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Welfare Impacts of Index Insurance in the Presence of a Poverty Trap

SOMMARAT CHANTARAT[a], ANDREW G. MUDE[b], CHRISTOPHER B. BARRETT[c] and CALUM G. TURVEY[c,*]

[a] *Puey Ungphakorn Institute for Economic Research, Bank of Thailand, Thailand*
[b] *International Livestock Research Institute, Kenya*
[c] *Cornell University, United States*

Summary. — This paper evaluates the welfare impacts of an index-based livestock insurance designed to compensate for satellite-based predicted livestock mortality in northern Kenya, where previous work has established the presence of poverty traps. We simulate household wealth dynamics based on rich panel and experimental data. The bifurcated livestock dynamics associated with the poverty trap gives rise to insurance valuation that is highly nonlinear in herd size. Estimated willingness to pay among vulnerable groups who most need insurance is, on average, lower than commercially viable rates. Targeted premium subsidization nonetheless appears to offer more cost-effective poverty reduction than need-based direct transfers.

Key words — index insurance, asset risk, poverty traps, safety net, risk preference elicitation, Kenya

1. INTRODUCTION

Index insurance has gained widespread interest in recent years as an instrument for reducing uninsured covariate risk in poor rural areas that typically lack access to commercial insurance products. These financial instruments make indemnity payments based on realizations of an underlying index—based on some objectively measured random variable—relative to a pre-specified threshold, the "strike" (Barnett, Barrett, & Skees, 2008). Index insurance offers significant potential advantages over traditional insurance. Because indemnity payments are not based on individual claims, insurance companies and insured clients need only monitor the index to know when payments are due. This sharply reduces the transaction costs of monitoring and verifying losses, while also eliminating the asymmetric information problems (i.e., adverse selection and moral hazard) that bedevil conventional insurance. These advantages have sparked considerable interest in index insurance for poor regions otherwise lacking formal insurance access (Barnett & Mahul, 2007).

The advantages of reduced transaction costs and asymmetric information problems, however, come at the cost of increased "basis risk", the imperfect correlation between an insured's loss experience and the behavior of the underlying index on which the index insurance contract is written (Woodard & Garcia, 2008). A contract holder may experience losses but not receive a payout if the overall index is not triggered. Conversely, the aggregate experience may trigger indemnity payments even to insurees who experience no loss.

Given this tradeoff between basis risk and reduced incentive problems and transactions costs, the impact of index insurance on well-being remains under-investigated, especially in the case of index insurance on assets that determine the time path of future earnings and welfare. And because the current experience of index insurance has thus far been plagued by limited uptake and predictable questions about the quality of the initial contracts (Binswanger-Mkhize, 2012), empirical evidence on the impact of index insurance on the well-being of otherwise-uninsured poor populations remain quite rare. This paper offers some initial, ex ante impact assessment of a specific index insurance contract that launched in Northern Kenya in 2010. It also offers an innovative approach to establishing the ex ante welfare effects of and willingness to pay for asset insurance and demonstrates how the presence of asset thresholds associated with poverty traps can affect insurance valuation and effectiveness.

The arid and semi-arid lands (ASAL) of east Africa are among the poorest regions on Earth, with severe (less than $1/day) poverty rates routinely in excess of 75%. Given meager rainfall and infrastructure, the pastoralist populations who inhabit these areas rely heavily on extensive livestock grazing for their livelihood. Recent economic research, building on extensive prior ethnographic work, finds that east African pastoralists operate in an environment characterized by multiple herd size equilibria characteristic of poverty traps (Barrett *et al.*, 2006; Lybbert, Barrett, Desta, & Coppock, 2004; Santos & Barrett, 2011). The prominent role that uninsured covariate climate risk plays in driving pastoral poverty traps (Santos & Barrett, 2007) and growing concern that droughts are driving growing numbers of pastoralists into destitution (Sandford, 2006; Little, McPeak, Barrett, & Kristjanson, 2008; Barrett & Santos, 2014), naturally

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motivated the recent development of index-based livestock insurance (IBLI) against catastrophic herd loss in the northern Kenyan ASAL (Chantarat, Mude, Barrett, & Carter, 2013). These IBLI products have been commercially piloted since January 2010.

Like typical insurance, IBLI compensates for livestock loss. But unlike traditional insurance, it only compensates for covariate herd losses that are predicted by the historical relationship with remotely sensed Normalized Differential Vegetation Index (NDVI) measures; an indicator of vegetative cover widely used in drought monitoring programs in Africa. These data are publicly available in near-real time and objectively verifiable. Chantarat *et al.* (2013) explain the details of the IBLI contract design and show that it performs extremely well out-of-sample in insuring against catastrophic covariate shocks in this region. In this paper we use household-level panel observational data, coupled with data from field experiments, to simulate the impact of IBLI on Northern Kenyan pastoral households' welfare dynamics. [1]

This paper makes several novel contributions to the literature. First, IBLI insures assets rather than income. Although the overwhelming majority of the global insurance market insures assets through property and casualty, life or health insurance products, most index insurance on offer in the developing world focus on replacing lost income, typically due to rainfall shocks that affect crop production. The loss of productive assets like livestock potentially disrupts future income processes, not just current earnings. Furthermore, in the presence of a poverty trap, shocks that push herd sizes below a critical threshold at which herd dynamics bifurcate can have especially severe consequences, because below this point livestock wealth is expected to collapse, compromising future income generation. Thus insurance that effectively protects households from slipping into the poverty trap can be of especially high value to those near the threshold (Lybbert & Barrett, 2011). Conversely, insurance that consumes scarce resources and fails to protect the household from catastrophic shocks can do damage. Given these considerations, we evaluate IBLI's performance using a dynamic simulation model rather than the usual static approach employed in the existing literature. We show that the effectiveness of IBLI depends on initial herd size relative to the bifurcation threshold as well as, to a lesser degree, on household-specific basis risk and risk preferences as well as, of course, the terms of the IBLI contract.

Second, rather than modeling insurance impact for a representative agent, as is the norm in the extant literature (Skees *et al.*, 2001; Turvey & Nayak, 2003; Vedenov & Barnett, 2004; Deng, Barnett, Vedenov, & West, 2007), we explicitly study how welfare impacts of IBLI varies based on variation in household characteristics, such as initial herd size, and key basis risk and risk preference parameters. And rather than making assumptions about these parameters, we estimate them from panel data and field experiments from the area. Contracts that perform well for a representative household may not prove effective for target sub-populations. We show that may be the case with IBLI.

Finally, household-level simulation analysis allows us to compare the outcomes of various subsidization programs and targeting schemes that might vary IBLI contract terms faced by prospective purchasers. Our analysis finds that IBLI subsidies targeted toward vulnerable-but-non-poor pastoralists create an effective safety net by protecting such households from slipping into a poverty trap after a drought. This reinforces prior work suggesting that safety net interventions targeting the non-poor can reduce poverty in the long run by stemming the rate of inflow into the ranks of the chronically poor following a shock (Barrett, Carter, & Ikegami, 2012).

The rest of the paper is organized as follows. Section 2 briefly explains the study locations and the multiple equilibria poverty trap found in the region in multiple prior studies. Section 3 introduces IBLI. Section 4 then describes the dynamic model we use in the simulations and introduces the certainty equivalent herd growth rate, which we use as a key welfare impact evaluation criterion. Section 5 estimates distributions of basis risk, risk preferences and other key household characteristics necessary for the simulations. Section 6 reports the welfare impacts of IBLI estimated through simulation and how these vary based on identifiable household characteristics. Section 7 estimates households' willingness to pay for the optimal contract and aggregate demand for IBLI. Section 8 then explores how alternative approaches to offering IBLI commercially or with safety net subsidies affect wealth and poverty dynamics in the system. Section 9 concludes.

2. PASTORALISM IN NORTHERN KENYA AND MULTIPLE-EQUILIBRIA POVERTY TRAPS

Extensive livestock grazing represents the key livelihood in the northern Kenyan ASAL. Pastoralists move their herds in response to spatiotemporal variability in forage and water access. Northern Kenya experiences bimodal rainfall, defined by long rains that fall during March–May, followed by a long dry season (June–September), then a short rains season from October-December followed by a January–February short dry season. We henceforth refer to the March-September period as the LRLD season (for long rains and long dry), and the October-February period as SRSD (for short rains and short dry). When the rains fail, especially over two rainy seasons in a row, catastrophic herd losses commonly ensue.

As seasonal migration is critical to sustain viable herd accumulation but migratory livelihood requires minimum household consumption out of household herd, positive herd growth overtime might not be achievable by everyone in this region. Previous research (Barrett *et al.*, 2006; Barrett & Santos, 2014; McPeak, 2004; Lybbert *et al.*, 2004; Santos & Barrett, 2007, 2011) has indeed found prominent evidence of multiple-equilibria of long-run herd sizes, whereby herd accumulation bifurcates with respect to a critical herd size threshold typically in the range of 10–20 total livestock units (TLU). [2] Using longitudinal herd accumulation data from the region, this literature found that, on average, herd sizes above the critical threshold tend to grow over time toward a high-level stable equilibrium of 55–60 TLU, while herd sizes below this critical herd threshold tend to collapse over time toward irreversible destitution—another stable equilibrium. In the absence of financial markets, pastoral households with small herd sizes are credit constrained and thus unable to restock toward the critical threshold. They tend to be trapped in a low-level equilibrium poverty trap. The presence of a multiple-equilibria poverty trap in the region also implies that uninsured shocks could have irreversible long-term consequences for herd accumulation and welfare, in particular when shocks make household herds fall below the critical threshold. Insurance that could protect herd size from falling below the threshold could thus be very valuable.

We investigate IBLI performance in Marsabit District, Kenya, for which this product was developed on a pilot basis. We use data from four locations—Dirib Gombo, Logologo, Kargi, and North Horr (Figure 1)—from which we have two complementary household-level data sets: panel data collected