Power when it matters most

Risk, investment, and insurance when income drives bargaining power

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9/23/2019

Abstract

Economic shocks have disproportionate impacts on women and girls. Studies have found that shocks increase mortality and malnutrition for girls but not for boys (Hoddinott and Kinsey (2000), Anttila-Hughes and Hsiang (2013)). Other studies have found that economic shocks reduce school graduation and increase poverty later in life for women and girls (Maccini and Yang (2009)). This paper builds on the separate spheres model developed by Lundberg and Pollak (1993) to study how investment decisions, risk, and insurance affect household decisions. The theory I develop suggests that insurance has the potential to increase the bargaining power of women in the event of droughts, but only if it is linked to assets or expenditures within women's traditional sphere within the household. I conduct a lab-in-the-field experiment in Sambury County, Kenya using a tablet-based insurance game and find that women buy significantly more insurance when it is linked to household expenditures.

Introduction

Droughts, floods, and other economic shocks cause hunger and perpetuate poverty. Costs are often disproportionately borne by women and girls, for whom being removed from school or temporarily malnourished can have lifelong consequences. Index insurance is a broadly applicable tool to help reduce the costs of economic shocks, but the design of existing products generally directs insurance payments to men. This paper develops a household bargaining model that suggests directing insurance products toward women's budgets could increase demand for index insurance and its benefits, and finds support for that hypothesis using a lab-in-the-field experiment.

Women and girls often bear the brunt of economic shocks (Horton (1986), Sen (1990), Duflo (2005), Qian (2008), Akresh, Verwimp, and Bundervoet (2011)). Hoddinott and Kinsey (2000) find that droughts adversely affect the body mass index (BMI) of women and daughters in Zimbabwean households, but not men and sons. Anttila-Hughes and Hsiang (2013) find that typhoons in the Philippines increase child mortality for female infants, but not males. Dercon and Krishnan (2000) find evidence of asymmetric risk sharing among poor households in Southern Ethiopia: when women get sick, they receive a smaller share of household nutrition, but the same is not true for men. Maccini and Yang (2009) show that Indonesian women who grow up in areas with higher-than-average rainfall during their early years are taller, complete more school, and live in households with more assets later in life.

Index insurance is intended to help households cope with economic shocks.[1] Existing index-based insurance products are generally linked to the primary crop cultivated by agricultural households. This is because theory predicts that the benefit of insurance will be much greater when it is linked to crops that constitute a large share of household income. However, in many cases, social norms dictate that primary crops are cultivated by men (Udry (1996), Doss (2002), Carr (2008), Orr et al. (2016)), meaning men are likely to be the buyers of index insurance and recipients of payouts.

The household bargaining literature documents that in many settings money received by husbands and money received by wives are put to different uses. For example, a policy change in the UK that effectively shifted child allowance receipts from men to women increased expenditures on women's and children's clothing (Lundberg, Pollak, and Wales (1997)). In the

[1] Though index insurance has primarily been applied to weather shocks, it could also be used for for other types of covariate shocks such as exchange rates or food prices.

Cote D'Ivoire, rainfall associated with higher yields on women's crops increase expenditure on food, while rainfall associated with men's crops increase expenditures on 'adult goods' (Duflo and Udry (2004)).[2] Bobonis (2009) finds that increases to women's incomes in Mexico increase expenditures on children's goods. These findings suggest that when insurance payments are received by men, they are likely to be spent differently than if received by women. In particular, men may be less likely to spend insurance payments on education and nutrition for women and girls, which as highlighted above are areas where cuts during crisis lead to long-term consequences.

This paper develops a household model to study the mechanisms that lead shocks to disproportionately affect women and children. The model builds on the separate spheres models of Lundberg and Pollak (1993) and Carter and Katz (1997) by extending them to two periods and explicitly modeling the impact of asset ownership on bargaining power. Each of the household members maintains control of their own assets in the event that no agreement reached, but primary responsibility for the welfare of the children falls to the wife. The theory yields a number of intuitive results that are consistent with published findings. It predicts productive inefficiency as documented by Udry et al. (1995) and Udry (1996) as well as the asymmetric effects of transfers to women and men on household expenditures documented by Duflo (2012) and others. It also predicts that women whose income is low relative to their husbands are likely to invest more in children's goods and save less, as reported by Doepke and Tertilt (n.d.). Finally, it suggests that insurance indemnity payments received by women will enable them to protect their assets, their children, and their consumption from the ill effects of shocks.

This paper was inspired by a project in Northern Kenya called the BOMA Rural Entrepreneur Acess Project (REAP). REAP is a multifaceted poverty graduation program that provides women with cash grants and mentorship, helps them form savings groups, and provides health

[2] An exception is yams, which are cultivated by men but which social norms link strongly to providing for family nutrition.

insurance. Banerjee et al. (2015) conducted survey study including similar programs from six countries and found evidence of long term positive impacts on household consumption, food security, wealth, and a range of other measures. These programs also increased measures of women's empowerment and physical health at the project endline, but 12 months later at follow-up, effects on empowerment and health had diminished and the difference from baseline was no longer statistically significant. Our partners at BOMA have reported the same: the program has long-term benefits for households, but women's businesses are often liquidated during droughts.

This paper's theory suggests that providing insurance against shocks to household incomes while decoupling it from male controlled assets could substantially benefit women and girls. For the women in the REAP program who have small businesses, such insurance could help them maintain control of their assets through droughts by increasing their bargaining power when it is most valuable. For women with fewer assets, insurance makes small scale investment more appealing and reduces the likelihood that negative shocks will force them to liquidate assets, reduce investment in their children's food consumption or pull children out of school.

In order to test the market potential of insurance designed to guarantee payment of household expenses rather than replace lost livestock, I implemented a lab-in-the-field experiment in Samburu County Kenya. In the experiment, women and men make insurance investment decisions in a tablet-based game designed to simulate their life. Individuals choose a portfolio of goats and insurance, and the quality of rainfall dictates whether the insurance pays out and how many goats reproduce or die. In half of the sessions, we linked insurance to goats, which social norms dictate are a male-controlled asset. In the other half, we linked insurance to household expenses. Women bought more insurance when the product was linked to household expenses. Men appeared to buy somewhat less insurance when it was linked to household expenses, though that result is more sensitive to specification.

The Separate Spheres Model

This paper builds on the household bargaining model with transfers described by Lundberg and Pollak (1993). This section introduces terminology and provides an overview of the results of that model important to my analysis here. Additional detail can be found in the original paper.

Lundberg and Pollak (1993) study how traditional gender divisions of responsibility interact with the individual incomes of household members. Their central finding is that changes in women's own income has little effect on their bargaining power when women are traditionally responsible for household public goods and are dependent on discretionary transfers from their husband. Intuitively, this is because increases in their income will be offset by reductions in discretionary transfers, muting their affect on bargaining power. On the other hand, if their earning potential is high enough that in the event of a disagreement they would support themselves and their children without transfers from their husband, further increases in earning power also increase bargaining power.

The household is composed of a man and a woman with with von Neumann-Morgenstern utility functions $u_w(c_w, z)$ and $u_m(c_m, z)$ where c_w is the woman's consumption, c_m is the man's consumption, and z represents household public goods. Their incomes are y_w and y_m, respectively.

The household determines allocations of c_w, c_m, and z by maximizing the product of the gains to cooperation, meaning they solve the Nash bargaining problem:

$$\max_{c_w, c_m, z} (u_w(c_w, z) - T_w(y_w, y_m))(u_m(c_m, z) - T_m(y_w, y_m)) \text{ s.t. } c_w + c_m + z \leq y_w + y_m.$$

where $T_w(y_w, y_m)$ and $T_m(y_w, y_m)$ represent the threat points of each partner. These threat points represent the outcome that would result if the two cannot reach an agreement, and the model presumes that in this case gender roles would play an important role in determining the allocation. Concretely, in the event of disagreement, the woman is responsible for providing household public goods z and the man can contribute to z goods only by providing a transfer to his wife. This means that in the event of non-cooperation the man faces a principal agent problem and intrahousehold allocations are inefficient.

The man's threat point can be written mathematically:

$$T_m(y_w, y_m) = \max_{c_m, t} u(c_m, z(t, y_w)) \text{s.t. } c_m + t \leq y_m \text{and } t \geq \bar{t}$$

where z is the wife's reaction function and $\bar{t}$ is a minimum transfer agreed upon at the beginning of the marriage and/or enforced by laws or cultural norms.[3]

The woman's threat point can be written:

$$T_w(y_w, y_m) = \max_{c_w, z} u(c_w, z) \text{ s.t. } c_w + z \leq y_w + t(y_w, y_m)$$

The most important implication of this model for the purposes of the analyses below is that individual earnings only affect the distribution of resources in the household when the wife's income is high enough that the man only provides her the minimum transfer in the event of noncooperation. Mathematically, that means that $t = \bar{t}$ at the optimum.

Exactly how high the wife's income must be for this to occur depends on the preferences of the husband and the wife. If the wife values z more than the husband, he may provide the minimum transfer when her income is quite low since he knows that she will allocate a large share of her budget to z. On the other hand, if the husband values z more than his wife, he may provide more than the minimum transfer even if her income is quite high to increase her investment in z.

In the language of the household bargaining literature, the household behaves as if unitary

[3] For example, in countries with alimony or child support laws, $\bar{t}$ could be dictated by those. In Samburu County Kenya, where the motivation for this study originated, $\bar{t}$ is dictated by a tradition that requires that upon marriage men allocate the production of a several of their livestock to their wife (Spencer (2012)).

when the man chooses to make a transfer greater than the minimum, so an increase in the woman's income and an increase in the man's income have identical effects on bargained outcomes. On the other hand, when the constraint on t binds, an increase in the woman's income strengthens her relative threat point and therefore will increase the weight of her preferences in the bargained outcome.

It is helpful to introduce some terminology to support the analysis of investment decisions to come. I will refer to solutions to the household bargaining problem in which $t = \bar{t}$ as *independence* from the woman's point of view since increases in her income in this situation will have no effect on t. Solutions in which $t > \bar{t}$ will be termed *dependence* from the woman's point of view since her income depends on both her own and her husband's.

For use in the dynamic analysis to follow, let $(\tilde{c}_w(y_w, y_m), \tilde{c}_m(y_w, y_m), \tilde{z}(y_w, y_m))$ represent the solution to the household bargaining problem above. Define

$$v_m(y_w, y_m) = u_w(\tilde{c}_w(y_w, y_m), \tilde{z}(y_w, y_m))$$

and

$$v_w(y_w, y_m) = u_m(\tilde{c}_w(y_w, y_m), \tilde{z}(y_w, y_m)).$$

These indirect utility functions represent the value of a given income level to one partner given the other's income and will be useful in the dynamic analysis to follow.

Investment and Bargaining Power

Since individual incomes can affect bargaining power in the household model, individuals within the household should take that into account when making decisions. Existing literature has focused on relative wage rates as determinants of bargaining power because in an economy where wage labor is the norm the wage rates of each partner drive their individual incomes.[4] I build on that literature here by extending the analysis to a context in which income is principally earned from investments in small businesses or agricultural investments. This is the case in many developing country settings, particularly in rural areas where most people are subsistence farmers and wage labor is not generally available. In particular, this model is suited to the pastoralist communities of Northern Kenya that inspired this analysis.

A key insight of this model is that when women make investment decisions in a separate spheres model, they are also making a decision about their bargaining power. If they invest a large enough amount relative to their husband, they will be independent in the event of noncooperation and will thus bargain with a stronger threat point. On the other hand, if they do not have enough resources to optimally choose independence, it may make sense to invest only a small amount since a lower income in the future would increase their transfer from the husband in the event of noncooperation.

The first stage of this model begins with an initial 'cash on hand' allocation and y_w^0, y_m^0, and a level of public goods z^0 which could either be the result of a prior round of a prior bargaining process or the beginning of the relationship. Each partner must make an investment decision in addition to their expenditure decisions. Their investment decisions will determine the levels of y_w and y_m that will drive bargaining in the next period as described above. As before, the husband moves first, picking t and k_m, and the wife makes her decision taking those two as given.

We can write the husband's problem:

$$\max_{c_m^0, k_m} u_m(c_m^0, z^0) + \beta_m E[v_m(y_w, y_m)] \text{ such that } c_m^0 + k_m \leq y_m^0 y_w = f(k_w, \epsilon) y_m = f(k_m, \epsilon)$$

And the wife's problem:

[4] The wage rate is more important than actual earnings because partners can adjust their hours worked in the event of a disagreement but not their wage rate.

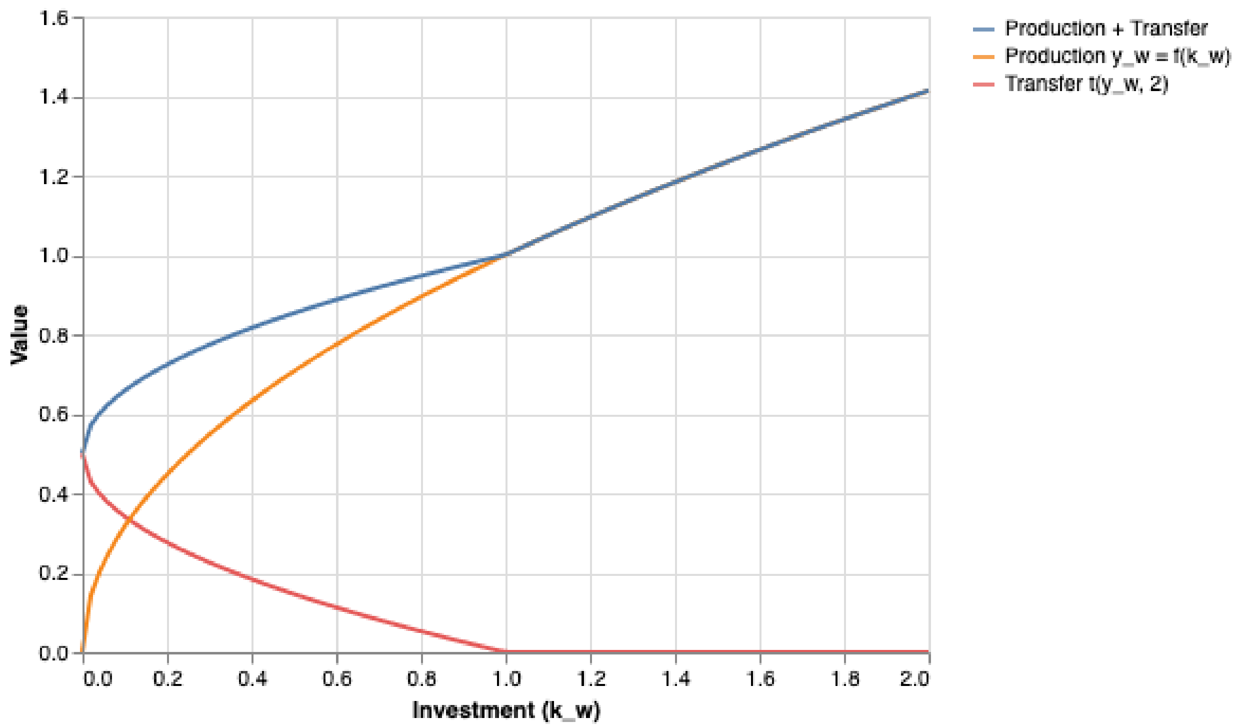

Figure 1: In general, the woman's next period budget is not a concave function of her investment level

$$\max_{c_w^0, k_w} u_w(c_w^0, z^0) + \beta_w E[v_w(y_w, y_m)] \text{ such that } c_w^0 + k_w \leq y_w^0 y_w = f(k_w, \epsilon) y_m = f(k_m, \epsilon)$$

From the discussion of the separate spheres model above, it is clear that the choices of k_w and k_m are strategic. As with the intrahousehold decision in the case of noncooperation, I assume the husband is the Stackleberg leader and makes his investment decision first, and that the wife makes her decision taking her husband's as given.

Since the wife knows that her income in the future will not affect her bargaining power unless it is high enough that the transfer from her husband to be fixed at $\bar{t}$, $v(y_w, y_m)$ is generally not concave in y_w. This means that in general, household production decisions will not be productively efficient.

Figure 1 depicts the relationship between the wife's investment level and her income at the

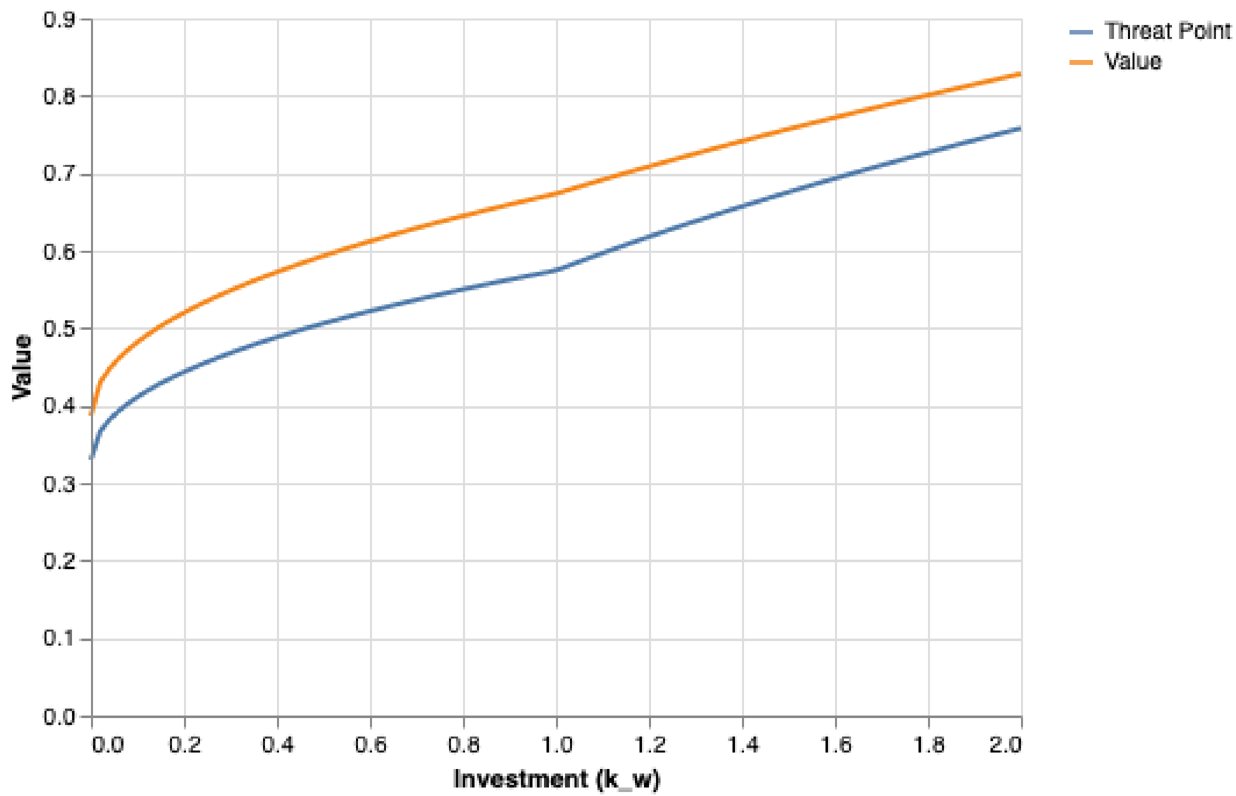

Figure 2: The woman's next period indirect utility function is also nonconcave

beginning of the second period in the simple situation in which both partners have identical Cobb-Douglas production functions, a concave production technology ($f(k) = k^{1/2}$), no production risk, and the man's investment is held constant at 1. The woman would never optimally select the point at which $t = \bar{t}$ since slightly increasing her investment would substantially increase her bargaining power and slightly decreasing it would increase her present consumption more than it would reduce her future income.

Figure 2 depicts the relationship between the woman's investment level, threat point, and bargained utility. It shows that the non-convexity from the threat point translates into the bargained outcome, meaning that even with bargaining the final period value function is not convex. As a consequence, the choice between dependence and independence is an important element of her decision even if she is confident that an agreement will be reached.

Because the woman effectively faces a production function with a nonconvexity, her optimal

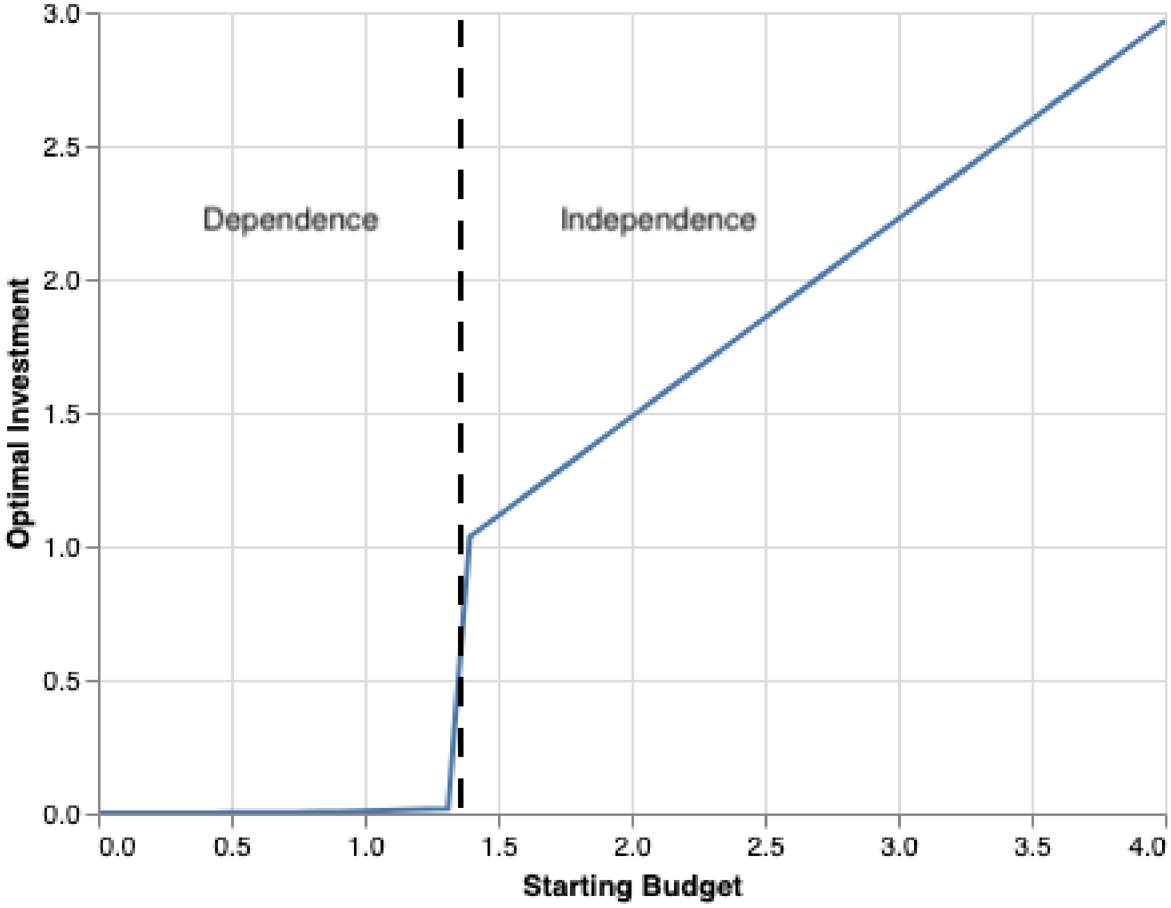

Figure 3: Because the production function is not concave, the optimal investment function is not continuous, and multiple equilibria are possible

investment decision is not a continuous function. In particular, there are two important thresholds: the budget level at which she invests more than zero, moving from full dependence on her husband's investments to partial dependence, and the budget level at which she moves from partial dependence to independence.

Figure 3 depicts the woman's first period optimal investment choices as a function of her income. It shows that until her income gets quite high, she invests very little, despite the fact that the marginal product of capital is very high at low levels of investment. Again, this is because investment will reduce her transfer receipt from her husband, so it is optimal to invest less than the amount that would be productively efficient from a household production standpoint.

The results in this section provide a theoretical explanation for the observation that household investment decisions are often observed to be inefficient, with underinvestment in assets controlled by women.[5] It simply does not make sense for women to invest heavily when their increased production does little to increase their bargaining power.

Bargaining, Insurance, and Risk

Without risk, the future state of the world is certain, so the wife's choice is between dependence and independence. With risk, independence and bargaining power can vary with the state of the world. The justification for insurance in general is the fact that income is most valuable on the margin in hard times. From the woman's perspective, it is also the case that the level of income required to achieve 'independence' is smaller during hard times and that bargaining power is more valuable in hard times. Insurance has the potential to provide a double benefit by simultaneously increasing household income and bargaining power in the event of negative shocks.

Bargaining power is much more valuable in bad years because household income is lower. In many households, dependence might be quite an appealling option in good years: there are plenty of resources so t will be generous. On the other hand, in a bad year, the research cited above suggests t is in some cases too low for the wife to keep children in school while maintaining good nutrition for her and her family. Fortunately, bargaining power is less expensive in bad years because the income the the wife must have to attain independence decreases when her husband's income decreases.

There are a number of strategies the wife might rely on to ensure that she has enough bargaining power in bad years to assure that family needs are met. One option is maintaining savings. However, savings will reduce t in future periods both good and bad, which means

[5] See Udry et al. (1995) and Udry (1996).

that they essentially face a high tax rate.[6] Another option is investment, but when shocks are covariate that is likely to lead to low bargaining power exactly when it is most critical. Insurance has a number of advantages compared to other options: it provides income at the most critical times and eliminates the 'tax burden' of reduced transfers in good years.

With insurance, we can write the woman's problem:

$$\max_{c_w^0, k_w} u_w(c_w^0, z^0) + \beta_w E[v_w(y_w, y_m)] \text{ such that } c_w^0 + k_w + p_i q_i \leq y_w^0 y_w = f(k_w, \epsilon) + q_i i(\epsilon) y_m = f(k_m, \epsilon)$$

where all variables are as above and q_i is the quantity of insurance, p_i is the price of insurance and the i function is the insurance payout as a function of the shock.

Figure 4 compares optimal portfolio choices with and without insurance in the same simple scenario described above with one important change: it includes risk and insurance.[7] As depicted, optimal portfolio choices include purchase of insurance by women from both the dependent and independent groups. The availability of insurance also increases the first round budget required to induce independence because it increases bargaining power in bad years.

Household Insurance

The key implication of the theory above is that insurance has outsize benefits for women in agrarian settings because it can increase their bargaining power when it is most valuable: in the event of a crisis. Further, since the weather events such as droughts or floods are the principal risks farmers face, index insurance is an appropriate tool. However, since in most households cultivation of important cash crops is the role of the man, existing

[6] This is consistent with the literature documenting that women are more likely to use savings products when they can be kept secret or are difficult to access (e.g. see Jakiela and Ozier (2015)).

[7] Specifically, a shock is drawn from a truncated normal distribution with a mean of 1 and a standard deviation of 0.3. The insurance pays the difference between the shock and 1 if the shock is less than 1.

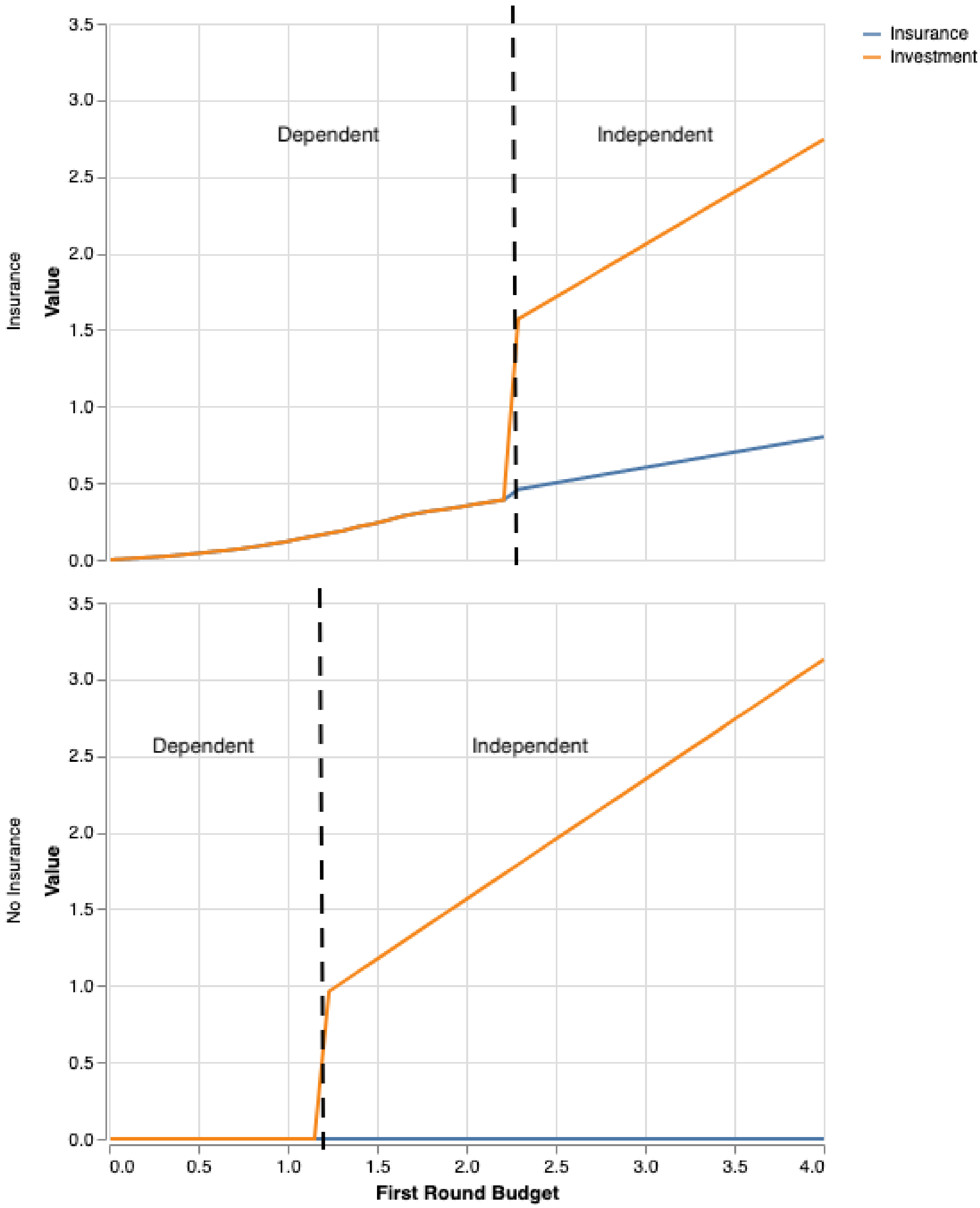

Figure 4: With insurance, optimal investment increases at low budgets

agricultural insurance products have been sold to men and indemnity payments have entered their incomes.

There are three reasons for linking insurance to household expenditures rather than investment. First, the optimal quantity of insurance to buy and the optimal amount to invest in her case are not tied together in a straightforward way. As shown above, it can be rational for a woman who depends on her husband's income to buy insurance even if she does not have any investments. More generally, even if a woman does invest, it may be optimal for her to more than fully insure her own investment. Second, in many settings most or all of a household's investments are made by men, men may claim power over indemnity payments linked to investments even if they did not buy the insurance contract. Third, it is conceptually easier to think about the quantity of money needed to buy essentials such as food and clothing in the event of a crisis than the share of production to insure, particularly when the link between production and consumption is only linked indirectly through bargaining.

A Demand Experiment

The theory above suggests that for women, the optimal quantity of insurance may not be tied to the assets they own. Further, it suggests that insurance may have outsize benefits for women by increasing their bargaining power in the event of a drought. In order to test whether decoupling insurance from male-controlled assets increased demand among women, we designed a lab-in-the-field experiment using a tablet-based videogame. Our results support the hypothesis advanced by the theory: women are more likely to buy insurance when it is associated with household expenses rather than assets.

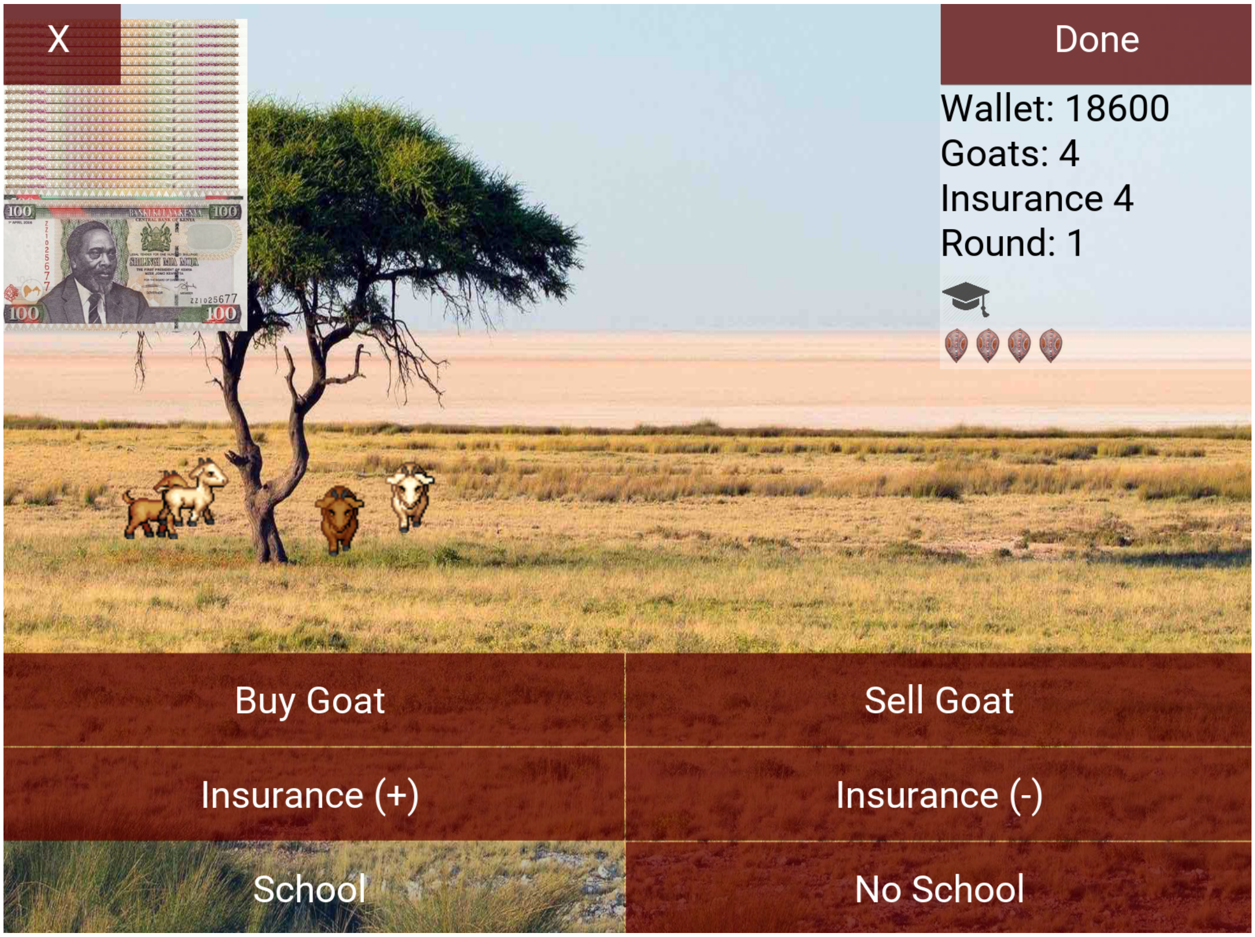

Figure 5: SimPastoralist

SimPastoralist

The SimPastoralist game makes it possible to collect rich data on decisionmaking by individuals and couples in a setting that mirrored the decisions they make in their daily lives. The game was developed over the course of several months at UC Davis, and was then intensively revised for several weeks with feedback from local pastoralists in Samburu. The probabilities, prices, and the insurance markup were all designed to match reality as closely as possible while keeping the game relatively simple.

Figure 5 depicts the gameplay screen from SimPastoralist. The shield icons represent the amount of insurance the player holds, and the graduation hat icon represents years of school. The wallet balance is shown both numerically and by adjusting the size of visible stack of cash on the left hand side of the screen. The enumerators explain all of these symbols to the players, and update them on their balances of cash, goats, and insurance before they finalize each decision and at the beginning of each round.

Because data collection is integrated into the game, it is possible to move through the game quickly. This increases participant engagement and allows participants to practice the game many times before they participate in the incentivized round. As a result, participants remained engaged, and many asked to stay longer to play more after the incentivized sessions were over. Participants also reported without prompting that they felt the game was educational and reflective of their lives. Based on those reactions, SimPastoralist has since been used for extension as well as data collection.

SimPastoralist is designed to mimic reality, but it differs from reality in one very important way: the player does not have the opportunity to choose consumption (or withdraw from the game) until the end. Instead, consumption is fixed at a level designed to represent subsistence in each period, and the player gets to collect the full value of their cash and herd at the end of the game. I therefore assume that the player is seeking to maximize the utility of their final payout rather than the sum of discounted utilities of consumption. Specifically, at time $t < T$ the player chooses goats ($g_t \in \mathbb{Z}^+$), insurance ($i_t \in \mathbb{Z}^+$), and whether to send their child to school ($e_t \in \{0, 1\}$)

$$V_t(W_t, E_t) = max_{g_t, i_t, e_t} \beta^{T-t} E(U(W_T, E_T)) \text{ where } 2000g_t + 350i_t + 2000e_t \leq W_t$$

where

$$W_{t+1} = \begin{cases} W_t + 2000g_t\epsilon_t - 350i_t - 2000e_t - 5000 & \text{in a good year (p=2/3)} \\ W_t - 2000g_t\epsilon_t + 650i_t - 2000e_t - 5000 & \text{in a drought (p=1/3)} \end{cases}$$

and ϵ_t is drawn from a binomial distribution with $n = g_t$ and $p = 2/3$. In other words, goats reproduce with probability 2/3 in a good year and die with probility 2/3 in a bad year. The insurance premium is 350 and it pays 1000 in the event of a drought, which is why the net income from insurance is -350 in a good year and 650 in the event of a drought.

Education (E_t) was designed to have a small economic value specifically because we believe that people view it as valuable beyond its economic benefits. By giving it a negative expected economic value, we can measure differences in non-economic value placed on school graduation. Were it to have a positive expected value, it would be impossible to disentangle non-economic valuations from economic valuations. The transition equation for education is

$$E_{t+1} = E_t + e_t$$

A student is considered 'graduated' when $E_t = 6$, and the player receives 10000 KSh bonus at the end of the game if their child graduated, otherwise nothing.

The game can end in one of two ways. If the player does not have sufficient funds to pay the mandatory 5000 KSh for household consumption at the beginning of the round, the game ends early with a score of zero. Otherwise, the games ends at the tenth round. The final score is the sum of the value of the goats in their herd and the cash in their wallet, plus a bonus of 10000 KSh if their child finished school. The incentive is calculated so that every 500 KSh in the game translate into 1 KSh of real-world payment.

In the 'couples' version of the game, the rules are the same as above, with several important modifications. First, the initial budget is split between the two members of the household. Second, household members are given the option to split the cost of education/ consumption or allow one member to pay it entirely. Third, household members can transfer money to each other at any time and for any reason. This version of the game is used to study household preferences as distinct from individual preferences.

Experimental Design and Data Collection

The experimental sessions were conducted by four groups of enumerators who worked with roughly 8 couples per session[8] for a total of 387 couples. The couples were randomly selected from a larger sample of women who are participating in our randomized controlled trial of the BOMA REAP program. For that evaluation, women were selected randomly from a group screened by BOMA through a participatory process designed to identify the poorer households in each village.

In each session, we introduced the concepts in the game gradually. First, the enumerators performed a scripted skit situating the game. Each player then played a version of the game without insurance twice. This was designed to introduce the part of the game that parallels life as they already experience it without the complication of insurance (insurance had not yet been introduced in the study region). The wife and husband alternated, with the person going first determined at random and selected by the tablet. The enumerators then performed another skit introducing the insurance version of the game, and each member of the couple played that game.

After each player practiced the game without insurance twice and then with insurance twice, they were reminded that they were now playing the incentivized game. Figure 6 provides a visual representation of the sequence of individual games.

After the individual games the 'couples' version of SimPastoralist is introduced. In that version, each partner begins with a smaller herd so that the total household budget is the same as in the original game. As depicted in Figure 7 the couples game, the two play on the same screen. They are able to transfer money to each other at any time, and expenses can either be split of paid by one party. # Data {-}

The SimPastoralist game yields a rich dataset. Data are recorded on every player decision, as well as the time it took them to make the decision. We began the game with a short

[8] The same number of couples were invited to each session, but in some cases a few did not show up.

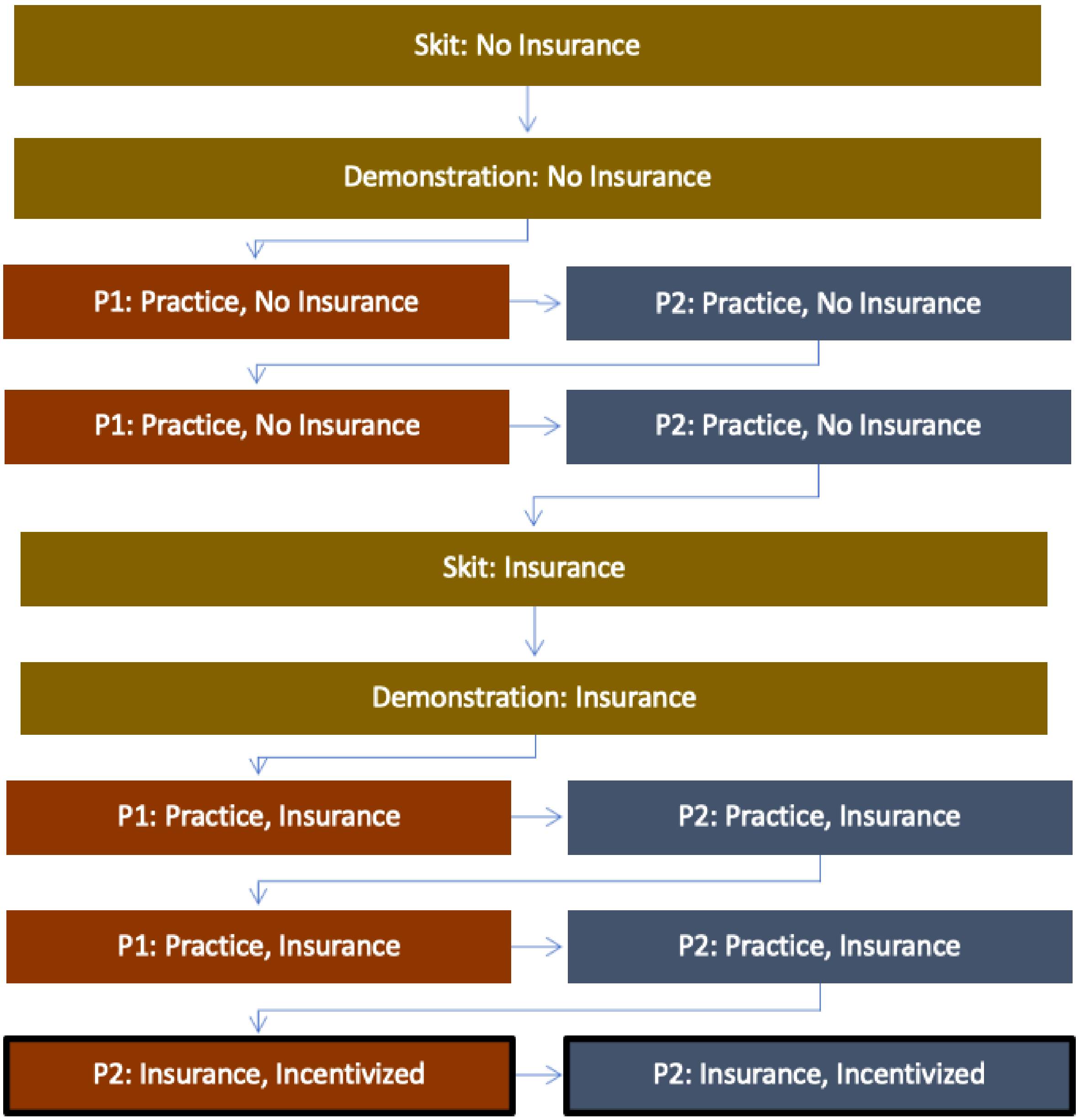

Figure 6: Sequence of individual games

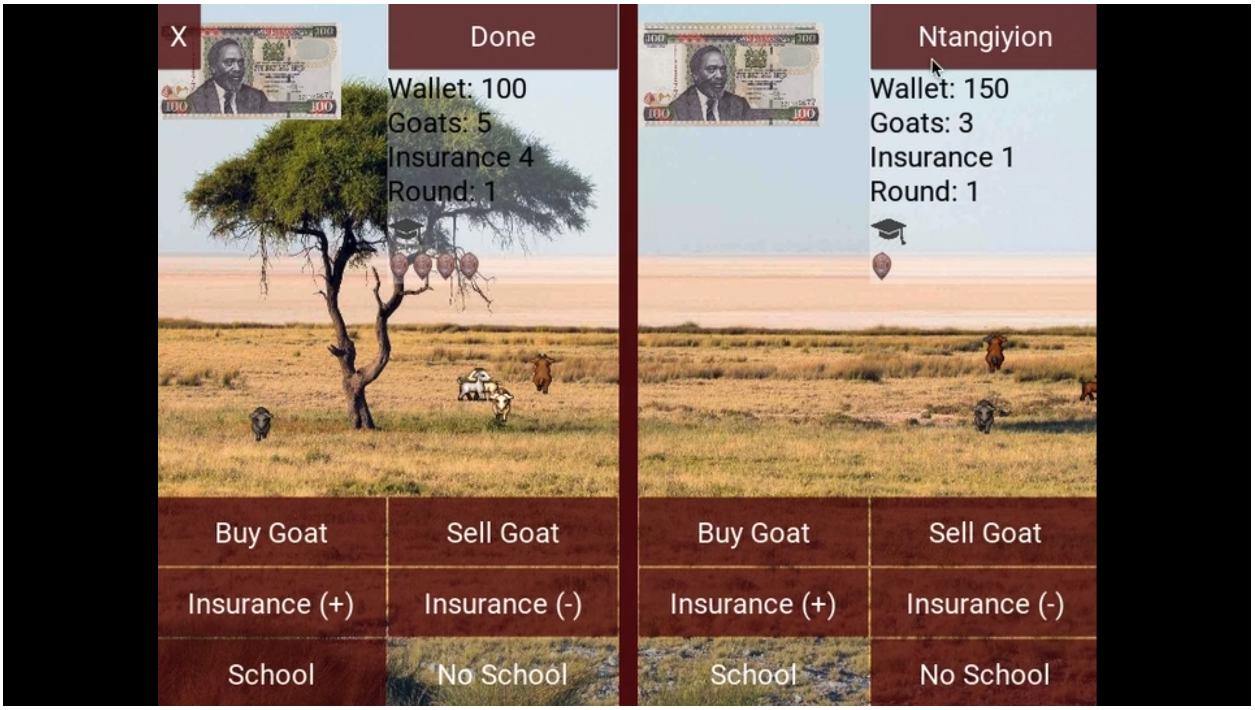

Figure 7: SimPastoralist Two Player

survey on player characteristics, and are able to link the game data to the extensive survey data from the BOMA REAP evaluation.

We start players with a relatively small budget: enough to buy 12-18 goats. This corresponds to a herd size of less than 4 Total Livestock Units (TLU). In a non-game setting, herds this small have been found to be below the Micawber Threshold, which is an asset level below which both theory and empirical evidence suggests households are more likely to fall into poverty.[9] One testament to the fact that SimPastoralist accurately approximated reality is that the results are consistent with the research on Micawber thresholds: participants who experienced good luck in the first few rounds so that their herds grew above the critical threshold tended to remain in play throughout the game, while others did not.

Figure 8 shows the percentage of players who remained in the game at the beginning of each round by gender. The game reflects the challenging dynamics of being a poor pastoralist:

[9]For discussion and evidence on Micawber thresholds in Northern Kenya see Janzen and Carter (2018) and Ikegami et al. (2017).

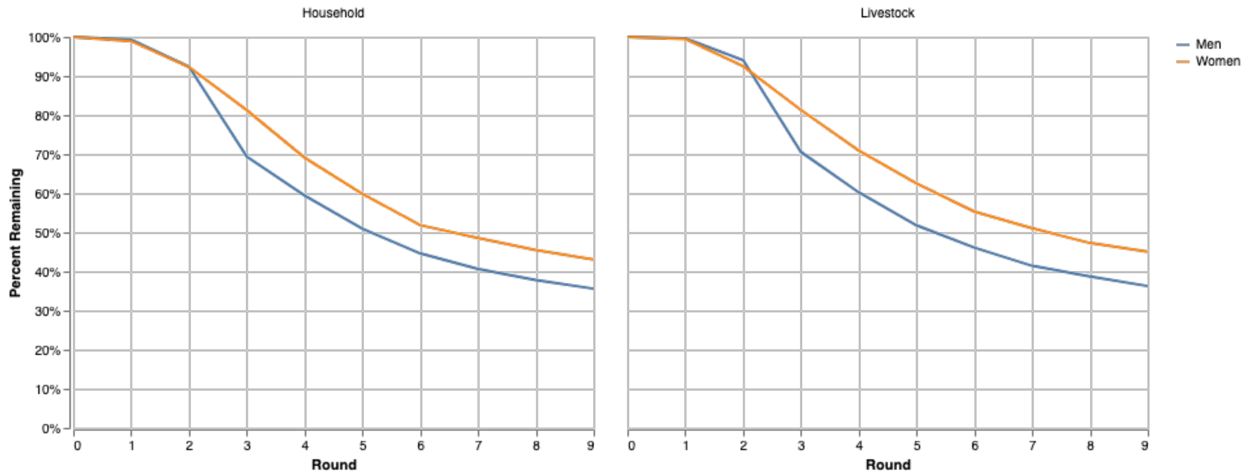

Figure 8: Survival rates were similar across framings, but a subset of men seem to systematically underperform women

more than half of players did not last until the final round of the game. Attrition is fastest in the two rounds: by round 3, about 20% of women and 30% of men are already bankrupt. The difference in performance between women and men is consistent across framings of the game. While not the subject of this paper, it is worth noting that women seem to be more skilled on average at managing goats than men, at least in a simulated environment, despite the fact that it is not generally their role in the household.

In half of the game sessions, we framed insurance using the traditional 'livestock' framing. Insurance is explained as a product designed to help the household replace or support livestock in the event of a drought. In the other half, we framed insurance as something the household could use **either** to support livestock or to pay for household expenses such as food, medical expenses, and school fees. The hypothesis, based on the theory above, is that women will buy more insurance under the household framing because it will increase their claim over the funds in the event of a drought and thus improve their bargaining position.

Before analyzing the data to formally test the hypothesis that the household framing increases demand among women, we can look at the raw data on the share of budgets spent on insurance by round. As shown in Figure 9, in all but one of the ten total rounds, women spent a larger share of their budgets on insurance on average under the household framing.

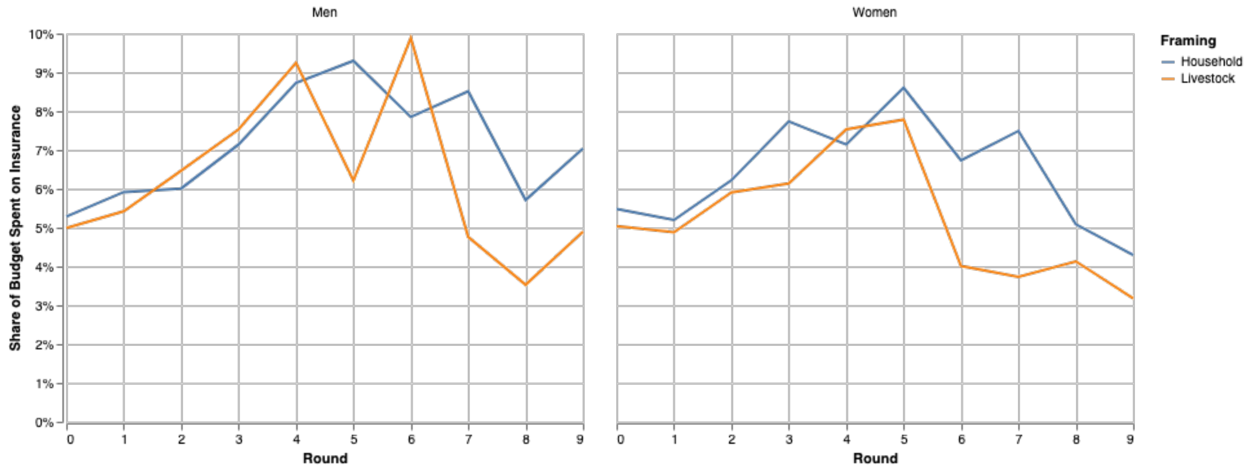

Figure 9: Women spent a larger share of their budgets on insurance in the household framing on average in all but one round.

Among men there is no clear trend. The regression analysis to follow will provide additional evidence of the impact of the framing, but this illustrates the main result in a clear and simple way.

Measuring the Effect of Framing on Insurance Uptake

The theory above generates the hypothesis that insurance linked to household expenses will be more appealing to women than insurance linked to livestock because it could increase their bargaining power in the event of a drought. This section focuses on testing the impact of the household framing compared to the livestock framing, which represents current practice.

I examine two specifications: one to estimate the average effect of the household framing on units of insurance purchased and another to compare insurance demand as a function of budget levels in each framing. In both specifications, I pool the data from the individual and couples versions of the game. Partitioning the data and running the analysis on couples and individuals separately yields results that are qualitatively similar. In both specifications, women buy more insurance under the household framing. Further, some specifications suggest men buy less insurance under the household framing.

Average Treatment Effect

From the model above, we can see that the factors affecting decisions are the total budget, the time t, and the individual's preferences. This leads naturally to estimating the equation

$$D_{it} = \beta_1 Treat_i Woman_i + \beta_2 Treat_i + \beta_3 Woman_i + \beta_4 Budget_{it} + \beta_5 Budget_{it}^2 + \gamma_t + \epsilon_{it}$$

where D_{it} is the dependent variable (goats or insurance), $Treat_i$ is a variable equal to 1 in the household framing, $Woman_i$ is a dummy variable equal to 1 when the respondent is a woman, and γ_t is a round fixed effect.

The key challenge in identifying the above equations is that the budget is endogenous after the first round, since preferences affect prior investment decisions which have some effect on future budgets. Fortunately, the design of the game provides a set of ideal instruments: the history of drought shocks that the player has experienced at time t and the starting budget.

The first stage of our instrumental variables position can be written

$$Budget_{it} = \sum_{i=1}^{t} \delta_t I_t FracGood_{it} + \sum_{i=1}^{t} \kappa_t I_t StartBudget_i + \text{controls} + \mu_{it}$$

where I_t is a year dummy, and the controls are the exogenous variables, and

$$FracGood_{it} = \frac{\sum_{j=1}^{t} \omega_{ij}}{t}$$

where ω_t is a dummy variable that is equal to 1 in the event of a good year and 0 in the event of a drought. In words, it represents the share of years that have been good for the pastoralist. The instrument is very strong: the first stage F-statistic is 53.75.[10]

[10]This substantially exceeds the rule of thumb proposed by Staiger and Stock (1997), who find that first stage F-statistics less than 10 are likely to lead to weak instrument problems.

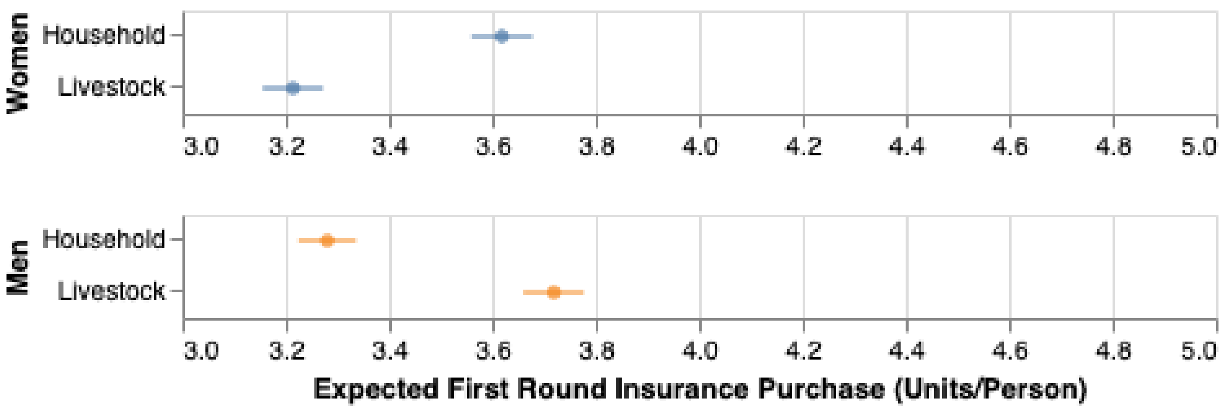

Figure 10: The household framing increases insurance demand for women and reduces it for men

We can estimate all three of these equations simultaneously: two equations for goats and insurance and one equation estimating the budget as a function of the instruments. In a two stage least squares framework the budget equation would be the first stage, but all three are estimated simultaneously in this case. Because the instrument was randomly generated by the tablet, I know for certain it is strictly exogenous and can use System Generalized Least Squares (GLS) rather than the Generalized Method of Moments to estimate the system of equations, which improves efficiency. Here I focus on the effect on demand for insurance; other regression results can be found in Appendix 1.

Figure 10 summarizes the regression results by plotting a confidence interval for the predicted insurance purchase at the starting budget. The household framing leads women to increase insurance purchase from 3.2 to 3.5 units on average, a 12.5% increase. Interestingly, it appears to reduce demand for men by about the same amount.

Table 1: Coefficient Estimates for Average Effects Regression

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Household	-0.4384	0.0318	-13.775	0.0000	-0.5008	-0.3760

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
Female	-0.5048	0.0392	-12.869	0.0000	-0.5816	-0.4279
Household x Female	0.8428	0.0470	17.922	0.0000	0.7506	0.9349
Budget	5.115e-05	1.054e-06	48.509	0.0000	4.908e-05	5.321e-05
Budget^2	-1.657e-11	7.743e-13	-21.405	0.0000	-1.809e-11	-1.506e-11

The coefficient estimates for the average effects regression are available in Table 1. The standard errors reported are heteroskedasticity robust.

Variable Treatment Effect

In order to obtain more estimates that allow the treatment effect to vary with the budget, I estimate a regression similar to the above with an important modification: the 'Budget' variables are interacted with framing and gender variables so that the effect of the framing on demand can vary with the budget. This more flexible specification is a better fit for the theory, in which insurance demand is a function of budget. Due to the many interaction terms, the coefficient estimates are difficult to interpret and so I have relegated them to Appendix 1. Instead, I provide visualizations of predicted insurance purchase in each framing along with 95% confidence intervals.

As depicted in 11, these results are consistent with the average results above except that the effect of the household framing on men is no longer statistically significant. Further, the effect for women becomes statistically insignificant at high budgets. This makes sense given the theory: since household expenditures do not depend on the number of goats in the herd, they will play a smaller role in the quantity of insurance purchased as budgets grow.

Because treatment was randomized at the session level rather than the individual level, the results depicted in Figure 11 may underestimate standard errors.[11] As shown in Figure 12,

[11] According to Abadie et al. (2017), it is appropriate to cluster standard errors in this setting at the

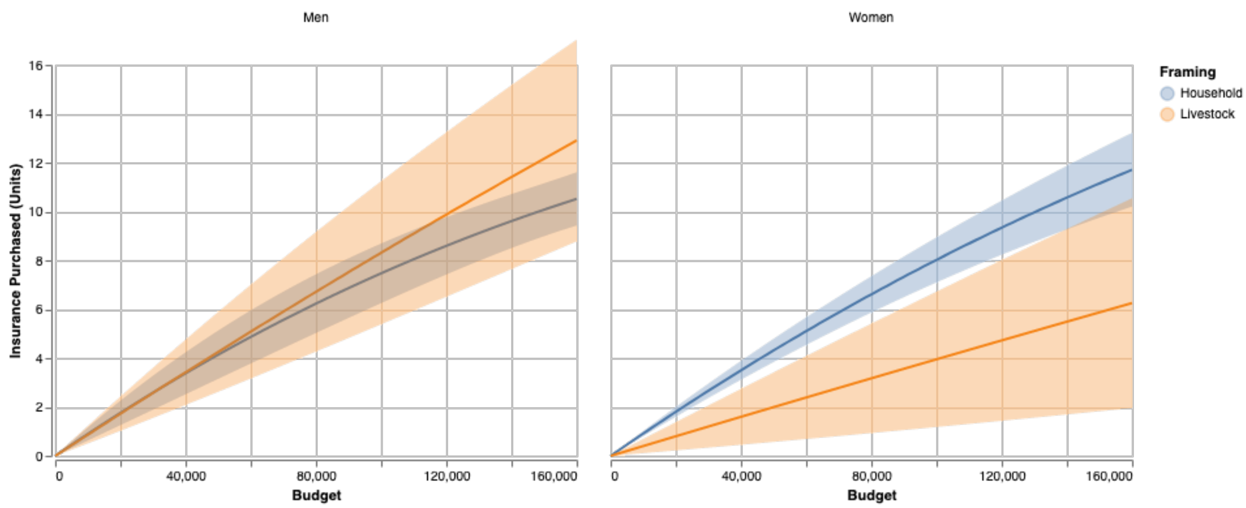

Figure 11: The household framing increases insurance demand for women and reduces it for men (robust standard errors)

clustering standard errors at the session level increases the size of the confidence intervals, which means that the effect of the treatment on demand is only statistically significant at the 95% level at very low budgets. Again, this is consistent with the theory: we would expect the household framing to make the largest difference when consumption expenses are highest relative to the size of the herd.

In general, these results suggest that the finding that the household framing increases demand by women is more robust than the finding that it decreases demand by men.

Conclusion

This paper set out to connect theory to the common empirical finding that women are disproportionately affected by droughts and to use that theory to identify measures that could reduce that disparity. It argues that income in the event of negative shocks is especially valuable to women because it is in hard times that it has the largest effect on their bargaining power. However, existing insurance products linked to men's income sources do not generate

session level since that was the level at which the treatment was randomized.

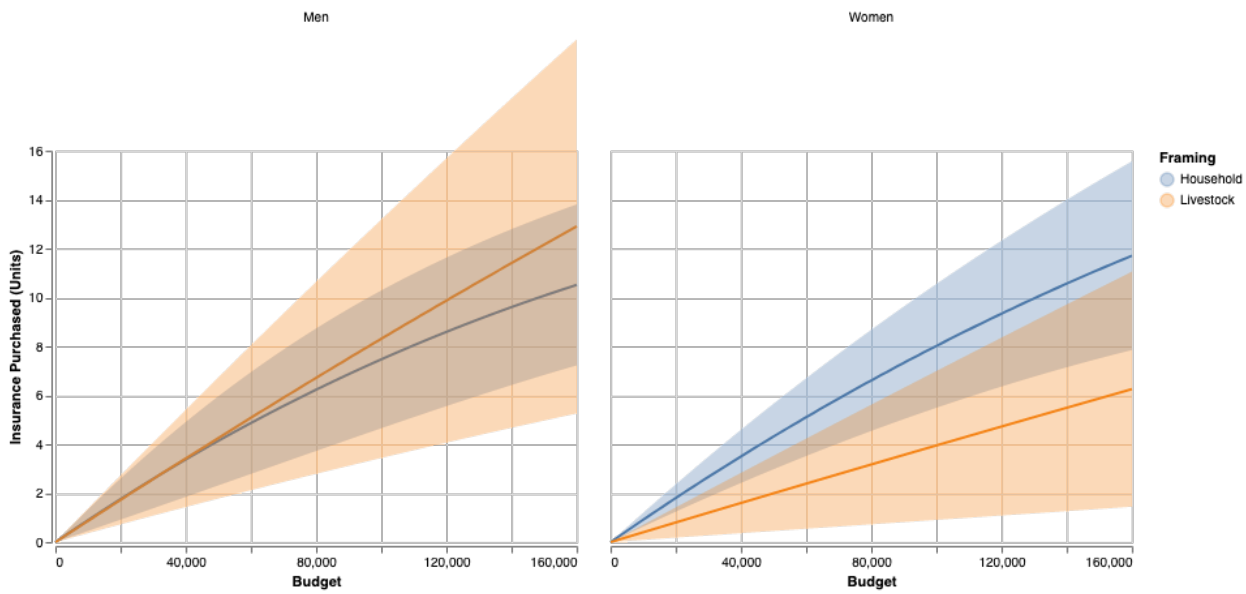

Figure 12: The household framing increases insurance demand for women and reduces it for men (clustered standard errors))

bargaining power for women. A potential solution to this problem is to reframe insurance as a transfer to be used to pay for household expenses in the event of a drought. We tested this framing using a lab-in-the-field experiment in Samburu County, Kenya, and found that as the theory predicts, women bought more substantially more insurance when it was associated with household expenses.

The theory laid out in this paper also provides an explanation for two other empirically documented gender disparities. First, it explains why households appear to make productively inefficient investment decisions by underinvesting in women's plots relative to men's (see Udry (1996)). Second, it explains why grants given to women's businesses have smaller impacts on profits than grants to men's businesses when women are partnered, but not when they are single (see Bernhardt et al. (n.d.)). Of course, the fact that this theory can explain these results does not prove that it does; testing this linkage is a promising area for future research.

Our experiment made it possible to measure differences in demand, but not differences in the impact of household insurance. In order to test for differences in impact, household insurance must be tested in the real world. The next step in this line of research is therefore to roll out household insurance in the real world to confirm that its greater popularity in the SimPastoralist game translates into the real world and that it does increase women's bargaining power in the event of droughts as predicted.

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Appendix 1: Average Effect Regression Results

The following tables contain the full System GLS results from the joint estimation of equations for insurance, goats, and the 'first stage' equation that estimates budgets as a function of the instruments.

Goats

The results for goats are analogous to the results for insurance.

Table 2: (#tab:goats_full) Coefficient Estimates for Average Effects Regression for Goat Demand

Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI	
Round 0	0.2518	0.0307	8.1978	0.0000	0.1916	0.3121
Round 1	0.4283	0.0316	13.559	0.0000	0.3664	0.4902
Round 2	0.5333	0.0348	15.338	0.0000	0.4651	0.6014
Round 3	0.3463	0.0393	8.8135	0.0000	0.2693	0.4233
Round 4	-0.0204	0.0475	-0.4299	0.6673	-0.1136	0.0727

Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI	
Round 5	-0.6857	0.0596	-11.497	0.0000	-0.8026	-0.5688
Round 6	-1.0514	0.0760	-13.837	0.0000	-1.2003	-0.9024
Round 7	-2.0048	0.0845	-23.737	0.0000	-2.1704	-1.8393
Round 8	-3.7095	0.0994	-37.328	0.0000	-3.9043	-3.5147
Round 9	-6.9385	0.1219	-56.900	0.0000	-7.1775	-6.6995
Household	0.0161	0.0315	0.5101	0.6100	-0.0457	0.0779
Female	-0.1677	0.0349	-4.8081	0.0000	-0.2361	-0.0994
Household x Female	-0.1677	0.0470	-3.5663	0.0004	-0.2598	-0.0755
Budget	0.0003	1.055e-06	266.84	0.0000	0.0003	0.0003
Budget^2	1.182e-11	3.768e-13	31.362	0.0000	1.108e-11	1.256e-11

Insurance

The results below are the same as those included in the paper except I include coefficient estimates for the round fixed effects.

Table 3: (#tab:insurance_full) Coefficient Estimates for Average Effects Regression for Insurance Demand

Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI	
Round 0	2.1993	0.0297	74.063	0.0000	2.1411	2.2575
Round 1	2.1193	0.0301	70.467	0.0000	2.0604	2.1783
Round 2	2.1762	0.0324	67.110	0.0000	2.1126	2.2398
Round 3	2.2412	0.0371	60.394	0.0000	2.1684	2.3139
Round 4	2.4055	0.0453	53.053	0.0000	2.3167	2.4944
Round 5	2.5781	0.0531	48.550	0.0000	2.4740	2.6821

Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI	
Round 6	2.4308	0.0636	38.226	0.0000	2.3062	2.5554
Round 7	2.4754	0.0742	33.377	0.0000	2.3300	2.6207
Round 8	2.6892	0.0698	38.546	0.0000	2.5525	2.8260
Round 9	3.0565	0.0939	32.544	0.0000	2.8724	3.2406
Household	-0.4384	0.0318	-13.775	0.0000	-0.5008	-0.3760
Female	-0.5048	0.0392	-12.869	0.0000	-0.5816	-0.4279
Household x Female	0.8428	0.0470	17.922	0.0000	0.7506	0.9349
Budget	5.115e-05	1.054e-06	48.509	0.0000	4.908e-05	5.321e-05
Budget^2	-1.657e-11	7.743e-13	-21.405	0.0000	-1.809e-11	-1.506e-11

Budget

These results are equivalent to the 'first stage' in a two stage least squares regression. As shown below, the instruments individually are very significant: chance plays a major role in determining future budgets.

Table 4: Coefficient Estimates for First Stage

Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI	
FracGood x Round 0 x StartBudget	0.5879	0.0006	999.44	0.0000	0.5868	0.5
FracGood x Round 1 x StartBudget	0.8348	0.0005	1538.6	0.0000	0.8338	0.8
FracGood x Round 2 x StartBudget	1.0362	0.0006	1659.9	0.0000	1.0350	1.0
FracGood x Round 3 x StartBudget	1.2890	0.0008	1523.0	0.0000	1.2874	1.2
FracGood x Round 4 x StartBudget	1.6090	0.0010	1538.3	0.0000	1.6069	1.6
FracGood x Round 5 x StartBudget	2.0690	0.0011	1890.8	0.0000	2.0668	2.0
FracGood x Round 6 x StartBudget	2.7623	0.0012	2215.9	0.0000	2.7599	2.7

Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI	
FracGood x Round 7 x StartBudget	3.7089	0.0014	2698.5	0.0000	3.7062	3.7
FracGood x Round 8 x StartBudget	5.2575	0.0018	2874.8	0.0000	5.2539	5.2
FracGood x Round 9 x StartBudget	7.2813	0.0006	1.233e+04	0.0000	7.2801	7.2

Appendix 2: Variable Effect Regression Results

The following are the results from the OLS regression with robust standard errors used to create Figure 11.

Table 5: Coefficient Estimates for OLS Specification of Variable Effect Regression

Variable	Coefficient	Std. Err	z	p-value
Intercept	9.31e-10	2.69e-10	3.460	0.001
Round 1	-1.812e-08	9.12e-09	-1.986	0.047
Round 2	1.051e-08	4.79e-09	2.196	0.028
Round 3	2.573e-09	1.53e-09	1.684	0.092
Round 4	4.945e-09	3.31e-09	1.492	0.136
Round 5	1.062e-10	2.3e-11	4.625	0.000
Round 6	1.255e-10	2.08e-11	6.034	0.000
Round 7	1.362e-10	2.29e-11	5.950	0.000
Round 8	1.253e-10	2.34e-11	5.355	0.000
Round 9	1.168e-10	1.76e-11	6.657	0.000
Household	-2.076e-10	7.28e-10	-0.285	0.776
Female	4.472e-10	3.03e-10	1.478	0.139
Household x Female	8.374e-10	4.97e-10	1.685	0.092

Variable	Coefficient	Std. Err	z	p-value
Budget	8.717e-05	1.86e-05	4.679	0.000
Household x Budget	4.321e-06	2.38e-05	0.182	0.856
Female x Budget	-4.691e-05	2.38e-05	-1.967	0.049
Household x Female x Budget	4.808e-05	2.85e-05	1.685	0.092
Budget^2	-3.997e-11	4.98e-11	-0.802	0.423
Household x Budget^2	-1.389e-10	1.14e-10	-1.216	0.224
Female x Budget^2	3.265e-11	5.06e-11	0.645	0.519
Household x Female x Budget ^2	1.755e-11	1.17e-10	0.150	0.881
Budget^3	-3.828e-18	2.71e-17	-0.141	0.888
Household x Budget^3	1.158e-16	1.15e-16	1.003	0.316
Female x Budget^3	3.93e-18	2.74e-17	0.143	0.886

The following are the results with clustered standard errors, used to create Figure 12:

Table 6: Coefficient Estimates for Cluster Robust Specification of Variable Effect Regression

Variable	Coefficient	Std. Err	z	p-value
Intercept	9.31e-10	3.85e-10	2.418	0.016
Round 1	-1.812e-08	1.01e-08	-1.787	0.074
Round 2	1.051e-08	5.36e-09	1.961	0.050
Round 3	2.573e-09	1.78e-09	1.449	0.147
Round 4	4.945e-09	3.81e-09	1.299	0.194
Round 5	1.062e-10	3.33e-11	3.188	0.001
Round 6	1.255e-10	2.83e-11	4.429	0.000
Round 7	1.362e-10	2.89e-11	4.716	0.000

Variable	Coefficient	Std. Err	z	p-value
Round 8	1.253e-10	2.81e-11	4.454	0.000
Round 9	1.168e-10	2.52e-11	4.637	0.000
Household	-2.076e-10	9.26e-10	-0.224	0.823
Female	4.472e-10	3.42e-10	1.308	0.191
Household x Female	8.374e-10	5.36e-10	1.561	0.119
Budget	8.717e-05	2.57e-05	3.392	0.001
Household x Budget	4.321e-06	3.15e-05	0.137	0.891
Female x Budget	-4.691e-05	2.29e-05	-2.051	0.040
Household x Female x Budget	4.808e-05	3.08e-05	1.561	0.119
Budget^2	-3.997e-11	8.7e-12	-4.592	0.000
Household x Budget^2	-1.389e-10	1.11e-10	-1.251	0.211
Female x Budget^2	3.265e-11	7.27e-12	4.491	0.000
Household x Female x Budget ^2	1.755e-11	8.29e-11	0.212	0.832
Budget^3	-3.828e-18	2.7e-18	-1.416	0.157
Household x Budget^3	1.158e-16	9.09e-17	1.274	0.203
Female x Budget^3	3.93e-18	4.91e-18	0.801	0.423
Household x Female x Budget^3	-7.2e-17	7.41e-17	-0.972	0.331