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Gender targeting of unconditional income transfers and child nutritional status: Experimental evidence from the Bolivian Amazon

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Abstract

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Keywords

Cash transfers, nutrition, gender, native Amazonian, randomized control trial

Disciplines

International Public Health | Maternal and Child Health | Nutrition | Social and Behavioral Sciences

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Gender targeting of unconditional income transfers and child nutritional status: Experimental evidence from the Bolivian Amazon

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Abstract

Observational studies suggest that women's income benefits children's health and nutritional status, as well as education, more than men's income, apparently because women are more likely to shift marginal resources to their children. These studies have influenced policies such as conditional cash transfers, which typically target women. However, previous studies have been unable to control for unobserved heterogeneity in child endowments and parental preferences. We report the results of a trial that allocated randomly one-time in-kind income in the form of edible rice (the main staple and cash crop in the study area) or rice seeds to the female or male household head (edible rice transfers, range: 30-395 kg/household; rice seeds: 5.9 kg/household). The trial took place in a society of native Amazonian forager-farmers in Bolivia (2008-2009). Outcomes included four anthropometric indicators of short-run nutritional status of 848 children from 40 villages. We found that the transfers produced no discernible impact on short-run (~5 months) nutritional status of children, or any differential effects between girls and boys by the gender of the household head who received the transfers. These null results probably relate to specific social norms of the Tsimane', such as pooling of food resources, shared preferences, and relatively equal bargaining power between Tsimane' women and men. The results highlight the probable importance of culture in household resource allocation and suggest that gender targeting in cash transfer programs might not increase investments in children in societies where women and men have more egalitarian household relationships.

Keywords: Cash transfers | nutrition | gender | native Amazonians | randomized control trial

JEL code: D13, H31, I20

Summary of contents:

Text: 4,924 words (including abstract); Tables: 5; Figures: 2.

1. Introduction

There is a widely-held belief that income in the hands of women benefits children more than income in men's hands, presumably from the socialization of women and from a biological pre-disposition of women to care and to shift marginal resources more toward young children (Gettler, 2010; Trevathan, 2010). The belief finds support in observational studies (Behrman, 1997; Handa, 1996; Pfeiffer et al., 2001; Qian, 2008; Rogers, 1996; Smith et al., 2003), but such studies do not permit firm conclusions about causality owing to endogeneity biases. Despite the uncertainty surrounding the estimates, cash transfer programs typically transfer income to women (Fiszbein and Schady, 2009). To our knowledge there is no published evidence with exogenous gendered-allocation of resources to support the belief that the well-being of young children improves more when women rather than men receive income (Yoong et al., 2012).

Recent experimental studies provide *indirect* evidence that the conclusion might need reappraisal. Chattopadhyay and Duflo (2004) estimated the effects of having women leaders on public investments in India. They found that communities with women leaders invested more in water (which might improve child health), but some invested less in education (which might erode child health). Braido et al. (2012) and Morris et al. (2004) used a natural experiment from a conditional cash transfer program in Brazil to examine the effect of the transfer on women's bargaining power and child nutrition. Braido et al. (2012) found that women in households with a male partner who received transfers had similar expenditure patterns to their peers in control households, and Morris et al. (2004) found that children (<3 years old) of women who received transfers had lower rates of weight gain than their peers in control households. A recent evaluation of the *PROGRESA* (*Oportunidades*) program in Mexico found no difference in women's use of conditional and earned income (Handa et al., 2009). A randomized experiment of cash transfers labeled for education in rural communities in Morocco found large gains in child school participation, but it made essentially no difference to target transfers to female rather than to male household heads (Benhassine et al., 2013). Finally, Gitter and Barham (2008) found that conditional income transfers to women in Nicaragua increased child school enrollment, but the effects declined if a women's bargaining power far exceeded that of her male partner.

Taken together, these studies suggest that exogenous improvements in women's income might not change consumption or improve child outcomes (or do so only under particular conditions), but most do not allow to assess the comparative effects of gender-targeted income transfers on child well-being because income was transferred only to women. To our knowledge, only two randomized control trials (RCTs) allow assessing the comparative effects of gender-targeted transfers: a study in Morocco, which found no differential effects by recipients' gender (Benhassine et al., 2013), and a recent study in Burkina Faso where gender effects are still under analysis (Akresh et al., 2013).

Here we present the results of a RCT in which we randomized the female or the male household head to receive a one-time, unconditional in-kind transfer of income in the form of edible rice, to assess whether gender targeting of unconditional cash transfer increase investments in children. The trial took place in a foraging-farming society of native Amazonians in Bolivia, the Tsimane' (Saidi et al., 2012). The Tsimane' were an attractive society for the RCT because government conditional cash-transfer programs target populations with low monetary income, like the Tsimane', but have overlooked specific characteristics of the populations such as the egalitarian social status of Tsimane' men and women. Moreover, in recent years, the Bolivian government has begun to implement similar types of cash transfer programs (e.g., *Juancito Pinto*, conditional on school attendance, *Juana Azurduy,* conditional on medical checkups) which have reached marginalized communities, including the Tsimane' (Undurraga et al., 2013). While the Tsimane' are still moderately engaged in the market economy and cash is of limited use in the communities, such a setting allowed us to control for confounders that are common in more industrialized societies. Rice is their most important staple and cash crop (Vadez et al., 2004), a proxy for cash that is both fungible and consumable. The trial built on continual ethnographic studies since 1995 and on a panel study (2002-2010) among the Tsimane' of a nearby area (Leonard and Godoy, 2008). We assessed the impact of the transfers on four anthropometric indicators of short-run nutritional status of children 2-9 years old about five months after the transfers.

2. Background and study design

2.1 The Tsimane'

Tsimane' live mostly along the Maniqui and the Apere rivers, in a relatively remote corner of the Department of Beni (Huanca, 2008; Ringhofer, 2010). Missionaries and colonists have brought market goods and employment opportunities, but most Tsimane' remain highly autarkic. A comparative study among 15 small-scale foraging and horticultural societies ranked the Tsimane' next to the lowest in market exposure, with an average of about 7% of total household calories bought in the market (Henrich et al., 2010). About 40% of adults (≥ 16 years) during 2002-2007 had earned no monetary income during the two months before the interview. Tsimane' earn monetary income through the sale of forest and farm goods, and through occasional wage labor in logging camps or cattle ranches; but they have low levels of monetary or non-monetary savings (Undurraga et al., 2013). In 2009, mean daily monetary income per person reached US$0.90 (SD=2.1).

Depending on the age bracket, 33-40% of Tsimane' children are growth-stunted, similar to other native Amazonian societies (Foster et al., 2005; Godoy et al., 2010b; Orr et al., 2001). Household-level analyses of food-use patterns suggest that the Tsimane' diet is sufficient to meet daily energy and protein requirements (Godoy et al., 2005), so the high levels of child stunting probably reflects high infectious disease loads and marginal dietary quality rather than limited food availability. Another explanation for the ubiquity of stunting may be related to modest height premiums among adults as perceived by parents (Godoy et al., 2006a; Godoy et al., 2010a; Undurraga et al., 2012). Other anthropometric measures also suggest that Tsimane' children are not experiencing observable protein-energy malnutrition. Specifically, weight-for-height, body fatness, and indices of muscularity among Tsimane' children all more closely approximate age-specific and sex-specific reference values than height-for-age (Foster et al., 2005). The average girl or boy in our sample was 0.33 standard deviations (SD) above their age-specific and sex-specific peers in the USA in weight-for-height measures, and only 1.2% of the sample was wasted.[1]

Tsimane' women are considerably empowered, although this does not seem obvious from standard economic and human capital indicators. For example, women lag behind men in monetary income, value of modern physical assets, and also in formal schooling, academic skills, and fluency speaking Spanish (Godoy et al., 2006b). The value of modern assets (e.g., metal tools) and monetary earnings of male household heads was 2.5 times larger than that of female household heads at baseline (2008). Female household heads had 1.3 fewer grades of schooling

[1] Children with low (≤ -2 standard deviations) height-for-age Z-scores were considered stunted and children with low weight-for-height Z-scores were considered wasted; both measures indicate that children are nutritionally at risk.

attainment, a 30 percentage-point lower probability of speaking fluent Spanish, and lower formal math skills than male household heads of the same age.

These disadvantages are partially offset by other indicators that relate to life away from the market. Observational data suggests that women maintain social status equal to men within community and home life. For example, female and male household heads did not differ in the monetary value of physical assets owned made from local materials (e.g., canoes) or in the value of their stock of domesticated animals (e.g., chickens). Additionally, female household heads in this and in a previous study (Godoy et al., 2006b) had better average nutritional indicators, such as higher age-standardized and sex-standardized Z-scores of muscle area, skinfolds, and weight-for-age than their male counterparts.

Although women and men own and keep physical assets separately, they pool resources in farming, with all in the family often literally eating from a common pot. The practice of preferential cross-cousin marriage plus matrilocal post-marital residence means that adult women live in villages with close kin to provide support, which enhances perceived empowerment. Several aspects of Tsimane' life suggest gender equality in running the household. For example, both women and men pool labor resources for agricultural production, and both have equal say in food production. Men hunt, but women collect plants and produce *chicha*, a locally-fermented beverage that contributes to social gatherings and, thus, to a household's status in the village.

2.2 Experimental Design

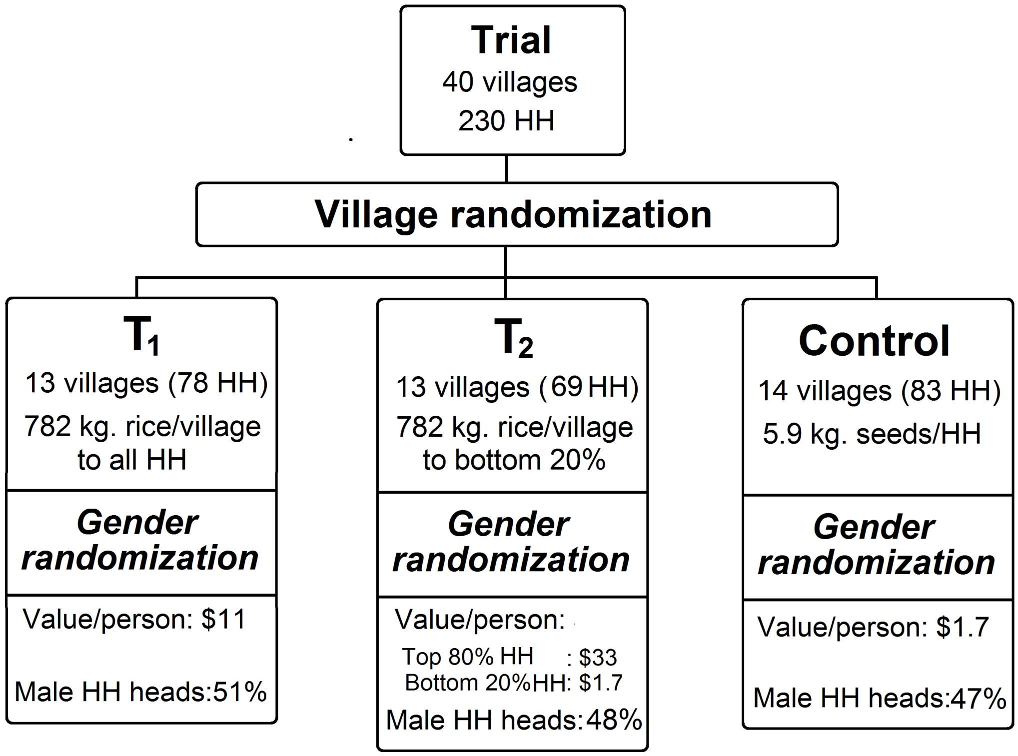
Recent estimates suggest that Tsimane' number ~14,200 and live in ~95 villages of at least eight households each (Gran Consejo Tsimane', 2013). To select the 40 villages for the trial, we excluded villages participating in other studies, too costly to reach, too small or unsafe, or that contained other ethnic groups. This left 65 villages of which we selected 40 based on accessibility (Figure 1). Only 4% of households in the sample were single-headed.

The random assignment of income transfers to female versus male household heads was part of a trial to estimate the effects of unconditional income transfers on adult and child health in 40 Tsimane' villages. The trial had two treatment groups that received edible rice – one treatment included transfers to all households and in the other transfers was targeted at the poorest 20% – and a control group that received improved rice seeds (Figure 2). The baseline survey happened during February-May, 2008, the transfers happened during October 2008-January 2009, and the follow-up survey happened during February-May 2009.

Figure 1. Tsimane' villages in the panel study and randomized control trial (Beni, Bolivia)

Notes: The colors of the territory denote elevation; mamsl denotes meters above mean sea level. The square symbols and letters in each town are approximately proportional in size to town population. [Color online, grayscale on print]

Figure 2. Summary of Experimental Design



<u>Notes</u>: HH denotes household. All households in T1 received rice transfers; only the households in the bottom 20% of the village income distribution in T2 received income transfers, and the top 80% received rice seeds; all households in the control group received rice seeds. The recipient of the transfers was chosen at random between the male and female household head in all groups. The households by treatment arm and the total households shown in the figure include only households that had children between 2 and 9 years old, and that were present during the baseline and follow-up of the trial. The complete trial included 494 HH; 153 HH in T1, 176 HH in T2, and 165 in the control group.

<u>*Treatment 1*</u> *(T_1)*: Each of the 13 villages received a total of 782 kg of edible rice, which was divided equally among all households of the village. Hence, the amount of rice per person varied within and across villages for two reasons. First, the amount of edible rice received by each household was inversely related to the number of households in a village (mean: 58 kg; median: 52 kg; SD: 23 kg; range 30-131 kg). Second, the amount of rice per person varied further by household size.

Treatment 2 (T_2): Thirteen villages received the same aggregate amount of edible rice as in T_1 (782 kg), but the transfers were targeted only to households in the bottom 20% of the village income distribution (mean: 177 kg; median: 157 kg; SD: 81 kg; range 98-395 kg). Not surprisingly –considering the limited sample of villages for the trial– the quantity of edible rice transferred to households in T_2 was only about three times larger than in T_1 (as opposed to five times larger) since the village population distribution of the two treatments was not identical.

We used the area of old and fallow forest cleared by households (per person) at baseline to identify the poorest 20% of households in a village (Behrman et al. 2011). Each year households clear forests to plant annual and perennial crops. Forest area cleared is a reasonable proxy for annual income because all farm output from cleared plots is consumed, sold, or bartered, thus capturing household total annual consumptions and monetary income from farm products. But area of forest cleared does not include occasional income from wage labor or from the sale of forest products.

Controls: Control households included all households in the 14 villages that were not part of T_1 or T_2. Households in the top 80% of the village income distribution of villages receiving T_2 received the same transfer as controls, but were analyzed as a separate group. All households in the control group received 5.9 kg of rice seeds.

Random gender-targeting in the delivery of transfers: All transfers were randomly assigned to the female or to male household head; however, not all them were present during the transfers to directly receive the rice from us (present: treatment=62%, control=52%; χ^2= 4.5, p=0.03). If the female or male household head selected was missing, we gave the transfer to a third party (e.g., teacher) and asked the person to give the transfer to the absent household head when the head returned to the village. In the robustness analysis we exclude third-party recipients.

2.3 Significance of the transfers

We used rice rather than money because of the limited use of money in remote villages and because of the importance of rice as a staple and as a cash crop (Vadez et al., 2004). Total monetary expenditures on all foods did not change due to the rice transfers, suggesting that the transfers did not displace other foods.

The transfers of rice amounted to ~US$11/person for people in villages receiving T_1 and to ~US$ 33/person for people in the bottom 20% of the income distribution in villages receiving T_2. The transfers amounted to income earned over 12.4 days (T_1) or 36.5 days (T_2) for an average Tsimane'. Annual panel data (2002-2007) suggests that mean weekly rice consumption per person was ~1 kg, so expressed in terms of rice consumption and assuming a household had six people –the average for the sample– a person in either T_1 or T_2 would have had enough rice for 10 weeks (T_1) or 30 weeks (T_2).

The monetary value of the rice seeds given to control households was US$ 1.7/person, but the perceived value of the improved rice seeds at delivery time may have been lower, as there is no market for improved rice seeds in the study area and Tsimane' reported they did not like the harvested rice from improved seeds in focus groups and interviews following the study (February 2011).

From a nutritional perspective, the rice transfers represented a substantial infusion of energy and protein (Table 1). Assuming 10% wastage over five months (150 days), the 58 kg transfers would have added 1,249 kcal/day and 25 g/day of protein to average household availabilities. For the 177 kg transfers, the daily increases would have been 3,813 kcal of energy and 75 grams of protein. Considering the nutritional needs of an average Tsimane' child (Table 1) even a small allocation of the household rice allotment would have important nutritional implications for Tsimane' children. Indeed, for the 58 kg rice transfers, a 10% allocation to a five-year old child would meet ~10% of the child's daily energy requirements and 16-17% of daily protein needs. For the large rice transfers (177 kg) of T_2, a 10% allocation accounts for ~30% of the energy requirements and half of the protein needs of a 5.5 year old Tsimane' child. The WHO recommends that an increase of ~3-4% in dietary energy consumption is necessary for 'catch up' growth in body weight for a child of this age (FAO/WHO/UNU, 2004).

Table 1. Nutritional significance of rice transfers for household energy and protein availability

	58 kg rice Transfer		177 kg rice Transfer	
	Energy (kcal)	Protein (g)	Energy (kcal)	Protein (g)
Total infusion	208,220	4,118	635,430	12,567
Daily increase (household/day)[a]	1,249	25	3,813	75
Boy's daily needs[b]	1,281	15	1,281	15
Percent of needs (10% rice allocation)	9.8%	17.0%	29.8%	50.0%
Girl's daily needs[b]	1,165	14	1,165	14
Percent of needs (10% rice allocation)	10.7%	17.9%	32.7%	53.6%

Notes: [a] Daily increase calculated over 150 days of consumption, assuming 10% wastage. [b] Estimates based on WHO energy and protein requirements (FAO/WHO/UNU, 2004; WHO, 2007) for an average Tsimane' boy and girl of 5.5 years of age (boy: 17.2 kg; girl: 16.3 kg)

2.4 Methods: Anthropometric data and analysis

We collected children's anthropometric data following Lohman et al.'s (1988) protocol. Linear growth (stature/length) was measured to the nearest millimeter using a portable stadiometer. Body weight was measured to the nearest 0.2 kg using a standing scale. We measured mid upper-arm circumference (MUAC) to the nearest millimeter using a plastic tape measure and triceps skinfold thickness (TST) to the nearest 0.5 mm using Lange skinfold calipers. From raw anthropometric measures, we calculated two additional indices: weight-for-height Z-score (WHZ) and arm muscle area (AMA). WHZ values were calculated relative to the WHO (1995, 2006) reference values. We followed the procedure of Frisancho (1990) to calculate AMA (cm^2) from MUAC and TST measures.

Weight-for-Height Z-score (WHZ) was used to assess wasting and mortality risk. Because the growth velocities of children in both weight and stature depend on age, changes in weight-for-height were assessed as Z-scores. Z-scores capture the difference between the measured value of the Tsimane' child's weight-for-height and the median value of the reference population for weight-for-height at the same sex and age, divided by the standard deviation of the reference population for that nutritional indicator. Low values of WHZ reflect acute energy deficiency; children with WHZ scores ≤ -2.0 are classified as wasted.

Mid-Upper Arm Circumference (MUAC) measures the diameter of the upper arm and assesses both fat storage (source of energy) and muscle mass (source of protein or amino acids). Fat and muscle mass are energy reserves for vital functions during infection. MUAC can predict mortality among young children independent of WHZ and other weight-based or height-based measures (Berkley et al., 2005; Briend et al., 1989; Van den Broeck et al., 1998). MUAC is a stronger predictor of early childhood mortality than either height-based or weight-based anthropometric indices (deOnis et al., 1997; Trowbridge and Sommer, 1981).

Arm-Muscle Area (AMA) captures muscular development and protein reserve (Saito et al., 2010). Consequently, as with low WHZ, low AMA is indicative of protein-energy malnutrition.

Triceps Skinfold Thickness (TST) measures the thickness of subcutaneous adipose tissue and captures total body fat and energy reserves (Jebb et al., 1993; Pecoraro et al., 2003). High fat content is associated with high calorie intake or low energy expenditure (Frisancho, 1990). Fat assessment has an added advantage because fat remains stable among children 1-7 years of age (Gurney, 1969). The use of muscle and fat measures was of primary interest because these dimensions are affected by nutritional disorders and can change in the short run (Briend et al., 1989; Holliday, 1978).

We limited the analysis to children from 2 to 9 years old. We set the upper age bracket to ensure puberty did not affect estimates of growth rates. Previous studies suggest that Tsimane' children may enter pre-pubertal growth spurt as early as 10-12 years of age (Byron, 2003; Godoy et al., 2010b). Tsimane' mothers breastfeed their children for about two years, so including children less than two years old would have increased age-related heterogeneity regarding the possible consumption of rice by children. The final sample included 40 villages, 191 households, and 848 children (girls=407, boys=441) (Table 2). The total baseline sample contained 959 children (girls=473; boys=486), but by the time of the follow-up survey 24 girls and 21 boys had left (4.7% loss of the baseline sample).

We analyzed the pooled sample, and also divided the sample into four groups to take into account that we transferred two resources (rice and seeds) and that treatment effects in T_2 might vary by the household's position in the village income distribution (Saidi et al., 2012). The groups included: *(1)* all households in T_1, *(2)* all households in the 14 control villages, *(3)* households in the bottom 20% of the village income distribution in T_2, and *(4)* households in the top 80% of the village income distribution in T_2.

We estimated the effect of the income transfers to female or male household heads on child nutritional status using a double-difference estimator, based on the following model for each anthropometric outcome:

$$Y_{aihvt} = \alpha + \beta MaleT_{hvt} + \gamma After_{ihvt} + \delta MaleT{*}After_{ihvt} + \upsilon X_{ihvt} + \varepsilon_{aihvt} \quad (1)$$

Where the subscripts stand for anthropometric indicators (a), individual or child (i), household (h), village (v), and year (t). *MaleT* is an indicator for treatment (1=recipient was a man; 0=recipient was a woman); *After* is an indicator for time (0=2008 or baseline; 1=2009 or follow up, after), *MaleT*After* is an interaction term, *X* is a vector of control variables (child age and sex, and outcome at baseline), and ε is a disturbance term. The coefficient δ is the difference-in-difference (DID) estimate for the effect of gender-targeting the transfer. We estimated expression [1] for each of the four groups separately, and in some regressions we pooled the four groups and add indicator variables for T_1 and T_2, to increase statistical power. We adjusted the standard errors for clustering at the village level.

Table 2. Descriptive statistics at baseline (children 2-9 years old)

	T_1	T_2		Control	Sub-totals		Total
	(Rice)	Bot 20% (Rice)	Top 80% (Seeds)	(Seeds)	T_1+Bot 20% T_2 (Rice)	Control+ Top 80% T_2 (Seeds)	(Both)
Children							
Girls (N)	132	42	94	139	174	233	407
Boys (N)	124	45	108	164	169	272	441
Attrition (N)	9	4	15	17	13	32	45
Household winner[a]							
Women (N)	23	14	23	28	37	51	88
Men (N)	38	7	23	35	45	58	103
Villages	13	13		14			40
Child attributes: mean (standard deviation)							
Age	5.5 (2.2)	5.3 (2.2)	5.3 (2.3)	5.5 (2.2)	5.4 (2.2)	5.4 (2.3)	5.4 (2.2)
WHZ	0.4 (0.8)	0.3 (0.7)	0.2 (0.9)	0.3 (0.7)	0.4 (0.8)	0.3 (0.8)	0.3 (0.8)
AMA	16.1 (3.6)	15.2 (4.2)	15.9 (4.2)	16.4 (4.1)	15.9 (3.8)	16.2 (4.2)	16.1 (4.0)
MUAC	16.4 (1.7)	16.0 (1.8)	16.3 (1.8)	16.4 (1.7)	16.3 (1.7)	16.4 (1.8)	16.3 (1.7)
TST	7.3 (2.3)	7.3 (2.8)	7.2 (2.5)	6.9 (1.9)	7.3 (2.4)	7.0 (2.2)	7.2 (2.3)

Notes: [a]*Household winner* refers to household head who was selected to receive the transfer, even if absent at the time of the transfer. T_1, T_2 denote treatment 1 and treatment 2.

3. Results

Tables 3 and 4 contain the parameter estimates for equation [1]. The most striking finding in Tables 3 and 4 is the absence of almost any statistically significant result for the difference-in-difference coefficient, whether we did the analysis with the four separate groups or pooled all groups while controlling for T_1 and T_2.

Table 3. Difference-in-difference estimate of the effects of -targeted income transfers on child anthropometric indicators of nutritional status, controlling for baseline outcomes (T_1 and T_2 villages)

	T_1				T_2: Bottom 20%				T_2: Top 80%			
Explanatory variables:	WHZ	MUAC[b]	AMA[b]	TSF[b]	WHZ	MUAC[b]	AMA[b]	TSF[b]	WHZ	MUAC[b]	AMA[b]	TSF[b]
DID[a]	-0.023	0.003	0.029	-0.064	-0.044	0.040	0.064	0.070	0.123	-0.016	-0.038	0.012
	(0.124)	(0.011)	(0.030)	(0.058)	(0.120)	(0.025)	(0.058)	(0.039)	(0.151)	(0.022)	(0.054)	(0.048)
After	-0.073	0.013	0.016	0.027	-0.021	-0.003	0.017	-0.054	-0.088	0.002	0.022	-0.044
	(0.094)	(0.010)	(0.023)	(0.038)	(0.120)	(0.017)	(0.056)	(0.076)	(0.133)	(0.011)	(0.029)	(0.050)
MaleT	-0.017	-0.000	-0.005	0.010	-0.028	-0.014	-0.029	-0.020	-0.105	-0.007	-0.012	-0.014
	(0.033)	(0.003)	(0.012)	(0.009)	(0.054)	(0.008)	(0.017)	(0.022)	(0.056)	(0.006)	(0.012)	(0.023)
Boy (child sex)	-0.056	-0.007	-0.011	-0.021	0.002	-0.022*	-0.043	-0.017	0.017	-0.012	-0.018	-0.042
	(0.036)	(0.004)	(0.012)	(0.015)	(0.095)	(0.010)	(0.024)	(0.015)	(0.062)	(0.008)	(0.014)	(0.025)
Age (child age)	0.021	0.007*	0.023**	-0.004	0.024	0.012**	0.034**	-0.012	-0.007	0.009*	0.029**	-0.008
	(0.014)	(0.002)	(0.007)	(0.004)	(0.014)	(0.002)	(0.005)	(0.008)	(0.018)	(0.004)	(0.006)	(0.004)
Base outcome [c]	0.775**	0.765**	0.689**	0.745**	0.654**	0.664**	0.626**	0.725**	0.662**	0.678**	0.608**	0.654**
	(0.054)	(0.101)	(0.102)	(0.027)	(0.114)	(0.043)	(0.035)	(0.030)	(0.054)	(0.073)	(0.056)	(0.029)
Constant	0.024	0.623*	0.737*	0.522**	-0.014	0.884**	0.858**	0.610**	0.156	0.857**	0.932**	0.736**
	(0.070)	(0.271)	(0.247)	(0.063)	(0.105)	(0.118)	(0.090)	(0.063)	(0.125)	(0.192)	(0.136)	(0.079)
Observations	477	477	475	475	163	162	162	162	399	397	393	393
R^2	0.642	0.772	0.735	0.602	0.458	0.737	0.712	0.633	0.471	0.510	0.538	0.571

Notes: ** p<0.01, * p<0.05, robust standard errors (in parentheses) were adjusted for clustering at the village level. DID denotes difference in difference, T_1 and T_2 denotes treatment 1 and treatment 2. [a] DID=*MaleT *After*. [b] Outcomes in natural logarithms. [c] Base outcome denotes the indicator of child nutritional status at baseline.

Table 4. Difference-in-difference estimate of the effects of gender-targeted income transfers on child anthropometric indicators of nutritional status, controlling for baseline outcomes (control and pooled villages)

Explanatory variables:	Control				Pooled			
	WHZ	MUAC[b]	AMA[b]	TSF[b]	WHZ	MUAC[b]	AMA[b]	TSF[b]
DID[a]	0.087	-0.001	-0.023	0.058	0.046	0.001	-0.003	0.012
	(0.132)	(0.010)	(0.032)	(0.034)	(0.069)	(0.007)	(0.021)	(0.026)
After	-0.150	0.003	0.009	-0.009	-0.096	0.005	0.016	-0.014
	(0.080)	(0.012)	(0.028)	(0.027)	(0.049)	(0.006)	(0.017)	(0.023)
MaleT	-0.017	-0.004	-0.007	-0.009	-0.037	-0.004	-0.010	-0.004
	(0.028)	(0.003)	(0.009)	(0.010)	(0.021)	(0.002)	(0.006)	(0.007)
Boy (child sex)	0.013	0.001	0.010	-0.030*	0.000	-0.007*	-0.008	-0.029**
	(0.049)	(0.002)	(0.009)	(0.014)	(0.030)	(0.003)	(0.007)	(0.009)
Age (child age)	0.028	0.009**	0.029**	-0.011**	0.016	0.009**	0.028**	-0.008**
	(0.019)	(0.002)	(0.005)	(0.003)	(0.009)	(0.001)	(0.003)	(0.002)
Base outcome[c]	0.735**	0.725**	0.671**	0.670**	0.714**	0.722**	0.654**	0.692**
	(0.058)	(0.041)	(0.046)	(0.033)	(0.028)	(0.042)	(0.039)	(0.017)
T_1[d]					0.050	0.005	0.010	0.002
					(0.042)	(0.005)	(0.012)	(0.018)
T_2[d]					0.025	-0.003	-0.003	-0.017
					(0.044)	(0.006)	(0.014)	(0.014)
Constant	-0.072	0.718**	0.748**	0.706**	0.002	0.735**	0.807**	0.660**
	(0.087)	(0.106)	(0.108)	(0.068)	(0.059)	(0.111)	(0.093)	(0.042)
Observations	553	555	552	552	1592	1591	1582	1582
R^2	0.565	0.743	0.732	0.515	0.547	0.670	0.668	0.568

Notes: ** p<0.01, * p<0.05, robust standard errors (in parentheses) were adjusted for clustering at the village level. DID denotes difference in difference, T_1 and T_2 denotes treatment 1 and treatment 2 [a] DID=*MaleT*After*. [b] Outcomes in natural logarithms. [c] Base outcome denotes the indicator of child nutritional status at baseline. [d] Excluded category are control villages.

Next, we did several extensions and robustness checks. First, we re-estimated the regressions of Tables 3 and 4 by raising the upper age limit from nine years of age to include children ≤16 years old, and found no significant results (regressions not shown). Second, we assessed whether the treatment might have had a stronger effect on children 2-5 years of age since mothers might be particularly important for the nutrition of pre-school age children (Navia et al., 2003; Ovaskainen et al., 2009). We created an indicator variable for this age bracket (*child*), and interacted it with all variables from equation [1]. To assess whether the triple difference-in-difference estimate (*MaleT*After*child*) was significant, we ran the regression for the pooled sample with all these interaction variables and found no significant effect for any group (regressions not shown). Third, we assessed whether mothers and fathers skewed investments differently between daughters and sons (Godoy et al., 2006c; Thomas, 1994). Using the pooled sample, we interacted the child sex variable (*boy*) with all the variables of Tables 3 and 4, and assessed whether the triple interaction, *MaleT*After*boy,* was significant (Table 5). We found no significant results. Fourth, we limited the analysis to households that directly received the transfer from us rather than from third parties (Table 6) using the pooled sample, and again found no significant results.

Table 5. Triple difference-in-difference estimate of the differential effects of gender-targeted income transfers on anthropometric indicators of nutritional status of boys versus girls, controlling for baseline conditions (pooled sample)

Explanatory variables:	WHZ	MUAC[b]	AMA[b]	TSF[b]
DID [a]	0.079	0.003	0.004	0.033
	(.077)	(0.008)	(0.025)	(0.033)
After	-0.107	0.010	0.032	-0.029
	(.056)	(0.006)	(0.018)	(0.027)
MaleT	-0.065*	-0.006 *	-0.016 *	-0.004
	(.025)	(0.002)	(0.007)	(0.009)
Age (child age)	0.011	0.010 **	0.030 *	-0.003
	(.009)	(0.001)	(0.003)	(0.003)
Boy (child sex)	-0.049	0.026	0.001	0.014
	(.091)	(0.224)	(0.160)	(0.078)
Base outcome	0.730 **	0.719**	0.644**	0.684**
	(0.047)	(0.037)	(0.028)	(0.024)
T_1	0.078	0.009	0.020	0.001
	(0.047)	(0.005)	(0.013)	(0.020)
T_2	0.017	0.005	0.016	-0.014
	(0.051)	(0.005)	(0.012)	(0.016)
DID*boy [e]	-0.066	-0.005	-0.015	-0.041
	(0.133)	(0.0148)	(0.033)	(0.044)
After*boy	0.022	-0.010	-0.030	0.027
	(0.096)	(0.009)	(0.021)	(0.029)
MaleT*boy	0.055	0.003	0.012	0.002
	(0.032)	(0.004)	(0.010)	(0.012)
Age *boy	0.009	-0.002	-0.003	-0.010 *
	(.015)	(0.003)	(0.007)	(0.005)
Base outcome*boy	-0.026	-0.004	0.014	0.005
	(0.052)	(0.085)	(0.067)	(0.036)
T_1*boy	-0.054	-0.008	-0.020	0.002
	(0.067)	(0.005)	(0.015)	(0.022)
T_2*boy	0.011	-0.015*	-0.034*	-0.006
	(.077)	(0.006)	(0.015)	(0.022)
Constant	0.029	0.728**	0.807**	0.645**
	(0.057)	(0.097)	(0.066)	(0.050)
Observations	1592	1591	1582	1582
R^2	0.542	0.671	0.669	0.570

Notes: ** p<0.01, * p<0.05, robust standard errors (in parentheses) were adjusted for clustering at the village level. DID denotes difference in difference, T_1 and T_2 denotes treatment 1 and 2. [a] DID=*MaleT*After*. [b] In natural logarithms. [c] Excluded category is control villages. [d] Base outcome denotes the indicator of child nutritional status at baseline. [e] *DID*boy=MaleT*After*boy.*

Table 6. Difference-in-difference estimate of the effects of gender-targeted income transfers on child anthropometric indicators of nutritional status, restricted to households that directly received the transfer from researchers (pooled sample)

Explanatory variables:	WHZ	MUAC[b]	AMA[b]	TSF[b]
DID [a]	0.059	-0.006	-0.019	0.014
	(0.075)	(0.010)	(0.027)	(0.037)
After	-0.083	0.007	0.022	-0.019
	(0.058)	(0.009)	(0.024)	(0.035)
MaleT	-0.059**	-0.007	-0.013	-0.011
	(0.021)	(0.003)	(0.010)	(0.010)
Boy (child sex)	0.025	-0.011*	-0.015	-0.040**
	(0.032)	(0.005)	(0.010)	(0.011)
Age (child age)	0.022*	0.009**	0.028**	-0.009**
	(0.009)	(0.002)	(0.005)	(0.003)
Base outcome	0.751**	0.689**	0.634**	0.698**
	(0.031)	(0.059)	(0.055)	(0.022)
T_1	0.085*	0.006	0.003	0.023
	(0.041)	(0.006)	(0.014)	(0.022)
T_2	0.048	-0.006	-0.011	-0.013
	(0.053)	(0.008)	(0.017)	(0.016)
Constant	-0.074	0.825**	0.863**	0.652**
	(0.057)	(0.155)	(0.128)	(0.053)
Observations	940	943	936	936
R-squared	0.62	0.64	0.64	0.57

Notes: ** p<0.01, * p<0.05, robust standard errors (in parentheses) were adjusted for clustering at the village level. DID denotes difference in difference, T_1 and T_2 denotes treatment 1 and 2. [a] DID=*MaleT*After*. [b] In natural logarithms. [c] Excluded category is control villages. [d] Base outcome denotes the indicator of child nutritional status at baseline.

To test whether the transfers between female and male household heads were well randomized, we ran separate regressions using treatment (*MaleT*) as the outcome variable and the child's age, sex, and anthropometric indicator as independent variables, for each of the four groups and anthropometric indicators, considering only the baseline year. In all but one of the regressions all the individual coefficients and the overall F statistic were not significant at the

95% confidence interval, suggesting that the assignment of the treatments between female and male household heads was well randomized (regressions not shown).

Although the rate of child attrition was low (4.7%), we examined whether attrition could have driven the results. We regressed the raw anthropometric measures (outcome variables) against *MaleT*, child's sex and age, T_1 and T_2, a discrete indicator variable for attrition, and a vector of interaction variables of the attrition indicator variable with all the above explanatory variables. F tests for the joint significance of the interaction of the attrition variable with all the explanatory variables were never significant (regressions not shown).

4. Discussion

We found no effects of one-time, unconditional in-kind income transfers on child nutritional status, and no differential effect by whether the female or the male household head received the transfers. Here we discuss possible explanations for these results and implications of the study.

The lack of effects may be partially explained by the low income elasticities of nutrient consumption (Behrman and Deolalikar, 1989; Bouis, 1994; Bouis and Haddad, 1992) and by the relatively good anthropometric indicators of nutritional status of Tsimane' children at baseline except for stunting; quite possibly Tsimane' do not perceive their children to be short because their reference is their community, not international standards (Godoy et al., 2010a). Further, the transfers may have been inadequate to improve nutritional *quality*. Research on the dietary correlates of early childhood growth in the developing world, including South American populations, has shown that measures of dietary quality (i.e., nutrient density), such as percent of dietary energy/protein from animal foods, and amount of animal protein consumed are stronger predictors of physical growth patterns than overall intakes of energy or protein (Allen, 1993, 2003; Leonard et al., 1995, 2000). Consequently, even though the transfers likely increased total energy availability at the household level, that they may not have directly increased dietary quality may have limited their potential impact on children. These three qualifications might explain why we found no significant direct effects, but would not explain the absence of differential effects on child nutritional status by the parent receiving the transfer.

Intra-household resource allocation depends on the specific social norms of a community. We focus on three possible explanations which may affect the outcomes and results of the study: resource pooling within the household and common household decision-making, shared preferences, and equal bargaining power between female and male household heads.

Unlike physical assets, over which Tsimane' have well-defined private property rights, with food resources Tsimane' have an open-access policy of allowing any person in the household to consume the food. Tsimane' horticulture requires cooperation. Men cut the large trees for farming, but thereafter women and men work jointly clearing the underbrush, burning, planting, weeding, and harvesting. Both have equal rights to the farm plots and equal say on the end uses of the harvest, including bartering or selling crops. There is no gendered division in food products, and no restrictions on access to food (except for food taboos during specific periods in the life cycle). Wildlife and harvested crops are pooled and food crops are stored in the house, available for any person in the household. Furthermore, although women or older un-married daughters take primary responsibilities for cooking, the food is placed in an open pot for all people to eat directly, or dished out. In sum, we might not observe differences in child nutritional status in relation to the parent who received the transfer because the food would have been accessible for all people in the household to eat.

The impact of the transfers might have been attenuated by leakages through gifts or reciprocal exchanges to other households. Households gave away 11% of the edible rice received, while control households gave away 3% of the transfer. Households maintain their own food stocks, but will cook and eat from communal pots, and often share a kitchen with the extended family. Tsimane' are less likely to share uncooked food, except at the end of the rainy season (January-April) when stocks of rice dwindle and the new crop has yet to be harvested. At this point those with extra rice might share it with their neighbors or extended family, but others might rely primarily on plantains or might buy food in towns.

Because the Tsimane' are a tightly-knit, small-scale endogamic society, it is not surprising that Tsimane' parents would share preferences about food consumption and child rearing. Indirect evidence suggests that Tsimane' share many traits, such as ethno-botanical knowledge (Reyes-Garcia et al., 2003), and practice positive assortative mating for age, schooling, body size and type, ethno-botanical knowledge, and psychological traits (Godoy et al., 2008). We found almost no significant gender differences in the amount of rice allocated to barter, sale, gifts to others, or that they had in storage at the time of the follow-up survey. However, women reported allocating 25% more rice to direct consumption than men (t=4.15; p=0.001), most likely because women cook and keep closer tabs on rice stocks.

Last, we might have observed no differential impact on child nutritional status if women and men were equally empowered (Basu, 2006; Gitter and Barham, 2008; Smith et al., 2003). In an earlier study (Godoy et al., 2006b) we found that women saw themselves as the major decision makers and tie breakers when spouses could not reach an agreement in various economic domains of the household economy (e.g., buying or selling goods, child schooling), except with decisions about wage labor and the purchase of commercial alcoholic beverages.

Equality in the ownership of traditional wealth and stocks of domesticated animals, and a wide support of kin may explain female empowerment. A person's fallback position when cooperation fails is thought to play a major role in empowerment (Agarwal, 1997; Behrman and Rosenzweig, 2006; McElroy, 1990).

Our results have at least one policy implication. If other societies resemble the Tsimane' in resource pooling, sharing of preferences, and female empowerment, then targeting transfers to women might not affect investments in children. Gender targeting not only has equity implications but may also raise implementation costs or produce gender-based conflicts (Hidrobo and Fernald, 2012). The absence of large effects on child nutritional status raises the questions of whether larger transfers, more frequent transfers, or conditionality would be required to have measureable impact on child nutritional status. A systematic review comparing the effect of conditionality of income transfers on educational outcomes suggests that while conditional and unconditional cash transfers improved schooling outcomes, these improvements were always larger with conditionality (Baird et al., 2013).

The results shown also raise concerns about the potential limits of standard economic and modern human capital indicators to infer intra-household bargaining power and female empowerment. Researchers typically estimate the gap or ratio in earnings, asset wealth, or human capital between female and male household heads to make inferences about the degree of female empowerment (Gitter and Barham, 2008). If applied to the Tsimane', the approach would lead one to the conclusion that adult women lacked bargaining power compared with men. What we find, instead, is that female empowerment seems to reflect not only access to some material resources, but also harder-to-measure social norms.

5. Conclusion

To conclude, in this highly autarkic and relatively egalitarian society, large one-time gender-targeted unconditional income transfers produced no discernible impact on short-run nutritional status of children. The trial did not allow us to identify the mechanisms for the null finding, but ethnographic research and panel data suggest that specific social norms of the community, such as pooling of resources, shared preferences, and female empowerment might be plausible explanations. The null findings are in accord with the predictions of a unitary household model with common preferences and constraints (Behrman, 1997). More importantly, our results highlight the probable importance of culture in determining household decision-making and resource allocation, and raises questions about the belief that income in the hands of women benefits young children more than income in the hands of men.

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