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IMPACT OF COORDINATED ASSET TRANSFERS AND ASSET OWNERSHIP ON
POVERTY REDUCTION, WOMEN'S EMPOWERMENT, AND CHILD EDUCATION:
EVIDENCE FROM ZAMBIA AND TANZANIA

BY

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DISSERTATION

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ABSTRACT

This dissertation assesses the impact of coordinated asset transfers and asset ownership on poverty and food security, women's empowerment, and child education in Zambia and Tanzania. In contrast to the traditional view of assets uniformly improving child development outcomes through wealth effects, Chapter 2 assesses whether different types of assets have differential effects on child education. I find that household durables and housing-quality characteristics have the expected positive effects, but agricultural assets have adverse effects on highest grade completed and test scores. I extend the agricultural-household model by explicitly including child labor to portray a theoretical framework for different assets to have differential effects and use three waves of National Panel Survey data from Tanzania to estimate empirical relationships. I correct for the endogeneity of assets and control for time-invariant unobservable by using the Hausman-Taylor instrumental variable (HTIV) method. Further examination reveals that the negative effect of agricultural assets is more pronounced among boys, rural children, poor children, and children from farming households. These conditions may raise the opportunity cost of schooling and result in weaker education outcomes.

Building on the finding that different assets have differential effects, the third and fourth chapters assess the impact of an intervention that provides livestock, support services, and associated training to impoverished households in Zambia. In Chapter 3, I confirm previous findings that physical asset transfers increase income and consumption expenditures. Then I examine the practical significance of the increase in expenditures to assess whether it is large enough to trigger changes in consumption patterns or in subjective assessment of wellbeing status. Changes in composition of expenditures, composition of diet, and subjective self-assessment of poverty all suggest that the intervention contributes to a growing sense of economic security and a practically significant change in wellbeing. As transfers included three different types of animals – dairy cows,

meat goats, and draft cattle – I am able to discern that the impact does differ by the types of assets transferred. Examination of changes in the composition of consumption shows substantial effects on poverty and food security starting within six months of asset transfers. Persistence of the impact through the next 18 months of the study period indicates that livestock transfers can have a sustained effect on poverty and food security.

In Chapter 4, I assess the impact of the same livestock transfer and training intervention on intra-household ‘decision-making’ over different farm household activities and resources. Using a two-period panel dataset, I use decision-making abilities as empowerment measures and find that the intervention significantly improved both women’s and men’s empowerment by expanding the scope of joint decision-making in household activities. In particular, the intervention helped increase the proportion of joint decisions by 17% in all household activities considered and both men’s and women’s independent decisions decreased by as much as 9%. Similar pattern follows when household activities were categorized to ‘treatment related’ and ‘other’ activities; women’s and men’s joint decisions increased at the expense of their independent decision-making participation. I confirm that the finding is consistent with the prediction of the Nash bargaining model because transferring economic resources to women or men leads to Pareto optimality in intra-household resource allocation only through co-operation between men and women.

To my parents Jivanath and Buddhi Maya Kafle

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CHAPTER 1

INTRODUCTION

In this dissertation, I present three studies that collectively provide empirical evidence of asset-specific effects on measures of household wellbeing, women's empowerment, and child education. I am specifically interested in these outcomes because, following the Millennium Development Goals (MDG), most developmental interventions in the last 15 years have integrated 'hunger and poverty eradication', 'gender equality', and 'universal primary education' in their programs. Policy interventions transferring economic resources have become increasingly popular and often transfer physical assets to impoverished families primarily through women and also provide awareness training (Banerjee et al. 2015; Kafle, Winter-Nelson and Goldsmith 2016; Jodlowski et al. 2016; Das et al. 2013). Other programs that do not directly transfer physical assets, such as conditional cash transfers (de Brauw et al. 2014; Gertler 2004; Bourguignon, Ferreira and Leite 2003; Skoufias et al. 2001; Fiszbein and Schady 2009; Akresh, De Walque and Kazianga 2013), micro-credit (Pitt, Khandker and Cartwright 2006; Garikipati 2012), and other in-kind physical asset transfers (Denning et al. 2009; Muralidharan and Prakash 2013), do contribute to asset accumulations in many ways. Collectively, these papers seek to provide insights about the particularities associated with transfers of specific economic resources to agrarian communities characterized by poverty and incomplete markets. Such transfers not only raise a recipient household's wealth, but also alter the asset composition of the household and community. Given incomplete markets, these changes in asset mix could yield distinct impacts that warrant exploration.

The existing body of literature suggests that assets reflect long run wealth status and can contribute to livelihood improvement through positive wealth effects (Filmer and Pritchett 2001a; Kim and Sherraden 2011a; Zhan and Sherraden 2003; Sahn and Stifel 2000; Sahn and Stifel 2003; McKenzie 2005). However, in contrast to the traditional view of assets uniformly contributing to wellbeing status through wealth effects, different types of assets can have differential effects on both

individual and household welfare. For example, transferring labor-using assets (such as livestock) may contribute to household food security and economic wellbeing, but may increase child labor to the detriment of child education. In contrast, labor-neutral assets like household durables and labor-saving assets (such as access to electricity, water etc.) may contribute to household food security, poverty reduction, and child education. I provide three empirical studies first to examine differentiated effects of assets and then use a real world asset transfer program to assess the claim of asset-specific effects and investigate the role of transferred assets. If the claim that different types of assets have differential effects is robust, it may open a door for a new discussion in the development literature and potentially help reshape the current approach of transferring physical assets.

In Chapter 2, I investigate whether different types of assets have differential effects on educational outcomes of children ages 6-18 in Tanzania. I explicitly include child labor in the standard agricultural-household model (Singh, Squire and Strauss 1986) to portray a mechanism for different assets to have differential effects on child education. Using the Hasuman-Taylor instrumental variable (HTIV) method (Hausman and Taylor 1981), I show that in contrast to the undifferentiated view of assets uniformly contributing to child education through positive wealth effects, agricultural assets have negative effects but household durables and housing quality assets have expected positive effects on child education. I argue that, in absence of a well-functioning labor market, any increase in labor-intensive assets increases child labor demand and at the same time may increase the opportunity cost of schooling to incentivize parents to move their children from school to household activities. In contrast, increase in labor-neutral or labor-saving assets contribute to individual and household wellbeing through positive wealth effects. This implies that, in general, the net effect of increases in household asset holdings is ambiguous and depends on types of assets, initial wealth status, and local labor market conditions.

Drawing on the general findings that the effect of assets on specific outcomes is dictated by the types of assets, the next two chapters assess the impact of an intervention transferring specific physical assets and support services in Zambia. These two chapters use longitudinal household survey data from a livestock transfer and training program in Zambia's Copperbelt Province. The intervention is implemented by the NGO Heifer International and I take advantage of the program rollout to effectively design a controlled experiment. The intervention transfers 3 specific livestock species and support services to eligible households primarily through women. It also provides a comprehensive training on various societal themes to women and men from eligible households. Households receiving both livestock transfers and training form a 'treated' group and other eligible households that are scheduled to receive animals and training in the future form a 'control' group for the study.

In Chapter 3, using data from baseline and 3 follow up surveys, I first confirm the previous findings that asset transfers help increase consumption expenditures (Jodlowski et al. 2016; Banerjee et al. 2015; Rawlins et al. 2014) and then assess the practical significance of the small absolute increase in consumption. The growth in consumption expenditure, though small, was transformative and had persistent effects on dietary quality, food security, and also helped trigger enhanced feeling of economic security and subjective wellbeing among program participants. Although all transferred assets had positive impact, the magnitude of the impact varied by the types of assets transferred suggesting asset-specific effects. Further examination reveals that non-recipients and non-participants also benefitted from the program as the intervention helped transform the local food economy through increased availability of nutritious food items and reduced local food prices.

In Chapter 4, I use a two-period panel dataset that comes from the field experiment in the Copperbelt Province. This chapter first confirms the previous findings and theoretical evidence that women's empowerment corresponds to food security and economic wellbeing (Sharaunga, Mudhara

and Bogale 2015; Wilcox et al. 2015; Duflo 2012). Then I investigate whether the asset transfers and training alter the existing gender relations and intra-household decision-making, with a particular focus on women's empowerment. Unlike the existing body of literature in gender studies and women's empowerment, I examine both women's and men's decision-making participation and find that the intervention helped improve both women's and men's positions by expanding joint decisions in most household activities accompanied by a reduction in solitary decisions. This implies that transferring physical assets through women may place them in better position within the household and, as the Nash bargaining model predicts, this leads to increased co-operation and shared responsibilities between men and women.

Taken together these papers suggest both potential and problems with specific asset transfers to private households. Cash transfers may dominate in-kind transfers when markets are complete, but in agrarian settings in-kind transfers can alter the local economy and have positive spillover effects that would not emerge from cash transfer. Moreover, I see evidence that in-kind transfers can stimulate changes in household decision-making that could improve resource allocation and other development outcomes. On the other hand, altering the asset mix in a household can influence the opportunity cost of education and negatively affect human capital development. Overall, this suggests a need to understand local contexts in order to discern the appropriateness of a specific asset transfer.

CHAPTER 2

DO DIFFERENT TYPES OF ASSETS HAVE DIFFERENTIAL EFFECTS ON CHILD EDUCATION? EVIDENCE FROM TANZANIA¹

2.1. Introduction

Policy interventions that aim to reduce poverty and improve livelihood often transfer economic resources to people in need. Livestock transfers, such as BRAC's (the largest non-governmental development agency in the world) Ultra-poor Program (Das and Shams 2011) and Heifer International's programs in many countries (Jodlowski et al. 2016; Kafle et al. 2016), represent one type of asset transfer program, but programs transferring agricultural inputs (Denning et al. 2009) and other in-kind physical assets have also been increasingly popular (Banerjee et al. 2015; Muralidharan and Prakash 2013). Other forms of interventions, such as cash transfer, microcredit, or training, which do not transfer assets directly also contribute to asset accumulation by increasing household income. Although there is a strong current in the development literature advocating for cash transfers as superior to other asset transfers (Blattman and Niehaus 2014), it is believed that both asset and cash transfers contribute to asset accumulation.

While poverty is typically measured in terms of whether someone has sufficient daily income or consumption to meet basic needs, wealth creation through asset ownership is viewed by many development organizations as the long-run pathway out of poverty. A core element of a poverty-reduction program in Bangladesh, run by BRAC and replicated in over 20 countries, for example, is an asset transfer program targeted to poor households. Banerjee et al. (2015) presents evidence from randomized control trials from several countries, with an asset transfer similar to the BRAC program as the core element, and shows that the effects on poverty reduction are significant and long-lasting.

¹ I would like to thank Dean Jolliffe, Alex Winter-Nelson, Kathy Baylis, Hope Michelson, Ben Crost, and Craig Gundersen for valuable comments and feedback. The paper has benefitted greatly from comments received from participants of i) the 2015 Agricultural and Applied Economics Association (AAEA) annual meeting, San Francisco, USA ii) the 2016 Association of African Agricultural Economists (AAAE) conference, Addis Ababa, Ethiopia, and iii) the 2017 Center for Studies of African Economics (CSAE) Conference in Oxford, UK, and iv) International Policy and Development seminar at University of Illinois.

Their findings indicate that the positive effects continue to exist three years after receipt of the asset transfer, and the positive effects are seen in all six countries in which the experiment was carried out (Ethiopia, Ghana, Honduras, India, Pakistan, and Peru).

Increased asset ownership increases household wealth and greater wealth can improve wellbeing in many different ways. One path is through increased investments in human capital which can serve to break cycles of poverty and help to extract people from chronic poverty. As a key example of this pathway, a large body of evidence has established that increased holdings of physical assets result in greater investments in children's education, particularly in the rich country context (Deng et al. 2014; Chowa et al. 2013; Huang 2013; Huang 2011; Elliott, Destin and Friedline 2011; Kim and Sherraden 2011b; Shanks 2007; Zhan and Sherraden 2003; Conley 2001a; Loke 2013; Elliott and Sherraden 2013). There is also a fairly extensive body of research on the 'asset-child education' relationship in developing countries. Deng et al. (2014) and Filmer and Pritchett (2001) construct a measure of wealth based on assets and examine child education outcomes, others including Chowa et al. (2013) and Cockburn and Dostie (2007), construct measures of asset ownership and examine education outcomes. Chowa et al. (2013) finds that Ghanaian children in households which own at least one of five key assets – TV, refrigerators, electric iron, electric or gas stoves, and kerosene – outperformed the control group in English test scores. Similarly, Filmer and Pritchett (2001) constructs an asset-based wealth indicator in India and finds a rich-poor gap of more than 30 percent in school enrollment rates.

A common aspect of the literature establishing a positive link between increased asset ownership and improved child-education outcomes is the implicit assumption that the type of asset does not affect this relationship. Most studies either monetize or count asset holdings, converting all assets into a singular wealth scalar, and find a positive relationship between wealth and child education. A question I explore in this paper is whether an undifferentiated view of assets ignores

the potential for different types of assets to have varying effects on child education. More specifically, I explore whether agricultural assets discourage education investment, potentially by increasing the returns to child labor, while other assets could contribute to child education by increasing returns to schooling or raising the efficiencies of time spent studying (e.g. electricity, bicycle, and close source of water).

If there are differential effects across different types of assets, there is likely significant scope to improve the design of asset transfer and public investment programs. A growing body of literature indicates that such programs usually transfer income generating assets such as livestock (Jodlowski et al. 2016; Kafle et al. 2016; Rawlins et al. 2014), agricultural inputs (Denning et al. 2009), and other in-kind physical assets (Banerjee et al. 2015; Muralidharan and Prakash 2013). While physical asset transfers may provide a practical approach for programs aiming to improve livelihood outcomes in the short run, some assets could influence the returns to child labor in ways that discourage investment in formal education and hurt longer term economic development.

My contribution to the literature is twofold. First, I establish a theoretical relation between different types of assets and child education under perfect and imperfect labor market conditions. In the empirical analysis, I provide evidence demonstrating that different types of assets have differential effects on child education. More specifically I show that household durables and housing quality indicators have expected positive effects but agricultural assets negatively affect child education. I also demonstrate that the negative effect of agricultural assets is more pronounced among rural children and children of crop producers, which I argue stems from higher opportunity cost of schooling.

The rest of the paper proceeds as follows. I provide a summary of related literature in section 2.2. In section 2.3, I present my theoretical model which builds on the Basu et al. (2010) model of child labor and landholding who adopted the framework of the agricultural household

model from (Singh, Squire and Strauss 1986). I extend the model to introduce an education production function which constrains the household's utility maximization problem. In Section 2.4, I provide a brief overview of education system in Tanzania. Section 2.5 describes the data – three waves of the Tanzania National Panel Survey (NPS)² – and empirical model followed by the results in section 2.6. As opposed to the undifferentiated view of assets, I disentangle assets into three groups – household durables, agricultural assets, and housing quality characteristics – and estimate the effect of each type of assets on children's educational outcomes and show that different types of assets have differential effects. Section 2.7 discusses policy implications and conclusions.

2.2. Background

The existing literature may have overlooked the causal relationship between household asset composition and child educational outcomes in developing countries (Elliott et al. 2011). A fairly large body of empirical studies examine the asset-child education relationship in developed countries but these studies often monetize asset holdings at some arbitrary market price and assess the relationship between the monetary value (also called wealth or net worth) and child education. Many studies are limited to the United States and the Panel Study of Income Dynamics (PSID) but do find a significant positive impact of asset holding/net worth on children's educational achievement (Elliott and Sherraden 2013; Loke 2013; Chowa et al. 2013; Huang 2013; Huang 2011; Shanks 2007; Zhan and Sherraden 2003; Conley 2001). For example, Huang (2013) uses the PSID data to examine the effects of household assets (net worth) on transmission of parental abilities to child educational achievement and finds a causal relationship. Conley (2001) also uses the PSID data to investigate the effect of assets on children's post-secondary education and finds that children from asset rich

² The Tanzania NPS is part of the LSMS-ISA program which aims to marry complex consumption-based household surveys with plot-crop detailed agricultural surveys. The Tanzania NPS data, along with details on the sample and instrument design, are publicly available.

households perform better in post-secondary education. Similarly, Kim and Sherraden (2011) assesses the effect of parental asset holding (\$ value) on educational attainment of high school and college students using data from the National Longitudinal Study of Youth 1979 and also finds a positive relation between parental net worth and child education. In particular, Conley finds a positive causal relation between child educational attainment and homeownership and financial assets. Other researchers who examine the effect of assets on child education also find similar results but argue that the effect is more pronounced on early childhood (Huang 2011) and operates through mother's expectations of their children's educational achievement (Loke 2013).

The assets-child education relationship is largely understudied in developing countries probably because appropriate data are rarely available. A recent study in China uses data from 2002 China Household Income Project and shows a significant causal relationship between net worth and liquid assets and educational attainment of children (Deng et al. 2014). Similar results are reported from Ghana where Chowa et al. (2013) uses data from a field experiment among Ghanaian youth, Ghana Youth Save Experiment. In particular, their results indicate that youth from households that own at least one of the five key assets that are considered primary indicators of socioeconomic status – TV, refrigerators, electric iron, electric or gas stoves, and kerosene – outperformed the youth from control households in English test scores by at least one point. Despite some evidence of causal relation between assets and child education, confusion prevails as to what particular school outcomes to consider. Some studies measure child education with school enrollment (Filmer and Pritchett 2001) but others use test scores (Cockburn and Dostie 2007) or grade completed (Deng et al. 2014). Filmer and Pritchett (2001) examines the relationship between assets (net worth) and school enrollment and finds a wide gap in the school enrollment rate between rich and poor children in India; children from rich households are 31% more likely to be enrolled than children from poor households. Cockburn and Dostie (2007) investigates the relationship between time allocation and

educational performance among Ethiopian children and reports a positive effect of having a close source of water on child education.

The scant body of empirical literature on child education-assets relationship lacks a strong theoretical support. Cockburn and Dostie (2007) uses a variant of the agricultural household model and demonstrates that the effect of assets on child education varies with the type of assets.

Cockburn and Dostie's point is that whenever the expected return to schooling is less than the return to child labor, providing households with more assets can have adverse effects on child education because child labor demand increases with asset holdings. That child labor adversely affects child education is a common finding in the existing literature on this issue and enjoys strong theoretical and empirical support (Haile and Haile 2012; Basu, Das, and Datta 2010). As in Cockburn and Dostie (2007), Basu, Das and Dutta (2010) examines the effect of land holdings on child labor in rural India and discovers that when the labor market is missing, land holding size and child labor have an inverted U-shaped relationship. The main message from these studies is that when the labor market is complete, increase in household wealth can decrease child labor and result improved child education. However, when the labor market is missing or imperfect, the effect of land holding on child labor (hence child education) is ambiguous (Basu et al. 2010). Basu and colleagues demonstrate that when the labor market is missing, the net effect of wealth (land) on child labor (education) depends on the specification of underlying utility and production functions.

While Cockburn and Dostie (2007) and Basu et al. (2010) provide a theoretical understanding of household wealth (land holding in both cases) and child labor, they do not provide evidence on how other household assets affect child labor and child education. Basu and colleagues estimated the effect of land holdings only and Cockburn and Dostie (2011) did not specifically test the hypothesis that different asset types have differential effects on child education. The present paper empirically tests whether different types of assets have differential effects on child education

and whether the effect of labor complementary assets is negative. In so doing, I first examine the data to verify that agricultural asset holding predicts child labor in agriculture, in my sample. I estimate a probit regression of child labor on all three types of assets and other control covariates for each of the three waves of the Tanzania LSMS survey. The results indicate that agricultural assets increase the likelihood of child labor but household durables and housing quality assets either decrease or have no effect on child labor (Table A2 in Appendix A). The rest of the analysis considers child labor as a potential mechanism for the causal effect of assets on child education. Next, I provide a theoretical model to demonstrate the relationship between child labor and household asset holdings.

2.3. Theoretical Model and Results

While the hypothesis that different types of assets can have differential effects on child education is intuitively appealing and empirically testable, there has been significantly less development on the theory of this relationship. A handful of studies model asset-education relationship using some variants of the agricultural household model, but they do not differentiate between types of assets. My theoretical exposition builds on the model of child labor and landholding presented in Basu et al. (2010) who adapted the framework of the agricultural household model from Sing, Squire, and Strauss (1986). I start with the basic structure as described in Basu et al. (2010) and introduce an education production function which constrains the household's utility maximization problem. I consider two different scenarios under each of two labor market conditions; the perfect labor market and missing labor market. In one case, the household is constrained by an education production function and in the other case it is not. My primary interest is in the interactions between assets and human capital investments in education and so in both cases I include education production functions. Nonetheless, for completeness, I

summarize the results from all four cases – perfect and missing labor market with and without education production function – in Table 2.1. In this analysis, I first demonstrate the effect of asset holding on child labor and household consumption in the settings of a perfect labor market. I then switch to the case of missing labor markets. In either case, I explicitly assume that child labor adversely affects child educational outcomes. Therefore, my theoretical analysis portrays the effect of assets on child education through child labor but does not attempt to find direct effects on child education.

2.3.1. Basic structure

Consider an economy where each household has one adult and one child. The adult always prefers to work and takes no leisure. The child either works or goes to school but takes no leisure. Suppose each household is endowed with the following utility function.

$$u = u(c, l) \tag{2.1}$$

where c is the total consumption and $l \in [0, 1]$ is child labor hours, 0 indicates no child labor and 1 indicates no school/study hours. Since the adult always prefers to work, the total labor supply of the household is always $1 + l$. The aggregate consumption good c increases utility but labor accrues disutility. I assume that the utility function is smooth and quasi-concave and the following relationship holds: $u_c > 0, u_{cc} \leq 0, u_l < 0$, and $u_{ll} \leq 0$. Similarly, I assume that the cross marginal utilities are negative; $u_{cl}, u_{lc} < 0$.³ Each household faces a budget constraint, is engaged in

³ These are a reasonable assumption because utility increases with consumption ($u_c > 0$) but at a decreasing rate ($u_{cc} < 0$) i.e. diminishing marginal utility. In case of labor, utility decreases with labor ($u_l < 0$) and it does so at an increasing rate ($u_{ll} < 0$). The marginal disutility from labor increases with labor. I also assume that the marginal utility of consumption decreases with labor i.e. $u_{cl}, u_{lc} < 0$.

some kind of household production activity, and owns agricultural assets (K) and non-agricultural assets (A). If a household has a school attending child, the household also faces an education production function, and is liable to the cost of schooling, p_q .

2.3.2. The Perfect labor market case

When a well-functioning labor market exists, household can supply labor to off-farm activities and hire labor to work on its farm. All households are price takers and hire in/out labor at a market wage rate, w . Following Basu et al. (2010), I assume that both adults and children earn exactly the same wage. Suppose each household faces a production function, $Q(L, K)$, and an education production function, $q(s, A, \theta)$ ⁴, where L is total labor used in household production, K is household's agricultural asset holding, $s=1-l$ is total school/study hours, A is household's non-agricultural asset holding which may directly affect child education, and θ denotes 'other factors' that affect child education. For simplicity, I suppress θ and assume the education production function to be linear on school hours i.e. $q(s, A) = s + q(A)$. The household production function is quasi-concave and therefore, $Q_L, Q_K > 0$; $Q_{LL} < 0$; $Q_{LK} > 0$. I assume $q_s, q_A > 0$ and $q_{ss} = 0$. The household's problem is:

$$\begin{aligned}
 \max_{c, l} \quad & u(c, l) \quad \text{subject to} \\
 & Q = Q(L, K) \\
 & q = q(s, A) \quad \text{and} \\
 & c + p_q q = Q + y + w(H - L)
 \end{aligned} \tag{2.2}$$

⁴ To the best of my knowledge, no previous studies introduced education production function in the settings of agricultural-household model. Introducing education production function may make the model complicated but the added complications help us understand the potential effects of assets and tools that are not used in agricultural production and may have direct impact on child education. Most agricultural households in developing countries face a decision of sending children to school or not.

where Q is output produced, q is children's educational outcomes, p_q is unit cost of child education, y is non-labor income, and $H = 1 + l$ is total labor supply of the household. The household supplies labor off-farm if $H > L$ and hires labor from outside if $H < L$. Since the labor market is well-functioning and the household can hire in/out labor as needed, the production decision is separable from the consumption decision. If a household possesses K units of agricultural assets, it can earn a profit of $\pi(w, K)$. Therefore, $c + p_q q = \pi(w, K) + wH + y$. The household's problem simplifies to

$$u(c, l) - \lambda[c + p_q q - \pi(w, K) - w(1 + l) - y] \quad (2.3)$$

Rearranging the first order condition from equation (2.3) gives us the following expressions

$$\begin{aligned} \text{i.) } \quad & \frac{u_l}{u_c} \equiv Z = -(p_q + w) \\ \text{ii.) } \quad & c + p_q q = \pi(w, K) + w(1 + l) + y \end{aligned}$$

Totally differentiating the above expressions with respect to K and solving the resulting equations, we get

$$\frac{\delta l}{\delta K} = -\frac{z_c \pi_K}{z_c(p_q + w) + z_l} \text{ and } \frac{\delta c}{\delta K} = \frac{z_l \pi_K}{z_c(p_q + w) + z_l}$$

By assumption, $\pi_K > 0$, $q_s > 0$, and I can demonstrate that $z_c < 0$, $z_l < 0$.⁵ Therefore, when the labor market is perfect, agricultural asset accumulation at the household level decreases child labor, i.e. $\frac{\delta l}{\delta K} < 0$ but increases household consumption i.e. $\frac{\delta c}{\delta K} > 0$. Similarly, differentiating expressions i.) and ii.) with respect to income y gives us the following conditions.

⁵ I view this as a reasonable assumption because marginal rate of substitution between child labor and consumption may decrease with consumption, i.e. $z_c = \frac{\delta u_l}{\delta c u_c} = \frac{u_{lc} u_c - u_l u_{cc}}{u_c^2} < 0$ because $u_c > 0$, $u_{lc} < 0$ and $u_l, u_{cc} < 0$, by assumption. Similarly, $z_l < 0$.

$$\frac{\delta l}{\delta y} = -\frac{z_c}{z_c w + z_l} < 0 \text{ and } \frac{\delta c}{\delta y} = \frac{z_l}{z_c w + z_l} > 0$$

This indicates that exogenous increase in income or assets unambiguously reduces child labor and increases consumption when the labor market is perfect. This is consistent with previous findings that an exogenous increase in land holdings decreases child labor when the labor market functions perfectly (Basu et al. 2010; Dostie and Cockburn 2007). However, further analysis shows that, unlike agricultural assets, increase in education-specific assets has negative effects on household consumption ($\frac{\delta c}{\delta A} < 0$) and positive effects on child labor ($\frac{\delta l}{\delta A} > 0$).⁶ Because child takes no leisure in this model, any gain in time spent studying due to education-specific assets is recorded as increase in child labor hours. Results imply that, when the labor market functions perfectly, the income effect on child labor is always negative but the effect of assets depends on the type of assets. Since assets are likely to affect household income, the net effect of increase in assets is ambiguous. The ambiguity gets more complicated when the labor market is missing.

2.3.3. The missing labor market case

In this case each household's consumption decisions are non-separable from production decisions. No outside labor is hired and no household labor is supplied to off-farm activities. Since the market wage does not exist, the household's problem in (2.2) can be modified as

$$\begin{aligned} \max_{c,l} u(c, l) \text{ subject to} \\ Q &= Q(L, K), \\ q &= q(s, A) \text{ and } c + p_q q = Q + y \end{aligned} \tag{2.4}$$

⁶ Differentiating conditions i) and ii) with respect to non-agricultural assets (A), I get, $\frac{\delta l}{\delta A} = \frac{z_c p_q q_A}{z_c(p_q + w) + z_l} > 0$ and $\frac{\delta c}{\delta A} = -\frac{z_l p_q q_A}{z_c(p_q + w) + z_l} < 0$.

Because of non-separability, the household's problem simplifies to

$$u(c, l) - \lambda[c + p_q q(s, A) - Q(L, K) - y] \quad (2.5)$$

Solving the equation (2.5) gives us the following first order conditions (FOCs)

$$\text{iii.) } \frac{u_l}{u_c} \equiv Z = -(p_q + Q_L)$$

$$\text{iv.) } c + p_q q = Q + y$$

Differentiating the first order conditions with respect to agricultural assets, K , I get

$$\frac{\delta l}{\delta K} = -\frac{Q_K z_c + Q_{LK}}{\beta}$$

$$\text{where } \beta = z_l + Q_{LL} + z_c(p_q + Q_{LL}) < 0$$

The denominator (β) is always negative but the sign of numerator depends on the sign of the expression $Q_K z_c + Q_{LK}$. As I assume $Q_K, Q_{LK} > 0$ and $z_c < 0$, this implies that the effect of agricultural assets on child labor is ambiguous; it can increase or decrease child labor depending on the magnitude of the change in the marginal product of labor caused by additional agricultural assets. The ambiguous effect is further complicated because assets contribute to household income and the income effect on child labor may work in a different direction than the direct effects of assets. To understand the income effect, I differentiate the FOCs with respect to non-labor income y ; I get $\frac{\delta l}{\delta y} = -\frac{z_c}{\beta} < 0$. Unlike agricultural assets, the increase in income decreases child labor, unambiguously. Similarly, the income effect on household consumption is always positive as $\frac{\delta c}{\delta y} = \frac{z_l + Q_{LL}}{\beta} > 0$.

I summarize theoretical results in Table 2.1. Results in case 1 and case 3 are essentially replication of Basu et al. (2010) and Dostie and Cockburn (2007) except that I use agricultural assets

in general as opposed to land ownership as the sole asset in these studies. Case 2 and case 4 are novel and more realistic in that they consider both household and education production functions and explicitly model the cost of education. Overall, the results imply that the effects of an exogenous increase in assets and income are clearly discernable when labor market is perfect. When no labor market exists and households have to make production and consumption decisions simultaneously, non-labor income and education-specific assets still have clearly discernible effects on child labor and consumption but the effects of assets used in agricultural production is more complicated to understand (Table 2.1).

If the expected return to schooling is sufficiently high, then an increase in both agricultural asset holdings can decrease child labor and improve child education. This is consistent with economic theory of factor productivity in that child labor increases when the return to labor is higher than the expected return to schooling and child school hours increase when expected return to schooling is higher. I resort to empirical analysis to help unpack the ambiguous effect of assets on child education. My empirical findings are consistent with the theoretical results as household income always has positive effect on child education and the effect of assets depends on types of assets. The rest of the paper focuses on empirical analysis. First, I provide an overview of Tanzanian educational system followed by nature of the data and research method I employ. I then discuss my empirical findings before I make concluding remarks.

2.4. Education System in Tanzania

Tanzania participated in the ‘World Conference on Education’ held in Dakar in 2000 and has since actively participated and committed to the UNESCO’s mission of ‘Education for All (EFA)’. It also considers education as one of the key sectors to achieve the goals of the Tanzania Development Vision 2025 (MoEVT 2014). In Tanzania, the government is the largest provider of

education and it allocates more budget in education than other African countries; it spends 26% of government expenditure on education compared to the regional average of 21%. Public expenditure favors primary education while secondary education in the country receives less funding than the regional average (UNESCO 2011). Recently, a remarkable improvement has been made in access to secondary school but the retention rate is still strikingly low and it is often associated with economic hardship, cultural barriers, and other factors contributing to low school demand (UNESCO 2011). As a result, Tanzania still has an enormous gap in skilled workers required to realize its goal of reaching Middle Income Country (MIC) status by 2025; for example, calculations based on the 2007 Integrated Labor Force Survey indicated that more than 275% more teachers are needed in the education sector. In addition, 80% of Tanzania's workforce is still in agriculture, an astonishing 37% of school age children are engaged in economic activities, and the adult literacy rate is below the average of other developing countries (UNESCO 2011; MoEVT 2014). While Tanzania's education sector enjoys a high budget priority, the country lags other low income countries in educational outcomes.

This analysis assesses child educational outcomes in the context of progression through the Tanzanian school system, represented in Figure 2.1. Tanzania follows a 2-7-4-2-3+ model of education that starts with 2 years of pre-primary school followed by 7 years of primary school which consists grades 1 to 7 and marks its completion with a national level examination called primary school leaving exam (PSLE) at the end of the 7th grade (MoEVT 2014). A pass score in the PSLE test is required to proceed to government secondary school. Those who fail the PSLE test can either retake the exam, proceed to private secondary school, or end their formal education. The first tier of secondary school ends after four years of schooling with another national level examination called Form IV exam (FIVE), alternatively O+ exam, at the end of grade 11.

Students passing the FIVE test can proceed to the second tier of secondary school and those who fail the FIVE test can either retake the exam or enroll in vocational courses (MS+). After two years of schooling at the higher secondary level, students take yet another national level examination, Form VI exam (also called A+ exam) at the end of the 13th grade. Students passing the A+ exam can go to university directly, but those who fail the exam have to pass a diploma course before they can go to university. Students are selected for further formal or non-formal education based on their performance on A+ exam. Secondary school with A+ exam in Tanzania is equivalent to a high school diploma in the United States and students who pass the exam can attend universities which consists three plus years of formal education.

2.5. Data and Method

2.5.1. Data

I use the data from three waves of Tanzania National Panel Survey (NPS), also called Tanzania LSMS. The NPS is a nationally representative survey that is implemented by the National Bureau of Statistics of Tanzania with technical support from the World Bank. I use three survey rounds with 3265 households in the baseline (2008/09), 3924 households in the second wave (2010/11), and 5015 households in the third wave (2012/13). The increase in the sample size is due to household splits. The NPS maintains a relatively low attrition rate (4.8%) at the household level across all the three waves of the survey. The number of observations at the individual level increased from 16,709 in the baseline to 20,599 and 25,412 in the second and third waves, respectively. The overall attrition rate at the individual level is 7.5%. In all the survey rounds, the NPS follows the same households and eligible members of the households. All household members of age 15 or older (excluding live-in servants) are considered eligible. Households and individuals are tracked to new locations when necessary. In this study, I use a balanced sample from the three survey rounds.

The full panel contains 3088 households and 14,577 individuals. For the highest grade completed, I use a panel of 4112 children from 2241 households who have once attended school and are 6-18 years old during the first wave. Similarly, for the PSLE variable, I use a panel of 3101 households having at least one PSLE eligible child of ages 6-18. A panel of 2696 households with at least one FIVE eligible adolescent of ages 16-24 is used for the FIVE variable.

2.5.2. Asset variables

Assets are broadly defined and they include household durables, housing quality characteristics, and agricultural assets. Household durables include tools and equipment used in the household such as television, radio, cellphone, bicycle etc. Housing quality characteristics consist information about type of floor, roof, and wall materials, number of rooms, access to electricity, safe drinking water, toilet facility etc. Similarly, agricultural assets include farm tools, equipment, livestock, and livestock related assets. Since each asset group consists of several individual assets, I run into a problem of finding appropriate weight for each asset. Including individual assets as explanatory variables in the regression equation correctly assigns weights but may not be pragmatic because it provides no measure of total wealth. Several previous studies rely on the principal component approach which assigns weight to the components based on their variance. The first principal component is considered to serve as a proxy for socioeconomic status as it captures the largest variation in assets (Filmer and Scott 2008; Vyas and Kumaranayake 2006; McKenzie 2005; Filmer and Pritchett 2001). I use the principal component approach to create asset indexes for the three different asset types – household durable assets, agricultural assets, and housing quality characteristics. Table A1 in Appendix A presents a list of individual assets under each category with their scoring factors – weight that is used to calculate the first principal component. The first component accounts for more than 26% variation in each case. In this analysis I am interested on

the effect of all three indexes – household durable index, agricultural asset index, and housing quality index – on child education.

Demographic controls in the econometric analysis include individual level variables (age, age started school, number of siblings, and maximum parent’s education) and household level variables (age, sex, and marital status of household head and logarithm of total consumption expenditure). Other controls include binary indicators for school in local community⁷, rural vs urban household, economic shock in the last 12 months, and household’s access to credit and saving facilities. Whenever the outcome variable is at the household level, no individual level control variables are included in the model.

2.5.3. Outcome variables

Based on the educational system in Tanzania, outcomes of interest for this analysis are the highest grade completed, the proportion of children in the household who pass the PSLE (PSLE ratio), and the proportion of children who pass the FIVE (FIVE ratio). The highest grade completed is a count variable ranging from 1 to 25. A grade of 25 marks the end of advanced university degree (eg. a PhD in the United States). For the highest grade completed, only the individuals who are 6-18 in the first round are included in the analysis. Individuals who have never attended school are not included because both school outcome and school related explanatory variables are missing for them. Individuals with informal schooling like adult education and other skill development trainings also are excluded. Current students are included with their highest grade completed calculated as their current grade minus one. As the results are conditional on attending school, inference from my empirical results on the effects of assets on highest grade completed should be taken with caution.

⁷ School in local community is coded 1 when the community has a primary school or a secondary school, or both, and 0 if no school.

While the highest grade completed is measured over individuals, the two pass ratios are measured at the household level, but both of them are based on children's individual performance in national examinations. The exam scores are recorded as pass or fail and individuals who pass the exam once will never retake the exam. On average 65% of students pass the test in the first attempt and retake rate among failing students is very low. In particular, only about 13% of students failing in the first attempt pass the test in the second attempt. As a result, students passing the exam in the first attempt are coded 1 in all waves and the majority of students failing in the first attempt are coded 0 in all waves. Since there is little to no variation in individuals' outcomes over time, I create a household-level measure of performance to capture the impact of assets on educational outcomes. The PSLE ratio is the number of children in the household who pass the PSLE over the total number of children aged 6 to 18 in the same household. Similarly, the FIVE ratio is the proportion of the number of youth in the household who passed the FIVE to the total number of adolescents of age 18 to 24 in the same household. As these proportions can represent performance of school age children at the household level only, using these ratios limits my ability to make inference about individual performance in the PSLE and FIVE exams.

2.5.4. *Econometric model*

My empirical approach considers the missing labor market case explained in section 2.3.3 because my sample consists primarily of agricultural households in rural settings. As described in section 2.3.2, children's educational performance (g) is determined by school hours (s), non-agricultural assets (A), and other factors (θ). Assume that the other factors include parental characteristics, household income (I), and child's individual ability (C_u) and school hours depends on agricultural assets (K), and household income. Parental characteristics consist of observed characters

such as education (P_e) and unobserved characters such as ability (P_u). Conceptually, child education is a function of parental characteristics, child ability, assets, and income. That is,

$$q = P_e + P_u + C_u + A + K + I + \text{error} \quad (2.6)$$

We know that certain parental characteristics such as hereditary trait and other abilities directly transmit to their children, i.e. $C_u = f(P_u) + \text{error}$. This implies that children's educational outcomes can be predicted by observed parental characteristics, child's ability, assets, and income i.e.

$q = P_e + \check{C}_u + A + K + I + \text{error}$. Note that $\check{C}_u = C_u + f^{-1}(C_u)$ is unobserved ability that is both inherited from parents and specific to the individual child. Since the parental ability is correlated with parental education and household asset accumulation, the unobserved child ability (C_u) is also correlated with both of them i.e. $\text{corr}(C_u, P_e) \neq 0$ and $\text{corr}(C_u, A) \neq 0$.

Since the observed and unobserved variables are correlated and affect child education, I face the problem of endogeneity. This is a concern which the existing literature has not addressed (Lerman and McKernan 2013; Elliott et al. 2011). I assume that these unobserved characteristics are time invariant and address the endogeneity problem empirically using panel data. I start with the following model for panel data.

$$q_{it} = x_{1it}\alpha + x_{2it}\beta + z_{1i}\theta + z_{2i}\gamma + u_i + \varepsilon_{it} \quad (2.7)$$

where i indicates individual and t indicates time, or survey round. Thus, q_{it} is child i 's education outcome at time t , x_{1it} is a vector of time-varying exogenous variables such as age and household size, x_{2it} is a vector of time-varying endogenous variables such as assets, z_{1i} is a vector of time

invariant exogenous variables such as gender and age started school, z_{2i} is a vector of time invariant endogenous variables such as maximum parent's education, u_i is a time invariant individual effect which consists of unobserved individual abilities correlated with both asset ownership and parental education, and ε_{it} is idiosyncratic error term. Equation (2.7) provides a required structure for an instrumental variable estimator proposed by Hausman and Taylor (1981) (hereafter referred to as HTIV) to address this endogeneity problem.

The HTIV model relies on instruments but the instruments come from within the model; z_{1i} serves as an instrument for itself, the within transformations $x_{1it} - \bar{x}_{1i}$ and $x_{2it} - \bar{x}_{2i}$ serve as valid instruments for x_{1it} and x_{2it} , respectively and the between transformation $\bar{x}_{1i}$ serves as a valid instrument for z_{2i} . Conditions (i) and (ii) are both necessary and sufficient conditions for the HTIV estimator to produce unbiased estimates.

$$\text{i.) } E(u_i|x_{2it}) \neq 0, E(u_i|z_{2i}) \neq 0$$

$$\text{ii.) } E(u_i|x_{1it}) = 0, E(u_i|z_{1i}) = 0 \text{ and } E(\varepsilon_{it}|x_{1it}, x_{2it}, z_{1i}, z_{2i}) = 0$$

In this analysis, I assume that the idiosyncratic error term is correlated with no explanatory variables but the unobserved specific effect is correlated with both asset indexes (x_{2it}) and parental education (z_{2i}).

Estimating equation (2.7) with the random effects model yields inconsistent estimates because the ‘zero correlation’ assumption is clearly violated. The fixed effects model and the HTIV method⁸ both yield consistent estimates, but the HTIV approach is more efficient and can estimate coefficient estimates on time constant variables as well (Baltagi, Bresson and Pirotte 2003; Hausman

⁸ In practice, HTIV can be estimated using the STATA in-built command ‘Xthtaylor’. I use the Xthtaylor command specifying asset indexes and parental education as endogenous variables. Conceptually, first, equation (2.7) is estimated with the fixed effects model saving the residual. The residual is used to run a regression on z_{1i} and z_{2i} by using x_{1it} and z_{1i} as instruments. All variables in the model are then transformed by using the estimated variance from the residual regression. The transformed model is estimated by using $x_{1it} - \bar{x}_{1i}$, $x_{2it} - \bar{x}_{2i}$, z_{1i} and $\bar{x}_{1i}$ as instruments.

and Taylor 1981). Efficiency gain is particularly important for this analysis because the data comes from a comprehensive nationally representative survey which is likely suffered from unforeseen measurement errors. Also, I would like to estimate the effects of time constant variables like parent's education and gender. For these reasons, my preferred method is HTIV. However, for comparison purposes, I provide results from three different estimators – random effects model, fixed effects model, and the HTIV model.

2.6. Results

2.6.1. Summary statistics

Summary statistics are presented in Tables 2.2-2.4. All point estimates are weighted to allow inferences to the population of either individuals or households, depending on the variable. Table 2.2 presents demographic characteristics of sample in all three waves. The first panel presents individual characteristics, middle panel presents household characteristics, and the last panel presents characteristics of the household head. Tanzania has a very young population with the average age of 21 years in baseline, 23 in the second wave, and 24 years in the third survey wave. Based on those who have attended school, the average school starting age is 8 which is higher than the regional average of 7 years for sub-Saharan Africa. The average household size is about 5 in all three waves and about half of them are children ages 6-18 years. Parental and household head's characteristics are important for the analysis because effect of assets on child education mostly operates through parental decisions about child labor, schooling, and intra-household resource allocation. Parental education is measured with 'maximum parent's education', the maximum level of father and mother's level of education. As a vast majority of parents in my sample are not current students, I keep parental education constant across waves. On average, both parents and household heads have attended primary school but about 20 percent of the heads are still illiterate. Other

characteristics of household head includes age, gender, and marital status. Household heads are relatively young with the average age of 45 years in baseline, 47 in the second wave, and about 49 in the third wave. On average, more than 70 percent of household heads are married but gender balance of headship is skewed to males; only about 25 percent households are female headed.

Apart from individual and household head's characteristics, effects of assets may differ by income level, rural and urban areas, household's response to transitory shocks, and access to school in local community. Apparently, even though my sample comprises more than 70 percent rural households, a strikingly large proportion (90 percent) of households have access to primary or secondary school in village. Access to primary and secondary schools in rural areas signals large public investment in child education but the quality of education is not known. Descriptive results also indicate an increased resilience over time; 78 percent households experienced negative economic shock at some point of time but the poverty rates did not increase. Consistent with reduction in national poverty rates (World Bank 2015), average annual household consumption expenditure increased over time from 2.5 million Tanzanian Shilling in baseline to 3.8 million Shilling in the third wave.

Children's educational outcomes are summarized in Table 2.3. As educational outcomes are not available for children who have never attended school, both my summary statistics and empirical results are conditional on attending school. I track the cohort of 6 to 18 year old children in baseline to estimate the effect of assets on 'highest grade completed'. On average, children in my sample have completed 5th grade in baseline, 7th grade in the second wave and 9th grade in the third wave. As the primary school leaving exam (PSLE) and Form IV exam (FIVE) data are not available for the first wave, I use the PSLE and FIVE data from the second and third NPS surveys only. Even though passing rate for both PSLE and FIVE tests is higher than 65 percent in both waves, only a small proportion of eligible children passed the tests because a majority of school-age children were

not enrolled in school and had no opportunity to take the tests. Nevertheless, the proportion of school-age children passing PSLE test has increased over time from 18 percent in 2010 to 23 percent in 2012. Similar pattern holds for the FIVE test. Descriptive statistics of asset indexes across three waves are presented in Table 2.4. Since I calculate asset indexes at the household level, I assume that all children within a household have equal access to household assets. On average, all asset index values are small but agricultural asset index is not significantly different from zero in either wave. Household durable index is negative in baseline but it's not different from zero in follow up rounds. Housing quality index is negative in baseline and significantly improves over time.

2.6.2. Empirical results

I first examine the data to verify that agricultural asset holding predicts child labor in agriculture. I pooled the data from the three waves and estimate a pooled probit regression of child labor on all three types of assets for various sub-samples. Results indicate that agricultural assets increase the likelihood of child labor among crop producers and rural households in general, but children are less likely to engage in any labor generating activity with increased ownership of household durables and housing quality assets (Appendix A Table A2). This finding supports my assumption that effects of assets on child education operate through child labor. Next I estimate the effect of asset holding on children's educational outcomes.

Effects of assets on highest grade completed

I estimate the effects of assets on highest grade completed using equation (2.7) for two different model specifications with three different panel estimators; random effects, fixed effects, and HTIV models. Both specifications are exactly the same in all but the treatment of asset variables. The first specification in Table 2.5 does not allow differential effects of assets as it

aggregates all assets into the same index but the second specification includes all three disaggregated asset indexes (Table 2.6). Results in Table 2.7 also come from the second specification estimated with my preferred HTIV model for various subsamples. Standard errors are clustered at the household level in all regressions. Tables are structured such that results in the first column are obtained from the random effects model which is inconsistent under conditions (i) and (ii) in section 2.5.4. Under the same conditions, results in the second and third columns are consistent as they are obtained from the fixed effects and HTIV models, respectively. Results in the third column are my preferred results because HTIV approach is more efficient than fixed effects model.

Table 2.5 presents the effect of aggregated asset index on children's highest grade completed. The aggregated asset index has the expected sign suggesting positive wealth effects on children's education. Positive coefficient on consumption expenditure, proxy for household income, also suggests positive income effects. Among other controls, both having educated parents and access to a school in village help children achieve higher grades; about 5 percent increase in total expenditure and increase in parental education by one more level (such as primary to secondary school) have identical effect on child education. Educated parents may see larger expected return from sending kids to school so the opportunity cost of schooling may not be as high for their children. Similarly, children who live nearby a school may manage to both attend school and take part in farm-household activities occasionally. This would lead to the positive effect of 'school in village' variable even when child labor is employed in agriculture. Results indicate that, after controlling for endogeneity, effect of parental education on children's highest grade completed gets more than four times bigger than it was with the random effects model. This implies the potential endogeneity of parental education and shows the importance of using HTIV method over the fixed effect model. Interestingly, having a male head of household adversely effects children's grade level but girls are more likely to achieve higher grades than boys. This is consistent with existing evidence

from developing countries that boys are more likely to forgo school for agricultural activities in comparison to girls who usually take care of household and kitchen activities (Akresh et al. 2013; Burke and Beegle 2004). The level of education increases with age but late school starters hurt their chances of achieving higher grades. Finally, household size has smaller but significant negative effect on child education suggesting any increase in household size reduces child education.

In Table 2.6, I disaggregate assets to three different groups – household durables, agricultural assets, and housing quality assets. Although results in Table 2.5 suggest that assets uniformly contribute to child education through positive wealth effects, results in Table 2.6 suggest different types of assets have differential effects on child education. Household durables and housing quality characteristics have the expected positive effects but agricultural assets have negative effects on children's highest grade completed. As agricultural assets include farm tools and equipment, land, and livestock, owning more agricultural assets may increase the opportunity cost of schooling and lead to higher child labor demand which contributes to school dropout. Overall, the adverse effect of agricultural assets is more than offset by household durables and good housing characteristics as the later have larger positive effects than agricultural assets. The estimated effects of other variables including access to school in village are qualitatively identical to the results presented in Table 2.5 and discussed above.

The evidence of negative effects of agricultural assets on the grade level completed is particularly striking because it is in contrast to the traditional view of positive wealth effect on education. Agricultural assets (or any productive assets) are a form of wealth, but they may behave differently than durable assets and housing quality assets in that the productive assets incur labor and other input cost to be operational. Ownership of agricultural assets may indicate wealth acquisition but it may increase the opportunity cost of schooling and child labor demand, especially among agrarian households which have no or limited access to labor market. The evidence points

that an undifferentiated view of assets is misleading. Because ownership of agricultural assets increases the likelihood of child labor in own-farm activities (Appendix A Table A2), the results also imply that the opportunity cost of schooling rises with agricultural assets presumably through an effect on child labor in farming.

That different assets have differential effects and agricultural assets increase child labor in agriculture is a striking result for policy makers and planners and deserves further exploration. In Table 2.7, I estimate my preferred HTIV model for various sub-samples to identify the potential mechanism behind the differential effects of different types of assets. I estimate the model for eight different sub-samples – rural, urban, crop producers, livestock keepers, boys, girls, poor, non-poor – and results indicate that different types of assets have differential effects among rural children or children from crop producers. Although aggregated asset index has positive effects on child education in both cases, I find no evidence of asset-specific effects on educational outcomes of urban children and children from livestock producers. Results for boys vs. girls, and poor vs. non-poor sub-samples are not presented here, but I find evidence of differential effects in none of these cases. This indicates that while positive wealth effects on child education consistently holds in various scenarios, different types of assets have differential effects mostly among rural children and children from grain crop farmers. The results make a perfect sense in that the opportunity cost of schooling may not increase with agricultural assets if the household is not farming regardless of wealth status. In rural areas, labor markets are mostly absent and most households operate in agrarian settings so increased stock of agricultural assets increases opportunity cost of schooling.

Effects of assets on exam performance

Results so far show that agricultural assets have negative effects on highest grade completed and the negative effects largely stem from child labor in agriculture because most agricultural assets

are complement to child labor. While the ‘highest grade completed’ provides a valid measurement of school enrollment and grade completion, it does not measure individual performance in specific exams. I use the PSLE ratio to examine the effects of assets on school-age children’s performance in the primary school leaving exam (Table 2.8) and FIVE ratio to assess the effects of assets on adolescent’s performance in the form IV exam (Table 2.9). I still use the framework in equation (2.7) and estimate the same two model specifications, one with aggregated asset index and another with dis-aggregated indexes, but this analysis is carried out at the household level. While the key variables of interest are still the same, the new set of control covariates excludes all individual level controls but includes other household level controls.⁹ Results from the first specifications are not presented here, but as expected, I find positive wealth effects on children’s performance in both PSLE and FIVE tests (See Appendix A Tables A3 and A4).

Table 2.8 presents the estimated effects of asset holdings on the PLSE ratio, proportion of school-age children passing the PSLE exam. Results from the second specification, where the asset index is disaggregated to three sub-indexes, reveals that the positive wealth effect on PSLE performance mainly comes from household durables and housing quality assets. However, in contrast to the ‘highest grade completed’, PSLE performance is not affected by agricultural assets at all. Similar results hold for performance in the FIVE test as well; the aggregated wealth index has strong positive effect on FIVE ratio and the positive effect stems from effects of household durables and housing quality index but agricultural assets have no effect on adolescent’s performance in the FIVE test (Table 2.9). This implies that the effect of agricultural assets is not homogenous among children from the same household and may depend on children’s ability. To elaborate, children doing well in school may not be affected from agricultural assets as much

⁹ The new set of control variables include log(total expenditure), education of head, age of head, sex of head, marital status of head, household size, number of children, and binary indicators for residence in mainland or Zanzibar, and economic shock in the last 12 months.

because parents' expected returns from sending high ability children to school may be higher than the expected return from investment on low ability children's education. Because expected return from schooling is higher for high ability children (Akresh et al. 2012), opportunity cost of schooling for high ability children may be not as high as compared to children performing poorly in school. As a consequence, children who were not doing well in school may have had no opportunity to take the tests because they might have been taken out of school for farm activities. Since increased agricultural assets may incentivize parents to take out low ability children from school, agricultural assets adversely affect the highest grade completed but do not affect test performance because children taking the tests are mostly high ability students.

Among other variables, household consumption expenditure has a strong positive effect on PSLE and FIVE ratios, suggesting positive income effect on child educational outcomes. Similarly, maximum parents' education has a positive effect on both ratios. Parental education contributes to enhanced performances in both tests, but unlike the effects on 'highest grade completed', having a school in village has no effect on children's performance on either test. An implication is that students who are doing well and still in school may find it worthwhile to travel to nearby community for schooling, but students who are not doing well may drop out when school is far away.

2.6.3. Robustness check

I run several alternative specifications for all three outcome variables – highest grade completed, PSLE ratio, and FIVE ratio – and the results are more or less consistent with my results from the main specifications. First, to avoid potential confounding effects of assets on child education through income, I exclude consumption expenditure variable from the model specification and estimate the effects of different types of assets. I find that excluding consumption expenditure from the model slightly attenuates the negative effects of agricultural assets (coefficient

estimate decreases from -0.013 to -0.014), but amplifies the positive effects of both household durables (0.026 to 0.036) and housing quality index (0.066 to 0.073). Similar pattern holds for both PSLE and FIVE ratios, no significant change in the effects of agricultural assets but strengthened positive effects of other assets. Second, to address the concern of potential endogeneity of household size variable, I run my preferred model specification (HTIV with expenditure variable included) specifying household size as time-varying endogenous variable. Results are consistent with the main results and the negative effect of household size remains the same leaving no evidence for positive effects of household size through so called ‘economies of scale’ effects.

2.7. Conclusion

A large body of empirical evidence indicates that household wealth helps improve child education (Deng et al. 2014; Chowa et al. 2013; Huang 2013; Huang 2011; Elliott et al. 2011; Kim and Sherraden 2011; Shanks 2007; Zhan and Sherraden 2003; Conley 2001). Despite the positive effect of household wealth, there is extremely limited empirical evidence on how different components of the wealth (i.e. different assets) contribute to child education after controlling for household income. In this paper I developed a simple theoretical model that explains how different types of assets can have differential effects on child education. My model predicts, when labor market is perfect, increase in assets contributes to child education, but when labor market is missing, the effect of assets depends on asset types and other conditions. Under the assumption of missing labor market, my empirical results confirmed the theoretical findings and revealed that different assets have differential effects on child education presumably through child labor.

I showed that agricultural assets have adverse effect on the highest grade completed but have no effect on performance in the primary school leaving exam and the form IV exam. This implies that agricultural assets may increase the opportunity cost of schooling for children but the increment

may not be homogenous among siblings or other children in the same household. For children who are doing well in school, the opportunity cost of schooling is warranted because they have higher expected return from education than other children. As child schooling largely depends on parental decision about when and which child to send to school, parents may choose to take the low performing children out of school and invest more in 'good' children's education. This is likely the case in many developing countries and it certainly leads to negative effect of agricultural assets on grade completed or school enrollment but no effect on school performance because children who are still in school are not affected by household's endowment of agricultural assets. Evidence that agricultural assets have negative effects on child education because they represent labor using technologies and increase the opportunity cost of schooling is provided by the larger negative estimated effect of agricultural assets for children working in household agricultural activities than for other children. My finding that the negative effects of agricultural assets is amplified for rural children or children of crop producers also backs up the evidence that the negative effect of agricultural assets operates through child labor in agriculture.

Household durable assets such as radio, TV, bicycle and housing quality assets such as better toilet facility, access to electricity, and good quality house have positive effects on both 'grade completed' and exam performance. Unlike agricultural assets, household durables and good quality housing are not labor using technology and they are unlikely to increase the opportunity cost of schooling. Instead, a large endowment of household durables and good housing conditions are perceived as household wealth or higher socioeconomic status that contribute to better education for children via wealth effect. In addition, these assets may provide enhanced economic security and reduced economic stress among parents which usually leads to better child education through good parenting. The positive effect of housing quality assets is a part of wealth effect on child education, but some assets such as access to electricity, safe drinking water, and good toilet facility may have a

direct effect on child education; electricity increases efficiency studying, and access to safe water and good toilet facilities may improve school performance through improved health of children.

Results imply that even though assets serve as a good predictor of child educational performance, asset based interventions that capitalize in agricultural assets may not be favorable for child education. If child education is an intended goal of the intervention, transferring agricultural assets or other resources to build agricultural asset holding may not yield the desired result. Despite the potential negative effect of agricultural assets on child education, there may be ways to increase agricultural asset holdings without compromising child education. Since the negative effect of agricultural assets essentially boils down to child labor in agriculture, asset-based interventions conditional on ‘no child labor in agriculture’ policy may help increase household welfare without hurting child education; although implementing such a policy may be extremely difficult. Another implication of our findings is that transferring agricultural assets in combination with awareness training or adult education to parents, or establishing a public school in the target community also may help mitigate the potential adverse effects of agricultural assets on child education.

Programs that help accumulate household durables or improve housing quality characteristics contribute to child education and therefore may be incorporated in policy interventions aiming to improve both household welfare and child education. Although policy interventions that transfer household durables or housing quality assets are rare in practice, empirical findings in this study suggest that interventions that combine agricultural asset transfers with household durables or housing quality assets may contribute to household socioeconomic status as well as temper the potential negative effect of agricultural assets on child education. Since I control for household income, my findings should still hold regardless of the level of household income. One caveat is that this study does not consider the threshold level of income or asset holding above

which change in asset ownership may have no effect on child education because demand for child education is inelastic to the opportunity cost of schooling.

Overall, the key implication of this study is that assets are an important element of social policies that focus on improving both household and individual welfare. The traditional method of considering all assets under household's possession as an aggregated measure of household wealth may be misleading because different type of assets have differential effects on child education and this may be true for other outcomes too. The evidence that, even after controlling for household income, asset holding has a significant positive effect on child education but the effect differs by the type of assets is a novel finding and deserves further exploration. If similar findings hold for other countries and contexts, it should help researchers and policymakers to design asset based interventions or other interventions that help accumulate assets in a more meaningful way.

2.8. Figures and Tables

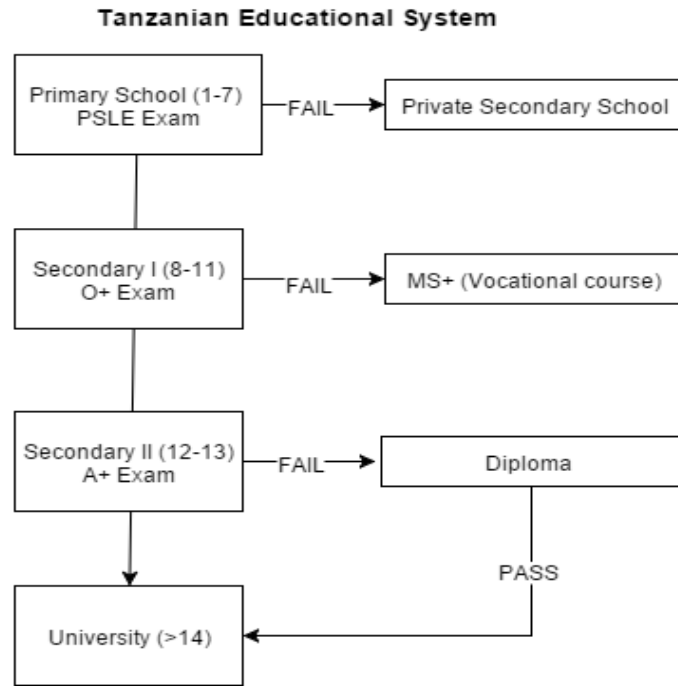


Figure 2.1. Educational system in Tanzania

Table 2.1. Effects of exogenous increase in assets and income on child labor and household consumption

	Perfect labor market				No labor market			
	Case 1		Case 2		Case 3		Case 4	
	l	c	l	c	l	c	l	c
Agricultural Assets (K)	-	+	-	+	$\pm$	+	$\pm$	+
Assets specific to child education (A)	.	.	+	-	.	.	+	-
Income (y)	-	+	-	+	-	+	-	+
Education production function (q)	No		Yes		No		Yes	

Notes. l indicates child labor, and c indicates household consumption. Similarly, -, +, and $\pm$, indicate negative, positive, and ambiguous effects of assets or income, respectively, on child labor and household consumption.

Table 2.2: Summary statistics of individual and household characteristics

Characteristics	Wave 1 (2008/09)	Wave 2 (2010/11)	Wave 3 (2012/13)	Observations
<i>Individual</i>				
Age	20.97 (0.150)	22.76 (0.150)	24.48 (0.144)	14552
Gender (1=male,0=female)	0.49 (0.004)	0.49 (0.004)	0.49 (0.004)	14552
Age started school†	8.01 (0.021)	8.01 (0.021)	8.01 (0.021)	9645
<i>Household</i>				
Expenditure, real (million TZS)	2.50 (0.042)	2.91 (0.046)	3.84 (0.062)	3069
Maximum parent's education‡	2.23 (0.023)	2.23 (0.023)	2.23 (0.023)	3064
Household size	5.01 (0.048)	5.27 (0.049)	5.26 (0.049)	3073
Number of children 6-18	2.79 (0.038)	2.89 (0.039)	2.84 (0.039)	3073
Shock in last 12 months (1=Yes,0=No)	0.53 (0.009)	0.41 (0.009)	0.36 (0.009)	3073
Rural	0.72 (0.008)	0.71 (0.008)	0.71 (0.008)	3069
School in village (1=Yes, 0=No)	0.89 (0.003)	0.94 (0.004)	0.96 (0.003)	3073
<i>Household Head</i>				
Age	45.3 (0.28)	47.1 (0.276)	48.7 (0.27)	3073
Gender (1=Male, 0= Female)	0.76 (0.008)	0.75 (0.008)	0.74 (0.008)	3073
Education level (grade)	2.27 (0.022)	2.27 (0.022)	2.27 (0.022)	3073
Marital status (1= Married, 0 else)	0.75 (0.008)	0.74 (0.008)	0.72 (0.008)	3073

Notes. Point estimates are population weighted means. Standard errors are in parentheses.

†Number of observations of 'age started school' is much smaller than other variables because about 35 percent of the population has never attended school

‡Maximum parent's education is maximum education level of father or mother. It is coded as follows: 1= no education, 2= primary not finished, 3= primary, 4= secondary not finished, 5= secondary, and 6= higher than secondary.

Table 2.3: Summary statistics of child educational outcomes across three waves

Educational outcomes	Wave 1 (2008/09)	Wave 2 (2010/11)	Wave 3 (2012/13)	Observations
Highest grade completed	5.86 (0.050)	7.64 (0.053)	9.14 (0.054)	4112
PSLE pass ratio‡	-	0.18 (0.005)	0.23 (0.006)	3101
FIVE pass ratio‡	-	0.10 (0.005)	0.13 (0.006)	2696

Notes. Point estimates are population weighted means. Standard errors are in the parentheses.

‡Primary school leaving exam (PSLE) and Form IV exam (FIVE) are national level examinations administered after 7th and 11th grades, respectively. The PSLE and FIVE ratios are the proportions of children passing the PSLE and FIVE tests to total children of ages 6-18 and 16-24, respectively. Because test scores data are not available for the first wave, both PSLE and FIVE ratios are presented for the second and third waves only.

Table 2.4: Summary statistics of asset indexes across three waves

Asset indexes	Wave 1 (2008/09)	Wave 2 (2010/11)	Wave 3 (2012/13)
Aggregated Asset index†	-0.227 (0.058)	0.020 (0.060)	0.207 (0.059)
Household durable index	-0.128 (0.043)	0.082 (0.044)	0.046 (0.043)
Agricultural asset index	0.067 (0.047)	0.025 (0.046)	-0.091 (0.011)
Housing quality index	-0.155 (0.038)	-0.028 (0.040)	0.182 (0.041)
Observations	3082	3082	3082

Notes. Point estimates are population weighted means. Standard errors are in the parentheses. All asset indexes are constructed using the Principal Component Analysis (PCA) and the same loading factors obtained from the pooled data are used across three waves.

†Aggregated asset index consist of 59 variables, and three sub-indexes – household durable index, agricultural asset index, and housing quality index – consist 23, 22, and 14 variables, respectively.

Table 2.5. Effects of aggregated asset index on highest grade completed of children ages 6 to 18

	Dep. variable: Highest grade completed		
	RE	FE	HTIV
Log(Total expenditure)	0.263*** (0.035)	0.152*** (0.040)	0.164*** (0.034)
Aggregated Asset index	0.098*** (0.011)	0.038** (0.016)	0.051*** (0.012)
School in village (1=Yes,0=No)	0.145** (0.063)	0.239*** (0.086)	0.248*** (0.073)
Max. parent's education	0.224*** (0.025)	-	0.843*** (0.077)
Gender (1=Male, 0=Female)	-0.275*** (0.053)	-	-0.293*** (0.060)
Head's gender (1=Male, 0=Female)	-0.229*** (0.076)	-0.289** (0.114)	-0.046 (0.056)
Age (Years)	0.810*** (0.008)	0.814*** (0.010)	0.814*** (0.006)
Age started school	-0.463*** (0.025)	-	-0.431*** (0.024)
Household size	-0.080*** (0.014)	-0.079*** (0.017)	-0.074*** (0.013)
Observations	11992	11992	11992

Notes. Standard errors are in parentheses. Significance level: * $p < .10$, ** $p < .05$, *** $p < .01$. Results are based on panel of children who have attended school and were 6 to 18 years old in 2008. Results are presented for key variables only, estimated model includes additional variables.

Table 2.6. Effects of different assets on highest grade completed of children ages 6 to 18

	Dep. variable: Highest grade completed		
	RE	FE	HTIV
Log(Total expenditure)	0.241*** (0.035)	0.146*** (0.040)	0.157*** (0.034)
Household durable index	0.073*** (0.014)	0.020 (0.018)	0.026* (0.015)
Agricultural asset index	-0.009*** (0.003)	-0.012*** (0.004)	-0.013*** (0.004)
Housing quality index	0.096*** (0.017)	0.053** (0.021)	0.066*** (0.017)
School in village (1=Yes, 0=No)	0.150** (0.063)	0.242*** (0.086)	0.248*** (0.073)
Max. parent's education	0.213*** (0.025)	-	0.827*** (0.078)
Gender (1=Male, 0=Female)	-0.275*** (0.053)	-	-0.292*** (0.060)
Head's gender (1=Male, 0=Female)	-0.243*** (0.076)	-0.287** (0.114)	-0.149** (0.071)
Age (Years)	0.810*** (0.008)	0.811*** (0.010)	0.812*** (0.006)
Age started school	-0.459*** (0.025)	-	-0.429*** (0.024)
Household size	-0.079*** (0.014)	-0.078*** (0.017)	-0.074*** (0.013)
Observations	11992	11992	11992

Notes. Standard errors are in parentheses. Significance level: * $p < .10$, ** $p < .05$, *** $p < .01$. Results are based on panel of children who have ever attended school and were 6 to 18 years old in 2008. Results are presented for key variables only, estimated model includes more variables.

Table 2.7. Effects of different assets on highest grade completed of children ages 6 to 18, under various scenarios

	Model: HTIV			
	Rural	Urban	Grain crop farmers	Livestock keepers
Log(Total expenditure)	0.152*** (0.040)	0.258*** (0.071)	0.221*** (0.040)	0.191*** (0.044)
Household durable index	0.068*** (0.023)	0.021 (0.021)	0.057*** (0.022)	0.081*** (0.025)
Agricultural asset index	-0.026*** (0.008)	-0.007 (0.005)	-0.012* (0.007)	0.002 (0.008)
Housing quality index	0.123*** (0.024)	0.010 (0.028)	0.102*** (0.023)	0.109*** (0.026)
School in village (1=Yes, 0=No)	0.241* (0.134)	0.074 (0.091)	0.314*** (0.101)	0.327*** (0.119)
Max. parent's education	0.581*** (0.139)	0.470** (0.192)	0.837*** (0.133)	0.759*** (0.145)
Gender (1=Male, 0=Female)	-0.313*** (0.065)	-0.185* (0.102)	-0.289*** (0.065)	-0.298*** (0.070)
Head's gender (1=Male, 0=Female)	-0.224*** (0.086)	-0.065 (0.128)	-0.144* (0.085)	-0.075 (0.096)
Age (years)	0.764*** (0.007)	0.902*** (0.012)	0.782*** (0.007)	0.792*** (0.008)
Age started school	-0.420*** (0.031)	-0.437*** (0.054)	-0.422*** (0.030)	-0.405*** (0.033)
Household size	-0.073*** (0.016)	-0.084*** (0.024)	-0.078*** (0.016)	-0.068*** (0.016)
<i>Observations</i>	8095	3897	8796	7217

Notes. Standard errors are in parentheses. Significance level: * $p < .10$, ** $p < .05$, *** $p < .01$. Results are based on panel of children who have ever attended school and were 6 to 18 years old in 2008. Results are presented for key variables only, estimated model includes more variables.

Table 2.8. Effect of different assets on Primary School Leaving Exam (PSLE) performance of children ages 6 to 18

	Dep. variable: PSLE pass ratio		
	RE	FE	HTIV
Log(Total expenditure)	0.051 ^{***} (0.007)	0.035 ^{***} (0.009)	0.040 ^{***} (0.008)
Household durable index	0.012 ^{***} (0.003)	0.008 [*] (0.005)	0.010 ^{***} (0.004)
Agri. asset index	0.001 [*] (0.001)	0.000 (0.001)	-0.000 (0.002)
Housing quality index	0.018 ^{***} (0.003)	0.003 (0.006)	0.010 [*] (0.005)
School in village	0.007 (0.009)	0.012 (0.012)	0.011 (0.009)
Max parent's education	0.006 (0.005)	-	0.073 ^{***} (0.019)
Head: age	0.003 ^{***} (0.000)	0.004 ^{***} (0.001)	0.005 ^{***} (0.001)
Head: Gender (1=male, 0=female)	-0.036 ^{***} (0.013)	-0.075 ^{***} (0.025)	-0.033 ^{**} (0.014)
Household size	-0.024 ^{***} (0.002)	0.002 (0.004)	-0.021 ^{***} (0.003)
Observations	6029	6029	6029

Notes. Standard errors are in parentheses. Significance level: * $p < .10$, ** $p < .05$, *** $p < .01$. As the dependent variable is at the household level, no individual characteristics are included in the model. Results are presented for key variables only, estimated model includes more variables.

Table 2.9. Effect of different assets on Form IV Exam (FIVE) performance of youth ages 18 to 24

	Dep. variable: FIVE pass ratio		
	RE	FE	HTIV
Log(Total expenditure)	0.036*** (0.006)	0.024*** (0.008)	0.031*** (0.008)
Household durable index	0.018*** (0.003)	0.004 (0.004)	0.009*** (0.003)
Agri. asset index	-0.000 (0.001)	-0.001 (0.002)	-0.002 (0.001)
Housing quality index	0.019*** (0.003)	0.009* (0.006)	0.015*** (0.005)
School in village	0.008 (0.009)	0.007 (0.011)	0.010 (0.008)
Max parent's education	0.011*** (0.004)	-	0.077*** (0.019)
Head: age	0.001*** (0.000)	0.001 (0.001)	0.003*** (0.001)
Head: Gender (1=male, 0=female)	-0.029** (0.013)	-0.033 (0.035)	-0.018 (0.013)
Household size	-0.010*** (0.001)	-0.000 (0.003)	-0.006*** (0.002)
Observations	5219	5219	5219

Notes. Standard errors are in parentheses. Significance level: * $p < .10$, ** $p < .05$, *** $p < .01$. As the dependent variable is at the household level, no individual characteristics are included in the model. Results are presented for key variables only, estimated model includes more variables.

CHAPTER 3

DOES 25 CENTS MORE PER DAY MAKE A DIFFERENCE? THE IMPACT OF LIVESTOCK TRANSFER AND DEVELOPMENT IN ZAMBIA.¹⁰

3.1. Introduction

Programs to transfer productive assets to poor households often intend to place recipients on a new trajectory of higher productivity and reduced vulnerability. In some rural settings, transfer of assets in the form of livestock may be a particularly effective mechanism toward this end as the introduction of animal production can contribute to income, improved diet, and greater food security at the individual, household, and community levels (Hoddinott and Yohannes 2002; Ruel 2003; Sansoucy 1995; Randolph et al. 2007). Recently, a few empirical studies including Rawlins et al. (2014), Banerjee et al. (2015), and Jodlowski et al. (2016) have applied rigorous field experiments and found positive effects on food security and poverty indicators attributable to livestock transfers embedded in multifaceted programs. While these studies find statistically significant effects, it is not clear that the effects are sufficiently large to be considered transformative. Reported impacts on per capita consumption expenditures show increases of about US\$0.25 per day or more, but absolute levels of per capita consumption remain near international poverty lines after the transfer. This study seeks to determine whether impacts of this scale affect the composition of consumption or subjective attitudes about poverty in ways that suggest meaningful change in welfare.

Poverty status is often conceptualized with reference to expenditures needed to secure a minimum requirement of food and essential non-food goods and services (Ravallion 2015).

Observing greater consumption of goods that are locally considered discretionary or luxury items

¹⁰ This chapter is co-authored with Alex Winter-Nelson and Peter Goldsmith and has been already published in Food Policy. The published version (Kafle, Winter-Nelson and Goldsmith 2016) slightly differs from this chapter as the former includes Independent households in the analysis. I would like to thank Alex Winter-Nelson, Peter Goldsmith, Craig Gundersen, Kathy Baylis, and Hope Michelson for their feedback. Comments from participants of AAEA annual meeting, 2nd global food security conference, Mid-west development economics conference, and IPAD seminar at University of Illinois have improved the paper in many ways.

can therefore signal a substantive transition beyond poverty into greater economic security. I identify goods as luxuries or necessities based on income elasticities from my baseline sample and examine whether there are shifts in consumption toward luxuries which would signal a qualitative change in economic status despite low total expenditures. Similarly, I examine the change in composition of household diet to understand whether observed increases in household dietary diversity correspond to improved nutritional quality. Finally, I examine whether increased total expenditures and changes in the composition of diet and expenditure correspond to changes in self-perceived poverty and food security status. By looking for variation in these outcomes over three different species of livestock that are transferred (dairy cows, draft cattle, or meat goats) I observe the degree to which specific types of assets influence outcomes for recipients and others in their communities.

As in Jodlowski et al. (2016) I use the rollout of a multifaceted asset transfer program administered by the NGO Heifer International to identify current and future recipients of livestock transfers. Identification of these two groups is the basis of a quasi-experimental approach to impact assessment in which future recipients are the comparison group for current recipients. Other recent work on the impact of asset transfers (Banerjee et al. 2015) uses similar field experiments to assess the impact of multifaceted asset transfer programs. Like other recent studies, this paper also uses the NGO's program rollout to address the selection bias and endogeneity that undermined earlier work. In this paper I first validate the results of Jodlowski et al. (2016), finding that an increase in consumption expenditures of 20% to 30% (about US\$0.25 per capita per day) can be attributed to the livestock transfers and capacity building program. Extending Jodlowski et al. (2016) and other studies, I then assess whether the increases in expenditures have been significant enough to qualitatively change consumption patterns. I find evidence of increased consumption of foods that can be considered luxury goods, suggesting qualitatively improved economic status among recipients. I further use subjective self-assessments of poverty and food security to confirm whether

an enhanced sense of economic security has emerged. The analysis includes a sample of households that had selected out of participation to indicate the degree to which selection bias could have influenced results had the general population been used as a comparison group, rather than the subset of future livestock recipients.

This paper continues with background on the arguments and evidence concerning livestock transfers in developing countries. I then present my research methods, explaining both the structure of the field experiment and the econometric techniques applied in this impact assessment. This is followed by a presentation of results and conclusions.

3.2. Background

Livestock may represent a particularly strategic form of asset transfer. In developing countries, livestock provide nutrient-dense animal source foods (ASF) and a stable source of income through sales of milk, meat, manure, draft power or the animals themselves (Randolph et al. 2007; Murphy and Allen 2003). Moreover, livestock can serve as a store of wealth and as insurance that can be liquidated when needs arise (Sansoucy 1995; Hoddinott 2006; Alary, Corniaux and Gautier 2011). Additionally, increased investment in livestock can diversify income sources, provide continuous employment for men and women, and can serve as an income source for households with very little or no land (Upton 2004).

Livestock production may represent a pathway to help poor people move out of poverty by providing access to market opportunities, increasing income and improving a household's asset base (ILRI 2006; Randolph et al. 2007). Animal agriculture may also offer a positive spillover effect on the local community by increasing the availability of nutritious but perishable foods that might not be provided through external markets. As livestock development can affect the local food economy, it could be expected to have a disproportionately strong impact on food security compared to its

poverty effect. In addition to the direct provision of ASF, livestock can enhance crop productivity through supply of manure and draft power (Otte et al. 2012). While animal production can divert food crops into feed, livestock may also convert low value, unpalatable and even inedible materials into nutrient dense foods (Smith et al. 2013).

Animal products such as milk, meat, and eggs contribute to enhanced food utilization through their nutrient density. Essential nutrients which are lacking in plant based foods are naturally more bioavailable in animal products (Smith et al. 2013). Six micronutrients that are critical for human physiology -calcium, vitamin A, B12, iron, zinc, and riboflavin- are primarily obtained from ASF. For example, 100 gm of beef is more than enough for the entire day of protein, vitamin B12 and zinc requirement (Murphy and Allen 2003). Adding a small amount of ASFs to staple based diets can contribute to food security by improving the quality of diet substantially (Murphy and Allen 2003).

Despite the potential contributions of animal agriculture to development, the livestock sector is often neglected in development policy in Africa. Alary et al. (2011) argued that although some African countries consider livestock as an important sector, cereal crops have received far more attention in policy papers, empirical analysis, and policy initiatives. One reason for limited government commitment to livestock development could be the absence of rigorous analysis to quantitatively measure the contributions livestock make.

In the Copperbelt Province of Zambia, ownership of livestock, aside from poultry, has been rare until recently. Despite the natural potential for crop and livestock production, previous reliance on mine employment had left little livestock development. In this context, Heifer International-Zambia (HI-Zambia), has been sponsoring livestock donation with coordinated training to enhance both human and social capital. The core of the program is to transfer pregnant livestock to selected families who will pass on the first female offspring to other project families. The type of animal

transferred depends on the environmental and market context, as well as the capacities of the target families. HI-Zambia emphasizes a multifaceted approach that attempts to build the capacities of the individual families they support and of groups of families that embody social capital to provide services to the members after the formal close of the NGO program. Social capital is developed through a coordinated training on various social issues such as sharing and caring, self-help group formation, benefits of collective action, group self-reliance, and business management. Other support includes regular monitoring and evaluation, continued training, establishment of basic veterinary service providers, establishment of cooperatives, and intermediation with marketing agents. In addition, the requirement that beneficiaries ‘pass-on’ livestock and knowledge reinforces social capital for sustained impact.

3.3. Research Methods

3.3.1. Data

This research took advantage of the rollout of a livestock donation program by HI-Zambia to establish a field experiment that enabled the measurement of treatment effects. As in Jodlowski et al, (2016) I use the rollout of asset transfers to identify current recipients of livestock and future recipients. Since both current and future recipients are subject to the same selection processes, I avoid problems of selection bias. Moreover, I am able to identify future recipients who are spatially and socially remote from the current recipients and those that are in close physical and social proximity which allows for identification of spillover effects.

Prior to this research activity, HI-Zambia identified a number of farmer groups from communities in the Copperbelt Province which were eligible to receive livestock and associated services. However, limited resources dictated that only a subset of those farmer groups and communities would receive animals in the next few years. All groups selected for eventual support

were required to demonstrate appropriate membership with respect to households' capacity and needs, cohesiveness of the group, and other eligibility criteria including a commitment to assemble appropriate equipment, construct animal sheds, and make other preparations. The screening implies that the poorest households are ineligible as they may not have resources to maintain the animals while non-poor households are excluded based on asset and income criteria. Since the members of all groups have self-selected to participate, I assume that they are similar to each other in terms of relevant non-observable factors, though they may not be typical of the population at large.

Groups that are selected for inclusion receive support in a sequence that reflects the timing of their application. A queue is formed based on timing of application in order to determine rollout of support across the groups. Some eligible groups receive services in an initial round of donations and other groups, classified as “prospective”, must wait until resources are available for more donations. In this study, households from farmer groups in three communities that had been selected to receive livestock donations between November 2011 and January 2012 formed the treatment group for analysis. These groups represented all households in the program area receiving livestock transfers at the time of the baseline survey. In addition, households from two farmer groups from different communities in the same region that had been selected for future support were identified as “Prospectives”. These prospective groups were the next groups in line for services. As long as there are no systematic differences between groups based on timing of application, households in “prospective” groups can be used in an impact assessment as a control group for households that receive livestock in the initial distribution. This approach follows suggestions from De Janvry, Dustan and Sadoulet (2010) who note that staggered rollouts can be analyzed similarly to randomized control trials (RCTs) even when they lack explicit randomness.

The second step in the selection process determined which households in the farmer groups selected for services in the first phase of the rollout would receive initial livestock transfers. While all

households in the groups receive training and the benefits of enhanced social capital, only a subset of them initially receive donated animals. The specific treatment groups identified through the HI-Zambia rollout are summarized in Table 3.1.

Households that receive animals in the initial distribution are identified as “Originals”. These households receive pregnant animals and are required to pass on the first female off-spring of those animals to other group members, identified as “Pass on the Gift” recipients or “POGs”. Key informant interviews with group members indicated that selection of original recipients was random, but the purity of that randomness is not known. The POGs, like the Prospectives, represent future adopters, but their proximity to the Originals implies that they may be subject to spillover effects as well as the benefits of training, neither of which are available to the households in prospective groups. Finally, the analysis identified a group of households in the communities receiving treatment that had chosen not to participate in the farmer groups. These independent households likely differ from the participating households in unobservable ways and are therefore unsuitable as a control group. I exclude the Independents from the analysis as they may be different from other groups in observable ways may contribute to estimation bias.

Data were collected through four survey rounds administered every six months beginning in January 2012 and ending in August 2013. The baseline survey was administered to 324 households and a complete panel of four rounds exists for 300 households. Table 3.2 describes the baseline survey.

Community 1 and Community 2 did not receive animals or services during the survey period. Households surveyed in the treated villages- Communities 3, 4, and 5- are either Originals, POGs, or Independents. In all cases pregnant animals were delivered and farmers received training well before animals were transferred. Based on the ecological and market conditions of the three villages, group members received either one pregnant dairy cow, two pregnant draft cattle, or seven

female meat goats. When cattle were distributed the groups received one bull to share as a group to service the females. A male goat was given to each goat recipient in addition to the seven females. The total value of the asset transfer was similar regardless of the species transferred. The baseline survey covered 106 Originals, 111 POGs, 67 Prospectives and 40 Independents. Attrition left a panel of 102 Originals, 100 POGs, 66 Prospectives, and 32 Independents. The attrition rate of the full sample is 3.1%, 3.7% and 4.9% in the second, third and fourth survey rounds, respectively. I find no obvious pattern in attrition. The Originals and Prospective groups have fairly low attrition rates, 3.8% and 1.5%, respectively compared to the POGs (10%) and the Independents (20%). Jodlowski et al (2016) presents a more complete analysis of attrition in this sample and finds no evidence of bias. As I exclude the Independents from the analysis, my full sample consists a panel of 268 households.

3.3.2. Difference-in-difference (DID) framework

Taking advantage of the panel data available, I use the difference-in-difference (DID) method to measure the impact of the intervention. Combined with fixed effects estimation, the DID approach corrects for endogeneity that may arise from unobserved individual effects (Bertrand, Duflo and Mullainathan 2004). Within the DID framework I am able to accommodate the fixed effects model for normally distributed outcome variables, the poisson model for outcomes measured in count data, and the probit model for binary outcome variables. I use the DID method with household level fixed effects to estimate the effect of treatment on expenditures and revenues.¹¹ As I have a panel of multiple treatment groups defined by species of animal received across four periods,

¹¹ This method is similar to the approach used in Jodlowski *et al* (2016) but it differs from Jodlowski et al (2016) by considering POGs as a different treatment group rather than part of the comparison or control. These differences in specification were adopted because results from earlier study found evidence of a spillover effects in milk consumption on POGs which indicates that POGs would not be appropriately included in the control group when considering consumption of specific food items and food groups, which is the case in this study.

the empirical model (Equation 3.1) includes multiple dummy variables for time and treatment. Equation (3.1) is equivalent to the DID model specification for multiple time periods and multiple treatment groups suggested in Wooldridge (2010). I do not include dummy variables for the two treatment groups (Originals, and POGs) in this presentation as time invariant factors do not contribute to the fixed effects estimation.

$$y_{it} = \alpha_0 + \sum_{t=2}^4 \beta_t \text{Round}_t + \sum_{t=2}^4 \delta_t \text{Original}_{it} + \sum_{t=2}^4 \gamma_t \text{POG}_{it} + \Pi X + c_i + \varepsilon_{it} \quad (3.1)$$

In equation (3.1), i indicates the household and $t = 2, 3, 4$ represents the time period for survey rounds after the baseline. Thus, y_{it} is the outcome of interest for household i at time t , Round_t is a time dummy variable equaling 1 for rounds 2, 3, or 4 and 0 otherwise, and Original_{it} is the interaction of (Round_t) and the full treatment (Original_i) . Original_{it} equals 1 for original households in round 2, 3, or 4 and 0 otherwise. Similarly, POG_{it} is the interaction between time dummy (Round_t) and the partial treatment (POG_i) . Similarly, β_t is a time-varying effect; δ_t is a true program effect in that it is the difference in mean difference between original (treatment) and prospective (comparison) households; and γ_t is the combined effect of the program's 'Pass on the Gift' initiative and spatial or social spillovers. Finally, c_i is a household level fixed effect, X is a vector of control variables and Π is a matrix for estimated coefficients for elements of X . In this case, X includes gender and marital status of household head, and binary indicators for positive and negative shocks. Positive shocks include new job, business expansion, new source of income, or large gift in the last 6 months, and negative shocks include serious illness, theft or robbery, loss in business or job, natural disaster, crop failure, or loss of main income source in the last 6 months.

Equation (3.1) may be applicable when the outcome under study is represented with continuous data. This condition does not hold for all the variables of interest in this paper. The frequency of consumption of specific food items may reflect how people's consumption behavior changes in response to asset transfer and is therefore of interest here. Consumption frequency is reported in the count of days with consumption per week and is estimated using a poisson regression. Since, estimating the poisson regression with the time-invariant individual effect leads to the incidental parameter problem,¹² I combine the poisson model with the Chamberlin-Mundlak approach (Mundlak 1978). This correlated random effect approach allows the unobserved effect (c_i) to be correlated with the control variables, x_{it} . I estimate the resulting equation (3.2) by Quasi-Maximum Likelihood (QMLE) method and obtain a consistent estimate of the treatment effect, β .

$$E(y_{it} | x_{it}, \bar{x}_i) = \exp \left(\sum_{t=2}^4 \beta_t \text{Round}_t + \sum_{t=2}^4 \delta_t \text{Original}_{it} + \sum_{t=2}^4 \gamma_t \text{POG}_{it} + \Pi X + \theta \bar{X} \right) \quad (3.2)$$

where the covariate vector X includes all control covariates, and $\bar{X}$ includes time constant mean of the control covariates. Control covariates include household size, number of children five or under, age, gender, and marital status of household head, number of sheep, number of pigs, and dummy variables for positive and negative shocks. In equation (3.2) estimation of the treatment effect on consumption frequency is carried out by regressing consumption frequency on dummy variables for treatment and time as well as control covariates, (x_{it}) and their time constant averages ($\bar{x}_i$) with a constant included in the pooled poisson model. From equation (3.2), $\delta_t = \log(\mu_1) - \log(\mu_0)$ and

¹² Estimating a poisson fixed effects model resulted in loss of 221 observations because outcome variables which equal 0 across all time periods, ($y_{it} = 0 \forall t$) did not contribute to the estimation.

$\exp(\delta_t) = \frac{\mu_1}{\mu_0}$. The incidence rate ratio, $\exp(\delta_t)$, is interpreted as a count of times the change in the outcome variable differs between the treated and control groups.

Subjective poverty outcomes are measured with binary response variables. Following Wooldridge (2010) and Mundlak (1978), I estimate the treatment effects on subjective outcomes using the pooled probit method.¹³ Thus, the correlated random effect approach presented in equation (3.2) is adopted for the probit model to estimate the impact on subjective poverty measures. In particular, I assume that the unobserved effect (c_i) is normally distributed and correlated with the control variables (x_{it}), i.e. $c_i \sim N(\alpha + \theta \bar{x}_i, \sigma_u^2)$. The resulting equation below gives the consistent estimate of the treatment effect.

$$P(y_{it} \mid x_{it}, \bar{x}_i) = \Phi\left(\sum_{t=2}^4 \beta_t \text{Round}_t + \sum_{t=2}^4 \delta_t \text{Original}_{it} + \sum_{t=2}^4 \gamma_t \text{POG}_{it} + \Pi X + \theta \bar{X}\right) \quad (3.3)$$

Similar to equation (3.2), I estimate equation (3.3) by pooling the data and regressing the outcome variable on dummy variables for treatment and time, x_{it} , and $\bar{x}_i$ with a constant included in the pooled probit model.

3.3.3. Outcome variables

Analyses of the impact of asset transfer programs often focus on consumption expenditures to gauge poverty impacts and dietary diversity to measure household food security effects (Banerjee et al. 2015, and Jodlowksi et al. 2016). After identifying an impact on expenditures poverty, I examine expenditures by consumption category considering food and non-food aggregates and also

¹³ The probit fixed effects model is not available and the logit fixed effects model is not appropriate. Under the logit fixed effect, observations with time invariant outcome i.e. $y_{it} = a \forall t$ do not contribute to the estimation of causal effect implying the loss of over 300 observations with the logit fixed effect.

considering specific food groups that represent staples and luxury food items in the local economy. Food expenditure includes the value of home produced foods that are consumed by the household economy. Increased consumption of luxury items can be taken as evidence that the treatment has led to a qualitative change in welfare, even if the absolute value of consumption remains low.

Similarly, I estimate an impact on dietary diversity and then examine dietary composition. Dietary diversity is measured as the total count of food groups consumed at home in the past 24 hours from a set of 13 possible groups, each containing multiple food items. My classification of 13 food groups is consistent with FAO's guidelines for household dietary diversity (Kennedy, Ballard and Dop 2011), but I merged 'other vegetables' with 'green leafy vegetables', 'flesh meat' with 'organ meat', and 'beverages/spices' with 'sweets' reducing the number of groups from 16 to 13. The 13 food groups included are: cereals, white tuber, yellow/orange tuber, vegetables, orange/red flesh fruits, other fruits, meat/chicken, eggs, fish, legumes/nuts/seeds, milk and milk products, oils and fats, and sweets/beverages. I then examine the frequency of consumption of specific food items as another indicator of change in consumption mix and also to assess how any increase in dietary diversity corresponds to consumption of nutrient dense foods. Consumption frequency is measured as the number of days a household consumed food items from a particular food group over the last 7 days.

Increased expenditures on luxury items or increased frequency of consumption of such items is taken as evidence of a qualitative shift in economic status. Absence of such a shift would suggest that any increases in consumption expenditures have not been sufficiently large to alter beneficiaries' sense of economic wellbeing or security. If the change in consumption has been sufficiently large to trigger a greater sense of economic wellbeing, I would expect subjective self-assessment of poverty status to have changed. Therefore I examine whether changes in subjectively reported poverty status are consistent with observed changes in composition of consumption.

Various protocols for eliciting subjective assessments of welfare have been developed (Pradhan and Ravallion 2000; Gustafsson, Shi and Sato 2004). Although subjective measures themselves are difficult to validate, they provide a means to confirm whether perceptions of changes in economic status are consistent with the observed changes in consumption patterns (Ravallion 2012; Carletto and Zezza 2006). One advantage of these measures is that they implicitly include the utility people receive from community-level or non-market goods, rather than just utility from private consumption. I constructed the subjective measure, 'Feeling Poor', combining two different poverty questions. The first question asks about self-sufficiency of the household and the second question assesses whether household circumstances are getting better over time. 'Feeling Poor' equals 0 if the respondent thinks the household always had at least enough resources to sustain itself or it is getting better over time. If the respondent thinks the household needs help or the situation is getting worse over time, then 'Feeling Poor' equals 1.

Subjective measures of food security can also suggest whether a household's status has been substantively changed by the asset transfer. There exist well developed methods for eliciting self-perceived food security status such as the Household Food Insecurity and Access Scale developed by USAID's FANTA project (Headey and Ecker 2012). In this study, a household is classified as feeling food secure if the respondent chooses either of the first two responses from the question: "When you think about what you can feed your household, which of these best describes your situation? a) Always able to feed my family enough of the foods I want to give them, b) Always able to feed my family enough food, but not always the variety of foods I want to give them, c) Usually able to feed my family enough food, but not the variety I want to give them, and d) Usually unable to feed my family enough food or the variety I want to give them."

3.4. Results

3.4.1. Summary statistics

Table 3.3 presents summary statistics for outcome variables at the baseline. Salient features of the sample include, first, that households report very low consumption expenditures in the baseline, with mean expenditures levels in most groups well below the \$1.25/day international poverty line. Second, food insecurity appears prevalent in the sample, as a large share of expenditures is devoted to food for all groups, consumption of nutrient-dense ASF is rare, and the majority of households report that they do not feel food secure. The last two columns in Table 3.3 present balance tests based on normalized differences (ND)¹⁴ between the Originals (treatment group) and Prospectives (control group) and between the Originals and POGs, respectively. Imbens and Wooldridge (2008) suggest that two groups can be considered different in observables when the value of normalized difference exceeds the threshold 0.25.

Based on the normalized difference in baseline values (ND1), Prospective households appear to be slightly better off than the original recipients at the baseline in some dimensions but those differences should not affect the analysis as long as the explanatory variables are not qualitatively different. Other response variables such as livestock revenue, milk consumption days, meat consumption days, and dietary diversity are not significantly different between treated and control groups. Baseline dietary diversity scores are similar for all groups and all of them consume milk and meat products only about one day per week. Overall, treated and control groups look similar in the baseline survey. Similarly, all the values of normalized difference between the Original and POG groups (ND2) are well below the threshold level. Hence, the POGs and Originals also are

¹⁴Normalized differences (ND) are calculated as $\Delta X = \frac{\bar{X}_1 - \bar{X}_0}{\sqrt{S_1^2 + S_0^2}}$ where $\bar{X}_i$ and S_i^2 are sample mean and variance of covariates (X) for treated and control groups. This approach is preferred to the simple t-test because it does not vary with sample size.

similar in observable characteristics, supporting the information from key informant interviews that selection across these two groups was random.

Table 3.4 summarizes characteristics of households, household heads, and assets in the baseline survey. In addition to confirming similarity across the treatment and comparison groups in the baseline, these data reveal the very limited use of livestock in farming systems prior to the intervention. Ownership of cattle and goats is very low among sample households at the baseline.

The values of normalized differences in the fifth column of Table 3.4 indicate that the Original and Prospective groups are similar in all characteristics but household size. The difference in household size should not affect the analysis because household size is essentially time invariant for the period of my study and not included in the DID framework. The normalized differences in the last column of Table 3.4 indicate that the Originals and POGs are similar in all characteristics but age of the household head. I find no statistically significant differences in asset ownership in the baseline.

3.4.2. Impact on consumption expenditure

This analysis begins by estimating the impact of the program intervention on broad measures of poverty over time and across the species of animal transferred. In so doing I document the evolution of the impact at six month intervals and confirm the results of other analyses that used this data set. I then extend previous analysis by examining changes in the composition of consumption and in subjective assessments of wellbeing.

Results concerning consumption expenditures and livestock revenue are presented in Table 3.5. All outcome variables are log-transformed to smooth their distribution and results are obtained by estimating equation (3.1) with the fixed effects model. Results indicate that 18 months after the livestock distribution, receipt of an animal resulted in a 20% increase in total consumption

expenditures which implies an absolute increase of about US\$0.20 per day per person. Six and 12 months after the intervention the growth in consumption expenditure is 23% and 27%, respectively. In dollar values, these growth rates imply an absolute increase in per-capita expenditure from \$.96/day at the baseline to \$1.18/day after 6 months, \$1.22/day after 12 months, and \$1.15/day after 18 months. These results confirm Jodlowski et al. (2016) and Banerjee et al. (2015) in that the livestock transfer has a rapid, persistent, and statistically significant impact on consumption, but one that leaves initially impoverished households at low levels of absolute consumption.¹⁵

Although all animal recipients have moved close to the absolute poverty threshold of \$1.25/day, the measured impact still has left the households at a low level of consumption, well below the \$2.00/day poverty line. Whether this increase has been sufficient to transform consumption patterns is examined below. As with total consumption, the impact of livestock transfer on the value of food consumption is positive, rapid, persistent, and statistically significant. After controlling for other factors, the growth in food expenditure (including the value of home produced foods and gifts) among the Originals is 24% after 6 months, 27% after 12 months and 28% after 18 months. These impacts translate to an increase in per-capita daily food expenditure from \$0.51 at the baseline to \$0.65 after 18 months. The pattern of growth in livestock revenue suggests the mechanism through which livestock transfer increases consumption. All animal recipients generate income by selling animal products or services.

The growth in livestock revenue came to about 200% over 18 months. Daily per-capita livestock revenue increased from \$0.07 at the baseline to \$0.24 after 18 months of intervention. Despite the growth in income, there is negligible growth in non-food expenditure. This result may be partly driven by the large contribution of home produced animal source foods to consumption. But the failure to diversify increased income into non-food consumption raises questions about how

¹⁵ Results differ slightly from those reported in Jodlowski et al. (2016) primarily because Jodlowski et al. includes POGs in the control group.

transformative the asset transfer has been. Unlike the original recipients, the POG households show almost no impact on expenditure growth or livestock revenue.

The POGs do show a statistically significant increase in the value of food consumption 18 months after the intervention. This impact could reflect spillovers caused by changes in the local food economy due to the increased availability of milk locally. Dairy cow recipients reported selling about one liter of milk per day locally, while five to eight liters was sold daily into a national market through a collection center. Food consumption growth among the POGs may imply a difference in preferences among different groups or may reflect spillover effects that are social rather than purely spatial.

Table 3.6 presents the effects on consumption expenditures by species. In this estimation the treatment periods are defined as baseline and post-treatment with post-treatment period consisting of all three follow up rounds. Treatment effects are therefore the average across the effects after six months, 12 months and 18 months. Results indicate that dairy cow recipients increase their total consumption expenditures by about 24% and the value of food consumption by 36% but experience no change in non-food expenditures.

The average consumption expenditure growth in the goat recipients is about 20% with no impact on non-food expenditure. Those who received draft cattle had a 28% increase in total consumption expenditure and 42% increase in non-food expenditures but no change in the value of food consumption. Further calculations show that these changes translate to a growth in total expenditure from \$0.98/day to \$1.22/day among dairy cow recipients, \$0.95/day to \$1.15/day among goat recipients, and \$0.95/day to \$1.22/day among draft cattle recipients. Increase in the value of food consumption (including the value of home production that is consumed) for dairy cow and goat recipients but not for draft cattle recipients suggests that having the option for direct consumption of ASF affects the consumption pattern. The increased consumption of non-food

items by draft cattle recipients may signal a qualitative change in consumer behavior; it is not immediately clear whether such a change occurred for meat goat and dairy cow recipients.

Unpacking the food expenditures into specific food items provides insight about the practical significance of the increases in the value of consumption identified above. Examination of specific patterns of consumption can suggest whether households achieve a level of economic security that allows them to diversify their consumption patterns or not. In particular, I can assess whether there has been an increase in consumption of items that are luxuries in the local setting, such as milk, meat, and rice which have income elasticities of demand of 2.4, 2.1, and 2.7, respectively. Maize and cereals, in contrast have estimated income elasticities of 0.7 and 0.9 and therefore are considered staples in the local settings. Further, the analysis can suggest whether the type of product produced by livestock (milk, meat or draft power) influences the consumption pattern of the owner.

Table 3.7 presents expenditures for individual food items by species of animal received. As expected, dairy cow recipients increased the value of milk and milk products consumed dramatically (by 421% compared to Prospectives), but also increased consumption of sweets and beverages by 91%. Growth in food expenditure among the draft cattle and goat recipients is explained by the growth in rice consumption, which is a local luxury food item and served as an occasional alternative to the primary staple, maize. Although the POGs had no growth in food expenditure in aggregate, they consumed significantly higher values of meat (88%) and milk (115%) products after the intervention. Results from my analysis of the impact over time are consistent with and do confirm this finding (Appendix B Table B1). The results imply that the local food environment has been changed after the intervention as households that did not receive animals are also changing the composition of their food expenditures. Program participants consuming more of rice and sweets and beverages along with animal products suggests that the mechanisms for changes in composition

of food expenditures have included market participation as well as direct consumption. Moreover, while growing expenditures on maize indicate greater consumption of the staple that could be consistent with persistent poverty, diversification of consumption into foods that represent luxury items in the local context signals substantive economic transition.

3.4.3. Impact on diet

Table 3.8 presents the impact of the intervention on dietary diversity and frequency of consumption of specific foods by animal species transferred. Results indicate that recipients diversify their diet by about one more food group per day ($e^{0.20} = 1.2$). These impacts on aggregate dietary diversity are similar to those reported in Jodlowski et al (2016). To further understand the significance of this increase in dietary diversity, I estimate the impact of the program on the consumption frequency (days per week) of specific food groups using the model specified in equation (3.3). The estimated coefficients are log difference of expected consumption frequencies or simply a percentage change. As expected, milk consumption among the treated households has increased over time. Both ‘treated’ and ‘control’ groups increased milk consumption frequency by two to five days per week. Compared to the Prospectives, the dairy cow recipients consume milk and milk products about 5 ($e^{1.58} = 4.9$) more days per week. The meat goat and draft cattle recipients also increased milk and meat consumption frequency by about 2 more days per week compared to the Prospective group. The POGs also have a significant but smaller increase in milk consumption frequencies confirming the spillover effect shown in the expenditures data (Table 3.8).

The results on milk consumption imply that animal recipients are consuming more milk because either they have new home production, or they now have enough income to buy milk, or milk has become more available in their community. Community level data show that milk has become more affordable as increased milk availability has driven down the local milk prices from

5000 kwacha per liter in the baseline to 3000 kwacha per liter in the final round. Over the 18 month period, the local milk price fell further in cow recipient villages to 2300 kwacha per liter. While the local market appears to be saturating with milk, the bulk of production is sold into the national market through collection centers where the price remained stable throughout the period.

None but the goat recipients increased consumption of meat (2 more days per week) suggesting no evidence of income and price effects on meat consumption among other animal recipients. The intervention has no impact on the frequency of cereal or oil consumption, which were generally consumed daily in the baseline. Dairy cow and draft cattle recipients consumed sweets and beverages one more day per week as a result of treatment. This growth in non-nutritious food intake is much smaller than the growth in milk consumption, implying that the impact on dietary diversity is primarily from increased consumption of nutritious food items. The increase in ASF consumption may be a combination of both income and price effects. Because the POGs are consuming milk and meat more frequently, there is evidence of spillover effects in ASF consumption. I also run analysis over multiple periods considering all three animals as a single ‘treatment’ and similar results hold (Appendix B Figure B1). Overall, the results indicate a gradual shift from staple foods to more luxury food items.

3.4.4. Subjective assessment of poverty and food security

Subjective measures of poverty and food security reinforce the impression that households who received animals have achieved a level of security despite their fairly low absolute consumption expenditures. Table 3.9 presents the impact on the subjective assessment of poverty and food security over time. Since the response variables (“Feeling Poor” and “Food Secure”) are binary, the

treatment effect on subjective measures is estimated with the pooled probit model.¹⁶ Results indicate that the predicted probability of “feeling poor” among the treated households has decreased over time. All animal recipients are less likely to feel poor after treatment but the POGs report no change relative to the Prospectives. Although dairy cow recipients are feeling less poor and more food secure, those who received goats or draft cattle report feeling that they are less poor but are indifferent about their food security status. Results suggest that even though all treated groups perceive themselves to be better off than the control groups do, draft cattle and meat goat recipients may be less affected than dairy cow recipients. It also suggests that the regular flow of milk from the dairy cows probably contributes to a feeling of food security.

When the Independents are included in the analysis, the independent households claim to feel poor with increased frequency (Appendix B Table B2). The diminished sense of wellbeing among the Independents may reflect material changes not captured elsewhere in this analysis or a subjective feeling of dissatisfaction compared to the improved status of others in the community who have received asset transfers.

3.5. Conclusion

Rigorous analyses have shown that multifaceted interventions blending asset transfers and other services can have statistically significant impacts on consumption expenditures among impoverished rural households (Jodlowski et. al., 2016; Bannerjee et. al., 2015). This paper explored the practical implications of those statistically significant effects by examining the impacts on the composition of consumption and subjective attitudes of program participants. In so doing I assess the behavioral and attitudinal impacts of the changes in expenditures. Taking advantage of

¹⁶ Full specification of the pooled probit model includes all time dummy variables, the following controls and their time averages. Controls: household size, kids age 5 or under, age of head, female head, married, number of sheep, pigs, chickens, positive shock, and negative shock.

differences in the forms of asset transfer (species of animal donated), the analysis provides insights into how specific types of assets may have divergent impacts on composition of consumption.

Results indicate that livestock transfers to extremely poor households coupled with coordinated training on animal management and other themes can increase consumption expenditures, provide additional sources of income, improve dietary quality, and make people feel more prosperous and food secure. As a result of the program, the value of food consumption grew by as much as about 36% and total consumption expenditure by about 25%. However, the increases in expenditures that were observed left most households near or below the absolute poverty line, raising questions about the practical significance of the measured impacts. I find that observed changes in composition of food expenditures suggest that the treated households have achieved a new level of financial and food security, despite low absolute levels of consumption. The modest absolute change in expenditures (about 25 cents per person per day) has triggered a substantial qualitative change in the consumption mix and in perceptions of food security and poverty. Results indicate that livestock donation with complementary services can be an effective tool against hunger and poverty.

Some of the changes in composition of consumption suggest ways in which transfers of livestock may have different effects from other asset transfers. Transfers of livestock that produce food encourage direct consumption of such foods, while transfer of other livestock assets (draft cattle) encourages non-food consumption by the beneficiaries. This result suggests an opportunity to skew expected consumption growth toward food if that were desirable from a policy perspective. Furthermore, growth in the value of milk consumption and in the frequency of milk consumption by the POG households who did not receive livestock donation suggests that the transfers have altered the local food markets in a way that implies community-wide benefits. While a cash transfer could have inflationary impacts on perishable, nutrient dense food items and thereby negatively

affect consumption among non-recipients, the transfer of livestock that produce such foods has the opposite effect. Against these potential benefits, transfer of specific assets like livestock implies higher costs of transfer and continued programmatic support and imposes rigidity in programs that could hamper effectiveness. Results suggest, however, that mastery of the details associated with transfers of specific assets can yield practically significant impact.

The pattern of food expenditures growth raises some questions about measurement of impacts in practice and particularly the use of dietary diversity or cereal consumption as an outcome measure. Household dietary diversity measurement normally treats cereals as a food group, thereby pooling rice, maize and other grain consumption. In this case, increased access to food at the household level manifested itself in increased purchase of rice shifting the diet away from maize. This change marks enhanced household food security, but would not be captured in either a household dietary diversity score or in a “revealed preference” approach to food security presented in Jensen and Miller (2010) which considers declining share of expenditures to cereals as a marker of increased food security. In areas where large shares of the population consume a single staple crop, the scope and scale of substitution among cereals in the diet may have important implications for assessing the likely nutritional impact of income growth as well as identifying economic effects. The growth in consumption of sweets and beverages as a result of the program also raises concerns. That increased access to food manifests itself in greater consumption of bottled beverages and sweets presents a reminder that household food security may not necessarily translate into improved individual nutrition. The observed pattern of consumption may well reflect a larger problem of limited consumer options in rural communities. Low levels of market development in rural Africa mean that an incremental \$0.25/day can be spent in very few ways in the local community. If the evolving patterns of consumption reflect limited range of consumer items available, the longer term impact of rising incomes may be to attract a broader array of consumer products into communities,

resulting in greater diversification of consumption. If this is the case, public investment to facilitate market development could be a key component to ensuring that any level of income growth allows consumers to exercise purchasing power effectively. Similarly, there may be scope for nutrition education and communication to promote diversification into more nutritious diets as income growth allows changes in composition of consumption.

3.6. Tables

Table 3.1: Treatment and control groups

Group	Treatment	Selection	Services	Location
Originals	Full treatment	Self-selected and screened for participation	Receive services and pregnant livestock at baseline	In treated communities
POG	Partial treatment	Self-selected and screened for participation	Receive immature animals 6 to 18 months after baseline	In treated communities
Independents	No treatment	Self-selected out of participation	Receive no services	In treated communities
Prospectives	No treatment (control group)	Self-selected and screened for participation	Receive no services during period of analysis	In non-treated communities

Table 3.2: Survey characteristics and attrition

Panel A:		Treatment Status				
Community	Species	Total	Originals	POGs	Independents†	Prospectives
1	None	31				31
2	None	35				35
3	Cow	83	31	40	12	
4	Goat	100	51	41	8	
5	Draft	51	20	19	12	
Total		300	102	100	32	66

Panel B:						
Treatment Status	Round1	Round4	Attrition (%)	Panel	Attrition (%)	Attrition
Originals	106	103	2.8	102	3.8	-4
POGs	111	104	6.3	100	9.9	-11
Independents	40	35	12.5	32	20	-8
Prospectives	67	66	1.5	66	1.5	-1
Total	324	308	4.9	300	7.4	-24

Notes: Communities 1 and 2 are comparison groups for this study. These communities were selected for the program but they have not received the program yet. All other communities are treatment communities but not everyone in these communities received animals and training.

†Independents are excluded from the analysis because they may be different from other groups in observable ways and contribute to estimation bias

Table 3.3: Summary of outcome variables in baseline

Variable	Originals	POGs	Prospectives	ND1	ND2
Total expenditure (\$/day)	0.96 (0.695)	0.93 (0.585)	1.37 (0.957)	-0.32	0.03
Food expenditure (\$/day)	0.51 (0.283)	0.52 (0.386)	0.72 (0.494)	-0.35	-0.03
Livestock revenue (\$/day)	0.07 (0.335)	0.12 (0.582)	0.032 (0.114)	-0.11	-0.07
Household dietary diversity score	5.765 (1.862)	5.690 (1.650)	5.64 (1.935)	0.05	0.03
Days milk served/week	1.32 (2.13)	1.01 (1.967)	1.64 (2.647)	-0.09	0.12
Days meat served/week	1.01 (0.949)	1.19 (1.426)	1.23 (1.275)	-0.14	-0.11
Feeling poor (1=Yes, 0=No)	0.63 (0.486)	0.75 (0.435)	0.86 (0.346)	-0.37	-0.18
Food secure (1=Yes, 0=No)	0.37 (0.486)	0.39 (0.490)	0.38 (0.489)	-0.01	-0.02
<i>Observations</i>	102	100	66		

Notes: Point estimates are mean; Standard deviations are in parentheses. ND1 and ND2 are Normalize Differences between Originals and Prospectives and Originals and POGs, respectively. All monetary values are in \$/day per-capita. The exchange rate used is 1 USD= 5,000 Kwacha.

Table 3.4: Summary of household characteristics in baseline

Variable	Originals	POGs	Prospectives	ND1	ND2
Household Size	7.40 (2.833)	7.08 (2.809)	5.67 (2.073)	0.45	0.08
Number of children 5 or under	1.18 (1.009)	1.29 (0.935)	1 (0.911)	0.13	-0.08
Number of children 6 to 16	2.40 (1.643)	2.56 (1.748)	1.79 (1.398)	0.27	-0.07
<i>Household head characteristics</i>					
Age	50.53 (12.35)	43.54 (12.37)	45.12 (14.75)	0.27	0.37
Education	2.90 (1.432)	3.10 (1.570)	2.91 (1.296)	-0.003	-0.09
Gender (1=Female, 0=Male)	0.29 (0.458)	0.26 (0.441)	0.21 (0.412)	0.13	0.05
Married (1=Yes, 0=No)	0.81 (0.391)	0.89 (0.314)	0.79 (0.412)	0.04	-0.15
<i>Household Assets</i>					
Cultivated land (HA)	4.66 (6.545)	3.94 (3.802)	2.65 (2.921)	0.27	0.05
Number of cattle	0.89 (2.320)	0.60 (2.287)	0.61 (1.528)	0.10	0.09
Number of goats	0.92 (5.762)	1.60 (3.370)	1.24 (2.327)	-0.05	-0.10
Number of sheep	0.25 (1.347)	0.48 (1.925)	0.045 (0.369)	0.15	-0.095
Number of pigs	0.56 (1.838)	0.21 (0.967)	1.47 (10.63)	-0.08	0.17
Own TV (1=Yes, 0=No)	0.48 (0.502)	0.38 (0.488)	0.39 (0.492)	0.12	0.14
Own bicycle (1=Yes, 0=No)	0.86 (0.346)	0.82 (0.386)	0.86 (0.346)	-0.002	0.08
<i>Observations</i>	102	100	66		

Notes: Point estimates are mean; Standard deviations are in parentheses. ND1 and ND2 are Normalize Differences between Originals and Prospectives and Originals and POGs, respectively.

Table 3.5: Impact on poverty measures over time

	Expenditures			Livestock revenue
	Total	Food	Non-food	
Original2	0.226** (0.103)	0.236** (0.116)	0.175 (0.145)	2.417** (0.662)
Original3	0.266*** (0.097)	0.274** (0.116)	0.290** (0.134)	2.485*** (0.727)
Original4	0.199* (0.114)	0.277** (0.116)	0.029 (0.174)	1.790** (0.768)
POG2	0.022 (0.109)	0.081 (0.125)	-0.012 (0.144)	-0.195 (0.517)
POG3	0.076 (0.099)	0.074 (0.118)	0.142 (0.140)	-0.341 (0.634)
POG4	0.149 (0.122)	0.309** (0.130)	-0.092 (0.174)	-0.890 (0.696)
<i>Observations</i>	1072	1072	1072	1072

Notes: Standard errors in parentheses, Level of significance: * $p < .10$, ** $p < .05$, *** $p < .01$

Dependent variables are log of expenditures and livestock revenue. Both expenditures and revenue are in Kwacha per-capita per week. The full specification of the estimated model is: $\ln y_{it} = \beta_0 + \sum_{t=2}^4 \beta_t Round_t + \sum_{t=2}^4 \delta_t Original_{it} + \sum_{t=2}^4 \gamma_t POG_{it} + \Pi X + c_i + \varepsilon_{it}$ where X= (dummy variables for female head, marital status, positive shock, negative shock)

Original_i, and POG_i are ‘treatment’ dummies for i=2,3,4. For example, Original2 equals 1 for all Originals in the second survey round, and Original4 equals 1 for all Originals in the final round and 0 otherwise.

Table 3.6: Impact on poverty measures by animal species

Recipients	Expenditures			Livestock revenue
	Total	Food	Non-food	
Dairy Cow	0.243** (0.116)	0.365*** (0.117)	-0.075 (0.188)	7.021*** (0.651)
Meat Goats	0.205** (0.104)	0.223* (0.121)	0.208 (0.143)	-0.432 (0.682)
Draft Cattle	0.276** (0.124)	0.205 (0.132)	0.422** (0.196)	1.672** (0.704)
POG	0.082 (0.090)	0.155 (0.103)	0.012 (0.124)	-0.469 (0.547)
Observations	1072	1072	1072	1072

Notes: Standard errors in parentheses, Level of significance: * $p < .10$, ** $p < .05$, *** $p < .01$

Dependent variables are log of expenditures and livestock revenue. Both expenditures and revenue are in Kwacha per-capita per week. The full specification of the estimated model is: $\ln y_{it} = \beta_0 + \sum_{t=2}^4 \beta_t \text{Round}_t + \delta_1 \text{Cow} + \delta_2 \text{Goat} + \delta_3 \text{Draft} + \gamma \text{POG} + \Pi X + c_i + \varepsilon_{it}$. X is a vector of covariates, i.e. X= (dummy variables for female head, marital status, positive shock, negative shock)

Cow, Goat, Draft, and POG are treatment dummy variables equal to 1 for the specific treatment in the follow-up rounds and zero otherwise (eg. Cow equals 1 for all cow recipients in all follow-up rounds and zero otherwise).

Table 3.7: Impact on various food expenditures by animal species

Recipients	Food expenditures					
	Rice	Meat	Milk	Oil	Sweets/beverages	Maize
Dairy Cow	0.436 (0.928)	0.473 (0.488)	4.208*** (0.761)	0.455 (0.452)	0.915** (0.411)	1.119** (0.486)
Meat Goat	1.242* (0.657)	0.800 (0.649)	1.076 (0.654)	0.314 (0.364)	0.293 (0.262)	0.044 (0.226)
Draft Cattle	2.276*** (0.828)	0.704 (0.723)	0.826 (0.954)	0.266 (0.393)	-0.115 (0.280)	0.187 (0.258)
POG	0.509 (0.645)	0.873* (0.481)	1.150** (0.521)	0.297 (0.281)	-0.024 (0.222)	0.650*** (0.247)
Observations	1072	1072	1072	1072	1072	1072

Notes: Standard errors in parentheses, Level of significance: * $p < .10$, ** $p < .05$, *** $p < .01$

Dependent variables are log of food expenditures. All expenditures are in Kwacha per-capita per week.

Table 3.8: Impact on food security measures by species

	HHDDS	Consumption Frequency				
		Milk	Meat	Cereal	Oil	Sweets/Beverages
Dairy Cow	0.200*** (0.047)	1.578*** (0.080)	0.040 (0.107)	-0.001 (0.049)	0.036 (0.050)	0.192*** (0.055)
Meat Goat	0.004 (0.043)	0.684*** (0.088)	0.345*** (0.086)	-0.001 (0.043)	-0.031 (0.045)	0.063 (0.050)
Draft Cattle	0.207*** (0.055)	0.756*** (0.105)	-0.011 (0.125)	0.021 (0.057)	0.026 (0.059)	0.154** (0.065)
POG	0.054 (0.036)	0.482*** (0.080)	0.022 (0.079)	0.001 (0.036)	-0.014 (0.038)	0.029 (0.043)
<i>Observations</i>	1071	1071	1071	1071	1071	1071

Notes: Standard errors in parentheses, Level of significance: * $p < .10$, ** $p < .05$, *** $p < .01$

Dependent variable in the first column is household dietary diversity score (HHDS) and rest of the dependent variables are number of days a food item is consumed in last week (counts). Results are obtained from the pooled poisson regression.

Table 3.9: Impact on poverty and food security measures

	Feeling poor	Food secure
Dairy Cow	-1.349*** (0.270)	0.582*** (0.169)
Meat Goats	-0.322** (0.155)	0.062 (0.149)
Draft Cattle	-0.663*** (0.240)	0.178 (0.197)
POG	0.160 (0.130)	-0.099 (0.128)
<i>Observations</i>	1072	1072

Notes: Standard errors in parentheses, Level of significance: * $p < .10$, ** $p < .05$, *** $p < .01$

Both dependent variables are binary. Feeling poor equals 1 if people are feeling relatively worse and 0 if feeling same or better. Food secure equals 1 if people feel food secured and 0 if they feel otherwise. Results are obtained from the pooled probit regression.

CHAPTER 4

HIS, HERS, OR OURS: THE IMPACT OF LIVESTOCK TRANSFER AND TRAINING ON INTRA-HOUSEHOLD DECISION-MAKING IN ZAMBIA.¹⁷

4.1. Introduction

Women's empowerment has received considerable attention among development practitioners and researchers in recent years. Empowering women – improving their economic and social status and enhancing their decision-making power within the household – is considered both to have intrinsic value and to serve as a means to other economic development objectives (Deere et al. 2013; Deere and Doss 2006; FAO 2011; Johnson et al. 2016; Meinzen-Dick et al. 2011).

Numerous policies and interventions work to empower women through education, training, improved access to credit, leadership development, and transfer of economic resources. These programs tend to provide training to both men and women but focus on women for transfer of project-related assets and income (Banerjee et al. 2015; Das et al. 2013; Jodlowski et al. 2016; Johnson et al. 2016; Kafle et al. 2016; Rawlins et al. 2014). The design of these projects is motivated by evidence that improving women's economic resources can alter the dynamics of intra-household decision-making. While research has focused on women's empowerment, empirical evidence regarding how such interventions impact men's decision-making power is limited (Garikipati 2013). Successful household enterprises that are seeded through asset transfer may well benefit from some degree of male support or active involvement. Thus, a negative effect of the transfer on men's engagement in decision-making could be detrimental to sustained impact. Some argue that

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empowerment is a zero-sum-game and improving women's position disempowers men (Hanstad 2014; Miller 2011) while others believe that empowerment can be a positive-sum game. Whether women can experience increased empowerment without disempowering men could be a critical question for multifaceted asset transfer programs, but empirical evidence to evaluate whether empowerment effects are zero-sum or not remains scarce.

Whether and how a multifaceted asset transfer program affects household decision-making has consequence for the overall wellbeing of program participants in multiple dimensions. Empirical evidence strongly supports the claim that increasing women's decision-making power can improve children's health and nutritional outcomes and have other desirable welfare effects (Deere et al. 2013; Duflo 2012; Malapit et al. 2013; Sharaunga et al. 2015; Wilcox et al. 2015). As a result, asset transfer programs often concentrate on women and include women's empowerment as an objective. But, excluding men from such multifaceted programs may make it difficult to fully realize women's empowerment if men respond by withdrawing or withholding their support from women-led enterprises (Chant and Gutmann 2000). For example, successful implementation of a livestock transfer may require an allocation of adult labor and management within the household that can most easily be achieved with men's cooperation. In an extreme, there is evidence that the disempowerment of men can be associated with sexually aggressive behaviors (Silberschmidt 2001) and increased incidence of domestic violence (Schuler, Bates and Islam 2008; Vyas and Watts 2009).

A shift from individual to collective or joint decision-making could allow a household to reconcile an expanded scope of decision-making for women with continued participation by men. Aside from facilitating access to the physical resources of both men and women, collective decision-making could be superior to individual decision-making due to the expanded information available when multiple parties are involved. Thus, there could be a benefit to expanding women's and men's shared engagement in decision-making. In the context of an asset transfer program, changes in

decision-making dynamics could emerge at the extensive margin, affecting only those new management decisions that arise as a result of the asset transfer (eg. where to sell the milk produced by the transferred dairy cow) or might permeate pre-existing decision spheres.

In this analysis I consider a multifaceted program that combines training in multiple areas, including gender awareness, with livestock transfers. This program could affect women's empowerment either through its focus on women as recipient of the transfers or through the training. The livestock that are transferred place a high demand on labor and management, making it likely that male engagement is beneficial to success. I assess (1) whether the program affected the pattern of decision-making in the beneficiary households, (2) whether joint decision-making emerged and the consequent implications for the scope of male and female influence on decisions, and (3) whether changes in decision-making were confined to the extensive margin of new decisions related to the transfer or permeated pre-existing decision domains. Understanding the impact on joint decisions is of particular interest as there is reason to suspect that engagement of men and women could be important for program success. Understanding whether a program affects decision dynamics beyond areas directly related to the asset transfer can suggest the breadth of impact that transfer programs have.

Consistent with recent literature, I use decision-making within the household as a measure of empowerment (de Brauw et al. 2014; Doss 2013; Wiig 2013). Attempts to measure female empowerment through decision-making confront the need to weight joint decisions in which men and women both participate. As in the Women's Empowerment in Agriculture Index (WEAI), I present measures in which women's participation in a joint decision signals as much empowerment as women making decisions independently. I present analogous measures that gauge decision making processes only through changes in the prevalence of independent decisions for men or women and through changes in the prevalence of joint decisions.

This paper makes three primary contributions to the literature. First, my analysis is an early attempt to evaluate the impact of a multifaceted intervention – physical asset transfers and training – on women’s empowerment. I construct empowerment measures based on women’s control and authority over eight different decision spheres of household activities and identify causal relationships between the ‘livestock transfer and training’ intervention and women’s empowerment. The eight spheres include decisions about sending children to school, slaughtering animals, live animal sales, animal product sales, crop produce sales, control over farm income, access to loan/credit opportunities, and crop storage/sales. Within these spheres I measure 42 household decisions and treat all decisions directly related to the intervention (1. Cattle and goat sale and slaughter, 2. Milk, meat, and draft power sale, and 3. Access to loan/credit) as ‘treatment-related’ decisions. I use remaining decisions to test for spillovers into other spheres of non-livestock related household activities. I find an increase in women’s decision-making power, limited to areas directly related to the transfer. Second, I extend the literature by assessing men’s decision-making power and demonstrate that an increase in women’s empowerment need not imply reduction in men’s decision-making power in the household. This result emerges because of an increase in the prevalence of joint decision-making in the household. Third, because I am able to identify households that received training related to gender and household decision-making but had not received asset transfers, I can assess the relative impact of training with and without the transfer. The households that received training but no asset transfer showed no change in decision-making dynamics. My findings imply that there may be an essential complementarity between gender awareness training and providing asset transfers; the economic resource transfer leads to an increase in joint-decision making that is not observed in households that receive gender awareness training but not asset transfer. Moreover, the findings suggest that decision-making is more malleable on the extensive margin than in areas where decision dynamics are well-established. Methodologically, this analysis

demonstrates the importance of aggregating and analyzing joint and solitary decisions separately in empowerment studies and measures in order to capture the dynamics of intra-household decision-making.

My finding that most changes in decision-making are on the extensive margin may reflect two features of my sample. First, the number of decisions being made in the household is small in the baseline because of a lack of economic diversification. Of the 42 decisions that I can measure using the survey instrument I use, households on average report activity in 5 decisions in baseline and 10 decisions in endline. Second, in my sample the majority of decisions that I observe are made jointly at baseline. Combined these factors may drive the majority of project impacts to the extensive margin, introducing new decisions into the household.

The rest of this paper proceeds as follows. In Section 4.2, I discuss approaches to measure women's empowerment and present a brief survey of the empirical evidence regarding the impacts of a range of interventions on intra-household decision-making or women's empowerment. I then present the research methods, explaining both the structure of the survey and my econometric techniques. I present results and contextualize these results in existing theories of intra-household bargaining models. I discuss implications of the findings in the conclusion.

4.2. Background

Economic development and women's empowerment are critical complements (Duflo 2012; Malhotra and Schuler 2005; Mehra 1997). Empirical evidence suggests that more empowered women contribute more to household wellbeing and food security (Sharaunga et al., 2015; Wilcox et al., 2015), have healthier children (Doss, 2013; Lundberg, Pollak, & Wales, 1997), have fewer children and lower rates of child mortality (Dyson and Moore 1983; Rosenzweig and Schultz 1982), and contribute to improved household nutrition and dietary quality (Malapit et al. 2013). In addition, households with more empowered women enjoy greater resource allocation to children and children

from empowered mothers are likely to have better educational outcomes (Bruce et al. 1995; Garikipati 2013; Luz and Agadjanian 2015). Despite research establishing the importance of women's empowerment for overall economic development, empirical evidence of the impact of policy interventions on women's empowerment is not definitive. Das et al. (2013) assesses the impact of a multifaceted intervention in Bangladesh that transfers physical assets, primarily livestock, and provides training to rural women and finds ambiguous effects on women's empowerment. Despite the fact that beneficiary women had ownership of the transferred assets, men retained control over other household assets, investments, and income generated from the transferred assets.

Numerous studies have examined the impact of micro-credit, conditional cash transfers, or 'training and education' on women's empowerment. Garikipati (2013) reviews existing literature on the relationship between microcredit interventions and women's empowerment and finds mixed evidence; while some studies find a positive impact, others find neutral or even negative impacts. For example, while (Bandiera et al., 2014; de Brauw, Gilligan, Hoddinott, & Roy, 2014; Hashemi, Schuler, & Riley, 1996) find microcredit interventions to have positive impacts on women's empowerment, Yoong, Rabinovich, & Diepeveen (2012) and Pitt, Khandker, & Cartwright (2006) argue that recipient's gender affects the outcome. Pitt et al. (2006) takes a unique approach to test the difference in the impact of similar micro-credit programs targeting women versus men. When women were the primary recipients, the micro-credit program improved women's empowerment but the opposite result emerged when men were the primary recipients. In a systematic review of related literature, Yoong et al. (2012) notes that transferring resources to women does not guarantee improvement in women's empowerment because men generally control the majority of household assets and income. While the evidence of effects of asset transfers and micro-finance on women's empowerment is mixed, studies of women's education (Bandiera et al., 2014; Kandpal, Baylis, & Arends-Kuenning (2012), and conditional cash transfers (de Brauw et al., 2014) find more

consistently positive effects. The literature, however, is mostly silent about the impact of these interventions on men's decision-making roles and responsibilities in the household and on the impact of transfers on joint decision-making.

A large body of literature has established that women's empowerment depends on existing gender relations (Garikipati 2013; Sraboni et al. 2014), reflects women's control over resources (Behrman 2010), and access to education, income, and assets (Doss, 2013; Garikipati, 2013; Johnson et al., 2016), yet little consensus exists regarding the measurement of empowerment. The choice of empowerment measures in a given study tends to be dictated by data availability, research questions, and cultural or geographical contexts. Common measures of women's empowerment include women's decision-making power (de Brauw et al., 2014; Doss, 2013; Hou & Ma, 2013; Wiig, 2013), a multidimensional index based on women's participation in social and economic activities (Bandiera et al., 2014; Bandiera & Natraj, 2013; Lépine & Strobl, 2013; Hashemi et al., 1996), women's access to employment and physical mobility (Kandpal, Baylis and Arends-Kuenning 2012), women's empowerment in agriculture index (WEAI) (Alkire et al. 2013; Malapit et al. 2013; Sharaunga et al. 2015), women's time use data (Garikipati 2012), and women's entrepreneurial index (Bandiera & Natraj, 2013). Garikipati (2012) argues that women's time use data can measure women's empowerment because policy interventions that contribute to women's welfare also affect women's time allocation. Bandiera et al. (2014) takes a different approach, defining women's empowerment as the number of times a respondent provides an affirmative answer to questions on women's economic and social status. Hou and Ma (2013) create a composite index from eight different dimensions of empowerment – physical mobility, economic security, purchase ability, ability to make large decisions, relative freedom from family, and political awareness – and argues that a positive score on either any individual dimension or the composite index indicates empowerment. Unlike other studies, Wiig (2013) interviews both men and women using the same survey instrument and

calculates an empowerment index consisting four domains and 26 specific decisions. Wiig's methodology assigns equal weight to both joint and sole decisions and women's empowerment considers decision-making power of the primary woman only.

Despite methodological differences, most empowerment measures reflect women's bargaining power, role in decision-making, and control over household resources and income. The WEAI is a comprehensive tool that brings together most of these attributes to measure women's empowerment in agrarian settings (Alkire et al. 2013; Malapit et al. 2013). It combines five dimensions of empowerment – production, resources, income, leadership, and time allocation – in a complex methodology and assigns arbitrary weights to the five dimensions. It also includes several indicators that are difficult to measure and interpret, such as speaking in public and autonomy in production (*see* Alkire et al. 2013). My measure of empowerment is based on a subset of the dimensions of the WEAI focusing on decision-making but considered separately rather than aggregated into a single index. I concentrate on the first two dimensions of the WEAI, production decisions and control over economic resources, because I want to understand how the livestock intervention affects women's decision making power on production activities and access to economic resources. I expect that production activities and control over economic resources are the two domains most likely to be affected by physical asset transfers and associated training. As in Wiig (2013) and in the WEAI, I quantify empowerment based on a count of decisions that an individual makes either independently or jointly with another person.

4.3. Data and Methods

4.3.1. Project Description

This study uses the implementation of a multifaceted asset transfer program by the NGO Heifer International in the Copperbelt Province of Zambia to construct a field experiment to

measure empowerment impacts. The program was initiated in 2011 in 12 communities and involves provision of donated livestock, training and social capital development to households that belong to organized groups. Groups applied to Heifer Zambia for the opportunity to participate. The self-help groups that applied to Heifer Zambia were typically women's groups at the time of application, but the screening process of the NGO favored groups that include participation of male and female household members when both sexes are present in the household. Thus, most groups were organized and led by women but included male participation. Selected groups received support and training over the course of a year, whereupon livestock were transferred to a subset of group members. Based on the ecological and market conditions, group members received either one pregnant dairy cow, or two pregnant draft cattle, or seven female meat goats and one male goat. Cattle recipients also received one bull to share as a group to service the cows. The total value of the asset transfer was similar regardless of the species transferred. The program requires that individuals receiving a donated animal pass on the first female offspring of that animal to group members who did not receive a gift in the initial distribution. Eventually, all group members are expected to receive animal asset transfers. The training component of the project includes training on gender balance, accountability, shared responsibilities, sustainability and self-reliance, social justice, environmental sustainability, improved animal management, and nutrition. Both men and women from recipient households receive the same training.

The Heifer program emphasizes women's empowerment in at least three ways. First women's empowerment could be enhanced through capacity building in groups that have significant female leadership. Second the training component of the program stresses the benefits of collective decision-making, cooperation, mutual respect, and the importance of women's contributions in household production. Finally, the assets that are transferred are formally given to women or to couples in almost all cases. Thus they are expected to increase women's resources.

4.3.2. Sample Selection

The number of groups that applied to Heifer Zambia for support exceeded the number that could be supported by the resources available in 2011. The research leveraged the phase-in design of the intervention to define a control group for the analysis. After the eligible groups were identified, livestock transfers were scheduled by order of application within the geographic scope of the project. Twelve groups were identified for transfers and training in the initial round. Groups from three communities were selected for study representing each of the three livestock types transferred. Additionally, eligible groups in two communities that were next in queue for future participation were selected to form a comparison group for the treated households. Households in these comparison communities had received nothing from Heifer after three years, but were considered eligible.

Eligible groups that were ahead in a queue and received services in an initial round of distributions and are classified as “Early recipients”. Other eligible groups not selected as early recipients are classified as “Prospectives” and were deferred from receiving services until additional resources become available. Since all group members have self-selected to participate, I assume that they are similar in terms of relevant non-observable factors. They are also similar in terms of the observables that the NGO considers when selecting groups for participation. These observable factors include: appropriate membership in terms of household capacity and needs, cohesiveness of the group, and commitment to contribute to livestock insurance fund managed by the group and make complementary investments in sheds and fencing for livestock. As long as there are no systematic differences between groups based on timing of application, households in the “Prospectives” groups can form a control group for the “Early Recipients”.

Within the “Early Recipients” groups, all households received training and the benefits of enhanced social capital, but only a subset initially received animals. I designate those who received

assets in the initial distribution as “Original” recipients, while other households who received the offspring from the original livestock are labeled “Pass on the Gift” (POG) recipients. Figure 4.1 details the selection procedure. Key informant interviews with group members indicated that selection of original recipients within the group was random, but the purity of that randomness is not known. The POGs receive second generation animals from Original recipients and majority of POGs had already received animals by the endline survey for this study (January 2015). The spatial proximity of the POGs to the Originals implies that they may be subject to spillover effects as well as the benefits of training; neither spillovers nor training are relevant for the Prospectives who serve as a control because they are geographically separated from the communities where Originals and POGs live and because they had not received the training by the project endline survey. For convenience, I refer to the Originals and POGs jointly as the “treated” groups and Prospectives as the “control” group¹⁸.

4.3.3. Data

Data collection included an initial survey in January 2012, at approximately the time when livestock transfers were being made to Original recipients (Initial livestock distribution extended from November 2011 through March 2012). Five additional rounds were conducted in July 2012, January 2013, July 2013, January 2015, and July 2015. This study uses a two-period panel because women’s empowerment questions were administered in two survey rounds only. Figure 4.2 outlines the survey timeline and corresponding sample sizes. The baseline for this study is the first follow up survey (July 2012), conducted four to six months after the initial animal distribution, and the endline for this study is the fourth follow up survey conducted in January 2015. Using the first follow up

¹⁸ A group of 30 households who were not members of any group and therefore ineligible for participation were also surveyed. These ‘Independent’ households are not included in this analysis due to concerns over sample selection bias.

survey as baseline should not make a qualitative difference because empowerment is a long run outcome and I do not expect empowerment or other factors in the analysis to change substantially in the program's first six months. Note that if the program did contribute to women's empowerment in the first six months, using the first follow up survey as baseline will underestimate the treatment effect.

Table 4.1 presents survey characteristics and attrition rates. The baseline includes 276 households of which 260 households were successfully re-interviewed in the endline giving us a two-period panel of 260 households. The full sample attrition rate is about 6% but POGs have a slightly higher attrition rate of 8% while attrition among the Prospective households was 3%. I found no obvious pattern in attrition related to observable characteristics of the households. The structure of the livestock transfer and training intervention and availability of longitudinal data on men's and women's control over intra-household decisions lead to four testable hypotheses:

Hypothesis 1. *The asset transfer and training intervention expands women's decision-making power.*

Hypothesis 2. *The intervention improves women's decision-making power in activities related to the transferred assets only, with no spillover into other decision spheres.*

Hypothesis 3. *As a result of training and asset transfers, both men's and women's decision-making scope improves as they move from solitary decisions to joint decisions.*

Hypothesis 4. *Effects of the intervention on decision-making are not observed among households that do not receive asset transfers in the initial distribution.*

4.3.4. Empowerment measures

I specify two types of empowerment measures – decision scores and an empowerment index. I calculate decision scores for five different types of decisions – men's and women's joint decisions, men's independent decisions, women's independent decisions, men's independent and

joint decisions combined, and finally, women's independent and joint decisions combined. First, I use a decision score that measures decision-making power based on men's and women's independent and joint participation in decision-making, essentially giving equal weight to joint and independent decisions in the empowerment measure. The score based on the combination of joint decisions and women's independent decisions is consistent with the approach of the WEAI. I use the decision scores that calculate the prevalence of uniquely male, female and joint decisions in the household to reveal changes in the decision dynamics between independent and joint decisions. All five scores can be applied to specific decision domains to determine if impacts differ between the domains closely related to the transferred asset and those that are not. These scores give equal weight to each of the eight decision domains I consider. As a robustness check I estimate weights from a principal components analysis and calculate an empowerment index to compare to the empowerment scores. Both the index and the scores can be applied to the Originals and the POGs separately to determine whether the asset transfer is essential to observing the empowerment effect.

To construct the decision scores, first I calculate the proportion of independent and joint decisions made by male and female members of the household for each of the 8 decision spheres. Then, a decision score is computed by taking an arithmetic average over all decision spheres the household has reported some activity. Since there are only a few households with activities on all 8 decision spheres, decision scores for most households are average over fewer than 8 decision spheres. Suppose T denotes the total number of decisions made in the household, T_i denotes the number of decisions under each activity domain i , W_i denotes the number of decisions under domain i made by female members, M_i denotes the number of decisions under domain i made by male members, and J_i denotes the number of joint decisions under domain i . Let N_k be the number of decision spheres in which household k has reported some activity. Then decision scores for household k are computed as follows:

1. Female and joint score (WJ_k) = $\frac{1}{N_k} \sum_i \frac{W_i + J_i}{T_i}$
2. Male and joint score (MJ_k) = $\frac{1}{N_k} \sum_i \frac{M_i + J_i}{T_i}$
3. Joint score (J_k) = $\frac{1}{N_k} \sum_i \frac{J_i}{T_i}$
4. Female only score (W_k) = $\frac{1}{N_k} \sum_i \frac{W_i}{T_i}$
5. Male only score (M_k) = $\frac{1}{N_k} \sum_i \frac{M_i}{T_i}$

By construction, all five scores lie in the continuum from 0 to 1. The decision scores assign equal weight to each of the eight decision domains. Where there are more decisions in a given domain, each decision receives less weight in the score. Conversely, decisions that have more impact on the outcomes in a domain receive greater weight. The Female (Male) and Joint score can be interpreted as the mean over the domains of the share of decisions in which the women (men) participated. The Female (Male) Only score is the mean of the share of decisions over each domain in which the woman (man) had independent control.

Changes in the Female and Joint Score and the Male and Joint Score will indicate changes in the scope of participation in decision-making, but will not reveal shifts from individual to joint decision-making. I use the Joint score and the Male only and Female only scores to test the effect of the asset transfer and training on participation in the share of independent and joint decisions (Hypothesis 3). I test whether joint decisions increase significantly and independent decisions decrease at the same time.

As a validity check of decision scores, I calculate five empowerment indexes analogous to the five scores but weighting the decision domains based on principle components analysis (PCA). First I calculate the proportions of joint or independent decisions to total decisions by decision spheres and run PCA over the eight proportions. In all cases, I retain the first principal component

only because it captures the maximum variation present in the data (Filmer and Scott 2008; McKenzie 2005; Vyas and Kumaranayake 2006). The assumption underlying the use of the PCA first principal component as weights for the aggregation is that empowerment underlies the component of maximum variance in the data. In my case the first component explains 26% variation in baseline data and 30% variation in endline data.

4.3.5. *Econometric method*

I use difference-in-differences (DID) to estimate the impact of the livestock intervention on empowerment outcomes. Combined with household level fixed effect estimation, the DID approach corrects for endogeneity that may arise from unobserved individual effects (Bertrand et al. 2004). As I have a panel of two ‘treatment’ groups (Original recipients and POG recipients) across two periods, the estimating equation includes multiple interactions of time and treatment.

$$y_{it} = \alpha_0 + \alpha_1 Time + \beta_1 Original \times Time + \beta_2 POG \times Time + \Pi X + c_i + \varepsilon_{it} \quad (4.1)$$

where y_{it} is outcome of interest for household i at time t . *Time* is a time dummy that equals one for endline and zero for baseline, *Original* is a treatment indicator that equals one for Original group and zero for others, *POG* equals one for POG group and zero for others, X is a vector of control variables that includes household size, number of children ages five years or below, number of children ages six to sixteen, age of the household head, level of education for the head, dummy variable for female head, and dummy variable for marital status of the household head, c_i is the household level fixed effect, and ε_{it} is idiosyncratic error term. The coefficients of interest are β_1 and β_2 ; β_1 represents the program effect on the households experiencing full treatment and β_2

represents the effect of training and spillover effects as well as the effect of delayed receipt of an animal.

4.4. Results

4.4.1. Descriptive results

Table 4.2 presents descriptive statistics and balancing tests for both control variables and outcome variables in the baseline. Overall, summary statistics and balancing test results indicate that my sample is reasonably balanced and the baseline characteristics are smoothly distributed across both the recipients and non-recipients. As in Chapter 3, I use the normalized differences (ND) for balancing test. The normalized difference is a difference between sample means of ‘treated’ and ‘control’ groups weighted by the sum of sample variances. An absolute value of normalized differences greater than 0.25 may indicate violation of balancing assumption and suggests a potential to introduce bias in the regression (Imbens and Wooldridge 2008). Based on the normalized differences, household size and age of the household head for the ‘treated’ groups are significantly different from that of the ‘control’ group. All other observed characteristics of the ‘treated’ and ‘control’ groups are equivalent. Even though household size and age of the household head are different for the ‘treated’ and ‘control’ groups, they are unlikely to contribute to selection bias as these variables do not change much over time so play only a small role in the fixed effects regression. Balancing tests on the outcome variables indicate that the various empowerment scores are similar across the ‘treated’ and ‘control’ groups in baseline. Moreover, the baseline results indicate a high prevalence of joint decision-making in all groups and similar scores for Male only and Female only decision-making. Given that both control and treated households applied to the program, their unobserved characteristics are also likely to be similar. I correct for any time invariant unobserved characteristics through the use of household fixed effects.

On average, households in the ‘treated’ groups have slightly larger household size than the ‘control’ groups but the number of children under the age of five is the same across households in both groups; the difference in household size partly comes from the number of children ages six to sixteen. As a result, ‘treated’ households have slightly higher dependency ratios than control households. Across the sample, approximately 20% of households are headed by women and about 80% of household heads are married. Household heads from the ‘treated’ groups are about seven years older than the heads from ‘control’ households (Table 4.2). The second half of Table 4.2 presents women's and men's empowerment measures in baseline. Normalized differences for both men's and women's decision-making power (scores) show no difference in empowerment across treated and control groups in the baseline. Table C1 in Appendix C presents the mean number of decisions made in baseline and endline. On average, both ‘treated’ and ‘control’ households reported more decision-making activities in endline and the increase was greater among ‘treated’ households.¹⁹ This suggests that the intervention can alter intra-household decision-making directly through activities related to transferred assets or indirectly through spillover to other decision spheres.

Table 4.3 presents the distribution of intra-household decisions made by men and women members jointly or individually at baseline and endline by treatment group. Both women's and men's solitary decisions decrease after the intervention as the share of decisions in the household made together increases significantly. Households in the Original group had the biggest increase in joint decisions from 44% in baseline to 63% in endline followed by POG households, 56% to 65%. The share of joint decisions among control households barely increased and no increase was statistically significant. Table 4.4 presents decision scores that combine both joint and independent decisions together. Considering the scores that combine men's independent and joint decisions, it is

¹⁹ The expansion in decision-making mostly came from ‘treatment’ related decision spheres such as animal slaughter and animal sale as well as activities related to access to loan/credit and crop produce sales which are not directly related to animal transfer but may have influence from associated training.

apparent that men's involvement in decision-making increases in both treatment groups but has a statistically insignificant change in the control group. Likewise, women's decision scores (including involvement in joint decisions) increase for original treated households, but have no significant change in other groups. Note that these decision scores combine both joint and individual decisions to calculate men's and women's decision-making power. As a result, the increase in decision score for both men and women is less than the increase in their decision scores presented in Table 4.3 because any increase in joint decision-makings is tempered by decrease in individual decisions.

Table 4.5 presents women's decision scores over the eight decision spheres for Originals and Prospectives at baseline and endline. Similar statistics for men's decision scores are presented in Table 4.6. Over time, both women's and men's participation in decision-making has increased in most decision spheres due to the growth in joint decision-making. After the intervention, male and female beneficiaries saw increased roles in most household decisions but the increase was statistically significant only in decision spheres related to transferred assets. For example, the Female and Joint decision scores for live animal sales rose from 0.66 in baseline to 0.89 in endline, suggesting that on average women are involved in all but a small share of decisions in the household related to live animal sales. The Male and Joint decision scores for live animal sales also increased from 0.65 in baseline to 0.74 in endline. Among other decisions, women had more say on sending kids to school and men gained involvement in loan/credit services. This observation is robust in that similar results hold for both joint and independent decision scores as well (Figure 4.3). In Figure 4.3, the change in the proportion of joint decisions between baseline and endline survey rounds is bigger for the Originals across all decision spheres except control over off-farm income. Consistent with observations in Tables 4.5 and 4.6, changes are larger for the decision spheres directly related to transferred assets.

Table C2 in the Appendix C presents full results for both joint and women's individual

decision ratios and the results are consistent across all five empowerment scores. Overall the descriptive results suggests that, when joint and solitary decisions are weighted equally in the empowerment score, the livestock and training intervention can expand women's decision-making abilities without shrinking men's role in household decision-making. This suggests that women's empowerment can be increased while increasing men's engagement if the main source of growth in both men's and women's decision making scope is expansion in joint decisions.

4.4.2. Empirical results and discussion

I begin by using my data to explore the relationship between women's empowerment and household wellbeing. I seek to confirm previous findings of the existence of positive correlations between women's empowerment and economic development. Next, I use empowerment measures as outcome variables and assess the impact of the livestock intervention on women's and men's decision-making power and on the role of joint decision-making. I estimate the impact on men's decision-making power because I argue that assessing intra-household decision-making dynamics may be incomplete without analyzing changes for men. In contrast to the belief that intra-household decision-making is a zero-sum game, expansion in one's decision-making abilities may not mean contraction in other's decision-making abilities. If more decisions are being made jointly by men and women, it is possible that both men and women's scope of decision-making can increase. Such an outcome might imply the benefits for women's empowerment are achieved while maintaining male involvement.

Table 4.7 presents the relationship between baseline women's and men's decision-making power and baseline poverty and food security outcomes. I run regressions of wellbeing outcomes on both decision scores and empowerment indexes. Results on the decision scores are positive but not statistically significant. Results based on empowerment indexes indicate that expansion in both joint

and women's decision-making power positively corresponds to household consumption expenditures and dietary diversity, consistent with previous findings (Duflo 2012; Sharaunga et al. 2015; Wilcox et al. 2015). Results for men's empowerment index are not presented but expansion in men's independent decision-making power has no correlation with consumption or dietary diversity.

Table 4.8 presents the impact of the intervention on decision scores. The first two columns present the impact on women's and men's joint and independent decision-making power and columns (3), (4), and (5) present the impact on joint decisions, women's independent decisions and men's independent decisions. Results indicate that being an original recipient of the transfer and training resulted in a 9.3% increase in the Female and Joint decision score and a 7.6% increase in the Male and Joint decision score. Thus the program resulted in increased decision-making participation by men and women. Considering joint decisions and independent decisions separately reveals that the intervention caused an expansion of joint decision-making by 17% and a 9% reduction in men's independent decision making with no statistically significant impact on women's independent decision making. Because the number of decision spheres does not change over time, expansion in joint decisions almost always comes from contraction in solitary decisions or addition of new joint decisions within existing decision spheres.

In contrast to the original recipients, the POGs experience no statistically significant impacts from the treatment on the empowerment scores. The POG households received the same training but delayed and lower value asset transfers compared to the Originals. Thus, the lack of evidence of change in men's and women's decision-making among the POG households suggests a possible difference in the impact of training and education with and without asset transfers. Absent asset transfer, empowerment effects are not observed. The increase in women's and men's joint decision score with no change in their independent decision scores suggests that there has been a shift from independent to joint decision-making due to the intervention.

Results of the analysis using PCA to generate empowerment indexes rather than the scores are presented in Table 4.9. These results confirm the finding that receiving the initial asset transfer and training resulted in an increase in joint decisions and a decrease in decision's made independently. The impression in this case is that there is an increase in the participation of women in decision-making, but no change in the participation of men in independent and joint decisions combined. When joint and independent decisions are considered separately, the intervention helped expand joint decision-making but at the expense of women's and men's independent decision making, consistent with my findings in case of decision scores. This implies that when joint and solitary decisions are combined, the decrease in solitary decisions may mask the expansion in joint decisions. Overall, results confirm that the intervention expanded joint decision-making. This finding is robust in that the results are consistent across the two different measures used in the analysis.

To assess whether the impact on decision-making is restricted to decision spheres related to the asset transfer, I combine the eight decision spheres into a 'treatment' related sphere and a sphere for all other domains. The "treatment related" sphere includes decisions about cattle and goat sale, milk, meat, and draft power sale, cattle and goat slaughter, and women's and men's access to loan/credit. The "all other" sphere includes all remaining decisions across the eight decision spheres. Since I have only two decision spheres, my formula for decision score is not applicable in this case. So, I use the number of decisions as outcome of interest. Results based on women's and men's joint decisions are presented in Table 4.10 and results based on independent decisions are in Appendix C Table C3. When decision-making is measured for treatment-related activities only, both women and men who were original recipients saw expansion in their independent and joint decisions, but no evidence of significant effect on their independent decisions over treatment related activities. However, when decision-making is measures for 'other activities' not related to the intervention, the

intervention had no impact at all on joint and women's decision-making but negative impact on men's independent decision-making. Similar pattern holds for men and women in POG households.

4.5. Discussion

My empirical findings suggest that in agrarian settings transferring physical assets along with providing awareness training to both women and men can increase women's empowerment by expanding the scope of collective decision-making, and thus increases women's influence in decisions while maintaining male participation. Motivated by this finding, I provide a potential theoretical explanation of the empirical results. Economic theory suggests several potential mechanisms for intra-household bargaining but Manser and Brown's (1980) threat point bargaining and Lundberg & Pollak's (1993) 'separate spheres' bargaining models are noteworthy for the case considered here. In their examination of a cash transfer program, Lundberg and Pollak argue that transferring cash to women as opposed to men may yield different results because household members have full control over the payoff of household resources under their control. The member who controls the majority of household resources may use non-cooperation, such as reduced work effort and refusal to share output, as a threat-point. This implies that transferring livestock to women could help increase women's bargaining power in household activities, mainly among livestock related activities. This is consistent with my finding that the livestock intervention helps expand women's decision-making power. However, this model fails to explain why men's decision-making power also improves simultaneously. What could explain this finding is Nash bargaining solution or altruism.

The Nash bargaining solution to an intra-household bargaining model predicts that strategic non-cooperation by either player leads to Pareto inefficiency in household resource allocation and therefore household members are forced to negotiate or cooperate. In addition, altruism also may incentivize household members to come together and cooperate because altruism usually dominates

threat-point bargaining (Doss & Meinzen-Dick, 2015). Altruism and Nash bargaining solutions imply that even though women have the ownership of transferred animals, they may cooperate with their husbands or other adult males and share decision-making roles because non-cooperation leads to inefficiencies for the household. In Figure 4.4, I demonstrate how cooperation leads to Pareto efficiency in resource allocation. I start with the basic model from Manser and Brown (1980) and integrate the conceptual framework presented in (McElroy and Horney 1981; Basu 2006; Himmelweit et al. 2013; Lépine and Strobl 2013).

Let us consider a household with two adults, one male (m) and one female (f). Let U^i be a utility function of adult $i = m, f$ defined over consumption vector (X) which includes private goods for adult i and shared goods for all household members. The utility function is strictly quasi-concave and monotone i.e. $U_X^i > 0, U_{XX}^i < 0$ and each adult is endowed with a reserve utility V_0^i , the guaranteed minimum level of utility. Assuming the reserve utility depends not only on income (y) and market prices (p) but also on individual bargaining power (θ) i.e. $V_0^i = V_0^i(p, y, \theta)$, the livestock intervention can impact intra-household-decision making through θ . Using the reserved utility pair as a threat point for cooperative bargaining process, the Nash solution for the bargaining problem is obtained by solving the following functional form ²⁰

$$\begin{aligned} \max_{x \in \mathbb{R}^+} N &= \max [U^f(x) - V_0^f(p, y, \theta)] \cdot [U^m(x) - V_0^m(p, y, \theta)] \text{ subject to} \\ px &\leq y \end{aligned} \tag{4.2}$$

²⁰ Nash solution satisfies all key requirements of cooperative bargaining; both parties know each other's preferences, the problem is symmetric, the outcome is invariant to linear transformation of utility functions, and independent of irrelevant alternatives

Given that the utility functions are strictly quasi-concave, solving equation (2) yields a unique solution. Figure 4.4 depicts the unique solution (N) in utility space where women's utility is in y-axis and men's utility is in x-axis. The locus of utility pairs results from Pareto optimal consumption bundles form the utility possibility frontier (UPF). If women and men do not cooperate, they are guaranteed their reserved utilities, V_0^f and V_0^m , which also constitute a threat point, $T = (V_0^f, V_0^m)$. As neither player accepts anything below their threat point utility, if cooperation has to happen, the optimal solution must lie in the triangular region above TM^* and to the right of TF^* . Any payoff combination that lies below the utility possibility frontier is Pareto suboptimal and therefore the solution must lie in the arc between M^* and F^* . Although there can be multiple Pareto optimal solutions, the Nash solution assumes that men and women in the same household care about each other's welfare and the altruistic behavior leads to the choice of a payoff combination that maximizes the product of their gains in utility over the threat point. The solution is unique because N is the only point in the Pareto efficient locus that maximizes the product of men's and women's gains over threat point utilities. In essence, if men and women cooperate, women's empowerment can be improved without disempowering men. This model explains my empirical findings and also implies that the initial threat point utility of each adult dictates the final solution. If men have higher threat point utility to start with, the final solution may lie near M^* and it will lie near F^* if women have higher threat point utility. As policy interventions can change the initial threat point utility through θ , granting primary ownership of transferred animals to women may yield a final solution skewed to F^* i.e. we can expect larger impact on women than on men.

4.6. Conclusion

This study assesses the impact of livestock transfers and training on the dynamics of intra-household decision-making. Using data from a livestock allocation and training program in the

Copperbelt Province in Zambia, I investigate whether household decision making patterns are affected by the program and if expansion in women's decision-making power within household can be reconciled with continued male engagement. Maintaining male participation may be important to completion of necessary activities that benefit from men's labor and management. This study is among the first to test for effects of a program targeting women on both men's and women's decision-making influence. In addition to testing for the effects of the intervention on decision-making spheres directly impacted by the project such as livestock related activities, I also test for spillovers into other household activities including child education and crop sales. Results show that transferring physical assets along with providing awareness training to both women and men of recipient households helps expand cooperation in intra-household decision-making. The results also reveal that women's empowerment can be improved without compromising men's engagement because the intervention promotes cooperation between the two and expands joint decisions. The improvement in joint decision-making accompanied by reduction in individual decision-making implies that women and men in the beneficiary households may have shifted from independent decision-making to joint decision-making after the intervention. However, since the proportion of households making any decisions has also increased over time significantly, the expansion could also come from addition of new decisions due to asset transfers and training. Due to the lack of appropriate data, this analysis is unable to detect exact contribution of the shift from independent to joint decision-making and that of addition of new joint decisions on expansion in joint-decision-making.

Further examination shows expansion in men's and women's decision-making participation largely comes from increased roles in activities directly related to the transferred assets. In particular, the intervention helped increase the proportion of joint decisions by 17% in all household activities considered and both men's and women's independent decisions regarding all 8 decision spheres

decreased by as much as 9%. When household activities were categorized to ‘treatment related’ and ‘other’ activities, women’s and men’s joint decisions increased at the expense of their independent decision-making participation. The intervention also contributed to increases in joint decisions among POG households, but the impact was limited to the decision spheres related to the transferred assets only. When solitary and joint decisions are combined together to measure decision-making power, the positive impact of the intervention subsided probably because the expansion in joint decisions is offset by a reduction in individual decisions. This finding highlights a critical methodological point: the importance of considering joint and solitary decisions separately because combining them obscures intra-household dynamics, in particular, the fact that expansion in joint decisions is probably masked by the reduction in solitary decisions. Failure to attend to this point will likely underestimate of the true impacts of interventions on decision-making and empowerment.

In general, the larger impact on the Original recipient households and minimal or no effect on the POG households who received lower value assets after a delay, implies that programs that provide awareness or educational training on gender balance, social justice, and other themes related to day-to-day household activities may be more effective when combined with physical asset transfers. The observed large increase in joint decisions accompanied by a decrease in the proportion of solitary decisions indicates that the intervention helped move households toward gender equity and shared responsibilities in activities on the extensive margin. Impacts on decision making in established areas were less pronounced even in the presence of asset transfer. This result suggests that changes in decision-making power are more likely to emerge in the presence of economic transformations that introduce new decisions to the household.

My analysis reveals that empowerment is not a zero-sum game in agrarian settings where household decisions are often made independently by men or women and involve a relatively

narrow range of activities. The introduction of new management opportunities with new decisions can create space for more joint decision-making, expanding women's overall engagement without diminishing men's involvement. Incorporating men in women's empowerment programs may also incentivize cooperation between the two. Therefore, interventions that aim to improve women's empowerment may enhance effectiveness by integrating men in program design. One way to do so could be transferring economic resources to the family through women but providing associated training to both men and women simultaneously so that men are willing to share decision-making responsibilities in household activities.

4.7. Figures and Tables

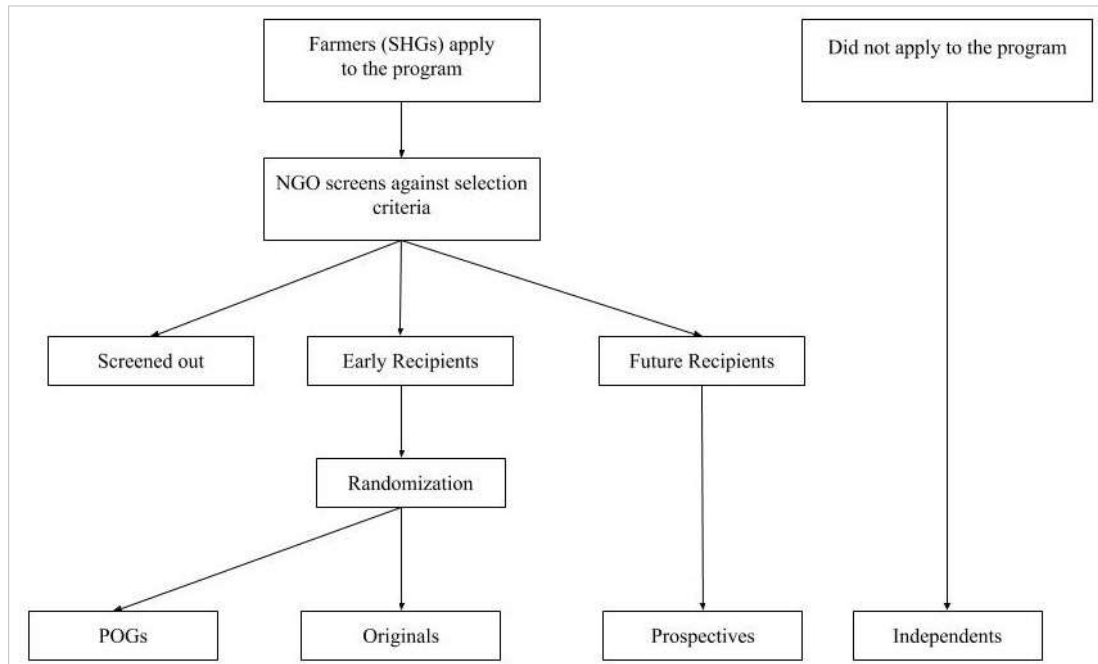


Figure 4.1. Selection procedure and treatment groups

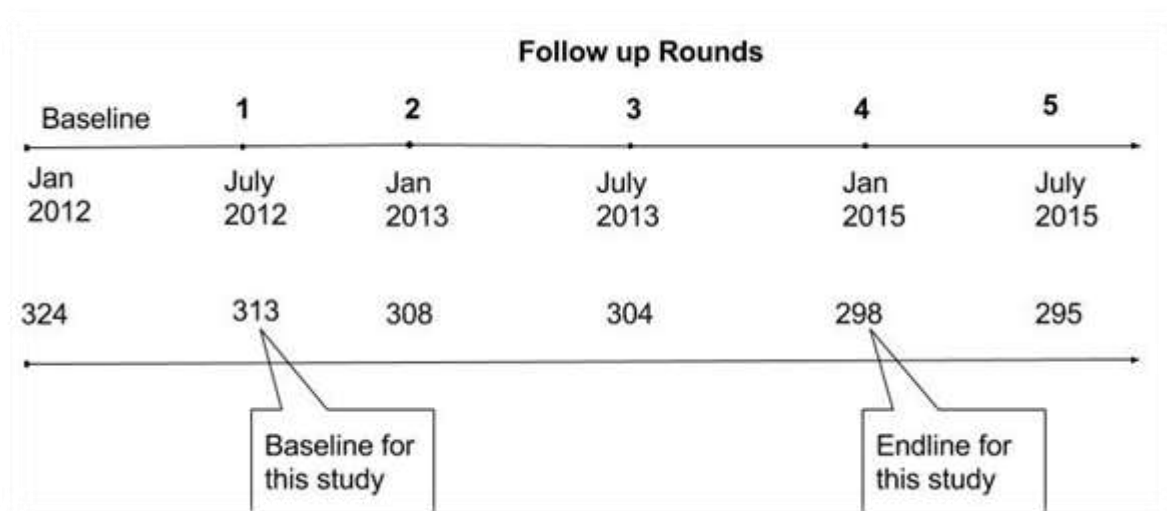


Figure 4.2. Timeline of survey and corresponding sample size

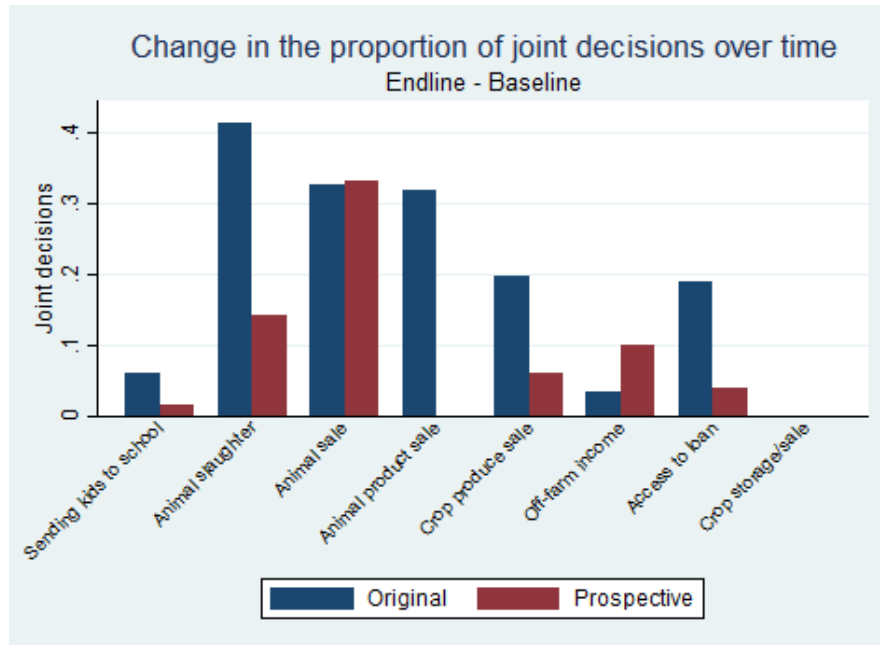


Figure 4.3. Change in the joint decision scores over time

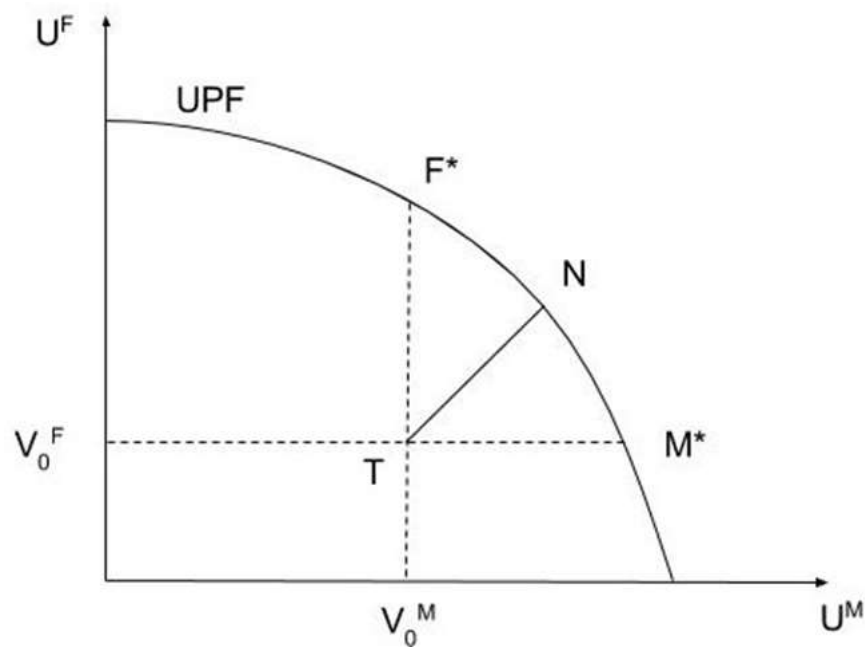


Figure 4.4. Nash solution for a cooperative bargaining model

Table 4.1: Survey characteristics and attrition

Treatment Status	Baseline	Endline	Attrition (%)	Attrition
Originals	104	100	3.8	-4
POGs	105	96	8.6	-9
Prospectives	67	64	4.5	-3
<i>Total</i>	276	260	5.8	-16

Notes: Baseline is the first follow up survey from a larger field experiment I conducted in the Copperbelt Province. See Kafle et al. (2016) and Jodlowski et al. (2016) for details about the experiment and other survey rounds. Independents are excluded from the analysis.

Table 4.2: Summary statistics and balancing tests on baseline sample

Variables	Treatment Status			Normalized Difference	
	Original	POG	Prospective	ND1	ND2
Household Size	7.24 (0.266)	7.10 (0.296)	5.84 (0.292)	0.36	0.32
No. of children 5 or under	1.19 (0.101)	1.22 (0.099)	1.00 (0.134)	0.13	0.15
No. of children 6 to 16	2.28 (0.168)	2.52 (0.183)	1.84 (0.198)	0.18	0.27
Female head (1=Yes, 0=No)	0.21 (0.041)	0.15 (0.036)	0.19 (0.049)	0.04	-0.08
Married head (1=Yes, 0=No)	0.82 (0.038)	0.89 (0.033)	0.78 (0.052)	0.07	0.19
Education of head	2.90 (0.142)	3.10 (0.158)	2.94 (0.165)	-0.02	0.08
Age of head	51.1 (1.300)	44.6 (1.404)	43.7 (1.800)	0.35	0.04
Female and joint decision score	0.74 (0.030)	0.80 (0.026)	0.79 (0.036)	-0.12	0.02
Male and joint decision score	0.70 (0.034)	0.77 (0.032)	0.78 (0.041)	-0.16	-0.03
Female only decision score	0.30 (0.034)	0.23 (0.032)	0.22 (0.041)	-0.25	-0.01
Male only decision score	0.26 (0.030)	0.20 (0.027)	0.21 (0.036)	0.16	0.02
Joint decision score	0.44 (0.035)	0.56 (0.036)	0.57 (0.045)	0.12	-0.01
<i>Observations</i>	100	96	64		

Notes: Point estimates are mean and standard errors are in parentheses.

ND1 and ND2 indicate the value of normalized difference between Originals and Prospectives, and POGs and Prospectives, respectively.

Table 4.3: Distribution of decision scores by treatment groups over time

	Joint		Female only		Male only	
	Baseline	Endline	Baseline	Endline	Baseline	Endline
Original	0.44 (0.035)	0.63*** (0.041)	0.30 (0.034)	0.19** (0.026)	0.26 (0.030)	0.18** (0.021)
POG	0.56 (0.036)	0.65* (0.038)	0.23 (0.032)	0.16 (0.021)	0.20 (0.027)	0.18 (0.021)
Prospective	0.57 (0.045)	0.59 (0.046)	0.22 (0.041)	0.18 (0.028)	0.21 (0.036)	0.23 (0.027)
Full sample	0.52 (0.022)	0.63*** (0.024)	0.26 (0.020)	0.18*** (0.014)	0.22 (0.018)	0.19 (0.013)
<i>Observations</i>	260	259	260	259	260	259

Notes: Point estimates are mean. Standard errors are in parentheses, asterisks indicate the level of significance for test of equality of means over time, * $p < .10$, ** $p < .05$, *** $p < .01$.

Decision scores are the weighted scores of joint or independent decisions made by women, men, or jointly. Joint and independent decisions are equally weighted.

Table 4.4: Distribution of decision scores by treatment groups over time

Treatment status	Female & Joint*		Male & Joint	
	Baseline	Endline	Baseline	Endline
Original	0.74 (0.030)	0.81** (0.019)	0.70 (0.034)	0.80** (0.026)
POG	0.80 (0.027)	0.83 (0.019)	0.77 (0.032)	0.83* (0.022)
Prospective	0.79 (0.036)	0.77 (0.027)	0.78 (0.041)	0.81 (0.028)
Full sample	0.77 (0.018)	0.81* (0.012)	0.74 (0.020)	0.81*** (0.015)
<i>Observations</i>	260	259	260	259

Notes: Point estimates are mean. Standard errors are in parentheses, asterisks indicate the level of significance for test of equality of means over time, * $p < .10$, ** $p < .05$, *** $p < .01$.

*Women's (men's) score is the weighted score of women's (men's) joint or independent participation in intra-household decision-making. Joint and independent decisions are equally weighted.

Table 4.5: Women's independent and joint decision scores by individual decision spheres

Decision spheres	Originals		Prospectives	
	Baseline	Endline	Baseline	Endline
Sending kids to school	0.78 (0.042)	0.92*** (0.028)	0.88 (0.042)	0.89 (0.040)
Animal slaughter	0.76 (0.048)	0.90** (0.028)	0.83 (0.056)	0.79 (0.051)
Live animal sale	0.66 (0.081)	0.89*** (0.028)	0.79 (0.114)	0.79 (0.051)
Animal product sale	0.73 (0.082)	0.77 (0.072)	0.50 (0.50)	0.86 (0.143)
Crop produce sale	0.76 (0.047)	0.72 (0.041)	0.86 (0.054)	0.78 (0.045)
Off-farm income	0.61 (0.090)	0.55 (0.071)	0.52 (0.102)	0.51 (0.077)
Access to loan/credit	0.75 (0.046)	0.76 (0.044)	0.80 (0.052)	0.80 (0.049)
Crop storage/sale	0.68 (0.102)	0.50 (0.167)	0.60 (0.163)	0.73 (0.141)
<i>Observations</i>	100	100	64	64

Notes: Point estimates are mean decision scores for women's independent and joint decisions.

Standard errors are in parentheses, asterisks indicate the level of significance for test of equality of means over time, * $p < .10$, ** $p < .05$, *** $p < .01$.

All decision spheres, except sending kids to school, involve multiple decisions and the women's empowerment score is the weighted score of women's independent and joint decisions made in the household

Table 4.6: Men's independent and joint decision scores by individual decision spheres

Decision spheres	Originals		Prospectives	
	Baseline	Endline	Baseline	Endline
Sending kids to school	0.86 (0.035)	0.78 (0.042)	0.88 (0.042)	0.89 (0.040)
Animal slaughter	0.50 (0.057)	0.73*** (0.043)	0.61 (0.075)	0.72 (0.058)
Live animal sale	0.65 (0.083)	0.74*** (0.043)	0.57 (0.137)	0.73 (0.057)
Animal product sale	0.70 (0.085)	0.86 (0.060)	0.50 (0.50)	0.71 (0.184)
Crop produce sale	0.66 (0.052)	0.94 (0.021)	0.77 (0.067)	0.89 (0.037)
Off-farm income	0.65 (0.088)	0.67 (0.067)	0.74 (0.094)	0.73 (0.068)
Access to loan/credit	0.75 (0.046)	0.94*** (0.026)	0.84 (0.047)	0.90 (0.038)
Crop storage/sale	0.57 (0.106)	0.50 (0.167)	0.60 (0.163)	0.55 (0.157)
<i>Observations</i>	100	100	64	64

Notes: Point estimates are mean decision scores for men's independent and joint decisions. Standard errors are in parentheses, asterisks indicate the level of significance for test of equality of means over time, * $p < .10$, ** $p < .05$, *** $p < .01$.

All decision spheres, except sending kids to school, involve multiple decisions and the men's empowerment score is the ratio of number of men's solitary and joint decisions to number of total decision made in the household

Table 4.7: Relationship between empowerment measures and household wellbeing: expenditures and dietary diversity (DDS)[†]

	Total Exp.	Food Exp.	DDS	Total Exp.	Food Exp.	DDS
Joint empowerment index	0.051* (0.030)	0.049* (0.029)	0.22** (0.10)	-	-	-
Women's empowerment index	-	-	-	0.054* (0.029)	0.066** (0.029)	0.080 (0.096)
Household Size	-0.070*** (0.023)	-0.092*** (0.022)	0.091 (0.092)	-0.074*** (0.022)	-0.097*** (0.022)	0.081 (0.093)
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	259	259	259	259	259	259

Notes: Standard errors are in parentheses, level of significance * $p < .10$, ** $p < .05$, *** $p < .01$.

Both joint and women's empowerment indexes are calculated by running the principal component analysis method on joint and women's independent decision scores for 8 decision spheres.

Total and food expenditure are in Kwacha per capita per week. Household dietary diversity is calculated using USDA FANTA's approach, includes 13 food groups.

*Other controls include number of children ages 5 or under, aged 6 to 16, indicators for female head and married head, and age and education of head

[†]Results are obtained from simple OLS regression on baseline data.

Table 4.8: Project impact on women and men's decision-making power based on decision scores

	Decision scores				
	(1) Female & Joint	(2) Male & Joint	(3) Joint	(4) Female only	(5) Male only
Endline	-0.033 (0.038)	0.037 (0.036)	0.003 (0.049)	-0.036 (0.035)	0.034 (0.038)
Original x Endline	0.093* (0.050)	0.076* (0.046)	0.17*** (0.058)	-0.073 (0.046)	-0.090* (0.050)
POG x Endline	0.058 (0.049)	0.029 (0.045)	0.085 (0.062)	-0.027 (0.044)	-0.056 (0.049)
Household Controls	Yes	Yes	Yes	Yes	Yes
Observations	517	517	517	517	517

Notes: Standard errors in parentheses, significance level, * $p < .10$, ** $p < .05$, *** $p < .01$

Household controls include household size, number of children ages 5 or under, number of children ages 6 to 16, indicators for female head and married head, and level and squared of age and education of head

Table 4.9: Project impact on women and men's decision-making power based on decision index

	Decision index				
	(1) Female & Joint	(2) Male & Joint	(3) Joint	(4) Female only	(5) Male only
Endline	-0.39 (0.24)	-0.066 (0.19)	-0.43* (0.23)	0.18 (0.17)	0.49** (0.20)
Original x Endline	0.54* (0.29)	-0.053 (0.24)	0.56* (0.30)	-0.27 (0.24)	-0.99*** (0.27)
POG x Endline	0.32 (0.28)	-0.006 (0.23)	0.40 (0.29)	-0.16 (0.22)	-0.40 (0.26)
Household Controls	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	518	518	518	518	518

Notes: Standard errors in parentheses, significance level, * $p < .10$, ** $p < .05$, *** $p < .01$

Household controls include household size, number of children ages 5 or under, number of children ages 6 to 16, indicators for female head and married head, and level and squared of age and education of head

Table 4.10: Project impact on women and men's decision-making power based on treatment related and other activities

	Treatment related domains		Other domains	
	Female & Joint	Male & Joint	Female & Joint	Male & Joint
Endline	1.04*** (0.22)	0.95*** (0.22)	2.46*** (0.39)	2.11*** (0.37)
Original x Endline	0.93*** (0.25)	0.67*** (0.25)	0.67 (0.53)	0.28 (0.52)
POG x Endline	0.49* (0.28)	0.92*** (0.27)	0.42 (0.50)	0.018 (0.46)
Household Controls	Yes	Yes	Yes	Yes
<i>Observations</i>	518	518	518	518

Notes: Standard errors in parentheses, significance level, * $p < .10$, ** $p < .05$, *** $p < .01$

Household controls include household size, number of children ages 5 or under, number of children ages 6 to 16, indicators for female head and married head, and level and squared of age and education of head

CHAPTER 5

CONCLUSION

Policies aiming to improve individual and household wellbeing often transfer economic resources to families in need, especially in developing countries. Examples include conditional or unconditional cash transfers, physical asset transfers, or micro-credit, but there is no gold standard for what economic resources to transfer for the best results. One strand of development literature argues for superiority of cash transfers over physical asset transfers (Blattman and Niehaus 2014) but, more recently a large body of evidence points to a wide range of positive impacts of physical asset transfers (Banerjee et al. 2015; Jodlowski et al. 2016; Das et al. 2013; Muralidharan and Prakash 2013; Rawlins et al. 2014). Unlike cash, assets are multidimensional and the effects of assets may vary with the types of assets.

In this dissertation, I demonstrate that, in contrast to the traditional view of assets having positive effects as wealth, different types of assets have differential effects. Specifically, I find child education being negatively affected by agricultural assets but non-agricultural assets have expected positive effects. Then, using data from a livestock transfers intervention in Zambia, I examine the practical significance of the impact of exogenous increase in physical assets (livestock) on dietary quality, consumption pattern, and women's empowerment and intra-household decision-making. After confirming the previous findings that transferring livestock to impoverished families has a relatively small absolute impact on consumption expenditure, I show that, though small in magnitude, the positive impact is persistent and transformative. Livestock recipients diversified their diets with more nutritious foods and had an enhanced feeling of economic wellbeing. It also helped improve the local food economy as more varieties of food items are being consumed and local prices of animal source foods is decreasing in recipient villages. Men and women from the recipient households also received training on gender balance, entrepreneurship, animal management, nutrition, and other themes related to day-day activities and further examination reveals that the

intervention altered the dynamics of intra-household decision-making. Men and women receiving both livestock and training have moved from solitary decision-making to joint decision-making in most household activities.

Taken together, as the effects of physical asset accumulation differ with the types of assets, the traditional undifferentiated view of assets as wealth indicator may need a careful review. In addition, policies transferring specific assets or contributing to asset accumulation may need to use caution as to what specific resources to transfer and the potential negative effects of transferred assets in long-run economic development. Even though transferring physical assets may help reduce poverty, and improve food security in short run by providing additional source of income and nutritious foods, it may hurt economic development in long run by discouraging investment in childhood development and children's education. Since assets that may hurt childhood development may also contribute to poverty reduction, and food and nutrition security, asset transfer programs contingent on children's schooling or 'no child labor' policies may help improve both short- and long-run economic development goals. However, my finding of coordinated asset transfers contributing to women's empowerment through expansion of joint decisions in intra-household decision-making implies that efforts to promote gender equity and women's empowerment may benefit by incorporating asset transfers and awareness training together. One explanation for this is that transferring assets does increase recipient's bargaining position which, as the Nash bargaining model predicts, eventually should lead to cooperation between household members for Pareto optimal resource allocation.

Studies in this dissertation have some limitations as well as scope for improvement. One limitation of my findings is that the differential effects of different types of assets may hold only for people in certain economic class. As income grows child labor demand becomes more inelastic to the opportunity cost of schooling or market wage and the negative effects of agricultural assets may

be more than offset by positive wealth effects. Transferring physical assets to the ultra-poor may be counter-effective because the recipients may be unable to afford the maintenance cost of the transferred assets. For this reason, the intervention in Zambia excludes ultra-poor households and the results from the third and fourth chapters may not hold for households trapped in persistent poverty.

This dissertation may be improved in multiple ways. One could expand the second chapter by further exploring negative effects of agricultural assets on child education. Designing a randomized control trial to assess the impact of transferring agricultural assets on child education outcomes may be a path forward. Because the asset indices are hard to interpret, considering an alternative approach for the principal component method for constructing asset variables may be worth pursuing. Chapter 4 can be improved with detailed data on men's and women's empowerment variables such as decision-making dynamics on consumption activities, access and control over income, land and home ownerships, household assets etc. This study would provide further insights if one could identify the effects of asset transfers and training separately. Several questions on comparison of cash versus asset transfers still remain unanswered and there is a scope to design an experiment to directly compare cash and asset transfers intervention by transferring equal value of assets and cash to households of similar economic status.

APPENDIX A

SUPPLEMENTARY MATERIALS FOR CHAPTER 2

Table A1. Pooled scoring factors and baseline summary statistics of asset variable

Household durables	Mean	Scoring factors	Agricultural assets	Mean	Scoring factors	Housing quality characteristics	Mean	Scoring factors
Radios	0.79	0.15	Hoes	2.27	0.03	Own dwelling (1=Yes 0=No)	0.78	-0.26
TVs	0.24	0.36	Spraying machines	0.04	0.10	Rent dwelling (1=Yes 0=No)	0.14	0.26
Telephones	0.02	0.12	Water pumps	0.02	0.13	House wall (1=cement/concrete, 0=else)	0.28	0.34
Mobile phone	1.11	0.30	Reapers	0.00	0.31	House roof (1=metal sheets 0=else)	0.66	0.25
Refrigerators	0.14	0.33	Tractors	0.00	0.31	House floor (1=concrete/cement/tiles 0=else)	0.43	0.36
Sewing machines	0.13	0.19	Trailers	0.00	0.31	Number of rooms (=1 if 3 or more 0=else)	0.55	0.01
Video/DVDs	0.19	0.26	Ploughs	0.07	0.08	Safe water (1=boiled/bottled/treated 0=else)	0.33	0.17
Computers	0.07	0.05	Harrows	0.00	0.31	Water source (1=protected, 0=open source)	0.53	0.24
Irons	0.36	0.29	Milking machines	0.00	0.40	Water hauling time(1=less than average, 0 else)	0.62	0.00
Electric/gas stoves	0.08	0.26	Harvesters/threshers	0.00	0.40	Access to toilet (1=Yes 0=No)	0.90	0.04
Other Stoves	0.69	0.24	Hand miller	0.01	0.22	Toilet type (1=modern, 0=Vault/Pit)	0.13	0.26
Water heaters	0.04	0.23	Coffee pulper	0.00	0.25	Electricity (1=Yes 0=No)	0.23	0.37
Cassette players	0.02	0.07	Fertilizer distributors	0.00	0.38	Fuel(1=electricity/gas/generator/solar,0=else)	0.24	0.37
Music systems	0.03	0.12	Livestock	3.84	0.03	Cooking fuel (1=firewood 0=else)	0.71	-0.36
Cars	0.05	0.23	Poultryes	5.81	0.01			
Motor cycles	0.05	0.14	Donkeys	0.06	0.04			
Carts	0.54	0.05	Plots	1.61	0.02			
Bicycles	0.02	0.09	Outboard engines	0.03	0.03			
Wheel barrows	0.03	0.07	Land owned (1=Yes, 0=No)	0.64	0.01			
Boats/canoes	0.01	0.02	Land rented (1=Yes)	0.06	0.00			
Houses	1.17	-0.03	Land shared (1=Yes)	0.01	0.00			
Fan/ACs	0.23	0.30		0.13	0.00			
Dish antennas	0.13	0.26						
<i>Observations</i>	3082	3082		3082	3082		3082	3082

Notes. All asset variables are in count, unless otherwise indicated. Asset indexes calculated by using binary indicators of asset ownership are not qualitatively different from the indexes resulting from count variables. Scoring factor is the weight that is used to calculate the first principal component. The first component explains 26 percent of the variance in durable assets

Table A2. Likelihood of child labor on own-farm agricultural activities

	Model: Pooled Probit			
	Rural	Urban	Crop producers	Livestock keepers
Log(Total expenditure)	0.165*** (0.033)	0.053 (0.064)	0.123*** (0.031)	0.143*** (0.034)
Household durable index	-0.014 (0.016)	-0.011 (0.021)	-0.004 (0.015)	-0.025 (0.017)
Agricultural asset index	0.016** (0.006)	-0.005 (0.004)	0.011* (0.006)	0.008 (0.006)
Housing quality index	-0.222*** (0.018)	-0.192*** (0.026)	-0.168*** (0.017)	-0.133*** (0.018)
School in village (1=Yes, 0=No)	0.807*** (0.117)	0.404*** (0.105)	0.693*** (0.090)	0.549*** (0.105)
Max. parent's education	-0.112*** (0.020)	-0.030 (0.030)	-0.100*** (0.018)	-0.079*** (0.018)
Gender (1=Male, 0=Female)	0.154*** (0.035)	0.218*** (0.069)	0.169*** (0.033)	0.152*** (0.035)
Head's gender (1=Male, 0=Female)	0.005 (0.060)	-0.120 (0.133)	-0.065 (0.060)	-0.062 (0.063)
Age (years)	0.094*** (0.005)	0.049*** (0.010)	0.093*** (0.005)	0.096*** (0.005)
Age started school	-0.022 (0.013)	-0.045 (0.029)	-0.019 (0.013)	-0.015 (0.014)
Household size	-0.058*** (0.013)	-0.111*** (0.024)	-0.063*** (0.012)	-0.069*** (0.012)
<i>Observations</i>	8097	3897	8798	7219

Notes. Standard errors are in parentheses. Significance level: * $p < .10$, ** $p < .05$, *** $p < .01$.

Dependent variable is child labor in agriculture (1= yes, 0 = no) and the results are obtained from pooled probit model.

Table A3. Effect of asset ownership on primary school leaving exam performance

	Dep. variable: PSLE pass ratio		
	RE	FE	HTIV
Log(Total expenditure)	0.056*** (0.007)	0.036*** (0.009)	0.041*** (0.008)
Asset index	0.019*** (0.002)	0.011** (0.005)	0.016*** (0.003)
School in village	0.008 (0.009)	0.013 (0.011)	0.014 (0.009)
Max parent's education	0.006 (0.005)	-	0.063*** (0.019)
Head: age	0.003*** (0.000)	0.004*** (0.001)	0.005*** (0.001)
Head: Gender (1=male, 0=female)	-0.032** (0.013)	-0.072*** (0.025)	-0.030** (0.014)
Household size	-0.023*** (0.003)	0.002 (0.004)	-0.020*** (0.003)
Observations	6029	6029	6029

Notes. Standard errors are in parentheses. Significance level: * $p < .10$, ** $p < .05$, *** $p < .01$. As the dependent variable is at the household level, no individual characteristics are included in the model. Results are presented for key variables only, estimated model includes more variables.

Table A4. Effect of asset ownership on Form IV Exam (FIVE) performance

	Dep. variable: FIVE pass ratio		
	RE	FE	HTIV
Log(Total expenditure)	0.042*** (0.006)	0.025*** (0.007)	0.029*** (0.008)
Asset index	0.025*** (0.002)	0.008* (0.005)	0.018*** (0.003)
School in village	0.010 (0.009)	0.007 (0.011)	0.013 (0.008)
Max parent's education	0.011*** (0.004)	-	0.078*** (0.018)
Head: age	0.002*** (0.000)	0.001 (0.001)	0.004*** (0.001)
Head: Gender (1=male, 0=female)	-0.022* (0.013)	-0.032 (0.035)	-0.014 (0.013)
Household size	-0.009*** (0.001)	0.000 (0.003)	-0.005** (0.002)
Observations	5219	5219	5219

Notes. Standard errors are in parentheses. Significance level: * $p < .10$, ** $p < .05$, *** $p < .01$. As the dependent variable is at the household level, no individual characteristics are included in the model. Results are presented for key variables only, estimated model includes more variables.

APPENDIX B
SUPPLEMENTARY MATERIALS FOR CHAPTER 3

Table B1: Impact on food expenditures over time

	Expenditures					
	Rice	Meat	Milk	Oil	Sugar/beverage	Maize
Original2	0.785 (0.734)	0.459 (0.591)	0.941 (0.677)	0.467 (0.343)	0.225 (0.272)	0.331 (0.262)
Original3	1.169* (0.681)	0.798 (0.491)	3.136*** (0.688)	0.328 (0.313)	0.529** (0.253)	-0.053 (0.303)
Original4	1.635** (0.728)	0.786 (0.537)	1.866*** (0.712)	0.246 (0.387)	0.452 (0.328)	0.937** (0.401)
POG2	0.211 (0.754)	0.455 (0.649)	0.314 (0.620)	0.343 (0.350)	-0.374 (0.268)	0.382 (0.304)
POG3	-0.091 (0.730)	1.045* (0.559)	1.349** (0.638)	0.0226 (0.289)	0.108 (0.233)	0.502** (0.255)
POG4	1.400* (0.766)	1.119** (0.528)	1.803*** (0.689)	0.524 (0.323)	0.196 (0.310)	1.076** (0.417)
<i>Observations</i>	1072	1072	1072	1072	1072	1072

Notes: Standard errors in parentheses, Level of significance: * $p < .10$, ** $p < .05$, *** $p < .01$

Dependent variables are log of expenditures and livestock revenue. Both expenditures and revenue are in

Kwacha per-capita per week. The full specification of the estimated model is: $\ln y_{it} = \beta_0 +$

$\sum_{t=2}^4 \beta_t Round_t + \sum_{t=2}^4 \delta_t Original_{it} + \sum_{t=2}^4 \gamma_t POG_{it} + \Pi X + c_i + \varepsilon_{it}$ where X= (dummy variables for female head, marital status, positive shock, negative shock)

Original_i, and POG_i are 'treatment' dummies for i=2,3,4. For example, Original2 equals 1 for all Originals in the second survey round, and Original4 equals 1 for all Originals in the final round and 0 otherwise.

Table B2: Impact on poverty and food security measures

	Feeling poor	Food secure
Dairy Cow	-1.360** (0.270)	0.594** (0.169)
Meat Goats	-0.339** (0.155)	0.0677 (0.149)
Draft Cattle	-0.694** (0.239)	0.181 (0.196)
POG	0.153 (0.129)	-0.0868 (0.127)
Independent	0.425** (0.167)	-0.283 (0.176)
Observations	1200	1200

Notes: Standard errors in parentheses, Level of significance: * $p < .10$, ** $p < .05$, *** $p < .01$

Both dependent variables are binary. Feeling poor equals 1 if people are feeling relatively worse and 0 if feeling same or better. Food secure equals 1 if people feel food secured and 0 if they feel otherwise. Results are obtained from the pooled probit regression.

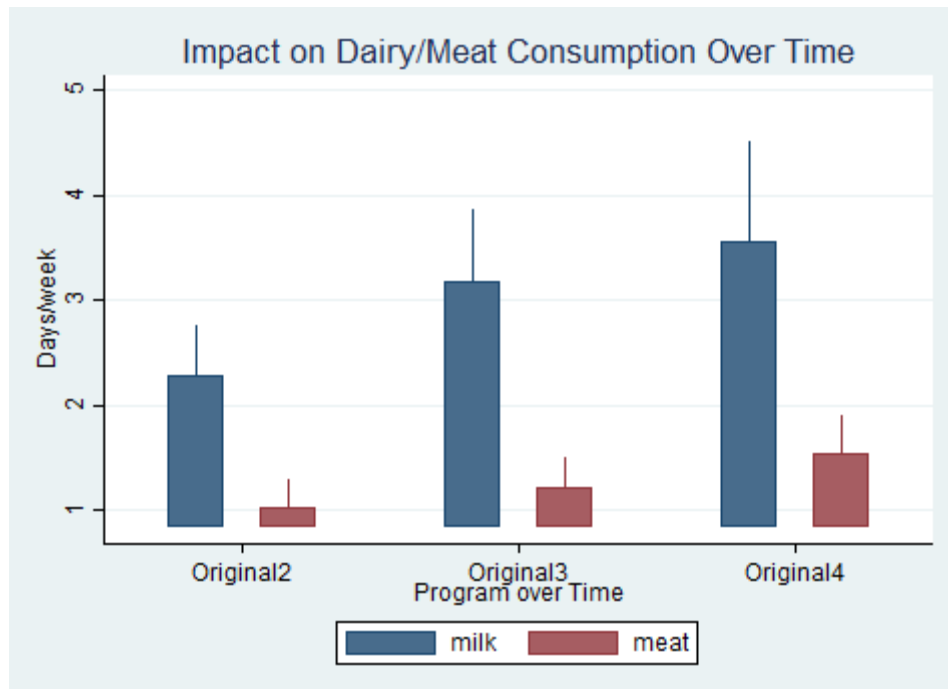


Figure B1: Impact of livestock transfers on dairy/meat consumption frequency

APPENDIX C
SUPPLEMENTARY MATERIALS FOR CHAPTER 4

Table C1. Mean number of decisions made in baseline and endline

Decision domains	Full sample		Original		Prospectives	
	Baseline	Endline	Baseline	Endline	Baseline	Endline
Sending kids to school	1.00 (0.00)	0.99 (0.01)	1.00 (0.00)	0.99 (0.01)	1.00 (0.00)	0.98 (0.02)
Animal slaughter	0.80 (0.04)	2.23 (0.07)	0.88 (0.07)	2.49 (0.10)	0.73 (0.07)	1.78 (0.14)
Live animal sale	0.28 (0.03)	2.23 (0.07)	0.38 (0.06)	2.48 (0.10)	0.25 (0.06)	1.78 (0.14)
Animal product sale	0.13 (0.02)	0.27 (0.03)	0.30 (0.05)	0.36 (0.05)	0.03 (0.02)	0.14 (0.05)
Crop produce sale	1.11 (0.07)	2.19 (0.07)	1.23 (0.13)	2.37 (0.12)	0.88 (0.12)	2.11 (0.13)
Off-farm income	0.40 (0.04)	0.55 (0.04)	0.30 (0.05)	0.51 (0.06)	0.41 (0.07)	0.70 (0.07)
Access to loan/credit	1.23 (0.05)	1.41 (0.05)	1.30 (0.09)	1.53 (0.08)	1.20 (0.09)	1.19 (0.08)
Crop storage/sale	0.23 (0.03)	0.12 (0.02)	0.24 (0.05)	0.10 (0.03)	0.16 (0.05)	0.17 (0.05)
<i>Observations</i>	260	260	100	100	64	64

Notes: Point estimates are mean number of decisions made. Standard errors are in parentheses.
If no decisions are made, then number of decisions made is recorded as zero.

Table C2. Distribution of decision ratios by decision domains over time

Decision domains	Originals				Prospectives			
	Female only decisions		Joint decisions		Female only decisions		Joint decisions	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
Sending kids to school	0.14 (0.035)	0.22 (0.042)	0.64 (0.048)	0.69 (0.046)	0.13 (0.042)	0.11 (0.039)	0.75 (0.055)	0.77 (0.053)
Animal slaughter	0.36 (0.047)	0.27*** (0.043)	0.18 (0.039)	0.62*** (0.046)	0.26 (0.055)	0.26 (0.053)	0.29 (0.057)	0.46 (0.061)
Live animal sale	0.12 (0.033)	0.26 (0.042)	0.11 (0.030)	0.63*** (0.045)	0.09 (0.037)	0.24 (0.052)	0.08 (0.034)	0.47 (0.061)
Animal product sale	0.09 (0.029)	0.05 (0.022)	0.13 (0.034)	0.22 (0.042)	0.02 (0.016)	0.03 (0.022)	0.00 (0.000)	0.06** (0.030)
Crop produce sale	0.23 (0.040)	0.06*** (0.020)	0.33 (0.046)	0.63*** (0.045)	0.14 (0.041)	0.11 (0.036)	0.37 (0.060)	0.65 (0.055)
Off-farm income	0.10 (0.028)	0.14 (0.034)	0.07 (0.026)	0.10 (0.029)	0.09 (0.037)	0.17 (0.046)	0.09 (0.035)	0.16 (0.046)
Access to loan/credit	0.21 (0.039)	0.06*** (0.024)	0.42 (0.048)	0.64*** (0.047)	0.13 (0.041)	0.09 (0.035)	0.54 (0.061)	0.63 (0.059)
Crop storage/sale	0.10 (0.029)	0.05 (0.022)	0.06 (0.022)	0.00** (0.000)	0.06 (0.030)	0.08 (0.034)	0.03 (0.022)	0.05 (0.027)
<i>Observations</i>	100	100	100	100	64	64	64	64

Notes: Point estimates are mean and standard errors are in parentheses, asterisks indicate the level of significance for test of equality of means over time, * $p < .10$, ** $p < .05$, *** $p < .01$. Male only decisions are not presented but they follow the similar pattern observed in case of female only decisions

Table C3: Project impact on women and men's decision-making power based on treatment related and other activities

	Treatment related domains			Other domains		
	(1) Joint	(2) Female only	(3) Male only	(4) Joint	(5) Female only	(6) Male only
Endline	0.74*** (0.21)	0.30** (0.12)	0.20** (0.092)	1.76*** (0.42)	0.70*** (0.22)	0.35* (0.19)
Original x Endline	0.75*** (0.24)	0.18 (0.16)	-0.083 (0.14)	0.80 (0.57)	-0.13 (0.33)	-0.52** (0.25)
POG x Endline	0.70*** (0.27)	-0.22 (0.15)	0.22 (0.14)	0.52 (0.53)	-0.096 (0.30)	-0.50* (0.27)
Household Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	518	518	518	518	518	518

Notes: Standard errors in parentheses, significance level, * $p < .10$, ** $p < .05$, *** $p < .01$

Household controls include household size, number of children ages 5 or under, number of children ages 6 to 16, indicators for female head and married head, and level and squared of age and education of head

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