Explaining Index Based Livestock Insurance to Pastoralists

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Acknowledgements: This work was conducted with funding from the Assets and Market Access Collaborative Research Support Program (AMA CRSP) funded by USAID. The ideas and opinions expressed in this paper are those of the authors and do not necessarily represent those of the AMA CRSP or USAID. With a similar disclaimer, the authors would like to thank Chris Barrett, Michael Carter, and Munenobu Ikegami for making major contributions to the work described in this paper as well as participants in the AAEA & ACCI annual meeting for helpful comments and advice. Finally, thanks to all of our enumerators in Marsabit, and the participants in the index based insurance games we played.

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Abstract: Livestock production in arid and semi-arid rangelands is a risky enterprise. Covariate risk of catastrophic livestock loss due to drought is the most critical uninsured risk facing livestock producers. These losses can lead to persistent poverty. We are trying to design an index based livestock insurance (IBLI) program as a viable means to help pastoralists in northern Kenya manage such covariate risk of livestock losses due to drought. A predicted livestock mortality index – established from a statistical relationship between satellite-generated vegetation imagery and historical records of community level livestock losses – represents an objectively, cost effectively measured and non-human manipulable index that triggers insurance payout. The insurance is offered by private insurance companies. The advantages of reduced transaction costs and asymmetric information problems, however, come at the cost of increased basis risk, which refers to the imperfect correlation between an insured's loss experience and the index. We have developed a game that explains to pastoralists how such an insurance product could work. We built in the game both covariate and idiosyncratic shocks, and use a subsistence constraint to generate bifurcating asset dynamics, observed empirically in the targeted communities. This paper describes how the game was designed, how it was used in the field, and presents findings on how individuals played the game. The paper concludes by discussing how these findings are being used in the design and broader extension of the index based insurance product.

Introduction:

Surviving from livestock and livestock products in the arid and semi arid rangelands of the developing world is a risky way to earn a living. However, it is often the most economically viable use of these dry areas (Homewood 2008, Ellis and Swift 1995, Westoby et al. 1993, Behnke et al. 1993) and the pastoral societies who live in these areas have developed a variety of strategies to both manage risk exposure *ex ante* as well as risk coping strategies that can be adopted *ex post* (Morton 2006, Bollig 2005, McCabe 2004, McPeak and Barrett 2001). Because covariate risk of livestock loss due to drought still represents the key uninsured risk that conditions pastoralists' livestock accumulation, our project aims to investigate the possibility that a market viable index based livestock insurance can be added as a risk management tool for pastoral producers in arid and semi arid rangelands, which could as well complement to the broader poverty reduction program in these areas.

The pastoral production system is frequently described as having a 'boom and bust' pattern in herd sizes over time (Scoones 1993). Slow steady herd growth over a number of years is reversed in sudden widespread die offs. Pastoralists have utilized herd mobility, livestock loaning practices, herd accumulation, species diversification, marketing, and a variety of other means to reduce the size of losses in these 'bust' phases and increase the rapidity of the recovery in the ensuing 'boom' period. However, the evidence suggests that these shocks not only lead to human suffering during and following the loss of livestock, but they also impact decisions that livestock owners make in 'boom' periods that lead to lower income streams than might be realized in the absence of this looming risk. As there is currently little prospect that the underlying production risk can be reduced through new production technologies in a cost effective manner (such as irrigated fodder production, introduction of new breeds, or pasture seeding), an alternative is to introduce financial instruments that allow people a way to manage the risk.   This paper discusses how we have gone about introducing index based livestock insurance (IBLI) as a formal sector financial tool that can potentially be added into livestock producers' risk management strategy in Marsabit District of northern Kenya.

Pastoralist Production:

Northern Kenya is characterized by bimodal rainfall, with two rainy seasons interrupted by two dry seasons with each season lasting roughly three months. Pastoralists raise livestock in lowlands of northern Kenya, and some rain fed cultivation is possible in the highlands of this area. Mean annual lowland rainfall can be as low as 150 mm while in the highlands it can go up to 800 mm.   All but one of the sites we played the game (Dirib Gumbo is the exception) are in the lowlands. Rainfall is highly variable both spatially and temporally, and herders rely on mobility as a means of coping with variability in pasture conditions. Most land is communally held, and pasture growth is triggered by rainfall.

A sense of the variability in pasture conditions over time can be seen in Figure 1. Normalized Differential Vegetation Index (NDVI) measures – an indicator of vegetative cover widely used in drought monitoring programs in Africa – are drawn from an approximately 30km by 30 km area (a geographic boundary that covers key migratory routes) around North Horr and Kargi communities in northern Kenya. They are then standardized using long-term (1982-2008) mean and standard deviation[4] to represent deviations of NDVI from normal condition. Major livestock losses in these areas were clearly noted in 1984, 1991-2, 1994, 1996, 2000, and 2005-6. Late 1997 / early 1998 was the El Nino event that led to flooding in this area.

[4] Chantarat et al. 2009a provides detailed derivations of NDVI, standardized NDVI and other constructed NDVI variables necessary for constructing predicted livestock mortality index.

[Insert figure 1 about here]

The PARIMA (Pastoralist Risk Management) Project was active in northern Kenya and southern Ethiopia from 1998 to 2009. Many on the IBLI team also worked with PARIMA. Extensive data was gathered from random samples in eleven communities. Four of them (Dirib Gumbo, Kargi, Logologo, and North Horr) are in Marsabit district. From the PARIMA data, we can derive some background information on pastoral production in Marsabit district. First, we can see the profile of total income from data collected quarterly from June 2000 to June 2002, where all home produced and consumed commodities are valued at their market prices.

[insert table 1 about here]

Almost all of the milk is home produced and consumed. This indicates that livestock and livestock products contribute the majority of income (58%). While there is a significant contribution from non – livestock sources, livestock and livestock products clearly serve as the foundation for the economy in this region.

Vulnerability to livestock loss is also evident in the data from these sites. Figure 2 reports mean and median herd size for the Marsabit sites over time. This is measured in Tropical Livestock Units (TLUs)[5]. Though not all sites were identically impacted, there is a pattern that livestock losses occurred in mid to late 2000, followed by a slow recovery. From our continued work in the area, we can report that this recovery continued until 2005, when losses were again experienced.

[Insert figure 2 about here]

[5] 1 TLU is the equivalent of 250 kilogram liveweight of an animal. 1 TLU = 0.7 camels = 1 head of cattle = 10 sheep = 11 goats using the weights in the Range Management Handbook for Kenya's report on Marsabit District (Schwartz et al. 1991).

Figure 3 represents the number of livestock deaths reported per survey round in the four Marsabit sites, and breaks down these deaths into categories corresponding to the reasons for the death cited by the owner. It illustrates that there was a major covariate shock in the first three periods driving mortality, and that mortality occurs at a lower frequency and from different causes following the opening rounds that were characterized by widespread drought loss. This corresponds to the idea of there being both a covariate and an idiosyncratic component to herd mortality.

[insert figure 3 around here]

One other finding of relevance to the design of the insurance game is the idea of asset thresholds and bifurcating asset dynamics. Studies of long term poverty dynamics have increasingly identified the possibility that there are multiple stable states in asset space, so that assets above the threshold lead one toward a 'good' outcome, and below the threshold one moves towards a 'poverty trap' outcome (Carter and Barrett 2006, Zimmerman and Carter 2003). This issue has been explicitly studied for pastoral areas by Barrett et al. (2006) Lybbert et al. (2004) and McPeak and Barrett (2001). Previous research suggests there is a herd size threshold in the 10-15 livestock unit range, above which one is likely to be able to recover from a 'bust' and below which one is in danger of eventually losing the herd completely. We wanted to design our game so that there was a mechanism to allow for bifurcating asset dynamics.

In summary, the information in this section conveys four main messages. One, livestock and livestock products are critical for the generation of income. Two, livestock wealth is vulnerable to shocks. Three, there is both a covariate and an idiosyncratic component to livestock mortality. Four, the loss of livestock can have long term implications for a households well being. We now briefly explain how index based insurance works before turning to the issue of how we went about explaining how it worked to herders in northern Kenya.

Index based Livestock Insurance

Index based livestock insurance (IBLI) is a financial tool that has the potential to be used in managing the risk of asset loss (Carter et al. 2009, Chantarat et al. 2009a, Barrett et al. 2008, Mude et al. 2008, Barnett and Mahul 2007, Mahul and Skees 2005). In the case of northern Kenya, IBLI triggers insurance payout at the end of the coverage season (long rain – long dry or short rain – short dry seasons) based on a well defined predicted livestock mortality index, which is established from a strong predictive relationship between historical data on household livestock mortality recorded monthly over 2000-2008 by the World Bank funded Arid Lands Research Management Project (ALRMP) and various constructed NDVI variables (Chantarat et al. 2009a).

Insurance contracts are written with a trigger strike point of predicted livestock mortality rate (%), above which insurance payout will be made to the insured. Herders can buy insurance on a 'livestock unit' which is the cash value of a head of cattle. They buy this at the start of a season. And so if NDVI-based predicted livestock mortality index exceeds the pre-specified strike point, insurance payout will be made to compensate for the incremental loss (%) beyond this strike for total insured livestock units of the herder, who bought insurance at the start of the season.

Clearly, herders bear some of the risk of livestock losses, both in terms of a share of the estimated losses due to the covariate shock (below the pre-specified strike point) as well as any basis risk associated with idiosyncratic losses that are not explained by the index. No attempt is made to assess losses to individual herders or adjust payouts to reflect individual realizations. Livestock losses are compensated based purely on the covariate signal captured by the NDVI-based predicted livestock mortality index. An important message we hope to convey to people who play the game is that no idiosyncratic shocks or idiosyncratic deviations from what is predicted to be the covariate shock are covered by the insurance product.

Defining parameters for the game:

In early 2008, we began discussions of the use of games in our project to accomplish two objectives. The first was as an extension tool, designed to illustrate the basic idea of what IBLI does and does not do. Since the model of this project is to work with the private sector insurance companies to offer insurance that livestock owners will buy, it is critical that potential consumers be aware of how insurance works. This motivated our extension effort. The second objective was to generate some insight into how people might respond to the presence of livestock insurance. This would help us think through targeting, marketing, and possible contract design issues and also allow us to report back to the insurance companies what kind of response they might find when this product becomes commercially available. This motivated the current and related studies conducted by team members (Lybbert et al. 2009 , Carter et al. 2009)

As one goal of this paper is documenting how we went about explaining index insurance, this section describes how the work was conducted. In May 2008, three team members met in Nairobi to discuss the game and we began formulating a plan to be ready to conduct the game in the field by August 2008. In early July, we calculated herd growth, drought frequency, and drought severity parameters based on the PARIMA data, ALRMP (Arid Lands Resource Management Project) data, IPAL (Integrated Project on Arid Lands) data, and other sources on livestock production in the area (Torry 1973; O'Leary 1985; Robinson 1984; Schwartz et al.

1991). In mid July, a team meeting was held in Ithaca to talk through the design of the game, and this discussion continued though the final weeks of July in Nairobi.

We were developing two variants of the game at this point. Both were being used to generate bifurcating asset dynamics, and were based on two theories about what could generate the outcome found in earlier empirical studies described above. One variant was based on the hypothesis that the dynamics were generated by a subsistence constraint. To represent this we made herd growth common across herders, but added in a constant subsistence constraint that had to be met in each round by all players. The second variant was based on the hypothesis that those with larger herds were able to have the herds grow faster due to their greater ability to access higher quality pasture through migration. To capture this we made herd growth rates a function of current period herd size. We could devise a way to implement this in the game in a way that had some plausibility by using the story that higher herd sizes corresponded to higher milk production, so that consumption in the form of offtake from the herd declined as herd size increased. We experimented with using different parameter values and random number generators to investigate the long term dynamics of the different specifications we were considering. After much discussion and simulation, the fixed consumption specification was selected as it was easier to explain and easily generated the desired bifurcating asset dynamics we wished to illustrate.[6] Expected herd growth in this specification is 7.5% prior to offtake to meet consumption needs. As consumption was fixed regardless of herd size, the expected growth rate reflecting consumption is 0.075-(0.5/herd size).[7] This leads to the following graph

[6] While it remains an open empirical question which hypothesis is best supported by the data, as a team we tend to think the growth rate conditional on herd size due to differences in more likely. Unfortunately it was harder to develop this into a simple game.

[7] Consumption was defined to be 0.5 TLU per six month season as that was an easy to implement approximation of reality as will be discussed below.

of expected growth rate conditional on herd size (asymptotically approaching 7.5%, crossing zero at 6 2/3rds TLU)

[insert figure 4 about here]

Testing the game

In late July 2008, three members of the team who were to implement the game and are the authors of this paper spent the day in Marsabit playing the game with each other and modifying it to be simpler. For example, we modified the probability distribution of the seasons and the magnitude of herd growth associated with these probabilities to make the game have fewer potential seasonal outcomes but with the same mean, we experimented with alternative starting herd sizes and reduced them from four starting values to three (6TLU, 8TLU, and 10TLU), we decided only integer values of herd sizes could be insured and went with a 1% premium among other 'about to go in the field' modifications. The three herd sizes were chosen to be realistic in terms of peoples' experiences (see figure one for the median herd size) and to straddle the expected herd growth threshold. Our goal was to ensure the game was easy to understand while still conveying the core messages. By the end of the day, we have gotten to a point we felt the game was ready to go forward with testing using the enumerators. We worked up some flip chart posters overnight to explain some of the key elements of the game and also came up with the happy face / average face / sad face bottle cap representation of the idiosyncratic luck described below.

Training the enumerators.

Over a two day period we trained the enumerators in how the game worked. Much of it was based on two of our team playing the game in front of the enumerators with the third writing the results up on flip chart paper and running the game. We showed a basic game with differing initial herd sizes and common shocks. We then showed how it worked with idiosyncratic shocks. Finally we discussed with them how insurance worked. At the end of the training we ran all the enumerators through a full game as players so they could see how it worked and also for us to troubleshoot any problems that arose. Lots of math problems were encountered, but slowly enumerators got the language down and the idea down. At first, we just stressed the herd dynamics, difference between covariate and idiosyncratic risk, and consumption requirement. We then added in insurance and had enumerators play a few rounds with it to show them how it was represented in the context of the game. We spent some time stressing how the fact that an idiosyncratic shock was not compensated could be used to illustrate what kinds of losses insurance could not help with. By the end of the day, they seemed to grasp what we were after. We developed a form to use to record the play of participants that was designed to minimize enumerator errors as much as possible. We quickly photocopied a set of these to be used the next and following days in the villages.

How a 'game day' was structured.

The basic pattern of the game was repeated two consecutive days in each community and five communities were visited so there were ten total 'showings' in all. Start time varied by site. We arrived at a central point in the village that had been arranged as the meeting point ahead of time between 8:30 and 10:00 and spent some time tracking down people that took a variable amount of time. When we did start, we first thanked them for coming and went ahead with oral consent procedures. In some cases a prayer was offered by the participants to start the meeting. We then spent some time introducing the game and the idea of index based insurance. We described how the PARIMA work, the ALRMP work, our parallel willingness to pay studies (Chantarat et al. 2009b), and the work we were doing today would be combined to generate the details of the real insurance we hoped to offer in the coming year. We noted that this was the first visit, but there would be more. Also, we stressed that insurance would be for whoever wanted to buy it when we really offered it, not just the people here today. There had been some confusion about this in the sites that we wanted to clear up.

We noted in the introduction that there were two main goals of our work in the village that day. First, we were still trying to design this insurance that we hope to have commercially available to them in the future. We wanted to use the evidence we gathered in the game play to come up with the best design possible. Second, insurance is a new idea. We told them that if we are going to offer people the opportunity to buy insurance, they have to understand how it works, and what it does and does not cover. We explained the basic concept behind insurance was to take money when times were good and return it when times were bad. We stressed that this was index insurance that would be based on the season but not tied to a particular animal, as there was no way the insurance company would be coming out to their satellite camps to check on their personal losses.

We then moved on to show participants NDVI data based graphs and tried to explain how these would be used by the actual insurance game. We had created a seasonal graph for a 30 kilometer radius around each of the sites before coming to the villages. We identified which were the high points and which were the low points so they could see how the patterns in the NDVI based graphs matched their memories of conditions on the ground. We talked some about the moving stars that they had seen at night being satellites taking pictures and how that could be used by this insurance product.

We then moved on to an explanation of the game. We showed them the chips, explaining that a white chip was a head of cattle, a red one a goat and a green one a sheep. In our game goats and sheep were the same value, and 10 of them equaled on head of cattle. We told them they could think of it in terms of exchange like the terms by which people in their villages trade livestock with each other outside of market exchange, and they said the rates were about right given their practices. In the camel raising sites we also said for our purposes, one head of cattle and four goats equaled one camel (1.4 TLU). We then explained that each season was six months long, and started with a rainy season followed by a dry season. We used the local terms to describe the rainy season – dry season pairs.

We talked about the need to sell livestock in each period to generate income for consumption goods, which from previous survey work averaged slightly less than one goat sale a month. For ease of transactions, we fixed consumption at 5 goats or sheep at the start of each six-month season. This was usually translated by enumerators and participants as some variant of 'food for the kids'.

We then showed them the ping pong balls and explained their meanings. There were 16 ping pong balls in a plastic bag. Each type of ball was explained in local language terms that are commonly used to describe kinds of seasons. There were five +20% balls with a crossing pattern drawn on them. These were said to be a really good season. For each head of cattle you had, two goats or sheep were born. Alternatively, if you had ten head of cattle, two more were added. This was described and illustrated by laying out chips to add to a herd. We then looked at the seven +10 % balls. This was a good season. This was the most likely kind of year, and for every one head of cattle you had, one goat or sheep was born. We did the laying out of chips for this again too. Two balls were all blue. These were zero growth balls, where none were added or taken away by the season. This was a bad year, but not a drought. Then there were two final balls. One, half covered in red, was a season where 20% was lost. We showed them again with chips how such a season would work. Then we showed them the final ball all covered in red, a very bad drought where 30% was lost. We illustrated with chips how this kind of season would work.

As noted above, expected growth is 7.5% with these values and when consumption is factored in, there is a herd size threshold at 6 2/3rds TLU that determines whether expected herd growth with consumption factored in is positive or negative (though we did not stress this in the description of the game to players, preferring to see if they could identify the larger pattern through playing the game). After answering a few questions and making clarifications, we told them we were ready to start the game.

We first played the game with each table (5 tables, 4 people per table was the usual format) having a herd size determined by drawing one of three knives from a sleeve that covered the blades. A red blade knife meant a 6 TLU starting herd size, a blank one 8TLU, a black blade knife 10 TLU. At each table, we usually had two people helping them with the game. One served as a calculator / recorder, the other as a translator / explainer / chip collector and distributor. One member of our team was at the center of the room making announcements about the game, and floated from table to table in the course of the each round checking math and answering questions while the other two worked at one of the tables as calculator/ recorders. To determine the covariate shock in each season, the person running the game walked around the room with the bag full of ping pong balls and had a different participant draw one ball from the bag. For a complete game this seasonal draw happened ten times corresponding to 5 years. This first run through was rather quick, showing them how the game worked in the most basic form.

After this first run through, we introduced the idea of individual luck. For this, we had a set of black bags, one for each table, each bag having a white plastic soda cap with a happy face drawn in black (+10%), an even face drawn in blue (0%), or a sad face drawn in red (-10%). We explained how the ball would be drawn, then we would adjust up or down by the value corresponding to the face to get their particular herd size change. We said the faces were representing things like sickness, raids, wild animal attacks, and stressed that these were the kinds of things that lead to herd loss that insurance would not cover. Only the draw of the ball from the bag could trigger insurance compensation.

We then ran the game again, but this time with each person having his or her own starting herd size. This variant of the game had random initial herd sizes, covariate shocks, and idiosyncratic shocks but no insurance. The balls were drawn one after the other for each season and we recorded what happened. We then took a lunch or a tea break depending on whether we started early or late, and came back again to illustrate how insurance works. We took the values of the faces and balls that were drawn in the last game and showed them how they would have come out with mandatory insurance to the nearest TLU.

We began by introducing the black chips and said they were like money. You sold a goat, you got ten black chips; if you sold a goat for 1000 shillings, each chip was like a 100 shilling note.[8] If you wanted to insure a head of cattle, you had to pay one black chip to cover it with insurance for a season. This worked most clearly if a set of white chips was laid out flat on the table and each one was covered in turn by a black chip that was scooped up and taken away.

We then illustrated how insurance worked. First we went through all the non-drought balls in turn, showing them that they would only pay at the start of such a season and nothing would come back to them. It was only the two red drought balls that returned something, and

[8] 100 shillings is around $1.30 with the exchange rate at $1=75 Ksh.

these did so in different ways. The one that was half red, the 20% loss, would give them one goat in compensation for each head of cattle insured. This was illustrated by taking a pile of ten white chips, covering them with ten black chips, drawing the half red drought ball, removing two of the white chips for losses during the drought, then bringing back 10 goats and sheep chips corresponding to the ten black chip payment. These ten goats were then transformed into one white chip for a net loss of one white chip. We did the similar illustration with the 30% all red drought ball, removing three white chips for the drought loss, bringing 20 goats and sheep, and turning them into two cattle for a net loss of one white chip. In technical terms, we illustrated that the insurance compensation they could expect to receive at the end of a drought round was defined by: (predicted covariate mortality rate – 10%) × total insured livestock units. We stressed that the bad thing about insurance was that you don't grow as fast during good years since you have to keep selling goats to buy insurance and get nothing back from the insurance company in these years. The good thing is that it brings you animals in the relatively rare instances that a drought occurs and you suffer losses. We told them that insurance makes it so your herd size does not climb as high as you would go in the absence of insurance payments, but you don't fall as low with insurance as you would have without insurance. We then went though how the covariate and the idiosyncratic could interact for losses, while the insurance was based on the covariate. We illustrated the different outcomes that could occur with each of the two drought balls interacting with the three different kinds of bottlecaps that could be drawn.

After making sure people had the basic idea, the enumerators at the tables took them through the calculations and changes to their herd size using the same starting herd size, covariate, and idiosyncratic shocks seen in the previous game. We then showed each of them what had happened to their herd in the game with insurance compared to without insurance.

This was rather mechanical, but did give them a ‘with’ and ‘without’ comparison. In almost all cases it showed you did not fall as far during the drought and ended up better off at the end of the game with insurance due to the combination of insurance payouts and herd growth being an increasing function of herd size. In one case, in Dirib Gumbo, people ended up about the same with and without insurance. This was used to illustrate another possible outcome, and came about because there was no drought until round 8 and it was a 20% drought, and the decreased herd growth in the first 7 rounds due to livestock sales to pay insurance was about the same size as the payout in the drought. This was a good message and one we stressed in other places, but after that we got a bit trickier about making sure a drought hit in rounds 3-5 (sampling without replacement and having the drought balls on top of the other balls when people reached in to draw a ball). We did make sure they understood it was possible that we could go all ten seasons with no drought happening so that you did not ever get a payment, but for demonstration purposes we attempted to make sure this did not happen in the demonstration of with and without insurance.

After getting through this comparison, we usually took a lunch break or a second tea break, depending on the timing. We came together for one final game. The analysis presented below is of the pattern of play revealed in this final game. In this game, we explained that now they had to make a choice about the share of the herd that they would insure in each round, just as they would have to do with the real insurance. If a player wanted to insure none, some, or all (to the nearest lower integer TLU value), that was up to each player. We stressed that the payoff in a drought would be based on the number of TLU insured, not what the player had or lost if they did not buy full insurance. We stressed that this would mean that if they did not insure or did not fully insure, they would not have to sell as many livestock over time to make insurance payments, but they also would not get as any or as many back in a drought compared to someone who fully insured. We noted that they had to make this insurance decision for each round; if you insured last round and did not insure this round and the drought came in this round, you would not be eligible for compensation. Finally, we discussed this decision in the real world context that an insurance company based in Nairobi would really have no way of knowing how many animals a herd owner truly had, so this decision was like the one we will face in the real world – they stated the number they wanted to insure.

Before starting the game, the person running the game showed them pieces of paper with numbers 6-10 on them. A player picked one of these papers and put it in the pocket of the person running the game. We told them in this game, we would give everybody 100 shillings (around $1.30) at the end to thank them for playing the game. However, you could win a cash bonus. If you were above your starting period herd size at the end of the round in my pocket by less than 1 TLU, you won 20 more shillings. If you were more than one but less than two TLU ahead, 40 shillings. For each additional TLU, an additional 20 shillings was added. After we had done this in a few places, we told them about the maximum and minimum kinds of payments we had been seeing in the other places. The idea behind this was that a cash reward for game play might induce people to take the game more seriously than they would otherwise. We then fielded any final questions and ran one final game.

In this version, we did not tamper with the balls to make a drought happen. In a few cases no drought happened. After we finished up this game and calculated payoffs, we had a final discussion before breaking for the day. Sometimes this was a longer discussion about how this would really work. We told them we would be coming back with more information as time went by and we would work with them on the details. Questions that came up were where one could pay, would the payout be in cash or in livestock, whether you buy for the year or the season, if you get paid if you pay for many years but not the one with the drought, and what kind of payment range we expected. We usually introduced our willingness to pay experiment to follow up on this work that would be going on in the next few days. We usually stressed that this was a 3-5 year project that we were starting. The donors were giving us money to both help develop the idea and to help extend the idea since it is a new concept. We would be coming back to explain and work with them on the design and to ensure they understand the idea. But our goal was to have this be something they could do to help themselves when we finished. If we do our job right, there will be no need for donors to help on this in the future; this is something they can do to protect themselves against drought. Sometimes we ended with a blessing or prayer, sometimes it was getting dark and people wanted to get home so we wrapped it up as fast as we could. We would pack it all up and get ready to either move to the next town or run the show again in the same town on the following day. The earliest we finished was 3:30 in the afternoon, the latest was 6:30 in the evening.

How they played the game:

We played the game for two days in each of five locations with a total of 207 players. It was interesting as we played that people figured out pretty quickly how they could get pulled under the herd size threshold. Once people got to about three animals, they started to make jokes about climbing on lorries and heading to Nairobi to become a watchman. They knew that it was just a matter of time before they got washed out and the question became would they make it to the end of the game. There were lots of comments about how this game was a lot like their lives. That was both encouraging and also helped explain why they seemed to grasp it quickly whether they were school teachers, herders, nursing mothers, grandmothers, business persons etc.

Another notable characteristic of the days was how much laughing and joking around there was. People got into it and though it was a long day with a complicated game, there was a lot of laughing and not all that much grumbling as the day went on towards night. The good luck / bad luck draws really got lots of reaction (to the extent that the -10% idiosyncratic red bottle cap went flying across the room after being thrown in a few cases). They also had reactions like covering their eyes or flicking their hands at the person running the game to go away when he went around the room showing the red -30% drought ball had been drawn. With regard to insurance, there was a sense that they knew it had to be more complicated than in our simple game (and they are right), but if something like this could come, it could be very helpful. There were also frequent requests to keep coming back to explain insurance, since they were interested but really wanted to get more detail. We told them that we were the researchers, not the insurance people, and that if they thought this was a good idea, go tell people that. If they think it is a bad idea, go tell people that too. We want this to be something that people choose because they think it will help them, and that is why we have come with this idea.

Analysis of participants' insurance decisions in the final variant of the game where they decided what share of the herd to insure reveals several noteworthy results. First, looking at play across all ten rounds, 49% of subjects insured half or more of their herds in all ten rounds and 12% insured the full value of their herds in all ten rounds.

Table 2 summarizes the comparison between 'with insurance' and 'without insurance' in the final version of the game. These results are generated by comparing actual play recorded in the game to a counterfactual that 'shuts down' the insurance market in a spreadsheet. These results allowed us to demonstrate to participants that the main benefit of IBLI was that it reduced variability in herd size over time – particularly for relatively small herds near dynamic thresholds. The differences in mean herd size insured across the different starting herd sizes are statistically significant using t-tests.

[Insert table 2 about here].

To further investigate insurance decisions, we estimate a tobit model with the fraction of the herd insured in a given round as the dependent variable (double-censored at 0% and 100%). The sample size in the regression is 1863, as we use lagged variables from the previous round in the regression to see if people react to past round outcomes.

[Insert table 3 around here]

The dynamic nature of the game is reflected in these results in a variety of ways. First, the share of the herd insured increases as more rounds were played. We are not entirely sure why this may be. It could be learning over time, or the fact that the payout round was announced in advance to be in rounds 6-10, or perhaps some other explanation.

[insert figure 5 about here]

Second, the dynamic structure of the experiment allows a nuanced understanding of the wealth dependent effects. On one hand, the coefficients for the initial herd size dummies illustrate that the higher the starting period herd size, the higher the share of the herd insured in subsequent rounds of the game. On the other hand, the beginning round herd size results indicate that the share of the herd insured is a decreasing function of herd size. Figure six presents simulated estimation results for the predicted share of the herd insured conditional on current round herd size. The contrast between the two effects helps to explain the summary statistics in Table 2. Subjects starting with 6 TLU insure a greater share of their herd on average not because of their starting point, but because they tend to have smaller herds across all rounds and share insured is inversely related to herd size. One interpretation of the shape of the curve is that people have in mind some worst case post-drought herd size, so that as herd size increases, there is less concern about having too small a herd following a shock.

[insert figure 6 about here]

Finally, subjects tend to insure more of their herd immediately after experiencing a negative shock. While this makes sense in some psychological sense if the value of insurance is clearer after getting hit with a bad shock and seeing others around you compensated, it does suffer from closing the barn door after the horse has escaped logic. Further adding to this puzzle, this response is both quantitatively and statistically stronger for the idiosyncratic shock even though insurance is explicitly linked to the covariate shock. In ongoing analysis, we will explore this effect further by linking the observed game play with a parallel contingent valuation study of individuals' willingness to pay for insurance and underlying risk preferences.

[insert figure 7 about here]

What comes next with the game?

Currently we are experimenting with using laptops and local wireless networks to automate data entry and within game computations. We need to find a way to make the game less labor intensive. Last year, it required a team of three project members to lead the game, together with a team of seven to ten enumerators per day to play the game with 20-25 people per day. This meant that we had to play the game two days in each village to reach 40 people per village. We are trying to find a way to make us able to reach more people in a more time and cost effective manner.

We will be modifying this game to match more closely what the insurance companies will be offering as we get closer to the launch date. We also will be extending this effort to sites we have not played the game in yet. But we will maintain the core approach of using the game to both extend the idea of insurance and to gather some information about how people are likely to use the product when it becomes available.

Conclusions.

As a team, we felt this effort met with some success in the field as an extension tool. People did seem to understand the basic idea of the game, and seemed to enjoy playing it. There has been a great deal of interest from people in the area where we played the game to know when we would be able to offer the real financial product it was designed to illustrate. At this point, we are hoping for a January 2010 launch and are in the midst of playing the game in a different set of communities using the local network and laptop approach.

It was also beneficial to have the results of the game play to develop a new set of questions we can focus on in the follow up work we are currently planning. A set of questions emerged that we plan on investigating:

1) Why does the share insured increase as players play more rounds?
2) What explanation would players give for the graph of the influence of herd size on insurance purchase?
3) Why are there site differences?
4) What explanation would players give for the reaction to the idiosyncratic shock we see in the estimation results?
5) How will game play match up to risk tolerance and willingness to pay evidence gathered in a related study with these same herders?

We intend to continue our work in this area for the next few years, with the overall goal of being able to offer to herders in these rangelands a financial instrument that they will be able to use to help manage risk. Once we feel we have it working in the Marsabit area we have the most experience with, we will look to expand to other arid and semi-arid rangelands where there is potential demand for this product.

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Figure 1: Standardized NDVI (1982-2008) for North Horr and Kargi

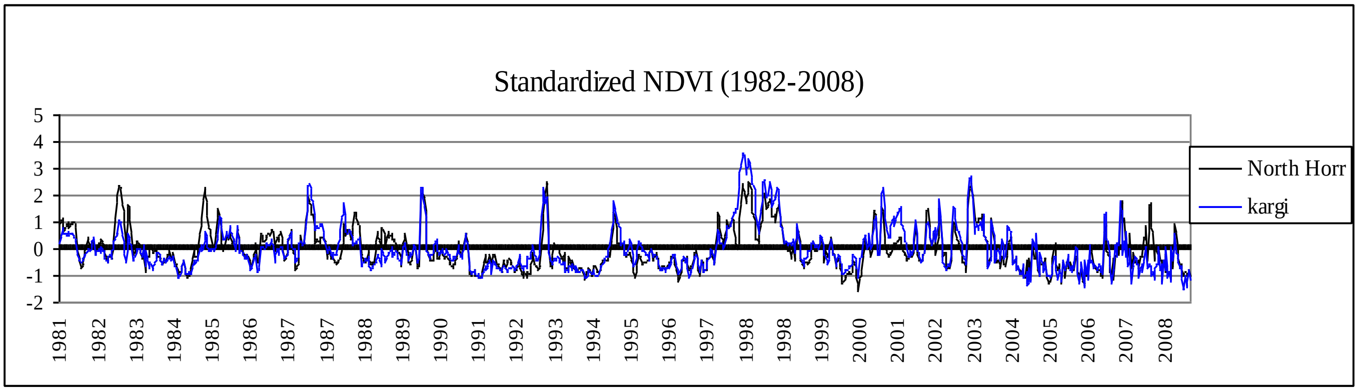

Figure 2: Mean and median herd size in TLU for the four Marsabit sites 2000-2002

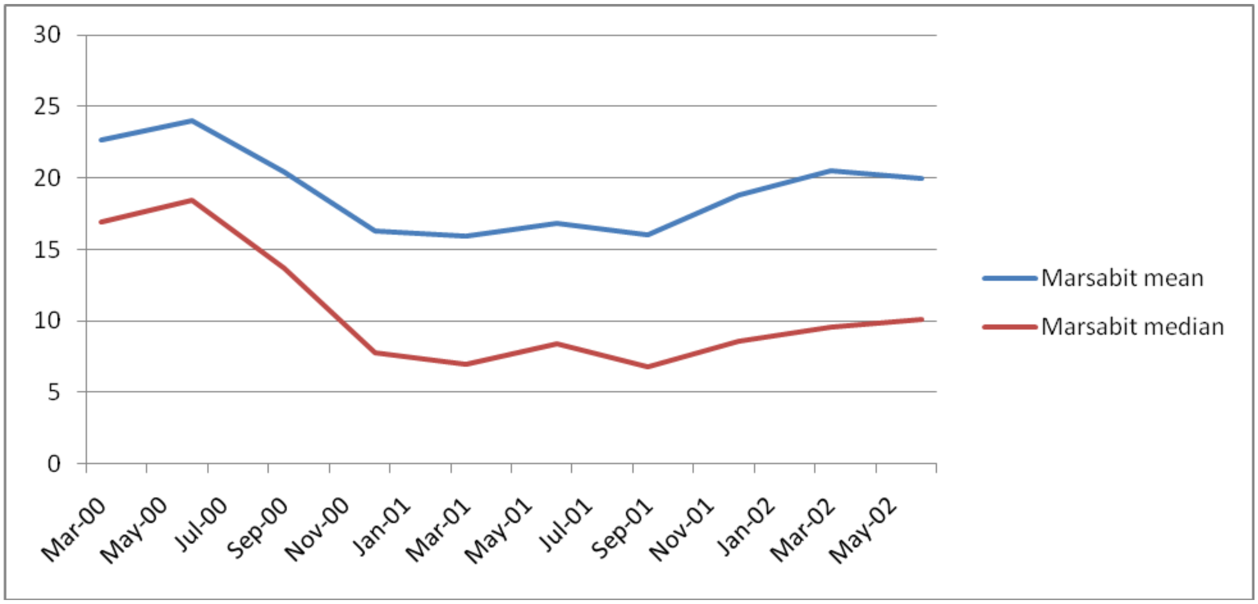

Figure 3: Reason cited for livestock mortality in the four Marsabit sites quarterly 2000-2002

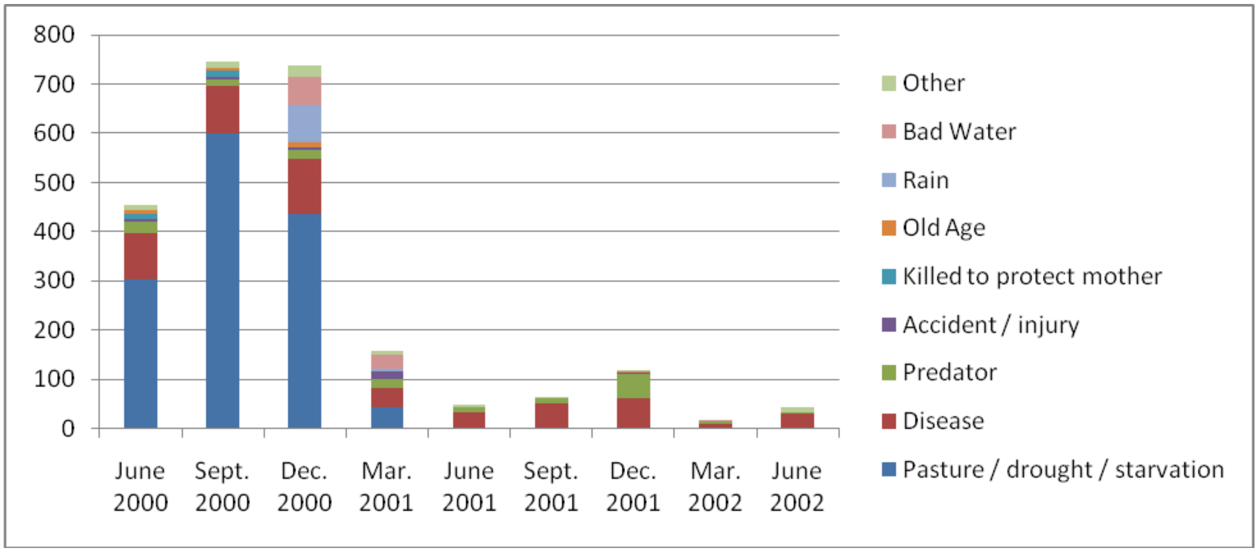

Figure 4: Expected Herd Growth reflecting Fixed Offtake

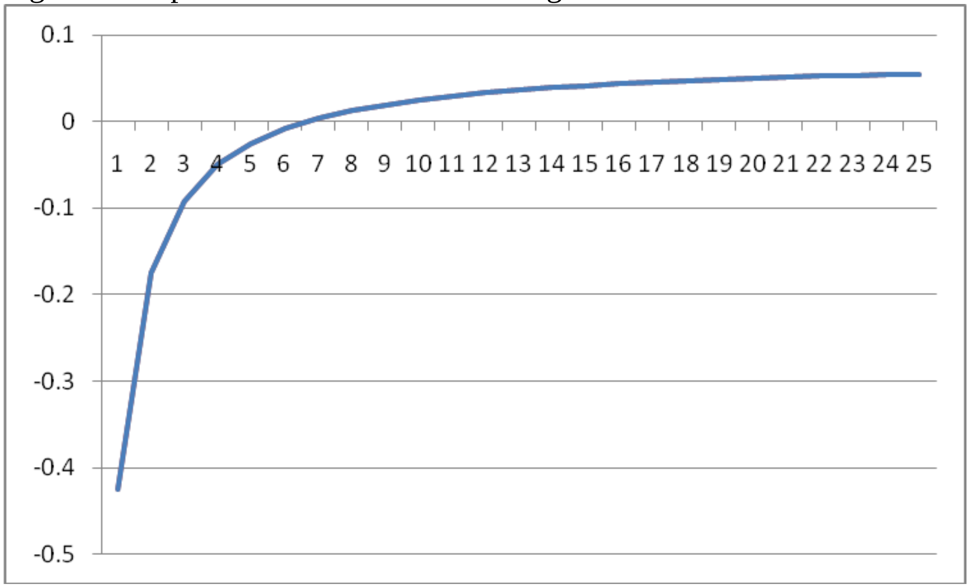

Figure 5: Predicted share of herd insured by round of the game

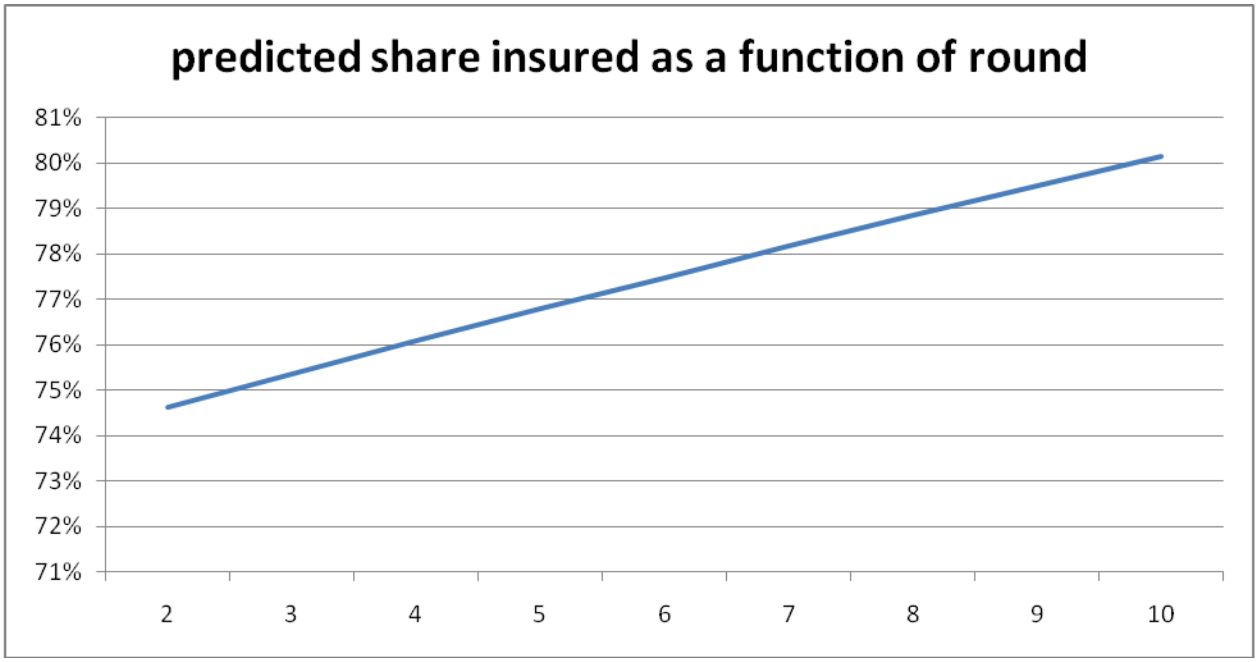

Figure 6: Expected share of herd insured conditional on starting game herd size and round specific herd size (herd size on x-axis)

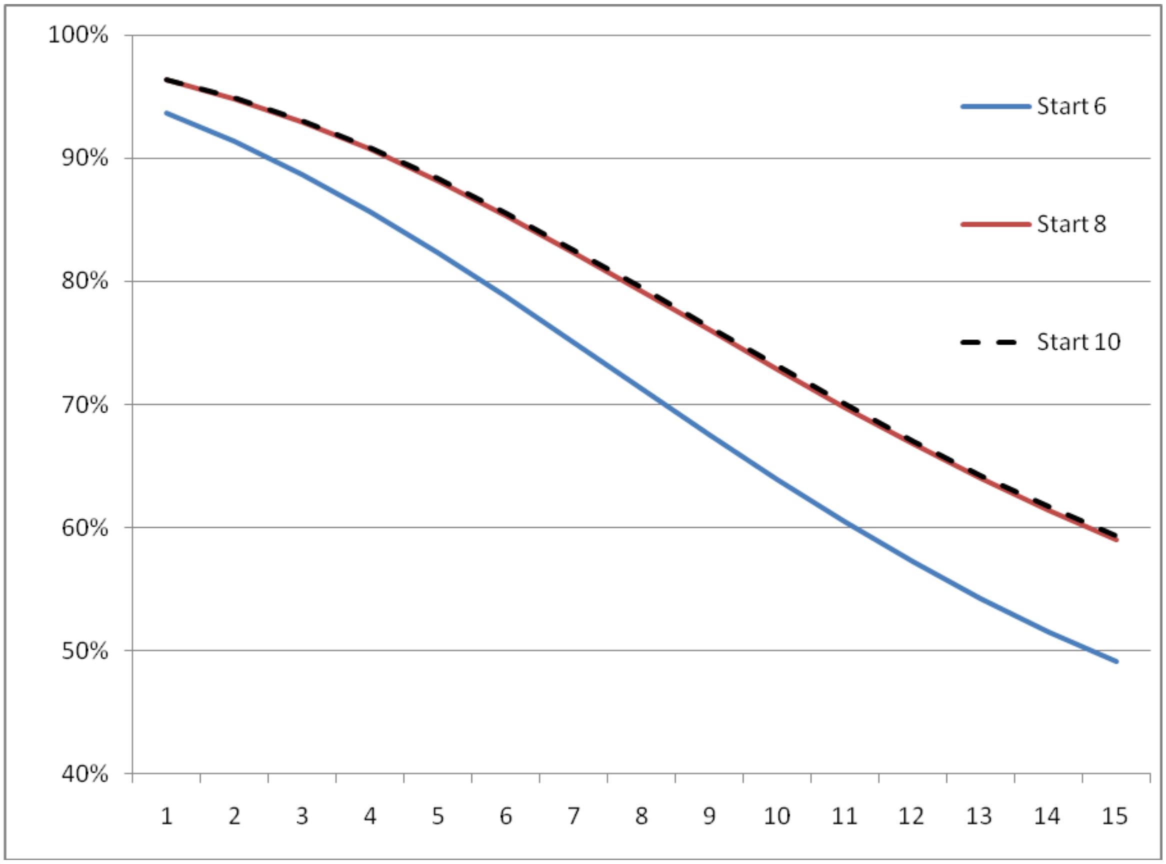

Figure 7: Share of the herd insured in current round as a function of last round's shocks

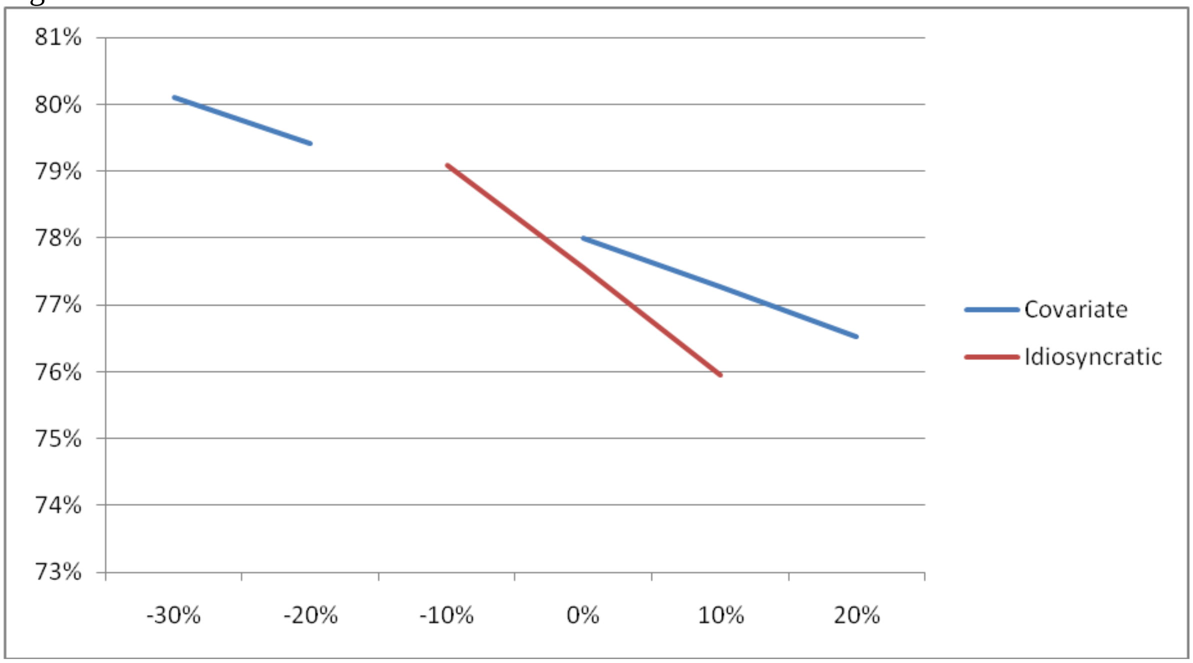

Table 1: PARIMA data on total income in four Marsabit District sites

Milk	Livestock Sale	Slaughter	Food aid	Salary/ wage	Cultivation	Trade	Gift
44%	10%	4%	15%	14%	6%	4%	2%

Table 2: Contrasting outcomes with and without insurance in Kenya

	Mean herd size 'with' greater than 'without'	**Mean variance in herd size across rounds 'with' compared to 'without'**	**Mean share of herd insured across rounds**
6 TLU start	+3%	-40%	81%
8 TLU start	+2%	-29%	78%
10 TLU start	+3%	-22%	68%

Table 3: Double censored Tobit estimation of share of herd insured in each round of final game

	Coefficient (Standard Error)
Round number 2-10	0.0123 *** (0.0046)
Dirib Gumbo dummy	0.1081 *** (0.0378)
Karare dummy	0.1285 *** (0.0346)
Kargi dummy	0.1365 *** (0.0354)
North Horr dummy	0.0906 *** (0.0365)
Start 6 TLU dummy	1.2458 *** (0.0771)
Start 8 TLU dummy	1.3811 *** (0.0938)
Start 10 TLU dummy	1.3854 *** (0.1022)
Herd size round start	-0.0910 *** (0.0139)
Herd size round start squared	0.0020 *** (0.0005)
Covariate last round	-0.0013 (0.0009)
Idiosyncratic last round	-0.0028 * (0.0015)
Sigma	0.4454 *** (0.0113)
Decomposition fit	0.47
N	1863

Logologo is omitted site dummy, no constant included, two limit tobit estimation, pooled data (no control for 9 rounds per player, 207 players)
*** is significant at the 1% level, ** at the 5% level, * at the 10% level

Endnotes