Essays Investigating Gender and Development in Rural Ethiopia

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Abstract

Essays investigating Gender and Development in Rural Ethiopia

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Gender and development is a primary goal in international development policy, and the status of women and girls is so important to the development agenda that the United Nations explicitly stated gender equality as its third Millennium Development Goal (UNDP 2010). Despite its importance, assessing the advancement of women's status has been challenging due to the limited availability of valid and reliable indicators, as well as research establishing causal linkages between development projects and outcomes for women and girls. My research addresses each of these topics using a primary dataset from three villages in rural Ethiopia to advance the gender and development literature.

Dedication

To my family who have always supported and encouraged me in my adventures.

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Introduction

The primary goal of development is to sustainably increase population well-being. Within this broad agenda, the advancement of women and girls receives special attention due to historical inequities and empirical evidence showing that increasing well-being for both groups provides a powerful pathway to broader economic development (World Bank 2012). The status of women and girls is so important to the development agenda that the United Nations explicitly stated gender equality as its third Millennium Development Goal (UNDP 2010), while the World Bank (2012) declared it a core development objective. Despite its importance, assessing the advancement of women's status has been challenging due to the limited availability of valid and reliable indicators, as well as research establishing causal linkages between development projects and outcomes for women and girls. My research addresses each of these topics to advance the gender and development literature.

Many water infrastructure projects are justified in part on the belief that improved water access will lead to increased school attendance for girls through increased time savings. Most evidence offered by organizations has been anecdotal (e.g., Water Aid 2013), while formal research has been limited due to the use of cross-sectional data, the endogenous nature of water access,[1] and the use of a binary school enrollment indicator from household surveys. Not addressing these limitations is problematic, as unsubstantiated claims can lead to poor investments, policy failures, or even to the continuation of programs that have unintended negative impacts on women and girls. My first paper addresses this issue using panel data from a quasi-experimental study and a difference-in-difference estimator to determine the causal impact of water access on child school

[1] The causal pathway between water access and school attendance is hypothesized to not be through health benefits. The link between improved water access and health benefits is well established (e.g., Fewtrell et al. 2005; Clasen et al. 2007), but health impacts benefit children below school-age. Recent

attendance. The paper finds overall positive effects of water access on school attendance, but once disaggregated by gender the benefits of improved water access accrue largely to boys. School attendance increases for boys by 14 percent, while there is no significant effect for girls.

My second paper addresses the issue of multiple measures for women's autonomy in the gender and development literature. Previous research has largely relied on three approaches to operationalize women's autonomy: proxy variables, summative indices, and factor scores. These approaches differ in their assumptions and rigor, and no study has investigated their construct and criterion validity. This is a critical issue given the importance of monitoring and measuring impacts of development policies on women and girls. Using an invalid or weak proxy for women's autonomy can lead to biased estimates and incorrect interpretations of findings. Studies have used these three approaches due to limited data availability and the associated challenges of capturing women's autonomy (Malhotra et al. 2002; Samman and Santos 2009). Indeed, women's autonomy is often context-specific, occurring in different social structures, domains of activity, and levels of society (Malhotra and Mather 1997; Mason 2005; Narayan 2005; Samman and Santos 2009). Perhaps most challenging is that by definition women's autonomy is a latent, multidimensional concept (Malhotra et al. 2002). My paper uses a subset of Malhotra et al.'s (2002) classification for the dimensions of autonomy (*economic* and *socio-cultural*) to examine whether the three approaches to measuring autonomy are consistent with one another. I find that measures of less well-defined dimensions, such as *socio-cultural* dimensions, share little in common, while measures of the *economic* dimension are more similar. Like Vaz et al. (2013) and Kishor and Suaiya (2008), I find that common sources of autonomy such as work status and education are not associated with all dimensions or measures of autonomy (also sample size and study site may be confounding factors), and that correlates of

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work by Freeman et al. (2012) found that water, sanitation, and hygiene interventions had almost no effect on school attendance.

autonomy differ by the employed measure. This suggests that proxy variables and indirect measures of autonomy may not adequately capture their intended dimension, and greater care should be given when operationalizing autonomy.

My third paper investigates the correlates of spousal perceptions of the wife's decision-making power. Many surveys ask both the husband and the wife, separately, about the wife's decision-making power over herself and the household, but very few incorporate the husband's responses into analyses. This is especially problematic in patriarchal countries such as Ethiopia where men possess most of the power over individual and household decisions. Recent reports from Ethiopia provide corroborating evidence, finding that women have little or no decision-making power over contraceptive use, participation in social activities, and large household purchases (UNFPA 2008). This paper considers both spouses' responses together to create five spousal decision-making categories: *wife decides, joint, deferential, husband decides,* and *adversarial*. I then examine factors associated with these categories for the wife's decision-making power over her time socializing and in leisure and at the market. Finally, I investigate whether spousal perceptions are associated with the wife's actual behavior by looking at spousal perceptions and the wife's time spent in social and leisure activities and at the market. I find that dominant sources of bargaining power, such as the woman's work status and education, increase the probability of perceptions to favor the wife's decision-making power. At the same time, these factors may have a more limited impact than previously thought, as they tend to increase the probability for spouses to view decision-making as jointly determined rather than decisions being determined solely by the wife. In addition, wives in *adversarial* households (households where the husband claims control over the wife's time but the wife fully disagrees) spent up to 11 percent more time (1.7 hours) in social and leisure activities, and up to 6 percent less time (0.95 hours) at the market compared to other households. This suggests

that there is a relationship between spousal perceptions and the wife's actual behavior, and excluding the husband's responses ignores the varying spousal constraints wives face in patriarchal societies.

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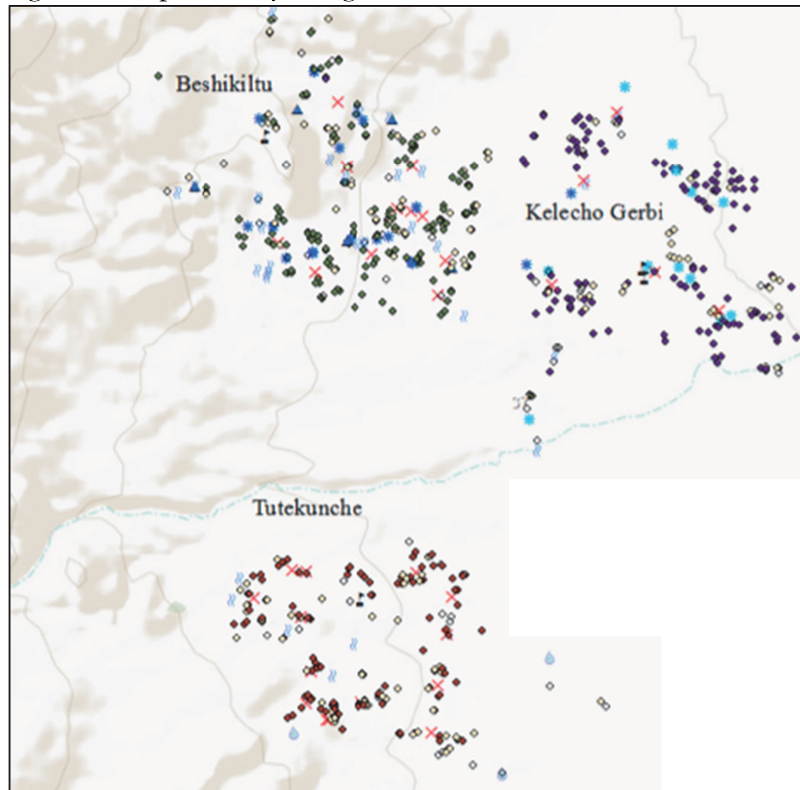
Data and study site

Data for all papers come from a larger study evaluating the social impacts of a rural water supply project being implemented jointly by two NGOs, Water Action (based in Ethiopia) and Water 1st International (based in the US). The study consists of three villages (Beshikiltu, Tutekunche, and Kelecho Gerbi) in the Oromia region of Ethiopia (Figure 1 below), and data were collected only during the rainy season. Villages are chosen for water projects somewhat at random, although project costs, proximity to paved roads, and prioritization by the district government may have influenced decisions. Data were collected during the summers of 2009, 2010, and 2011. Chapter 1 uses data from 2010 and 2011, and chapters 2 and 3 use data from 2011 because this year contains the full module of bargaining questions.

Figure 1: Map of study villages[a]



[a] Dark green points represent household sin Beshikiltu, purple points represent households in Kelecho Gerbi, and red points represent households in Tutekunche.

Each village is divided into community-identified housing clusters called subvillages. There are approximately 30 subvillages in each village. Thirty percent of households were randomly selected and interviewed from each subvillage. We chose this study design due to time and budget constraints and also to ensure that we would have sufficient geographic coverage for the entire village. The data are panel data, and 456 and 452 households were interviewed in 2010 and 2011, respectively. Furthermore, we interviewed households in project villages before and after implementation of the water system where appropriate. Beshikiltu had water systems in place during 2010 and 2011, while Tutekunche did not have a water system in all survey periods. Finally, Kelecho Gerbi did not have a water system in 2010, but it did in 2011. Villages are approximately 10 kilometers apart and surround a smaller town where market day is held. All villages are largely agrarian. The main crops in this area consist of teff, chickpeas, wheat, maize, and beans. There are distinct dry and rainy seasons. During the rainy season households are busy with farming activities, while the dry season is the harvest and also when school is in session.

Chapter 1 uses a subset of school-aged children that did not leave the household between 2010 and 2011, and did not graduate from school in 2011 (See Appendix A in Chapter 1 for details). There were 350 households that had school-aged children (77 percent), and of these 322 households (92 percent) met the criteria outlined above. Thus, there are 633 school-aged children in the analytic sample for chapter 1. Chapters 2 and 3 use data that includes households with a married household head, narrowing the sample to 343 out of 452 households (76 percent).

Does improved water access increase child schooling? A quasi-experimental approach from rural Ethiopia

Yuta J. Masuda and Joseph Cook

Abstract (word count: 100)

This paper estimates the causal impact of improved water access on schooling using primary individual-level panel data from rural Ethiopia. We find that there are overall positive effects of water access on school attendance, but once disaggregated by gender the benefits of improved water access accrue largely to boys, although robustness checks indicate some positive effects on school attendance for girls. We also find that improved water access may result in households reallocating water collection tasks from boys to girls. The potential extra burden of water collection does not appear to have a significant negative impact on girl's school attendance.

Introduction

In much of the developing world women and girls predominantly conduct the water collection work for the household, and children who work frequently and for long hours may have reduced opportunities to enroll in school or attend regularly (JMP 2012). Many water infrastructure projects are justified on the basis of reducing the burden of labor for women and girls and increasing opportunities for greater social and economic participation (Ilahi and Grimard 2000; King and Mason 2001; Blackden and Wodon 2006), yet there is surprisingly little careful empirical work examining the relationship between water access and education.

This relationship is a complex one. Parents and students face a decision about whether to enroll a child in school, as well as decisions about how much time children should spend attending school and studying. These decisions are influenced by a host of factors, including school fees, birth order, the parents' education levels, and others (Haile and Haile 2012). Bhatty et al. (1997) found that work in rural areas, which included water collection, may not require the entire day, and children were able to attend school while meeting work commitments. At the same time, the nature of those commitments may vary by gender. Rose and Al-Samarrai (2001) and Rose et al. (1997) suggested that water collection work is less compatible with schooling than activities usually conducted by boys such as cattle herding which often allows for substantial idle time. At the same time, they found that parents *perceived* chores done by girls to be more compatible with schooling despite contrary evidence.[2]

Cultural factors also play a role. In rural Ethiopia, Tietjen (1998) and Rose and Al-Samarrai (2001) found that parents perceived the returns to education for girls to be lower than boys because sons remain home when married while daughters leave the household upon marriage. Research by Chaudhury et al. (2006), Fafchamps et al. (2009), Weir (2010), Haile and Haile (2012), and

Quisumbing and Maluccio (2003) also suggest that there may be bias against investment in education for girls in rural Ethiopia. Even if attitudes toward education are positive, existing time and monetary constraints mean that parents are unable to send all their children to school, suggesting that tradeoffs must be made between children. Although numerous studies have suggested that girls are responsible for collecting water for the household and spend more time collecting water than boys (Nankhuni and Findeis 2004; Haile and Haile 2012; JMP 2012), culture factors may limit the benefits accrued to girls from improved water access. We concentrate on the potential increases in schooling as a result of freed time and not health because the literature has shown that health impacts from water infrastructure have a greater effect on infants rather than school-aged children. For example, Freeman et al. (2012) recently explored the association between water, sanitation, and hygiene on school absences, and they report almost no effects.

Lacking direct time use data, three studies have examined the relationship between schooling and distance to the nearest water source as a proxy for water collection time.[3] In Tanzania, Akabayashi and Pacharopoulos (1999) found that increased distance to the water source was associated with increased work hours for both boys and girls, and girls worked approximately 45 minutes more than boys. They found no association, however, on school enrollment or study hours. Cockburn and Dostie (2007) found that more proximate primary water sources were associated with lower demand for child labor for boys in rural Ethiopia, but not for girls. Also in Ethiopia, Haile and

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[2] For more on the gendered nature of work in rural Ethiopia see Camfield (2011).

[3] Our focus is predominantly rural. A number of studies have found that access to piped water in the home increases schooling outcomes (Psacharopoulos and Arriagada (1989) in Brazil, Guarcello and Lyon (2002) in Yemen, and Cigno and Rosati (2005) in El Salvador, Ghana, Guatemala, Morocco, and Yemen). Devoto et al. (2011), however, found children in households that connect to piped system in urban Morocco were no more likely to attend school. As they noted, however, children were not commonly involved in water collection in Morocco. Although unconnected urban households in many countries may also face water collection time burdens (often from queuing rather than walking), the problem looms larger for rural households where in-house piped connections are much less common (JMP 2012).

Haile (2012) found that girls in households farther from water sources were more likely to engage in domestic tasks and not attend school, while boys were more likely to attend school and not work.

Studies that observed time use directly show mixed results. In Kenya, Ndiritu and Nyangena (2011) found that children spending more than two hours collecting water or firewood were 21 percent less likely to be attending school. In Malawi, Nankhuni and Findeis (2004) examined both urban and rural areas and found that piped water access in the home significantly reduced children's time spent collecting water among rural households, and was also positively associated with child school enrollment. Koolwal and Van de Walle (2013) conducted a cross-country analysis measuring the effect of access to water on women's work, child school enrollment, and child health. They found a statistically significant and positive effect of water access on school enrollment in Yemen, Morocco, Nepal and Pakistan, but no effect in the four Sub-Saharan African countries studied. More recently, Nauges and Strand (2013) built a panel of GPS-identified communities and examined the effects of water access on girls' school attendance. They found that girls in male-headed households had lower school attendance, and estimated school attendance to increase by 2.4 percent if time spent collecting water were reduced by half. Meanwhile, they found similar results for boys' school attendance, although household size and other demographic characteristics affected boys' school attendance differently.

We contribute to this literature in two important ways. First, we use individual-level panel data from a three-year quasi-experimental study rather than relying on cross-sectional data. As a result, we are able to account for unobserved changes that may influence schooling outcomes in the village that received a water system. With the exception of Koolwal and Van de Walle (2013) and Nauges and Strand (2013), existing studies rely on a single cross-section of data, and only Nankhuni and Findeis (2004), Koolwal and Van de Walle (2013), and Nauges and Strand (2013) account for

the non-random and potentially endogenous nature of water access (for instance, more wealthy households are more likely to invest simultaneously in schooling and water access).

Second, we use a more robust schooling measure in the form of school attendance data gathered through random school attendance checks.[4] There is significant variation in how household surveys ask schooling questions, and this can lead to large differences in responses (Orazem and King 2007). The majority of studies use self-reported binary indicators from household surveys (usually school enrollment), while some studies use hours spent studying at home in the past week as an indicator of human capital. There are two primary concerns with relying on self-reported binary measure for school enrollment. First, household heads may feel pressured to report that their children are enrolled, especially in the many countries (including Ethiopia) where primary school education is compulsory. One would expect this measurement error to cause researchers to underestimate any treatment effects. Indeed, Baird and Özler (2012) recently found self-reported schooling data could result in underestimating schooling impacts. Second, a binary schooling indicator misses the importance of school attendance rates in children's educational attainment, and may also miss the effect of seasonal work patterns which are especially important in regions with rainy and dry seasons.

We find differential impacts of improved water access on schooling by gender: water access has a positive, statistically significant impact on school attendance for boys, while there are no negative impacts for girls. Robustness checks show some positive impacts of water access on school attendance for girls, although these findings are not consistent across models. In addition, our findings also suggest that households reallocate water collection tasks from boys to girls as a result

[4] See Orazem and King (2007) on the various schooling variables and their relative strengths and weaknesses.

of improved water access, which suggests households may be choosing to invest more in boys' education.

Research design and study site

We draw on two years of data from a larger quasi-experimental study evaluating the impacts of a rural water supply project that was implemented jointly by two NGOs, Water Action (based in Ethiopia) and Water 1st International (based in the U.S.). The project supplied a system of public taps to three villages (Bishikiltu, Tutekunche, and Kelecho Gerbi) in the Oromia region. The villages had previously relied on natural springs, rivers and creeks, and shallow hand-dug wells, especially during the rainy season. Some households also used treated water sources outside the village.

Because of the NGOs' funding constraints, one village per year received an improved system. Table 1 presents individual and household sample sizes, as well as the implementation schedule of the water systems. Bishikiltu was first to receive an improved system in May 2010 and received 12 water taps. Kelecho Gerbi's system was completed in May 2011 and received nine water taps. Tutekunche's system was completed after the study ended. Tutekunche thus serves as a control as it was untreated over the study timeline. Similarly, Bishikiltu was treated during the entire survey period and also serves as a control. Our analysis relies on changes in Kelecho Gerbi to identify effects.

Each village is divided into community-identified housing clusters we call subvillages. There are approximately 30 subvillages in each village. Household rosters were obtained from village elders and community leaders. Thirty percent of households were randomly selected and interviewed from each subvillage during July-August (the rainy season) of 2010 and 2011. The surveys collected information on basic demographics, farming, water collection, water use, and time use. The survey also asked about school enrollment for any children between the ages of 7 and 15, but we focus on

school attendance data collected through random school attendance checks (see Appendix B for analysis using school enrollment data). Surveys were developed in English, translated into the local dialect (afaan Oromo), tested, and then administrated by native speakers trained in survey enumeration.

The villages are similar in most, but not all, ways. They are ethnically and religiously homogenous: all households reported being Orthodox Christian and the majority of individuals spoke only afaan Oromo. They are all predominantly agrarian, relying on teff, wheat, barley, and sorghum for, on average, approximately 83 percent of annual household income. All three villages are approximately 4-5 kilometers from a central town where households go to market. The study villages are not close enough to benefit from the treated village's water system, and data on household water usage provide supporting evidence. The geography and size of the three villages are somewhat different. Kelecho Gerbi is the largest, and most households are situated in a plain where groundwater is more easily accessible, while some households in Bishikiltu and Tutekunche lie along a slope of a hill.

Surveys were fielded two months after project completion in both time periods, and it is possible that households in the treatment villages did not fully adjust their water collection patterns. A majority of households reported using water taps once water systems were installed. In 2010, 90 percent of households in Bishikiltu reported using the new system. In 2011, 97 percent and 85 percent of households in Bishikiltu and Kelecho Gerbi, respectively, reported using the new water system. We discovered during the 2011 round of data collection, however, that two of the water taps were not operational in Kelecho Gerbi. This may account for the lower reported rate of adoption in Kelecho Gerbi in 2011 relative to Bishikiltu in 2010. Follow up interviews with NGO staff indicate that these taps were operational by September 2011. Thus, the reported usage of new water taps by households in Kelecho Gerbi may be underestimated. School attendance data were collected seven

months after Bishikiltu's project completion and 11 months after Kelecho Gerbi's project completion, and as a result we believe lagged effects are less of a concern with the school attendance models.[5]

Schools

Children are expected to begin school at age 7, and primary education up to the 8th grade has been compulsory in Ethiopia since 1994. Government schools are prohibited from requiring student fees (Ethiopian Ministry of Education, 1999), and we did not observe any mention of school fees being paid in our three village schools.[6] Our data also suggest that children in our study did not attend other schools outside the study villages. Not all village schools, however, teach up to the same grade level. Schools in Bishikiltu and Tutekunche teach up to the 8th grade, while the Kelecho Gerbi school teaches only to the 6th grade. Children that reach the terminal grade there are expected to continue their education at neighboring schools.

Since the household surveys were fielded during the summer school holiday (early July through the end of September), we supplement the self-reported school enrollment data with random school attendance checks. Although school administrative attendance records were available in our villages, we chose not to use them for a number of reasons.[7] Four random school attendance

[5] Our main analysis uses school attendance data collected during the same time (January - June) in both time periods. If we use all post-treatment random school attendance data then data collection in the post-treatment period started four months after Kelecho Gerbi's project completion. Analyses were conducted using the full set of attendance checks, and the findings are the same (Table C1 in Appendix C).

[6] For more information on Ethiopia's educational policy see Rose and Al-Samarrai (2001) and Chaudhury et al. (2006).

[7] The first concern is that, because schooling is compulsory by law in Ethiopia and communities are extremely close-knit, teachers and principals have incentives to over-report school attendance. Second, records were, for the most part, difficult to decipher due in part to messy handwriting. Third, many study participants go by different names both within the household, within their respective household clusters (subvillages), and within the broader village. Thus, matching school-

checks were conducted during the pre-implementation period between January – June 2011. In the post-treatment period, eight random school attendance checks were conducted from September 2011 – June 2012. Random school attendance checks consisted of a field staff member visiting each village school on a randomly chosen day with a printed roster of each school-age child listed in our sampled households. The enumerator noted the child's attendance and current grade. For our analysis, we use only school attendance data collected during the same time (January – June) in both time periods. We do so because attendance rates vary considerably during the year (see Table 1), and are at times twice as high in some periods. In summary, our schooling measure is the average attendance rate (ranging from 0 to 100 percent) during four random school checks for pre- and post-treatment periods.

We limit our analytic sample in three ways (see Appendix A for more details). First, we include children up to the sixth grade in our sample so children of the same grade level are compared across all three villages. This results in excluding 43 children from Bishikiltu and Tutekunche. Second, because we lack post treatment data for the 72 children that left the household between pre- and post-treatment periods and pre-treatment data for the 63 children who joined the household between time periods, we exclude them. Third, we exclude 51 children who graduated during the study period. To ensure that students who were absent were graduates rather than truants, we triangulated the grade of the child based on data from the household survey and the grade the child was reported to be in during the pre- and post-treatment random checks. In addition, if a child was 15 years of age or older in Kelecho Gerbi, or 16 years of age or older in the other two villages, we assumed they graduated or dropped out of school.

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aged children in household surveys to school attendance rosters would have been extremely difficult or impossible. Freeman et al. (2012) also note reservations about using school attendance rosters, although they do not elaborate on what those reservations are.

The original study consisted of a panel of 452 randomly selected households. Of these, 350 households had school-aged children. Limiting our analysis based on the criteria outlined above, the final sample consists of 318 households, or 590 school-aged children across three villages.

Empirical strategy

We estimate a difference-in-difference (DD) model to take advantage of the quasi-experimental design and to account for unobserved village level changes that may have influenced school attendance.[8] Our untreated group is children in households in the village that received a water system after the study was completed (Tutekunche). By accounting for unobservable characteristics that may be correlated with water access and schooling, the DD estimator presents the difference between pre- and post-water system within-subject differences of the treatment and control group (Wooldridge 2010). In addition, because the DD estimator compares rates of schooling outcomes within the treatment group pre- and post-water system implementation, it controls for any endogeneity associated with being in the treatment group and the schooling outcomes. The key assumption is that secular time trends are the same for the treatment and control groups pre-implementation (the "parallel trend" assumption). If the time trend in the absence of water implementation is not the same in the treated villages our estimate of the treatment effect will be biased. Unfortunately we do not have data on schooling trends in the villages prior to 2010. We include Bishikiltu (the village treated in both time periods) to attempt to separately identify the effects of the time trends. Households in Tutekunche and Bishikiltu are controls for households in Kelecho Gerbi, and the change in outcomes for Tutekunche and Bishikiltu give the time trend.

[8] First-difference models were also estimated, but we find no impact of improved water access on schooling outcomes. This may be because the first-difference model is a "within" estimator and does not account for unobserved village level changes that may have influenced schooling outcomes.

Table 1: Water project timeline and individual and household sample size[a,b,c]

	July - August 2010	January - June 2011	July-August 2011	September 2011-February 2012	April - June 2012
Season	Rainy	Dry	Rainy	Dry	Dry
Data collected	*Household survey*	*School checks*	*Household survey*	*School checks*	*School checks*
Bishikiltu	176 children 92 households	28% attending	176 children 92 households	39% attending	26% attending
Tutekunche	181 children 95 households	60% attending	181 children 95 households	61% attending	50% attending
Kelecho Gerbi	233 children 131 households	36% attending	233 children 131 households	37% attending	31% attending
n by treatment group					
Control	414 children 226 households		181 children 95 households		
Treatment	176 children 92 households		409 children 223 households		
Total n					
	590 children 318 households		590 children 318 households		

[a] Gray cells denote villages with water systems at the time of data collection.
[b] "Children" here is defined as children in school through the end of sixth grade. Because children often do not complete grades and may
repeat them, the age children in school ranges from 6-16 for all villages.
[c] The rainy season in Oromia is from June-September, while the dry season is from October-May.

The DD regression equation for school attendance (y_{ijt}) can be written as:

$$y_{ijt} = \beta_0 + Post_t\beta_1 + treatment_{jt}\beta_2 + treatment_{jt}{}^{*}Post_t\beta_3 + \boldsymbol{X_{ijt}\beta_4} + \boldsymbol{Z_{ijt}\beta_5} + \boldsymbol{V_j}\beta_6 + \varepsilon_{ijt} \quad (1)$$

where *i* indexes the school-aged child, *j* indexes her village, and *t* indexes the year. $\mathrm{Post_t}$ is a dummy variable for observations post-water infrastructure implementation, and $treatment_{jt}$ is a dummy for being in the treatment village. $\boldsymbol{X_{ijt}}$ is a vector of child-level controls such as age and sex; $\boldsymbol{Z_{ijt}}$ is a vector of household-level controls such as household size; and $\boldsymbol{V_j}$ are village fixed effects that control for differences in villages that are common across years.

Possible factors that might influence demand or supply of water would most likely be uniform across villages due to their proximity. For instance, variation in rainfall, climate, crop yields, and the political climate would have a similar effects on all households because they are all part of a larger community surrounding the same central town. If the parallel trend assumption holds and the implementation of water systems is uncorrelated with other contemporaneous events in the study villages related to school attendance, the coefficient estimate for β_3 can be interpreted as the causal impact of the water project on schooling. Interviews in the field staff confirm there were no other NGO or government programs that occurred contemporaneously with improved water systems that could have influenced household time allocation or child schooling. Strict exogeneity of the treatment indicator is violated if the assignment of treatment is dependent on past school attendance, but we have no evidence to believe that school attendance data influenced the NGO's decision about the order in which village water projects were built. Following Bertrand et al. (2004), standard errors are clustered at the village-level because variation is at the village-level by design, the

dependent variable is often serially correlated, and conventional standard errors often understate the standard deviation of the estimators.[9]

In addition to schooling attendance, we examine whether improved water access had any impact on whether a school-aged child was a dry season water collector using a DD model. The dependent variable in this model is a dichotomous measure for whether the child was a dry season water collection and comes from the household survey. The data on dry season water collectors was collected in the rainy season. Although it is possible respondents reported dry season water collectors from previous dry season, we assume respondents reported household members who they thought would be a water collector in the upcoming dry season. We estimate this model to investigate whether impacts of water access on schooling also impact allocation of water collection duties within the household. The equation is similar to model 1. For the DD models on changes in water collection tasks, we use all covariates in the school attendance model.

Separate models are examined for boys and girls, as well as a pooled model that controls for gender with a dummy variable. At the individual level, we also include variables for age and age-squared. At the household level, the literature suggests that household income, the highest grade attained by the household head, and a female household head all influence schooling and child labor outcomes (Akabayashi and Pacharopoulos 1999; Cockburn and Dostie 2007; Ndiritu and Nyangena 2011). We include household age and sex composition and the number of donkeys owned by the household to control for substitute labor available in the household, though household age and sex composition may also influence schooling decisions through other channels, so our a priori expectation of the sign is indeterminate (Akabayashi and Pacharopoulos 1999; Cockburn and Dostie 2007; Nankhuni and Findeis 2004; Haile and Haile 2012).

[9] Models were also estimated using a wild bootstrap-t method to estimated clustered standard errors (Cameron et al. 2008) and findings are the same.

We also control for whether households used a treated water source outside the village.[10] It is important to note that some households had private wells, and we account for this by including a dummy variable for households with private wells. Although the wells are very close to the house, they are also typically shallow, hand-dug wells with no protection from contaminated surface water flowing into them. When an improved water tap is introduced nearby, households face a clear tradeoff between the convenience of continuing to get water from their well versus the higher quality of the new source that is farther away. As a result, the effect of providing a new source on attendance is ambiguous and depends on whether the household decides to switch to the new source. As is clear from Table 2, this issue is important mostly in Kelecho Gerbi, where 50 percent of households had a private well in the pre-treatment period, compared to 2 percent and 1 percent in the other two villages. In the post-treatment period, 59 percent of households in Kelecho Gerbi had private wells, and 76 percent of these households reported collecting water from the new water system. We also run robustness checks by estimating models excluding households that had private wells and those that used paid sources outside the village.

Results

Descriptive statistics

Figure 1 presents plots schooling attendance rates by sex and village for the pre- and post-treatment period. Looking at school attendance for all children, school attendance in Bishikiltu increased while Tutekunche and Kelecho Gerbi saw overall declines in attendance. Tutekunche's decline was steeper at 5 percent compared to 2 percent for Kelecho Gerbi. For boys, Bishikiltu saw

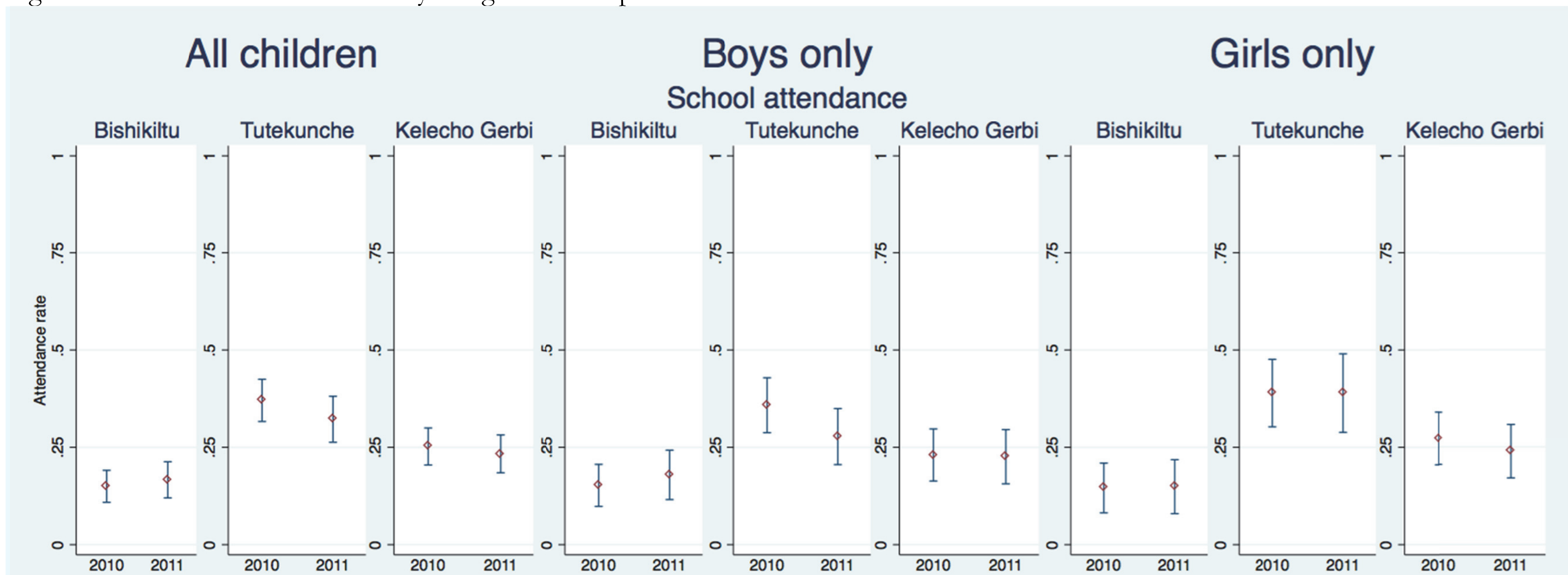
[10] Treated water sources in neighboring towns or villages all required a nominal fee for use. These water sources, however, are further away than the improved water sources built in treatment villages, and the data indicate households in Kelecho Gerbi stopped using these sources once they received a new water system: the percentage using them fell from 47 percent to 6 percent from 2010 to 2011.

the largest increase at 3 percent, while Tutekunche saw a large decrease (8 percent) and Kelecho Gerbi remained relatively unchanged. Finally, school attendance for girls remained the same for Bishikiltu and Tutekunche, but decreased by 3 percent in Kelecho Gerbi. There are no differences in school attendance by sex within a village in any given year, suggesting that any differential impacts by sex is not a result of girls catching up to boys, or boys catching to girls.

Many of the individual and household characteristics are similar (Table 2). There are no statistically significant differences in the proportion of children who are dry season water collectors at baseline. Kelecho Gerbi has a higher percentage of school-aged girls than Tutekunche but not Bishikiltu. Tutekunche had a higher percentage of children attending school at baseline. Note, however, that the particular values of schooling are not of concern since DD estimates test for significance while controlling for secular trends and differences at baseline.

A large proportion of households in Kelecho Gerbi reported using an improved source outside of the village at baseline, although the proportion of households that continue to use improved sources outside the village falls dramatically to 6 percent once water systems were installed. There are no statistically significant differences in household income across all villages. Although not shown, approximately the same proportion of households in each village reported some type of nonfarm income, and approximately a third of the households in each village reported no nonfarm income at all. The majority of nonfarm income came from selling local alcohol or working as a daily laborer, and was, on average, 12 percent of overall household income across all three villages. Income from farming is largely the same across villages.

Figure 1: School attendance means by village and time period[a]



[a] 95% confidence intervals shown.

Tutekunche had significantly more donkeys at baseline than Bishikiltu or Kelecho Gerbi. Household age and sex composition was largely similar with the exception of Tutekunche having more under school-aged females. Further, there are no differences in the highest level of education attained by the household head and the proportion of households with a female head of household.

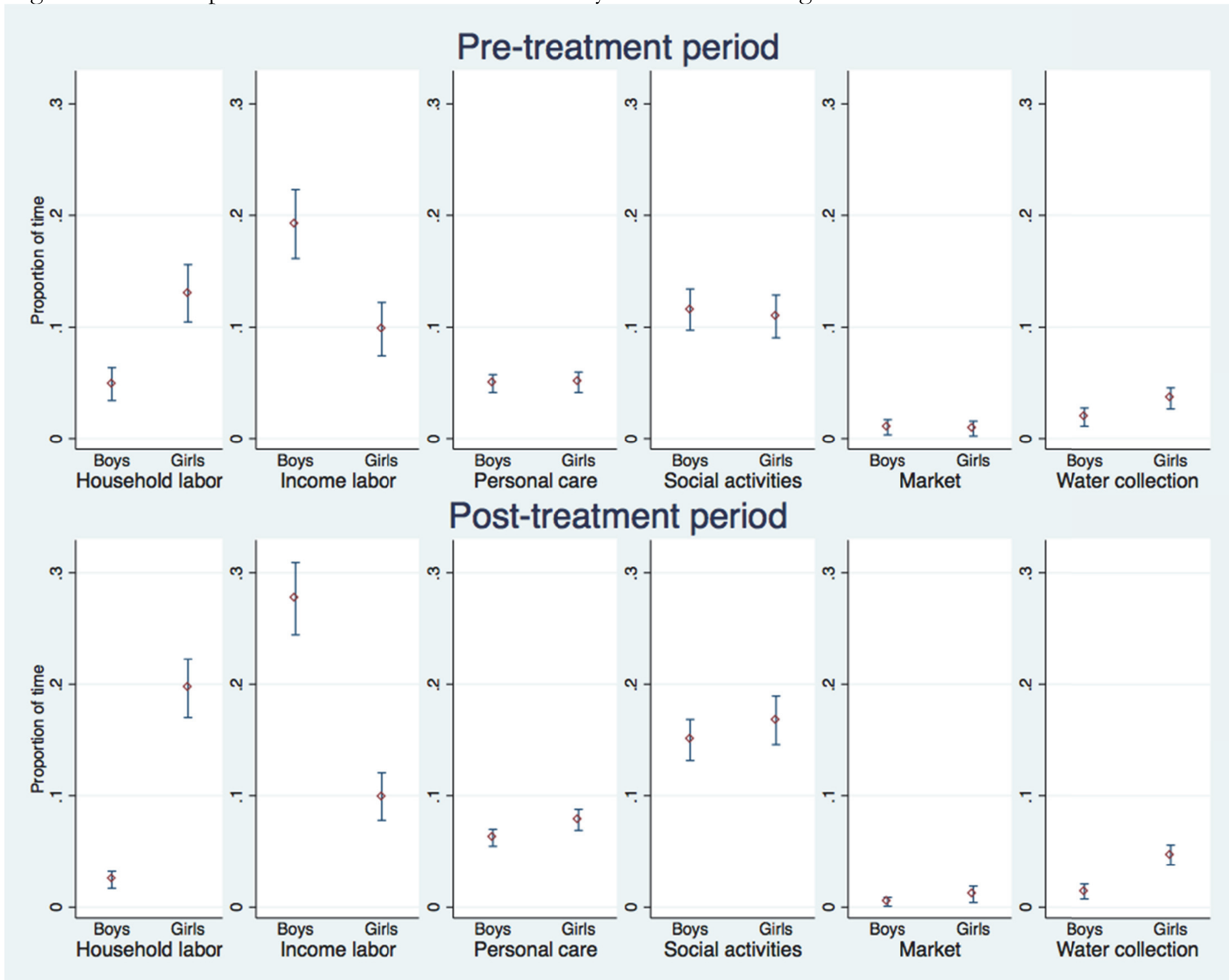
We briefly discuss time use data for children in our sample using Masuda et al.'s (2012) time use classification, as they can be useful for illustrating everyday life for boys and girls in the study villages (Figures 2). Data are available for children over 10 years of age only during the rainy season when school is not in session, so data are missing a dominant activity (schooling) and are not fully representative of their time use during the dry season. Girls spend significantly more time than boys in household labor (time preparing food, collecting firewood, and doing other household chores) and collecting water in both time periods. Meanwhile, boys spend significantly more time than girls on income labor (time spent farming, caring for animals, and in other work). There are no significant differences between boys and girls in their time allocated to personal care, social activities, or going to the market. Girls divide their time amongst a broader range of activities, while boys spend a large portion of their time in income labor (27 percent). Notably, girls spend more than twice the amount of time on water collection than boys in both time periods. Much like the broader literature on household labor in Sub-Saharan Africa, the data show that there are clear divisions of labor by sex and that girls spend significantly more time collecting water than boys.

Table 2: Baseline summary statistics for select variables

	Bishikiltu		Tutekunche		Kelecho Gerbi	
School-aged child characteristics	Mean	SD	Mean	SD	Mean	SD
School attendance (%)	15	(28)	37	(37)	25	(37)
Dry season water collector (%)	25	(0.44)	19	(0.39)	24	(43)
Age	9.8	(2.6)	9.2	(2.4)	9.3	(2.4)
Female (%)	42	(50)	40	(49)	52	(50)
Household characteristics						
Household owns private well (%)	2.0	(15)	2.0	(13)	53	(50)
Household income[a]	3,375	(3,859)	3,368	(3,554)	4,030	(4,764)
Uses improved but not new source[b] (%)	0.0	(0.0)	4.0	(0.21)	48	(50)
Number of donkeys	1.1	(1.1)	1.5	(1.0)	1.0	(1.2)
Highest grade attained by household head	2.4	(3.3)	2.5	(3.5)	2.0	(2.8)
Head of household is female (%)	10	(30)	16	(37)	16	(37)
Number of under school-aged males	0.49	(0.67)	0.49	(0.63)	0.51	(0.80)
Number of under school-aged females	0.52	(0.67)	0.66	(0.73)	0.52	(0.63)
Number of school-aged males	1.0	(0.92)	1.1	(0.98)	0.80	(0.89)
Number of school-aged females	0.82	(0.84)	0.84	(0.89)	0.96	(0.88)
Number of adult males	1.4	(1.1)	1.5	(1.0)	1.5	(0.95)
Number of adult females	1.5	(0.67)	1.4	(0.66)	1.4	(0.75)
n (school-aged children)	176		181		233	
n (households)	92		95		131	

[a] Figures are reported in Ethiopian Birr, and 1 U.S. dollar was approximately 17 Ethiopian Birr in July 2011.
[b] Improved sources refer to treated water sources available to households in neighboring towns or villages.

Figure 2: Pre- and post-treatment time use allocation by sex for children ages 10 and older[a,b]



[a] Masuda et al.'s (2012) time use classifications are presented.
[b] 95% confidence intervals shown.

Table 3: Difference-in-difference estimates for school attendance[a,b,c]

	All children			**Boys only**			**Girls only**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treat	-0.04***	-0.05***	-0.01	-0.03***	-0.04***	0.01	-0.04***	-0.05***	-0.02
	(0.000)	(0.002)	(0.026)	(0.000)	(0.003)	(0.022)	(0.000)	(0.003)	(0.025)
Post	-0.05***	-0.10**	-0.12***	-0.08***	-0.13**	-0.15***	-0.00	-0.05**	-0.07**
	(0.000)	(0.015)	(0.004)	(0.000)	(0.020)	(0.004)	(0.000)	(0.011)	(0.009)
Treat*Post	0.07***	0.08***	0.10***	0.11***	0.12***	0.14***	0.00***	0.01**	0.03
	(0.000)	(0.002)	(0.008)	(0.000)	(0.004)	(0.001)	(0.000)	(0.002)	(0.018)
Individual covariates		YES	YES		YES	YES		YES	YES
Household covariates			YES			YES			YES
R^2	0.04	0.13	0.19	0.04	0.11	0.21	0.06	0.16	0.20
Adjusted R^2	0.04	0.13	0.18	0.03	0.10	0.18	0.05	0.15	0.17
BIC	903.28	802.78	717.82	471.01	433.11	357.37	425.70	376.88	354.65
n	1,180	1,180	1,180	646	646	646	534	534	534

[a] Standard errors in parentheses

[b] All models estimated with village fixed effects and clustered robust standard errors.

[c] Estimated individual- and household-level coefficients are presented in Table D1 in Appendix D.

*** p<0.01, ** p<0.05, * p<0.10

DD main results for schooling attendance: All children[11]

Columns 1-3 in Table 3 present the DD estimates for the effect of improved water access on school attendance (Table D1 in Appendix D presents individual- and household-level coefficient estimates). First, there is an overall positive treatment effect (Treat*Post) in school attendance. The effect remains statistically significant as individual- and household-level covariates are added. Improved water access increases school attendance by 7 and 8 percent for the base model (column 1) and the model including individual-level controls (column 2), respectively. Once household-level controls are included (column 3) the effect is larger at 10 percent.

DD main results for schooling attendance: Separate analysis by sex

Columns 4-6 and 7-9 in Table 3 presents the DD estimates for boys and girls, respectively (Table D1 in Appendix D presents individual- and household-level coefficient estimates). In the model with individual- and household-level covariates, school attendance (Panel A Table 3) increases by 14 percent and is statistically significant for boys (Table 3 column 6), while school attendance increases by 3 percent for girls but is not statistically significant (Table 3 column 9).

[11] Models using birth order were also estimated, and results are largely the same (Table C2 in Appendix C). We do so because the literature suggests birth order has an impact on child labor and schooling (Ejrnæs and Pörtner 2004; Emerson and Souza 2008).

Table 4: Difference-in-difference estimates for school-aged dry season water collectors[a,b]

	All children	Boys only	Girls only
Panel A: School-aged children			
	(1)	(2)	(3)
Treat	-0.06**	-0.01	-0.14**
	(0.007)	(0.019)	(0.027)
Post	-0.01	-0.01	-0.01
	(0.005)	(0.017)	(0.004)
Treat*Post	0.00	-0.05**	0.09**
	(0.001)	(0.008)	(0.010)
R^2	0.26	0.13	0.31
Adjusted R^2	0.25	0.10	0.29
BIC	1025.75	386.54	557.46
n	1,180	646	534
Panel B: Adults	**All adults**	**Men only**	**Women only**
Treat	0.04*	0.03*	0.03
	(0.011)	(0.008)	(0.027)
Post	-0.04**	0.01	-0.08**
	(0.004)	(0.004)	(0.009)
Treat*Post	-0.01	-0.01***	-0.01
	(0.006)	(0.001)	(0.013)
R^2	0.40	0.07	0.23
Adjusted R^2	0.39	0.05	0.21
BIC	1426.86	233.30	935.99
n	1,610	780	830

[a] Standard errors in parentheses
[b] All models estimated with individual- and household-level covariates, village fixed effects and clustered robust standard errors. Coefficients are presented in Table D2-D3 in Appendix D.
*** p<0.01, ** p<0.05, * p<0.10

DD main results for dry season water collection

The results so far suggest that boys benefit more than girls from improved water access. One possible explanation is that boys are "catching up" to girls for school attendance. Figure 1 and t-tests comparing within village sex differences by year suggest that this is not the case. Indeed, there are no within village differences in school attendance by sex in both years, indicating that the parallel assumption holds for both sexes and boys are not "catching up" to girls. As an alternative

explanation, we explore the possibility that households may be reallocating household water collection duties in response to improved water access.

Households may choose to allocate water collection duties in two ways: 1) they may spread water collection duties across multiple household members, or 2) they may have fewer household members make multiple trips. In the first case, it is possible that household members who were not water collectors now also collect water because the source is closer and the burden of water collection is minimal and now a trivial task. Given that water collection is seen as a predominantly female activity, we would expect water collection responsibilities to concentrate among women and girls. In our study, this would mean that girls concentrating on tasks other than water collection at baseline are now responsible for those same tasks *and* water collection with the advent of a closer water source. If this were to occur with no negative impact on school attendance, the assumption is that the burden to the water collector is less or the same as it was when the water source was further away.

In the second case, households may shift water collection tasks away from some household members (namely men or boys) if a closer water source allows for households to assign water collection duties to fewer people and collect the same or more amount of water with no additional burden. This may occur if households reallocating water collection tasks away from, for example, boys to girls, wanted household members to further specialise in other activities. This would be in line with research suggesting that there may be bias against investment in education for girls in rural Ethiopia (Chaudhury et al. 2006; Fafchamp et al. 2009; Weir 2010; Haile and Haile 2012; Quisumbing and Maluccio 2003), as well as research suggesting that closer proximity to a water source reduced labor demand for boys but had no effect for girls (Cockburn and Dostie 2007). A key consideration is whether water collection is now a trivial task that adds no extra burden. If so, households may choose to concentrate water collection tasks among women and girls, while boys

that were water collectors may now specialise in other tasks such as schooling, animal husbandry, or other male-oriented tasks.

To examine this we run a DD model (Table 4 Panel A) to estimate the impact of water access on dry season water collector for school-aged children and adults (Table D2 in Appendix D presents individual- and household-level coefficient estimates. In addition, Figure D1 plots the percentage of children that are dry season water collectors with 95 percent confidence intervals). The results suggest that households reallocate water collection tasks from boys to girls as a result of improved water access (Table 4 Panel A). When examining all children, the number of dry season water collectors is unchanged. Looking at boys and girls separately, however, there is a 5 percent decrease for boys while there is a 9 percent increase for girls. All estimates are statistically significant (Table D3 in Appendix D presents the same analysis conducted with rainy season data and there is no change in rainy season water collectors).

It is possible that other household members, namely adults, took on water collection duties in addition to school-aged girls. While there are no changes for adult women being a dry season water collector, there is a small but statistically significant 1 percent decrease for men who are dry season water collectors (Table 4 Panel B. Table D4 in Appendix D present individual- and household-level coefficient estimates). These estimates indicate that only school-aged girls took on additional dry season water collection duties, while only school-aged boys and adult men experienced a decline in dry season water collection duties. Unfortunately, we do not have data on the amount of water collected during the dry season, so we are unable to determine whether the change in the number of dry season water collectors has any association with changes in the household demand for water.[12]

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[12] We also explore the effect of improved water access on time allocation to water collection activities during the rainy season (Table E1 in Appendix E). Time use data are only available for the

Taken together, our results suggest that villages that received improved water access saw the number of school-aged dry season water collectors decrease for boys and adult men but increase for girls. At the same time, this resulted in an increase in school attendance for boys and no statistically significant impact for girls. Although girls took on more of the household's water collection duties, water collection duties appear to be of low enough intensity that it did not have a negative effect on school attendance. These results also suggest that parents are choosing to invest more in the boys' education by reallocating water collection tasks as the water source gets closer. The findings are consistent with existing research on parental preferences to invest in boys' education, as well as with parental perceptions that chores done by girls are relatively light work and do not disrupt schooling.

Robustness checks

We conduct two sets of robustness checks to address potential concerns with our study: one for the main analysis and one for the schooling variable. First, there may be concerns because many households in Kelecho Gerbi had private wells and used an improved water source outside the village at baseline. We conduct robustness checks by investigating two subsets of the sample to address these concerns. The first subset excludes households that used an improved water source outside the village. The second subset excludes households that used an improved water source and a private well. In addition, we conduct robustness checks for the schooling attendance variable. Because of the potentially high number of zeros in school attendance data, we dichotomise school attendance so it is equal to 1 if school attendance was more than 25 percent.

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rainy season for children ages 10 and older, and do not reflect time allocation of younger children, as well as how time is allocated during the dry season when school is in session. We find that the proportion of time spent collecting water increases by 1 percent for all children, and increases by 3 percent for girls. Boys saw a negligibly small statistically significant decrease in time spent collecting water.

For the first robustness checks (Table 5), the findings remain the same for analyses using both subsets of households. The impact of water infrastructure on school attendance (Table 5 first row) for all children and boys remains statistically significant. For all children, the effect size remains the same at 10 percent, while the effect size is larger for boys at 16 percent. Improved water access now has a statistically significant 3 percent increase for girls' school attendance is now, although when excluding households that use improved water sources and private wells there is no statistically significant effect. For robustness checks examining dry season water collectors (Table 5 second row), the findings also remain the same, but the magnitude of the effect increases for all children (2 percent) and decreases for boys (-2 percent) and girls (6 and 8 percent).

Finally, robustness checks for the dichotomized schooling shows that findings remain largely the same for school attendance, although the magnitude of effects is higher (Table 6 first row). A notable exception is that there is a 7 percent increase in school attendance for girls for the dichotomised schooling variable, indicating that girls that were going to school less than 25 percent of the time are more likely to attend school.

Table 5: Treatment*Post coefficients for robustness checks for difference-in-difference estimates for main analysis[a,b]

	All children		**Boys only**		**Girls only**	
Outcome	(1)	(2)	(3)	(4)	(5)	(6)
School attendance	0.10***	0.10***	0.16***	0.16***	0.03*	0.02
	(0.005)	(0.005)	(0.006)	(0.008)	(0.008)	(0.009)
Dry season water collector	0.02**	0.02**	-0.02***	-0.02**	0.06**	0.08**
	(0.003)	(0.004)	(0.001)	(0.004)	(0.008)	(0.013)
No improved source	YES	YES	YES	YES	YES	YES
No private well		YES		YES		YES
n	862	654	490	382	372	272

[a] Standard errors in parentheses
[b] All models estimated with individual- and household-level covariates, village fixed effects, and clustered robust standard errors. Coefficients are presented in Table D5-D6 in Appendix D.
*** p<0.01, ** p<0.05, * p<0.10

Table 6: Treatment*Post coefficients for robustness checks for schooling outcomes[a,b,c]

Outcome	All children (1)	Boys only (2)	Girls only (3)
Dichotomised school attendance (>0.25)	0.11** (0.013)	0.15*** (0.007)	0.07* (0.022)
n	1,180	646	534

[a] Standard errors in parentheses
[b] The dichotomised school attendance measure is equal to 1 if school attendance during the rainy season was greater than 0.25.
[c] All models estimated with individual- and household-level covariates, village fixed effects, and clustered robust standard errors. Coefficients are presented in Table D9 in Appendix D.
*** p<0.01, ** p<0.05, * p<0.10

Conclusion and policy implications

Our study combines primary panel data from a quasi-experimental study with high-quality school attendance data to examine the impact of water infrastructure. Our findings show that water infrastructure at our study sites increase schooling mainly for boys. Girls appear to benefit from improved water access in models using a dichotomized school attendance measure and a restrictive subset of households, although even with these estimates we still find that boys benefit more than girls.

The study also had access to self-reported school enrollment data from household surveys, and we present detailed analysis in Appendix B but briefly discuss findings here. The school enrollment variable was collected during the rainy season after the school year had ended, and we assume parents of children who had graduated or dropped out at the end of the previous school year would have responded that their child was not currently enrolled in school. The findings using school enrollment are largely the same for the main analysis. For robustness checks, however, we find mixed results. Models analyzing the subset of households that do not use a private source, an improved source outside the village, or both show a significant and positive increase only for girls' school enrollment. Meanwhile, for the model using the 'corrected' school enrollment indicator (one that assigns children as being enrolled in school if they were present at school but not reportedly

enrolled in school), we find that boys benefit more than girls as a result of improved water access. If one believes that random school attendance checks are a more accurate measure of schooling, however, improved water access appears to benefit boys more than girls.

Although these findings are not encouraging to those in the water sector, they may not be surprising. Households are complex social structures, and the gendered nature of work in rural areas may interact with parents' gender biases in complicated ways. Recall also that Cockburn and Dostie (2007) reported that closer proximity to a water source reduced labor demand for boys but had no effect for girls, and that girls are more likely than boys to be engaged in both school and work (Nankhuni and Findeis 2004; Haile and Haile 2012). These differences need not be based in parents' gender biases: Nankhuni and Findeis (2004) suggest parents do not discriminate schooling on sex, but that girls are simply more likely to be given resource-collection work.

Although we feel our research design and data represent an improvement over existing studies, our results should also be interpreted cautiously, especially in extrapolating beyond our study region in rural Oromia, Ethiopia. Our findings differ in methodology and context from other studies looking at water access and schooling in Africa, and we outline five possible reasons for these differences. First, the urban and rural context of the study may matter. The demand for household labor for girls living in urban areas may be significantly different and possibly smaller compared to girls living in rural areas. The nature of household chores will differ greatly, although household members in urban areas may still spend significant amounts of time queuing at public water points. Second, variation in findings across countries may and perhaps should be expected. Although not directly related to schooling, Kevane and Wydick (2001) found that social norms significantly explain differences in time allocation between two ethnic groups in Burkina Faso. Ethiopia is an extremely diverse country with over 80 ethnic groups (Ethiopian Central Statistical Agency, 2007). The ethnic group in our study, the Oromos, is the largest ethnic group in the country and makes up

more than a third of the population in Ethiopia. Research has suggested that cultural and social norms play a large role in dictating the intrahousehold allocation of time and resources (Kevane and Wydick 2001), and the expected payoff for investment in boys and girls' education may differ as a result. Third, physical geography and the scope of implemented water system may matter. If villages are in located in areas where the water source was extremely remote, then the baseline time burden of water collection may be extremely large. In addition, a number of studies have demonstrated that piped connections in the home, which reduce water collection burden to zero, improve school enrollment for both boys and girls (Psacharopoulos and Arriagada 1989; Guarcello and Lyon 2002; Nankhuni and Findeis 2004). Consequently, this may make a significant difference in the effects of improved water access, and households may reallocate time and task differently. Finally, as our and other research suggests (Orazem and King, 2007; Baird and Özler 2012), differences in how school attendance is measured may also have an effect on findings. If the many children who were reportedly enrolled in school but were never present during school attendance checks are an indication of reliability, then more weight should be given to estimates using school attendance data.

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Appendix A: Sample attrition and selection process

Table A1 below presents the number of children and households dropped from the sample due to attrition and sample selection. We have panel data on 756 school-aged children in 350 households. We exclude children who left the household or graduated between 2010 and 2011, and also limit the sample to grade 6 in Tutekunche and Bishikiltu to match Kelecho Gerbi. Seventy-eight school-aged children (or 16 households) are dropped for leaving the household between 2010 and 2011. Forty-three percent were female. Fifty-one children (or 12 households) are dropped because they graduated between 2010 and 2011. Forty-seven percent of graduates were female. Forty-three children are dropped for being in grades 7 and 8, and 15 and 28 percent were from Bishikiltu and Tutekunche, respectively. In total, we drop approximately 22 percent of the sample across all villages, and the proportion of children who graduated or left the household is roughly the same across villages. School-aged children leave the household for a variety of reasons (see Table A2). The most common reason school-aged children reportedly left the household was to be sent to a relative or friend's home for reasons other than work or marriage. This presumably means that they were sent as caretakers. Finally, in addition to children that were dropped for leaving the household or graduating from school, we also excluded 63 school-aged children that joined the household in 2011 because we did not have 2010 data for these children.

Table A1: Sample attrition and selection by village

	Individual				**Household**			
	Bishikiltu	Tutekunche	Kelecho Gerbi	Total	Bishikiltu	Tutekunche	Kelecho Gerbi	Total
Full sample	680	668	890	2,238	142	131	179	452
Sub-sample of school-aged children	232	244	280	756	103	105	142	350
Number of school-aged children who left household	29	21	22	72	6	3	7	16
Number of school-aged children who graduated	12	14	25	51	3	5	4	12
Dropped for being over grade 6	15	28	-	43	2	2	-	4
Total dropped	56	63	47	166	9	8	11	28
Percent lost to attrition or selection	24	25	17	22	8.7	7.6	7.7	8.0
Final sample	191	209	233	590	92	95	131	318

Table A2: Distribution of responses for why a school-aged child left the household

	Bishikiltu	Tutekunche	Kelecho Gerbi	Total	Percent of total
Other (reason unclear)	3	0	0	3	4.2
To be with parents	8	4	3	15	21
To be near school or get a better education outside village	1	0	1	2	2.8
Parents were too sick or unable to care for him/her	0	0	1	1	1.4
Sent to relatives or friends for other reason	9	8	13	30	42
To live with spouse/marriage	1	0	0	1	1.4
Returned home	0	1	0	1	1.4
To look for work	1	2	1	4	5.6
To take up a job	0	1	0	1	1.4
Work contract ended	1	1	3	5	6.9
To run a farm or enterprise	4	3	0	7	9.7
Migrated, intentions unknown	0	1	0	1	1.4
Death	1	0	0	1	1.4
Total	29	21	22	72	100

Appendix B: Difference-in-difference analysis using school enrollment data

This appendix estimates the impact of water access on school enrollment. School enrollment data come from the household survey (see Table 1 for timeline), and the survey question asked, "Are they [the child in question] currently enrolled in school?" We asked this question in July after the school year had ended. Therefore, parents of children who had graduated or dropped out at the end of the previous school year would have responded that their child was not currently enrolled in school. Note that because two of the water taps were not operational in Kelecho Gerbi during the 2011 round of data collection, reported of new water taps by households in Kelecho Gerbi may be underestimated. This may be somewhat of a concern since households may have not fully adapted to improved water access when reporting school enrollment status.

School enrollment data often conflict with school attendance data, which may highlight the measurement error associated with self-reported measures (Baird and Özler 2012). For instance, we found 106 children who were reported as enrolled but were not present during any of the 12 checks, while also finding 47 children in school during at least one random school attendance check although their parents did not report them as being enrolled.

Figure B1 plots school enrollment by sex and village for the pre- and post-treatment period. School enrollment presents a contrasting view of changes in children's schooling (see comparison to Figure 1 in main text). All villages see increases in school enrollment when examining all children, and this increase is statistically significant for Kelecho Gerbi (15 percent). When disaggregating by sex, however, we see that the change in school enrollment is statistically significant only for girls. Boys and girls in Bishikiltu and Tutekrunche experienced no significant changes in pre- and post-treatment school enrollment, although trends are generally positive.

Table B1 presents DD estimates for the model estimating the effect of improved water access on self-reported school enrollment. The effect in the base model (column 1) and model with

individual covariates shows school enrollment increases by 1 and 4 percent, respectively. Once the full model is estimated (column 3), the school enrollment increases by 5 percent and is statistically significant.

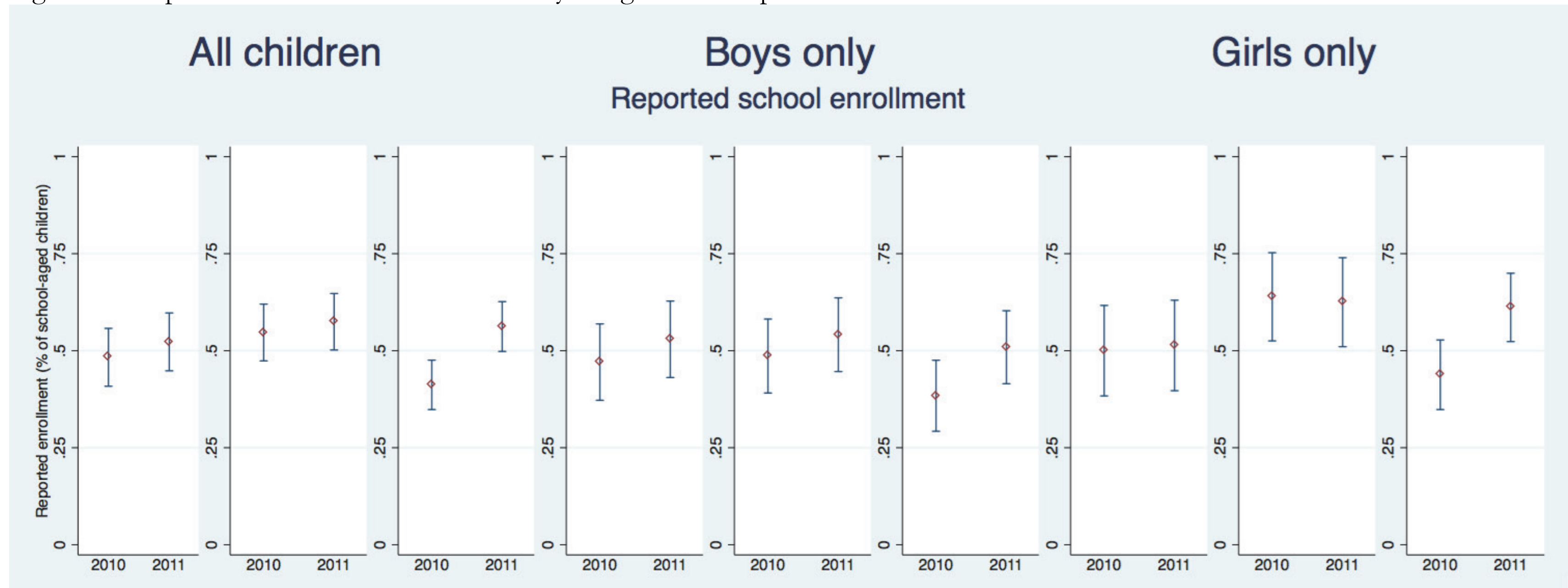
When estimating DD models for boys and girls separately, we find positive and significant effects for both sexes across all model specifications (Table B1 Columns 4-9). For boys, school enrollment increases in the base model and the model with individual-level covariates, and in the full model school enrollment increases by 6 percent and is statistically significant (Table 3 column 6). The effect of improved water access remains statistically significant for girls as individual- and household-level covariates are added, and school enrollment significantly increases by 4 percent in the final model (Table 3 column 9). Even with school enrollment measures, boys experience greater benefits to schooling than girls (6 percent vs. 4 percent).

Much like in the main analysis of the paper, we conduct robustness checks for the main analysis and the school enrollment variable. We analyze subsamples excluding households that did not use an improved source outside the village, and for households that had private wells and used an improved source outside the village. In addition, we examine an alternative measure of school enrollment because we found some children attended school even though they were reportedly not enrolled in school. This alternative measure of school enrollment is equal to 1 if children were either reportedly enrolled in school, or if they were present but not reportedly enrolled in school.

School enrollment increases significantly by 2 percent for all children and is statistically significant at $p<0.10$ for the most restrictive subset (Table B2 column 2). We no longer see significant impacts for boys, while school enrollment increases 4 percent for girls and is statistically significant for the most restrictive subset. Finally, the impact of improved water access is significant and positive for all models using the alternative measure of school enrollment (Table B3). The alternative measure for school enrollment increase by 12 percent for all children, and 19 percent and

2 percent for boys and girls, respectively. The sensitivity of findings to the school enrollment indicator suggests that, much like Orazem and King (2007) find, there can be significant variation in response patterns based on how the schooling variable is asked or gathered. The findings largely remain the same, however, with the main empirical analysis and alternative school enrollment measure suggesting that, although there are no negative impacts on schooling, boys appear to benefit more then girls from improved water access.

Figure B1: Reported school enrollment means by village and time period



[a] 95% confidence intervals shown.

Table B1: Difference-in-difference estimates for school enrollment[a,b]

	All children			Boys only			Girls only		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treat	0.11***	0.09***	0.09***	0.07***	0.04***	0.06*	0.16***	0.13***	0.11***
	(0.000)	(0.002)	(0.008)	(0.000)	(0.003)	(0.017)	(0.000)	(0.001)	(0.002)
Post	0.03***	-0.09**	-0.10***	0.06***	-0.06**	-0.08***	-0.01***	-0.13***	-0.12***
	(0.000)	(0.010)	(0.007)	(0.000)	(0.014)	(0.007)	(0.000)	(0.006)	(0.007)
Treat*Post	0.01***	0.04***	0.05**	0.00***	0.04**	0.06*	0.03***	0.05***	0.04***
	(0.000)	(0.003)	(0.008)	(0.000)	(0.004)	(0.017)	(0.000)	(0.001)	(0.001)
Individual covariates		YES	YES		YES	YES		YES	YES
Household covariates			YES			YES			YES
R^2	0.01	0.30	0.31	0.01	0.24	0.28	0.02	0.36	0.38
Adjusted R^2	0.01	0.29	0.30	0.00	0.23	0.26	0.02	0.35	0.35
BIC	1695.73	1312.01	1285.05	930.07	771.46	735.01	756.84	542.41	531.41
n	1,180	1,180	1,180	646	646	646	534	534	534

[a] Standard errors in parentheses

[b] All models estimated with village fixed effects and clustered robust standard errors.

*** p<0.01, ** p<0.05, * p<0.10

Table B2: Treatment*Post coefficients for robustness checks for difference-in-difference estimates for main analysis[a,b]

	All children		Boys only		Girls only	
Outcome	(1)	(2)	(3)	(4)	(5)	(6)
School enrollment	0.03**	0.02*	0.02	-0.00	0.05***	0.04**
	(0.008)	(0.007)	(0.010)	(0.008)	(0.004)	(0.005)
No improved source	YES	YES	YES	YES	YES	YES
No private well		YES		YES		YES
n	862	654	490	382	372	272

[a] Standard errors in parentheses

[b] All models estimated with individual- and household-level covariates, village fixed effects, and clustered robust standard errors.

*** p<0.01, ** p<0.05, * p<0.10

Table B3: Treat*Post coefficients for robustness checks for schooling outcomes[a,b,c]

Outcome	All children (1)	Boys only (2)	Girls only (3)
Alternative indicator of school enrollment	0.12*** (0.002)	0.19*** (0.012)	0.02** (0.003)
n	1,180	646	534

[a] Standard errors in parentheses

[b] The alternative school enrollment indicator equals 1 if a child was reportedly enrolled in school, or if the child was reportedly not enrolled but present during any of the rainy season school attendance checks.

[c] All models estimated with individual- and household-level covariates, village fixed effects, and clustered robust standard errors.

*** $p<0.01$, ** $p<0.05$, * $p<0.10$

Appendix C: Difference-in-difference estimates for alternative model specifications

Tables C1-C2 present alternative specifications for the main DD models examining schooling outcomes. Table C1 presents results for models using the full set of school attendance data. Here, the post-treatment school attendance data is the average of 8 random school attendance checks and occurred from September 2011 to June 2012. Results are consistent with those in the main paper. We find that when examining all children there is a 10 percent increase in school attendance due to improved water access. When disaggregating by sex, we find that boys are the main beneficiaries with a 14 percent increase in school attendance, while there are no significant effects for girls.

Table C2 presents estimates DD models using birth order and age. Ejrnæs and Pörtner (2004) and Emerson and Souza (2008) suggest that birth order impacts child labor and schooling. Estimates and statistical significance of improved water access on school attendance and enrollment are largely similar. For school attendance, there is a 10 percent increase for all children, while schooling increases by 14 percent for boys. There is no statistically significant impact on school attendance for girls. Results for school enrollment remain the same with birth order included as covariates, with significant increases in school enrollment for the regressions examining children and girls only.

Table C1: Difference-in-difference estimates for models using school attendance data from all periods[a]

	All children			Boys only			Girls only		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treat	-0.08***	-0.09***	-0.05	-0.07***	-0.08***	-0.03	-0.09***	-0.10***	-0.08*
	(0.000)	(0.002)	(0.032)	(0.000)	(0.003)	(0.032)	(0.000)	(0.002)	(0.026)
Post	-0.01***	-0.06**	-0.08***	-0.04***	-0.09**	-0.11***	0.03***	-0.02	-0.03*
	(0.000)	(0.014)	(0.006)	(0.000)	(0.020)	(0.002)	(0.000)	(0.009)	(0.009)
Treat*Post	0.07***	0.08***	0.10***	0.10***	0.11***	0.14***	0.03***	0.03***	0.05
	(0.000)	(0.002)	(0.009)	(0.000)	(0.004)	(0.005)	(0.000)	(0.002)	(0.018)
Individual covariates		YES	YES		YES	YES		YES	YES
Household covariates			YES			YES			YES
R^2	0.05	0.15	0.21	0.04	0.12	0.23	0.06	0.18	0.22
Adjusted R^2	0.04	0.14	0.20	0.03	0.11	0.21	0.05	0.17	0.19
BIC	792.08	672.88	581.41	417.01	371.59	286.95	368.77	308.05	283.70
n	1,180	1,180	1,180	646	646	646	534	534	534

[a] All models estimated with village fixed effects. Clustered robust standard errors are in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table C2: Difference-in-difference estimates for models using birth order[a]

	All children			**Boys only**			**Girls only**		
Panel A: School attendance									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treat	-0.04***	-0.05***	-0.01	-0.03***	-0.04***	0.01	-0.04***	-0.04***	-0.02
	(0.000)	(0.001)	(0.026)	(0.000)	(0.002)	(0.023)	(0.000)	(0.002)	(0.023)
Post	-0.05***	-0.10**	-0.12***	-0.08***	-0.13**	-0.15***	-0.00	-0.05**	-0.07**
	(0.000)	(0.014)	(0.005)	(0.000)	(0.019)	(0.003)	(0.000)	(0.011)	(0.011)
Treat*Post	0.07***	0.08***	0.10**	0.11***	0.12***	0.14***	0.00***	0.01**	0.04
	(0.000)	(0.002)	(0.010)	(0.000)	(0.003)	(0.003)	(0.000)	(0.002)	(0.022)
Individual covariates		YES	YES		YES	YES		YES	YES
Household covariates			YES			YES			YES
R^2	0.04	0.13	0.19	0.04	0.12	0.21	0.06	0.16	0.20
Adjusted R^2	0.04	0.12	0.18	0.03	0.10	0.18	0.05	0.14	0.16
BIC	903.28	798.83	715.03	471.01	426.55	353.70	425.70	375.79	352.17

Table C2 (Continued)

Panel B: School enrollment

	All children			**Boys only**			**Girls only**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treat	0.11***	0.08***	0.09***	0.07***	0.04**	0.06*	0.16***	0.13***	0.11***
	(0.000)	(0.004)	(0.009)	(0.000)	(0.006)	(0.019)	(0.000)	(0.003)	(0.001)
Post	0.03***	-0.09**	-0.10***	0.06***	-0.06*	-0.08**	-0.01***	-0.13***	-0.12***
	(0.000)	(0.009)	(0.007)	(0.000)	(0.015)	(0.008)	(0.000)	(0.006)	(0.008)
Treat*Post	0.01***	0.04***	0.05**	0.00***	0.04**	0.05	0.03***	0.05***	0.04***
	(0.000)	(0.003)	(0.009)	(0.000)	(0.007)	(0.019)	(0.000)	(0.001)	(0.001)
Individual covariates		YES	YES		YES	YES		YES	YES
Household covariates			YES			YES			YES
R^2	0.01	0.30	0.32	0.01	0.26	0.29	0.02	0.37	0.38
Adjusted R^2	0.01	0.30	0.30	0.00	0.24	0.26	0.02	0.35	0.35
BIC	1695.73	1298.55	1276.05	930.07	757.52	726.90	756.84	536.74	528.54
n	1,180	1,180	1,180	646	646	646	534	534	534

[a] All models estimated with village fixed effects. Clustered robust standard errors are in parentheses.

*** $p<0.01$, ** $p<0.05$, * $p<0.10$

Appendix D: Individual- and household-level coefficient estimates for difference-in-difference models for school attendance, number of household dry season water collector, individual dry season water collector, and robustness checks

Table D1: Estimated coefficients for individual- and household-level covariates school attendance model

	All children		Boys only		Girls only	
	(2)	(3)	(5)	(6)	(8)	(9)
Age	0.24**	0.23*	0.22	0.21*	0.26**	0.24**
	(0.053)	(0.059)	(0.076)	(0.068)	(0.060)	(0.054)
Age-squared	-0.01**	-0.01*	-0.01*	-0.01*	-0.01*	-0.01**
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)
Female	0.02	0.03	-	-	-	-
	(0.014)	(0.023)	-	-	-	-
Household owns private well	-	0.07	-	0.07		0.07
	-	(0.051)	-	(0.049)		(0.062)
Number of donkeys	-	0.04**	-	0.04*		0.02**
	-	(0.008)	-	(0.011)		(0.004)
Log household income	-	-0.00	-	-0.00		-0.00
	-	(0.003)	-	(0.002)		(0.006)
Uses improved but not new source	-	0.11	-	0.14*		0.08
	-	(0.046)	-	(0.034)		(0.057)
Highest grade attained by household head	-	0.01	-	0.02*		0.01
	-	(0.008)	-	(0.005)		(0.014)
Household head is female	-	-0.07	-	-0.05		-0.10
	-	(0.062)	-	(0.073)		(0.038)
Number of under school-aged males		0.01		0.00		0.02
		(0.035)		(0.054)		(0.015)
Number of under school-aged females		-0.02		-0.01		-0.04
		(0.032)		(0.035)		(0.037)
Number of school-aged males		-0.00		0.00		-0.00
		(0.009)		(0.018)		(0.023)
Number of school-aged females		0.02*		0.03		0.00
		(0.005)		(0.010)		(0.012)
Number of adult males		-0.00		-0.01		0.01
		(0.026)		(0.021)		(0.033)
Number of adult females		-0.02		-0.03		-0.01
		(0.017)		(0.013)		(0.022)
Tutekunche dummy	0.20***	0.22**	0.20***	0.22**	0.19***	0.24**
	(0.005)	(0.032)	(0.012)	(0.024)	(0.005)	(0.041)

Table D1 (Continued)

Kelecho Gerbi dummy	0.07***	0.03	0.05***	0.02	0.09***	0.05*
	(0.003)	(0.014)	(0.005)	(0.020)	(0.004)	(0.016)
Constant	-1.15*	-1.19	-1.03	-1.11	-1.25*	-1.24*
	(0.317)	(0.416)	(0.436)	(0.473)	(0.322)	(0.340)
n	1,180	1,180	646	646	534	534

*** $p<0.01$, ** $p<0.05$, * $p<0.10$

Table D2: Estimated coefficients for school-aged children individual dry season water collector

	All children (1)	**Boys only** (2)	**Girls only** (3)
Age	0.10	0.03	0.20**
	(0.042)	(0.066)	(0.031)
Age-squared	-0.00	0.00	-0.01*
	(0.002)	(0.003)	(0.001)
Female	0.22**	-	-
	(0.051)	-	-
Household owns private well	0.05*	0.02	0.08*
	(0.013)	(0.056)	(0.024)
Number of donkeys	0.01	0.02	-0.00
	(0.009)	(0.015)	(0.016)
Log household income	-0.00	-0.00	-0.00
	(0.003)	(0.002)	(0.005)
Uses improved but not new source	-0.03*	0.03	-0.09
	(0.010)	(0.048)	(0.055)
Highest grade attained by household head	0.00	0.00	-0.00
	(0.008)	(0.004)	(0.017)
Household head is female	0.04	0.09	-0.01
	(0.042)	(0.040)	(0.020)
Number of under school-aged males	-0.00	-0.01	0.01
	(0.020)	(0.015)	(0.027)
Number of under school-aged females	0.05**	0.05**	0.04
	(0.011)	(0.008)	(0.025)
Number of school-aged males	0.02	0.02	0.01
	(0.023)	(0.014)	(0.048)
Number of school-aged females	-0.01	0.01	-0.01
	(0.017)	(0.018)	(0.014)
Number of adult males	-0.02	-0.00	-0.03
	(0.018)	(0.019)	(0.029)
Number of adult females	-0.06**	-0.04	-0.08
	(0.013)	(0.015)	(0.054)
Tutekunche dummy	-0.09**	-0.04	-0.19**
	(0.010)	(0.023)	(0.039)
Kelecho Gerbi dummy	-0.07	0.00	-0.18***
	(0.025)	(0.037)	(0.006)
Constant	-0.55	-0.19	-0.77**
	(0.231)	(0.354)	(0.145)
n	1,180	646	534

*** p<0.01, ** p<0.05, * p<0.10

Table D3: Difference-in-difference estimates for changes in water collectors for the rainy season[a,b]

	All children	**Boys only**	**Girls only**
	(1)	(2)	(3)
Treat	-0.06**	-0.01	-0.14**
	(0.011)	(0.030)	(0.015)
Post	0.04**	0.03	0.08**
	(0.006)	(0.013)	(0.008)
Treat*Post	-0.00	-0.01	0.02
	(0.003)	(0.008)	(0.009)
R^2	0.29	0.09	0.34
Adjusted R^2	0.27	0.06	0.31
BIC	966.04	301.63	546.10
n	1,180	646	534

[a] Standard errors in parentheses

[b] All models estimated with individual- and household-level covariates, village fixed effects, and clustered robust standard errors

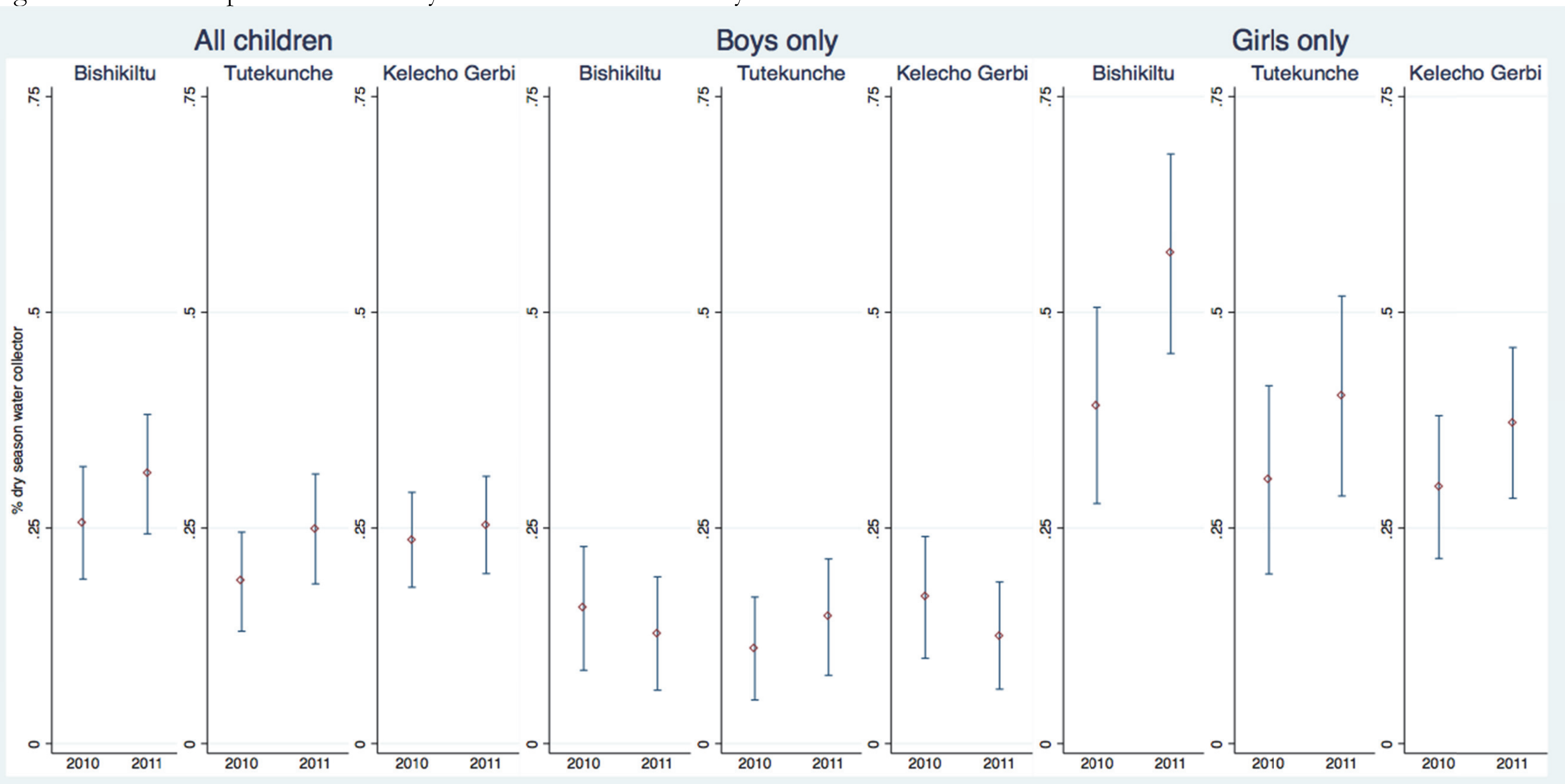
*** p<0.01, ** p<0.05, * p<0.10

Table D4: Estimated coefficients for adult individual dry season water collector model

	All adults (1)	**Men only** (2)	**Women only** (3)
Age	-0.00	-0.00	0.01
	(0.004)	(0.003)	(0.006)
Age-squared	-0.00	-0.00	-0.00*
	(0.000)	(0.000)	(0.000)
Female	0.55***	-	-
	(0.046)	-	-
Household owns private well	0.04	-0.02	0.09
	(0.040)	(0.024)	(0.062)
Number of donkeys	-0.00	0.00	-0.00
	(0.011)	(0.003)	(0.022)
Log household income	0.00	0.00	0.00
	(0.002)	(0.002)	(0.003)
Uses improved but not new source	0.05	0.00	0.08
	(0.027)	(0.014)	(0.065)
Highest grade attained by household head	-0.01	-0.00	-0.01
	(0.003)	(0.002)	(0.005)
Household head is female	-0.06**	0.14**	-0.13*
	(0.009)	(0.021)	(0.038)
Number of under school-aged males	0.02*	-0.00	0.04
	(0.006)	(0.028)	(0.017)
Number of under school-aged females	0.02	0.00	0.02
	(0.010)	(0.007)	(0.022)
Number of school-aged males	-0.03*	-0.01	-0.06***
	(0.009)	(0.013)	(0.005)
Number of school-aged females	-0.05**	-0.04	-0.08**
	(0.006)	(0.014)	(0.012)
Number of adult males	-0.01	0.03**	-0.06**
	(0.004)	(0.006)	(0.013)
Number of adult females	-0.09***	-0.04**	-0.13**
	(0.007)	(0.007)	(0.016)
Tutekunche dummy	-0.07**	0.02	-0.14**
	(0.009)	(0.013)	(0.032)
Kelecho Gerbi dummy	-0.08**	0.01	-0.15**
	(0.013)	(0.013)	(0.024)
Constant	0.50**	0.17**	1.12**
	(0.093)	(0.023)	(0.136)
n	1,610	780	830

*** p<0.01, ** p<0.05, * p<0.10

Figure D1: Pre- and post-treatment dry season water collectors by sex[a]



[a] 95% confidence intervals shown.

Table D5: Estimated coefficients for individual- and household-level covariates for school attendance robustness check regressions

	All children		Boys only		Girls only	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat	-0.04**	-0.07***	-0.03	-0.04**	-0.04***	-0.11**
	(0.007)	(0.005)	(0.009)	(0.009)	(0.003)	(0.018)
Post	-0.13***	-0.12***	-0.17***	-0.17***	-0.07***	-0.05*
	(0.008)	(0.006)	(0.009)	(0.008)	(0.001)	(0.014)
Age	0.23*	0.25*	0.24**	0.26**	0.24*	0.23
	(0.063)	(0.065)	(0.051)	(0.034)	(0.067)	(0.097)
Age-squared	-0.01*	-0.01*	-0.01**	-0.01**	-0.01*	-0.01
	(0.003)	(0.003)	(0.002)	(0.001)	(0.003)	(0.004)
Female	0.03	0.03	-	-	-	-
	(0.021)	(0.039)	-	-	-	-
Household owns private well	0.10*	-	0.09**	-	0.11	-
	(0.031)	-	(0.014)	-	(0.062)	-
Number of donkeys	0.04***	0.02	0.05**	0.03	0.02*	-0.01
	(0.003)	(0.018)	(0.007)	(0.021)	(0.007)	(0.021)
Log household income	0.00	0.00	-0.00	-0.00	0.00	0.00
	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)
Highest grade attained by household head	0.01	0.00	0.02	0.01	0.01	-0.00
	(0.011)	(0.009)	(0.007)	(0.007)	(0.020)	(0.018)
Household head is female	-0.04	-0.03	-0.05	-0.03	-0.05*	-0.06
	(0.033)	(0.054)	(0.060)	(0.090)	(0.012)	(0.029)
Number of under school-aged males	-0.02	-0.00	-0.03	-0.00	-0.00	0.00
	(0.046)	(0.052)	(0.068)	(0.088)	(0.025)	(0.019)
Number of under school-aged females	-0.02	0.00	-0.01	0.02	-0.02	-0.00
	(0.039)	(0.030)	(0.047)	(0.039)	(0.032)	(0.010)
Number of school-aged males	-0.02	-0.01	-0.02	0.00	-0.03	-0.02
	(0.025)	(0.037)	(0.032)	(0.022)	(0.035)	(0.049)
Number of school-aged females	0.01	0.02	0.01	0.02***	0.01	0.02
	(0.014)	(0.012)	(0.006)	(0.002)	(0.021)	(0.014)
Number of adult males	0.02	0.02	-0.00	-0.00	0.04	0.04
	(0.025)	(0.026)	(0.021)	(0.023)	(0.037)	(0.039)
Number of adult females	0.01	0.01	-0.02*	-0.00	0.04	0.03
	(0.004)	(0.011)	(0.005)	(0.013)	(0.023)	(0.019)
Tutekunche dummy	0.21***	0.18***	0.22***	0.20**	0.21***	0.16**
	(0.011)	(0.006)	(0.020)	(0.021)	(0.005)	(0.028)
Kelecho Gerbi dummy	-0.07**	-0.09**	-0.06**	-0.07**	-0.07*	-0.12**
	(0.010)	(0.011)	(0.009)	(0.009)	(0.019)	(0.015)

Table D5 (Continued)

Constant	-1.21*	-1.29	-1.17*	-1.36**	-1.32*	-1.15
	(0.415)	(0.445)	(0.389)	(0.296)	(0.380)	(0.552)
Without paid source	YES	YES	YES	YES	YES	YES
Without private well		YES		YES		YES
R^2	0.23	0.26	0.23	0.26	0.27	0.30
Adjusted R^2	0.22	0.24	0.20	0.22	0.23	0.26
BIC	370.42	234.30	172.90	118.79	186.97	106.97
n	862	654	490	382	372	272

*** p<0.01, ** p<0.05, * p<0.10

Table D6: Estimated coefficients for individual- and household-level covariates for dry season water collector robustness check regressions

	All children		Boys only		Girls only	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat	-0.11***	0.07***	-0.04**	0.21***	-0.21***	-0.13***
	(0.005)	(0.004)	(0.004)	(0.013)	(0.016)	(0.010)
Post	-0.03**	-0.05***	-0.05***	-0.07**	0.01	-0.01
	(0.005)	(0.001)	(0.004)	(0.010)	(0.018)	(0.023)
Age	0.15**	0.16**	0.07	0.11*	0.25**	0.22***
	(0.020)	(0.030)	(0.024)	(0.034)	(0.027)	(0.014)
Age-squared	-0.00*	-0.00	-0.00	-0.00	-0.01*	-0.01**
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Female	0.24*	0.23	-	-	-	-
	(0.058)	(0.081)	-	-	-	-
Household owns private well	0.04	-	0.01	-	0.08	
	(0.036)	-	(0.077)	-	(0.030)	
Number of donkeys	-0.00	0.01	0.01	0.01	-0.02	-0.01
	(0.020)	(0.011)	(0.027)	(0.020)	(0.026)	(0.032)
Log household income	-0.00	-0.00	-0.00	-0.00	-0.00	0.00
	(0.003)	(0.001)	(0.002)	(0.001)	(0.006)	(0.004)
Highest grade attained by household head	0.00	-0.00	0.00	-0.00	-0.00	-0.00
	(0.008)	(0.011)	(0.005)	(0.001)	(0.018)	(0.031)
Household head is female	0.05	0.06	0.07	0.09	-0.01	-0.04
	(0.083)	(0.062)	(0.062)	(0.063)	(0.076)	(0.078)
Number of under school-aged males	-0.01	-0.02	-0.02	-0.03	0.00	-0.01
	(0.017)	(0.011)	(0.016)	(0.020)	(0.035)	(0.043)
Number of under school-aged females	0.05**	0.05*	0.04*	0.04	0.05	0.05
	(0.012)	(0.016)	(0.013)	(0.017)	(0.020)	(0.034)
Number of school-aged males	0.01	0.02	0.01	0.04**	-0.01	-0.03
	(0.024)	(0.027)	(0.013)	(0.009)	(0.060)	(0.074)
Number of school-aged females	-0.02	-0.02	-0.00	-0.01	-0.02	-0.01
	(0.022)	(0.024)	(0.016)	(0.017)	(0.025)	(0.031)
Number of adult males	-0.00	-0.01	0.01	-0.00	-0.02	-0.03
	(0.016)	(0.029)	(0.010)	(0.007)	(0.040)	(0.053)
Number of adult females	-0.06	-0.05	-0.05**	-0.05*	-0.06	-0.04
	(0.024)	(0.025)	(0.011)	(0.013)	(0.089)	(0.102)
Tutekunche dummy	-0.13**	0.05**	-0.04**	0.21***	-0.28**	-0.19**
	(0.014)	(0.009)	(0.006)	(0.007)	(0.032)	(0.033)
Kelecho Gerbi dummy	-0.10	0.01	0.00	0.19***	-0.24**	-0.24**
	(0.040)	(0.011)	(0.047)	(0.006)	(0.045)	(0.038)

Table D6 (Continued)

Constant	-0.70**	-0.96**	-0.34	-0.79**	-0.92**	-0.87***
	(0.101)	(0.125)	(0.117)	(0.098)	(0.137)	(0.054)
Without paid source	YES	YES	YES	YES	YES	YES
Without private well		YES		YES		YES
R^2	0.28	0.28	0.14	0.17	0.32	0.33
Adjusted R^2	0.27	0.26	0.10	0.13	0.29	0.29
BIC	744.62	553.81	296.62	219.40	394.41	284.04
n	862	654	490	382	372	272

*** p<0.01, ** p<0.05, * p<0.10

Table D7: Estimated coefficients for individual- and household-level covariates for dichotomised school attendance robustness check regressions

	All children (1)	**Boys only** (2)	**Girls only** (3)
Treat	0.02	0.05	-0.00
	(0.045)	(0.039)	(0.049)
Post	-0.19***	-0.22***	-0.16**
	(0.015)	(0.011)	(0.019)
Age	0.33*	0.34*	0.31*
	(0.089)	(0.098)	(0.080)
Age-squared	-0.01*	-0.01*	-0.01*
	(0.004)	(0.004)	(0.004)
Female	0.03	-	-
	(0.025)	-	-
Household owns private well	0.05	0.04	0.08
	(0.041)	(0.054)	(0.038)
Number of donkeys	0.05*	0.06	0.04*
	(0.017)	(0.022)	(0.011)
Log household income	-0.00	-0.00	-0.00
	(0.004)	(0.003)	(0.008)
Highest grade attained by household head	0.12	0.14	0.11
	(0.085)	(0.074)	(0.099)
Household head is female	0.02	0.02*	0.00
	(0.010)	(0.007)	(0.019)
Number of under school-aged males	-0.10	-0.11	-0.10
	(0.093)	(0.120)	(0.070)
Number of under school-aged females	-0.00	-0.03	0.04*
	(0.040)	(0.070)	(0.013)
Number of school-aged males	-0.02	-0.01	-0.02
	(0.043)	(0.048)	(0.042)
Number of school-aged females	-0.01	0.00	-0.02
	(0.012)	(0.016)	(0.025)
Number of adult males	0.02**	0.03	0.01
	(0.003)	(0.011)	(0.014)
Number of adult females	-0.00	-0.01	0.01
	(0.030)	(0.033)	(0.031)
Tutekunche dummy	-0.03	-0.04	-0.01
	(0.021)	(0.014)	(0.029)
Kelecho Gerbi dummy	0.35**	0.35**	0.36**
	(0.055)	(0.044)	(0.077)

Table D7 (Continued)

Constant	0.04*	0.05	0.04
	(0.011)	(0.019)	(0.018)
R^2	0.19	0.21	0.18
Adjusted R^2	0.17	0.18	0.15
BIC	1407.23	754.21	651.46
n	1,180	646	534

*** p<0.01, ** p<0.05, * p<0.10

Appendix E: Difference-in-Difference estimates for time use data for children ages 10 and older

Table E1: Difference-in-difference estimates for the proportion of time spent water collection for school-aged children 10 and older [a,b]

	All children	Boys only	Girls only
Treat	-0.02**	-0.00**	-0.04*
	(0.004)	(0.001)	(0.011)
Post	0.00	-0.00*	0.00
	(0.002)	(0.000)	(0.002)
Treat*Post	0.01**	-0.00*	0.03***
	(0.001)	(0.001)	(0.003)
R^2	0.16	0.07	0.21
Adjusted R^2	0.13	0.01	0.15
BIC	-1855.07	-1028.40	-848.35
n	572	307	265

[a] Standard errors in parentheses

[b] All models estimated with individual- and household-level covariates, village fixed effects, and clustered robust standard errors

*** p<0.01, ** p<0.05, * p<0.10

Comparing three measures of women's autonomy in rural Ethiopia

Yuta J. Masuda

Abstract (word count: 170)

Women's autonomy is a multidimensional, context-specific, and latent concept. As a result it is challenging to operationalize. Proxy variables, summative indices, and factor scores are the three dominant (or major) approaches, and there has been limited discussion on their construct and criterion validity. In other words, are different measures of the same dimension of autonomy comparable, and do they correlate with autonomous behavior? This study compares the three dominant measures of autonomy using two dimensions of autonomy from Malhotra et al.'s (2002) classification: *economic* and *socio-cultural* autonomy. The study finds, consistent with the literature, many theorized indicators of autonomy are significantly correlated with at least one dimension of autonomy across all measures. In addition, the paper finds that measures representing the same dimension of autonomy differ based on the way it is operationalized, suggesting that measures should be validated and tested. The results also imply that measures are more similar for well-defined dimensions of autonomy, such as *economic* autonomy, than for less well-defined and context-specific dimensions such, as *socio-cultural* autonomy.

Introduction

Improving women's status is a priority within the development agenda, so much so that gender equality is the third Millennium Development Goal (UNDP 2010). Reliable and valid indicators provide important information in understanding whether policies have advanced women's status, and the dominant indicator for women's status has been women's autonomy. A wide literature has found large, positive associations between women's autonomy and individual and household-level outcomes, thus highlighting the broader implications of women's autonomy in the development agenda. For instance, women's autonomy has been positively associated with decreased fertility and labor hours for girls, and increased nutritional status of girls, prenatal and delivery care, spending on children's clothing and education, and resources allocated to boys (Haddad and Haddinot 1994; Abadian 1996; Quisumbing and Maluccio 2000; Quisumbing and de la Briere 2000; Beegle et al. 2001; Sahn and Stifel 2010; Reggio 2011; Brauw et al. 2013). Despite the importance of women's autonomy, there has been little discussion on whether different measures of autonomy are similar. This paper adds to the literature on women's autonomy by investigating whether competing measures of women's autonomy are comparable.

Women's autonomy remains challenging to measure as it is context-specific, often intangible, and by definition a latent, multidimensional concept. There are three dominant approaches to operationalizing women's autonomy: proxy variables, summative indices, and factor scores. Proxy variables using direct indicators for women's autonomy often use responses to household decision-making questions (see Panel B in Table 2).[13] For analytic simplicity responses are often dichotomized

[13] For simplicity, this study only examines *direct* indicators, which use actual decision-making questions. In comparison, *indirect* indicators are variables widely believed to be correlated with autonomy. Common *indirect* indicators are resources brought to marriage, resources from families of the spouse, inherited assets, the share of assets controlled by the mother and the father, control over income, age at marriage, and level of human capital (Schultz 1990; Thomas 1990; Doss 1996;

for when women have some versus no decision-making power. Summative indices usually create a single, aggregate measure of autonomy by dichotomizing and then summing multiple decision-making questions. Each dichotomized indicator is assumed to represent the same (although sometimes different) dimension of autonomy and is often given equal weight in a summed index. Both proxy variables and summative indices largely rely on face validity. Finally, factor scores (or variables deriving from other data reduction techniques such as principal component analysis and multiple correspondence analysis) have been used to investigate the dimensionality and underlying structure of the data. This approach allows for context-appropriate dimensions of autonomy to be identified and calculated in the form of factor scores, and as a result this method more closely matches the theoretical construct of autonomy. However, identification of the dimensions of autonomy that emerge from the data can be somewhat subjective. When informed by expert knowledge of cultural and social norms, qualitative interviews, or past research, however, factor analysis can provide a rigorous method for identifying latent dimensions that emerge from the analysis.

Despite a vast literature, there has been limited discussion on the construct and criterion validity of women's autonomy. In other words, are measures derived from each approach representing the same concept, and are the measures correlated with what are believed to be valid indicators of women's autonomy? Without validation of these measures, a study may rely on an unreliable or invalid measure, which can result in biased estimates and incorrect interpretations, thereby misinforming policymakers, practitioners, and researchers. In addition, giving equal weight to studies using proxy variables, summative indices, and factor scores might lead to ill-advised comparisons.

Thomas et al. 1997; Quisumbing 1994; Quisumbing and Maluccio 2000; Gitter and Barnham 2008; Felkey 2005; Lundberg et al. 1997; Rubaclava and Thomas 1997).

Using a subset of Malhotra et al.'s (2012) classification for dimensions of autonomy, this paper investigates construct and criterion validity for proxy variables, summative indices, and factor scores for *economic* and *socio-cultural* autonomy. Here, construct validity is investigated by examining whether determinants of autonomy are similarly correlated across the three measures representing the same dimension of autonomy. Determinants are variables widely believed to be correlated with autonomy but are not used in constructing any of the measures. Criterion validity is examined by investigating whether each measure of autonomy is correlated with autonomous behavior. In addition, the two dimensions of autonomy explored in this paper provide information on well-defined (*economic*) and less well-defined (*socio-cultural*) dimensions of autonomy, thus providing insight into whether construct and criterion validity differ by the dimension of autonomy. Factor analysis (Appendix B) informs the questions used for proxy variables, summative indices, and factor scores, and also ensures that at least one question is in common between all measures.

The study finds, consistent with the literature, many of the theoretical correlates of autonomy, such as women's age and differences in spousal characteristics, are significantly correlated with at least one dimension of autonomy. However, some variables commonly associated with increased autonomy, such as the wife's education and work status, are not significantly associated with any dimension of autonomy explored in this paper (sample and site characteristics are discussed as possible confounds). In addition, the paper finds that measures representing the same dimension of autonomy differ based on the way it is operationalized, suggesting that measures should be tested and validated to ensure that they have, at minimum, face validity. Validation may also be through cross validation via mixed methods, or relatively simple concurrent criterion validity tests. The results also imply that measures are more likely to agree for well-defined dimensions of autonomy, such as *economic* autonomy, than for less well-defined, more context-specific dimensions such as *socio-cultural* autonomy. It is possible that the relative ease of operationalizing valid constructs for well-

defined dimensions of autonomy bias the field towards *economic* autonomy, and as a result may miss important but "fuzzy" constructs that are arguably more context specific. Models can be sensitive to the dimension of autonomy that is being examined, and researchers should be cautious when comparing studies using different approaches.

Defining and measuring autonomy

A primary challenge facing researchers interested in operationalizing women's autonomy is the highly fragmented theoretical and empirical literature. Frameworks can differ by context, discipline, and study. Most confusingly, the literature often uses status, empowerment, autonomy, bargaining power, and other terms interchangeably (Malhotra et al. 2002), although the primary terms are women's autonomy and empowerment. Recent literature on women's status, however, has argued that women's autonomy and empowerment are distinct concepts (Jejeebhoy 1995; Malhotra and Mather 1997; Govindasamy and Malhotra 1996; Kabeer 1998; Agarwala and Lynch 2006). While autonomy is variously defined in the literature (e.g., see Malhotra et al. (2002) and Brunson et al. (2009)), definitions commonly focus on women's *control* over oneself, resources, opportunities, freedoms, and other areas of life. Importantly, autonomy can be measured in a cross-section of time, while empowerment is a process where individuals gain autonomy across time. Empowerment has also been conceptualized as a collective process, while autonomy is an individual-level outcome (Agarwala and Lynch 2006). For this paper, I focus solely on autonomy.

There is also consensus that autonomy is a multidimensional concept, although the dimensions of autonomy identified in the literature vary substantially by the study context and availability of data (Malhotra et al. 2002). For instance, Ahmed (2006) identified three dimensions, Pitt et al. (2006) along ten dimensions, Sen (1999) along seven dimensions, and Stromquist (1995) along four dimensions. These dimensions cover areas such as household purchases, resources,

mobility and networks, and fertility and parenting. Notably, Malhotra et al.'s (2002) synthesis of the literature found that common dimensions were *economic* (control over/access to resources), *socio-cultural* (e.g., freedom of movement), *legal* (e.g., knowledge of legal rights), *political* (e.g., exercising right to vote), *familial* (e.g., child care, fertility decisions), and *psychological* (e.g., self-efficacy).

Given its latent, multidimensional, and context-specific properties, it is unsurprising that operationalizing women's autonomy is a challenge. In response, scholars have used proxy variables, summative indices, and factor scores to operationalize women's autonomy, often by separately investigating different dimensions of autonomy (see Malhotra et al. 2002 for examples). A common practice is to assign a proxy variable to one dimension of autonomy (e.g., Dercon and Krishnan 2000; Sahn and Stifel 2002), while others use summative indices by selecting a set of proxy variables believed to represent the same dimension of autonomy to calculate a continuous measure (e.g., Bloom et al. 2001; Parveen and Leonhauser 2004). Studies commonly assume a variable captures a dimension of autonomy without conducting any validation. The standard for a good indicator appears to be plausibility, or face validity. Proxy variables and summative indices, while tractable, can be unsatisfying. Employing only one proxy variable may not adequately characterize an entire dimension of autonomy or mischaracterize important components of that dimension. This could then lead to an incomplete analysis of the determinants and consequences of autonomy. Critics have also noted the challenges of using a single question on decision-making as a proxy due to measurement issues, and some have questioned whether proxies themselves are even defensible (Haddad et al. 1997; Beegle et al. 2001; Bloom et al. 2001). Another approach is to use data reduction techniques, such as factor analysis. This approach allows researchers to systematically examine whether indicators that are assumed to represent different dimensions of autonomy actually describe one underlying dimension, thus avoiding double counting.

Still, each approach has advantages and disadvantages (Table 1). Proxy variables are the simplest to employ, and if intrahousehold decision-making data are limited, it may be the only available option. At the same time, because proxy variables are often dichotomous measures, they may lack sufficient variation for analysis. Indeed, these two reasons may be why *indirect* proxy variables (e.g., such as the wife's education or employment status) are often used. Summative indices also provide a simple way of operationalizing autonomy using multiple decision-making questions, and by design a summative index has greater variation than a proxy variable. At the same time, however, summative indices rely on the assumption that items included in the index do not capture the same aspect of a single dimension of autonomy. Further, a summative index assumes each item contributes equally to the selected dimension of autonomy. For example, when measuring *familial* autonomy, a question on who makes decisions about purchasing school supplies versus a question asking about who makes decisions whether children attend school may not merit equal weight if decision-making over school attendance is more indicative of *familial* autonomy. Finally, while factor scores provide an inductive and data-driven approach, the approach is more complicated and may require specialized knowledge. Identifying factors that emerge from the analysis also requires knowledge of the context or other expert knowledge, and can still be somewhat arbitrary. Researchers may face a dilemma if questions thought to represent a dimension of autonomy do not correlate together to represent one underlying dimension.

Table 1: Advantages and disadvantages of proxy variables, summative indices, and factor scores

	Advantages	Disadvantages
Proxy variables	• Requires no special training • Only need one question instead of a series of questions	• Single variables represent multidimensional concept • Single dichotomous variable may lack variation • Not data driven and often relies heavily on face validity
Summative Indices	• Requires no special training • Can selectively choose questions to be included in index given theory • Series of questions to represent one dimension of autonomy • Greater variation than single proxy variable	• Identification of all items in an index can be subjective and rely heavily on face validity • All items in an index usually assumed to contribute equally to index score without consideration to how much each individual question is correlated with underlying construct • May result in redundancy among collinear indicators, artificially inflating index scores
Factor scores	• Items can be weighted by strength of correlation with underlying construct when creating scores • Data-driven, inductive technique used to assess and identify underlying dimensions in data • Factor model matches theoretical relationship between construct and items	• Requires training and computational resources • Requires validation because dimensional structure observed in data may not be consistent across samples • Identifying factors requires knowledge of context, theory, or other expert knowledge.

Researchers must weigh the advantages and disadvantages of each approach, but an important consideration that has not yet fully been explored is whether proxy variables, summative

indices, and factor scores share construct and criterion validity. This has implications for future studies and policies. Policies aiming to increase women's autonomy may be relying on information from a study that examined only one dimension of autonomy using an untested proxy variable or summative index. If the three measures are largely similar, this implies that any measure provides a rigorous analysis of the determinants and effects of women's autonomy. On the other hand, large differences between measures imply that researchers should be cautious when employing any of the approaches, and further suggest measures should be validated.

Data on autonomy from rural Ethiopia

This paper uses the same data as Chapter 1 (see "Research Design and Study Site" in Chapter 1 for more). The study randomly selected 30 percent of households from three villages. Although the survey period was 2009-2011, only the 2011 survey dataset is used because it includes the full series of household decision-making and autonomy questions. This paper only uses households with a married household head, narrowing the sample to 343 out of 452 households (76 percent) across all three villages. When possible, the study separated the husband and wife during the interview, although husbands were present during the wife's interview for 15 percent of the cases (see Appendix A for robustness checks).

The survey asked a series of questions about individual and household decision-making, household responsibilities, and freedom of movement (Table 2). Respondents answering questions in Panels A and B (Table 2) could respond that decisions were made by: 1) *myself*, 2) *my husband*, 3) *jointly*, or 4) *by someone else*. Responses for 2) *my husband* and 4) *by someone else* were collapsed because these responses represent situations where decision-making is done with no input from the wife. Questions in Panels C and D (Table 2) are binary questions with respondents having the choice to answer *yes* or *no*.

Unique to this survey are questions regarding control over the wife's time allocation (Panel A in Table 2). The survey asked about general time use, and time allocated to household chores, farm work, the market, and socializing and leisure. No study has asked questions about control over the wife's time allocation, and these questions go beyond common questions about the woman's freedom and mobility outside the household.

In addition, household decision-making questions asked wives about buying and selling valuable assets, purchasing everyday household items, and children's education (Panel B in Table 2). The survey also included a battery of 10 questions about primary responsibilities regarding household activities (Panel C in Table 2). These questions capture differences between perceptions of authority versus perceptions about who in the household conducts the work. For instance, it is possible that the wife may state she is responsible for firewood collection for the household, but her daughters may do the actual firewood collection. Women who conduct work without having household responsibility (or final say) may have less autonomy than those that do. The last decision-making question asked about the acceptability of leaving to go to the market without permission of the husband (Panel D in Table 2).

Finally, to investigate criterion validity time use data are used as a measure for autonomous behavior (for more on time use data see Masuda et al. 2012). Autonomous behavior is measured by the wife's time allocated to *economic* and *socio-cultural* activities for *economic* and *socio-cultural* autonomy, respectively. *Economic* activities include the wife's time allocated to the market and in other work. *Socio-cultural* activities include the wife's time allocated to eating, socializing, and caring for or visiting the sick.

Table 2: Distribution of survey questions and components of proxy, index, and factor scores[a]

	Response distribution (%)			*Economic*			*Socio-cultural*		
Panel A: Individual decision-making	**Wife**	**Joint**	**Not wife**	**Pxy**	**Idx**	**Ftr**	**Pxy**	**Idx**	**Ftr**
A1. Who usually makes decisions about how much time you spend generally?	76	22	2					▯	▯
A2. Who usually makes decisions about how much time you spend on household tasks?	88	10	2						
A3. Who usually makes decisions about how much time you spend on farm work?	7	23	70		▯	▯			
A4. Who usually makes decisions about how much time you spend on leisure and socializing?	31	59	9				▯	▯	▯
A5. Who usually makes decisions about how much time you spend at the market?	36	62	2					▯	▯
Panel B: Household decision-making									
B1. Who usually makes decisions about major household purchases?	1	91	8	▯	▯	▯			
B2. Who usually makes decisions about selling assets of high values such as land and livestock?	0.0	91	9		▯	▯			
B3. Who makes decisions about children's education?	2.9	83	14						
B4. Who usually makes decisions about making purchases for everyday household needs?	69	30	0.87						
Panel C: Household responsibilities		**Yes**	**No**						
C1. Do you have primary responsibility for the household over household chores?		98	2						
C2. Do you have primary responsibility for the household over preparing food and coffee?		97	3						

Table 2 (Continued)

C3. Do you have primary responsibility for the household over collecting firewood?	92	8			
C4. Do you have primary responsibility for the household over collecting water?	90	11			
C5. Do you have primary responsibility for the household over caring for children?	94	6			
C6. Do you have primary responsibility for the household over activities at the market?	89	11			
C7. Do you have primary responsibility for the household over agricultural work and farming?	3	97	▯	▯	
C8. Do you have primary responsibility for the household over caring for animals?	11	89	▯	▯	
C9. Do you have primary responsibility for the household over other work?	21	79			
C10. Do you have primary responsibility for the household over caring for the sick?	91	9			
Panel D: Freedom of movement	**Yes**	**No**			
D1. It is acceptable for me to go to the local market without informing my husband	71	29			

[a] **Pxy** stands for proxy, **Idx** stands for index, and **Ftr** stands for factor scores. Factor loadings presented in Table B2 in Appendix B.

Operationalizing autonomy

This paper operationalizes autonomy in three ways (Table 2): proxy, a summative index, and factor analysis. I use Malhotra et al.'s (2002) classification of the dimensions of autonomy and identify two dimensions: 1) *socio-cultural* autonomy (e.g. freedom of movement, freedom for social and leisure activities) and 2) *economic* autonomy (e.g., household finances, control over resources). Factor analysis informs the selection of questions used in proxy variables, summative indices, and factor scores (Appendix B). Factor analysis is a systematic data-driven technique that examines the covariance structure among questions (i.e., items) to determine whether distinct dimensions are present, and if so, which items best represent each underlying dimension of autonomy. As a result, this provides a more rigorous method for selecting proxy variables and questions used in summative indices compared to face validity. This also ensures that at least one question is the same across all three measures. In other words, the measures themselves are nested, and the main difference between summative indices and factor scores are the weights applied to each question. With the factor score, each question is weighted by how correlated the question is to the underlying factor, while for the summative index each question is given equal weight.

Proxy variables

I operationalize *socio-cultural* autonomy using the question on the wife's time allocation in social and other leisure activities (A4 in Table 2) and *economic* autonomy using the question on major household purchases (B2 in Table 2). Each variable is dichotomized for the main analysis. Variables are given a value of 1 if the wife has any say (Response: "Wife" or "Joint") and given a value of 0 otherwise. This approach is similar to Rahman and Rao (2004) who examined household decision-making using both proxy variables and an index.

These proxy variables are of interest because they include both gendered activities (major household purchases) and dimensions where correlates of autonomy are somewhat ambiguous (social and leisure activities). For instance, while we expect men to have greater say in decision-making over major household purchases, it is unclear what factors correlate with autonomy over how a woman spends her time in social and leisure activities, as the effects of observable characteristics are mediated by social norms.

Summative indices

To create a summative index I follow Bloom et al. (2001) and Jejeebhoy and Sathar (2001) and dichotomize and sum bargaining variables identified in the factor analysis (Panels A - D). Decision-making variables receive a value of 1 if the wife has any say in the decision (Response: "Wife" or "Joint") and a value of 0 otherwise. Unlike some studies, however, I do not examine an overall autonomy index, and instead create two separate indices to capture each dimension of autonomy to be able to compare summative indices to proxy variables and factor scores. The *economic* dimension of autonomy consists of decision-making over major purchases, selling large assets, the wife's time allocation on farm work, and household responsibility over farm work and animals (A3, B1, B2, C7, and C8 in Table 2). This index ranges from 0-5. *Socio-cultural* autonomy consists of decision-making over the wife's overall time allocation, time in leisure and socializing, and time at the market (A1, A4, and A5 in Table 2). This index ranges from 0-3.

Factor scores

Finally, I conduct a factor analysis to explore an inductive and data-driven approach to identifying dimensions of autonomy (See Appendix B for details). I first derive factors from the exploratory factor analysis (EFA) and then conduct confirmatory factor analysis (CFA) as a

diagnostic procedure to identify items that may have cross-loaded onto separate factors (see Appendix 2 for more). The analysis identifies four factors, suggesting the data represent four dimensions of autonomy. Only two of the four factors, however, fit into Malhotra et al.'s (2002) common dimensions of autonomy, and these two dimensions are the *economic* and *socio-cultural* autonomy. The other two factors emerging from the analysis appear to cover autonomy over *household responsibilities* and *household actions* based on the questions that clustered together (Table B2 in Appendix B), and these are not considered further because there are no proxy variable and summative index counterparts to conduct a comparison. Factor scores are distribution-based and are interpreted like conventional Z-scores with a mean of 0 and standard deviation of 1.

Empirical strategy

I use two strategies to examine whether different measures of the same dimension of autonomy are similar. First, to investigate construct validity I examine whether correlates of the same dimension of autonomy differ across measures. Correlates are variables that are not used to construct the measures of autonomy. If different measures of the same dimension of autonomy do not share similar significant correlates, this suggests that the construct validity is less certain and that measures themselves are dissimilar. Second, concurrent criterion validity is examined using an approach similar to Ghuman et al. (2006) and Bohrnstedt (1983). This approach investigates whether different measures of the same dimension of autonomy correlate with an external variable hypothesized to be related to the measure. In this case, the external variable is the wife's autonomous behavior, which is represented by the wife's actual time use. Differences in significant correlates for both approaches indicate measures are dissimilar.

For construct validity, both a logistic regression and a linear regression are estimated because proxy variables are dichotomous, while summative indices and factor scores are continuous. The model examining proxy variables for autonomy is a logistic regression such that:

$$log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \beta_0 + \beta_1 \boldsymbol{x}_{ij} + \beta_2 \boldsymbol{z}_{ij} + \boldsymbol{v}_j \beta_3 \quad (1)$$

where $p_i = P(Y = 1 \mid \boldsymbol{x_{ij}}, \boldsymbol{z_{ij}}, \boldsymbol{v_j})$. For the summative indices and factor scores the following regression is estimated:

$$y_{ij} = \beta_0 + \beta_1 \boldsymbol{x}_{ij} + \beta_2 \boldsymbol{z}_{ij} + \boldsymbol{v}_j \beta_3 + \varepsilon_{ij} \quad (2)$$

where *i* indexes the individual in village *j*. y_{ij} represents the continuous outcome variable of interest. For both models, $\boldsymbol{x}_{ij}$ represents a vector of individual covariates, $\boldsymbol{z}_{ij}$ represents a vector of spousal characteristic differences and household covariates, and $\boldsymbol{v_j}$ represents village fixed effects. All models are estimated with robust standard errors.

For concurrent criterion validity, each dimension of autonomy is regressed against autonomous behavior matching the dimension of autonomy, where autonomous behavior is measured by the wife's time use. All models use a linear regression such that:

$$t_{ij} = \beta_0 + \beta_1 \boldsymbol{x}_{ij} + \boldsymbol{v}_j \beta_2 + \beta_3 \boldsymbol{a}_{ij} + \varepsilon_{ij} \quad (3)$$

Where $\boldsymbol{t}_{ij}$ represents the wife's time use, and $\boldsymbol{x}_{ij}$ and $\boldsymbol{v}_j$ represent the same covariates as in equations 1 and 2. $\boldsymbol{a}_{ij}$ represents each measure of autonomy for a given dimension, and a separate model is estimated for each measure. All models are estimated with robust standard errors.

Covariates[14,15]

Existing literature on autonomy informs covariate selection, with an emphasis on variables found to be determinants of autonomy. For individual-level covariates, the model includes the wife's education, age, employment status (Allendorf 2012), marital experience (number of times married) (Dercon and Krishnan 2000), and kinship network (the number of siblings living within the same subvillage) (Rammohan et al. 2009). Age-squared is included for any nonlinear relationships that may exist between age and autonomy. Differences in spousal characteristics include differences in age, education, marital experience, and kinship network. In all cases, the differences in spousal characteristics are the husband's characteristics relative to the wife's. Household characteristics include household age and sex composition (Acharya 2010) and household assets and income (Martinsson et al. 2010). Finally, I use a dummy variable for whether the husband was present during the interview to capture whether the presence of the husband had any effect on responses (Appendix A has robustness checks).

In general, characteristics that strengthen the wife's options outside of marriage are positively associated with autonomy, although these factors can be tied to women's autonomy

[14] See Figures C1-C2 for the correlation matrix for covariates.

[15] Numerous other factors also correlate with women's autonomy, but because the survey did not include questions on these topics they are not included. These include, for example, resources brought to marriage, resources from families of the spouse, inherited assets, the share of assets controlled by the mother and the father, control over income, division of assets upon divorce (Schultz 1990; Thomas 1990; Doss 1996; Thomas, Contreras, and Frankenberg 1997; Quisumbing 1994; Quisumbing and Maluccio 2000; Gitter and Barnham 2008; Felkey 2005; Lundberg et al. 1997; Rubaclava and Thomas 1997; Fafchamps and Quisumbing 2005).

through other pathways. For instance, wives who work and are more educated can have a higher likelihood to be exposed to newer ideas, which can lead to increased preferences for autonomy that women may not have acted on before (Rogers 1995; Schuler et al. 1997; Maitra 2004). Kinship networks can also provide women with moral, social, and economic support in the event of divorce (Bennett 1983; Quisumbing and Briere 2000; Deshmukh-Ranadive 2005; Allendorf 2012). These examples also extend to differences in household characteristics, where greater differences that favor the wife are associated with greater levels of autonomy. My analysis also includes household composition and wealth to account for potential systematic differences that exist between households by wealth and age and sex composition.

Finally, as discussed in Chapter 1 two of the villages had newly implemented water infrastructure at the time of the survey. The advent of water infrastructure may have altered women's autonomy, especially in households that experienced time savings. Although this may seem unlikely on such a short time scale, Chi-square tests show significant differences between villages with and without water systems for control over how time is spent generally (A1 in Table 2), how time is spent in leisure (A4 in Table 2), and the wife's ability to go to the market without informing the husband (D1 in Table 2). I address this by including village-level fixed effects to control for inter-village differences.

Results

Descriptive statistics

The average wife's age is 38 years old, and with a median age of 33 and a minimum age of 15 the age distribution skews younger (Panel C in Table 3). The average age difference between the husband and wife is 8.3 years while the largest is 40 years. Women who have been married more than once have a greater average age difference of 9.8 years. Women in the study have, on average,

0.68 years of education, while the husbands have, on average, 1.8 years more years of education. This difference also persists across the other observable characteristics as well. Husbands have a larger kinship network suggesting that women typically move away from their subvillages for marriage. The average household size is approximately 6 people, and households have more males than females (52 percent male). Households in our study are also largely agrarian with approximately 83 percent of household income coming from farm wages (not shown). The proportion of income from nonfarm wages is minimal, as nonfarm wages typically come from working as a day laborer or selling alcohol.

Panels A-B in Table 3 present descriptive statistics for each measure of autonomy. Proxy variables present a higher level of autonomy relative to summative indices or factor scores, which suggest studies using proxy variables may overestimate women's autonomy (Panels A-B in Table 4). For summative indices, women have the highest level of autonomy in *socio-cultural* autonomy and the lowest for *economic* autonomy. Finally, for factor scores the highest level of autonomy was for *economic* autonomy (0.24 standard deviations above the mean in a random draw), while the lowest was for *socio-cultural* autonomy (-0.0002 standard deviations below the mean in a random draw). Clearly, based on the employed approach the relative level of autonomy differs, suggesting that investigating the impact of women's autonomy may be inconsistent with other studies when employing different measures of autonomy.

Table 3: Descriptive statistics

Panel A: Economic autonomy	Mean	SD
Proxy variable (%)[a]	84	(37)
Summative index (0-5)	2.2	(0.82)
Factor score[b]	0.24	(0.21)
Panel B: Socio-cultural autonomy		
Proxy variable (%)[a]	91	(29)
Summative index (0-3)	2.8	(0.35)
Factor score[b]	-0.00020	(0.33)
Panel C: Covariates		
Age of wife	38	(14)
Highest grade attained by wife	0.68	(1.7)
Wife who work for wages (%)	13	(34)
Size of wife's kinship network	0.70	(1.6)
Husband present during interview (%)	15	(0.36)
Number of times wife has been married	1.2	(0.48)
Difference in size of kinship network between husband and wife	1.4	(2.5)
Difference in number of times married between husband and wife	0.22	(0.93)
Difference in educational attainment between husband and wife	1.8	(2.9)
Difference in age between husband and wife	8.3	(6.7)
Number of under school-aged males	0.53	(0.69)
Number of under school-aged females	0.54	(0.67)
Number of school-aged males	1.1	(1.0)
Number of school-aged females	0.87	(0.90)
Number of adult males	1.6	(0.87)
Number of adult females	1.4	(0.67)
Total assets and income[c]	18,051	(13,190)
Bishikiltu	33	(47)
Tutekunche	29	(45)
Kelecho Gerbi	38	(49)
n	343	

[a] Each variable is equal to 1 if the wife has any say in decision-making.
[b] Each outcome is estimated from a model with mean=0 and standard deviation=1.
[c] Figures are reported in Ethiopian Birr, and 1 U.S. dollar was approximately 17 Ethiopian Birr in July 2011. Assets include productive livestock, which include horses, donkeys, mules, cows, and oxen. Prices for livestock are obtained from the July 2011 retail price report published by the Central Statistical Agency in Ethiopia.
http://www.csa.gov.et/images/documents/pdf_files/retailprice/2011/july2011.pdf

Correlations for the three measures of autonomy are shown in Table 4. All have positive and significant correlations. *Economic* autonomy measures are more highly correlated than *socio-cultural* autonomy measures, suggesting that more well-defined dimensions of autonomy are more easily

captured by proxy variables. Index and factor scores for the *economic* dimension of autonomy are the most highly correlated (0.87), while the weakest correlation is between the proxy variable and factor score for *socio-cultural* autonomy (0.16). Interestingly, the correlation is also relatively weak between the summative index and the factor score for *socio-cultural* autonomy. Because these two measures use the same questions, the weak correlation are likely due to the different weights assigned to each item by factor analysis compared to the equal weighting of the summative index.

Table 4: Correlations for dimensions of autonomy by measure

		Proxy	Index
Economic	Index	0.62***	
	Factor	0.59***	0.87***
Socio-cultural	Index	0.79***	
	Factor	0.16**	0.26***

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Construct validity

Main results: Economic autonomy

Column A in Table 5 present coefficients for *economic* autonomy. The husband's presence is significantly associated with the summative index and factor score, suggesting that the husband's presence may positively bias responses for *economic* autonomy. Interestingly, the wife's individual characteristics are not significantly correlated with any measure of *economic* autonomy. Spousal characteristic differences are negatively correlated with the proxy variable (-0.11) and factor score (-0.03), but not the summative index. Household composition is significantly correlated with all

measures, as the number of school-aged males is positively associated with all measures. All measures appear to share similar correlates of autonomy, suggesting that the measures for *economic* autonomy are largely similar.

Table 5: Logistic and OLS regression results for *economic* and *socio-cultural* dimensions of autonomy[a,b]

	Economic autonomy (A)			**Socio-cultural autonomy (B)**		
	Proxy (1)	Index (2)	Factor (3)	Proxy (4)	Index (5)	Factor (6)
Wife's age						+
Wife's age-squared						*
Wife's education						
Wife works						
Kinship network						
Husband present		***	***			***
Marital experience				*	+	*
Difference in kinship network						+
Difference in marriage count			*	*	+	***
Difference in education	*				+	
Difference in age						*
Number of under school-aged males						*
Number of under school-aged females						
Number of school-aged males	*	*	*	*		
Number of school-aged females						
Number of adult males						
Number of adult females					*	
Log total assets and income						*
Tutekunche						
Kelecho Gerbi				+		
Constant		***			***	**
R^2	-	0.11	0.12	-	0.11	0.15
BIC	309	987	-6.9	275	647	286
Log-likelihood	-76	-	-	-93	-	-
n	343	343	343	343	343	343

[a] All models estimated with robust standard errors.
[b] All models examining proxy variables are logistic regressions (columns 1 and 4).
[c] Red indicates negative coefficient and green positive coefficient. The table of full coefficients is shown in Table E1 in Appendix E.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Main results: Socio-cultural autonomy

Column B in Table 5 presents coefficients for *socio-cultural* autonomy, and there are greater differences in association between measures of autonomy and observables compared to *economic* autonomy. The wife's characteristics have no significant association for the proxy and index measures, while age and age-squared are significantly correlated with the factor score. The husband's presence is negatively correlated with the factor score, but not for other measures. Spousal characteristic differences are significant across all measures, but as we move from the proxy variable, summative index, and factor score the number of significant variables increases (1, 2, and 4 significant correlations, respectively). Household composition variables also differ across measures. Household composition is positively correlated with the proxy variable, while it is negatively correlated for the summative index and factor score. It appears that measures for s*ocio-cultural* autonomy have greater differences compared to measures for *economic* autonomy, suggesting scholars should be cautious when selecting measures for *socio-cultural* autonomy.

Criterion validity

Table 6 presents results for models estimating the association between each measure of autonomy against autonomous behavior, the proportion of the wife's time spent on *economic* and *socio-cultural* activities. Again, we see that measures of *economic* autonomy share more common significant correlations than *socio-cultural* autonomy. This also suggests that for *economic* autonomy, proxy variables and factor scores are more closely associated with actual autonomous behavior, while for *socio-cultural* activities only proxy variables is significantly associated with autonomous behavior. The summative index for *economic* autonomy was not significantly correlated with *economic* behavior, which may indicate that weighing individual items by the strength of their correlation with the underlying construct of autonomy creates a more highly correlated measure for autonomy,

Further, the differences in magnitude across all measures of autonomy also suggest caution. For instance, the proxy variable for *economic* autonomy estimates that wives with greater autonomy spend 4 percent more time in *economic* activities, while the factor score estimate suggests a standard deviation increase in autonomy for wives leads to 8 percent more time in *economic* activities.

Table 6: Criterion validity check[a,b,c]

	Proportion of work in *economic* activities			**Proportion of time in *socio-cultural* activities**		
	Proxy (1)	Index (2)	Factor (3)	Proxy (4)	Index (5)	Factor (6)
β_4 (autonomy)	0.04+	0.01	0.08*	0.04*	0.01	-0.001
SE	(0.022)	(0.008)	(0.035)	(0.020)	(0.017)	(0.028)
R^2	0.05	0.04	0.05	0.11	0.10	0.10
BIC	-271.11	-269.95	-279.31	-248.64	-246.52	-246.39
n	337	337	337	337	337	337

[a] All models estimated with robust standard errors.
[b] *Economic* activities include the wife's time allocated to the market and in other work. *Socio-cultural* activities include the wife's time allocated to eating, socializing, and caring for or visiting the sick.
[c] Table of full coefficients shown in Table E2 in Appendix E.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Discussion and limitations

By exploring construct and concurrent criterion validity for three measures of women's *economic* and *socio-cultural* dimensions of autonomy, this paper demonstrates the importance of carefully choosing and constructing measures of autonomy. No covariate tested was consistently a significant correlate of both dimensions of autonomy, indicating that autonomy is a multidimensional concept and observable characteristics may not be correlated with all dimensions. This also suggests that proxy measures claiming to characterize overall autonomy may be limited. In addition, only household composition was significantly associated with at least one measure across both dimensions of autonomy. Few measures within *socio-cultural* autonomy shared many overlapping

correlates suggesting that proxy variables may only be appropriate for well-defined dimensions of autonomy.

This has implications for research studying the causes and consequences of autonomy. First, indirect measures of autonomy, such as educational attainment and participating in outside work, may not be strong measures and may be misleading. For instance, a consistently used indirect proxy for *economic* autonomy is women's work status, yet this variable was not significantly correlated with any of the measures of *economic* autonomy in this field site. A possible explanation for this is that the sample size was relatively small and few women engaged in the sample worked for wages (13 percent), but at the same time, it is possible that other variables may be stronger predictors of *economic* autonomy. Second, given that some measures of autonomy were weakly correlated, the paper highlights the importance of examining each dimension of autonomy separately. The literature often discusses the importance of this, but it is rarely implemented in empirical studies of autonomy, suggesting that a careful selection of questions is critical for a robust assessment of autonomy. Simply assuming that proxy variables or summative indices represent a certain dimension of autonomy without any validation is somewhat arbitrary. Proxy variables, while convenient, suffer from the assumption that a single question captures an entire dimension of autonomy, while summative indices and factor analytic models allow for broader evaluations of the dimensionality of autonomy using multiple indicators.

Although there were few significant correlates of *economic* autonomy, there were more variables that were significantly correlated across measures compared to *socio-cultural* autonomy, which had greater variation in significant correlates. In addition, two of the three measures of *economic* autonomy were significantly associated with *economic* autonomous behavior. This suggests that this dimension of autonomy is more easily captured regardless of how it is operationalized. *Economic* autonomy may simply be a more well-defined dimension of autonomy that is easier to

operationalize regardless of the approach, while *socio-cultural* autonomy may be a dimension that is broader in scope, less well-defined, and as a result is more context-specific and difficult to capture with a proxy variable or summative index. The findings suggest that studies interested in broad or less well-defined dimensions should, at a minimum, explore expert local knowledge, or, more preferably, factor analysis or other data-driven techniques to investigate whether data credibly capture these dimensions. In addition, researchers interested in studying the impacts of these dimensions of autonomy should be cautious about impacts if proxy variables or summative indices are used.

There are also some interesting insights from regressions as well. Across all measures and dimensions, the wife's education, work status, kinship network did not have any significant association with any dimension of autonomy. It is possible, however, that other mediating factors such as social or cultural norms are limiting the significance of these variables in the study site. Where significant, differences in spousal characteristics were negatively correlated with *economic* autonomy, which is in line with expectations as husbands with greater levels of each are hypothesized to have more bargaining power. Household wealth was only significantly correlated with the factor score for *socio-cultural* autonomy, indicating no systematic variation between wealth classes in the study villages. For all dimensions of autonomy, young household members were significantly correlated, which is in line with much of the literature (Acharya 2010). Where significant, school-aged children increased autonomy, while children below school-age decreased autonomy.

There were also some unexpected associations. The significant effect of the husband's presence highlights the importance of separating the husband and the wife during interviews. Results suggest that wives answered *socio-cultural* autonomy questions to appear more obedient in front of the husband, which is line with reports of subservient wives in Ethiopia (UNFPA 2008). In comparison,

for *economic* autonomy the husband's presence is positively associated with more autonomy. Finally, differences in characteristics between spouses were expected to decrease autonomy, yet for *socio-cultural* autonomy the majority of spousal difference characteristics were positively associated with autonomy.

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Appendix A: Robustness checks for when the husband was present

This appendix explores whether results are robust for subsamples where husbands were and were not present during the wife's interview. Results should be interpreted cautiously as the subsample where the husband was present consists only of 53 households, while the subsample where the husband was not present consists of 290 households. It was not possible to run robustness checks for proxy variables, as the sample size was insufficient to run the logistic regression for the subsample of households where the husband was not present. Regressions suggest that there are differences for subsamples where the husband is present and not present during the wife's interview for *socio-cultural* autonomy but not for *economic* autonomy. This indicates that researchers should be careful and separate husbands and wives when asking decision-making questions, especially for less well-defined dimensions of autonomy.

There are few differences in observable characteristics between the subsamples (Table A1). Households where the husband is present had fewer adult females in the household. A larger proportion of households where the husband was not present were in Tutekunche, while fewer in Bishikiltu.

For *economic* autonomy (Table A2), there are not major differences in correlates of autonomy between the households where the husband was present and not present. The wife's age was significantly correlated with autonomy for nearly all measures of autonomy, regardless of whether the husband was present or not. Interestingly, however, the wife's age is negatively correlated with *economic* autonomy measures when the husband is not present, but positively correlated when the husband is present. Spousal differences are largely not significantly correlated across measures and subsamples. The number of school-aged males is positively correlated with all measures of autonomy, while the number of school-aged females is positively associated with autonomy for households where the husband is present.

There were more noticeable differences for *socio-cultural* autonomy (Table A3). With the exception of the wife's marital experience for factor scores, no individual covariate is significantly correlated with *socio-cultural* autonomy for households where the husband was not present. In addition, this subsample had significant correlations with spousal difference variables. In comparison, the wife's age, the wife's work status, and kinship network are significantly correlated for the subsample where the husband is present. Household composition was significantly associated with the index for households where the husband was present, but not for the factor score. Only household wealth overlaps across subsamples, but this was only for factor scores. These large differences highlight the importance of separating spouses when decision-making questions are asked.

Table A1: Differences in observable characteristics for when the husband is present and not present[a]

Panel A: Individual	Present	Not present	Difference
Wife's age	37.04	40.36	-3.31
Highest grade attained by wife	0.71	0.49	0.21
Size of wife's kinship network	0.67	0.87	-0.19
Number of times wife has been married	1.21	1.15	0.061
Wife works for wages (%)	13	11	2.1
Panel B: Differences in spousal characteristics			
Difference in size of kinship network between husband and wife	1.46	0.79	0.67
Difference in number of times married between husband and wife	0.22	0.23	-0.0091
Difference in educational attainment between husband and wife	1.88	1.70	0.17
Difference in age between husband and wife	8.28	8.47	-0.19
Panel C: Household characteristics			
Number of under school-aged males	0.55	0.42	0.13
Number of under school-aged females	0.54	0.60	-0.062
Number of school-aged males	1.06	1.21	-0.14
Number of school-aged females	0.88	0.85	0.030
Number of adult males	1.58	1.51	0.069
Number of adult females	1.33	1.53	-0.19+
Total assets and income[b]	18,178.88	17,030.71	1,148.17
Bishikiltu (%)	31	45	-13*
Tutekunche (%)	31	15	15*
Kelecho Gerbi (%)	38	40	-2.0
n	290	53	

[a] Mean values presented

[b] Figures are reported in Ethiopian Birr, and 1 U.S. dollar was approximately 17 Ethiopian Birr in July 2011. Assets include productive livestock, which include horses, donkeys, mules, cows, and oxen. Prices for livestock are obtained from the July 2011 retail price report published by the Central Statistical Agency in Ethiopia. http://www.csa.gov.et/images/documents/pdf_files/retailprice/2011/july2011.pdf

*** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.10$

Table A2: Robustness checks for *Economic* autonomy measures for when the husband is and is not present

	Proxy		**Index**		**Factor score**	
	Not present	**Present**	**Not present**	**Present**	**Not present**	**Present**
	(1)	(2)	(3)	(4)	(5)	(6)
Wife's age	-0.18+	-	-0.05*	0.11*	-0.01+	0.01
	(0.104)	-	(0.020)	(0.051)	(0.005)	(0.009)
Wife's age-squared	0.00+	-	0.00*	-0.00*	0.00*	-0.00+
	(0.001)	-	(0.000)	(0.000)	(0.000)	(0.000)
Wife's education	0.12	-	0.00	-0.01	0.01	-0.01
	(0.181)	-	(0.036)	(0.093)	(0.008)	(0.017)
Wife works	0.56	-	-0.06	0.79	-0.03	0.11
	(0.888)	-	(0.137)	(0.606)	(0.033)	(0.089)
Kinship network	0.27	-	0.05	0.02	0.00	-0.01
	(0.223)	-	(0.033)	(0.119)	(0.008)	(0.020)
Wife marriage count	-0.24	-	0.01	0.15	-0.03	0.03
	(0.530)	-	(0.138)	(0.295)	(0.033)	(0.051)
Difference in kinship network	-0.08	-	-0.01	0.01	-0.01	-0.01
	(0.101)	-	(0.022)	(0.081)	(0.006)	(0.015)
Difference in marriage count	-0.11	-	-0.08	-0.18	-0.04*	-0.04
	(0.181)	-	(0.060)	(0.135)	(0.015)	(0.027)
Difference in education	-0.17*	-	-0.01	-0.01	-0.00	-0.00
	(0.075)	-	(0.022)	(0.066)	(0.005)	(0.011)
Difference in age	-0.01	-	-0.00	-0.00	0.00	0.00
	(0.033)	-	(0.008)	(0.031)	(0.002)	(0.006)
Number of under school-aged	-0.11	-	0.01	0.22	0.01	0.06
males	(0.270)	-	(0.082)	(0.187)	(0.019)	(0.038)
Number of under school-aged	-0.19	-	-0.03	0.52+	-0.01	0.10*
females	(0.381)	-	(0.081)	(0.275)	(0.020)	(0.043)
Number of school-aged males	0.61*	-	0.13*	0.31+	0.03*	0.06*
	(0.252)	-	(0.056)	(0.159)	(0.014)	(0.028)

Table A2 (Continued)

Number of school-aged females	-0.25	-	-0.03	-0.27+	-0.00	-0.03
	(0.240)	-	(0.061)	(0.151)	(0.015)	(0.028)
Number of adult males	0.16	-	0.04	-0.18	-0.01	-0.05
	(0.286)	-	(0.064)	(0.252)	(0.015)	(0.050)
Number of adult females	-0.43	-	-0.03	0.13	-0.01	0.04
	(0.308)	-	(0.116)	(0.236)	(0.026)	(0.040)
Log total assets and income	0.09	-	-0.04	0.07	-0.01	-0.01
	(0.123)	-	(0.036)	(0.078)	(0.009)	(0.015)
Tutekunche	-0.91	-	-0.21	0.61	-0.03	0.10
	(0.563)	-	(0.139)	(0.491)	(0.034)	(0.082)
Kelecho Gerbi	-0.03	-	-0.11	0.33	-0.02	0.10+
	(0.611)	-	(0.111)	(0.300)	(0.028)	(0.051)
Constant	6.38**	-	3.48***	-0.85	0.32**	-0.19
	(2.352)	-	(0.447)	(1.346)	(0.122)	(0.233)
R^2	-	-	0.06	0.40	0.07	0.42
BIC	-	-	833.72	194.18	16.91	8.24
n	290	-	290	53	290	53

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table A3: Robustness checks for *Socio-cultural* autonomy measures for when the husband is and is not present

	Proxy		**Index**		**Factor score**	
	Not present	**Present**	**Not present**	**Present**	**Not present**	**Present**
	(1)	(2)	(3)	(4)	(5)	(6)
Wife's age	-0.06	-	0.00	0.07***	0.01	0.04**
	(0.120)	-	(0.008)	(0.016)	(0.009)	(0.013)
Wife's age-squared	0.00	-	-0.00	-0.00***	-0.00	-0.00***
	(0.001)	-	(0.000)	(0.000)	(0.000)	(0.000)
Wife's education	0.02	-	-0.01	-0.03	-0.02	0.02
	(0.148)	-	(0.014)	(0.027)	(0.013)	(0.032)
Wife works	0.06	-	0.05	0.25+	0.07	-0.04
	(0.656)	-	(0.065)	(0.134)	(0.055)	(0.099)
Kinship network	0.05	-	0.01	0.03	0.00	0.04+
	(0.152)	-	(0.017)	(0.019)	(0.014)	(0.023)
Wife marriage count	0.50	-	0.06	-0.01	0.11*	-0.07
	(0.537)	-	(0.048)	(0.073)	(0.043)	(0.076)
Difference in kinship network	0.11	-	0.01	0.01	0.01	0.03
	(0.121)	-	(0.011)	(0.015)	(0.010)	(0.021)
Difference in marriage count	0.66	-	0.04+	-0.01	0.09***	0.00
	(0.444)	-	(0.024)	(0.044)	(0.021)	(0.046)
Difference in education	-0.11	-	-0.02+	0.00	-0.01	0.00
	(0.068)	-	(0.010)	(0.011)	(0.008)	(0.011)
Difference in age	-0.03	-	-0.01	-0.01	-0.01*	0.00
	(0.035)	-	(0.005)	(0.010)	(0.003)	(0.007)
Number of under school-aged males	-0.16	-	-0.03	0.13+	-0.06+	-0.05
	(0.297)	-	(0.044)	(0.070)	(0.033)	(0.056)
Number of under school-aged females	-0.38	-	-0.05	0.11*	-0.03	-0.05
	(0.284)	-	(0.042)	(0.046)	(0.033)	(0.049)
Number of school-aged males	0.55*	-	0.04	0.07	-0.03	-0.05
	(0.233)	-	(0.025)	(0.051)	(0.022)	(0.031)

Table A2 (Continued)

Number of school-aged females	-0.12	-	-0.06+	-0.07**	-0.03	-0.03
	(0.284)	-	(0.034)	(0.024)	(0.025)	(0.039)
Number of adult males	0.15	-	0.03	-0.04	0.03	0.06
	(0.263)	-	(0.021)	(0.048)	(0.026)	(0.070)
Number of adult females	-0.10	-	-0.01	0.13*	-0.01	-0.02
	(0.352)	-	(0.040)	(0.064)	(0.031)	(0.048)
Log total assets and income	-0.21	-	-0.01	-0.03	0.03*	0.04+
	(0.244)	-	(0.011)	(0.025)	(0.011)	(0.023)
Tutekunche	0.36	-	-0.04	0.33**	0.03	0.01
	(0.537)	-	(0.067)	(0.100)	(0.051)	(0.099)
Kelecho Gerbi	0.56	-	0.05	0.13+	0.04	-0.10
	(0.500)	-	(0.050)	(0.073)	(0.046)	(0.066)
Constant	4.56+	-	2.97***	1.54***	-0.39*	-1.25***
	(2.639)	-	(0.181)	(0.386)	(0.192)	(0.308)
R^2	-	-	0.08	0.76	0.12	0.56
BIC	-	-	393.69	35.09	16.91	8.24
n	290	-	290	53	272.18	32.78

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Appendix B: Factor analysis

In order to investigate dimensionality of the data an EFA was conducted. Unlike for proxy variables and the summative index, all variables maintain their original numerical values. Thus, variables in Panels A and B in Table 2 are ordinal for the factor analysis, and variables in Panels C and D in Table 2 are dichotomous. This is done to maintain maximum variation of the data when exploring dimensionality. Given the categorical and ordinal nature of the data, traditional factor analytic approaches for continuous measures are inappropriate. Instead, a weighted, polychoric correlation matrix was used in the factor analysis (Kolenikov and Angeles 2009). While the use of a summative index makes an *a priori* assumption about which items measure a unique unidimensional domain of interest, exploratory factor analysis (EFA) evaluates the number of potential dimensions that are present in the data based on similar covariance patterns among the items (i.e. variables) themselves. EFA thus generates indices of autonomy from the data themselves.

There are multiple criteria used to inform decisions about the optimal number of dimensions in a dataset. Given that EFA can alternately be seen as a data reduction technique (i.e. reducing all of the variance contained within all items to a smaller, more informative factor structure), interpretability and utility of identifiable factors must also inform selection of the optimal factor solution. Scree plot inspection, which plots factors on the x-axis and eigenvalues on the y-axis, is particularly informative when determining the minimum number of factors present in the data, while the Kaiser criterion is more informative in determining the maximum number of dimensions present in the data by identifying factors with an eigenvalue greater than 1 (i.e. the variance contained within a single item). In addition to shared-item content, identification of factors is guided by the clustering of items (variables) into separate factors (dimensions), and by the magnitude and direction of factor loadings themselves. Once the optimal factor solution has been identified in the EFA, a CFA was conducted to validate the optimal solution from the EFA with additional constraints to ensure

sufficient separation of the dimensions (i.e. zero or negligible cross-loadings between items and factors).

Four items were excluded due to insufficient variation in response patterns, thus prohibiting estimation of a polychoric correlation matrix required for factor analysis of categorical data. These items reflected household responsibilities related to household chores, water and wood collection, and other work (Panel C in Table A1). EFA with the remaining 16 items identified six factors with eigenvalues greater than 1, but screeplot inspection indicated that a four-factor solution was preferable (Figure B1). Items that load onto factors at levels of 0.40 or higher are considered to be indicators of the latent factor (Table A1). Beyond the one and two factor solutions, consistent patterns among items and factors emerged and were maintained across the 3, 4, and 5 factor solutions. Model fit consistently improves in EFA with the addition of each factor (up until the variance contained in all items is explained by an equal number of factors), but the four-factor solution was the smallest factor model to demonstrate adequate model fit per the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error Approximation (RMSEA) (Hu and Bentler 1999).

While the five-factor model accounted for 76 percent of the variance among all of the 16 items, it also had higher cross-loadings between items and factors than the four-factor model, leading to a less discrete and interpretable factor structure. Accordingly, the four-factor solution was selected as optimal given it was a more parsimonious model with a simpler and more interpretable structure that still accounted for 68 percent of the variance among all items in the data. The four factors are identified as: 1) autonomy over household action (*hhaction*), 2) autonomy over productive assets and income (*economic*), 3) autonomy over household responsibilities (*hhresp*), and 4) autonomy over social and other unstructured activities (*socio-cultural*). Some items cross-loaded onto multiple factors, but the highest factor loadings guided item-factor assignment. Control over how much time

to spend generally and on household tasks, and decision-making over everyday household purchases loaded highly onto *hhaction* (Factor 1 in Table B1). Questions that load high only to *economic* (Factor 2 in Table B1) are control over time spent working on the farm, decision-making about buying and selling large assets and major household purchases, and responsibilities over farming and animals. *hhresp* (Factor 3 in Table B1) consisted of responsibilities over food, market, childcare, and caring for the sick. Finally, *socio-cultural* (Factor 4 in Table B1) had questions on control over social and market time. Interestingly, decision-making over children's education and perceptions on informing the husband when going to the market did not load onto any of the factors across all EFA models, suggesting they capture unique information distinct from the factors identified here. These items are thus excluded from further covariance-based analyses.

In order to validate the four-factor solution, a CFA was carried out using the aforementioned factors and their respective item indicators that constrained cross item-factor loadings and item level correlations to zero. Fit was less than optimal (CFI= 0.92, TLI=0.89, and RMSEA=0.062), as control over general time allocation was highly correlated with *hhaction* and *socio-cultural*. Inspection of the residual correlation matrix also indicated that some covariance remained unexplained between decision-making over major purchases and large assets. Factor loadings for responsibility over market activities and caring for the sick were also low in the constrained CFA model suggesting they were weak indicators of the underlying factors. As a result, these variables were dropped from the model. A second CFA model was constructed using control over general time allocation as an indicator for both *hhaction* and *socio-cultural* to account for their shared covariance with an additional item-level correlation that accounts for the residual correlation observed between decisions about major household purchases and large assets (items B1 and B2). With these minor modifications to the constrained CFA model, fit substantially improved and meets traditional thresholds of model fit (CFI=0.95, TLI=0.93 and RMSEA=0.052). The final factors and

factor loadings for each item are shown in Table B2, and a graphical representation of the model is shown in Figure B2.

Interestingly, there appears to be a relatively strong negative relationship between *economic* and *socio-cultural,* and a relatively strong positive relationship between *socio-cultural* and *hhaction*. In the real world, we expect different dimensions of autonomy to be related to one another, and these correlations provide some insight into these relationships of autonomy. Finally, factor scores are estimated for each factor for all respondents, thus providing a measure of autonomy in each identified dimension for each respondent. Factor scores are distribution-based and are interpreted like conventional Z-scores with a mean of 0 and standard deviation of 1.

Figure B1: Scree Plot from exploratory factor analysis

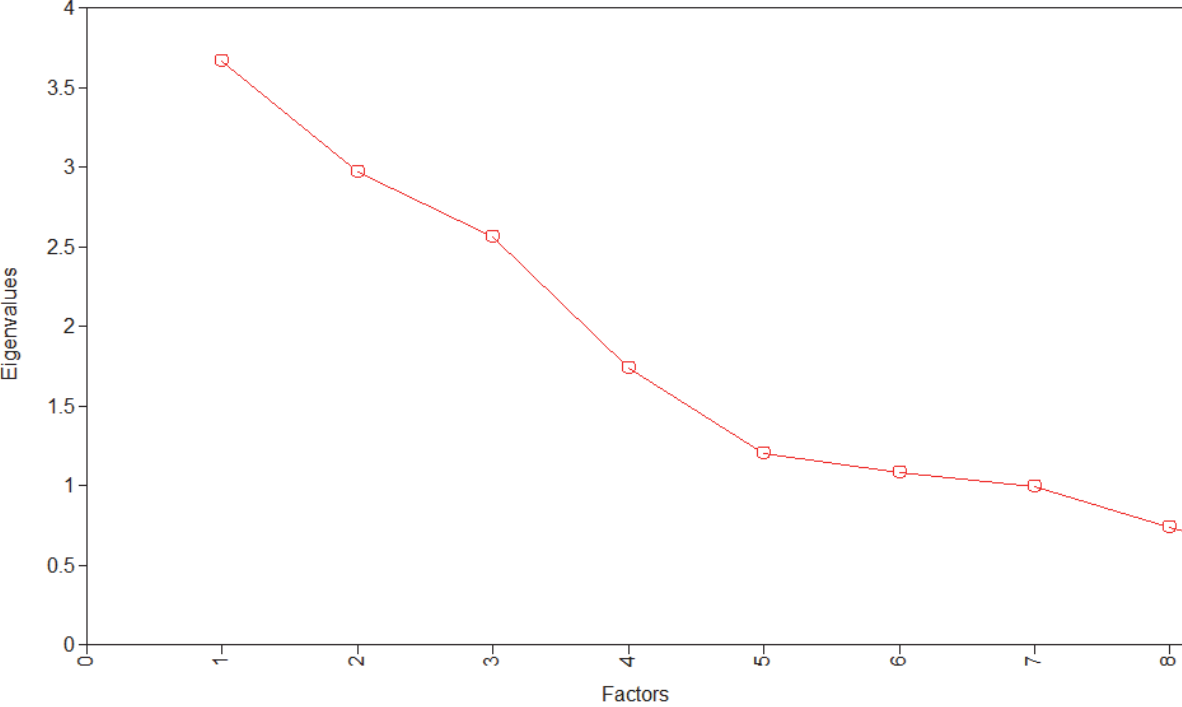
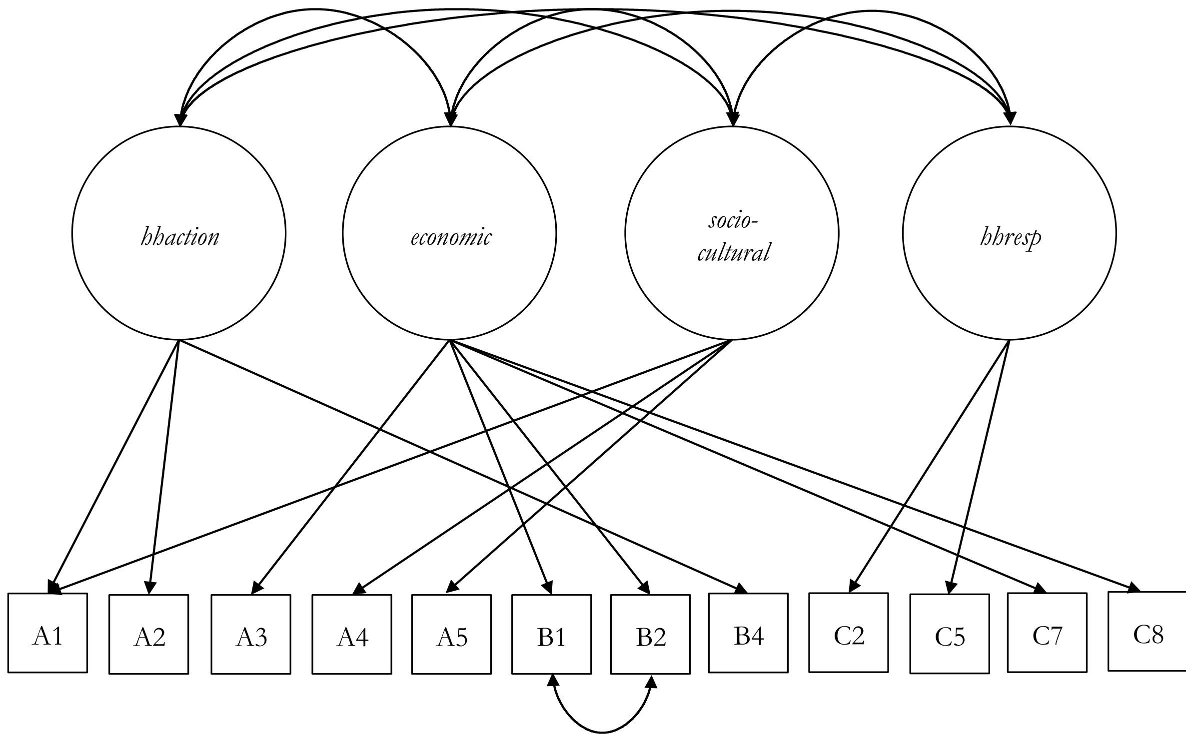


Table B1: Exploratory factor analysis diagnostics

Panel A: Eigenvalues from EFA	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**	**CFI**	**TLI**	**RMSEA**
Factor 1	3.66	0.69	0.23	0.23	0.56	0.49	0.10
Factor 2	2.97	0.41	0.19	0.41	0.74	0.65	0.085
Factor 3	2.56	0.82	0.16	0.57	0.88	0.82	0.061
Factor 4	1.74	0.54	0.11	0.68	0.94	0.88	0.05
Factor 5	1.20	0.12	0.08	0.76	0.97	0.94	0.036
Factor 6	1.08	0.09	0.07	0.83	0.99	0.98	0.021
Factor 7	1.00	0.26	0.06	0.89	1.0	1.0	0.00
Factor 8	0.74	0.24	0.05	0.93	1.0	1.0	0.00
Panel B: Four factor model loading[a]	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**			
A1: Time generally	0.70	0.07	0.02	-0.40			
A2: Time on household tasks	0.95	-0.03	-0.07	0.02			
A3: Time on farm work	-0.10	0.56	-0.08	-0.35			
A4: Time socializing	0.40	0.06	-0.08	0.57			
A5: Time at the market	0.47	-0.12	0.14	0.54			
B1: Major household purchases	0.05	0.89	0.56	0.05			
B2: Selling large assets	-0.12	0.62	0.44	-0.18			
B3: Children's education	0.05	0.19	0.01	0.28			
B4: Everyday household purchases	0.54	-0.21	0.12	-0.13			
C1: Responsible for household	-	-	-	-			
C2: Responsible for food	0.01	-0.02	0.70	-0.55			
C3: Responsible for firewood	-	-	-	-			
C4: Responsible for water	-	-	-	-			
C5: Responsible for childcare	0.09	0.02	0.88	-0.46			
C6: Responsible for market	-0.03	-0.50	0.89	0.06			
C7: Responsible for farming	-0.20	0.62	0.05	0.45			
C8: Responsible for animals	0.16	0.75	-0.12	-0.01			
C9: Responsible for other work	-	-	-	-			
C10: Responsible for caring for sick	-0.05	0.01	0.54	0.50			
D1: Can leave household	0.00	-0.06	0.12	0.22			

[a]Different shades indicate varying factor loading cutoffs. The ***dark gray*** indicates a 0.20 cutoff, a ***medium gray*** shade indicates a 0.30 cutoff, and a ***light gray*** indicates a 0.40 cutoff. Note that the 0.20 cutoffs include *all* shades of gray, the 0.30 cutoff includes ***dark gray*** and ***medium gray*** cells, and the 0.40 cutoff only includes ***light gray* cells.** Refer to Table 2 for specific questions

Figure B2: Final four factor model for confirmatory factor analysis[a,b]



[a] Circles represent latent factors and squares represent items. The questions of the items are presented in Table 2.
[b] *hhaction* refers to autonomy over household actions, *economic* refers to *economic* autonomy, *socio-cultural* refers *socio-cultural* autonomy, and *hhresp* refers to autonomy over household responsibilities.

Table B2: Standardized factor loadings for final CFA four factor solution[a]

hhaction	**Factor loadings**
Time on hh tasks	0.89
Everyday hh purchases	0.63
Time generally	1.1
economic	
Major purchases	0.36
Large assets	0.54
Time on farm work	0.99
Responsibility for farming	0.44
Responsibility for animals	0.51
hhresp	
Responsibility for food	0.74
Responsibility for childcare	0.93
socio-cultural	
Time socializing	0.47
Time at the market	0.93
Time spent generally	-0.58

[a]*hhaction* refers to autonomy over household actions, *economic* refers to *economic* autonomy, *socio-cultural* refers *socio-cultural* autonmy, and *hhresp* refers to autonomy over household responsibilities.

Appendix C: Correlation matrices for dependent and independent covariates

Figure C1: Correlation matrix for independent variables (Part 1)

	Wife's age	Wife's age squared	Wife's education	Wife works outside household: 0/1	Wife's kinship network	Husband is present	Marital experience
Wife's age squared	0.981						
Wife's education	-0.206	-0.200					
Wife works outside household: 0/1	-0.228	-0.207	0.028				
Wife's kinship network	-0.073	-0.081	-0.093	-0.088			
Husband is present	0.084	0.087	-0.047	-0.023	0.045		
Marital experience	0.345	0.335	-0.051	-0.057	-0.049	-0.047	
Husband and wife difference in kinship network	-0.278	-0.256	0.120	0.062	-0.490	-0.097	-0.053
Husband and wife difference in number of times married	0.088	0.077	-0.044	0.011	-0.019	0.004	-0.074
Husband and wife difference in education	-0.214	-0.225	-0.083	0.023	-0.015	-0.022	-0.050
Husband and wife age difference	0.071	0.028	-0.116	-0.019	-0.007	0.010	0.118
Proportion of hh that is female	0.049	0.052	-0.060	0.008	-0.029	0.009	-0.034
Household size	0.108	0.025	0.087	-0.134	0.051	0.031	-0.115
# of productive livestock. horses donkeys mules cows oxen	0.260	0.217	0.075	-0.153	-0.049	-0.051	-0.003
Log of total household income	-0.215	-0.227	0.153	0.099	0.026	-0.086	-0.134
Bishikiltu	-0.061	-0.051	-0.115	-0.075	0.109	0.106	0.020
Tutekunche	0.089	0.086	0.238	-0.074	-0.102	-0.128	0.027
Kelecho Gerbi	-0.024	-0.030	-0.109	0.141	-0.011	0.015	-0.044

Figure C2: Correlation matrix for independent variables (Part 2)

	Husband and wife difference in kinship network	Husband and wife difference in number of times married	Husband and wife difference in education	Husband and wife age difference	Proportion of hh that is female	Household size	# of productive livestock. horses donkeys mules cows oxen	Log of total household income	Bishikiltu	Tutekunche	Kelecho Gerbi
Husband and wife difference in kinship network											
Husband and wife difference in number of times married	-0.059										
Husband and wife difference in education	0.075	-0.047									
Husband and wife age difference	-0.146	0.375	0.031								
Proportion of hh that is female	0.002	0.119	-0.091	0.049							
Household size	-0.071	-0.099	0.146	0.066	-0.103						
# of productive livestock. horses donkeys mules cows oxen	-0.075	-0.067	0.106	0.031	-0.098	0.545					
Log of total household income	0.086	-0.038	0.130	-0.126	-0.073	0.221	0.319				
Bishikiltu	0.073	-0.048	-0.012	-0.039	-0.029	-0.123	-0.136	-0.084			
Tutekunche	-0.054	0.025	-0.037	0.033	-0.041	0.051	0.084	-0.019	-0.449		
Kelecho Gerbi	-0.021	0.023	0.046	0.008	0.067	0.072	0.054	0.099	-0.555	-0.494	

Appendix D: Divorce in Ethiopia

Recent research has highlighted the state of marriage in Ethiopia. Ethiopia has over 82 ethnicities, and as a result there are numerous norms on marriage and divorce. Still, recent research found that the gender norms on property ownership, inheritance, and division of assets upon divorce favor men (Fafchamps and Quisumbing 2005). More recently, divorce as a legal institution has been reformed to equally favor men and women, and divorce is a common, credible, and available option to married couples since the passage of the Revised Family Code (Federal Democratic Republic of Ethiopia 2000). The law gave equal rights to men and women within marriage, and requires that all assets be divided equally upon divorce (Federal Democratic Republic of Ethiopia 2000; Hallward-Driemeier and Gajingo 2011; Kumar and Quisumbing 2012). The law also requires that men and women give consent, raised the minimum age of marriage to 18 years of age, spouses cannot deny permission to work outside the home, more authority is given to courts when settling disputes such as divorce. Indeed, Hallward-Driemeier and Gajngo (2011) argued that the new law has increased the bargaining power of women. Still, the institution of divorce is common and appears to carry little stigma in the study villages. Approximately 16 and 25 percent of wives and husbands, respectively, in the study have been divorced at least once.

Appendix E: Coefficients from regressions

Table E1: Logistic and OLS regression results for Table 5[a,b]

	Economic autonomy (A)			Socio-cultural autonomy (B)		
	Proxy (1)	Index (2)	Factor (3)	Proxy (4)	Index (5)	Factor (6)
Wife's age	0.05	-0.02	-0.01	-0.05	0.01	0.02+
	(0.10)	(0.026)	(0.006)	(0.11)	(0.013)	(0.008)
Wife's age-squared	-0.00	0.00	0.00	0.00	-0.00	-0.00*
	(0.00)	(0.000)	(0.000)	(0.00)	(0.000)	(0.000)
Wife's education	0.01	0.01	0.01	0.10	-0.01	-0.01
	(0.15)	(0.031)	(0.007)	(0.18)	(0.012)	(0.012)
Wife works	0.11	-0.01	-0.02	0.58	0.05	0.05
	(0.64)	(0.138)	(0.031)	(0.85)	(0.055)	(0.049)
Kinship network	0.12	0.04	0.00	0.26	0.01	0.01
	(0.15)	(0.034)	(0.007)	(0.20)	(0.014)	(0.013)
Husband present	0.70	0.62***	0.14***	1.54	0.06	-0.15***
	(0.59)	(0.134)	(0.026)	(1.00)	(0.044)	(0.038)
Wife marriage count	0.74	0.09	-0.01	0.03+	0.08+	0.08*
	(0.47)	(0.133)	(0.031)	(0.55)	(0.044)	(0.040)
Difference in kinship network	0.14	-0.01	-0.01	-0.09	0.01	0.02+
	(0.12)	(0.022)	(0.005)	(0.10)	(0.010)	(0.009)
Difference in marriage count	0.80	-0.06	-0.03*	-0.06*	0.05*	0.07***
	(0.41)	(0.054)	(0.013)	(0.19)	(0.020)	(0.018)
Difference in education	-0.11*	-0.01	-0.00	-0.17	-0.02+	-0.00
	(0.07)	(0.020)	(0.004)	(0.07)	(0.009)	(0.007)
Difference in age	-0.04	-0.00	0.00	-0.02	-0.01	-0.01*
	(0.03)	(0.007)	(0.002)	(0.03)	(0.005)	(0.003)
Number of under school-aged males	-0.02	0.01	0.02	-0.06	-0.02	-0.06*
	(0.29)	(0.072)	(0.016)	(0.26)	(0.037)	(0.027)
Number of under school-aged females	-0.36	0.00	0.00	-0.19	0.01	-0.04
	(0.27)	(0.074)	(0.018)	(0.36)	(0.013)	(0.029)
Number of school-aged males	0.56*	0.13*	0.03*	0.56*	-0.00	-0.03
	(0.23)	(0.052)	(0.013)	(0.24)	(0.000)	(0.020)

Table E1 (continued)

Number of school-aged females	-0.23 (0.25)	-0.08 (0.056)	-0.01 (0.013)	-0.31 (0.23)	-0.05 (0.036)	-0.03 (0.022)
Number of adult males	0.13 (0.24)	0.02 (0.061)	-0.01 (0.015)	0.12 (0.26)	0.03 (0.022)	0.02 (0.024)
Number of adult females	0.05 (0.39)	-0.01 (0.107)	-0.01 (0.024)	-0.38 (0.30)	-0.06* (0.029)	-0.01 (0.028)
Log total assets and income	-0.18 (0.22)	-0.02 (0.036)	-0.01 (0.008)	0.09 (0.10)	0.02 (0.019)	0.03** (0.011)
Tutekunche	0.56 (0.51)	-0.12 (0.135)	-0.01 (0.032)	-0.68 (0.58)	0.01 (0.037)	0.01 (0.047)
Kelecho Gerbi	0.79 (0.47)	-0.00 (0.106)	0.01 (0.025)	0.19+ (0.57)	0.07 (0.044)	0.01 (0.039)
Constant	1.8 (2.4)	2.6*** (0.58)	0.20 (0.13)	3.9 (2.4)	2.7*** (0.26)	-0.50** (0.289)
R^2	-	0.11	0.12	-	0.11	0.15
BIC	309	987	-6.9	275	647	286
Log-likelihood	-76	-	-	-93	-	-
n	343	343	343	343	343	343

[a] All models estimated with robust standard errors.

[b] All models examining proxy variables are logistic regressions (columns 1 and 4). Coefficients can be interpreted as effects on log-odds of the dependent variable.

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table E2: Coefficient estimates for Table 6[a]

	Economic autonomy (A)			**Socio-cultural autonomy (B)**		
	Proxy (1)	Index (2)	Factor (3)	Proxy (4)	Index (5)	Factor (6)
Wife's age	-0.00 (0.003)	-0.00 (0.003)	-0.00 (0.003)	-0.05 (0.11)	0.01 (0.013)	0.02+ (0.008)
Wife's age-squared	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	0.00 (0.00)	-0.00 (0.000)	-0.00* (0.000)
Wife's education	-0.00 (0.007)	-0.00 (0.007)	-0.00 (0.007)	0.10 (0.18)	-0.01 (0.012)	-0.01 (0.012)
Wife works	-0.02 (0.024)	-0.01 (0.024)	-0.01 (0.024)	0.58 (0.85)	0.05 (0.055)	0.05 (0.049)
Kinship network	-0.01+ (0.004)	-0.01+ (0.004)	-0.01+ (0.004)	0.26 (0.20)	0.01 (0.014)	0.01 (0.013)
Wife marriage count	0.00 (0.017)	0.00 (0.017)	0.00 (0.017)	0.03+ (0.55)	0.08+ (0.044)	0.08* (0.040)
Difference in kinship network	-0.01 (0.014)	-0.02 (0.014)	-0.02 (0.014)	-0.09 (0.10)	0.01 (0.010)	0.02+ (0.009)
Difference in marriage count	0.01 (0.014)	0.01 (0.014)	0.01 (0.014)	-0.06* (0.19)	0.05* (0.020)	0.07*** (0.018)
Difference in education	-0.00 (0.008)	-0.00 (0.008)	-0.00 (0.008)	-0.17 (0.07)	-0.02+ (0.009)	-0.00 (0.007)
Difference in age	-0.00 (0.003)	-0.00 (0.003)	-0.00 (0.003)	-0.02 (0.03)	-0.01 (0.005)	-0.01* (0.003)
Number of under school-aged males	0.00 (0.000)	0.00 (0.000)	0.00 (0.000)	-0.06 (0.26)	-0.02 (0.037)	-0.06* (0.027)
Number of under school-aged females	-0.00 (0.007)	-0.00 (0.007)	-0.00 (0.007)	-0.19 (0.36)	0.01 (0.013)	-0.04 (0.029)
Number of school-aged males	-0.02 (0.024)	-0.01 (0.024)	-0.01 (0.024)	0.56* (0.24)	-0.00 (0.000)	-0.03 (0.020)

Table E2 (continued)

Number of school-aged females	0.03** (0.011)	0.03** (0.011)	0.03** (0.011)	-0.31 (0.23)	-0.05 (0.036)	-0.03 (0.022)
Number of adult males	-0.00 (0.011)	-0.00 (0.011)	-0.00 (0.011)	0.12 (0.26)	0.03 (0.022)	0.02 (0.024)
Number of adult females	0.01 (0.015)	0.01 (0.015)	0.01 (0.015)	-0.38 (0.30)	-0.06* (0.029)	-0.01 (0.028)
Log total assets and income	-0.01 (0.007)	-0.01 (0.007)	-0.01 (0.007)	0.09 (0.10)	0.02 (0.019)	0.03** (0.011)
Tutekunche	0.01 (0.020)	0.01 (0.020)	0.01 (0.019)	-0.68 (0.58)	0.01 (0.037)	0.01 (0.047)
Kelecho Gerbi	0.01 (0.019)	0.01 (0.019)	0.01 (0.019)	0.19+ (0.57)	0.07 (0.044)	0.01 (0.039)
Constant	0.18* (0.083)	0.19* (0.087)	0.20* (0.085)	3.9 (0.070)	2.7*** (0.26)	-0.50** (0.289)
n	337	337	337	343	343	343

[a] All models estimated with robust standard errors.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Agreeing to disagree? The determinants of couples' perceptions of control over wife's decision-making power and its relation to the wife's time use in rural Ethiopia

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Abstract (word count: 169)

This paper investigates two questions: what are the determinants of spousal concordant and discordant perceptions of control over the wife's autonomy over her time allocated to leisure and the market, and how does the wife's actual time allocation differ between these households? This paper does so by combining spousal decision-making responses into five response categories (*wife decides, joint, deferential, husband decides,* and *adversarial*). *Wife decides, joint,* and *husband decides* are concordant response categories, *adversarial* is a discordant response category, and *deferential* represents neither agreement nor disagreement. I find that dominant sources of bargaining power, such as the woman's work status and education, increase the probability for spouses to view decision-making as jointly determined rather than decisions being determined solely by the wife for her time allocation in leisure and the market. In addition, women in discordant households (*adversarial* households) spend up to 11 percent more time (1.7 hours) in social and leisure activities, and up to 6 percent less time (0.95 hours) at the market compared to other households.

Introduction

A vast literature investigates the causes and consequences of women's autonomy in developing countries, yet most studies only investigate the wife's responses about her decision-making authority while ignoring the husband's (Becker 1996; Jejeebhoy 2002; Ghuman et al. 2006). In patriarchal societies where men have the majority of bargaining power, women's perceptions of autonomy and their subsequent actions may be limited and shaped by their spouse's perceptions. The literature on women's autonomy and empowerment acknowledges this (Malhotra et al. 2002), and the empirical literature has found contrasting spousal perceptions of the wife's decision-making power, suggesting the potential limitations of examining only the wife's responses (Jejeebhoy 2002; Becker et al. 2006; Ghuman et al. 2006; Story and Burgard 2012). Not understanding spousal concordance and discordance (or agreement and disagreement) over the wife's decision-making power may be problematic as it overlooks the broader, complex social interactions that affect women's autonomy and well-being. This also has larger implications. Women's autonomy may be an important step for advancing broader development goals, as it has been found to increase household welfare by, for example, increasing prenatal and delivery care (Beegle et al. 2001), investments in children (Quisumbing and Maluccio 2000), and nutritional status of girls (Sahn and Stifel 2010). Despite this, few studies have explored the factors influencing spousal concordant and discordant perceptions of the wife's decision-making power, and no study has examined this in the context of the wife's time allocation.

Considering women's autonomy without including the husband's perceptions can be problematic in two ways. First, there may be inconsistencies between responses to decision-making questions and the actual choices available to women, and this can be especially problematic in patriarchal societies such as Ethiopia (UNFPA 2008). Second, outliers may heavily influence inference on the causes and effects of the wife's decision-making power when examining only the

wife's responses. For example, a woman may report she is free to visit friends and relatives at will, but if the husband disagrees this may indicate disagreement over the extent of her autonomy not captured by the wife's response alone. In this case it is possible that the wife's mobility is more restricted compared with women whose husbands agree their wives are free to visit friends and relatives. Grouping women whose spouses agree and disagree into the same category may miss the range of intrahousehold perceptions, relationships, and actions.

This paper investigates two questions: 1) what are the determinants of spousal concordant and discordant perceptions of control over the wife's autonomy over her time allocated to leisure and the market, and 2) how does the wife's time allocation differ between concordant and discordant households? The results from this analysis contribute to the literature in three ways. First, I use novel decision-making questions from a primary dataset from rural Ethiopia. These new questions ask about the wife's decision-making authority over her own *time allocation*, not the wife's decision-making authority over *household domains* or *individual tasks* as is common in typical household surveys. The new questions take the form, "Who usually makes decisions about how much time you spend on…?", and ask about household tasks, farm work, leisure and socializing (herein referred to as leisure), and the market. This differs from the questions in large-scale surveys, such as the Demographic Health Survey (DHS), which commonly take the form, "Who usually makes decisions about…?", and ask about household domains (e.g., children's schooling or household finances) or individual tasks (e.g., the wife's ability to visit health clinics or relatives). Understanding decision-making over the wife's time allocation is critical, as time may be the most fundamental and valuable resource available to women living in rural poor households, and the ability to control their own time may affect personal and household well-being (Ilahi 2000).

Second, this paper addresses limitations in previous studies that use a dichotomized variable for spousal responses, which may have missed variation in couples' concordant and discordant

responses. Instead, this paper uses a more nuanced classification of couples' responses with three types of concordance (when both spouses agree the wife decides, when decisions are joint, and when the husband decides) and one type of discordance (when both spouses say they have decision-making power over the wife's time allocation).

Finally, studies investigating the association of couples' perceptions of the wife's decision-making power on the wife's actual behavior has largely been limited to health seeking behavior (Jejeebhoy 2002; Allendorf 2007a; Becker et al. 2012; Story and Burgard 2012). I instead investigate how concordant and discordant responses are associated with the wife's time allocation to leisure and the market. These two domains are "gender neutral" domains, which are areas or activities that are not associated with traditional gender roles. These contrast with "gendered" domains, which are domains that are traditionally assigned as female activities by existing social and cultural norms (e.g., household chores and childcare). As a result, gendered domains often have high levels of spousal concordance and tend to lack variation (Allendorf 2007a). Gender neutral domains, however, may be highly contested because existing social and cultural norms do not define clear "ownership" of the domain, and as a result wives in concordant and discordant households may allocate their time differently.

I find that factors traditionally linked to increased female autonomy and bargaining power, such as female labor force participation and education, may have a more limited impact on spousal perceptions of the wife's decision-making authority than expected. These factors increase the probability of decisions being jointly determined, but do not increase the probability that wives will have sole decision-making authority over her own time allocation. Still, wives who work for wages almost always have more decision-making authority than those that do not. Similar to past studies, gender neutral domains explored here show high levels of disagreement compared to gendered domains, suggesting the most contested domains are those without traditional gender roles. Finally,

results indicate a significant relationship between spousal perceptions of the wife's decision-making power and her own time allocation. Wives in discordant households (i.e., households where each spouse claimed decision-making authority) spent significantly more time in social and leisure activities and less time at the market and compared to other households. These findings suggest there is meaningful variation in spousal responses and the wife's behavior, and that it is important to incorporate the husband's responses into decision-making questions.

Background

The empirical literature rarely incorporates the husband's responses when investigating the determinants and effects of the wife's decision-making power. A primary factor is the limited availability of surveys asking both spouses about the wife's decision-making power (Malhotra et al. 2002). Nevertheless, studies eliciting responses from wives and husbands using the same questions rarely make use of these responses. In a review of studies examining women's autonomy (Table A1 in Appendix A), 26 of 31 studies (83 percent) used decision-making questions to investigate women's autonomy. Of these 26 studies, 50 percent (n=13) of studies interviewed both spouses but only used the wife's responses, 30 percent (n=8) interviewed only the wife, and the remaining 19 percent (n= 5) interviewed and used responses from both spouses.

Studies investigating couples' responses to the wife's decision-making authority have largely examined concordance versus discordance over household decisions (Allendorf 2007a; Jejeebhoy 2002; Becker et al. 2006; Anderson et al. 2012; Story and Burgard 2012). Concordance over decision-making authority was found to be associated with increased reproductive healthcare utilization (Allendorf 2007a; Story and Burgard 2012), contraceptive use (Jejeebhoy 2002), and maternal emergency planning (Becker et al. 2006). Only two studies investigated the factors associated with spousal concordance and discordance (Allendorf 2007a; Anderson et al. 2012). Allendorf (2007a)

found that household size was negatively associated with the couples' perception of the wife having at least some decision-making authority, while the wife's age was positively associated with the wife having some say. Meanwhile, Anderson et al. (2012) found that the probability of accord can depend on the decision type and whether it ultimately benefits the entire household. The probability of accord for uncertain livelihood decisions (such as investment in new seeds) increased with compatible spousal risk-taking for uncertain livelihood outcomes, while accord over the private use of money was associated with the age of the spouses. For decisions affecting the entire household, the probability of accord was positively associated with household assets, food security, and presence of young children.

While these studies provide valuable insight into the correlates and consequences of spousal perceptions of the wife's decision-making power, they still have some limitations. First, no study has looked at individual decision-making domains, such as the wife's individual time allocation. Large differences in concordance and discordance within household decision-making domains suggest spousal perceptions may vary considerably for individual domains (Allendorf 2007a; Story and Burgard 2012), especially if the individual domain benefits only the wife versus the entire household.

Second, the majority of studies dichotomized spousal responses to concordance and discordance for some or all of their analyses,[16] and there was little overlap among the studies on how responses were classified. Jejeebhoy (2002) and Becker et al. (2006) dichotomized responses for each decision-making question for when husbands and wives agreed and disagreed, and then summed all dichotomized variables to create the wife's autonomy index for the husband and wife, separately. Allendorf (2007a) collapsed four decision-making questions into one dichotomous variable for the husband and wife, separately. Variables were equal to one if the wife had sole decision-making

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[16] The variation in classifications may be because of the challenges associated with developing "clean" and meaningful indicators for couples' responses (Brauw et al. 2013).

authority in at least one of four of the decision-making questions. Story and Burgard (2012) operationalized couples' responses to concordant categories (wife decides, husband decides, jointly determined, and someone else decides) and discordant (disagreement in responses). Finally, Anderson et al. (2012) explored accord, two types of discord, and two types of indecision, although their main analysis on the probability of accord used a dichotomized variable for spousal responses. Across all studies, few have examined different types of concordance (e.g., spouses agree that the wife decides versus decisions are jointly determined) and discordance.

Theoretical framework

While scholars have taken various approaches to examining spousal perceptions of the wife's decision-making power, they all recognize the role that cultural and social norms play in the wife's decision-making authority. The sociology and anthropology literature emphasize the dominant role culture plays in shaping women's opportunities and freedoms (Stromquist 1995; Kabeer 1997, 1998, 2005; Mason 1998; Narayan 2005). This is especially the case in patriarchal societies where men possess most of the power in the home and community, resulting in expectations that women will be subservient to husbands and thus have limited bargaining power over most individual and household decisions (Haddad et al. 1997; Quisumbing and de la Briere 2000; King and Mason 2001). Social and cultural norms are typically reinforced outside the household through laws, while inside the household women's autonomy may be enabled or limited by the husband's perceptions of the wife's decision-making power.

Economic frameworks take a slightly different approach. Bargaining models tend to parameterize the husband and wife's bargaining power using a Nash bargaining framework and incorporating bargaining via "threat points" (Manser and Brown 1980; McElroy and Horney 1981; McElroy 1990; Lundberg and Pollak 1993). The classic assumption is the utility gained by divorce is

each spouse's threat point, and models include "extrahousehold environmental parameters" such as laws, social norms, and institutions (McElroy 1990). The more recent collective approach conceptualizes household utility as a weighted sum of the husband and wife's utilities where the weight represents the wife's power (Chiappori 1988, 1992; Bourguignon and Chiappori 1994). The assumption is that intrahousehold allocations are Pareto optimal. Decision-making is subject to the intrahousehold balance of power, which implies that, again, in patriarchal societies the husband's perceptions can limit or enable the wife's actions and responsibilities. These models, however, do not directly address spousal concordance and discordance about the wife's decision-making power in individual and household decisions.

More recently, Anderson et al. (2012) directly address spousal concordance and discordance using a property rights framework, which is also the base framework for this paper. This framework builds on cooperative and noncooperative bargaining models, arguing that concordance results from a unitary household model or a zero transaction cost world, while discordance results from imperfectly defined property rights over decision-making. Concordance and discordance are subject to transaction costs associated with negotiating decision-making authority. The lower the transaction costs, the higher the likelihood of well-defined property rights over decision-making authority and thus concordance. Transaction costs are divided into negotiation and monitoring costs, and individual and household characteristics are important to decision-making to the extent they mitigate costs associated with determining decision-making authority. Negotiation costs are expected to decrease with repeated decisions and rise with spousal risk and value differences, and the magnitude of the outcome. Private goods (e.g., personal leisure) have higher negotiating costs relative to public goods, which can result in a higher likelihood for discordance. Clear decision-making hierarchy (such as in patriarchal societies) set by cultural and social norms also decrease negotiating costs and results in a higher likelihood of spousal accord. Monitoring costs are subject to the "visibility and frequency

of decision process and outcome" (page 9, Anderson et al. 2012), and can be higher for activities that are, for instance, geographically distant (e.g., going to the market).

Observable characteristics strengthening the wife's options outside of marriage increase transaction costs and the likelihood of discordance (Anderson et al. 2012). These can be the wife's human capital, level of fertility, social network, and work status. Characteristic differences between spouses may decrease transaction costs, where the wife's characteristics relative to the husband's may result in a decreased likelihood of options outside of marriage if the husband is in a more powerful position (e.g., larger social network and higher levels of education). Household size and wealth (as a proxy for land ownership in subsistence communities) can increase monitoring costs to the extent that these characteristics make it more difficult to monitor behavior for the decision domain, and as a result may increase the likelihood of discordance.

In the context of this study, three points merit further discussion to examine how this framework applies to spousal perceptions of decision-making over the wife's time allocation to the market and leisure. First, the wife's time allocation in leisure is likely a private good, while her time at the market may be a public good if it benefits the household. As a result, spousal decision-making perceptions over the wife's time in leisure is likely to have higher transaction costs and thus have a higher likelihood of being discordant relative to decisions about the wife's time allocated to the market. In addition, the decision-making over the two time allocation questions are gender neutral domains, which are subject to higher negotiation and monitoring costs resulting in a higher likelihood of discordance compared to gendered domains (e.g., decision-making over major household purchases).

Second, although this framework outlines explanations for concordant and discordant spousal perceptions, it is unclear about the factors that are likely to be associated with different types of concordance (i.e., when spouses perceive decisions to be determined by the wife, jointly, or by the

husband). Individual characteristics likely play a large role in determining different types of concordance. Education and labor market experience have been found to expose individuals to new ideas and peer experiences, which may potentially lead to greater familiarity with existing rights, such as divorce laws (Rogers 1995; Schuler et al. 1996; Parveen and Leonhauser 2004; Jejeebhoy 2000; Jejeebhoy and Sathar 2001; Salem 2011). These factors may increase the likelihood spouses prefer joint decisions or decisions by the wife if spousal preferences are homogenous. Further, individuals adhering more strictly to social and cultural norms may have a higher probability of agreeing that the husband has decision-making authority. This may be the case for individuals that are older, less educated, and who do not work outside the household.

Finally, because time allocation is a post-bargaining outcome it may systematically differ between concordant and discordant households. I posit that discordant households are, *ceteris paribus*, more likely to assert preferences towards leisure if it is preferred to work (Ilahi 2000). This may be possible because wives with more options outside of marriage (and thus more decision-making power) are likely to be in discordant households, and they may be in a greater position to assert and act on their preferences for leisure compared to concordant households. Within concordant households, I posit that wives in households where decisions are jointly determined or determined by the wife will spend more time in leisure relative to households where both spouses agree the husband has final say. This is because wives in households where decisions are jointly determined or determined by the wife have at least some say in the final decision. It is unclear whether time at the market is a preferred activity for wives, so there are no *a priori* expectations whether concordant or discordant households allocate more time to the market. If wives perceive going to the market as an unpleasant task, it is likely that discordant households will spend less time at the market relative to concordant households for the reasons discussed above. If it is seen as a pleasant task, however,

discordant households are more likely to spend more time at the market relative to concordant households.

Study site and data

Ethiopia is ranked in the bottom quartile in OECD's Social Institutions and Gender Index (OECD 2013). The most recent report on gender inequality in Ethiopia found girls are often held in inferior positions to boys and are often raised to "conform, be obedient and dependent, and specialize in indoor activities" (page 16, UNFPA 2008). Further, UNFPA (2008) found that women have little or no decision-making power over contraceptive use, participation in social activities, and large household purchases, but have the most authority over daily life activities. Hirut (2004) found qualitative evidence that women perceived themselves to have lower abilities than men, highlighting a self-limiting psychological factor in women's decision-making. Despite this, in the past decades the Ethiopian government has enacted laws favorable to women's autonomy. For instance, the Revised Family Code institutionalized equal rights to men and women within marriage and required the equal division of assets upon divorce, and divorce is a common and credible option in most areas (Federal Democratic Republic of Ethiopia 2000; Hallward-Driemeier and Gajingo 2011; Kumar and Quisumbing 2012).[17] In addition, Ethiopia has made considerable progress towards gender equity at the federal level by instituting an affirmative action system for its national parliament (African Development Bank 2011). In 2004, the proportion of females in the national parliament was 8 percent, and has since increased to 28 percent in 2013 (World Bank 2013). Still, Ethiopia is a diverse country estimated to have at least 82 ethnicities (Fafchamps and Quisumbing 2002), and as a result

[17] Other favorable policies enacted include the 1993 National Policy on Women, the 1994 Education and Training Policy, the 1997 National Cultural Policy, and amendments to the constitution prohibiting gender-based discrimination.

norms and patrimonial traditions can greatly vary resulting in inconsistent implementation of laws improving women's status (UNFPA 2008).

Data come from the 2011 round of a larger study in rural Ethiopia (for more see "Research Design and Study Site" in Masuda and Cook 2013). The study collected village rosters for three villages and then randomly selected 30 percent of households for interviews, resulting in a sample of 452 households. Data from the 343 households (76 percent) with a married head of household are used for this study. The study interviewed spouses separately when asking about the wife's decision-making authority whenever possible, but spouses were present during 15 percent of the interviews (n=53). These households are dropped from the analysis because initial tests indicated that the presence of both spouses influenced responses (see Appendix B).

Four questions covered individual decision-making domains, and four questions covered household decision-making domains (Table 1). Household decision-making questions asked about major household purchases, selling of large assets, purchasing everyday household goods, and children's education. Individual-level questions asked about decision-making over the wife's time allocation to household tasks, farming, at the market, and in leisure. The survey did not ask a question on control over time spent on wage labor, but only 13 percent of wives in the sample reported working for wages. All household decision-making questions and the wife's time allocated to household tasks and farming are gendered domains. The wife's time allocated to leisure and the market are gender neutral domains, and the main analysis uses these two questions. I do so because raw responses show that gendered domains (e.g., time spent on farm work or in household chores) lack variation (Figure 1), just as Allendorf (2007a) and others found.

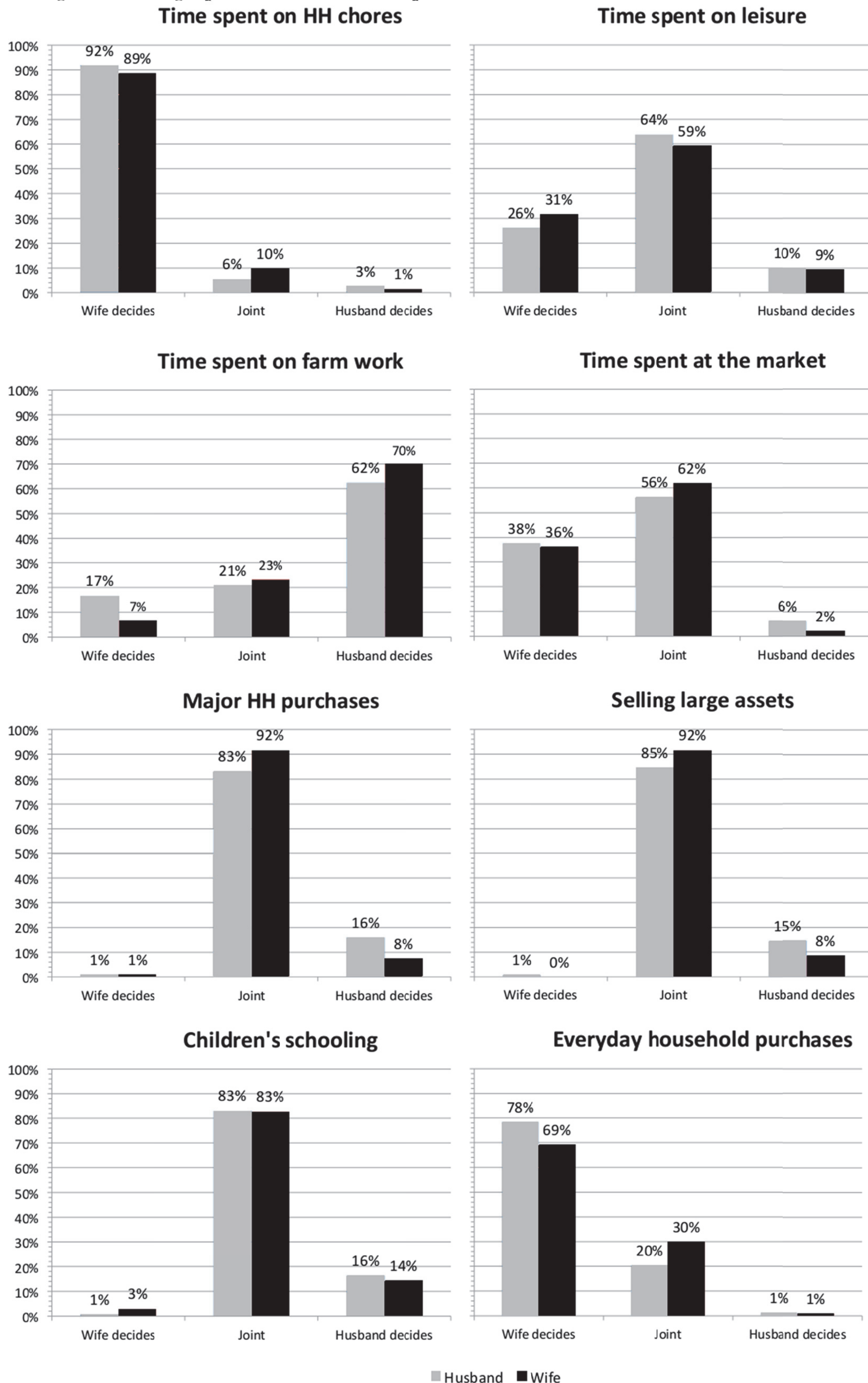
Table 1: Individual and household decision-making questions

Individual[a]	Gendered domain	Gender neutral domain
Who usually makes decisions on how much time you spend on household tasks?	X	
Who usually makes decisions on how much time you spend on farm work?	X	
Who usually makes decisions on how much time you spend on leisure and socializing?		X
Who usually makes decisions on how much time you spend on market?		X
Household[b]		
Who usually makes decisions about major household purchases?	X	
Who usually makes decisions about selling of assets of high value such as land and livestock?	X	
Who usually makes decisions about your children's education?	X	
Who usually makes decisions about making purchases for everyday household needs?	X	

[a] Questions asked to the wife are presented. Questions asked to the husband asked, "Who usually makes decisions about how much time your wife spends on [activity]?"

[b] Questions asked to the wife are presented. Questions asked to the husband asked, "DHS), which commonly take the form, "Who usually makes decisions about [domain]?"

Figure 1: Bar graphs of individual responses from the husband and the wife



The husband and wife separately answered the same question about the wife's decision-making authority (Table 1). Possible responses for each question for the husband were: (1) *me*, (2) *my wife*, (3) *jointly*, or (4) *someone else*. For the wife, possible responses were: (1) *my husband*, (2) *me*, (3) *jointly*, or (4) *someone else*. Categories for *someone else* and *me* (*my husband*) are combined into one category because in both cases the husband and the wife both state that decision-making is not determined jointly or by herself, indicating that both individuals agree that someone other than the wife has decision-making power (Allendorf 2007 also collapses categories in this way). Thus, the wife's responses are (1) *myself*, (2) *jointly*, and (3) *my husband*, while the husband's responses are (1) *my wife*, (2) *jointly*, and (3) *myself*.

In addition, I use time use data to explore whether variation in spousal concordance and discordance over the wife's decision-making power result in actual differences in the wife's behavior. Time use data were collected for household members ages 10 and above using a pictorial approach (Masuda et al. 2012). Respondents recalled the previous day's activities using predefined activity categories capturing all possible activities in a day. The two time use categories explored in this paper are the wife's time spent at the market and in leisure. Time allocated to the *market* includes time spent traveling to and from the market, as well as time spent at the market. The wife's time in *leisure* includes time spent eating, visiting or caring for the sick, socializing, attending coffee ceremonies, at community meetings, church, funerals, or relaxing.

Categorizing couples perceptions on the wife's decision-making authority

Table 2 presents a classification of couples' responses for the wife's decision-making authority identifying agreement and disagreement.[18] **(1) *Wife decides*** indicates responses where the

[18] Alternative classifications were explored (see Appendix C), but they had less precise definitions of spousal agreement and disagreement and as a result were not as informative (Table C1 and C2 in

wife is perceived to have power over decision-making by both spouses, and **(2)** ***Joint*** indicates the condition where decision-making is jointly determined. **(3)** ***Deferential*** indicates responses where disagreements exist over decision-making authority and at least one spouse concedes some authority to the other. I assume that responses indicate that the husband perceives he has more decision-making authority than the wife, that the wife is not fully aware of her decision-making authority, or that the wife is under the assumption that she has more power than she actually possesses. **(4)** ***Adversarial*** represents a conflicting position over decision-making authority. Finally, **(5)** ***Husband decides*** shows the position where both spouses agree the husband has power over decision-making. One of the main assumptions of this classification is that responses reflect the true state of decision-making in the household, and that there is little to no measurement error (see Lokshin and Ravallion 2008 for similar assumptions). In addition, the classification assumes that the husband's perception influences actual decision-making, which is a plausible assumption given existing social and cultural norms.

The top-left to bottom-right diagonal axis displays concordant responses, and is similar to past studies on spousal concordance with the exception that it differentiates concordance into three different categories. *Adversarial* and *deferential* are discordant responses, although *adversarial* is different in that it shows active disagreement while *deferential* shows passive disagreement. The *adversarial* category is a unique classification explored in this paper, which is of particular interest because it may represent households where empowerment is actually occurring. Indeed, if empowerment is a dynamic process where women gain further control over their own lives, *adversarial* households may represent a case of this occurrence.

Appendix C). Findings, however, are similar for *joint* and *adversarial* categories, as these classifications remain the same.

The *deferential* category merits further discussion because previous studies have differed in their treatment of this category, with some defining it broadly, and others defining it more narrowly. Story and Burgard (2012) broadly defined *deferential* by grouping *adversarial* and *deferential* responses, arguing that all discordant responses lacked any clear pattern to be divided into further categories. It is possible that the decision-making domain influences whether discordant responses provide meaningful information, and gender neutral individual decision domains (such as those explored in this paper) may provide more meaningful variation in spousal responses. Indeed, Story and Burgard (2012) investigated decision-making over maternal health care usage, which is a household domain that arguably requires more spousal communication compared to the wife's time allocation. Meanwhile, Anderson et al. (2012) took the opposite approach by classifying *deferential* responses into three categories for part of their analysis. Unfortunately, the sample size did not permit this classification.

Table 2: Classification for spousal perceptions of the wife's decision-making power[a]

		Husband's response		
		My wife	**Jointly**	**Me**
Wife's response	**Me**	(1) Wife decides	(3) Deferential	(4) Adversarial
	Jointly	(3) Deferential	(2) Joint	(3) Deferential
	My husband	(3) Deferential	(3) Deferential	(5) Husband decides

[a] Alternative classification schemes are explored in Appendix C.

Table 3: Distribution of decision-making questions

Panel A: Raw responses		
	Time in leisure	Time at the market
Wife decides	7%	13%
Joint	38%	34%
Deferential	50%	50%
Adversarial	4%	3%
Husband decides	1%	0%
Initial *n*	343	343
Panel B: Analytic sample		
Wife decides	8%	15%
Joint	33%	28%
Deferential	55%	54%
Adversarial	4%	3%
Husband decides	-	-
% dropped due to small cell sizes	1%	0%
% dropped because spouse present	15%	15%
Final *n*	288	290

Panel A in Table 3 presents raw responses fitting the classification outlined in Table 2, while Panel B in Table 3 presents the distribution of responses for the final analytic sample. *Husband decides* is dropped from the final sample for the wife's time in leisure because the cell size was insufficient for further analysis (just 1 percent of the sample). One option would be to collapse categories with small cell sizes with other categories, but the classification scheme allowed little overlap across categories in any meaningful way. In addition, as stated above I drop households where the husband was present during the household survey because tests indicate the husband's presence influenced responses (see Appendix B). Thus, the final sample includes 288 households for spousal responses about decision-making over the wife's time in leisure, and 290 households for spousal responses about decision-making over the wife's time at the market.

Empirical strategy

This paper uses two models. First, the determinants of spousal perceptions of the wife's decision-making power are estimated using a multinomial logistic regression (the five categories described above, less *husband decides*). Second, a linear regression estimates the relationship between spousal perceptions of the wife's decision-making power and the wife's time use. Although the wife's time use is endogenous to spousal perceptions of the wife's decision-making power over her own time, exploring this relationship is a first step in understanding if there are any meaningful associations between spousal perceptions and the wife's actual behavior. All models are estimated with robust standard errors.

The multinomial model has four unordered categories following the classification outlined above such that k = 1, 2, 3 and 4 for selected dependent variables. Let k = 1 be the baseline category, which for all models will be *deferential*. $\boldsymbol{y}^*$ is a latent variable such that:

$$y_{ij}^* = \beta_{ij}\boldsymbol{X_{ij}} + \gamma_{ij}\boldsymbol{Z_{ij}} + \delta_j\boldsymbol{v_j} \tag{1}$$

The regression equation can then be written as:

$$P\left(y_{ij}^* = k \middle| \boldsymbol{X_{ij}}, \boldsymbol{Z_{ij}}, \boldsymbol{v_j}\right) = \frac{exp(\beta_{ij}\boldsymbol{X_{ij}} + \gamma_{ij}\boldsymbol{Z_{ij}} + \delta_j\boldsymbol{v_j})}{\sum_{k=1}^{4} exp(\beta_{ij}\boldsymbol{X_{ij}} + \gamma_{ij}\boldsymbol{Z_{ij}} + \delta_j\boldsymbol{v_j})} \tag{2}$$

for $\boldsymbol{i}$ = 1,…,N and $\boldsymbol{j}$ = 1, 2, 3. The choice probabilities must sum to 1.

For the regression estimating the relationship between spousal perceptions of control over the wife's time and her actual time use, $\boldsymbol{t_{ij}}$ is the wife's time spent in an activity and can be written as:

$$t_{ij} = \beta_0 + \beta_1 \boldsymbol{x}_{ij} + \beta_2 \boldsymbol{z}_{ij} + \boldsymbol{v}_j \beta_3 + \boldsymbol{y}_{ij} \beta_4 + \varepsilon_{ij} \qquad (3)$$

In all equations *i* indexes the household and *j* the village. $\boldsymbol{X_{ij}}$ is a vector of covariates representing the wife's characteristics, $\boldsymbol{Z_{ij}}$ represents spousal difference characteristics and other household-level covariates, $\boldsymbol{v_j}$ are the village dummy variables, $\boldsymbol{y}_{ij}$ represents the spousal responses. The reference category is *adversarial*.[19] (Figures D1 and D2 in Appendix D present correlation matrices for dependent and independent variables).

Individual covariates include the wife's age, age-squared, education, kinship network, number of marriages, and a dummy variable capturing whether the wife works outside the home for wages.[20] Employment is dichotomous and is defined as any wage-earning work, including work that is in the informal sector. Number of marriages is the number of times married, and kinship network is the number of siblings that live within the same subvillage. Differences in observable spousal characteristics include differences in age, education, number of marriages, and kinship network. In all cases, differences are simply the husband's characteristics relative to the wife's characteristics. Household characteristics include household age and sex composition, and the log of household assets and income. The cell sizes for spousal response categories may be of concern, but note that in

[19] Note that the reference category in all multinomial models was *deference*. Small cell sizes are not a concern given that the model converges using different reference categories and meets the criteria outlined by Hosmer et al. (2013). Finally, the paper presents marginal probabilities, which is the same for regardless of the selected reference category.

total there are 19 covariates, or about 15 cases, per independent variable. For multinomial logistic regressions, Hosmer et al. (2013) recommended a minimum of 10 cases per independent variable.

Table 4: Descriptive statistics

Panel A: Wife's time allocation	**Mean**	**SD**
Time spent at the market (hours)	0.88	(0.11)
Time spent socializing and in leisure (hours)	3.8	(0.13)
Panel B: Individual		
Wife's age	37	(14)
Highest grade attained by wife	0.71	(1.73)
Size of wife's kinship network	0.67	(1.55)
Number of times wife has been married	1.21	(0.49)
Wife works for wages (%)	13	(34)
Panel C: Differences in spousal characteristics		
Difference in size of kinship network between husband and wife	1.46	(2.49)
Difference in number of times married between husband and wife	0.22	(0.93)
Difference in educational attainment between husband and wife	1.88	(3.07)
Difference in age between husband and wife	8.28	(6.92)
Panel D: Household characteristics		
Number of under school-aged males	0.55	(0.70)
Number of under school-aged females	0.54	(0.67)
Number of school-aged males	1.06	(1.03)
Number of school-aged females	0.88	(0.91)
Number of adult males	1.58	(0.89)
Number of adult females	1.33	(0.66)
Total value of assets and income[a]	18,178	(763)
Bishikiltu (%)	31	(46)
Tutekunche (%)	31	(46)
Kelecho Gerbi (%)	38	(49)
n	290	

[a] Figures are reported in Ethiopian Birr, and 1 U.S. dollar was approximately 17 Ethiopian Birr in July 2011. Assets include productive livestock, which include horses, donkeys, mules, cows, and oxen. Prices for livestock are obtained from the July 2011 retail price report published by the Central Statistical Agency in Ethiopia. http://www.csa.gov.et/images/documents/pdf_files/retailprice/2011/july2011.pdf

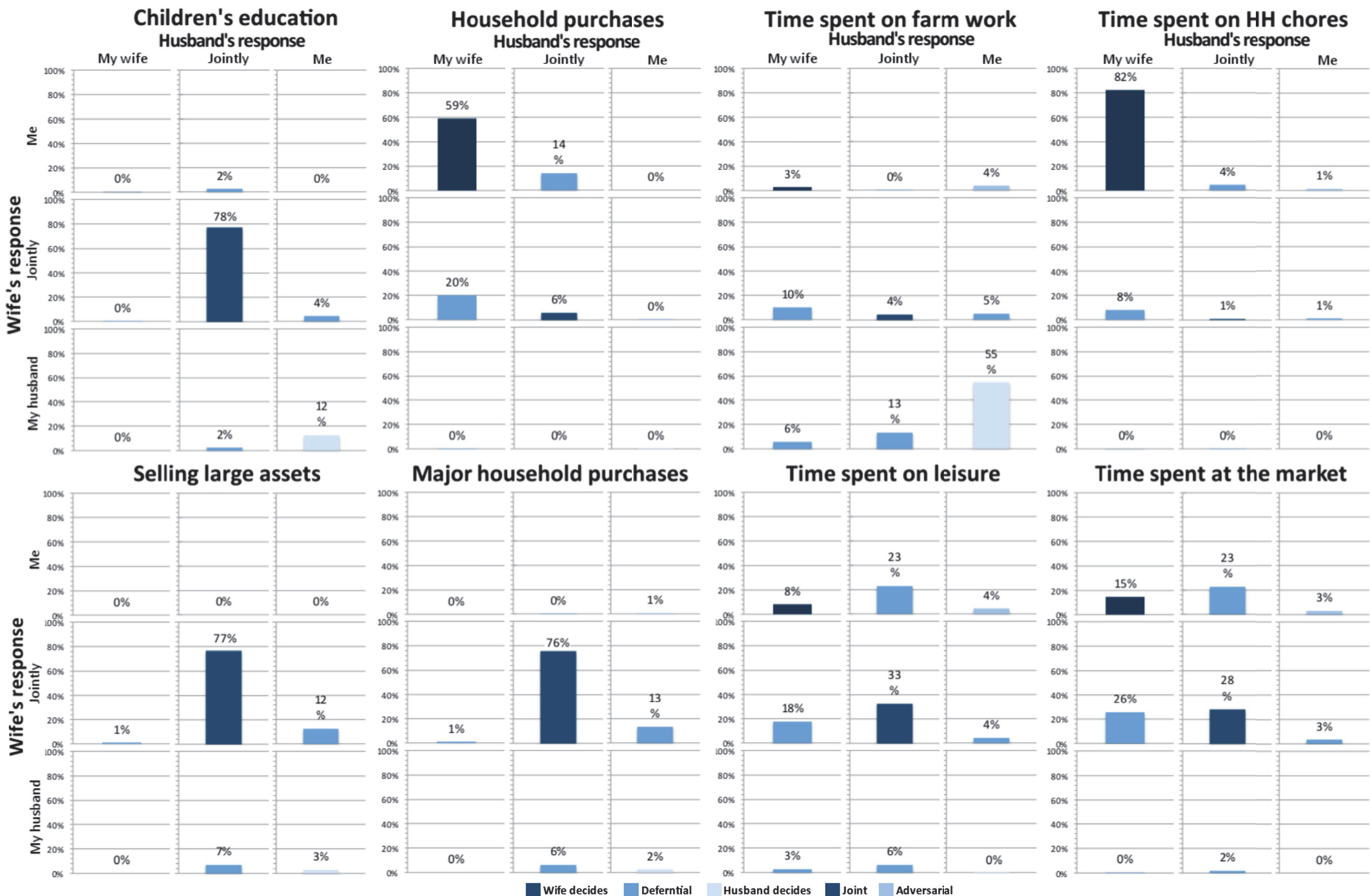
[20] Alternative models were estimated using a dichotomous education variable (ever received formal education) and a dichotomous marriage variable capturing whether a spouse has ever been divorced (Tables E4-E7 in Appendix E).

Results: Descriptive statistics

Wives in the study have completed, on average, one year of education (Table 4). Although wives are on average 37 years old, the age distribution skews younger with the youngest wife being 15 years old and the median age being 33 years old. This age distribution is comparable to much of Ethiopia. Thirteen percent of wives reported working for wages, comparable to the 18 percent of husbands that also work for wages. Husbands are generally in more dominant positions than wives: they have larger kinship networks, are married more, have more education, and are, on average, 8 years older than wives. The average household size was approximately six people. Annual household income was approximately 225 U.S. dollars given 2011 exchange rates, and nearly all households relied on subsistence farming.

Figure 2 plots the distribution of spousal responses for household and individual decision-making questions using the classification scheme outlined in Table 2. As expected, gendered domains (i.e., decisions about children's education, household purchases, selling large assets, major household purchases, and the wife's time allocated to farm work and household chores) all have higher levels of concordance compared to gender neutral domains (decisions about the wife's time in leisure and the market). This supports the hypothesis that transaction costs are higher for gender neutral domains. At least one concordance category in every gendered domain had over 50 percent agreement between spouses, and this was the highest for the wife's time allocated to household chores (82 percent of spouses stated the wife had decision-making authority). Interestingly, no household reported the wife had decision-making authority over major household purchases, selling large assets, or over children's education, with nearly all concordance being *joint*. Further, in half of the gendered domains there were no *adversarial* positions, and most discordance was passive disagreement (i.e., *deferential*). For gender neutral domains, the highest category of concordance was for the wife's time in leisure, with 33 percent of households agreeing decisions were *joint*.

Figure 2: Combined spousal responses for standard and new decision-making questions



The similar distribution of concordant and discordant spousal responses for the wife's time in leisure and at the market indicates that the wife's time at the market may not be seen as a public good. Closer inspection of the types of concordance shows spouses agree the wife has decision-making authority over her own time at the market at twice the rate as her time in leisure (15 percent vs. 8 percent), suggesting that monitoring costs are higher for the wife's time allocated to leisure than her time at the market.

A deeper look at household responses in the *deferential* category provides some interesting insights. The majority of households with *deferential* positions had at least one spouse perceive decision-making was jointly determined. Wives were more likely to report decisions were *joint* when their husbands reported that the wife had no decision-making authority at all (up to 96 percent of this subset of responses), thus highlighting the expected patriarchal social norms common in Ethiopian society. In addition, only the question on time spent in leisure had any "full deference" responses (i.e., situations where the wife responded that she had no say while husbands responded that it was solely the wife's decision). Although this was only for nine households, these responses highlight situations where women's own beliefs limited their decision-making power.

Results: Predicted probabilities

I report predicted probabilities of responses falling into one of the four categories to explore substantive implications of spousal perceptions of the wife's decision-making power over individual and household domains.[21] I first investigate standardized coefficients of covariates for each category. Coefficients are standardized for ease of comparison between independent variables.[22] I then estimate the predicted probabilities of each decision-making domain (time in leisure and time at the

[21] Table E1 in Appendix E presents coefficients from the multinomial logistic regression models for each outcome. The base category is *deferential*.

market) for changes in values of key statistically significant covariates of interest, looking at cases where the wife works and does not work for wages.

Standardized marginal effects

Figure 3 shows the changes in predicted probability that all covariates have on each outcome, with blue highlighted and underlined letters denoting statistically significant associations at the 0.10 level. There is mixed evidence that characteristics strengthening options outside of marriage increase the likelihood of spousal discordance. The wife's education and work status increases the likelihood of *joint* positions for time allocation domains, while the number of marriages increases the probability of being in *deferential* (or passive disagreement). Differences in spousal characteristics also provide mixed support for the hypothesis that larger differences favoring the wife will lead to higher levels of discordance. For time in leisure, differences in the number of marriages increase the probability of *adversarial*. For the wife's time at the market, however, differences in the number of marriages and differences in age increase and decrease, respectively, the probability of *wife decides* positions. Finally, household characteristics were expected to increase monitoring costs, and thus increase the likelihood of discordance. There appears to be evidence to support this, as household wealth decreases the probability of *joint* positions while increasing the probability of *adversarial* positions for time in leisure.

[22] Tables E2-E3 in Appendix E report unstandardized marginal effects.

Figure 3: Changes in predicted probabilities for standardized marginal effects[a,b,c]

Time in Social/Leisure

Time at the Market

Wife's age
Wife's education
Wife's kinship network
Wife's marital exp
Diff kinship network
Diff marital exp
Diff education
Diff age
males <6
females <6
males 7-15
females 7-15
males >15
females >15
Log assets and income
Wife works

-.1 -.08 -.06 -.04 -.02 0 .02 .04 .06 .08 .1

-.35 -.3 -.25 -.2 -.15 -.1 -.05 0 .05 .1 .15 .2 .25 .3 .35

Changes in Predicted Probabiliy

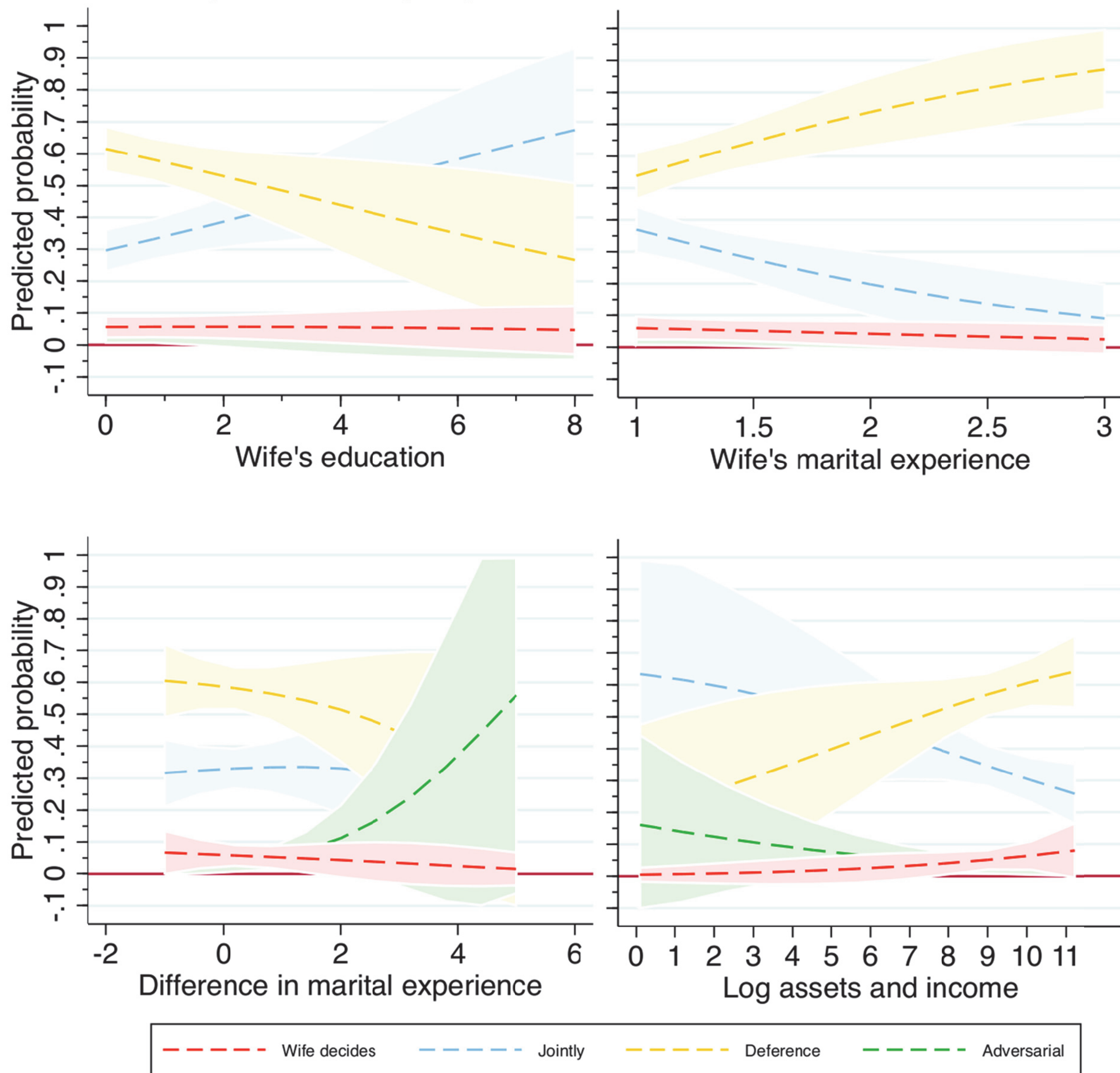
[a] **D** refers to *deferential*, **J** to *joint*, **W** to *wife decides*, and **A** for *adversarial* positions.
[b] *Wife works* shows the effect of a discrete change from 0 to 1 on the predicted probability of each category. All other coefficients are standardized and show the effect of a one-unit change on predicted probability of a category. Variables that are highlighted in blue are statistically significant at 0.10 level, and predicted probabilities are calculated with all other variables held constant at their means.
[c] See Tables F2-F4 in Appendix E for marginal effects.

Outcome 1: Time spent in leisure

Figure 4 shows the predicted probability of membership in each decision category for the wife's time in leisure across the full range of values for the wife's education, number of marriages, difference in the number of marriages, and value of household assets and income. Although small, the magnitude of effects vary by the wife's working status for all variables (not shown), and decision-making categories are always more advantageous for wage-earning wives. The wife's educational attainment has the largest positive association on the likelihood of being in the *joint* category, supporting the hypothesis that more educated wives are likely to be in *joint* positions if spousal preferences are homogenous. Wives who have married more, however, significantly decreases the probability of *joint* positions while increasing the probability of *deferential* positions.

The probability of being in the *adversarial* position increases in households where husbands have married more than their wives. Wealthier households appear to be less favorable to the wife's decision-making authority. The likelihood of *joint* positions decreases while that of *deferential* increases, suggesting that monitoring costs are higher for wealthier households. Interestingly, none of the examined covariates increase the probability of *wife decides* for time spent in leisure. This is the case even for households where the wife works outside the household and has the maximum educational attainment, presumably the scenario where the wife has the greatest level of bargaining power.

Figure 4: Predicted probabilities for perceptions of decision-making over the wife's time in leisure[a]

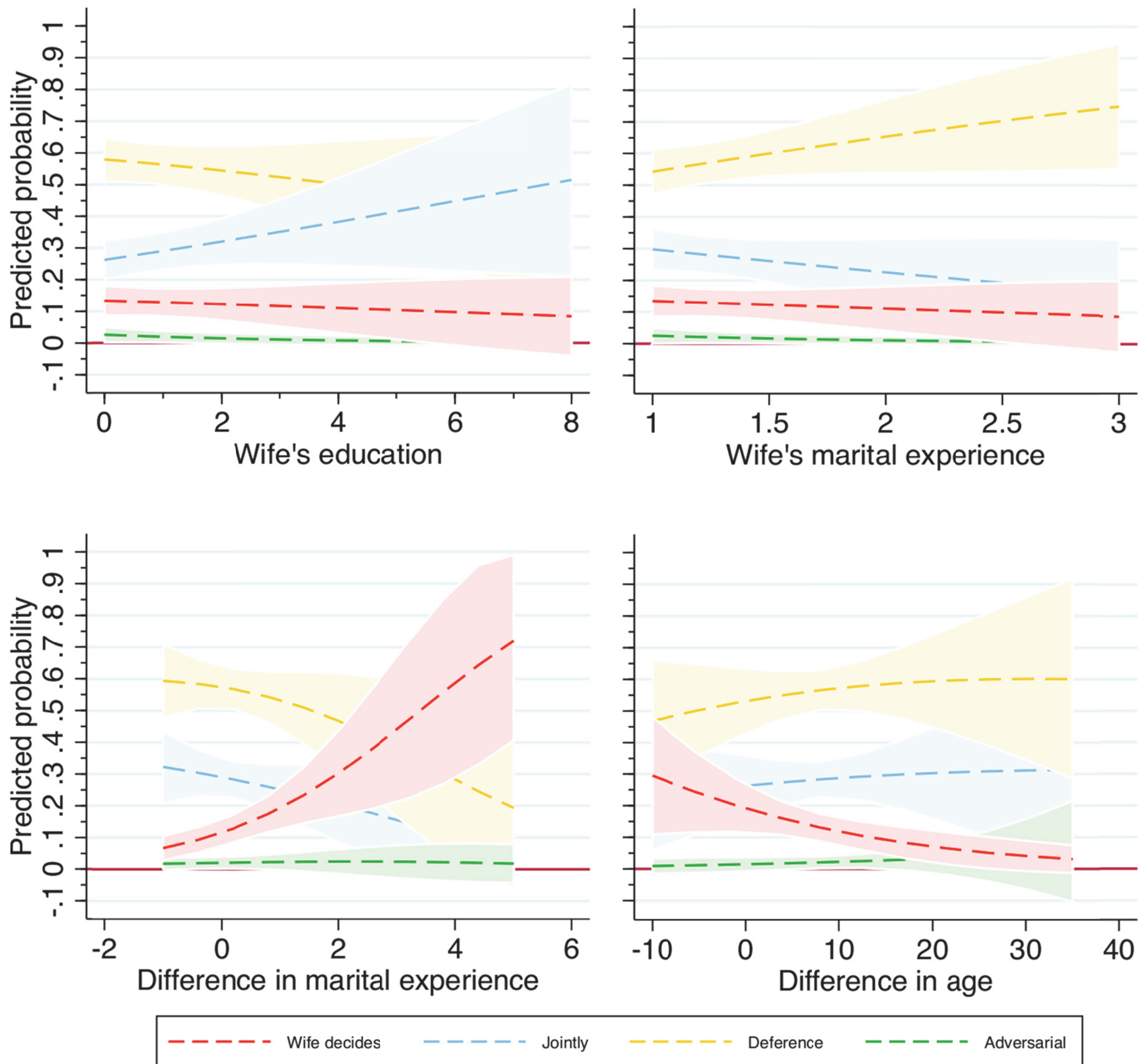


[a] Predicted probabilities are calculated by varying the wife's education, number of marriages, and log household assets and income. All other variables are held at their mean values. 5-95 percent ranges are shown

Outcome 2: Time spent at the market

Figure 5 plots the predicted probabilities for the wife's time at the market across the full range of values for the wife's education, number of marriages, difference in the number of marriages, and difference in age. Again, although the magnitude is small, wives who work are almost always at a more advantageous position than those that do not work (not shown). *Joint* or *deferential* positions (or passive disagreement) are the most likely. *Adversarial* positions are unlikely regardless of the wife's work status across any of the key variables of interest. There is a significantly higher probability of *wife decides* in households where husbands have married more times than the wife, suggesting that the husbands that have been married more decreases transaction costs by decreasing the wife's options outside of marriage. Finally, larger spousal age differences decrease the probability of *wife decides*. Note that age differences are not significantly correlated with differences in the number of marriages, and the probability of being in the *wife decides* position increases for older wives (data not shown).

Figure 5: Predicted probabilities for perceptions of decisions-making over the wife's time at the market[a]



[a] Predicted probabilities are calculated by varying the wife's education, number of marriages, differences in the number of marriages, and differences in age. All other variables are held at their mean values. 5-95 percent ranges are shown.

Results: The relationship between spousal perceptions and the wife's time use

The results so far show the factors associated with spousal perceptions of the wife's decision-making power, but they do not provide information on how this influences the wife's actual behavior. Table 5 below explores the relationship between spousal perceptions on the wife's decision-making authority over her time spent at the market (columns 1 and 2) and in social and

leisure activities (columns 3 and 4) on her time allocation in those activities. The reference category is *adversarial* for all regressions, as we expect behavior to differ significantly for this group. Wives in *adversarial* households spend up to 11 percent more time (1.7 hours) in social and leisure activities and up to 6 percent less time (0.95 hours) at the market compared to other households. In both cases *adversarial* households have large contrasts with *wife decides* and *deferential* households. Joint tests of significance show spousal perceptions are not significant for the wife's time spent in social and leisure activities, while spousal perceptions are jointly significant at $p<0.001$ for the wife's time at the market.

These findings are in line with expectations that leisure is a private good, and that wives in discordant households are more likely to be in positions to assert their preferences for leisure because they have tend to have characteristics that increase their options outside of marriage (and thus bargaining power). Interestingly, wives in *adversarial* households spending less time at the market suggests that the wife's time allocated to the market may be seen as a private good. This contrasts the finding that there were no large differences in concordance and discordance between spousal perceptions over the wife's time at the market versus her time in leisure. Importantly, spousal perceptions are clearly associated with the wife's time use, and thus actual behavior.

Table 5: Spousal perceptions of the wife's decision-making power and the wife's time use[a,b]

	Time at the market		Time in social and leisure	
	(1)	(2)	(3)	(4)
	% of daily time	Hours	% of daily time	Hours
Wife decides	0.06**	0.95**	-0.11+	-1.68+
	(0.023)	(0.353)	(0.058)	(0.885)
Joint	0.06**	0.86**	-0.07	-1.25
	(0.019)	(0.299)	(0.051)	(0.798)
Deferential	0.06***	0.87***	-0.10+	-1.49+
	(0.017)	(0.260)	(0.051)	(0.812)
F-stat	4.72	4.55	1.74	1.38
R^2	0.06	0.06	0.12	0.13
BIC	-302.83	1282.48	-186.41	1340.18
n	289	289	287	287

[a] Masuda et al.'s (2012) time use categories used. Time in social and leisure includes time spent eating, in coffee, social, or religious activities, and caring for sick or going to the clinic, while time spent at the market is its own category.
[b] The reference category is *adversarial.* All models are estimated with cluster robust standard errors. The models control for the wife's age, age-squared, education, number of marriages, kinship network, work status; spousal differences in education, age, kinship network, the number of marriages; household sex and age composition, household wealth, and village fixed effects. Table of coefficients for covariates are in Table F1 in Appendix F.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.1

Discussion and limitations

This study combines spousal responses about the wife's decision-making power and novel questions about the wife's time allocation to investigate the factors that are significantly associated with spousal perceptions of the wife's bargaining power, as well as its relationship to the wife's time use. Findings suggest that in patriarchal societies such as Ethiopia, traditional empowerment programs such as those targeting increases in female education or labor force participation may have a more limited impact on decision-making perceptions than previously thought. Perceptions of the wife's decision-making power over gendered domains have more concordance compared to gender neutral individual domains, supporting the hypothesis that unclear decision-making hierarchies can increase transaction costs and thus the likelihood of discordance. In addition, I find a strong relationship between spousal perceptions and the wife's time use. *Adversarial* households spend

significantly less time at the market and more social and leisure activities compared to other households, indicating the important role that spousal perceptions have on the wife's time allocation.

These results may also inform what individual and household factors should be targeted by women's empowerment policies. The wife's education and employment appear to have the largest impact on shifting spousal perceptions from *deferential* to *joint* for individual time allocation domains explored in this paper. Indeed, results suggest that shifting perceptions to where the wife has sole decision-making power will be challenging. The persistent low probability of the wife having sole decision-making authority highlights a larger underlying challenge having to do more with cultural and social norms that policies may have difficulty addressing. Third, the main factor increasing the likelihood that the wife will have sole decision-making ability over her time allocation is difference in the number of marriages, which may in practice be difficult to affect. Increasing the wife's education and labor market status greatly increases the probability that decisions will be *joint*, but targeting the husband's perceptions may be a better strategy to increase perceptions that time allocated to the market is solely up to the wife.

Further, although estimates of spousal perceptions and the wife's time allocation are not causal, it highlights how spousal perceptions on the wife's decision-making power can impact the wife's individual behavior. *Adversarial* households are situations where the wife perceives herself to be in control over her own time. It is possible that in these households both spouses favor the wife spend less time at the market and more in leisure, despite who perceives to be in control. It is also possible, however, that there are conflicting spousal opinions on the wife's time allocation, and that the wife exhibits purposive behavior to determine her time allocated to both activities. In either case, the findings demonstrate a clear relationship between spousal perceptions and time use, and further

work should explore how the husband's perceptions act as an enabling or constraining factor for the wife's time allocation.

Although the unique data and combination of spousal perceptions adds to the findings of past studies, future research should address some additional limitations. First, several new variables would provide more information on factors affecting perceptions. For instance, it is plausible that the number of years married in the current marriage also significantly impacts perceptions. Spouses that have been married longer will have had time to communicate and divide decision-making responsibilities for individual and household domains, while newlyweds may still be in the bargaining process. Second, this paper only analyzes the determinants of spousal perceptions of decision-making for married women. Unmarried women may face different constraints based on varying household structures. It is unclear how these dynamic intrahousehold relationships may be affecting opportunities for these women. Finally, future research should investigate the *deferential* category in further detail. This study lacks sufficient cell sizes to differentiate cases where the husband believes the wife has more bargaining power than she herself believes from cases where the wife believes she has more bargaining power than does the husband. These are potentially different situations that can lead to different outcomes for individual and household decisions and well-being.

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Appendix A: Literature review

There is an extensive literature on bargaining power on individual and household outcomes, and this table is meant to provide a range of papers that differ in the way they operationalize bargaining power (or related concepts), as well as papers that look at the determinants and consequences of bargaining power.

Table A1: Literature review on women's autonomy and outcomes

Study	Country	Data source	Husband and wife answer?	Measures of bargaining power, and dimension	Bargaining power's effect on outcome?	Research design and empirical strategy	Relevant results
Allendorf 2007b	Nepal	2001 Nepal Demographic and Health Survey	Yes, but only used wife's responses.	From four questions that ask about household decision-making over: own health care, large household purchases, household purchases for daily needs, and visits to family, friends, and relatives. Using these data: • Use factor analysis to create an additive empowerment scale ranging from 0-4. • Dummy variable denoting whether respondent has the final say alone on at least one of the four	No. In this case, the study looks at whether land rights have an impact on empowerment.	Ordinal logistic regression for model looking at empowermen t scale, and logistic regression for model looking at dummy variable.	• Positive association between land rights and empowerment. • Women who are older, have more education, household wealth, and who are employed are associated with higher levels of empowerment.

				decisions.			
Fafchamps et al. 2009	Ethiopia	1993-1995 Ethiopian Rural Household Survey	Interviewed separately, but only used wife's responses.	• Use factor analysis with questions on cognitive ability and on predisposition towards violence. • Land and livestock brought to marriage • Involvement in household purchases and if wife has nonfarm income. • Expected land and livestock upon divorce	Effect on BMI, physical mobility index of the husband and wife, distribution of work and leisure, consumption expenditures on alcohol and clothes for family members, and child welfare.	Tobit for mobility index and child schooling regression, and OLS for other regressions.	• Relative nutrition of spouses associated with correlates of bargaining power such as cognitive ability, independent sources of income, and divisions of assets upon divorce. • Benefits nutrition and children's educational attainment. • Find little evidence of systematic effect of bargaining variables on consumption expenditures. • Find evidence that more empowered women tend to divert more household resources towards children rather than themselves. • Unclear which

							bargaining variables matter. Not all jointly significant, which indicates that the bargaining variables are capturing different dimensions.
Dercon and Krishnan 2000	Ethiopia	1994-1995 Ethiopian Rural Household Survey	Interviewed separately	Bargaining power is proxied by variables measuring outside options on divorce. Specifically: • Joint goods received at the time of marriage • Assets shared equally upon divorce • Wealth of husband's family • Distance to nearest town	Quintile/Body Mass Index	GMM estimator and estimated in first differences	• Estimated Pareto weights in allocation of nutrition within the marriage by regressing multiple proxies for bargaining power within the household. • Found that women's Pareto weights in household allocation is better if customary laws on divorce are favorable, or if the wife comes from a wealthy background.
Sahn and Stifel 2002	20 countries (14	1990 Demographic Health Surveys	NA	Mother's and father's education as proxy for fallback positions	Child nutritional status:		• Bargaining power of father's leads to greater health for

	African)			outside of marriage, and thus their bargaining power over intrahousehold allocation decisions.	• age- and sex-standardized length or height (measure of stunted growth) • Sex-standardized weight-for-height (measure of wasting)		boys. • Greater bargaining power for mothers seen to effect girls' health.
Haddad and Haddinot 1994	Cote d'Ivoire	1986-1987 Cote D'Ivoire Living Standards Survey	NA	Share of wage income brought to the household. • Assumed that the person described as "the best informed to discuss the business' is the business operator and that he/she controls its profits." • For income from farming assumes male and female crops, which differs by ethnic group.	Effect on household expenditures	2SLS and GLS.	• Higher share of wives' income results in greater expenditures on food, less on children's and adult clothing, alcohol, meals out, and cigarettes. •
Lim et al. 2007	Ethiopia	1997 Ethiopian Rural Household Survey	Interviewe d separately.	• Value of livestock each spouse takes upon divorce	Effect on crop production (coffee output)	OLS	• Bargaining power is negatively correlated with coffee output

							when proceeds of the cash crop are controlled by men relying on the wife's labor.
Thomas et al. 1997	Indonesia	1993 and 1997 Indonesian Family Life Survey	Interviewe d separately.	• Value of resources brought to marriage is main variable of interest. • Other variables include: own labor income, nonlabor income, and assets at the time of survey.	Effect on child health (cough, fever, or diarrhea)	OLS and fixed effects.	• Distribution of assets at the time of marriage acts as a possible determinant of bargaining power within marriage • Mothers with more resources to allocate do so goods and services that benefit the sons.
Quisumbin g and de la Briere 2000	Banglades h	Three rounds of survey data from IFPRI study on impact of agricultural technologies.	Asked husband only on current assets, and interviewe d separately for assets brought to marriage and inheritance , and only wife	Two measures are used: • Current assets • Value of assets brought to marriage	Effect on allocation of intrahousehold expenditures.	OLS and median regressions for regressions on determinants of current assets and value of assets brought to marriage, and 2SLS for effect on	• Distribution of assets at the time of marriage acts as a possible determinant of bargaining power within marriage • Assets at marriage do not give wives any advantage in accumulating assets during marriage. • Reject unitary

			interviewed about transfers at marriage.			expenditures.	model • Increased resources controlled by women associated with positive allocations towards children's clothing and schooling.
Quisumbing and Maluccio 2003	Bangladesh, Ethiopia, Indonesia, and South Africa	For Ethiopia, data come from 1997 Ethiopian Rural Household Survey.	Interviewed separately.	Two measures are used: • Human capital • Individual assets at marriage.	Effect on household expenditures and child schooling outcome.	2SLS for husbands' and wives' assets and predict using information from family background.	• Distribution of assets at the time of marriage acts as a possible determinant of bargaining power within marriage • Positive correlation between female bargaining power and expenses on food, and more male assets increases education expenditures. • More assets at marriage for the wife negatively associated with educational outcomes for girls.

Martinsson et al. 2010	China	Primary data from Majiang County in the Guizhou province	Separately, then together	Experiment on economic decision-making in the household.	NA	Controlled experiment on inter-temporal choice Random parameter probit	• Investigates determinants of relative influence over household decisions • Husbands have stronger influence than wives, but in richer households where the wife is older than the husband wife has stronger influence over joint decisions.
Brauw et al. 2012	Brazil	Two years (2005 and 2009) of primary data with attrition of 6.5%	Separately with just the wife	Women asked a series of questions about: • Food purchases; clothing for self, spouse, and children; schooling; health expenditures; purchases of consumer durables; labor force participation of self and spouse; use of contraception. Responses are categorical with answers being *myself, spouse, jointly,* or *others.* Some questions	NA	Pre- and post-treatment evaluation using propensity score matching to create control group.	• Studies the effect of conditional cash transfer programs on women's intrahousehold decision-making power. • CCT increases women's decision-making power on contraception. • CCT also results in increased decision-making power over children's school attendance, health

				allowed for *decisions made by children* and *I don't know.*			expenses, and clothing women's own labor supply and clothing, and household durable goods purchases for women in urban areas and who are less educated relative to their husbands.
Abadian 1996	54 countries from Africa, Middle East and West Asia, south Asia, East Asia, South America, Central America and Caribbean	Aggregate data from multiple sources: • TFR from 1992 World Development Report • 1990 UN Publication on Mean Spousal Age Difference • 1995 UNESCO Statistical Yearbook • Numbers on Family Planning Effort Score from Maudlin and Ross (1991)	NA	Operationalizes female autonomy using three variables: • Female age at marriage • Age difference between spouses • Female secondary school education	Effect of autonomy on total fertility rate, infant mortality, female secondary schooling, and mean age at marriage	Cross-country analysis at the aggregate country level	• Significant impact on fertility of female education (-), age at marriage (-), and spousal age differences (+) • Education has a direct effect on fertility, but also is mediated through infant mortality rates to decrease fertility.

		• 1992 Human Development Report					
Jejeebhoy and Sathar 2001	India and Pakistan	Primary surveys targeting three distinct areas in India and Pakistan for variation by region and religion.	Separately. The husband was interviewed if he was present, but was not specifically targeted for interviews.	Additive index. Questions on intrahousehold decision-making over: • Economic decision-making • Mobility • Control over economic resources • Freedom from threat from husband	NA	Correlations, OLS, and focus group interviews	• Socio-cultural and regional context explain some variation in determinants of women's autonomy in South Asia. • Norms that prevail in regions and the social caste play a greater role in women's autonomy than religion or nationality. • At the individual level, female education, wage work, and assets have a positive effect on autonomy.
Maitra 2004	India	1990 National and Family Health Survey • Rural areas only	Unknown	Educational attainment of the husband and wife, and demographic measures of status of the woman within the household	Demand for prenatal care, hospital delivery, and child mortality.	Probit and hazard model jointly estimated using full information maximum	• Women's education relative to the husband has greater effect of healthcare utilization

						likelihood	• Greater female bargaining power results in greater healthcare usage
Argarwala and Lynch 2006	India and Pakistan	1993-1994 Survey on the Status of Women and Fertility. Has data from five countries, but study uses only India and Pakistan.	Just the wife.	54 questions on autonomy to capture four dimensions: • Autonomy from violence • Autonomy in family decisions • Autonomy in community involvement • Autonomy in household economics		Confirmatory factor analysis first with Indian data. Using the Indian data they refine measurement models based on "substantive considerations and modification indices". Then replicate analysis with Pakistani data to assess whether a fixed "best" model for the Indian data fits the Pakistani data.	• Constructs measure of autonomy using confirmatory factor analysis and compares it with the summed autonomy indices used in the literature. • CFA constructs fit much better than summed scales (indices) of autonomy. • Correlations between family, violence (first construct), community, and economic dimensions are moderately correlated. • Finds support that the decision-making over economics of the household and

							family decisions are highly correlated and may collapse into a single latent construct. Implies that dynamics involved in empowering women in household decision-making simultaneously affect a wide range of issues from reproduction, child education, and labor market participation.
Allendorf 2012	India	2002 Women's Reproductive Histories survey from Madhya Pradesh	Women's experience s only.	Creates measures for multiple dimensions: • Women's agency: index composed of questions on women's ability to make decisions and expenditures. • Relationship with husband: three questions on quality of relationship with husband. • Relationship with in-	NA	Creation of women's agency used exploratory factor analysis, while each variable for relationship with the husband was included separately.	• Issues with causation. • Find positive association agency and women who have good relationships with husbands, in urban areas, have more years of schooling and are older, and work outside the household.

				laws		OLS to test effects of family relationship quality on women's agency.	• Domestic violence has no effect on women's agency.
Salem 2011	Egypt	2006 Egypt Labor Market Panel Survey	Women only	Test three hypotheses and operationalize in different ways: • **Labor-value hypothesis:** material contributions of bride to overall expenses with marriage • **Modernization and bargaining perspective hypotheses:** additive index using women's decision-making in household over multiple items.	Effects of the three perspectives on marriage payments.	• Logistic regression for whether bride made any payments. • Zero-inflated negative binomial regression for labor market engagement and monthly wage on bride's share of total marriage costs, as well as model on effects on decision-making index.	• Wage labor not associated with significant differences in decision-making power. • Women with more education, living in nuclear families at start of marriage, and who have sons have higher decision-making power relative to other women. • No effect of bride's share of total payments on decision-making power. • Support of the bargaining perspective for decision-making in the household.

Beegle et al. 2001	Indonesia	1997 Indonesian Family Life Survey	Wives only. Targeted married women ages 15-49 only	• Assets owned by each spouse and respective value of assets: House, vehicles, appliances, jewelry, and furniture and utensils. • Assumes that ownership of assets is indicator of decision-making power since upon divorce each spouse keeps their assets. • Also include variables for relative social status of husband's and wife's families, relative education of their fathers, and husband's and wife's relative own education.	Effect of economic assets (proxy for decision-making power) over prenatal and delivery care.	• Logistic and negative binomial regressions.	• Since assuming that ownership of assets is a proxy for decision-making power, can be interpreted in two ways. First, can be interpreted that economic power plays no role in determining prenatal and delivery care. Second, can be interpreted that ownership of assets does not capture bargaining power. • As the share of household assets increases, so does her likelihood of seeking prenatal care and timing and number of visits. • Wife's higher share of assets also associated with delivering baby in a hospital. • Findings suggest

							that ownership and control of assets not the same, and just ownership may be a poor proxy. • Findings also suggest power is multifaceted. They run regressions for each 'power' variable, and then test for joint significance finding no joint significance.
Bloom et al. 2001	India	1995/1996 data from a larger study on maternal health care utilization among poor to middle-income women in Varanasi, India.	Youngest eligible woman in the household interviewed.	• Composite measures of Control over finances, decision-making power, and freedom of movement. • Composite for each was created using a summed index with equal weights of binary variables. Ranges from 0-1. • Questions on decision-making asked about whether the woman made decisions on what to	Effects of women's autonomy on utilization of antenatal care.	• OLS	• Women's autonomy as measured by freedom of movement is positively associated with maternal health care utilization. • Autonomy not captured well by one indicator.

				cook, schooling for children, and permission to leave the house.			
Branisa et al. 2013	Up to 106 countries	OECD Gender and Social Institutions database	NA	• Create the Social Institutions and Gender Index, which consists of five subindices. Argue it captures empirically nonredundant dimensions on the relationship between social institutions and gender inequality. • Subindices are *Family code, Civil liberties, Physical integrity, Son preference,* and *Ownership rights.* • Use multiple joint correspondence analysis to analyze structure of data, and then aggregate each subindex using polychoric principal component analysis. • Ranges from 0 to 1, where 0 is no inequality and 1 is total inequality.	Effects of SIGI and subindices on total fertility rates, gross female secondary school enrollment rates, and corruption.	• OLS of SIGI index and five subindicies on outcome variables. • Collapsed and took average of 5-6 years for dependent variable, and 10 years for independent variables.	• Lower SIGI index associated with lower female secondary education, higher fertility rates, higher child mortality, and higher levels of perceived corruption.
Pitt et al. 2006	Banglades h	1998-1999 household	Interviewe d	Captures bargaining power over multiple	NA	• Latent	• Presence of

		survey on microfinance conducted by Bangladesh Institute for Development Studies.	separately, but most bargaining questions asked to wife.	domains and use factor analysis/item response theory/latent variable model to estimate latent/factor scores: • Purchasing: ability to spend money independently and for household • Resources: economic power and access to funds • Finance: power over household borrowing • Transaction Management: power to spend and allocate household funds. • Mobility and networks: freedom of movement, networks, relationship with kin and in-laws. • Activism: awareness of laws/politics, autonomy on public and private matters. • Household attitudes: attitudes on women's empowerment, dowry, and status in the household. • Husband's behavior:		variable model to construct bargaining power measure. • OLS and with village fixed effects. • 2SLS	microcredit program has a positive effect on 8 of 10 factors of empowerment. • Credit programs lead to increased power in household decisions, financial and economic resources, social networks, and freedom of mobility.

				husband's actions/opinions about women's status • Fertility and parenting • All factors			
Garikipati 2008	India	Primary survey data between 2001-2003 in two villages for 291 married couples (117 in treatment group).	Randomly selected whether to interview the head of the household or the spouse.	Focused on four indicators: • Ownership and control over household assets and income • Control over minor finances • Control over major finances • Say in household decisions • Allocation of work time • Ability to share household chores • Binary variable denoting a woman was empowered if she had control over one of the six above questions	NA	• Randomly selects whether to interview head or spouse • Logistic regression with first-stage regression used for covariate for duration in microcredit program.	• Increased duration in microcredit program reduces probability that women share work, and overall empowerment score.
Kandpal et al. 2012	India	Primary survey data from 487 women from six randomly chosen districts.	No informatio n provided.	Focused on three indicator variables: • Access to outside employment • Physical mobility	NA	• Uses propensity score matching to identify comparison	• Looking at the efficacy of community-level empowerment program. Program provides support

		Because there was also social network data that were collected using snowball sampling within the village women are not randomly chosen.		• Political participation Also uses: • Wife's age relative to her husband's (as initial measure of bargaining power)		group • 2SLS • Two analyses for	groups, literacy camps, adult education classes, and vocational training. • Find participating increased outside employment, freedom to leave household, and participating in the political process.
Acharya et al. 2010	Nepal	Demographic Health Survey 2006, women ages 15-49	Yes, but only used wife's responses.	Four areas of autonomy in decision-making: • Own health care • Making major household purchases • Making purchases for daily household needs • Visits to family and friends Make variables into binary.	NA	• Logistic regression	• Correlational study looking demographic factors that influence women's autonomy. • Age, employment, and number of living children positively associated with autonomy. • Those in rural areas show less autonomy.
Parveen and Leonhauser 2004	Bangladesh	Primary data from three villages	Yes, but only interviewed wife	Uses six question domains to create a Cumulative Empowerment Index. Most use relative	NA	• OLS	• Positive association between formal and informal

				scales, with the exception of contribution to household income, which is % involvement. Domains are: • Contribution to household income • Access to resources • Ownership of assets • Participation in household decision-making • Perception on gender awareness • Coping capacity to household shocks			education, sex of children, spousal relationship, exposure to media, and spatial mobility on CEI.
Lepin and Strobl 2013	Senegal	Primary data from three rural communities	NA	Authors use Multiple Correspondence Analysis (MCA) to construct a direct multidimensional measure of bargaining power. Use 12 questions, although ultimately four questions load onto one factor. These are: • Woman's labor status • Decision-making about own health • Decision-making	Effect of female bargaining power on child nutrition. Dependent variable is the MUAC, or the circumference of the left upper arm.	• OLS and 2SLS	• Authors examine the bias that may occur when estimating a model that doesn't control for endogeneity between the other's bargaining power and children's nutrition. • Uses relative ethnicity of the wife compared to

				about visiting relatives • Ability to leave house without permission			the community as an instrument. • Once accounting for endogeneity they find bargaining power increases child nutrition by 0.81 standard deviations.
Ahmed 2006	Nigeria	Demographic Health Survey 2003	Yes, wife only	Factor analysis of 19 variables resulting in three factors: • Mobility • Vulnerability • Autonomy over household resource allocation	Effect of bargaining power on child health	• Factor analysis and 2SLS	• Not all empowerment variables affect outcomes equally.
Jejeebhoy 2002	India	Primary dataset	Separately. The husband was interviewed if he was present, but was not specifically targeted for interviews.	Dichotomized responses for each decision-making question for when husbands and wives agreed and disagreed, and then summed all dichotomized variables to create the wife's autonomy index for the husband and wife. Autonomy domains were: economic decision-making, mobility, and access to resources.	Effect on contraceptive use, discussion of family planning, unmet need for contraception, and childbirth in the past five years	• Logistic regression for each outcome and included the wife's and husband's perceptions in both.	• Wife's own perceptions of autonomy associated with increase in contraceptive use.

Story and Burgard 2012	Bangladesh	Demographic Health Survey 2007	Yes, separately interviewed	Couples' responses coded as concordant categories (wife decides, husband decides, jointly decides, jointly determined, and someone else decides) and discordant (disagree). Questions for: • Child's health care • Major household purchases • Daily household needs • Visiting relatives or family	Effect on maternal health care utilization	• Bivariate logistic regression of association between decision-making arrangement and having at least one antenatal check-up	• Found discordant responses were negatively associated with reproductive health care use, while households where both spouses stated the husband had authority were negatively associated with antenatal care use and skilled delivery care.
Becker et al. 2006	Guatemala	Guatemalan Maternal and Neonatal Health Program survey 2003	No information provided.	Dichotomized responses for each decision-making question for when husbands and wives agreed and disagreed, and then summed all dichotomized variables to create the wife's autonomy index for the husband and wife. Questions included: • Buying large assets • Child's health care • Buying medicine for family member	Effect of bargaining power on preventative care	• Logistic regression of women's autonomy scores on plan for pregnancy, delivered in health facility, and whether the wife had a postpartum checkup	• Women's autonomy score positively associated with pregnancy plan.

				• Care of sick pregnant family member			
Allendorf 2007a	Nepal	Demographic Health Survey 2001	Yes, separately interviewed	Collapsed four decision-making questions into one dichotomous variable for the husband and wife, separately. Variables were equal to one if the wife had sole decision-making authority in at least one of four of the decision-making questions. Decision-making questions covered: • Wife's health care • Making large household purchases • Making household purchases for daily needs • Mobility	Effect of bargaining power on health care utilization, and also examined "determinants" of couples' responses.	• Bivariate probit to investigate determinants of couples' perception • Both the husband and wife's perceptions into logistic regression.	• Wife's age, assets, and employment have a positive effect on the wife's perception, while household size has negative association. • Wife's age, education, and husband's employment status positively associated with perceptions, and household size negatively associated • Households agreeing about the wife's autonomy had higher levels of health care utilization.
Anderson et al. 2012	Mali and Tanzania	Primary dataset	Yes, separately interviewed	Combined spousal decision-making categories in multiple ways. Relied on bean counting exercise that had respondents allocate 10 beans to say the proportion of	Investigates two questions: 1. Decision-making authority varies across decision-	First question looks at response patterns. Second question uses logistic	• Distribution of decision-making authority varies across decision-types (i.e., domains) • In Mali, wife's

				decision-making he/she has over a certain domain. Examined 13 decision-making domains, although largely about farming decisions. Categories are created with respect to all decision-making domains. There are three levels of concordance: 1. Autocratic (all decisions taken by one spouse) 2. Joint (all decisions are shared) 3. Abstaining (all decisions deferred) Discordance defined as: 1. Dominant 2. Specialized 3. Subordinate Second part of analysis looked at probability of being in ***accord***, or when spouses were *specialized* or *joint*, or households with one *autocratic* and one *abstaining* spouse, or	type for the same household 2. Probability of accord is higher for decisions with transaction costs	regression for when there is accord vs. no accord (not just discord).	willingness to experiment, husband's education, and wife's labor are associated with higher probability of accord. Better health, young children, and a larger area cultivated were negatively associated with the probability of accord. • In Tanzania, food security, difference in risk attitudes, wife's education and age, cultivated land, and household assets increased probability of accord.

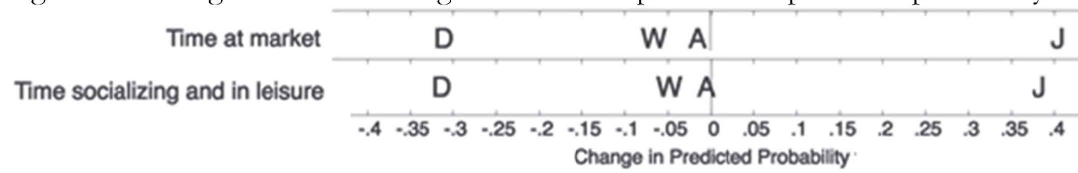
				one *dominant* and one *subordinate* spouse.			

Appendix B: Potential response bias in the presence of the husband

The presence of the husband during the interview appears to result in response bias for spousal perceptions of the wife's decision-making authority. Note that this is the same for the husband's responses since interviews were conducted for both spouses at once. Responses skew towards egalitarian responses, and as a result households where husbands were present during the interview are dropped from further analyses.

Figure B1 below shows the effect of the husband's presence on the predicted probability of responses when running the full model with a dummy variable for the husband's presence. We see that the predicted probability of *joint* increases by up to 40 percent whenever the husband is present. In addition, Table B1 presents t-tests for differences in observable characteristics for households where the husband was present during the interview versus those where the husband was not present. Differences in observable characteristics indicate that other factors may be influencing responses towards more egalitarian categories. By and large there are no significant differences between households whose husband was present and not present during the interview. Households whose husbands were present during the interview had slightly more adult females, and more were households live in Tutekunche and less in Bishikiltu, which may indicate that as the data collection proceeded enumerators became more skilled in separating the husband and the wife during decision-making questions. Still, it appears that there is little concern for systematic differences between the two groups, and suggesting that the presence of the husband influences response patterns. As a result, households where the husband was present during interviews are dropped from further analyses.

Figure B1: Change in discrete change in husband's presence to predicted probability[a]



[a] **D** refers to *deferential*, **J** to *joint*, **W** to *wife decides*, and **A** for *adversarial* positions.

Table B1: Differences in observables for households with and without husbands present[a]

Panel A: Individual	Present	Not present	Difference
Wife's age	37.04	40.36	-3.31
Highest grade attained by wife	0.71	0.49	0.21
Size of wife's kinship network	0.67	0.87	-0.19
Number of times wife has been married	1.21	1.15	0.061
Wife works for wages (%)	13	11	2.1
Panel B: Differences in spousal characteristics			
Difference in size of kinship network between husband and wife	1.46	0.79	0.67
Difference in number of times married between husband and wife	0.22	0.23	-0.0091
Difference in educational attainment between husband and wife	1.88	1.70	0.17
Difference in age between husband and wife	8.28	8.47	-0.19
Panel C: Household characteristics			
Number of under school-aged males	0.55	0.42	0.13
Number of under school-aged females	0.54	0.60	-0.062
Number of school-aged males	1.06	1.21	-0.14
Number of school-aged females	0.88	0.85	0.030
Number of adult males	1.58	1.51	0.069
Number of adult females	1.33	1.53	-0.19+
Total assets and income[b]	18,178.88	17,030.71	1,148.17
Bishikiltu (%)	31	45	-13*
Tutekunche (%)	31	15	15*
Kelecho Gerbi (%)	38	40	-2.0
n	290	53	

[a] Mean values presented

[b] Figures are reported in Ethiopian Birr, and 1 U.S. dollar was approximately 17 Ethiopian Birr in July 2011. Assets include productive livestock, which include horses, donkeys, mules, cows, and oxen. Prices for livestock are obtained from the July 2011 retail price report published by the Central Statistical Agency in Ethiopia.
http://www.csa.gov.et/images/documents/pdf_files/retailprice/2011/july2011.pdf

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Appendix C: Alternative classification schemes for couples' responses on the wife's decision-making power

I investigate the sensitivity of findings to the couples' response classification by exploring two alternative classifications (Table C1 and C2). The first alternative classification (Table C1) classifies couples' responses as: (1) *Wife dominant*, (2) *Joint*, (3) *Deferential*, (4) *Adversarial*, (5) *Husband dominant*. *Wife dominant* occurs if the husband and wife both state the wife controls her time, or if the husband "defers" to the wife. Here, a spouse "defers" when both spouses assume decision-making is shared or done by the other spouse. Conversely, *husband dominant* occurs when the husband and wife both agree that the husband controls the wife's time, or if the wife defers to the husband. Lastly, (3) *Deferential* is a classification where both the husband and wife defer to each other. (2) *Joint* and (4) *Adversarial* remain the same as in Table 2.

Table C1: Alternative classification 1 for spousal perceptions of the wife's decision-making power

		Husband's response		
		My wife	**Jointly**	**Me**
Wife's response	**Me**	(1) Wife dominant	(1) Wife dominant	(4) Adversarial
	Jointly	(1) Wife dominant	(2) Joint	(5) Husband dominant
	My husband	(3) Deferential	(5) Husband dominant	(5) Husband dominant

The key difference with this classification is that it combines concordance (*wife decides* and *husband decides* in Table 2) with *deferential* categories presented in Table 2. As a result, the newly defined *deferential* in Table C1 is more narrowly defined. *Wife dominant* and *husband dominant* now have larger cell sizes by design, but this classification should be interpreted with caution. These broader categories now include responses that represent a lack of certainty about the wife's decision-making authority (e.g., wife says "jointly" and the husband says "My wife."), and combines concordance with potentially passive disagreement. The category thus assumes that *wife dominant* responses mean that the wife has ultimate say in decisions in all situations when it is, in fact, unclear. For instance,

when the husband perceives the wife to have decision-making authority and the wife believes decisions are jointly determined, it is unclear whether this is a situation where the wife will actually exert her decision-making authority even if the husband is "deferring" to the wife. This also holds for *husband dominant*, except it is with respect to the husband. Indeed, if there are systematic differences between households where couples' responses showed concordance (*wife decides*, *husband decides*, or *joint* in Table 2) to the now broadly defined *wife dominant* that includes formerly *deferential* responses, this classification scheme may suffer from measurement error and any estimates may be misleading.

The second alternative classification explores a dichotomous measure like much of the literature (Table C2). Here (1) *Wife substantial* presents situations where the wife can be said to have substantial decision-making power, while (2) *Husband substantial* presents situations where the wife does not have substantial, agreed upon decision-making power. This classification loses all information for responses where there is concordance between spouses (*wife decides, husband decides,* and *joint* in Table 2), and does not differentiate where spouses clearly disagree (*adversarial* in Table 2). For instance, in this classification what was previously *joint* in Table 2 now assumes that the wife has the same or similar decision-making authority as when both spouses say the wife has sole decision-making authority. As this alternative classification is dichotomous and similar to previous studies, I will focus from this point forward on the classification presented in Table C1 above.

Table C2: Alternative classification 2 for spousal perceptions of the wife's decision-making power

		Husband's response		
		My wife	**Jointly**	**Me**
Wife's	**Me**	(1) Wife substantial	(1) Wife substantial	(2) Husband substantial
	Jointly	(1) Wife substantial	(1) Wife substantial	(2) Husband substantial
	My husband	(2) Husband substantial	(2) Husband substantial	(2) Husband substantial

Marginal effects

Marginal effects from the multinomial logistic regression using the alternative classification from Table C1 are presented in Tables C4-C5. The same models are estimated as those in the main paper (see equation 1 and 2 in "Empirical strategy"). I concentrate on comparing marginal effects for *joint* and *adversarial* for each model because these categories overlap between the original classification and the alternative one explored here.

The same variables are significant for *joint* and *adversarial* as the models in the main paper, and the magnitudes of the coefficients are nearly identical for both (Tables C4-C5). For the model looking at couples' responses to the wife's decision-making power over her time in leisure (Table C4), the wife's education and work status increases the likelihood of being in the *joint* category, while the wife's number of marriages and household wealth decreases this likelihood. Meanwhile, differences in the number of marriages increase the likelihood of being in an *adversarial* household, while household wealth decreases this likelihood. For the model looking at couples' responses to the wife's decision-making power over her time at the market (Table C5), the wife's education and wage status again increase the likelihood that decisions will be joint. Like the original model explored in the paper, we see that no coefficient is statistically significant for *adversarial*.

Different from the original classification are categories that broaden the definition of couples' perceptions of the wife's and husband's decision-making authority over the wife's time: *wife dominant* and *husband dominant*. Despite the broadened classification, almost no covariate is significantly associated with the *husband dominant* category, indicating that broadening the definition for households where the husband has decision-making authority over the wife's time allocation is too heterogeneous for any useful indicators to be identified. For the model examining decision-making over the wife's time in leisure, none of the covariates are significantly correlated with *husband dominant*. For the model looking at decision-making over the wife's time at the market, spousal age

differences increase the probability of households being in the *husband dominant* category, but the effect is extremely small.

For the *wife dominant* category, we see that broadening the definition for when the wife has decision-making power increases the number of significant covariates. For the wife's time in leisure, the wife's kinship network and number of marriages increase the probability of being in *wife dominant*, while the wife's work status decreases this probability. For the wife's time at the market, the wife's kinship network, number of marriages, and spousal differences in kinship network, the number of marriages, and education increase the probability of being in *wife dominant*. The wife's work status, meanwhile, decreases this probability. It is unclear what, exactly, is being captured here because this category now includes instances of concordance and where one spouse defers to the other.

Table C3: Distribution of decision-making questions with alternative classifications

	Household decisions				**Individual decisions**			
Panel A: Alternative classification 1								
	Major HH purchases	Selling large assets	Children's education	HH purchases	Time on HH tasks	Time farming	Time in leisure	Time at the market
Wife dominant	1.4%	1.0%	3.1%	93%	94%	13%	49%	63%
Joint	76%	77%	78%	5.9%	1.4%	4.5%	32%	29%
Deferential	0.7%	0%	0%	0%	1.4%	5.9%	2.8%	0.3%
Adversarial	0%	0%	0%	0%	1.4%	3.8%	4.5%	3.1%
Husband dominant	22%	22%	19%	1.0%	1.4%	73%	11%	5.2%
n	290	290	290	290	290	290	290	290
Panel B: Alternative classification 2								
Wife substantial	77%	78%	81%	99%	96%	18%	82%	91%
Husband substantial	23%	22%	19%	1.0%	4.2%	82%	18%	8.7%
n	289	289	289	289	289	289	289	289
In analytic sample							YES	YES

Table C4: Marginal effects for time in leisure with alternative classification 1

	Wife dominant	Joint	Deferential	Adversarial	Husband dominant
Wife's age	-0.020	-0.0040	0.0089	0.0029	0.012
	(-1.39)	(-0.31)	(1.19)	(0.70)	(0.90)
Wife's age-squared	0.00025	0.000063	-0.00015	-0.000018	-0.00015
	(1.53)	(0.45)	(-1.30)	(-0.46)	(-0.90)
Highest grade attained by wife	-0.019	0.037*	0.0049	-0.0040	-0.019
	(-1.01)	(2.41)	(0.63)	(-0.32)	(-1.40)
Size of wife's kinship network	0.049+	-0.036	0.0034	0.0067	-0.023
	(1.75)	(-1.19)	(0.76)	(0.83)	(-1.11)
Number of times wife has been married	0.18**	-0.15*	0.012	-0.013	-0.034
	(2.86)	(-2.24)	(0.40)	(-0.55)	(-0.68)
Wife works for wages	-0.20*	0.25***	0.014	0.010	-0.068
	(-2.20)	(3.48)	(0.59)	(0.30)	(-1.08)
Difference in size of kinship network between husband and wife	0.017	-0.0067	-0.0046	0.0021	-0.0080
	(1.23)	(-0.49)	(-0.81)	(0.33)	(-0.77)
Difference in number of times married between husband and wife	0.0021	0.015	0.014+	0.032*	-0.063
	(0.05)	(0.42)	(1.65)	(2.48)	(-1.52)
Difference in educational attainment between husband and wife	-0.0068	-0.0040	0.0058*	0.0014	0.0036
	(-0.71)	(-0.46)	(1.99)	(0.24)	(0.50)
Difference in age between husband and wife	0.0032	-0.0027	-0.00058	-0.0017	0.0018
	(0.62)	(-0.52)	(-0.25)	(-0.67)	(0.61)
Number of under school-aged males	-0.050	0.027	0.012	0.0075	0.0044
	(-1.21)	(0.63)	(0.65)	(0.60)	(0.17)
Number of under school-aged females	-0.018	0.011	-0.0048	0.018	-0.0061
	(-0.38)	(0.27)	(-0.22)	(0.92)	(-0.23)
Number of school-aged males	0.033	0.037	-0.045**	0.0015	-0.026
	(1.05)	(1.33)	(-2.58)	(0.16)	(-1.18)
Number of school-aged females	-0.014	0.0078	0.0070	-0.0023	0.0010
	(-0.38)	(0.22)	(0.33)	(-0.18)	(0.04)
Number of adult males	-0.012	0.030	0.0045	0.011	-0.033
	(-0.30)	(0.90)	(0.43)	(0.68)	(-1.12)
Number of adult females	-0.018	0.044	0.019	-0.0029	-0.043
	(-0.35)	(1.05)	(1.42)	(-0.13)	(-0.99)

Table C4 (Continued)

Log total assets and income	0.018	-0.037*	0.010	-0.0089*	0.018
	(0.83)	(-2.11)	(0.50)	(-2.26)	(0.80)
Tutekunche	0.0062	-0.022	-0.040+	0.023	0.033
	(0.08)	(-0.31)	(-1.82)	(0.76)	(0.65)
Kelecho Gerbi	0.21*	0.11	-0.38**	-0.0043	0.066
	(2.41)	(1.57)	(-3.28)	(-0.15)	(1.55)
n	290	290	290	290	290

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table C5: Marginal effects for time at the market for alternative classification 1

	Wife dominant	Jointly	Adversarial	Husband dominant
Wife's age	-0.0064	-0.0022	-0.000013	0.0087
	(-0.51)	(-0.18)	(-0.00)	(0.98)
Wife's age-squared	0.000068	0.000024	-0.0000032	-0.000089
	(0.50)	(0.18)	(-0.11)	(-0.97)
Highest grade attained by wife	-0.026	0.028+	-0.0086	0.0065
	(-1.56)	(1.81)	(-1.10)	(1.00)
Size of wife's kinship network	0.059*	-0.036	0.0022	-0.025
	(2.00)	(-1.21)	(0.30)	(-1.59)
Number of times wife has been married	0.14*	-0.062	-0.025	-0.057
	(2.18)	(-0.97)	(-1.12)	(-1.49)
Wife works for wages	-0.15+	0.14+	0.0046	0.0086
	(-1.85)	(1.84)	(0.13)	(0.23)
Difference in size of kinship network between husband and wife	0.027+	-0.015	0.0051	-0.017
	(1.84)	(-1.11)	(1.29)	(-1.52)
Difference in number of times married between husband and wife	0.086*	-0.041	0.0012	-0.046
	(2.15)	(-1.17)	(0.15)	(-1.08)
Difference in educational attainment between husband and wife	0.016+	-0.012	-0.00084	-0.0032
	(1.79)	(-1.44)	(-0.20)	(-0.60)
Difference in age between husband and wife	-0.0083	0.0028	0.0014	0.0041+
	(-1.64)	(0.57)	(0.82)	(1.84)
Number of under school-aged males	-0.032	0.019	0.0023	0.011
	(-0.75)	(0.46)	(0.19)	(0.63)
Number of under school-aged females	0.011	0.0025	-0.032	0.018
	(0.24)	(0.06)	(-1.25)	(0.97)
Number of school-aged males	-0.018	0.029	-0.0056	-0.0047
	(-0.64)	(1.05)	(-0.46)	(-0.39)
Number of school-aged females	-0.0021	-0.0068	0.0069	0.0020
	(-0.06)	(-0.22)	(0.75)	(0.11)
Number of adult males	0.044	-0.027	0.0026	-0.019
	(1.14)	(-0.76)	(0.16)	(-0.71)
Number of adult females	-0.0053	0.012	0.0022	-0.0090
	(-0.12)	(0.27)	(0.15)	(-0.39)

Table C5 (Continued)

Log total assets and income	0.0090	-0.028	0.0013	0.017
	(0.42)	(-1.44)	(0.23)	(1.18)
Tutekunche	0.0012	-0.027	0.013	0.013
	(0.02)	(-0.40)	(0.53)	(0.35)
Kelecho Gerbi	0.075	-0.068	-0.0069	-0.00013
	(1.12)	(-1.06)	(-0.30)	(-0.00)
n	289	289	289	289

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Appendix D: Correlation matrices for dependent and independent variables

Figure D1: Dependent variable correlation matrix

Figure D2: Independent variable correlation matrix (PART 1)

	Wife's age	Wife's age squared	Wife's education	Wife's kinship network	Marital experience	Wife works outside household: 0/1
Wife's age						
Wife's age squared	0.981					
Wife's education	-0.219	-0.209				
Wife's kinship network	-0.084	-0.094	-0.094			
Marital experience	0.365	0.358	-0.045	-0.043		
Wife works outside household: 0/1	-0.233	-0.212	0.048	-0.092	-0.069	
Husband and wife difference in kinship network	-0.258	-0.235	0.117	-0.471	-0.070	0.057
Husband and wife difference in number of times married	0.109	0.099	-0.038	-0.008	-0.072	-0.060
Husband and wife difference in education	-0.194	-0.204	-0.158	-0.020	-0.045	0.036
Husband and wife age difference	0.050	0.004	-0.128	-0.004	0.104	-0.051
# of boys under school age (<6)	-0.281	-0.267	-0.049	0.066	-0.051	0.053
# of girls under school age (<6)	-0.305	-0.299	0.162	-0.080	-0.196	0.149
# of boys under school age (<6)	0.032	-0.034	0.059	-0.048	-0.027	-0.093
# of girls under school age (<6)	0.028	-0.039	0.033	0.137	-0.059	-0.059
# of men over school age (>15)	0.399	0.363	0.024	0.019	0.049	-0.098
# of women over school age (>15)	0.382	0.348	-0.066	-0.037	0.003	-0.138
Log of total assets and income	0.019	-0.012	0.093	-0.036	-0.019	0.015
Bishikiltu	-0.083	-0.076	-0.106	0.068	0.069	-0.071
Tutekunche	0.094	0.089	0.233	-0.093	-0.004	-0.090
Kelecho Gerbi	-0.010	-0.013	-0.121	0.023	-0.063	0.153

Figure D2: Independent variable correlation matrix (PART 2)

Husband and wife difference in kinship network													
-0.049	Husband and wife difference in number of times married												
0.047	-0.056	Husband and wife difference in education											
-0.160	0.371	0.033	Husband and wife age difference										
0.069	-0.164	0.115	-0.109	# of boys under school age (<6)									
0.135	-0.062	0.061	-0.004	-0.082	# of girls under school age (<6)								
0.018	0.004	0.197	0.078	-0.009	0.036	# of school-aged boys							
-0.003	-0.035	0.046	0.106	-0.037	0.005	0.090	# of school-aged girls						
-0.200	-0.057	0.001	0.098	-0.158	-0.163	0.105	0.083	# of men over school age (>15)					
-0.115	0.028	-0.107	0.022	-0.092	-0.074	-0.005	-0.036	0.217	# of women over school age (>15)				
0.019	-0.123	0.077	-0.060	0.032	-0.022	0.220	0.164	0.253	0.059	Log of total assets and income			
0.122	-0.038	-0.014	-0.032	0.023	-0.047	-0.070	-0.124	-0.073	-0.061	-0.027	Bishikiltu		
-0.071	0.036	-0.060	0.008	-0.025	0.070	0.112	-0.042	0.075	0.021	0.028	-0.454	Tutekunche	
-0.050	0.002	0.071	0.022	0.002	-0.021	-0.040	0.159	-0.001	0.038	-0.001	-0.525	-0.521	Kelecho Gerbi

Appendix E: Marginal effects from multinomial logistic regressions

Table E1 presents coefficients from the multinomial regression model. Tables E2-E4 present the marginal effects of all multinomial logistic regression models.[23] Marginal effects are calculated with all other covariates held at their mean values.

Decision-making for time allocation domains

Columns 1 and 2 in Table E1 presents regression results for spousal perceptions of the wife's decision-making power over her own time allocation. The base category for all models is *deferential*. Surprisingly, not all of the wife's characteristics increased perceptions of her decision-making power. In both models the wife's age and kinship network does not have a significant impact for any of the categories. There is a higher likelihood that decisions will be *joint* for time in leisure for wives that are employed (1.41) and have more education (0.21). Wives that have been married more have a decreased likelihood (-0.94) that decisions will be *joint*, which may suggest that women who marry more may just be more likely to defer to husbands. This contrasts expectations, wives who have been married more were thought to be associated with wives who were more likely to be independent and not seek permission from husbands. Joint significance tests reveal that the wife's number of marriages and employment status are jointly significant at the 0.05 level.

Households where husbands have married more than their wives have a higher likelihood perceptions on decision-making power will be in favor of the wife. These households have an increased the likelihood that perceptions will be *adversarial* (0.80) for time spent in social or leisure, and a higher likelihood (0.59) that the *wife decides* time spent at the market. Differences in age, however, decreases the likelihood that the positions will be *wife decides* over time spent at the market

[23] When computing marginal effects the signs may differ from those of regression coefficients (Cameron and Trivedi 2010).

(-0.06), although the magnitude is much smaller than the coefficient for differences in the number of marriages. With regards to household characteristics, household assets and income has a negative effect on decisions being *joint* (-0.18) or *adversarial* (-0.26), although the magnitude for both of these is relatively small. It is possible that wives from wealthier households have husbands with stronger economic positions within the household, which may lead to spousal perceptions where the husband has greater decision-making authority than the wife. Wald test of joint significance shows that the value of household assets and income are significant at the 0.05 level for the model examining decisions over time allocated to social and leisure, and differences in the number of marriages was significant for both models.

Household composition was not significant for both models examining spousal perceptions of the wife's time allocation, indicating that perceptions of the wife's power over her own time allocation are not affected by sex composition, the potential availability of substitute labor, and other family member contributions. The wife's age surprisingly has no association with the likelihood for time at the market and in leisure, and education was only significant for positions being *joint* for social and leisure. In addition, almost no variables were significantly associated with the likelihood of the wife having sole decision-making power over her time in social and leisure activities, or having being in the *adversarial* position for time spent at the market. The largest positive effect was seen for wives who worked for wages. This is in line with much of the literature highlighting the importance of labor force participation as a pathway to increasing bargaining power. At the same time, it appears that work does not extend to significantly impacting the likelihood that the wife will have sole decision-making authority over her own time, indicating that work alone has limitations for increasing the wife's bargaining power.

A dichotomous indicator for the wife's schooling and marriage

I also estimate models to examine whether formal education versus no education and divorced versus never divorce matter more than different levels of each (Marginal effects are shown in Tables E4-E7). In both cases, the results are largely the same, but slight differences between the original model and models using dichotomized measures suggest the level of education and number of times married are more informative than a dichotomized measures. For instance, for couples' responses for the wife's time in leisure, the wife's dichotomous measure of education increases the predicted probability of households being in *wife decides*, while in the original model it increased the predicted probability of *joint* or *deferential* positions. For couples' perceptions about the control over the wife's time at the market, the wife's dichotomous measure of education is not significantly associated with any of the categories, while in the original model it increased the predicted probability of *joint.* The statistical significance of other covariates, meanwhile, remains unchanged and the magnitudes are also similar.

Table E1: Multinomial regression results for spousal perceptions of the wife's decision-making power[a]

	(1)			(2)		
	Time spent in leisure			**Time market**		
	Wife	Jointly	Adversarial	Wife	Jointly	Adversarial
Wife's age	0.02	0.01	0.11	0.03	0.01	0.02
	(0.133)	(0.071)	(0.111)	(0.079)	(0.068)	(0.119)
Wife's age-squared	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Highest grade attained by wife	0.08	0.21*	-0.02	-0.01	0.13	-0.27
	(0.122)	(0.087)	(0.327)	(0.111)	(0.087)	(0.251)
Size of wife's kinship network	0.13	-0.18	0.12	-0.08	-0.24	-0.04
	(0.174)	(0.166)	(0.214)	(0.129)	(0.159)	(0.247)
Number of times wife has been married	-0.67	-0.94**	-0.72	-0.38	-0.46	-1.08
	(0.499)	(0.353)	(0.648)	(0.404)	(0.348)	(0.719)
Wife works for wages	0.72	1.41***	0.77	0.44	0.83+	0.46
	(0.878)	(0.426)	(0.975)	(0.591)	(0.428)	(1.218)
Difference in size of kinship network between	0.13	-0.02	0.06	0.04	-0.09	0.14
husband and wife	(0.114)	(0.071)	(0.172)	(0.085)	(0.074)	(0.132)
Difference in number of times married	-0.09	0.07	0.80**	0.59**	-0.07	0.19
between husband and wife	(0.359)	(0.176)	(0.305)	(0.186)	(0.201)	(0.363)
Difference in educational attainment between	0.07	-0.00	0.06	0.01	-0.07	-0.05
husband and wife	(0.078)	(0.047)	(0.157)	(0.066)	(0.048)	(0.145)
Difference in age between husband and wife	0.00	-0.02	-0.05	-0.06*	0.00	0.03
	(0.028)	(0.028)	(0.065)	(0.026)	(0.027)	(0.061)
Number of under school-aged males	0.25	0.16	0.23	-0.33	0.05	0.05
	(0.324)	(0.228)	(0.333)	(0.309)	(0.227)	(0.418)
Number of under school-aged females	-0.34	0.05	0.49	-0.54	-0.14	-1.22
	(0.469)	(0.227)	(0.497)	(0.360)	(0.227)	(0.840)
Number of school-aged males	0.02	0.13	0.01	-0.07	0.10	-0.19
	(0.242)	(0.154)	(0.263)	(0.180)	(0.151)	(0.424)
Number of school-aged females	0.03	0.03	-0.08	-0.14	-0.08	0.19
	(0.248)	(0.190)	(0.342)	(0.236)	(0.174)	(0.308)

Table E1 (Continued)

Number of adult males	0.26	0.22	0.40	0.09	-0.13	0.06
	(0.305)	(0.183)	(0.418)	(0.215)	(0.195)	(0.566)
Number of adult females	0.45	0.30	0.07	-0.32	-0.02	0.00
	(0.366)	(0.230)	(0.626)	(0.369)	(0.243)	(0.521)
Log total assets and income	0.15	-0.18*	-0.26**	0.05	-0.11	0.04
	(0.265)	(0.087)	(0.100)	(0.114)	(0.104)	(0.202)
Tutekunche	2.50**	0.25	0.91	-0.21	-0.24	0.28
	(0.895)	(0.381)	(0.815)	(0.463)	(0.380)	(0.875)
Kelecho Gerbi	1.08	0.09	-0.51	-0.61	-0.50	-0.49
	(0.886)	(0.344)	(0.835)	(0.478)	(0.359)	(0.788)
Constant	-6.51	0.65	-3.66	-0.59	1.41	-2.11
	(3.988)	(1.469)	(2.419)	(1.844)	(1.561)	(2.750)
AIC	640.92			696.27		
BIC	860.70			916.46		
Pseudo-R^2	0.13			0.08		
n	288			290		

[a] All models estimated with robust standard errors. Model fit was also tested using likelihood ratio tests for nested models. Base categories for all models is *deferential*.
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table E2: Marginal effects for perceptions of the decision-making power for time in leisure

	Wife	Jointly	Deferential	Adversarial
Wife's age	0.00039	0.00088	-0.0052	0.0039
	(0.04)	(0.07)	(-0.36)	(0.95)
Wife's age-squared	0.000014	-0.0000083	0.000025	-0.000031
	(0.17)	(-0.06)	(0.17)	(-0.82)
Highest grade attained by wife	0.00027	0.038*	-0.035+	-0.0037
	(0.03)	(2.50)	(-1.95)	(-0.30)
Size of wife's kinship network	0.013	-0.040	0.021	0.0065
	(1.10)	(-1.31)	(0.73)	(0.80)
Number of times wife has been married	-0.019	-0.16*	0.19**	-0.012
	(-0.56)	(-2.37)	(2.92)	(-0.51)
Wife works for wages	0.0094	0.24***	-0.26**	0.0077
	(0.17)	(3.46)	(-3.07)	(0.22)
Difference in size of kinship network between husband and wife	0.0094	-0.0082	-0.0032	0.0020
	(1.22)	(-0.61)	(-0.24)	(0.31)
Difference in number of times married between husband and wife	-0.011	0.0047	-0.023	0.030*
	(-0.47)	(0.15)	(-0.66)	(2.56)
Difference in educational attainment between husband and wife	0.0049	-0.0032	-0.0035	0.0019
	(0.93)	(-0.36)	(-0.38)	(0.31)
Difference in age between husband and wife	0.00084	-0.0026	0.0033	-0.0015
	(0.43)	(-0.51)	(0.66)	(-0.65)
Number of under school-aged males	0.012	0.021	-0.039	0.0057
	(0.56)	(0.50)	(-0.94)	(0.47)
Number of under school-aged females	-0.027	0.013	-0.0048	0.019
	(-0.86)	(0.30)	(-0.10)	(0.99)
Number of school-aged males	-0.0019	0.024	-0.021	-0.0012
	(-0.12)	(0.85)	(-0.69)	(-0.12)
Number of school-aged females	0.0013	0.0062	-0.0040	-0.0036
	(0.08)	(0.18)	(-0.11)	(-0.28)
Number of adult males	0.011	0.030	-0.051	0.011
	(0.55)	(0.91)	(-1.42)	(0.71)
Number of adult females	0.023	0.046	-0.066	-0.0033
	(0.96)	(1.11)	(-1.43)	(-0.15)
Log total assets and income	0.016	-0.035*	0.027	-0.0082*
	(0.86)	(-2.16)	(1.46)	(-2.27)
Tutekunche	0.16**	-0.029	-0.15*	0.021
	(2.60)	(-0.42)	(-2.07)	(0.69)
Kelecho Gerbi	0.074	-0.0039	-0.046	-0.025
	(1.22)	(-0.06)	(-0.63)	(-0.80)
n	288	288	288	288

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table E3: Marginal effects for perceptions of the decision-making power for time at the market

	Wife	Jointly	Deferential	Adversarial
Wife's age	0.0028	0.0012	-0.0043	0.00022
	(0.34)	(0.10)	(-0.32)	(0.07)
Wife's age-squared	-0.000031	-0.000016	0.000053	-0.0000061
	(-0.35)	(-0.12)	(0.38)	(-0.21)
Highest grade attained by wife	-0.0048	0.027+	-0.013	-0.0087
	(-0.40)	(1.74)	(-0.77)	(-1.12)
Size of wife's kinship network	0.00035	-0.043	0.041	0.0013
	(0.02)	(-1.46)	(1.55)	(0.18)
Number of times wife has been married	-0.021	-0.065	0.11+	-0.026
	(-0.46)	(-1.03)	(1.72)	(-1.14)
Wife works for wages	0.016	0.14+	-0.16+	0.0046
	(0.26)	(1.85)	(-1.79)	(0.13)
Difference in size of kinship network between husband and wife	0.0071	-0.020	0.0082	0.0045
	(0.78)	(-1.52)	(0.58)	(1.14)
Difference in number of times married between husband and wife	0.068***	-0.036	-0.035	0.0032
	(3.56)	(-1.03)	(-0.93)	(0.33)
Difference in educational attainment between husband and wife	0.0037	-0.012	0.0096	-0.00085
	(0.52)	(-1.46)	(0.97)	(-0.20)
Difference in age between husband and wife	-0.0065*	0.0020	0.0032	0.0013
	(-2.31)	(0.42)	(0.64)	(0.72)
Number of under school-aged males	-0.039	0.022	0.015	0.0028
	(-1.20)	(0.53)	(0.33)	(0.24)
Number of under school-aged females	-0.050	0.0031	0.078+	-0.032
	(-1.25)	(0.07)	(1.65)	(-1.24)
Number of school-aged males	-0.010	0.023	-0.0063	-0.0059
	(-0.54)	(0.84)	(-0.21)	(-0.48)
Number of school-aged females	-0.014	-0.012	0.019	0.0070
	(-0.54)	(-0.39)	(0.55)	(0.78)
Number of adult males	0.015	-0.029	0.011	0.0025
	(0.65)	(-0.82)	(0.30)	(0.15)
Number of adult females	-0.035	0.0082	0.025	0.0019
	(-0.88)	(0.18)	(0.51)	(0.13)
Log total assets and income	0.0100	-0.023	0.011	0.0017
	(0.83)	(-1.29)	(0.55)	(0.31)
Tutekunche	-0.017	-0.039	0.044	0.011
	(-0.33)	(-0.57)	(0.59)	(0.44)
Kelecho Gerbi	-0.048	-0.068	0.12+	-0.0072
	(-0.94)	(-1.06)	(1.72)	(-0.32)
n	290	290	290	290

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table E4: Marginal effects for perceptions of the decision-making power for time in leisure with dichotomous education variable

	Wife	Jointly	Deferential	Adversarial
Wife's age	0.0029	-0.0015	-0.0041	0.0027
	(0.36)	(-0.12)	(-0.29)	(0.67)
Wife's age-squared	-0.0000035	0.0000085	0.000018	-0.000023
	(-0.04)	(0.06)	(0.12)	(-0.61)
Any formal education (0/1)	0.096*	0.095	-0.13	-0.056
	(2.07)	(1.08)	(-1.44)	(-0.97)
Size of wife's kinship network	0.014	-0.041	0.023	0.0044
	(1.07)	(-1.36)	(0.82)	(0.56)
Number of times wife has been married	-0.021	-0.14*	0.17**	-0.0067
	(-0.66)	(-2.22)	(2.70)	(-0.37)
Wife works for wages (0/1)	0.012	0.24***	-0.25**	0.0073
	(0.21)	(3.31)	(-2.96)	(0.19)
Difference in size of kinship network between husband and wife	0.0078	-0.0077	-0.0019	0.0018
	(0.99)	(-0.59)	(-0.14)	(0.28)
Difference in number of times married between husband and wife	-0.011	0.012	-0.029	0.028**
	(-0.45)	(0.33)	(-0.77)	(2.63)
Difference in formal educational between husband and wife	-0.026	-0.052	0.051	0.028
	(-0.62)	(-0.88)	(0.83)	(1.23)
Difference in age between husband and wife	0.0015	-0.0041	0.0040	-0.0014
	(0.73)	(-0.80)	(0.80)	(-0.63)
Number of under school-aged males	0.014	0.0090	-0.030	0.0068
	(0.63)	(0.21)	(-0.74)	(0.59)
Number of under school-aged females	-0.035	0.021	-0.0048	0.019
	(-1.16)	(0.48)	(-0.11)	(1.03)
Number of school-aged males	-0.0040	0.021	-0.018	0.0016
	(-0.24)	(0.73)	(-0.61)	(0.17)
Number of school-aged females	-0.0038	0.011	-0.0048	-0.0023
	(-0.22)	(0.32)	(-0.14)	(-0.19)
Number of adult males	0.0085	0.035	-0.056	0.012
	(0.42)	(1.08)	(-1.55)	(0.85)
Number of adult females	0.020	0.056	-0.070	-0.0064
	(0.82)	(1.37)	(-1.54)	(-0.28)
Log total assets and income	0.018	-0.034*	0.024	-0.0077*
	(0.89)	(-2.02)	(1.27)	(-2.12)
Tutekunche	0.15*	0.0014	-0.16*	0.017
	(2.44)	(0.02)	(-2.21)	(0.61)
Kelecho Gerbi	0.075	-0.013	-0.041	-0.021
	(1.28)	(-0.20)	(-0.58)	(-0.71)
n	288	288	288	288

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table E5: Marginal effects for perceptions of the decision-making power for time at the market with dichotomous education variable

	Wife	Jointly	Deferential	Adversarial
Wife's age	0.0037	-0.0026	-0.0019	0.00070
	(0.45)	(-0.22)	(-0.14)	(0.21)
Wife's age-squared	-0.000037	0.0000088	0.000039	-0.000011
	(-0.42)	(0.07)	(0.29)	(-0.38)
Any formal education (0/1)	0.017	-0.063	0.077	-0.031
	(0.27)	(-0.72)	(0.83)	(-0.91)
Size of wife's kinship network	0.0013	-0.046	0.044+	0.00100
	(0.09)	(-1.59)	(1.68)	(0.14)
Number of times wife has been married	-0.025	-0.048	0.10	-0.027
	(-0.57)	(-0.74)	(1.55)	(-1.18)
Wife works for wages (0/1)	0.017	0.14+	-0.17+	0.0088
	(0.28)	(1.92)	(-1.89)	(0.25)
Difference in size of kinship network between husband and wife	0.0070	-0.020	0.0080	0.0045
	(0.76)	(-1.50)	(0.57)	(1.05)
Difference in number of times married between husband and wife	0.066***	-0.030	-0.040	0.0028
	(3.45)	(-0.75)	(-1.02)	(0.29)
Difference in formal educational between husband and wife	-0.0052	0.054	-0.071	0.022
	(-0.13)	(0.96)	(-1.13)	(1.02)
Difference in age between husband and wife	-0.0061*	0.00012	0.0045	0.0014
	(-2.13)	(0.02)	(0.93)	(0.78)
Number of under school-aged males	-0.036	0.010	0.021	0.0053
	(-1.10)	(0.25)	(0.45)	(0.46)
Number of under school-aged females	-0.051	0.0089	0.075	-0.032
	(-1.30)	(0.21)	(1.57)	(-1.25)
Number of school-aged males	-0.0086	0.022	-0.0079	-0.0057
	(-0.45)	(0.84)	(-0.27)	(-0.49)
Number of school-aged females	-0.015	-0.0033	0.011	0.0070
	(-0.58)	(-0.11)	(0.32)	(0.75)
Number of adult males	0.013	-0.019	0.0036	0.0017
	(0.58)	(-0.53)	(0.10)	(0.11)
Number of adult females	-0.037	0.013	0.024	-0.00031
	(-0.92)	(0.28)	(0.49)	(-0.02)
Log total assets and income	0.0091	-0.023	0.012	0.0015
	(0.75)	(-1.24)	(0.58)	(0.31)
Tutekunche	-0.024	-0.0082	0.024	0.0077
	(-0.47)	(-0.12)	(0.32)	(0.30)
Kelecho Gerbi	-0.048	-0.068	0.12+	-0.0066
	(-0.94)	(-1.04)	(1.72)	(-0.29)
n	290	290	290	290

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table E6: Marginal effects for perceptions of the decision-making power for time in leisure with dichotomous number of marriages variable

	Wife	Jointly	Deferential	Adversarial
Wife's age	0.00063	-0.00060	-0.0035	0.0035
	(0.07)	(-0.05)	(-0.24)	(0.83)
Wife's age-squared	0.0000094	0.00000063	0.000016	-0.000026
	(0.11)	(0.00)	(0.11)	(-0.67)
Highest grade attained by wife	0.000014	0.037*	-0.033+	-0.0041
	(0.00)	(2.40)	(-1.82)	(-0.31)
Size of wife's kinship network	0.013	-0.040	0.022	0.0051
	(1.06)	(-1.29)	(0.76)	(0.54)
Ever divorced (0/1)	-0.022	-0.13	0.15+	0.0013
	(-0.44)	(-1.42)	(1.65)	(0.05)
Wife works for wages	0.0088	0.24***	-0.25**	-0.00041
	(0.16)	(3.43)	(-2.88)	(-0.01)
Difference in size of kinship network between husband and wife	0.0091	-0.0075	-0.0028	0.0012
	(1.18)	(-0.55)	(-0.21)	(0.18)
Difference in ever divorced between husband and wife	-0.018	0.034	-0.025	0.0086
	(-0.50)	(0.47)	(-0.33)	(0.30)
Difference in educational attainment between husband and wife	0.0048	-0.0027	-0.0029	0.00091
	(0.89)	(-0.31)	(-0.31)	(0.15)
Difference in age between husband and wife	0.00043	-0.0036	0.0026	0.00056
	(0.22)	(-0.74)	(0.54)	(0.27)
Number of under school-aged males	0.013	0.023	-0.030	-0.0061
	(0.59)	(0.53)	(-0.71)	(-0.49)
Number of under school-aged females	-0.025	0.017	-0.0054	0.013
	(-0.80)	(0.40)	(-0.12)	(0.70)
Number of school-aged males	-0.0024	0.026	-0.024	0.00041
	(-0.15)	(0.92)	(-0.80)	(0.05)
Number of school-aged females	0.0020	0.0081	-0.0059	-0.0042
	(0.12)	(0.23)	(-0.16)	(-0.26)
Number of adult males	0.012	0.034	-0.050	0.0035
	(0.65)	(1.06)	(-1.38)	(0.19)
Number of adult females	0.020	0.055	-0.072	-0.0031
	(0.86)	(1.33)	(-1.57)	(-0.16)
Log total assets and income	0.016	-0.035*	0.027	-0.0084*
	(0.87)	(-2.15)	(1.46)	(-2.18)
Tutekunche	0.16**	-0.023	-0.16*	0.016
	(2.65)	(-0.33)	(-2.09)	(0.53)
Kelecho Gerbi	0.075	0.0014	-0.050	-0.026
	(1.24)	(0.02)	(-0.69)	(-0.71)
n	288	288	288	288

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table E7: Marginal effects for perceptions of the decision-making power for time at the market with dichotomous number of marriages variable

	Wife	Jointly	Deferential	Adversarial
Wife's age	0.0020	0.00068	-0.0030	0.00039
	(0.23)	(0.06)	(-0.23)	(0.11)
Wife's age-squared	-0.000022	-0.000015	0.000046	-0.0000085
	(-0.24)	(-0.12)	(0.33)	(-0.29)
Highest grade attained by wife	-0.0035	0.025+	-0.013	-0.0091
	(-0.27)	(1.66)	(-0.73)	(-1.15)
Size of wife's kinship network	-0.0013	-0.042	0.042	0.0017
	(-0.09)	(-1.43)	(1.57)	(0.24)
Ever divorced (0/1)	0.047	-0.081	0.067	-0.032
	(0.69)	(-0.93)	(0.72)	(-1.42)
Wife works for wages	0.0053	0.14+	-0.15+	0.0046
	(0.08)	(1.87)	(-1.66)	(0.13)
Difference in size of kinship network	0.0068	-0.020	0.0082	0.0047
between husband and wife	(0.74)	(-1.51)	(0.58)	(1.23)
Difference in ever divorced	0.10*	-0.032	-0.059	-0.011
between husband and wife	(2.05)	(-0.42)	(-0.71)	(-0.45)
Difference in educational attainment	0.0027	-0.012	0.010	-0.00073
between husband and wife	(0.37)	(-1.41)	(1.01)	(-0.18)
Difference in age between husband	-0.0044	0.00057	0.0024	0.0015
and wife	(-1.58)	(0.12)	(0.50)	(0.88)
Number of under school-aged males	-0.050	0.027	0.022	0.0015
	(-1.46)	(0.65)	(0.48)	(0.13)
Number of under school-aged	-0.053	0.0069	0.078	-0.032
females	(-1.28)	(0.16)	(1.62)	(-1.25)
Number of school-aged males	-0.0066	0.023	-0.010	-0.0065
	(-0.34)	(0.85)	(-0.33)	(-0.54)
Number of school-aged females	-0.015	-0.010	0.018	0.0071
	(-0.58)	(-0.33)	(0.53)	(0.75)
Number of adult males	0.0031	-0.022	0.015	0.0030
	(0.12)	(-0.62)	(0.41)	(0.17)
Number of adult females	-0.027	0.010	0.016	0.00080
	(-0.64)	(0.23)	(0.32)	(0.06)
Log total assets and income	0.012	-0.023	0.0100	0.0011
	(0.94)	(-1.31)	(0.48)	(0.19)
Tutekunche	-0.019	-0.034	0.040	0.013
	(-0.36)	(-0.50)	(0.53)	(0.53)
Kelecho Gerbi	-0.042	-0.066	0.12	-0.0066
	(-0.84)	(-1.03)	(1.63)	(-0.29)
n	290	290	290	290

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Appendix F: Coefficients for time use regressions

Table F1: Coefficients for time use regressions at the market with dichotomous number of afadfasss marriages variable

	Time in social and leisure		Time at the market	
	% of daily time	Hours	% of daily time	Hours
Wife's age	0.01**	0.15**	-0.00	-0.01
	(0.003)	(0.049)	(0.003)	(0.046)
Wife's age-squared	-0.00**	-0.00**	0.00	0.00
	(0.000)	(0.000)	(0.000)	(0.000)
Highest grade attained by wife	0.00	0.06	0.01	0.08
	(0.006)	(0.084)	(0.005)	(0.080)
Size of wife's kinship network	0.00	0.05	-0.00	-0.04
	(0.005)	(0.076)	(0.005)	(0.079)
Number of times wife has been married	-0.01	-0.10	0.01	0.12
	(0.021)	(0.295)	(0.017)	(0.252)
Wife works for wages	-0.02	-0.14	-0.01	-0.19
	(0.024)	(0.363)	(0.021)	(0.325)
Difference in size of kinship network between husband and wife	0.00	0.06	-0.00	-0.03
	(0.005)	(0.070)	(0.004)	(0.057)
Difference in number of times married between husband and wife	-0.01	-0.06	0.01	0.08
	(0.012)	(0.201)	(0.010)	(0.141)
Difference in educational attainment between husband and wife	0.01+	0.09*	0.00	0.02
	(0.003)	(0.045)	(0.002)	(0.035)
Difference in age between husband and wife	0.00	0.02	-0.00	-0.02
	(0.002)	(0.026)	(0.001)	(0.017)
Number of under school-aged males	-0.02	-0.38+	0.02	0.30
	(0.015)	(0.221)	(0.013)	(0.206)
Number of under school-aged females	-0.00	-0.15	-0.00	-0.05
	(0.015)	(0.215)	(0.012)	(0.193)
Number of school-aged males	-0.02+	-0.15	-0.00	-0.02
	(0.008)	(0.124)	(0.006)	(0.093)
Number of school-aged females	-0.01	-0.09	0.01	0.20
	(0.009)	(0.137)	(0.010)	(0.161)
Number of adult males	-0.01	-0.16	-0.02*	-0.25*
	(0.010)	(0.158)	(0.007)	(0.115)
Number of adult females	0.00	0.15	0.00	0.06
	(0.012)	(0.171)	(0.011)	(0.174)
Log total assets and income	0.01**	0.15*	0.00	0.02
	(0.004)	(0.059)	(0.003)	(0.052)
Tutekunche	-0.05*	-0.72*	0.01	0.15
	(0.026)	(0.360)	(0.017)	(0.261)

Table F1 (Continued)

Kelecho Gerbi	-0.03	-0.60+	0.02	0.25
	(0.022)	(0.316)	(0.018)	(0.274)
Constant	0.06	1.18	-0.01	-0.12
	(0.075)	(1.108)	(0.069)	(1.063)

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10