband		
Discrepancy[a]	0.787	1.556
	(1.206)	(3.580)
Under-estimate[b]	0.841	0.772
Observations	258	219
Husband's Report on Wife		
Discrepancy[a]	0.763	1.478
	(0.315)	(2.112)
Under-estimate[b]	0.900	0.791
Observations	110	67
Chop Money Discrepancy[c]	0.604	
	(1.075)	
Observations	102	

Standard deviation appears in parentheses.
Data: 1996–98 Ghanaian Household Survey, www.econ.yale.edu/~cru2//ghanadata.html.
During this period, the exchange rate was approximately 1,750-2,250 GHS to 1 USD.
[a]Calculated as |cross report-true value|/true value.
[b]Proportion with cross report less than true value.
[c]|Husband's report-Wife's report|/Wife's report.

Rationality implies that individuals update their beliefs about their spouses' expenditure and income over time. However, our data reveal a very high frequency of under-estimates, suggesting that individuals are not necessarily reporting their beliefs about their spouses' expenditure/income but rather are reporting their (limited) knowledge and/or observations of their spouses' actions. Indeed, among those who underestimate their spouses' expenditure (income) in round 8, 90% (76%) underestimate it again in round 12. A persistent under-estimate suggests that the individual recognizes his/her inability to fully observe his/her spouse's expenditure/income. Conversely, among those who overestimate their spouses' expenditure (income) in round 8, only 17% (36%) overestimate it again in round 12. These figures suggest that over-estimates are much more likely to be revised and are therefore more likely the result of noise or recall error, while underestimates are more likely to be indicative of a known information problem.

We also have cross reports of the amount of chop money transferred between spouses. In this case, husbands and wives are reporting on a quantity that both have observed firsthand, so this measure can be seen as a proxy for baseline recall accuracy between spouses related to beliefs, prior history, etc. The discrepancy here is considerably smaller, although still roughly 60%. The magnitude of these discrepancies suggests imperfect and quite flawed information with regard to scale—that is, the quantity of resources. Moreover, there is evidence of discrepancies caused by both recall error and inherent/fixed information bottlenecks, which may be incidental (caused by inattention) or strategic (caused by purposive efforts to conceal resources).

Spouses are also quite inaccurate in estimating each other's expenditures on specific goods (table 2). Husbands are generally more accurate and less likely to underestimate their wives' absolute spending, with the exception of personal goods and purchased food. The discrepancies are moderate, less than 10% of total expenditure in most cases. But, even the smallest discrepancies are economically meaningful: for education,

Table 2. Average Expenditures and Discrepancies for Specific Goods

Self-Reported	Education	Health	Housing	Durables	Transport	Personal	Clothing	Events	Recreation	Purchased Food
Husband (% of total exp.)	7.176	7.899	14.59	0.81	8.856	5.435	11.45	4.898	3.704	34.92
	(10.92)	(11.68)	(12.80)	(3.75)	(13.25)	(5.90)	(13.94)	(8.05)	(7.04)	(20.50)
Wife (% of total exp.)	0.979	2.714	11.49	0.08	3.401	6.442	13.91	2.250	1.139	57.60
	(2.19)	(4.26)	(9.44)	(0.76)	(3.29)	(4.45)	(13.36)	(2.94)	(2.53)	(16.76)
Wife's Report on Husband Discrepancy[a]	5.975	8.267	14.26	0.07	8.535	5.328	0.15	5.358	3.720	34.09
	(9.51)	(12.43)	(17.05)	(0.91)	(15.64)	(14.80)	(0.44)	(10.55)	(6.89)	(60.69)
Share Discrepancy[b]	10.90	10.53	15.37	1.43	8.758	5.855	12.69	5.713	3.843	24.06
	(18.49)	(16.40)	(15.13)	(7.03)	(13.57)	(8.87)	(15.66)	(8.74)	(6.55)	(17.11)
Under-estimate[c]	0.580	0.680	0.712	0.13	0.780	0.728	0.72	0.656	0.440	0.659
Husband's Report on Wife Discrepancy[a]	1.135	3.592	10.94	0.00	3.446	5.713	0.15	2.279	1.241	44.55
	(2.22)	(7.72)	(10.32)	(0.01)	(3.80)	(4.58)	(0.16)	(3.78)	(2.68)	(31.36)
Share Discrepancy[b]	3.510	11.11	18.10	0.79	12.60	10.23	22.17	11.76	1.695	25.21
	(8.86)	(23.95)	(21.70)	(4.93)	(23.04)	(15.44)	(28.25)	(23.53)	(4.16)	(19.28)
Under-estimate[c]	0.322	0.567	0.789	0.01	0.667	0.833	0.77	0.611	0.422	0.722

Standard deviation appears in parentheses.
Data: 1996–98 Ghanaian Hh Survey, www.econ.yale.edu/~cru2//ghanadata.html.
[a]Calculated as |cross report-own report|/own report of total expenditure * 100.
[b]Calculated as |cross report of expenditure share-own report of expenditure share|.
[c]Proportion of observations for which cross report is less than own report.

the discrepancy between husbands' perceptions and wives' actual spending is just 1.1% of wives' total expenditure, but wives only commit about 1% of their total expenditure to education. Thus, husbands' perceptions of absolute education spending are off by more than 100%, on average.

However, as we saw in table 1, both husbands and wives underestimate each other's total expenditure by nearly 80%. Thus, it is possible that spouses inaccurately estimate the level of spending for their spouses but have accurate beliefs about the proportion of expenditure devoted to each category. On the contrary, discrepancies with respect to expenditure shares are similar to or slightly larger than those with respect to levels. For example, although husbands' estimates of their wives' expenditure share for recreation are accurate within 1.7 percentage points, wives spend only 1.1% of their total expenditure on recreation, so husbands are again off by over 100%. It appears that, for households in our sample, imperfect information pertains to both expenditure levels and shares to roughly the same degree.

Engel Curve Estimation

Thus far we have examined static information discrepancies, but this may not be the correct way to assess the economic relevance of imperfect information. Discrepancies at a single point in time may reflect not only strategic attempts to conceal income/expenditures but also various types of idiosyncratic measurement error (e.g., inattention, recall, miscommunication, etc.). Further, what is relevant for efficiency and coordination are marginal, not absolute, decisions. Accurate information about marginal behavior is also what allows household members to re-optimize efficiently in a dynamic context. In fact, if information about marginal behavior is highly accurate, then we would not expect to find a strong relationship between imperfect information and intra-household efficiency. Rather, imperfect information would seem to be more akin to random noise, resulting in some misallocation but no systematic pattern of inefficiency.

We assess whether spouses accurately perceive marginal expenditure choices—that is, the scope of allocation decisions—by estimating Engel curves. Our specification follows Working (1943) and Leser (1963):

$$s_i^j = \alpha^j + \beta^j \ln\left(\frac{x_i}{n_i}\right) + \delta^j \ln(n_i) + \sum \theta_k^j \left(\frac{n_{ki}}{n_i}\right) + \pi^k z_i + \mu_{vt} + \varepsilon_i^k$$

where s_i^j is the share of total expenditure devoted to good j by individual i, x_i is total expenditure, n_i is the total number of individuals in the household, n_{ki} is the number of individuals in the household in the kth age-sex category[4], z_i is a vector of individual characteristics (i.e., education and age), and μ_{vt} are village-round fixed effects. The coefficient of interest is β^j, which captures the change in the expenditure share for a percentage change in total expenditure per capita. Additionally, given that several studies have found differing expenditure patterns for men and women (e.g., Collins 2013; Phipps and Burton 1998), we substitute the following expressions for the constant term and the coefficient on per capita expenditure, respectively:

$$\alpha^j = \alpha_0^j + \alpha_w^j wife_i \quad \text{and}$$
$$\beta^j = \beta_0^j + \beta_w^j wife_i$$

where *wife* is an indicator variable equal to one for wives. This generalization allows wives to have both differing intercepts (levels) and differing income expansion paths.

Despite the use of relatively broad expenditure categories, there are still many cases of zero expenditure; thus, we employ a Tobit model to account for censoring of the dependent variable.[5] We run two regressions for each expenditure category: one utilizing the respondent's own report and an otherwise identical specification using his/her spouse's cross report of both the expenditure share

[4] Categories include ages 0–4, 5–15, 16–35, 36–54, and 55 and above, by gender.

[5] Aslam and Kingdon (2008) note that Tobit estimation implicitly averages across two decisions—the zero/positive expenditure decision (extensive margin) and the decision of how much to spend conditional on positive spending (intensive margin). A hurdle model would allow us to assess the accuracy of perceptions about the extensive and intensive margins separately rather than just average unconditional expenditure. However, with a relatively small sample size, our data are not well-behaved, and the likelihood for the hurdle model does not converge in most cases.

and total expenditure. By comparing the estimated β^j coefficients, which represent the true and perceived income expansion paths, we can assess the extent to which spouses accurately perceive each other's marginal behavior. We do not constrain the coefficients on any of the covariates to be identical across specifications; this allows other variables to account for some of the difference between actual and perceived expenditure shares, thereby reducing the likelihood that the estimated β^j coefficients will differ. Thus, our estimates are biased in favor of perfect information—that is, they overstate the quality of information that spouses possess about each other's behavior on the margin.

Estimates in table 3 suggest that there are also substantial asymmetries with respect to the scope of spouses' expenditures. Income expansion paths estimated from own and cross reports often have different signs (9 out of 20 cases) and, in some cases, differ by an order of magnitude (3 out of 20). However, our point estimates are also imprecise in several cases. To test for asymmetries, we select a criterion that is again biased in favor of perfect information: we consider a pair of β^j coefficients to be in "agreement" whenever they fall within two standard deviations of each other. By applying this relatively broad criterion, we reduce the probability of rejecting the null hypothesis of perfect information and, thereby, minimize type II error.

For husbands, we find agreement of the β^j coefficients for six out of ten categories—housing, transportation, personal, clothing, recreation, and purchased food. That is, wives correctly perceive their husbands' Engel curves for at most six broad expenditure categories; together, these categories account for just under 80% of husbands' total expenditure, on average, indicating that wives do not accurately predict at least 20% of their husbands' marginal spending. For wives, the same is true for seven of the ten categories—education, housing, durable goods, transportation, personal, clothing, and recreation. Still, together these categories account for only 37% of wives' total expenditure on average. In other words, husbands correctly perceive their wives' Engel curves for at most seven categories and do not accurately predict over 60% of their wives' marginal spending.

Given the large standard errors on many of our point estimates, these results should be interpreted with caution. However, when paired with the raw cross reports described in table 2, the Engel curve analysis suggests that, despite being highly inaccurate in their reports of expenditure levels and shares, husbands and wives may have better knowledge of their spouses' behavior on the margin—that is, how his/her spouse would allocate an additional cedi (GHS) of income. Interestingly, husbands appear to have a good sense of both scale and scope for certain goods, while wives have a good sense of scale for some goods and a good sense of scope for an entirely different set of goods. That is, the categories for which husbands most accurately perceive their wives' Engel curves are also those for which their cross reports of expenditure levels are most accurate, while the opposite is true for wives.

The accuracy of perceived expenditures and Engel curves is also not clearly related to the public or private nature of the good. This is somewhat surprising, as public goods would seem, a priori, to be both more easily and more readily observable. However, some public goods are produced by the household with inputs purchased in the market, in which case expenditures may be difficult to ascertain even though outcomes are easily observable. And, if there are gender divisions even within expenditure categories (e.g., men pay for major home repairs/renovations, while women pay for routine home maintenance), that could explain why husbands and wives differ in their accuracy for the same (public good) category.

In sum, we find that imperfect information is not only prevalent but also salient—husbands and wives have strikingly poor estimates of each other's income and expenditure, in total and by good type, as well as important differences in scale (the level of expenditure) and scope (the allocation of expenditures). Our descriptive analysis suggests a great deal of heterogeneity by gender and across expenditure categories, although much of the observed discrepancies may be due to inattention or classical measurement error, as suggested by the differing reports of chop money. Furthermore, despite individuals' accurate perceptions regarding their spouses' marginal behavior for certain expenditure categories, spouses mostly have inaccurate beliefs about each other's income expansion paths, which is likely to

Table 3. Actual versus Perceived Engel Curves, Working-Leser Specification, Tobit Estimates

	Own Report	Cross Report	Own Report	Cross Report
	Education		Health	
Ln(Per Capita Expenditure) for Husband	1.07	−5.69**	0.374	6.64***
	(1.28)	(2.34)	(1.63)	(2.06)
Ln(Per Capita Expenditure) for Wife	5.21**	2.299	1.087	−6.036*
	(2.05)	(2.21)	(1.66)	(3.23)
Observations	340	352	340	352
	Housing		Durable Goods	
Ln(Per Capita Expenditure) for Husband	−3.41***	−2.364	5.95***	33.12***
	(1.03)	(1.92)	(0.09)	(0.24)
Ln(Per Capita Expenditure) for Wife	−2.76	0.897	9.01***	7.35***
	(1.88)	(2.71)	(0.19)	(0.43)
Observations	340	352	340	352
	Transportation		Personal	
Ln(Per Capita Expenditure) for Husband	4.84**	2.86	−2.01***	0.16
	(2.04)	(1.91)	(0.58)	(1.39)
Ln(Per Capita Expenditure) for Wife	1.87	−0.39	−0.52	−0.41
	(1.69)	(2.15)	(0.82)	(1.95)
Observations	340	352	340	352
	Clothing		Events	
Ln(Per Capita Expenditure) for Husband	3.55*	8.53**	−0.556	2.859**
	(1.84)	(3.65)	(1.03)	(1.38)
Ln(Per Capita Expenditure) for Wife	9.28***	9.57***	0.408	−9.50***
	(2.29)	(3.01)	(1.02)	(2.60)
Observations	340	352	340	352
	Recreation		Purchased Food	
Ln(Per Capita Expenditure) for Husband	−0.277	0.73	−0.46	−1.261
	(1.14)	(1.15)	(2.26)	(2.46)
Ln(Per Capita Expenditure) for Wife	1.889	2.953	−4.19	9.77**
	(1.78)	(1.90)	(4.38)	(4.79)
Observations	340	352	271	278

Notes: Robust standard errors appear in parentheses. (***), (**), and (*) denote significance at the 1%, 5%, and 10% levels, respectively. All specifications include controls for household size (natural log), proportion of household members in 10 age-sex categories, age, education, and village-round fixed effects.

Data: Ghanaian Hh Survey, www.econ.yale.edu/∼cru2//ghanadata.html.

create inefficiency in other allocation decisions. In the next section, we consider how information problems affect farm production.

Information Discrepancies and Farm Outcomes

Several studies have documented inefficiency in household production (Dubois and Ligon 2010; Duflo and Udry 2004; Goldstein and Udry 2008). However, to the best of our knowledge, only one study attempts to identify the source of this inefficiency: Akresh, Chen, and Moore (2013) show that altruism among spouses may preempt cooperation by reducing the scope for punishment. Here, we look at whether imperfect information, already shown to be prevalent among spouses in our sample, may compromise efficiency.

There are several potential sources of imperfect information—recall error, inattention, and strategic behavior. Moreover, there are several channels through which imperfect information may affect farm production. For example, individuals who are inattentive to their spouses' expenditure/income may also be inattentive to the need for inputs and/or to the appropriate timing of tasks on their

Table 4. Plot-level Characteristics, by Cultivator

	Husband	Wife
Output[a]	459.2	66.23
(1,000s of GHS)	(1,336)	(232)
Profit[b]	357.1	55.44
(1,000s of GHS)	(1249)	(219)
Yield[c]	7.61	4.42
(1,000s of GHS per sq. yard)	(35.90)	(9.54)
Cropped Area	19175	5741
(sq. yard)	(41,990)	(11,668)
Soil Type (% of plots)		
Clay	11.42	5.26
Loam	6.36	4.51
Toposequence (% of plots)		
Mid-slope	35.56	23.31
Bottom	47.31	61.65
Steep	11.09	7.52
Primary Crop (% of plots)		
Cassava	30.72	57.89
Maize	25.82	33.08
Plantain	2.45	1.5
Cocoyam	2.29	1.5
Yam	2.78	1.5
Pineapple	25.65	1.5
Other Fruit/Veg	3.11	0.75
Oil Palm	6.21	0.75
Firewood	0.98	1.5
Observations	613	133

Standard deviation appears in parentheses.
Data: 1996–98 Ghanaian Household Survey, www.econ.yale.edu/~cru2//ghanadata.html.
[a]Valued at prevailing market prices.
[b]Output value net of input and hired labor costs.
[c]Output value per unit of cropped land.

spouses' plots. Alternatively, an individual who believes his/her spouse is withholding information may choose to respond by withholding farm inputs. In each case, imperfect information creates uncertainty about returns, making it difficult to allocate resources efficiently.

Empirical Approach

We examine both output and profit, by plot, and utilize discrepancies in farm income and total expenditure as measures of imperfect information. In Ghana, both husbands and wives cultivate multiple plots, so we present basic descriptive statistics at the plot level in table 4. Output value is calculated as the quantity harvested, valued at prevailing market prices. Profit is calculated as output value net of input and hired labor costs (cash and in-kind). As table 4 shows, men are much more active in farming; on average, their plots are much larger, and their per-plot output and profit are much higher, as are their yields. Men also have higher quality plots, on average, with a larger proportion having desirable soil (clay) and toposequence (mid-slope and bottom). Clear differences in crop choice also exist; the vast majority of women's plots are planted with cassava and maize, while men devote a larger proportion of plots to cash crops, predominantly pineapple (Goldstein and Udry 2008).

To account for these differences, we express outcome Q (output/profit) for plot i, planted by individual k, with crop c, in round t, in village v, in household h, as:

$$Q_{ikctvh} = \beta \boldsymbol{X}_{ikctvh} + \gamma \boldsymbol{G}_k + \delta_0 D_{ktvh} + \delta_1 U_{ktvh} + \mu_h + \lambda_{ctv} + \varepsilon_{ikctvh}$$

where $\boldsymbol{X}$ is a vector of plot characteristics (i.e., size, soil type, and toposequence), and $\boldsymbol{G}$ is a vector of cultivator characteristics (i.e., gender and age). To assess the effect of asymmetric information, we include the discrepancy in expenditure/income (D), measured as the absolute difference between k's own report and l's cross report of k's expenditure/income, scaled by the value of the own report. We also include an indicator taking on a value of one when the cross report is less than the own report (U). By allowing over- and under-estimates to have differing effects, we can assess the importance of known information asymmetries (which tend to appear as under-estimates) versus noise or recall error (which are equally likely to appear as either over- or under-estimates). Additionally, we control for village-crop-round fixed effects (λ) to account for local, crop-specific, time-varying shocks.[6] As shown in Udry (1996), efficient farm production implies that, controlling for land quality, crop choice, and shocks to the production process, farm outcomes should be unaffected by cultivator characteristics, including information about spousal expenditure/income.

To estimate the causal effect of imperfect information, we must also account for the

[6] We do not use household-crop-round fixed effects as in Udry (1996) and Akresh, Chen, and Moore (2012, 2013) because women in Ghana typically cultivate only one or two plots, resulting in little overlap of crops across cultivators in the same household and round.

fact that households differ in their proclivity for cooperation. Some couples may be unwilling to share both information and farm inputs, resulting in a spurious correlation between expenditure/income discrepancies and farm outcomes. With data on multiple plots cultivated by each household in each period, we can employ household fixed effects to account for any characteristics that are fixed within households over the course of our study (roughly 18 months). Because we are focusing on spouses, who have interacted repeatedly and will continue to do so for the foreseeable future, it seems reasonable to assume that their beliefs about each other are stable in the short- and medium-term.[7] But, shocks to farm production may also affect knowledge of spouses' expenditure/income. Ideally, we would use instrumental variables to address this issue; however, it is difficult to identify an exogenous source of variation that differentially affects the information available to husbands and wives.[8]

Hence, we use village-crop-round fixed effects to capture the effect of any local time-varying shocks; but there may be individual-specific shocks as well, so we return to this issue again below. Note that, with the inclusion of household fixed effects, our specifications focus on efficiency rather than productivity per se. That is, instead of examining differences in the level of productivity across households, we examine the allocation of inputs across plots within a household (i.e., the deviation of output/profit from the household mean, conditional on plot characteristics, shocks, and the household's specific constraints on technology, access to inputs, propensity for cooperation, etc.).[9] Thus, a negative coefficient on the expenditure/income discrepancy indicates that, when information is particularly poor, whether about a certain individual or in a certain time period, output and profit will be lower relative to the household mean and production will be more inefficient.[10]

Main Results

In panel A of table 5, we see that discrepancies in total expenditure significantly reduce both output value and profit[11] at the plot level, particularly when expenditures are being underestimated by one's spouse. That is, the more imperfect the husband's information about his wife's expenditure, the lower the wife's output/profit, and vice versa. This effect, although precisely estimated, is quite small: a 10 percentage point increase in the expenditure discrepancy reduces output (profit) by roughly 4,100 (4,700) GHS, equivalent to less than 1% (2%) of men's average output value (profit). However, if the respondent believes his/her spouse's expenditures are less than they actually are, there is a penalty of 200,000 (239,000) GHS, equivalent to about 45% (67%) of men's average output value (profit). Allowing discrepancies about husbands' and wives' expenditure to have differing effects (columns 2 and 4) provides very similar results, although under-estimates of wives' expenditure now have essentially no effect. The similarity between the point estimates for output value and profit suggests that information asymmetries primarily affect the quantity of output rather than production costs. This is consistent with an inefficient allocation of inputs within households rather than a reduction in the scale of production.[12]

Discrepancies in expenditure and discrepancies in income should have similar effects, to the extent that both reflect the degree of asymmetric information among spouses. However, in panel B of table 5, we see that discrepancies about farm income have no significant effect on either output or profit, and the point estimates are much smaller in magnitude. This suggests that information about farm income is less useful than information about total expenditure, which, in

[7] Note that, although discrepancies differ across spouses, each discrepancy is a function of the household-level interaction between spouses.

[8] Rainfall shocks differentially affect men's and women's crops (Duflo and Udry 2004). However, in our case they also directly affect the dependent variables of interest (yield and profit), making them invalid as instruments.

[9] Differences in productivity across households are subsumed in the household fixed effects. Note that, if household members are behaving efficiently and maximizing household rather than individual production, then household productivity will reflect the envelope of members' individual productivities. We return to the relationship between imperfect information and productivity in the following section.

[10] Discrepancies may affect either one's own production or the spouse's production, or both. With the inclusion of household fixed effects, we are identifying the effect of discrepancies on relative output/profit—that is, the effect on the spouse's output relative to one's own output.

[11] We also calculate profits net of household labor, valued at the median wage. Results are very similar and available upon request.

[12] A reduction in scale would tend to reduce both output and costs, resulting in a smaller net effect on profit.

Table 5. Effect of Discrepancies on Plot-level Outcomes, Household Fixed Effects Estimates

	A. Expenditure Discrepancies			
	I. Output[c]		II. Profit[d]	
Discrepancy[a]	−40.51*	−51.32**	−46.77**	−56.63**
	(21.79)	(24.15)	(21.13)	(23.10)
Under-estimate[b]	−200.6**	−302.3**	−239***	−341***
	(91.35)	(117.8)	(91.96)	(117.5)
Wife*Discrepancy		22.63		−31.00
		(189.9)		(180.1)
Wife*Under-estimate		376.4**		385.0**
		(169.2)		(192.6)
Observations	745	745	745	745
	B. Income Discrepancies			
	I. Output[c]		II. Profit[d]	
Discrepancy[a]	−3.416	−3.480	−4.017	−4.328
	(4.244)	(4.249)	(4.006)	(3.926)
Under-estimate[b]	130.8	179.4	89.63	131.7
	(101.3)	(130.1)	(89.60)	(117.8)
Wife*Discrepancy		3.856		10.4
		(10.43)		(10.09)
Wife*Under-estimate		−195.6		−142.4
		(215.9)		(199.8)
Observations	707	707	707	707

Notes: Robust standard errors appear in parentheses. Asterisks (***), (**), and (*) denote significance at the 1%, 5%, and 10% levels, respectively. All specifications include household fixed effects, village-crop-round fixed effects, controls for plot size (by decile), soil type (clay, loam), toposequence (mid-slope, bottom, steep), education, age, age squared, and an indicator for wife.

Data: 1996–98 Ghanaian Hh Survey, www.econ.yale.edu/~cru2//ghanadata.html.

[a]Calculated as |cross report-own report|/own report.

[b]Takes on a value of one if cross report is less than own report.

[c]Valued at prevailing market prices, in 1,000s of GHS.

[d]Output value net of input and hired labor costs (cash and in-kind), in 1,000s.

this context, is likely the result of data limitations. Recall that our measure of income discrepancy pertains to farm revenue, which reflects information about output, marketing, and production costs. Since decision-making is based on the quantity of resources available to one's spouse (i.e., profit) and not how those resources are obtained, our measure of income discrepancies may be more indicative of noise than strategic information asymmetries; hence, individuals appear to ignore income discrepancies when making production decisions and focus instead on the more enlightening expenditure discrepancies. However, cross reports of income are also more limited than those for expenditure, particularly for wives, so we cannot rule out sample selection as an explanation for the differences between panels A and B.

A formal behavioral model is beyond the scope of this article, but we offer some conjectures in the hope of guiding future research. First, we note that even when the fixed effects successfully isolate exogenous variations in information quality, the ultimate effect on farm output/profit may still operate through different channels. For example, suppose one of the husband's cows becomes ill, and as a result he misses a trip to the market with his spouse, which limits his ability to observe her purchases. The resulting discrepancy in the reports of her expenditure may then be due to the husband's random estimating error (noise), in which case he may be unaware of any specific information problem. Alternatively, the discrepancy may be due to a known information problem, caused either by the husband's failure to acquire the information in another way (inattention) or by the wife's attempt to conceal the unobserved purchases (strategic behavior). The latter reflects an *agency* problem, which may be distinct from an information problem not purposely caused by the actions of an individual.

With respect to imperfect information, our estimates suggest that discrepancies due to known information problems are much more important than those due to

noise. That is, under-estimates have a large negative effect, relative to over-estimates, and under-estimates are highly persistent over time, suggesting that individuals, rather than updating their beliefs about their spouses' expenditure/income, know that they consistently fail to obtain perfect information. And yet, individuals also seem aware that much of the discrepancy between their observations and the true values is caused by some inherent or fixed information bottleneck—perhaps inattention—rather than strategic behavior. That is, although the coefficients on the indicator for under-estimates are very large, suggesting that spouses are acutely aware of imperfect information, the coefficients on the absolute discrepancy are much smaller, suggesting that they do not place as much weight on the quality of the information as the fact that they are underestimating.

Conversely, if strategic behavior were the primary cause of discrepancies, we would expect spouses to update their beliefs about each other's expenditure/income, and production decisions would be more responsive to the quality of the information than to the mere fact that it is an under-estimate. Still, because the magnitude of the discrepancy does have a statistically significant effect, it appears that individuals are in fact responding to perceived strategic behavior, even though they recognize that their perceptions are quite noisy.

To summarize, our estimates suggest that efficiency in farm production is compromised by imperfect information among spouses. Individuals respond strongly to known information failures but recognize that they are unable to precisely infer the true magnitude of the agency problem, given that discrepancies in expenditure/income are in large part caused by inattention rather than strategic behavior.

Extensions and Robustness

This section discusses the main threats to the validity of our empirical strategy: unobserved household-specific shocks, reverse causation, and individual heterogeneity. We then consider two extensions of our empirical strategy to provide suggestive evidence on the relationship between imperfect information and (*a*) crop choice and (*b*) productivity differences across households.

Unobserved Shocks

The household fixed effects estimation strategy does not account for unobserved household-specific shocks that affect both information flows and farm production. For example, Akresh (2008) finds that households are more likely to exhibit Pareto efficiency in the presence of adverse production shocks; that is, shocks that reduce output/profit tend to improve coordination and information flows within the household. However, this is contrary to our results. We find a negative relationship between imperfect information and output/profits, suggesting that our results are not driven by unobserved shocks.

Reverse Causation

Alternatively, we might be concerned about reverse causation, where variation in output/profit is driving variation in expenditure discrepancies (e.g., when the wife's output/profit is higher than anticipated, it is also easier to conceal her expenditures). However, the absence of a significant relationship between income discrepancies and output/profit indicates that variation in output/profit is not strongly correlated with the quality of information about spousal income. This provides suggestive evidence ruling out reverse causation as an explanation for our results.

Individual-level Heterogeneity

Our empirical strategy is motivated by the observation that information discrepancies are a function of the interaction between household members, not simply the actions of one individual. However, there still may be unobserved, individual-level heterogeneity that is correlated both with information quality (after all, discrepancies are not symmetric across spouses) and with agricultural production. For example, individuals with lower-quality plots will have lower output/profits, but it may also be more difficult to discern their earnings and, therefore, their expenditures.[13]

[13] Because our outcome of interest is self-reported farm output/profit, it is unlikely that the results are driven by spouses systematically concealing both production and expenditure/income. Production values are reported by the cultivator to the enumerator in private, minimizing the incentive to mis-report. And, the fact that we observe large discrepancies in own and cross reports of expenditure and farm income suggests that individuals are, in

Table 6. Effect of Discrepancies on Plot-level Outcomes, Individual Fixed Effects Estimates

	A. Expenditure Discrepancies			
	I. Output[c]		II. Profit[d]	
Discrepancy[a]	−48.42**	−52.52**	−54.98**	−60.20**
	(24.11)	(25.53)	22.309	(23.77)
Under-estimate[b]	−234.4**	−276.4**	−277***	−332***
	(91.72)	(109.3)	(97.36)	(115.5)
Wife*Discrepancy		70.01		67.43
		(135.2)		(127.0)
Wife*Under-estimate		272.1**		350.4**
		(129.8)		(137.2)
Observations	745	745	745	745
	B. Income Discrepancies			
	I. Output[c]		II. Profit[d]	
Discrepancy[a]	−4.632	−4.379	−5.503	−5.322
	(4.108)	(4.143)	(3.782)	(3.803)
Under-estimate[b]	212.0	238.8	171.90	195.4
	(140.2)	(149)	(129.1)	(136.5)
Wife*Discrepancy		−23.75**		−18.12
		(11.99)		(11.56)
Wife*Under-estimate		−647.5**		−551.9**
		(252.3)		(222.1)
Observations	707	707	707	707

Notes: Robust standard errors appear in parentheses. Asterisks (***), (**), and (*) denote significance at the 1%, 5%, and 10% levels, respectively. All specifications include individual fixed effects, village-crop-round fixed effects, controls for plot size (by decile), soil type (clay, loam), toposequence (mid-slope, bottom, steep), education, age, age squared, and an indicator for wife.
Data taken from the 1996–98 Ghanaian Hh Survey, www.econ.yale.edu/~cru2//ghanadata.html.
[a]Calculated as |cross report-own report|/own report.
[b]Takes on a value of one if cross report is less than own report.
[c]Valued at prevailing market prices, in 1,000s of GHS.
[d]Output value net of input and hired labor costs (cash and in-kind), in 1,000s.

To test this, we re-run our main specifications with individual fixed effects in place of household fixed effects. These estimates, presented in table 6, are remarkably similar to our main results using household fixed effects (table 5) with respect to sign, significance, and magnitude, suggesting that individual-level heterogeneity does not drive our main results. An exception is the effect of income discrepancies for wives, which now have a negative and statistically significant effect, analogous to the findings for expenditure discrepancies. Thus, controlling for individual-level heterogeneity strengthens our main results. However, we do not utilize this as our preferred specification because the combination of individual and village-crop-round fixed effects substantially reduces the set of observations used to identify the parameters of interest, given that individuals cultivate less than three plots in each period, on average.

Endogenous Crop Choice

Although information discrepancies occur at the individual level and not at the plot level, we conduct a plot-level analysis because it allows us to account for crop-specific shocks. However, one drawback is that it limits our analysis to efficiency conditional on crop choice, and changes in crop choice may be another response to imperfect information among spouses. For example, individuals may be incentivized to substitute away from crops being planted by their spouse when the potential for transparency and cooperation is limited. Thus, we also examine farm outcomes at the individual level. To do so, we aggregate output value, profit, and cropped area across plots cultivated by the same individual and control for land quality using the proportion of total cropped area with various soil types and toposequence. We continue to

fact, not mis-reporting to avoid detection by their spouses (otherwise, individuals would report the same value to the enumerator and to his/her spouse, resulting in zero discrepancy between the own and cross reports). At a minimum, the large discrepancies we observe suggest that mis-reporting to enumerators is less than any mis-reporting to spouses.

Table 7. Effect of Discrepancies on Individual-level Outcomes, Household Fixed Effects Estimates

	A. Expenditure Discrepancies			
	I. Output[c]		II. Profit[d]	
Discrepancy[a]	−175.9**	−148.4*	−143.6	−121.7
	(78.91)	(85.02)	(69.86)	(75.59)
Under-estimate[b]	−458.8	−394.3	−472.1	−438.7
	(283.4)	(401.0)	(259.8)	(374.1)
Wife*Discrepancy		164.8		211.3
		(620.2)		(588.1)
Wife*Under-estimate		−1427**		−1,248**
		(612.8)		(545.8)
Observations	368	368	368	368
	B. Income Discrepancies			
	I. Output[c]		II. Profit[d]	
Discrepancy[a]	−1.443	−1.815	−2.776	−3.128
	(8.04)	(7.03)	(7.18)	(6.18)
Under-estimate[b]	618.1*	1,083***	429	859.6**
	(320)	(416)	(270.2)	(358.8)
Wife*Discrepancy		33.65		31.48
		(43)		(41.20)
Wife*Under-estimate		−1,231**		−1,140**
		(588)		(528.4)
Observations	335	335	335	335

Notes: Robust standard errors appear in parentheses. Asterisks (***), (**), and (*) denote significance at the 1%, 5%, and 10% levels, respectively. All specifications include household fixed effects, village-crop-round fixed effects, controls for plot size (by decile), soil type (clay, loam), toposequence (mid-slope, bottom, steep), education, age, age squared, and an indicator for wife. Data taken from the 1996–98 Ghanaian Hh Survey, www.econ.yale.edu/~cru2//ghanadata.html.

[a]Calculated as |cross report-own report|/own report.

[b]Takes on a value of one if cross report is less than own report.

[c]Valued at prevailing market prices, in 1,000s of GHS.

[d]Output value net of input and hired labor costs (cash and in-kind), in 1,000s.

include household fixed effects to account for time-invariant characteristics that affect both information and farm production, as well as village-round fixed effects to account for local shocks.

Individual-level regressions are presented in table 7. Without appropriate controls for crop-specific shocks, the estimates are less precise but still strikingly similar to the plot-level analysis, and the magnitudes are consistent with an average of 2-3 plots for male cultivators. However, we find that when a husband underestimates his wife's expenditure, there is a very large, significant negative effect on her output and profit at the individual level and essentially zero effect at the plot level. This suggests that when husbands are poorly informed about expenditures, wives do not reduce their work effort conditional on the crop that is planted but may switch to crops that are less valuable/profitable overall.

Conversely, our point estimates suggest that discrepancies in farm income will increase husbands' output and profit at the individual level; these effects are very large, although imprecisely estimated. This suggests that when men are able to conceal some of their earnings, they may substitute towards higher-value, higher-profit cash crops, even though they do not adjust their work effort conditional on crop selection. The incentive for these actions stems from the relationship between chop money given to wives by husbands and spouses' perceptions of each other's resources. When wives have fewer resources or husbands have more resources, husbands must increase chop money transfers; thus, wives gain by minimizing their perceived expenditures, while husbands gain by minimizing their perceived income.

Latent Household Productivity

Finally, we examine outcomes at the household level to assess the correlation between asymmetric information and productivity. In this case, our measure of imperfect information needs to be the aggregation of

Table 8. Effect of Chop Money Discrepancy on Household-level Outcomes

	I. Output[b]	II. Profit[c]
Discrepancy[a]	−27.87	−72.37***
	(38.79)	(20.08)
Observations	102	102

Notes: Robust standard errors appear in parentheses. Asterisks (***), (**), and (*) denote significance at the 1%, 5%, and 10% levels, respectively. All specifications include village-round fixed effects, controls for farm size (by decile), soil type, toposequence, education, age, age squared, household size, and proportion of household members in 10 age-sex categories. Data taken from the 1996–98 Ghanaian Hh Survey, www.econ.yale.edu/~cru2//ghanadata.html.

[a]Calculated as |husband report-wife report|/husband report.

[b]Valued at prevailing market prices, in 1,000s of GHS.

[c]Output value net of input and hired labor costs (cash and in−kind), in 1,000s.

discrepancies across spouses (in absolute value); the use of household fixed effects would therefore force us to rely on variation across only two time periods, which we find insufficient to produce robust causal estimates. Thus, we forgo household fixed effects and instead examine the discrepancy in spousal reports of chop money. Here, chop money is observed directly by both spouses and spouses are reporting on the same quantity, so any discrepancy must be caused by recall error rather than inattention or strategic efforts to conceal expenditure/income. Unfortunately, cross reports of chop money are available in only one survey round, so we utilize these data solely for the household-level analysis in which fixed effects estimation is infeasible.

Results from the household-level analysis, which maintains the village-round fixed effects, are presented in table 8. There is a significant negative correlation between discrepancies in reported chop money and household profit, but the magnitude of the effect is quite modest—a 10 percentage point increase in the discrepancy reduces total household farm profits by just 7,200 GHS compared to the sample mean of over 550,000 GHS. While we clearly cannot interpret this as a causal effect, it does suggest that recall error is correlated with only minor deviations from efficient farm production. Moreover, it seems unlikely that the causal effect would be much larger in magnitude, as we expect that households with weak preferences for cooperation will have both poor information flows and poor resource flows, which will ultimately prevent them from attaining efficiency in production.

Conclusion

In the same way that a bevy of articles in the 1980s demonstrated the need to recognize the household as collective rather than unitary, current research demonstrates the need to recognize household decision-making as potentially non-cooperative. For developing countries especially, the household remains the center of economic activity and the key to growth and poverty alleviation. Thus, we must have a clear and nuanced understanding of behavior within households and any impediments to efficiency in the intra-household allocation of resources. While these inefficiencies are small relative to national- and global-level misallocations of labor and capital, they will both affect and be affected by broader changes in the global economy.

In this article, we consider asymmetric information among household members as a cause of non-cooperative behavior and inefficiency. We take a broad approach and consider many different dimensions of asymmetric information, with the intent of highlighting several potential avenues for future research. We find that imperfect information pertains to both scale (the quantity of resources) as well as scope (the distribution of resources), although not always together. Further, there are stark differences in the extent of asymmetric information across spouses and across goods. In some cases, individuals have accurate perceptions of their spouses' marginal behavior (as exhibited by Engel curves) while inaccurately estimating the level of their expenditure; but, in other cases, the opposite is true.

Most importantly, we find that discrepancies in cross reports of expenditure have significant negative effects on efficiency within households. Our empirical specification includes village-crop-round fixed effects to account for local crop-specific shocks, as well as household fixed effects to account for unobserved characteristics of spouses that affect both information flows and farm production. The results indicate that, while the magnitude of the discrepancy matters, simply having expenditures underestimated by one's spouse results in a much larger reduction of output value and profit relative to other household members.

This suggests that individuals respond more strongly to information problems resulting from a known inability to observe

their spouses' actions (which are more likely to result in under-estimates) than to those arising from random noise or recall error (which are equally likely to result in under- and over-estimates). However, the modest response to the magnitude of the discrepancy also suggests that individuals recognize that discrepancies (information problem) are a noisy indicator of strategic efforts on the part of their spouses to conceal information (agency problem). In other words, individuals respond optimally to the agency problem by acknowledging that a large component of the information problem is incidental rather than strategic.

Additionally, we find suggestive evidence of crop choice being a response to imperfect information. Our point estimates are imprecise, but they suggest that men substitute towards cash crops when wives have poor information about their income, while wives substitute toward lower-value crops when husbands have poor information about their expenditure. This is consistent with strategic attempts by husbands (wives) to minimize (maximize) chop money transfers. Finally, our household-level estimates suggest that recall error, as represented by the discrepancy in reports of chop money, has a significant but very modest effect on farm profit. Conversely, our plot- and individual-level results show that an exogenous decline in information quality has a very large penalty—our preferred estimates imply that for husbands (wives), profits are approximately 45,000 (43,000) GHS lower at the mean expenditure discrepancy relative to the case of perfect information; further, if the discrepancy is an under-estimate, profits are an additional 341,000 GHS lower for husbands. These effects are sizable given that average output value (profit) in our sample is 459,000 (357,000) GHS for men and 66,000 (55,000) GHS for women.

A formal behavioral model incorporating different forms of imperfect information is beyond the scope of this article but clearly should be a priority for future research. Discrepancies between own and cross reports are very large and have important effects on efficiency. Furthermore, monitoring costs are likely to be an important determinant of these discrepancies and provide a clear channel for policy intervention. Our broad look at the different dimensions of asymmetric information indicates the need for additional data incorporating cross reports in order to gain a more complete understanding of which dimensions will be the most salient in various contexts.

Lastly, the issue of asymmetric information within households is relevant for many elements of the development process. By putting physical space between household members, migration clearly increases the potential for information problems. However, migration may also lead to a "feminization" of agriculture, which would eliminate the need for coordination among cultivators, potentially mitigating any adverse effects of imperfect information. Similarly, the growth of off-farm work may both increase the potential for asymmetric information and reduce the need for coordination, having an ambiguous effect on intra-household efficiency. On the other hand, concerns about the distributional effects of asymmetric information and strategic behavior may also affect incentives to invest in migration and off-farm work. We hope that future research will delve further into the myriad dimensions of asymmetric information among household members, as well as the potential implications for efficiency throughout the development process.

References

Abbas, J. 1993. Gender Asymmetries in Intrahousehold Resource Allocation in Sub-Saharan Africa: Some Policy Implications for Land and Labor Productivity. In *Intrahousehold Resource Allocation in Developing Countries,* ed. Haddad, L., J. Hoddinott, and H. Alderman, page–page. Washington DC: The International Food Policy Research Institute.

Abu, K. 1983. The Separateness of Spouses: Conjugal Resources in an Ashanti Town. In *Female and Male in West Africa,* ed. C. Oppong. London: George Allen and Unwin.

Akresh, R. 2008. (In)Efficiency in Intrahousehold Allocations. IZA Discussion Paper 1858.

Akresh, R., J. Chen, and C. Moore. 2012. Productive Efficiency and the Scope for Cooperation in Polygynous Households. *American Journal of Agricultural Economics* 94 (2): 395–401.

———. 2013. Altruism, Cooperation, and Efficiency: Agricultural Production in

Polygynous Households. Mimeo, The Ohio State University.

Ambler, K. 2013. Don't Tell on Me: Experimental Evidence of Asymmetric Information in Transnational Households. Mimeo, International Food Policy Research Institute.

Ashraf, N. 2009. Spousal Control and Intra-household Decision Making: An Experimental Study in the Philippines. *American Economic Review* 99 (4): 1245–1277.

Ashraf, N., D. Aycinena, C. Martinez, and D. Yang. 2013. Savings in Transnational Households: A Field Experiment among Migrants from El Salvador. Mimeo, University of Michigan.

Aslam, M., and G. Kingdon. 2008. Gender and Household Education Expenditure in Pakistan. *Applied Economics* 40 (20): 2573–2591.

Baden, S., C. Green, N. Otoo-Oyortey, and T. Peasgood. 1994. Background Paper on Gender Issues in Ghana. BRIDGE Report No. 19.

Bukh, J. 1979. *The Village Women in Ghana*. Scandinavian Institute of African Studies. Uppsala, Sweden.

Castilla, C., and T. Walker. 2013. Is Ignorance Bliss? The Effect of Asymmetric Information between Spouses on Intra-household Allocations. *American Economic Review* 103 (3): 263–268.

Chao, S. 1999. Ghana: Gender Analysis and Policymaking for Development. Discussion Paper No. 403. Washington DC: The World Bank.

Chen, J. 2013. Identifying Non-cooperative Behavior among Spouses: Child Outcomes in Migrant-sending Households. *Journal of Development Economics* 100 (1): 1–18.

———. 2014. The Interaction Between Migrants and Origin Households: Evidence from Linked Data. Mimeo, The Ohio State University.

Clark, G. 1999. Mothering, Work, and Gender in Urban Asante Ideology and Practice. *American Anthropologist, New Series* 101 (4): 717–729.

Collins, L. 2013. Intra-household Allocation in Ghanaian Households: Does The Unitary Model Exist? Mimeo, The Ohio State University.

Conley, T., and C. Udry. 2001. Social Learning Through Networks: The Adoption of New Agricultural Technologies in Ghana. *American Journal of Agricultural Economics* 83 (3): 668–673.

———. 2010. Learning about a New Technology: Pineapple in Ghana. *American Economic Review* 100 (1): 35–69.

Dubois, P., and E. Ligon. 2010. Nutrition and Risk Sharing within the Household. CUDARE Working Paper Series 1096, Department of Agricultural and Resource Economics and Policy, University of California, Berkeley.

Duflo, E., and C. Udry. 2004. Intrahousehold Resource Allocation in Cote d'Ivoire: Social Norms, Separate Accounts and Consumption Choices. Working Paper No. 10498, National Bureau of Economic Research.

Goldstein, M. 1999. Chop Time, No Friends Intrahousehold and Individual Insurance Mechanisms in Southern Ghana. Mimeo, University of California, Berkeley.

———. 2004. Intra-household Efficiency and Individual Insurance in Ghana. Development Economics Discussion Paper Series DEDPS 38. London School of Economics.

Goldstein, M., and C. Udry. 1999a. Agricultural Innovation and Resource Management in Ghana. Mimeo, Yale University.

———. 1999b. Gender and Land Resource Management in Southern Ghana. Mimeo, Yale University.

———. 2008. The Profits of Power: Land Rights and Agricultural Investment in Ghana. *Journal of Political Economy* 116 (6): 981–1022.

Leach, M. 1991. Locating Gendered Experience: An Anthropologist's View from a Sierra Leonean Village. *IDS Bulletin* 22 (1): 44–50.

Leser, C. 1963. Forms of Engel Functions. *Econometrica* 31 (4): 694–703.

Lloyd, C.B., and A.J. Gage-Brandon. 1993. Women's Role in Maintaining Households: Family Welfare and Sexual Inequality in Ghana. *Population Studies* 47 (1): 115–131.

Mazzucato, V. 2009. Informal Insurance Arrangements in Ghanaian Migrants' Transnational Networks: The Role of Reverse Remittances and Geographic Proximity. *World Development* 37 (6): 1105–1115.

Oppong, C. 1974. Marriage mong a Matrilineal Elite: A Family Study of Ghanaian Senior Civil Servants. *Cambridge Studies in Social Anthropology* 8: 16–187.

Phipps, S., and P. Burton. 1998. What's Mine is Yours? The Influence of Male and Female Incomes on Patterns of Household Expenditure. *Economica* 65 (260): 599–613.

Roncoli, M. 1985. Women and Small-scale Farming in Ghana. Women in International Development Working Paper Series, Michigan State University.

Udry, C. 1996. Gender, Agricultural Production, and the Theory of the Household. *Journal of Political Economy* 104 (5): 1010–1046.

———. 2003. Fieldwork, Economic Theory, and Research on Institutions in Developing Countries. *American Economic Review* 93 (2): 107–111.

Udry, C., and H. Woo. 2007. Households and the Social Organization of Consumption in Southern Ghana. *African Studies Review* 50 (2): 139–153.

Vercruijsse, E., L. Vercruijsse-Dopheide, and K. Boakye. 1974. Composition of Households in Some Fante Communities: A Study of the Framework of Social Integration. In *Domestic Rights and Duties in Southern Ghana: Legon Family Research Papers, Vol. 1,* ed. C. Oppong. Legon, Ghana: Institute of African Studies.

Whitehead, A. 1993. Poverty in North East Ghana. Draft report to ESCOR, ODA.

Working, H. 1943. Statistical Laws of Family Expenditure. *Journal of the American Statistical Association* 38 (221): 43–56.