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Research Backgrounders

Risk and Risk Transfer in Agriculture:

Facilitating food security and
poor farmer participation

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Oxfam America's Research Backgrounders

Series editor: Kimberly Pfeifer

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Introduction: Two perspectives on the food crisis

The current food crisis has manifested itself in high prices of most major food crops, posing the risk of serious hardship for consumers, and especially the most vulnerable poor. Humanitarian responses and special financing have sought to address the inability of poor people and of food-import-dependent least developed countries (LDCs) to afford food at such high prices. Beyond this emergency response, the crisis has prompted a search for measures that might boost the supply of food crops (and curtail “unnecessary” demand, such as that for biofuel feedstock).

But why would such interventions to boost production be necessary? Shouldn't the dramatic increase in prices provide a sufficient market incentive for producers to right the balance? Indeed, why was the current situation not anticipated and production expanded before it was too late?

These questions can be addressed from two different perspectives. One perspective, which is Malthusian-flavored, would suggest that the current situation is the result of the globe running up against the limits of its capacity to supply food. This capacity is not fixed but dependent on at least somewhat malleable production regimes. But it could be that both highly productive land and fossil energy-derived inputs (fuel, fertilizer) are becoming scarcer, and any additional production with current technology and production regimes will thus have to occur at higher marginal costs, driving food prices even higher.

This perspective points to two kinds of solutions that will bring lower food prices: (1) new technologies and production regimes that will help lower the marginal cost of expanding production and (2) subsidies and supports to reduce either the cost of inputs (fertilizer or seed subsidies, relaxed restrictions on land use) or the price of outputs (food subsidies). Much attention in the current crisis has focused on these options. A push for a new Green Revolution, public investment in agriculture, direct support for inputs, institutional investments, and food price support and aid all fall under these two rubrics.

With regard to public funding of such measures, the interventions have clear humanitarian as well as economic rationales. The right to food is fundamental because it pertains to basic survival – and it implies an obligation to secure it. In addition, in many LDC settings markets have clearly failed to provide sufficient individual incentives to provide a diverse set of goods – from basic trading

infrastructure and credit facilities, to input and output marketing chains, to agricultural extension – that would be desirable even from a narrow economic cost-benefit standpoint. These are thus situations where public support is called for to remedy market failures.¹

However, these solutions all come with drawbacks. Some new technologies are viewed with skepticism, both because of their inherent characteristics (e.g., genetically modified organisms) and because of their perceived implications for power in food production (e.g., dependence on seed companies or principals in contract farming arrangements). Direct supports are financially costly – and questions about their financial sustainability must be faced. Certain input supports, especially of the quick-fix variety that appear to be called for in the current situation, may be undesirable from an ecological and climate standpoint, raising questions about such measures' ecological sustainability as well. All such measures create the problem of dependency of consumers and the food production and marketing system on the state and other nonprivate actors. Sustained support – from governments, international organizations, or nongovernmental organizations (NGOs) – should not be assumed, and reliance on it is, therefore, potentially problematic if it replaces private sector initiatives to a significant extent.

The second perspective on the current crisis does not focus directly on physical or production technology capacity constraints, but instead sees the current crisis at least in part as the product of the risky nature of agricultural production. Viewed from this perspective, the current crisis is a particular manifestation of the tendency of agricultural markets to occasionally produce supply/demand imbalances that can cause pronounced spikes, *as well as* collapses, in prices.

A risk perspective has the advantage of being mindful of this latter possibility. A single-minded focus on boosting production, while it may seem sensible under current circumstances, largely ignores the possibility and may indeed run the risk of precipitating a collapse in prices. This would quickly cause people to revisit the way they viewed agriculture only a few years ago, when devising solutions for a world in which prices were too low for many producers to sustain themselves topped the agenda.

Focusing on risk, instead of just boosting production, pushes us to think about how the global agricultural system (as well as its subunits) can (1) be made less prone to develop supply/demand imbalances in *either direction* and (2) minimize

1. For a persuasive general argument that public support for "orphan investments" is not necessarily "charity", but may indeed be economically sound investments, see Sayre P. Schatz, "The World Bank's Fundamental Misconception in Africa," *The Journal of Modern African Studies* 34, no. 2 (1996): 239–47.

the costs and maximize the benefits for the most vulnerable, poor producers and consumers when such imbalances do arise. The overall aim of this Research Backgrounder is to broaden the discussion of what “support for agriculture” might mean in this direction and look beyond the current focus on direct support for physical production to consider how, from a risk perspective, agricultural markets can be made more hospitable places for poor LDC food importers, consumers, and producers.

The Backgrounder’s focus on risk is, of course, not to deny the importance of other dimensions of support for agriculture that have the most vulnerable players in mind. A fuller picture would involve a broad range of issues, such as trade, physical and institutional infrastructure, investments, and very importantly, the transition from agriculture to other economic activities. This Backgrounder will touch on aspects of these issues, but others are beyond its purview. Some excellent systematic explorations of this broader landscape can be found in other sources.²

2. Excellent overviews include: Christopher Barrett, “Smallholder Market Participation: Concepts and Evidence from Eastern and Southern Africa,” *Food Policy* 33 (2008): 299–317; Andrew Dorward et al., “A Policy Agenda for Pro-Poor Agricultural Growth,” *World Development* 32, no. 1 (2004): 73–89; Colin Poulton, Jonathan Kydd, and Andrew Dorward, “Overcoming Market Constraints on Pro-Poor Agricultural Growth in Sub-Saharan Africa,” *Development Policy Review* 24, no. 3 (2006): 243–77.

Risk and its effects in agriculture

Risk can be defined as exposure to variability in future outcomes. The key fact driving risk, therefore, is that such outcomes are uncertain. Sometimes risk – where probabilistic calculations about outcomes are possible – is distinguished from true uncertainty, where such calculations cannot be made. From the perspective of producers, there are two principal types of risk in agricultural markets. *Yield risk* is the result of factors like the weather, the health of the farmer, and crop diseases. *Price risk*, on the other hand, exists because agriculture requires production decisions months – and for certain crops, years – in advance of the sale of the crop. Price risk persists between the point when most production decisions have been made and harvest time, i.e., for the period when the crop is not yet available for sale, but even after harvest, the decision whether to sell or store must be made under conditions of price risk. The sources of price risk range from factors affecting supply, such as the production decisions of other producers, weather and disease, and policy decisions that may increase or decrease supply (e.g., trade restrictions and release or the release of buffer stocks), to factors influencing demand, such as individual consumption decisions, developments in related markets (e.g., biofuels), and official policy (purchasing, regulations, and supports). Yield and price risk may at least partially offset one another: if production losses are sufficient to influence supply in a given market (local, regional, national, or global), prices might rise and compensate producers for reduced volume.

An immediate corollary of risks in agricultural markets is that *ex post* outcomes will often be suboptimal: producers, for instance, will often find themselves in a position where they would have liked to have produced more (or less) of a crop than they did. To the extent to which the scenario where farmers would have liked to have produced more (or less) is more likely in a high-price (or low-price) environment, one of the effects of risk is more extreme price swings than *ex post* desired supply would have produced. This presents a mechanism that might have produced a significant part of the current upsurge in prices that is very different from the capacity constraints that some Malthusian-flavored commentaries on the crisis have pointed to: farmers would and could have produced more, and prices would have increased less, if current conditions had been anticipated in production decisions to a greater extent. Improving the predictability of production (reducing vulnerability to weather, for instance) and

improving predictions and their accessibility (information systems) can both be beneficial in this regard.

Risk has other implications as well. Crucially, the fact that there is a range of outcomes for any given production decision needs to be taken into account in decision-making. If, in making production decisions, farmers pay particular attention to the risk of adverse outcomes, or if they are generally uncomfortable with a lack of certainty, they will reduce their exposure to risk by investing less in the production of a crop than risk-neutral return maximization might indicate. The result is lower production. That farmers indeed often behave in this fashion is widely accepted in the literature.³ This may be the result of a disposition to avoid risk (risk aversion), but for many farmers, the issue is less one of their attitude toward risk than of their ability to bear it. Especially those with low levels of assets and little or no access to credit and safety nets – typical, poor LDC farmers, in other words – will find that their downside risk may often be catastrophic (loss of land or even starvation) and therefore has to be avoided, even at the cost of forsaking opportunities for large gains. Studies indeed frequently find that wealthier farmers are much more likely to participate in the often more lucrative production of cash crops and to utilize more rewarding but riskier production technologies.⁴ By affecting decisions in this way, risk may therefore lead to secularly lower supply and higher prices. This is how risk likely aggravated and prolonged the current food crisis – and through a particularly regressive effect, from a distributional perspective.

To concretize this point, we may look at the current situation with an eye on price risk, for instance. Current high prices seem to hold excellent prospects for farmers. But prices may fall before any future crops can be sold, and poor farmers in particular have to contend with this risk when they make their growing decisions. Price risk may thus stymie their ability both to contribute to solving the crisis and to benefit from what today appear to be lucrative opportunities.

Producers, of course, are not the only ones affected by volatility. From the perspective of national economies, variability in domestic production (which produces large swings in import requirements) and in prices (which produces large swings in budgetary requirements for any given level of import requirements) can both cause serious problems. For poor countries – where food

3. E.g., T.S. Jayne, Ballard Zulu, and J.J. Nijhoff, "Stabilizing Food Markets in Eastern and Southern Africa," *Food Policy* 31 (2006): 328–41.

4. E.g., Barry Barnett et al., "Poverty Traps and Climate and Weather Risk: Limitations and Opportunities of Index-based Risk Financing" (The International Research Institute for Climate and Society, Technical Report Number 07–03, 2007); Barrett, "Smallholder Market Participation"; Lamou Rutten and Frida Youssef, "Market-Based Price Risk Managements: An Exploration of Commodity Income Stabilizing Options for Coffee Farmers" (International Institute for Sustainable Development, 2007).

consumption makes up a high proportion of total consumption and where typically low foreign exchange reserves can easily be strained by a sudden surge in import needs – such variability in budgetary requirements poses a particular problem. Coping with a sudden surge of import requirements can be extremely costly, both because it throws budget planning into disarray and because strains on the balance of payments may set off broader, negative dynamics. To illustrate the magnitude of such shocks, the International Monetary Fund (IMF) estimated that the combined effect of higher energy and food prices could result in a negative shock of 15.5, 8.8, and 3.7 percent of 2007 gross domestic product to the 2008 trade balances of Liberia, Guinea-Bissau, and Malawi, respectively, and eat up 96, 31.5, and 58.2 percent of the three countries' foreign reserves.⁵ Price volatility has similar budgetary impacts on food aid organizations like the World Food Program.

Volatility and the resulting risk in agriculture are therefore costly. They should be of particular concern because – insofar as they affect producers who are not well prepared to bear risk – they can be thought of as feeding on themselves in a vicious circle: in the current situation, for instance, the presence of volatility might inhibit behavior that could effectively counteract the crisis if farmers are unable to respond effectively to high prices.

5. IMF, African Department, "The Balance of Payments Impact of the Food and Fuel Price Shocks on Low-Income African Countries: A Country-by-Country Assessment" (June 30, 2008). The assumption underlying these figures was for the price of oil to move from \$71.1 per barrel in 2007 to \$112 per barrel in 2008; the assumed magnitude of the food price shock is not specified.

Dealing with risk: A broad menu of options

Reducing variability of production

There is a plethora of ways to address the problem of volatility and exposure to it. Volatility in yield and price can be addressed directly: drought- or disease-resistant varieties and irrigation seek to reduce yield volatility at the farm level, for instance. (Climate change is considered to greatly increase the risks associated with agricultural production, so counteracting or containing it is directly relevant to risk reduction.) Better, more accessible information about current and expected trends in production and demand is a key factor that could reduce yield volatility (and also price volatility, insofar as price and yield volatility are connected) because such information may enable production decisions that can counteract emerging trends.

Altering risk through pooling or market interventions

Besides the strategy of directly tackling those factors that drive volatility at the level of production, geographical diversification and market integration are key mechanisms that can serve to counteract exposure to specific yield variabilities through pooling (i.e., aggregating different variabilities and thus creating an overall less variable portfolio). In addition, price variability can be targeted through policies that act on supply and demand, either by making them irrelevant for price determination (price setting) or by countercyclically manipulating them through the operation of buffers and trade policy. While from the perspective of participants in a particular market that is subject to such interventions, price volatility is reduced, these measures may impose greater volatility on different but connected markets (trade policy), involve taking on the significant financial risks of counteracting market trends (buffers, price setting), and create disincentive effects for producers when market price trends signal a need for stepped-up production (all three measures).

Diversification

For individual or national producers, diversification across different crops (and income-generating strategies), growing areas, and markets may reduce exposure to the volatility affecting each of these variables. However, especially from an individual producer's perspective, diversification does involve a trade-off insofar as it diminishes the possible benefits of specialization – to the point where it may be no better than a necessary evil that locks poor households into “poverty traps.”⁶ While diversification reduces exposure to volatility in one crop, location, or market, it naturally increases exposure to volatility in others. The hope, therefore, is that trends will at least be uncorrelated and that other, perhaps broader, markets will be less volatile than those in very localized settings. Price swings of 100 percent and more, both intra- and interseasonally, are a very common experience in many sub-Saharan African grain markets, for instance; a broad range of illustrative local price trends is available from the US Agency for International Development's online Famine Early Warning Systems Network. Specific examples include Tanzanian regional maize markets,⁷ maize in Kenya,⁸ and Malawi's food crop markets.⁹ Coulter and Onumah cite average six-month wholesale price increases for maize of 80 percent between 1994–5 and 1997–8 in African markets.¹⁰ From the perspective of consumers and importers, similar diversification strategies can be pursued, but similar caveats apply.

Price setting

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6. Barnett et al., “Poverty Traps and Climate and Weather Risk”; Barrett, “Smallholder Market Participation”; Stefan Dercon, “Risk, Crop Choice, and Savings: Evidence from Tanzania,” *Economic Development and Cultural Change* 44, no. 3 (1996): 485–513; Marcel Fafchamps, “Cash Crop Production, Food Price Volatility, and Rural Market Integration in the Third World,” *American Journal of Agricultural Economics* 74, no. 1 (1992): 90–99; Poulton, Kydd, and Dorward, “Overcoming Market Constraints”; Alan Winters, Neil McCulloch, and Andrew McKay, “Trade Liberalization and Poverty: The Evidence So Far,” *Journal of Economic Literature* XLII (2004): 72–115.
 7. Alexander Sarris and Ekaterini Mantzou, “Linkages between domestic and international maize markets, and market based strategies for hedging maize import price risks in Tanzania” (FAO of the United Nations, Commodity and Trade Policy Research Working Paper No. 14, 2005).
 8. Emma Stephens and Cristopher Barrett, “Incomplete Credit Markets and Commodity Marketing Behaviour,” (Working paper, 2008 version).
 9. Wouter Zant, “Food Import Risk in Malawi: Simulating a Hedging Scheme for Malawi Food Imports Using Historical Data” (FAO of the United Nations, Commodity and Trade Policy Research Working Paper No. 13, 2005).
 10. J.P. Coulter and G. Onumah, “The Role of Warehouse Receipt Systems in Enhanced Commodity Marketing and Rural Livelihoods in Africa,” *Food Policy* 27, no.4 (2002): 330; see also Derek Byerlee, T.S. Jayne, and Robert J. Myers, “Managing Food Price Risk and Instability in Liberalizing Market Environments: Overview and Policy Options,” *Food Policy* 31 (2006): 277.

Price setting may aim to provide producers with predictable and/or more stable prices. Such a scheme presupposes a high degree of control over domestic and import/export markets that has at times been sought through the institution of monopsonistic marketing boards. While price setting shares the problems of buffer stock operations (see below), perhaps its central handicaps are the level of risk borne by the operator of such a scheme and its strong tendency to be financially nonviable over the long term. If prices are set higher than market clearing levels, the loss (or surplus stock) has to be absorbed by the marketing board. If, on the other hand, prices are set at a level that turns out to be below market clearing levels, producers of food crops have typically found ways to evade official purchasing channels through black markets and smuggling. If a marketing board must, as is currently typical, compete with commercial purchasers, this situation is aggravated further because the marketing board will make few purchases in years when official prices are lower than market clearing levels, but be overwhelmed in years when prices are higher; the implication is losses over time.¹¹ Attempts to offer stable and predictable prices through outright price setting, therefore, require a great deal of control over markets and likely a willingness and ability to absorb large losses.

Buffer stocks

Buffer stocks, in addition to their function of maintaining an emergency reserve or reducing an importer's exposure to price swings, can likewise be used to reduce domestic price volatility by counteracting extremes in supply/demand dynamics (buying when prices are low and releasing stocks in the opposite scenario). If executed successfully, this strategy can reduce price volatility for both consumers and producers. However, such procurement and release operations have historically tended to go beyond mere stabilization.¹² Some have ended up subsidizing consumers over time – sometimes while simultaneously imposing an implicit tax on producers.¹³ It is not always clear whether such effects are by design or accident, as running a neutral, purely stabilizing buffer involves significant technical challenges.¹⁴ Not only are buffer stocks generally

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11. T.S. Jayne and Stephen Jones, "Food Marketing and Pricing in Eastern and Southern Africa: A Survey," *World Development* 25, no. 9 (1997): 1505–27.
 12. Overviews of the history of marketing boards with a particular focus on African countries are offered by Jayne and Jones, "Food Marketing"; T.S. Jayne, J. Govereh, A. Mwanaumo, J.K. Nyoro, and A. Chapoto, "False Promise or False Premise? The Experience of Food and Input Market Reform in Eastern and Southern Africa," *World Development* 30, no. 11 (2002): 1967–85; and Independent Evaluation Group, "World Bank Assistance to Agriculture in Sub-Saharan Africa: An IEG Review" (The World Bank, 2007), 114–19.
 13. Marketing boards in Kenya, Malawi, Zambia, and Zimbabwe, for instance, frequently import maize and then release it at a loss into local markets. Jayne, Zulu, and Nijhoff, "Stabilizing Food Markets," 336–37. Others have tended to subsidize producers. Ralph Cummings, Shahidur Rashid, and Ashok Gulati, "Grain Price Stabilization Experiences in Asia: What Have We Learned?," *Food Policy* 31 (2006): 304; Peter Timmer and David Dawe, "Managing Food Price Instability in Asia: A Macro Food Security Perspective," *Asian Economic Journal* 21, no. 1 (2007): 11–12.
 14. Robert Myers, "On the Costs of Food-Price Fluctuations in Low-Income Countries," *Food Policy* 31 (2006): 288–301.

very costly to store,¹⁵ but especially when they are not neutral, buffers impose significant costs on their operators (governments), consumers, or producers. In addition, unpredictable buffer procurement and release operations in particular imply significant disincentive effects for both farmers and private traders and storers.¹⁶ While some buffer schemes have been positively assessed (several Asian economies have quite successfully stabilized rice prices – although, with the partial exception of the earlier experience of Indonesia’s BULOG system, this success appears to have been bought at a relatively high and escalating price),¹⁷ many others, in particular in African settings, have been found to be unsuccessful at stabilization and immensely costly. Their use may thus best be restricted to maintaining small emergency reserves.¹⁸

Flexible trade regimes

Flexible trade regimes, operating through price and quantity restrictions (tariffs and quotas) on imports and exports, can be used to stabilize domestic markets. However, analogous to stabilization through buffer stocks, unpredictable policy shifts imply uncertainty and harmful disincentives for producers and private traders and storers.¹⁹ Support for domestic prices in particular may typically have undesirable welfare effects. From Asia, Timmer and Dawe report an elasticity of poverty incidence with respect to the price of rice between 0.32 and 0.45, despite the high rate of participation in rice production of poor households.²⁰ In typical African settings, significant food surplus production tends to be highly concentrated, with the vast majority even of rural households being net food purchasers or (semi-) subsistence producers who suffer from higher food prices.²¹ This needs to be borne in mind when the “benefits” of

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15. In a context of normal into-store prices of maize of around \$90 per ton, Poulton et al. cite annual maize storage costs per ton of \$20 in South Africa and between \$30 to \$60 in Zimbabwe, as well as a typical storage loss of 5 per cent per year in a well-managed store. Colin Poulton et al., “State Intervention for Food Price Stabilization in Africa: Can It Work?,” *Food Policy* 31 (2006): 345, 349. Citing frequent losses in excess of 15 per cent, see Mahmud Khan and A.M.M. Jamal, “Market Based Price Support Program: An Alternative Approach to Large Scale Food Procurement and Distribution System,” *Food Policy* 22, no. 6 (1997): 476. Even without accounting for the opportunity cost of tying up funds in buffers, costs are thus a very significant factor.
 16. Cummings, Shahidur, and Gulati, “Grain Price Stabilization Experiences”; Jayne, Zulu, and Nijhoff, “Stabilizing Food Markets”; Poulton et al., “State Intervention.”
 17. Cummings, Shahidur, and Gulati, “Grain Price Stabilization Experiences”; Timmer and Dawe, “Managing Food Price Instability.”
 18. Julie Dana, Christopher Gilbert, and Euba Shim, “Hedging Grain Price Risk in the SADC: Case Studies of Malawi and Zambia,” *Food Policy* 31 (2006): 361–63, 368–69; Poulton et al., “State Intervention,” 348–49.
 19. Coulter and Onumah, “Role of Warehouse Receipt Systems,” 330–33; Dana, Gilbert, and Shim, “Hedging Grain Price Risk,” 361; Jayne, Zulu, and Nijhoff, “Stabilizing Food Markets,” 336.
 20. Timmer and Dawe, “Managing Food Price Instability,” 5.
 21. Jayne, Zulu, and Nijhoff, “Stabilizing Food Markets”; Poulton et al., “State Intervention”; Stephens and Barrett, “Incomplete Credit Markets.”

stabilizing through trade are tallied up: lowering domestic prices by lowering import restrictions, for instance, presupposes that import restrictions that kept domestic prices above import-parity levels were kept in place. Restricting exports is another route to the same objective of dampening domestic prices that does not rely on otherwise keeping prices artificially high. With regard to the *domestic* welfare implications, this may well be a more justifiable measure, as most of the costs of export restrictions are borne by typically relatively well-off, significant surplus producers.²² The international implications of a flexible trade policy can, however, be far from benign, as the policy essentially amounts to a mechanism whereby outside markets selectively become buffers against adverse domestic developments. The rice export restrictions imposed by several key exporters in March 2008 vividly illustrate the possible “beggar thy neighbor” effects of such actions; moves on the part of importers, such as the Philippines and Indonesia, to boost their own production are responses to heightened risk (perception), but such a drive for greater self-sufficiency can have serious efficiency and welfare implications.

Risk transfer through market transactions

In contrast to these mechanisms, a different class of tools does not seek to manipulate the factors that drive variability or eliminate it through pooling or interventions in the market: the central logic behind these tools is rather to transfer exposure to volatility, using market transactions, from some participants and institutions onto others that might be better able to cope with it.

Credit

Such risk transfer mechanisms include credit. Access to credit at times when losses have materialized (*ex post*) serves the function of providing a safety net and hence making producers better able to take on risk. Credit for inputs, investments, or production, on the other hand, fulfills a different function. Essentially, it is a mechanism that *ex ante* transfers from the producer to the creditor some of the risk taken on by sinking investments into production. The easier and less consequential it is for the producer to default on a loan, the greater the transfer of risk onto the creditor. If the creditor wants to remain financially viable, increased risk transfer will be reflected in higher interest rates and possibly credit rationing. It is obvious why smaller and poorer producers often lack access to (affordable) credit. They are unlikely to have collateral, their risk might be difficult to assess, and if credit provision and due diligence involve

22. Byerlee, Jayne, and Myers, “Managing Food Price Risk.”

fixed costs irrespective of the size of the loan, making a loan to small creditors may be uneconomical. Although microfinance has attempted to find solutions to these problems, farm credit, because of its intrinsically risky nature, still remains a problem. Credit is a complex field in itself, and it cannot be treated adequately in this Backgrounder.²³ However, when individual producers utilize other risk transfer mechanisms that improve their risk profiles, it has the added benefit of making them far more attractive to creditors. Using such mechanisms, therefore, should have the important secondary effect of making credit more accessible and affordable to poor and small farmers. As discussed below, credit may also be bundled with other risk transfer measures into a single product that capitalizes on such synergies.

Insurance

The most common way of transferring risk is insurance. For farmers, this can be very broad (income insurance, which transfers both yield and price risk; note the similarity to safety net provisions), relatively broad (yield insurance), or quite specific (pest insurance). Many such products require relatively close monitoring and loss assessments. They also involve moral hazard and adverse selection problems. Where large covariate risks exist (e.g., an entire region is likely to be affected uniformly by a drought), the insurer's risk may also be extremely large and potentially not reinsurable. Because of this, such insurance products are generally not deemed viable in settings that exhibit the characteristics of many LDCs; small farmers in particular are not a viable client group. Even in the US and Canada, such products appear to rely on public subventions. Where yield insurance, for instance, has been tried (e.g., in Morocco from 1995), it has proven unviable.²⁴

One specific product, index-based weather risk insurance, however, has certain features that might make it a more suitable option in typical LDC settings.²⁵ Its basic concept is that if an easily observable weather index exhibits a close correlation with a typical farmer's yield, an insurance contract can be developed

23. Cf. Poulton, Kydd, and Dorward, "Overcoming Market Constraints," 259–61.

24. Andrea Stoppa and Ulrich Hess, "Design and Use of Weather Derivatives in Agricultural Policies: the Case of Rainfall Index Insurance in Morocco" (Paper presented at the international conference "Agricultural Policy Reform and the WTO: Where Are We Heading?", Capri, Italy, June 23–26, 2003); Panos Varangis, Don Larson, and Jock Anderson, "Agricultural Markets and Risk: Managing the Latter, Not the Former" (Background paper, 2002), 10–11.

25. Cf. Harold Alderman and Trina Haque, "Insurance Against Covariate Shocks: The Role of Index-Based Insurance in Social Protection in Low-Income countries of Africa" (World Bank Working Paper No. 95, Africa Human Development Series, 2007); Barnett et al., "Poverty Traps and Climate and Weather Risk"; Jerry R. Skees, Jason Hartell, and Jianquiang Hao, "Weather and Index-Based Insurance for Developing Countries: Experience and Possibilities," in *Agricultural Commodity Markets and Trade: New Approaches to Analyzing Market Structure and Instability*, ed. Alexander Sarris and David Hallam (Northampton, Mass.: Edward Elgar Publishing, 2006).

that pays out when the weather (typically rainfall) index indicates a likely level of crop loss. The attraction of this kind of insurance is that it avoids close monitoring and loss assessment: the weather index is a good enough proxy for yield levels. There is furthermore a vibrant international market where a local provider of weather insurance can in turn reinsure its own exposure. These features, attractive in principle, of course do not guarantee that all conditions that need to be in place for such a product to be feasible do in fact exist in any given setting. Some of the most critical conditions are the following:

- Index-based weather insurance requires good historical weather, as well as corresponding yield data to allow an accurate assessment of risk.
- Historical patterns need to be adequate guides to the future. Climate change might pose a particular challenge here, as past trends may not be a reliable guide to the future. (If an insurer decided that this was indeed the case, the added uncertainty about future risk would be reflected in higher premiums.)
- Likewise, yield patterns, as well as their correlation with the weather index, need to be relatively stable. Otherwise, the insurance contract would be suboptimal, potentially leading, for instance, to insurance payouts that are insufficient to compensate farmers for their loss.
- By the same token, microlevel variability in weather-crop correlations would make a weather-index insurance product difficult to design: its advantages essentially depend on the ability to make standardized assumptions without the need for microlevel data.
- Readily apprehendable, nonmanipulable, and representative weather data are a prerequisite for weather-index insurance. Different systems, from local weather stations with remote reading to satellite weather and vegetation data, are being explored: they offer different possibilities and challenges.

If these conditions can be met, and if designing an insurance product is feasible, index-based weather insurance has a number of possible applications. The most obvious application is of course to sell insurance to farmers directly. Against a premium, this will transfer some (or all) of the weather-based yield risk from the farmer to the insurer. (The size of the premium is of course a crucial aspect of the insurance. There are some indications that even actuarially fair premiums might exceed many farmers' willingness to pay; subsidies might be a necessary consideration.)²⁶ Risk transfer through weather insurance is attractive for two

26. Joanne Syroka, "Experience in Index-based Weather Insurance for Farmers: Lessons Learnt from India & Malawi" (Presentation at the Innovative Finance Meeting, New York, October 18, 2007), <http://www.un.org/esa/sustdev/sdissues/finance/egm2007/presentations/syroka.pdf>; Alexander Sarris, Panayiotis Karfakis, and Luc Christiaensen, "Producer Demand and Welfare Benefits of Rainfall Insurance in Tanzania" (FAO of the United Nations, Commodity and Trade Policy Research Working Paper No. 18, 2006).

reasons. First, such insurance works as a safety net in bad seasons by compensating farmers for lost income. In this function insurance can essentially be considered an alternative to other kinds of safety nets. If those other safety nets are reliable, adequate, and potentially free to their beneficiaries, the incentive to purchase insurance may be small. We could look at this as a case of private (through insurance) versus public provision.

Second, insurance may improve the risk profiles of producers. If insurance offers more reliable, adequate, and fungible (money, rather than food aid, for instance) compensation for loss than other safety nets, insurance improves producers' risk profiles even if other safety nets are already in place. This should make producers better able to take on risks and dramatically improve their risk profiles in the eyes of creditors. This, in turn, should enhance the producers' ability (access to credit) and willingness to invest in production, such as through the purchase of inputs. This indirect benefit of insurance is reflected in several schemes where insurance and credit have been packaged together. Credit can be purchased more cheaply with insurance or may only be available in a package.²⁷

Farmers are not the only possible clients for weather insurance. Other institutions may be indirectly exposed to the weather risks borne by farmers. Lenders (banks, cooperatives), governments, and relief organizations in particular share farmers' risks, so they, too, may benefit from insuring these risks.²⁸ The nature of their exposure to weather risk varies. Lenders must worry about the level of client defaults that might be associated with particular weather events. (Such events have wiped out rural banks and microlending institutions.)²⁹ Governments might be most worried about very large unforeseen food import and food aid requirements that may result from a drought that affects food availability in their countries. Relief organizations share the more extreme ends of this exposure, but they might have to add to this the possibility of a crisis that is not confined to a particular country.³⁰ Insurance for such low-

27. For a broad overview, see Barnett et al., "Poverty Traps and Climate and Weather Risk." For experience in Morocco, see Erin Bryla, Julie Dana, Ulrich Hess, and Panos Varangis, "The Use of Price and Weather Risk Management Instruments" (Paper presented at the International Conference on Best Practices, Paving the Way Forward for Rural Finance, 2003), http://www.basis.wisc.edu/live/rfc/cs_03a.pdf. On India, see Sidharth Sinha, "Agricultural Insurance in India: Scope for Participation of Private Insurers," *Economic and Political Weekly* 39, no. 25 (2004): 2605–12; Xavier Giné, Robert M. Townsend, and James I. Vickery, "Patterns of Rainfall Insurance Participation in Rural India" (Federal Reserve Bank of New York Staff Report No. 302, 2007). On Malawi, see Ulrich Hess and Joanne Syroka, "Weather-based Insurance in Southern Africa: The Case of Malawi" (The World Bank Agriculture and Rural Development Discussion Paper 13, 2005); Syroka, "Experience in Index-based Weather Insurance." On Tanzania, see Sarris, Karfakis, and Christiaensen, "Producer Demand."

28. Barnett et al., "Poverty Traps and Climate and Weather Risk."

29. For examples from Malawi, see Syroka, "Experience in Index-based Weather Insurance."

30. On the Mexican government's experience, see Victor Cardenas, Stefan Hochrainerb, Reinhard Mechlerb, Georg Pflugb, and Joanne Linnerooth-Bayerb, "Sovereign Financial Disaster Risk Management: The Case of Mexico," *Environmental Hazards* 7, no. 1 (2007): 40–53; Alderman and Haque, "Insurance Against Covariate Shocks." Barnett et al. note a

frequency but high-impact events is attractive because it smoothes budgetary requirements (relatively low annual premiums instead of occasional, very large requirements). Insurance would also ensure an immediate and adequate budget in the event of a crisis (in contrast to the often late and inadequate response to food emergencies in the current donor-appeal system). Insurance is thus judged to hold great promise as a component of a food crisis response system.³¹

Price risk transfer through financial markets

The remainder of this Backgrounder will focus on mechanisms that transfer not yield or associated income risk (tackled through insurance), but price risk. Before delving into a more detailed discussion of price risk transfer mechanisms through financial markets and their applications in LDC settings, we can point to some advantages of such mechanisms. Besides availability, the price that counterparties demand in exchange for taking on risk is of course a key question; if the price is reasonable, such mechanisms may present an alternative to overdiversification without the potentially high opportunity costs. Like buffer stocks, price risk transfer tools can reduce or eliminate an importer's exposure to price variability (through hedging), possibly at a lower cost than physical buffers or otherwise necessary large, precautionary savings.³²

Insofar as price setting, buffers, and trade policy aim at *stabilizing* prices (they may have additional aims, such as price support), price risk transfer mechanisms do not achieve the same result. In the first place at least, they can merely eliminate exposure to future price movements, not reduce volatility itself by counteracting price trends (although, as discussed in the context of buffers and trade, this is likely neither desirable nor economically feasible in the long run). While hedging may have the second-order effect of reducing the amplitude of price surges – for instance, because it may enable producers to respond better to prevailing high prices³³ – its primary benefit lies not in reduced volatility itself but in the reduction or elimination of uncertainty about prices that will be achieved in a hedged future transaction. (As is discussed in the next section, hedging may, however, be a useful tool insofar as it can help reduce the price risk exposure of institutions that may seek to stabilize prices through minimum guarantees.) Whereas buffers and flexible trade regimes change the risk

contract taken out by the WFP to insure against the risk of drought in Ethiopia. Barnett et al., "Poverty Traps and Climate and Weather Risk," 31. Hess and Syroka assess the benefits of insurance for Malawi as well as the group of SADC countries. Hess and Syroka, "Weather-based Insurance."

31. See especially Barnett et al., "Poverty Traps and Climate and Weather Risk," 28–32.

32. For the analogous case for commodity exporters, see Eduardo Borensztein, Olivier Jeanne, and Damiano Sandri, "Macro-Hedging for Commodity Exporters" (IMF Working Paper No. 09/229, 2009).

33. Cf. Janet Netz, "The Effects of Futures Markets and Corners on Storage and Spot Price Volatility," *American Journal of Agricultural Economics* 77, no. 1 (1995): 182–93.

environment of producers (and consumers) through interventions that directly alter price and/or quantity, risk management through financial markets does not directly affect prices or quantities traded. Instead, it transfers existing risk between parties with a differential willingness and ability to bear it.

Although there are thus limits to what price risk transfer tools can effect, the fact that price and quantity are not directly disturbed can be seen as bringing considerable advantages. Such tools for instance do not result in the significant disincentive problems that price setting, buffers, and flexible trade regimes are fraught with. They also do not shift the balance of benefits between net producers and consumers by political fiat. (Poverty alleviation is probably better served by shifting this balance in favor of consumers, but even better would be direct support that is well-targeted specifically to poor people on either side of the food equation.) Unlike buffer stocks, use of financial market risk management tools also does not imply a large exposure (and cost) for a public institution. Unlike flexible trade regimes, such tools do not impinge on the international flow of goods.

Price risk transfer through financial markets: Key tools

Financial markets can transfer price risk through the use of forward contracts, futures, options, and various other instruments. Good guides to the different instruments and possibilities in this area are available that explain technical details, often with useful illustrations from a US context.³⁴

Price risk can be transferred through a variety of financial tools. Essentially the tools are all contracts that specify certain rights and/or obligations regarding transactions in the future. The most basic such tool is a simple “*forward contract*” between producers and consumers or merchants (such as grain elevators, i.e., intermediaries that provide marketing and storage). Such a contract would typically commit the producer to deliver a particular quantity of a commodity at the predetermined, contracted price, time, and place. Forward cash contracting therefore involves parties who are closely tied to the cash market (physical goods). Certain contract farming arrangements, although they typically also cover other aspects of production, include such arrangements. A key risk in this transaction (as in the case of futures transactions) is that the producer may not (be able to) deliver the product; enforceability, collateral, and insurance (for instance, against weather-induced yield risk) therefore are important contextual prerequisites of these arrangements. (Although this is not an area that can be explored here, note that where producers’ ability to bear risk is limited, and where this seriously hampers their ability to prosper, contract farming may well present a potentially beneficial option that has some aspects of forward contracting.)

“*Futures*” similarly promise delivery (and acceptance) of a commodity at a certain price and on a certain date, but unlike forward contracts, they are standardized contracts that are traded on specialized commodity exchanges. Typically, exchange-traded futures are settled not through the physical delivery of goods but through buyers (sellers) selling (buying) back the contract they have taken out (sold). How does a futures contract transfer price risk? It does so by allowing producers to lock in the currently offered price for future delivery. A producer would sell a futures contract (going “short” in the futures market) that

34. For an overview, see Varangis, Larson, and Anderson, “Agricultural Markets and Risk.” A detailed and very useful guide to the functioning of US agricultural markets and commonly employed risk transfer mechanisms is Joy Harwood et al., “Managing Risk in Farming: Concepts, Research, and Analysis” (U.S. Department of Agriculture, Agricultural Economic Report No. 774, 1999).

obliges her to deliver a certain quantity at a certain time and place. To completely eliminate price risk for her crop, this futures position should be as large as the physical quantity of the commodity she holds or will produce (by virtue of which she is “long” in the cash market). If these positions are equal, the producer is said to be “fully hedged.” Now consider what happens if prices change. An example: In January, the producer sells the May delivery futures contract at \$1 to lock in what appears to be a good price; the current cash price is also \$1. (The “basis,” i.e., the difference between the spot and the futures price for a given delivery date, is zero). In May, when she can deliver the crop, both the cash price and the futures price have moved up to \$1.10 (so there is no movement in the basis, which is still equal to zero). She sells the crop in the cash market and, compared with the January cash price of \$1, makes a 10 percent gain. However, she also has to close out her position in the futures market by buying back the obligation she took on to deliver the crop: she buys back the futures contract she sold at \$1 at the current price of \$1.10, incurring a 10 percent loss. Overall, she is in the same position she would have been in had she sold her (then not yet deliverable) crop at \$1 in January. Thus the hedge eliminated her exposure to price fluctuations.

As in forward contracting, there is a risk here that the hedger may not have the anticipated physical commodity on hand to offset the futures transaction in the cash market. This exposes the hedger to a large financial risk (because the futures contract still has to be bought back). To deal with such counterparty risk, commodity exchanges limit futures access to well-capitalized, large participants; the participants also have to post a cash deposit (“margin”), a certain proportion of the total value of the futures contract, in return for which a broker will advance them the required credit to sell or purchase futures. If the futures position of participants deteriorates, they receive a “margin call” from their broker, which requires them to post additional deposits. This system makes futures trading a relatively restricted domain.

Another standard financial instrument that can facilitate risk transfers is an “option,” i.e., the right (but, unlike with futures, not the obligation) to buy or sell a particular futures contract or good at a predetermined price and within a given time frame. A “put” option is the right to sell, and a “call” option is the right to buy, at a particular price; the writer of a put (call) contracts with the buyer of a put (call). The effect of this arrangement on price risk is different from the effect of futures. Consider the following example. Instead of selling a future for \$1 as above, the producer now buys a put with a “strike” of \$1, i.e., the right to sell her crop at \$1. If the price rises above \$1, this right (and hence the option) becomes worthless, but if the price falls, the option gains value because it confers the right

to sell at a price higher than the current market price. This essentially works like an insurance against falling prices. The cost of this insurance is the “premium” the producer pays for the option contract. But unlike the case of the futures contract, the producer does not lose out on any potential price increases above the strike price: while the option is worthless (and the premium is lost), she is free to sell the physical crop at the prevailing market price. This feature (downside protection but upside participation) makes put options quite attractive to producers. Unlike with futures, options only require an upfront cash payment (the option premium) as the transaction is entered; this implies that counterparty risk is reduced and that option trading is generally far more accessible than trading in futures. Akin to an insurance product, options can be tailored to particular circumstances and do not necessarily depend on existing, deep markets as do futures.

Different instruments may also be combined, such as in the case of a participatory option that combines several options transactions: the result is that a minimum price can be insured – and that the premium for this is paid for by foregoing a small percentage of any price upside beyond the minimum price. The advantage is that no cash is required: the transaction pays for itself (by foregoing a percentage of the upside). There are also other, more complex structures, such as contracts on spreads (a spread is the difference of price over time) or volatility. In general, much of the activity in these derivative instruments takes place in the over-the-counter (OTC) market. In contrast with the exchange-traded futures market, the OTC market is not specifically regulated. Participants in such free contract arrangements will therefore not be protected by regulatory structures. Given that participants must be large and financially strong to access such contracts, and are generally assumed to be sophisticated, this may not be a big concern. But it is important for participants (including LDC governments) to understand the use and risks of various instruments. Possible applications, necessary conditions, limitations, benefits, and drawbacks of risk management through financial markets are discussed in detail in the following section.

Applications and experiences

There are three principal types of applications of these price risk management tools that have the potential of benefiting poor farmers and food-deficit LDCs. Importers (and analogously exporters and food aid providers) may hedge their price risk in international markets; in addition, different configurations of hedges by domestic buyers (traders, cooperatives, marketing boards) and farmers can effect hedging of price risk in two principal situations: before and after harvest.

Price risk transfer for buyers

The primary benefit of hedging price risk for importers and food aid providers is that expenditure requirements are made more predictable and, depending on the particular instrument chosen, smoother. It may also be possible to significantly reduce the size of costly physical buffer stocks (see section on buffer stocks) and supplement them through the “virtual buffers” that the financial instruments are able to offer.

Because Malawi has been a regular importer of quite large percentages of its maize requirements, because it is a poor country for which such imports can make up a very large percentage of total trade,³⁵ and because its import markets are closely linked to trading on the South African Exchange (SAFEX), Malawi has been a favorite candidate for case studies and pilot programs of hedging price risk for poor food importers. Several simulations of hedging indicate that Malawi may indeed benefit significantly from using such mechanisms. A study simulating different options and futures hedging schemes for Malawi and Zambia with 1997–2004 price data finds both cost reductions and, more robustly, large reductions in import expenditure variability compared with an unhedged import strategy.³⁶ Options strategies tend to be less costly in years when hedging makes a loss, but because these tend to be years of lesser import requirements, these cost savings may be of lesser importance for reductions in overall import expenditure variation. According to the study, in Malawi import expenditure variability would be reduced most through a simple, discretionary, leveraged futures-based strategy that has an average cost of only one-quarter the cost of

35. Zant, “Food Import Risk.”

36. Dana, Gilbert, and Shim, “Hedging Grain Price Risk.”

unhedged imports and results in much lower variability of 72.2 compared with 94.5 standard deviations. (The results for Zambia are similar.) Such results depend on the particular price history investigated, but studies working on different cases and with different historical price data generally confirm the potential of such schemes. One study, for instance, shows that hedging Tanzanian maize imports for 1983–2002 through SAFEX futures could have dramatically reduced import expenditure variability.³⁷ Another simulates discretionary hedging strategies for Malawi over the 1996–2003 period and finds potential cost savings over an unhedged import strategy. Again, options strategies cost less in years when hedging makes a loss. An interesting finding is that discretionary strategies can have serious drawbacks: one such simulated strategy dropped hedging above a certain price level – and would therefore entered 2003 without protection: however, this turned out to be a year when import prices and volumes turned out to be extraordinarily high and when protection would therefore have been very desirable.³⁸ A study investigating the use of shorter term Chicago Board of Trade (CBOT) options and futures hedging strategies finds that a variety of such strategies could have reduced the variability of the import bills of all eleven wheat and five maize importers studied for the period from 1986 to 2003.³⁹ Bearing in mind the caveat that consistent profits from hedging should not be expected, a Food and Agriculture Organization (FAO) study shows that during 1986–2004 the majority of LDCs examined may indeed have been able to make a profit from a variety of consistently implemented CBOT hedging strategies for wheat and maize imports, as well as from hedging coffee export price risk on the London International Financial Futures and Options Exchange (LIFFE).⁴⁰ Of particular interest is the fact that a fund that would have pooled these countries' hedging activities would have been able to improve considerably on individually implemented hedging. The study's authors therefore draw attention to the potential of such a pooled facility in the guise of an international food import financing facility that could be established in accordance with the World Trade Organization's (WTO) Marrakesh Agreement.⁴¹

In 2005–6, Malawi purchased through Standard Bank a tailor-made option to hedge against price increases for maize imports; at a reasonable premium, the

37. Sarris and Mantzou, "Linkages."

38. Zant, "Food Import Risk."

39. Alexander Sarris, Pietro Conforti, and Adam Prakash, "The Use of Organized Commodity Markets to Manage Food Import Price Instability and Risk" (FAO of the United Nations, Commodity and Trade Policy Research Working Paper No. 16, 2005).

40. FAO of the United Nations, "Issues and Actions on National and International Commodity Market Risk Management" (Document from a session of the FAO Committee on Commodity Problems, Rome, April 11–13, 2005).

41. On the potential advantages of multilaterally implemented "virtual" buffers, see Poulton et al., "State Intervention," 348–49, 354.

option provided for significant cost savings and relatively smooth deliveries. For 2006–7 – when, unlike in 2005–6, a surplus was expected – Malawi entered into a different tailor-made arrangement that amounted to a forward sale of part of its expected harvest with a clause that allowed repurchase in case of food deficits.⁴² Malawi’s experience is therefore beginning to show in practice the possibilities of price risk transfer mechanisms.

Price risk transfer for producers at the time of production decisions and before harvest

The difficulty of achieving viable price stabilization schemes was noted. Price risk transfer tools may facilitate the achievement of somewhat more limited goals, such as a minimum price guarantee and greater predictability (if not stability) of prices. A minimum price guarantee, for instance, can be achieved through the purchase, for a premium, of an option to sell at a particular price. (Typically, this makes financial sense only as insurance against future price declines below current levels, i.e., it is no solution to prevailing low-price environments.) Beyond minimum guarantees, price predictability can be achieved through option combinations, forward contracting, or selling futures. Pre-growing-season price risk transfer through such instruments provides a more predictable investment environment for farmers making production decisions. The direct benefit is a less risky investment/production environment – which may, in a second-order effect, reduce volatility. Since these tools are not accessible to small farmers, those farmers have to rely on intermediary institutions, such as marketing boards and their successor organizations, farmer cooperatives, trading houses, or credit providers, to provide access indirectly.

Consider, for instance, the case of Tanzanian cotton and coffee. Cooperative unions are major purchasers of these commodities and guarantee farmers a certain minimum price at the beginning of the season.⁴³ The resulting problem is equivalent to that of the traditional marketing board. If, by harvest time, market prices drop below the guaranteed price, the union would have to purchase at a loss; if prices rise above the guarantee, farmers might find better prices elsewhere. (In the latter scenario, the unions will purchase at the original,

42. Julie Dana, “Malawi’s Experience with SAFEX-based Market Solutions for Food Security” (Presentation at the United Nations Conference on Trade and Development [UNCTAD] Expert Meeting on the Trade and Development Implications of Financial Services and Commodity Exchanges, September 3, 2007).

43. Bryla et al., “Use of Price”; Rutten and Youssef, “Market-Based Price Risk Managements,” 17–18.

guaranteed minimum price but make additional payments to farmers later on as the unions resell the product, if the resale price allows for it.) This situation results in a high-risk profile for the cooperatives, and as a result, their borrowing costs are very high. A World Bank-initiated 2001 pilot with one of these Tanzanian cooperative unions led to the union's purchase of put options to hedge its guaranteed minimum price. This improved the union's creditworthiness with its bank and also allowed it to make earlier additional payments to farmers: because it had locked in a minimum price, it was less exposed to future price drops and could distribute profits as they were realized rather than keeping them for precautionary reasons. Rabobank, which acted as the financial intermediary for this transaction, has been involved in similar pilots in Nicaragua and Uganda.⁴⁴ It appears, however, that hedging by the Tanzanian cooperatives has so far been sporadic.⁴⁵ Ginners in Burkina Faso have offered cotton farmers a similar system of a guaranteed minimum price published before the sowing season and paid upon delivery, followed by an additional profit-sharing payment after the cotton is resold. Ginners have made use of hedging to insure against losses, and the system is judged to have worked well since the 1990s.⁴⁶

Costa Rican coffee millers provide prefinance to growers before harvest and pay an additional installment upon delivery; after export, they share any profit with the growers. This system is equivalent to guaranteeing a minimum price and then sharing any upside with growers. Millers who hedge the price risk they take on as a result of prefinancing and payment upon delivery reduce their own risk and, because of this, are able to provide larger payments to growers earlier. This makes them more attractive to growers.⁴⁷ The federation of Costa Rica's coffee cooperatives, FEDECOOP, has similarly engaged in hedging to deliver minimum price guarantees to its growers.⁴⁸

Individual Mexican farmers have been provided hedging options through the government's Apoyos y Servicios a la Comercialización Agropecuaria (ASERCA) scheme.⁴⁹ Preharvest, ASERCA offers farmers a variety of options (and,

44. Rabobank International, "Insuring Fair Prices for Farmers in Developing Countries" (World Business Council for Sustainable Development, Case Study, 2004), http://www.wbcds.org/web/publications/case/rabobank_commodity_price_risk_mgmt_full_case_web.pdf; cf. Moses Masiga and Alice Ruhweza, "Commodity Revenue Management: Cotton and Coffee in Uganda" (International Institute for Sustainable Development, May 2007).

45. Rutten and Youssef, "Market-Based Price Risk Managements," 26.

46. Louis Goreux, "Cotton in Burkina Faso" (Unpublished typescript, 2005).

47. Rutten and Youssef, "Market-Based Price Risk Managements," 24–25.

48. Patrick de Fontenay and Suiwah Leung, "Managing Commodity Price Fluctuations in Vietnam's Coffee Industry" (Asia Pacific School of Economics and Government, Australian National University, Working Paper 02–4, 2002), 12.

49. Guillermo Benavides and Nicholas Snowden, "Futures for Farmers: Hedging Participation and the Mexican Corn Scheme," *Journal of Development Studies* 42, no. 4 (2006): 698–712; Rutten and Youssef, "Market-Based Price Risk

according to some sources, futures) products for cotton, maize, sorghum, rice, wheat, coffee, orange juice, live cattle, hogs, and soy. Through the options products, farmers can essentially buy minimum price insurance. In hedging its resulting exposure through international commodity exchanges, ASERCA acts as an aggregating intermediary. Although participation has recently grown speedily, it remains relatively limited; in the case of corn, at least, ASERCA has tended to benefit primarily larger farmers.⁵⁰

To briefly compare the Tanzanian, Costa Rican, and Mexican schemes, the Mexican system of farmers purchasing the price guarantee option is in contrast to the Tanzanian case, where cooperatives provide a floor price without any action by the farmer. As discussed above, the drawback of the latter system is that, unless it sets the price guarantee at extremely low levels, it runs the risk of attracting large sales in low-price years but few in good-price years, with the attendant risk for the cooperative; while the cooperative's put option insulates it somewhat against such a scenario, the put option might be costly (with concomitant effects on the competitiveness of the cooperative's price), and the appropriate size of the option hedge is difficult to predict. The actual sale of guarantee options to farmers, as in the Mexican case, solves these problems by making the guaranteed price available only to those farmers who precommit to sharing the cost of providing the guarantee. Prefinancing, as in the Costa Rican case, is potentially even more risky for the miller: the miller takes on price risk, which it can hedge, but it also exposes itself to yield risk and the risk of nondelivery of the product for other reasons; such a system therefore depends on the enforceability of promised delivery. The three cases nicely illustrate a range of risk transfer schemes and the different issues they raise.

As experience with preharvest price guarantees that rely on hedging is relatively limited in LDC settings and is confined largely to export cash crops, it may be instructive to look for best practices elsewhere. Grain elevators, which play the role of intermediaries between farmers and commodity markets in the US,⁵¹ could be a model. Because such operations require technical skill, adequate size, and access to capital and futures markets (necessary for hedging the operator's own options exposure, especially for longer term hedging), they would likely have to be located at a higher level of aggregation and financial and institutional capacity than that of many cooperatives – which might still fulfill a crucial role as

Managements," 26; Panos Varangis and Don Larson, "Dealing With Commodity Price Uncertainty" (World Bank, Policy Research Working Paper No. 1667, 1996), 19.

50. Benavides and Snowden, "Future for Farmers."

51. Harwood et al., "Managing Risk in Farming."

aggregators, though.⁵² Marketing boards or their successor institutions, large LDC banks that might have an interest in bundling price and yield risk management products with credit, or even large traders may be better suited to operate such schemes. State trading corporations or marketing boards may, for instance, be reconceptualized and retooled as providers of marketing and risk management services to farmers on a not-for-profit basis. With an eye to Costa Rican coffee markets, the introduction of such a player with even relatively modest market share may well act as a catalyst for the competitive provision of attractive services to farmers in contexts where purchasing can be dominated by a few uncompetitive players. (Examples are rice export markets in Vietnam and maize markets in Zambia.)⁵³

Trader and producer price risk transfer after harvest

After harvest, farmers have an easy way to eliminate risk price: sell all their produce. In settings where prices are regularly depressed at harvest time because of a supply glut in the market,⁵⁴ however, this option may not be attractive. Poor farmers may nonetheless be forced to sell at what are often perceived to be extortionary low prices for three key reasons: a lack of safe storage capacity, an inability to financially bridge the time until a sale is made, and an unwillingness or inability to bear the risk of price decreases (even if contrary to expectations). Postharvest hedging can cap the price risk and ameliorate the problem of a lack of bridge financing if the problem of storage is tackled. The goal of hedging against price declines in this scenario is to put farmers in a position to benefit from (suspected) systematic intertemporal arbitrage opportunities. A second-order effect of achieving this goal might be to reduce intraseasonal price volatility as market gluts at harvest times are reduced.

The examples of preharvest price risk transfer discussed above already contain one mechanism for allowing farmers to benefit from intertemporal arbitrage opportunities. The first installment payment that farmers receive upon delivery to a cooperative or miller effectively locks in a minimum – and the purchasers hedge their price risk while providing farmers with upside participation in the case of higher realized sale prices. As indicated, price risk management can play an important role in such systems.

52. Cf. Rutten and Youssef, "Market-Based Price Risk Managements," 28–32; Derek Byerlee, T.S. Jayne, and Robert J. Myers, "Managing Food Price Risk and Instability in Liberalizing Market Environments: Overview and Policy Options," *Food Policy* 31 (2006): 283.

53. Winters, McCulloch, and McKay, "Trade Liberalization," 86–87.

54. Cf. Coulter and Onumah, "Role of Warehouse Receipt Systems," 321–22; Poulton et al., "State Intervention"; Stephens and Barrett, "Incomplete Credit Markets"; Fafchamps and Hill, "Price Transmission."

Although coffee markets, for instance, have evolved such systems, they appear to be much rarer in grain markets, perhaps in part because of inherent difficulties in developing systems of secure storage, as well as policy-induced uncertainties that aggravate such difficulties (see sections on buffer stocks and flexible trade regimes). The development of warehousing systems that provide secure storage and collateral receipting to farmers thus warrants serious attention.⁵⁵ In addition to other benefits (reduction in harvest losses, greater market transparency), warehouse receipts may be used as collateral for obtaining credit, and receipts are an indispensable element in any price risk management strategies that require collateral (selling options or engaging in futures transactions).

Successful examples include India's grain warehousing system that is accessible to small farmers.⁵⁶ Colombia and Venezuela have likewise developed effective warehousing systems that work in conjunction with commodity exchanges and have significantly improved producer access to credit.⁵⁷ Since the 1990s, Ghana and Zambia have been developing similar systems with donor support;⁵⁸ Uganda has also recently paid particular attention to this issue.⁵⁹

55. Cf. Coulter and Onumah, "Role of Warehouse Receipt Systems."

56. Coulter and Onumah, "Role of Warehouse Receipt Systems," 335; Erik Bergloff and Raghuram Rajan, "Progress in Emerging Markets is Being Put at Risk," *Financial Times*, July 18, 2008.

57. UNCTAD, "Overview of the World's Commodity Exchanges" (Study prepared by the UNCTAD Secretariat, 2006), 15.

58. Coulter and Onumah, "Role of Warehouse Receipt Systems."

59. Masiga and Ruhweza, "Commodity Revenue Management."

Limitations and obstacles

Potentially beneficial as the use of price risk management tools may be, a number of limitations and difficulties impede their accessibility for LDC beneficiaries. Some of these are fundamental, others at least in principle malleable. This section offers an overview.

- A key fact to be borne in mind is that *price risk transfer from producers can directly benefit only those who in fact sell crops in the market*,⁶⁰ although there may still be secondary benefits conferred on consumers if producer risk transfer increases supply or decreases volatility in output markets. (Price risk transfer from consumers is likely to be possible only via the indirect route of reducing price risk for large importers, importing state institutions, and food aid organizations.) For assessing the size and characteristics of the potential (direct) beneficiary group of producer price risk transfer, it is useful to map out populations systematically with regard to their positioning vis-à-vis agricultural (or, more specifically, food) markets. Five categories can be distinguished:⁶¹
 1. Consumers of a crop who produce none of it: they are directly affected only as consumers. This is likely the position of many urban poor people, although in-kind transfers from the countryside, as well as urban agriculture, must be considered. With regard to food crops, the proportion of a total population that makes up this group varies from economy to economy, but many African countries are among those where this group constitutes the smallest proportion of the population.
 2. Net consumers of a crop who produce some of it, purchase some, and do not sell any: they are likewise directly affected only as consumers, but they are insulated from market prices to the degree to which they satisfy their own subsistence requirements.
 3. Autarkic producers with no or only an insignificant surplus: they are shielded from price movements. In terms of direct impact, hedging is irrelevant.
 4. Marginal surplus or marginal deficit producers of a crop who market some of this crop but typically also purchase some for consumption.

60. Varangis, Larson, and Anderson, "Agricultural Markets and Risk," 15.

61. For similar typologies, see Poulton et al., "State Intervention"; Jayne, Zulu, and Nijhoff, "Stabilizing Food Markets."

Their position will typically be that of sellers at harvest time and buyers during the hungry season.⁶² Because these producers may engage in market transactions to a much greater extent than their *net* purchasing or selling position might suggest, it is important to consider the possibility of price risk transfers for them. Intraseasonal price risk transfer – in particular if it might serve to erode arbitrage possibilities between harvest and lean season prices in food crops – might benefit members of this group both in their role as producers (better prices at harvest time) and in their role as consumers (less exaggerated prices during the hungry season).

5. Significant surplus producers: whether or not they cover their own consumption needs from their own crop, these producers' position is overwhelmingly determined by their activities as sellers.

With regard to staple crop producers, sub-Saharan African data suggest that group 5 constitutes only a small minority of producers. A recent study cites the following figures from a variety of sources:⁶³ the largest 16 percent of Malagasy rice farmers account for 80 percent of rice sales; 10 percent of Kenyan maize farmers account for 75 percent of sales; and in Mozambique, 6 percent of maize growers are responsible for 70 percent of sales. For southern and eastern African countries, 50 percent of marketed smallholder maize is estimated to be produced by the top 1–3 percent of smallholder farms.⁶⁴ In light of such figures, it is clear that a large part of any benefit from price hedging by food crop producers would accrue to a small minority of typically already relatively well-off farmers. However, group 4 may also stand to benefit significantly, especially from intraseasonal, postharvest hedging. There are indications that for food crops this is a relatively large group. (The available figures sometimes are for gross and sometimes for net sellers; net sellers are a subset of gross sellers. Group 4 comprises all gross sellers - except for the small number of significant net sellers categorized as group 5.) For various food crops in Africa, group 4 is reported to make up a significant proportion (between 10 and 45 percent) of varying samples (rural or all households, rural households growing a particular crop, etc. – care with these data is essential).⁶⁵ Nonetheless, many households, and typically those who are relatively least well-off, who grow a crop will not be able to draw

62. Stephens and Barrett, "Incomplete Credit Markets"; Poulton et al., "State Intervention," 344.

63. Barrett, "Smallholder Market Participation," 307–8.

64. Jayne, Zulu, and Nijhoff, "Stabilizing Food Markets," 333–34.

65. Jayne, Zulu, and Nijhoff, "Stabilizing Food Markets," 333–34; Poulton et al., "State Intervention."

direct benefits from producer price risk hedging even if hedging can be made available. This may have primary (widening income differentials) and secondary (land inequality rising as a result) effects on inequality. To the extent to which hedging by groups 4 and 5 stabilizes prices and enables additional production, however, groups 1, 2, and 3 all stand to benefit indirectly as consumers – group 3 insofar as more stable and lower prices lower the opportunity cost of nonsubsistence activities.

- As discussed in the section on price risk transfer, the principal *purpose of hedging is not the achievement of a higher or lower price than can be expected in cash transactions*. Any particular transaction in futures markets may, of course, make the party better (or worse) off than she would have been had she not hedged, but this cannot, as a rule, be expected. Some situations, though, may strongly suggest the possibility of such gains. The regular occurrence of very low prices at harvest time and much higher prices only a few months later,⁶⁶ which seem not justified by the cost and risk of storage,⁶⁷ may be one such situation; it suggests the existence of market power or market failure (e.g., in credit markets) that creates an arbitrage opportunity that producers might be able to access through postharvest hedging. Another similar possibility might exist in a regular pattern of high prices in one or two seasons followed by low prices, where this pattern is not reflected in futures and options markets. A grain importer may then wish to hedge its exposure in years of low prices but forego an expensive and likely unnecessary hedge in years when prices are high.⁶⁸ Note that such possibilities essentially rest on market imperfections and arbitrage opportunities that are likely to be eroded as futures transactions reveal their existence. In the case of the intraseasonal patterns described above, this would be beneficial: producers might get better prices at harvest time, and/or consumers might get lower prices during the hungry season. The point is that hedging should, in principle, not be able to generate profits in the long term: its principal goal is to make income and expenditure more predictable.
- A fundamental limitation of all hedging is the *limited time period for which price hedging is available or affordable*. In general, the longer the time period, the less available and the more costly the hedging. For agricultural commodities, hedging is typically practical only for the upcoming one or two harvests. This imposes a fundamental limit on hedging possibilities. Planting decisions for crops such as coffee, tea, and cocoa, for instance, are thus not likely

66. For some illustrative data on the seasonality of the price of maize in Malawi, see Zant, "Food Import Risk," 10–11, 44.

67. Poulton et al., "State Intervention," 344–345; Stephens and Barrett, "Incomplete Credit Markets."

68. With reference to Zambia and Malawi, such a "discretionary" hedging strategy is discussed by Dana, Gilbert, and Shim, "Hedging Grain Price Risk," 365, 369.

susceptible to price risk transfer mechanisms – although investments in pruning and inputs are.

- The kind of *standardized contracting through which hedging is effected requires a transparent system of standardized grades, weights, volumes, and production that can effectively feed into such a standardized system*. Nonuniform crop quality and very small volumes therefore make hedging markets unviable. This issue is also connected to storage and warehouses (see below).
- *An appropriate hedging product must exist*. At the most basic level, a contract is an appropriate hedging product if it is written in reference to a particular good (defined as an item that has certain characteristics and is available at a particular time and place) whose price is closely correlated with that of the good that is to be hedged. This importantly implies that a local commodities exchange is not necessarily required. It may, for instance, be possible to hedge March Malawi maize of a certain grade with a Chicago (CBOT) contract or a South African (SAFEX) contract – as long as the price movements in these different goods and markets are closely correlated. (It is generally assumed that the correlation between SAFEX and Malawi is reasonably close; CBOT and SAFEX price movements, however, are known not to parallel one another closely.)⁶⁹ Whether an effective hedging contract is available therefore depends on the specific situation. If an appropriate contract does not trade on an exchange, it may be possible to create one. In the case of a very large transaction (hedging Ethiopia's price risk in wheat import markets, for instance), it may be possible to tailor-make a contract in the over-the-counter market. (A large insurer or bank might be interested in writing such a contract.)
- *A local exchange (which may be dispensable for certain purposes) may or may not exist or be viable*.⁷⁰ In many LDC settings, relevant expertise and capital are in short supply. The costs of establishing an exchange must therefore be weighed against the benefits. An exchange can also only be viable and effective if it garners adequate interest and volumes. Thin markets are unreliable and costly providers of hedging solutions, and they may not sustain the operator of an exchange, so adequate size of an exchange's market is very important. Exchanges must also be regulated well and complemented by effective clearing arrangements (warehousing is crucial) that ensure that

69. Zant, "Food Import Risk," 13–16; Dana, Gilbert, and Shim, "Hedging Grain Price Risk," 363; Sarris, Conforti, and Prakash, "Use of Organized Community Markets."

70. Cf. Varangis and Larson, "Dealing With Commodity," 33–35; Rutten and Youssef, "Market-Based Price Risk Managements," 19–23, 29.

contracts are enforced. A corollary is that participants in an exchange must, for many products, be able to meet stringent requirements, for instance, of capital adequacy, in order to reduce counterparty risk. (This again precludes most small farmers from direct participation in most activities on commodity exchanges.)

However, local exchanges may be better able to, and more interested in, serving local markets with specific products, and they can also fulfill other important functions, such as price discovery and transparency. Nonetheless, it is clear that exchanges, especially if they are to venture into futures and options trading, are not viable in many settings. Often regional exchanges will be far better able to serve several local markets. Being regional exchanges does not prevent them, of course, from developing specific contracts for local markets if there is sufficient interest in such products.

To give a brief sense of the landscape of existing exchanges, in terms of the number of contracts traded in 2004, the largest agricultural commodity exchanges were (in order of volume) the following: the CBOT/Chicago Mercantile Exchange (merged), the Dalian Commodity Exchange (China), the New York Board of Trade, the Tokyo Grain Exchange, the Zhengzhou Commodities Exchange, the Shanghai Futures Exchange, the Euronext London International Financial Futures and Options Exchange, the National Commodity and Derivatives Exchange (India), the National Multi-Commodity Exchange of India, and the Kansas City Board of Trade. The largest five accounted for more than 90 percent of contracts traded.⁷¹ With the partial exception of China, the US is by far the largest market in this area.

The recent history of exchanges illustrates that many may indeed prove to be unviable or fraught with problems for the reasons enumerated above. Chinese exchanges have had a rocky history, where futures trading in particular has on occasions been banned because of insufficient regulatory rules to stem unhealthy speculation (the number and kind of contracts traded have also changed frequently).⁷² In India, fears of such problems have recently prompted authorities to halt trading of futures in several commodities (likely to little effect).⁷³ Indian exchanges offer a number of positive lessons, however. They have, for instance, been able to leapfrog technologies by instituting an electronic trading system with tickers and

71. A comprehensive overview of the world's commodities exchanges with many useful illustrations of practical challenges is UNCTAD, "Overview."

72. Wensheng Peng, Ivy Yong and Rina Suo, "Commodity Futures Market in Mainland China: Recent Developments and Issues," *China Economic Issues*, no. 6/06 (December 2006); UNCTAD, "Overview," 22–25.

73. "Speculators will be the first to bet on price fall," *Financial Times*, June 28, 2008.

access points in many rural centers.⁷⁴ Such innovations may present a useful model and make the Indian exchanges' developers a key group of experts in the establishment of local exchanges in contexts where infrastructure is a constraint. South Africa's SAFEX is a well-established and effective market that is key for price discovery and risk management for maize in the southern African region. A Zambian and a Zimbabwean exchange failed shortly after inception after policy reversals in the mid-1990s, and others have failed as a result of insufficient volume. Malawi, on the other hand, established a new exchange in 2005, and there was a recent initiative with involvement of the United Nations Conference on Trade and Development (UNCTAD) to establish a "hub and spoke" Pan-African Commodities and Derivatives Exchange.⁷⁵ There is also a new exchange (so far without futures trading) in Ethiopia.⁷⁶ Of the Middle and South American exchanges, Brazil's, dominated by coffee, is the most active in agricultural commodities. Other exchanges provide different services, not all of them including futures and other derivatives contracting.⁷⁷

- The typical, *very large standard size of commodity contracts also poses serious challenges for several applications* of financial market risk transfer mechanisms. Chicago contracts, for instance, are so large that they far exceed the total production of almost all individual farmers in LDC settings. There are two principal solutions: an intermediary could splinter such larger contracts (offer smaller contracts and aggregate them) or aggregate individual farmers' production to make a viable quantity for hedging. In the former case, the intermediary would likely be a local exchange; in the latter, a cooperative or large public or private trader. Such intermediary institutions are thus crucial components of a system that makes hedging products (indirectly) accessible to smaller farmers. (In the US, grain elevators typically fulfill this function.)

Differential access, which many of these points imply, of course means differential benefits from hedging: this likely has undesirable consequences because it would seem to naturally put larger, better-off, and non-LDC farmers at an advantage. There are also some suspicions that, at least for some products and

74. UNCTAD, "Overview," 25–27. On the related Indian initiative of agricultural information kiosks, see Rutten and Youssef, "Market-Based Price Risk Managements," 30.

75. UNCTAD, "Overview," 31–32.

76. Eleni Gabre-Madhin, "The Ethiopian Commodity Exchange (ECEX): Making the market work for all" (Presentation to an UNCTAD Expert Meeting on the Trade and Development Implications of Financial Services and Commodity Exchanges, 2007), http://www.unctad.org/sections/wcmu/docs/c1em33p10_en.pdf; Eleni Gabre-Madhin, "Rising Prices and the Role of Commodity Exchanges" (Statement to the Press, April 17, 2008), <http://www.ifpri.org/pressrel/2008/20080417Elenipressstatement.pdf>; Peter Heinlein, "Ethiopian Farmers Have New Market for Products" *Ethiopian Review*, March 5, 2008, <http://www.ethiopianreview.com/content/6855>.

77. UNCTAD, "Overview," 13–14.

markets, integrating local markets with foreign futures market activity that may be dominated by momentum traders might increase price volatility in local cash markets. While this has no effect on those who are adequately hedged, it may make the environment of nonhedgers even more problematic.⁷⁸ Both these concerns imply a special urgency to strengthen access for small and poor producers.

78. Fortenberry and Zapata raise this possibility in the context of price transmission between NYBOT and Guatemala's and Honduras' coffee markets. Randall Fortenberry and Hector Zapata, "Developed Speculation and Underdeveloped Markets – The Role of Futures Trading on [sic] Export Prices in Less Developed Countries," *European Review of Agricultural Economics* 31, no. 4 (2004): 451–71.

Conclusion

While hedging import price risk appears to be more and more accessible to LDCs, a number of typical, interlocking conditions are serious obstacles to making hedging accessible to small producers in LDC settings. Chief among these conditions are the characteristics of poor and small-scale farmers that imply high transaction costs and lack of often important collateral; undeveloped financial, commodity trading, and warehousing systems; low overall volumes of marketed produce of often nonstandard quality; and a dearth of reliable and up-to-date information about past and present price, production, demand, and stock trends that are an important basis for the calculations that underlie the design of price risk transfer instruments. Overcoming such hurdles requires innovative, context-specific product design and long-term strategies that include a focus on institution building. One key question is, What specific roles (adviser, supervisor, direct provider, intermediary provider) might the different institutional players (government agencies, cooperatives, local and international financial institutions) play? A connected set of questions concerns the design of particular hedging products that may specifically facilitate accessibility for small farmers (e.g. bundling of optionlike price insurance with credit or input packages versus stand-alone products). The practical experiences with hedging tools reviewed in this Backgrounder are an important inventory to draw on in tackling these questions.

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