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# Decomposing Producer Price Risk: A Policy Analysis Tool with an Application to Northern Kenyan Livestock Markets

By Christopher B. Barrett and Winnie K. Luseno

### Addressing Producer Price Risk

Pastoralist herders residing in the arid and semi-arid lands (ASAL) of northern Kenya are among the poorest subpopulations in sub-Saharan Africa by standard income or expenditure measures, they suffer high rates of malnutrition and illiteracy, and are vulnerable to regular drought, civil unrest and other serious shocks. More frequent and severe climatic shocks in the past two decades have pushed an increasing number of pastoralists deeper into abject poverty, prompting huge flows of international humanitarian aid into the ASAL. The livestock herder population of northern Kenya and the rest of the Horn of Africa is thus of considerable interest to government and to international donors and charities for both humanitarian and development reasons.

Many current strategies for addressing the vulnerability and poverty of pastoralists hinge on getting pastoralists to depend *less* on aid and *more* on markets. ASAL livestock markets pose a significant obstacle, however, due to high transactions costs, difficulties in contract enforcement, physical insecurity, and poor infrastructure. The resulting low and variable producer prices are among the most serious concerns of pastoralists and partially explain the extremely low marketed off take rates among ASAL pastoralists.

Many observers and pastoralist groups note in particular, the disincentives to market participation created by extraordinary price volatility. Livestock prices in northern Kenyan are highly variable for a given type of animals (e.g., an excellent condition adult ewe), with an unweighted (across species and gender) mean coefficient of variation of 0.511, quite

a high measure by the standards of either livestock markets in high-income countries or grains markets in east Africa. Very few pastoral households enjoy access to formal risk management instruments such as credit or insurance. Futures markets do not exist. Any near-term dampening of ASAL livestock producer price risk must therefore come through policy or project interventions such as road improvements, the introduction of auctions, local market infrastructure upgrades, price broadcasting services, or the reintroduction of a parastatal livestock marketing authority. In order to identify suitable interventions, however, one must locate the sources of price risk more precisely.

In the paper summarized in this policy brief, we introduce a simple method of price risk decomposition that determines the extent to which producer price risk is attributable to volatile inter-market margins, intra-day variation, intra-week (day of week) variation, or terminal market price variability. We apply the method to livestock markets in Marsabit and Moyale in northern Kenya. Our analysis shows that large, variable inter-market basis (i.e., price differentials) is the most important factor in explaining producer price risk in animals typically traded between markets. Local market conditions explain most price risk in other markets; in which traded animals rarely exit the region. Variability in terminal market prices – e.g., due to international exports and imports or seasonality – accounts for relatively little price risk faced by pastoralists in the northern Kenya ASAL, although this is the focus of most present policy prescriptions under discussion.

## **Price Risk Decomposition**

Our method involves a straightforward decomposition of price risk into four key components. The first component reflects the portion of producer price variability that is due to prevailing transactional institutions and associated information advantages (intra-day, intra-market variance). Even within well-developed markets, there can be significant intra-day trading risk, as a vast literature in empirical finance shows in studies of capital markets in high-income economies. In less-favored lands, poor communications and marketing infrastructure can create enormous informational disparities among buyers and sellers in the same location that can easily persist over the course of several hours. Many people speculate that, per the predictions of economic theory, auctions (of any of several designs) will generally dampen price variability relative to the price distributions arising in dyadic markets in which buyers and sellers search and negotiate bilaterally or with the assistance of brokers. The intra-day, intra-market component of price variability is meant to reflect these local level, institutional and informational factors that may contribute to producer risk exposure.

The second component of producer price risk we study reflects intra-week variability due to market thickness and day-of-the-week effects (inter-day, intra-week, intra-market variance). Like the intra-day, intra-market component just discussed, this component reflects in part institutional arrangements. In the main, however, it reflects the depth of the market, how many buyers and sellers arrive, inconsistently and perhaps irregularly, to transact at a common location. Where the density of buyers and sellers is great, one would expect daily trading volumes and thus prices to be relatively more stable, *ceteris paribus*, than in markets where the density is low, leading to sharp proportional day-to-day changes in bid or offer volumes. This inter-day, intra-market component thus reflects primarily local market density.

The third component of our measure relates to variability in the costs of spatial arbitrage (intra-week, inter-market variance). The literature on agricultural marketing, market integration testing and spatial price analysis pays considerable attention to transport costs and intermarket price differences, commonly known as “basis”. Intermarket price differentials capture mean intermarket price differentials, basis volatility due to the spatial marketing infrastructure that connects distant markets, and the degree of

competitiveness in intermarket arbitrage. If one market enjoys vigorous competition among traders while another does not, or if the costs of moving cargo between markets varies considerably due to changing road conditions, fuel availability, banditry, etc., then spatial intermarket basis may prove quite volatile. As a consequence price signals originating in destination markets due to demand shocks or policy interventions may transmit to satellite markets only noisily, if at all.

The fourth component into which we disaggregate producer price risk relates to terminal (destination) market price variability effects (inter-week, intra-market variance at the terminal market). These effects capture standard seasonality effects in consumer demand patterns, seasonality in supply from competitor supplier markets, other shocks to demand due to, for example, changing prices for complementary or substitute goods, and macroeconomic phenomena such as exchange rate volatility or business cycle effects on employment or incomes. It has long been recognized that in developing countries, agricultural price stabilization programs have typically been designed chiefly for the benefit of urban consumer populations by governments aiming to stem prospective food crises – and attendant political unrest – in capital cities, as manifest in striking urban bias in the geography of food storage and transport infrastructure. Standard agricultural marketing interventions such as buffer stock schemes, trade promotion policies, pan seasonal pricing and open market interventions by parastatal authorities have been implicitly aimed at stabilizing this last component of prices.

One can easily compute the proportion of total producer price risk that is attributable to each of these four components, thereby locating the source(s) of aggregate price risk. Since the nature and policy implications of these four components of producer price risk differ markedly, such information is essential to proper targeting of any public interventions intended to stabilize producer (or consumer) prices.

## **Decomposing Producer Price Risk in Livestock Markets**

We apply this price risk decomposition technique to data collected in two source markets in Northern Kenya, Marsabit and Moyale, and in the Nairobi terminal market (Dagoretti market, in particular), the largest market in East Africa. The data were collected opportunistically, and therefore do not

comprise a random sample. The enumerators observed livestock transactions under negotiation, and recorded final sales price and some basic information about the animals traded (gender, species, and a subjective judgment of the animal's body condition), but not weight and health, which also contribute to their market value.

Several intuitive findings emerge immediately from our analysis. First, terminal market variability accounts for a negligible proportion of producer price risk. Although proposals periodically emerge to reinstate pan seasonal pricing that once prevailed under state monopsony and although there is significant predictable seasonal variation in livestock prices due to the region's bimodal rainfall, there seems to be little empirical justification to worry about terminal market risk. Indeed, because variability in the terminal market uniformly covaries negatively with basis, terminal effects are actually stabilizing on balance (i.e., contribute negatively to producer price risk) in one-third of the gender-species-market-specific series we study. Current policy proposals aimed at stabilizing Nairobi livestock prices appear unlikely to dampen appreciably the producer price risk faced by ASAL pastoralists.

Size, condition and species are important variables in determining whether animals move only within local markets or instead to terminal markets. Males tend to be of larger size than females of similar condition and are therefore more commonly sold for slaughter in Nairobi, while the latter will tend to be earmarked for local butcheries or for restocking local herds, especially if fertile and in good condition. Indeed, males typically account for three-quarters or more of total market transactions, while markets in fertile females are very thin. Such patterns help explain sources of price risk.

Inter-market basis risk proves most influential in those markets in which animals are mainly destined for slaughter in terminal markets. This describes markets for males of each species in Marsabit, as well as poor condition (i.e., infertile and nonlactating) cows there. Basis risk appears to be the most important source of producer price risk in almost every case of spatially traded livestock. This serves to underscore the crucial role of physical infrastructure, rural law and order, and competition within the marketing channel in creating an attractive marketing environment for pastoralists.

Trade in good condition females of each species is mainly for local stock replacement and breeding. As a result, inter-market basis matters relatively little

since the animals rarely leave the area. Between them, informational/institutional risk and local market risk consistently account for at least two-thirds of price risk. Female goats in Moyale are a notable exception that proves this rule, because in that area pastoralists raise goats mainly for export-oriented sale in order to finance the purchase of cows. When trade is highly localized, price variability emerges naturally from weakness in local markets; the broader economy and volatility in spatial arbitrage have limited impact.

The covariances between all four components of price risk exhibits some interesting patterns as well. Covariance between basis risk and terminal market risk is negative in every case in our data. As terminal market prices reach seasonal or business cycle highs, inter-market basis falls, likely reflecting heightened competition. This effect is also uniformly the greatest among the six covariances, typically by an order of magnitude. The covariance between basis risk and local market risk is typically positive and second largest in magnitude. As inter-market basis increases, inter-day differences within the week in source markets tend to rise as well. This likely reflects the adverse effects of higher spatial arbitrage costs on the number of market participants, with transactions prices varying more day-to-day in markets made thinner by high costs of spatial arbitrage. By contrast, informational-institutional risk is unrelated to the other three terms. In every case, its covariance with each other risk source accounts for less than one millionth of total producer price variance.

Finally, our results underscore the intuitive importance of controlling for product quality in order to guard against aggregation bias. Since the categorical quality measures available to us surely mask within-category variation and since observed prices are per head, not per kilogram, and there is without question unobserved weight variation, our estimates likely already overstate the importance of informational-institutional risk, further underscoring the relative importance of basis and local market risks in explaining producer price volatility in northern Kenyan livestock markets.

### **Summary and Policy Implications**

This paper explores the nature of producer price risk as experienced by pastoralists participating in livestock markets in northern Kenya. Large and variable inter-market basis is the single most important factor in explaining producer price risk in animals typically traded between markets. Local

market conditions explain most price risk in other markets, in which traded animals rarely exit the region. Price fluctuations in the terminal market accounts for relatively little price risk faced by pastoralists in the drylands of northern Kenya that we study.

The practical policy implication of these findings is that high, volatile costs of spatial arbitrage and competitiveness that is inconsistent over time between markets appear to be the main sources of livestock price volatility of concern to poor pastoralist populations in the northern Kenya ASAL. It seems unlikely that one can effectively mitigate the problem of extraordinary livestock producer price risk in northern Kenya without directly improving inter-market arbitrage, whether through efforts to reduce and stabilize transport costs, to improve physical security, or to stimulate new entry into the sub-sector.

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### Further Readings

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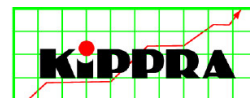
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