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MSU/FSG Study of the Impact of WFP Local and Regional Food Aid Procurement on Markets, Households, and Food Value Chains

by

MSU Study Team: David Tschirley, Robert Myers, and Helder Zavale

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All errors of fact, interpretation, and omission are the authors' alone.

EXECUTIVE SUMMARY

This study examines the impact of the World Food Program's (WFP) Local and Regional Procurement of food aid (LRP) on households and markets. It focuses on four countries and commodities where WFP LRP has had a meaningful share of the market: maize in Uganda and Mozambique, beans in Ethiopia, and High Energy Protein Supplements (HEPS) in Ethiopia and Malawi. The study investigates three specific impacts of LRP: (1) its effect on the level and variability of local market prices, (2) the impacts of resulting price and production changes on the economic welfare of local rural and urban households, and (3) the effect of LRP purchases and related training and inspection activities on the investment decisions and trading practices of traders and processors in the food system, and hence on the development of the food supply chain. To explore these questions, the study uses four complementary methodologies: (1) a structural computational model (CM) that predicts effects on local market prices; (2) a vector autoregression model (VAR) that empirically estimates the impact of past LRP on market prices; (3) a household model that estimates the effect of the resulting price increases on the economic welfare of different households; and (4) a case study approach to investigate trader and processor responses to engagement with WFP and their perception of the effects of WFP LRP on the food supply chain.

Maize accounted for 58% of all LRP volume in Africa between 2001 and 2011, and Uganda and Mozambique ranked first and second, respectively, in maize LRP purchases as a share of estimated market surplus in each country. HEPS was the next most procured item, at 12% of all volumes, and Ethiopia and Malawi ranked first and second, respectively, in total LRP volumes purchased. Beans accounted for 7% of all volumes and Ethiopia and Uganda were nearly tied for the largest total volume of bean procurement. Because we chose countries and commodities where LRP was largest, the impacts found in other countries are likely to be lower than those found in this study.

Case studies were conducted for all commodities. The CM and VAR models were estimated for maize in Uganda and Mozambique and beans in Ethiopia. Due to data limitations on beans, welfare effects were estimated only for maize in Uganda and Mozambique.

Several broad findings stand out from the study. First, with the exception of Uganda, the average price effects of LRP are modest. Second, price increases are economically meaningful during the two years of highest procurement in Mozambique and during many years in Uganda. Price effects are very small for beans in Ethiopia.

Third, welfare effects are small for the great majority of households, despite sometimes-meaningful price effects. Average welfare effects are less than a 1% loss for maize in Uganda and Mozambique, and about three-quarters of all households experience impacts between 1% and -1%. Because beans have lower shares in consumption and production and lower estimated price effects, its household level welfare effects will be even lower than those estimated for maize in Uganda and Mozambique.

Fourth, there are small groups of households that do experience significant welfare effects, both positive and negative. In Uganda, 8.9% of households are estimated to experience welfare gains or losses greater than 3%, while in Mozambique 6.9% experience such effects. Negative (and positive) welfare effects are distributed relatively evenly across the income distribution in Mozambique, while in Uganda negative effects are more concentrated among the poor. Focusing on the bottom third of the income distribution in that country, over 13%

had estimated losses of greater than 3%, and nearly 6% had losses greater than 5%. On the positive side, 4.4% enjoyed welfare gains of more than 3% and 1.6% had gains above 5%

With price effects that are generally modest and welfare effects that are small for at least three-quarters of households and near zero on average, the overall effect of LRP depends primarily on the systemic effects that WFP generates by the way in which it goes about its procurement. Case studies focused on three potential systemic effects: improved knowledge, practices, and investments regarding quality; operational efficiencies stemming from larger-scale transactions under less uncertain prices and quantities; and effects on entry into sectors and on companies' and sectors' ability to compete in the commercial sector.

Our fifth broad finding is that WFP has positively influenced the quality culture on maize in Uganda, beans in Ethiopia, on HEPS in Ethiopia and Malawi, but not on maize in Mozambique. In all these cases, traders and processing companies have invested in new machinery and new practices to satisfy WFP's market. Many companies indicated that WFP's quality training and ongoing interactions on quality have caused them to focus more analytically on quality parameters; to understand and implement practices to achieve and document these parameters; to consolidate and spread within their company the inconsistent quality practices that they already had; and in some cases to use these improved practices to enter the export market more strongly.

The quality story is positive but inconclusive on maize in Uganda. We document WFP/Uganda's move from Fair Average Quality to East African Community quality standards. Though a difficult transition, it resulted in substantial investment in cleaning and drying capacity by traders in Kampala, and testimony by traders as to the value of the training and the new procedures they had implemented. Yet poor quality grain re-emerged as a major problem late in 2012. Preliminary interviews suggested that, in addition to known structural factors, the problem was related to (a) high rainfall during harvest, and (b) aggressive buying by some traders of wet maize in the expectation of high prices.

WFP has had relatively little impact on quality practices in Mozambique, for multiple reasons: the highly dispersed marketing system that raises the cost of coordination for quality improvement, the dominant position of the two early trading firms who had no meaningful competition in supplying WFP, and the lack of any organized WFP quality training program.

Our sixth finding is that traders are able to generate greater operational efficiencies selling to WFP, due to the relatively large size of tenders and a price that is known once a tender is won. If firms are able to use their WFP experience to increase their scale of operation more generally, then these efficiency gains will be long lasting and generate high returns to the farmers and consumers operating in the local food system.

Finally, on the question of market entry, we found that WFP operations have spurred market entry in the Malawian and Ethiopian HEPS sectors, have facilitated greater commercial competitiveness of the Malawian HEPS and Ethiopian bean sectors, but have had limited effect on market entry in Mozambique's maize sector. By spurring entry into the Ethiopian HEPS sector, WFP has potentially facilitated a robust response by that sector to growing commercial markets, but that response has to date been limited, and WFP has not facilitated any entry by these firms into regional operations. As WFP moves now to include Ethiopian HEPS firms in regional tenders – as have done successfully for several years in Malawi – these companies may begin to be able to take broader advantage of the quality training they have received. In Mozambique, WFP has brought Maviga into its tendering process as a new, large seller. Maviga has not, however, expanded its commercial business into maize, remaining focused instead on its core trade in pulses. Interviews with Maviga did not reveal any intention to expand commercially into maize in the immediate future.

Looking ahead, we suggest that WFP must have a market presence of meaningful size and perceived medium- or long time frame to leverage change, and we ask how the agency can achieve this while not imposing excessive welfare costs on poor consumers. This question is particularly germane in light of the agency's goal of moving to 30% cash and vouchers by 2015, which will put continued downward pressure on LRP. Case studies and a review of procurement patterns suggest that WFP could maximize its systemic impact on African food systems through the following approaches:

- Continue to emphasize local procurement of value-added products. Such an emphasis is especially timely now in Africa, as their food systems are just beginning to transform and demand for value-added products is set to grow rapidly but is not yet as high as in Asia. As a result, WFP could, through its quality standards and training and, if possible, more forward planning in purchases through use of the agency's Forward Purchase Facility (FPF), help drive investment and good quality practices at an early stage, with long-lasting payoffs for the food systems. Moreover, doing this in value-added products would allow WFP to largely avoid imposing negative welfare effects on some poor households when it procures large amounts of basic staples such as maize.
- Assist local companies to produce Super Cereal Plus and other more nutrient-dense foods by providing them with an assurance of purchase subject to meeting quality and safety standards and without exposing the agency to unduly high prices. If WFP can do this, then growth potential for these products is tremendous based on substitution for European imports. The key decision for WFP, assuming firms can meet quality and safety standards, will be how flexible to be on pricing, delivery terms, or other contractual aspects that will facilitate or hinder the firms' ability to sell to the agency.
- Continue to expand the use of FPF and use it to engage in larger purchases over longer planning horizons. If staple food LRP in Africa declines over time, as suggested by recent trends and by the agency's emphasis on cash and vouchers, FPF will likely drive more positive systemic change if it is focused on a limited number of countries that can provide relatively large quantities, rather than being spread over numerous countries, each supplying smaller quantities.
- As WFP does this, however, it must be mindful of the finding of this study, that purchases at the levels seen in Uganda during the years of highest LRP can impose meaningful welfare losses on poor households that rely on maize purchases for part of their consumption.
- Take steps to further enhance the already high transparency of its tendering process. First, country offices could be more consistent in sending regret emails to losing bidders. Second, WFP could standardize and ensure implementation of the existing (but inconsistently applied) practice of announcing winning prices on tenders. Finally, in countries where relatively few companies are invited to tender, WFP could consider developing an SMS message and delivery list – additional to and separate from the tender invitation that goes only to qualified traders – that announces a tender without inviting bids

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LIST OF ACRONYMS

ACE	Malawi Agricultural Commodity Exchange
AIC	Alkaike's Information Criterion
CM	Computational Model
CSA	Ethiopian Central Statistical Agency
CSB	Corn-Soya Blend
CV	Coefficient of Variation
DRC	The Democratic Republic of the Congo
EAC	East African Community
EAGC	East Africa Grain Council
ECX	Ethiopian Commodity Exchange
ETB	Ethiopia BIRR
FAQ	Fair Average Quality
FBFs	Fortified Blended Foods
FEWSNET	Famine Early Warming Systems
FPF	Forward Purchase Facility
FSC	Food Share Company
GAO	United States Government Accountability Office
GDP	Gross Domestic Product
HEPS	High Energy Protein Supplements
IDP	Internally Displaced Person
IOF	Mozambique Household Budget Survey
Kg	Kilogram
LR	Likelihood Ratio
LRP	Local and Regional Procurement
MT	Metric Tons
MZN	Mozambique Metical
NGO	Non-Governmental Organization
OLS	Ordinary Least Squares
P4P	World Food Programme's Purchase for Progress Initiative
RUF	Ready to Use Food
RUTF	Ready to Use Therapeutic Food
SAGIS	South Africa Grain Information Service
SIMA	Mozambique's National Market Information System
SNNP	Southern Nations, Nationalities, and People
SPI	Seasonal Pricing Indicator
SSA	Sub-Saharan Africa
UBOS	Uganda Bureau of Statistics
UGX	Uganda Shilling
UNBS	Uganda National Bureau of Standards
UNPS	Uganda National Panel Survey
U.S.	United States
US$	United States Dollar
USDA	United State Department of Agriculture
VAR	Vector Autoregression
VEC	Vector Error Correction
WFP	United Nations World Food Programme
WINGS	World Food Programme's Information Network and Global System

1. INTRODUCTION

Local and Regional Procurement (LRP) of food aid – the purchase of food commodities in the country or region where food aid is being distributed to targeted groups of households – has been shown to have at least two important advantages compared to trans-oceanic food shipments. First, LRP generates large cost savings, making it possible to feed more people in need with a given emergency response budget. Tschirley and Del Castillo (2007) show that locally or regionally procured maize in Kenya, Uganda, and Zambia costs only 57% of what it would have cost to ship food transoceanically. These cost savings allowed 75% more food to be provided to beneficiaries for a given budget. Clay, Riley, and Urey (2005) found equivalent figures of 61% for maize and 52% for corn-soy blend (CSB)The United States Government Accountability Office (GAO) (2009) found comparable savings.[1] Second, LRP reduces the time it takes to deliver food, increasing the timeliness of response to food crises. GAO (2009) found that, compared to an average delay of 150 days for delivery of in-kind trans-oceanic food aid, locally procured food took only 35 days, and regionally procured took 41 days. Lentz, Passarelli, and Barrett (2013) found timesavings of 14 weeks equivalent to a 62% reduction.

Less research has been done on the impact of LRP on local markets, and existing research results are less definitive. Early studies (Wandschneider and Hodges 2005; Walker and Wandschneider 2005; Coulter 2007) used case study approaches and suggested that LRP had helped drive some investment in the trading systems of Uganda and Ethiopia, had driven improved quality practices for WFP transactions, and may have contributed to improved export trade of some foods in Ethiopia. Yet they also suggested that LRP had failed to have any appreciable effect on the broader trade and may in some instances have led to price spikes. With few years of experience to examine, these results had to be considered tentative. More recent quantitative research (Lentz, Passarelli, and Barrett 2013; Garg et al. 2013; Violette et al. 2013; Harou et al. 2013) finds that LRP had no detectable effect on market prices or variability. Yet this research focuses on the small-scale LRP carried-out by U.S. NGOs under the United States Department of Agriculture (USDA) pilot LRP programs. These pilot programs "were minuscule compared to the size of the market" (Garg et al. 2013) and even with WFP procurement, total procurement in the studied countries did not reach the levels found in the countries that we have chosen. We are not aware of any existing studies of LRP effects on local markets and households in countries where LRP purchases have been a significant share of total marketed surplus.

This study addresses these knowledge gaps by focusing on four countries and commodities where WFP LRP has had a meaningful share of the market: maize in Uganda and Mozambique, beans in Ethiopia, and High Energy Protein Supplements (HEPS) in Ethiopia and Malawi. The study investigates three potential impacts of this LRP: (1) the effect of LRP on the level and variability of local market prices; (2) the impacts of resulting price and production changes on the economic welfare of local rural and urban households; and (3) the effect of LRP purchases and related training and inspection activities on the investment decisions and trading practices of traders and processors in the food system, and hence on the development of the food supply chain. To explore these questions, the study uses four complementary methodologies: (1) a computational model (CM) that uses a structural economic model of local price determination, along with data on the level of LRP relative to the size of the market in which it occurs and estimated values of key parameters such as

[1] Lentz, Passarelli, and Barrett (2013) found nearly identical savings for grains and pulses even when examining the small-scale LRP purchases of U.S. NGOs funded under a USDA program. For corn-soy blend and vegetable oil, however, they found that these small-scale transactions sometimes resulted in higher total cost, not lower.

elasticities of supply and demand, to predict effects on local market prices; (2) a vector autoregression model (VAR) that uses data on past food aid distributions, LRP purchase quantities, and local market price movements to empirically estimate the impact of past LRP purchases on market prices; (3) a household model that uses household-level data to estimate the effect of the resulting price increases on the economic welfare of different households; and (4) a case study approach using interviews with a wide range of actors in each country to investigate trader and processor responses to engagement with WFP and their perception of the effects of WFP LRP on the food supply chain.

The study proceeds as follows. Chapter II reviews our criteria for country selection. Chapter III presents results from the case studies of maize in Uganda and Mozambique. Chapters IV and V focus on the case studies on beans in Ethiopia and HEPS in Ethiopia and Malawi, respectively. Chapter VI provides a non-technical summary of the CM and VAR modeling procedures, discusses their advantages and disadvantages, and present results from both. A more technical explanation of the modeling, including all mathematical derivations, may be found in Annexes B and C. Chapter VII provides a non-technical explanation of the methods for assessing the household welfare effects of LRP, and presents results for maize in Uganda and Mozambique. Technical details for this chapter are found in Annex D. Chapter VIII closes with a summary of key crosscutting findings from the research and with a discussion of implications for WFP programming.

2. COUNTRY AND COMMODITY SELECTION

A key objective in the study was to develop results at market, household, and food supply chain levels in as many of the study countries as possible. For this reason, countries and commodities were selected based on four factors:

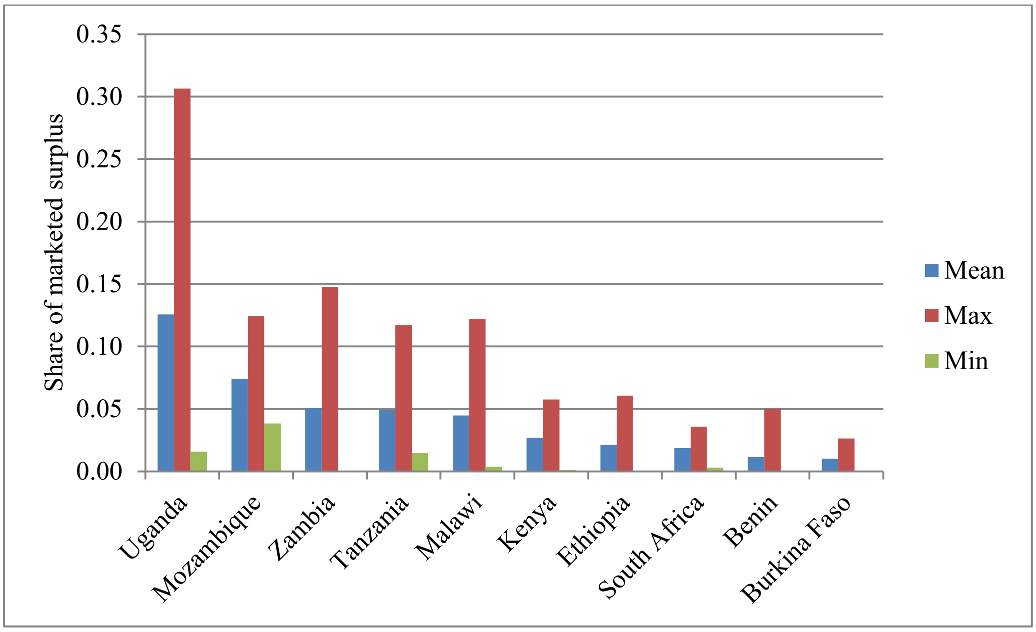
- The size of LRP purchases of a given commodity relative to the total estimated marketed surplus of that commodity. The impact of LRP on markets, and through markets on farmers and consumers, depends fundamentally on the size of LRP purchases relative to the total size of the market. While other factors can also intervene, any effects from very small purchases will be impossible to distinguish from the normal price variations seen in any liberalized market.
- The availability of price data of sufficiently long duration to support meaningful statistical analysis of LRP impacts on prices. With 11 years of data (2001-2011) from WFP on their LRP transactions, we looked for price series of at least monthly data that covered as much of this period as possible.
- The availability of household level data sets of sufficient detail, sample size, and quality of questionnaire design and collection to support reliable modeling of the effects of price changes due to WFP LRP on household welfare.
- The absence of other factors such as large-scale government purchases that would make it difficult to isolate statistically the effect of LRP purchases.

The five most procured commodities by WFP in Africa from 2001 to 2011 were maize, HEPS, sorghum/millet, maize meal and beans, accounting for 58%, 12%, 9%, 8% and 7%, respectively, of all procurement volumes. Wheat is next at about 3%. The contribution of all other commodities is 1% or below. Given their relative importance, this study focuses on the impacts of LRP purchases of maize, HEPS, and beans. We exclude sorghum and millet because data suitable for market modeling for these commodities are generally not available in African countries. We eliminated wheat because LRP's market share in Ethiopia, the only country with meaningful purchases, is less than 1%.

Figure 1 shows the mean, minimum, and maximum LRP purchases of maize as a share of estimated marketed surplus in the main African countries in which WFP operates. Data cover the period 2001-2011. Production data come from FAOSTAT. In countries where we have household survey data (Mozambique, Zambia, Kenya, Uganda, and Malawi), we used that data to compute the marketed share of production during the survey years, and apply that during each year of our period of analysis to compute WFP LRP share of marketed surplus. In other countries, we used secondary data and existing knowledge of the structure of production and marketing to estimate the share of marketed surplus. Production multiplied by marketed share gives estimated total marketed quantities for each year. We computed WFP's estimated share of the market by dividing WFP LRP purchases by marketed surplus.

In order, mean LRP purchases of maize as a share of marketed surplus were highest in Uganda, Mozambique, Zambia, Tanzania, and Malawi. Maximum share also matters, because it can drive large effects in years of high purchases despite potentially modest effects in other years. In this regard, Uganda has by far the highest maximum share followed by Zambia at 14% and then Mozambique, Tanzania, and Malawi at 11%-12%.

Figure 1. LRP Purchases of Maize as Share of Marketed Surplus, 2001-2011



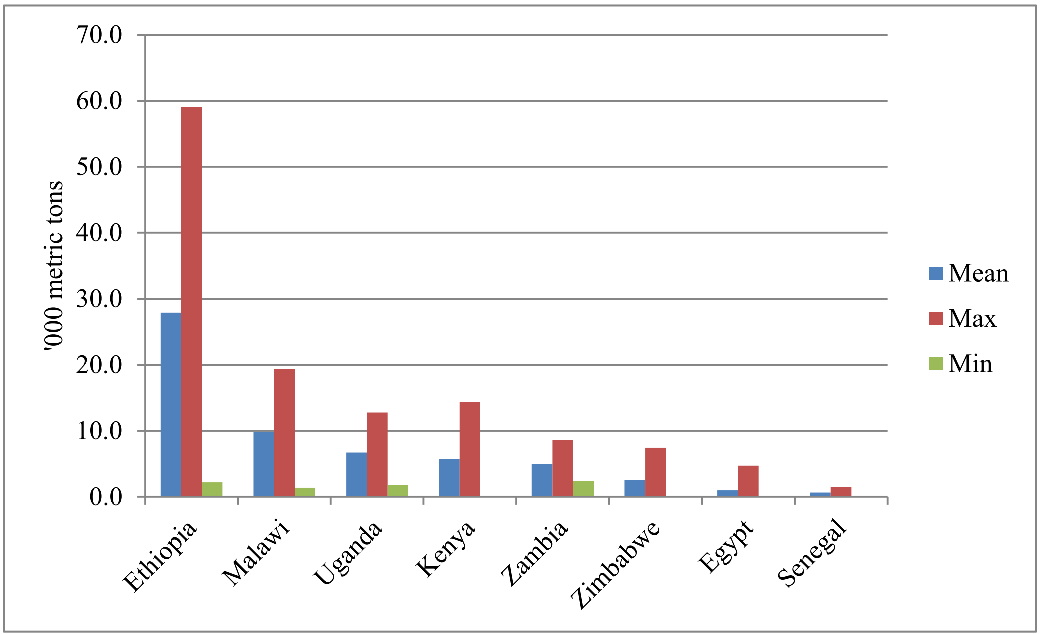
Source: Authors' elaboration using data from WFP WINGS database.

Estimating LRP's market share of beans is more difficult, as bean production frequently takes place in very small quantities at farm level, is more frequently intercropped than maize, and tends to be less commercialized. Both factors make production data for beans subject to more error than for maize. Following the procedure used for maize to estimate LRP share of marketed surplus of beans resulted in mean estimates of 14% in Ethiopia, 13% in Uganda, and less than 5% in all other countries. The mean estimates for beans in Ethiopia and Uganda are higher even than the estimate for maize in Uganda, where WFP is widely regarded to have played its most important role in LRP. We believed – and interviews during case studies later confirmed – that in fact WFP was not nearly as large a buyer in these bean markets as they were in Uganda's maize market. We therefore focused on total metric tons of beans procured across countries, which show Ethiopia and Uganda essentially tied, each with more than 160,000 total metric tons (MT) of procurement from 2001 to 2011.

For HEPS[2] we also focus on annual metric tons rather than market share because WFP is likely to be nearly the entire market for these products in most countries. Ethiopia clearly stands out with an average annual purchase of about 28,000 MT and a maximum of nearly 60,000 MT (Figure 2). Malawi is next at an average of nearly 10,000 MT. and per capita purchases of HEPS similar to those in Ethiopia, suggesting roughly comparable importance relative to broader markets. Average purchases in all other countries are 7,000 MT or lower, and will also be lower on a per capita basis than in Ethiopia and Malawi.

[2] From the product names in the WFP tender data base, we define HEPS to include biscuits, corn-soya blend (CSB), Faffa, high energy biscuits, Likuni Phala, pea-wheat blend, high energy supplements, and ready to use supplementary food. Among these, only pea wheat blend was not found originating from our two HEPS study countries. Faffa and CSB accounted for 92% of all observations, with Likuni Phala listed for 5.8%. We understand that Faffa and Likuni Phala are brand names and that products listed as these may sometimes have been comparable products produced by other companies.

Figure 2. Annual Average LRP Purchases of HEPS (2001-2011)



Source: Authors' elaboration using data from WFP WINGS database.

These data suggest Uganda, Mozambique, and Zambia as candidate countries for analysis of LRP purchases of maize. We eliminated Zambia due to the very large market presence of the Food Reserve Agency since 2008, which would make it difficult to isolate the impact of LRP. Available data in Uganda and Mozambique were sufficient to support both the market modeling and the household modeling for maize, so these two countries were chosen for the analysis of LRP maize purchases.

Bean purchases in Ethiopia and Uganda are sufficient to merit a focus on this commodity in those countries. However, lack of suitable price data precluded market level modeling and household welfare analysis for beans in Uganda. Therefore, we focused on beans only in Ethiopia. For HEPS, we chose Ethiopia and Malawi, the top two countries in total and per capita purchases. Note that the absence of any time series on HEPS prices precludes quantitative analysis of the impacts of these purchases on prices, so the impact of LRP for this product was therefore addressed only through case studies. Table 1 shows the countries, commodities, and type of analysis chosen for this study.

Table 1. Country and Commodity Focus

	Commodity			
Countries	Maize	Beans	HEPS	Analysis
Uganda	X			Modeling + case study
Ethiopia		X	X	Modeling (beans) + case study (both)
Mozambique	X			Modeling + case study
Malawi			X	Case study only

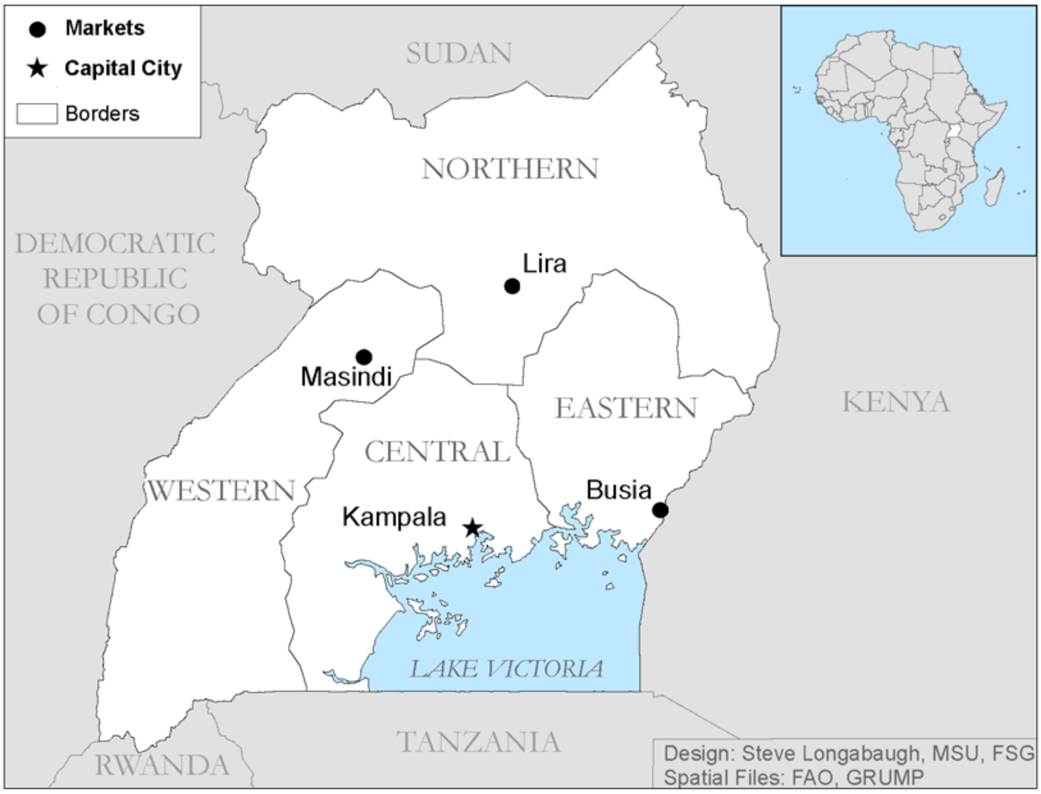
3. CASE STUDY RESULTS: MAIZE IN UGANDA AND MOZAMBIQUE

This chapter reports on the results of case studies of maize procurement in Uganda and Mozambique. We start by laying out the geography of maize production and trade in each country before presenting insights generated from analysis of WFP's procurement data – both tender level and vendor level data on every purchase made. We then report on the results of our interviews with actors in each country's maize sector, before closing with a summary of key findings and issues from this phase of the work.

3.1. The Geography of Maize Production and Trade

Figures 3 and 4 show maps of each country with regions and key markets indicated.[3] In Uganda (Figure 3), the Central region is maize deficit, dominated by the urban center of Kampala and its major wholesale market, Kisenyi. Eastern, Northern, and Western regions all produce a maize surplus, which flows primarily to Kampala, Kenya, South Sudan and, to lesser degree, The Democratic Republic of the Congo (DRC). Busia, located on the border with Kenya in Eastern region, is also a major reference market for traders and some farmers.

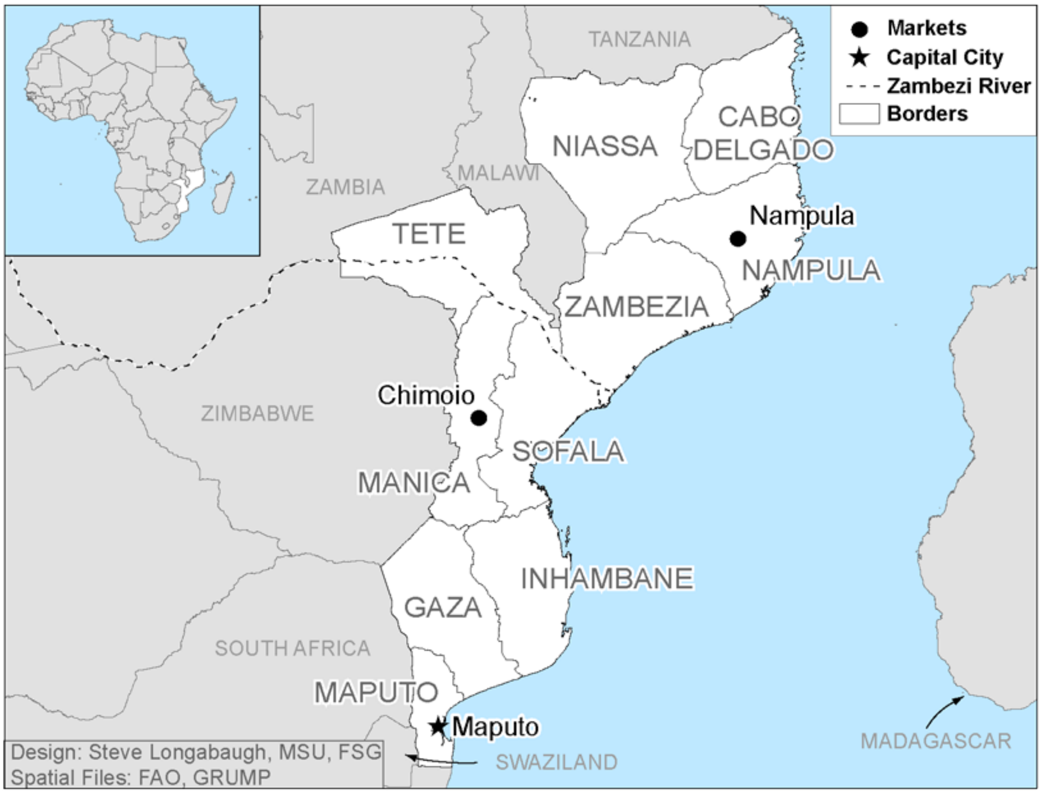
Figure 3. Map of Uganda Showing Provinces and Key Markets



Source: Authors.

[3] Highlighted cities reflect locations of important markets, many of which are used in analysis of price impacts of LRP further below.

Figure 4. Map of Mozambique Showing Provinces and Key Markets



Source: Authors.

Agriculture in Mozambique is often separated into three regions: the northern region consisting of the provinces of Niassa, Cabo Delgado, Nampula, and Zambezia; the central region including Tete, Manica, and Sofala provinces; and the southern region encompassing Inhambane, Gaza, and Maputo provinces. The northern and central are surplus regions, while the southern region is deficit during every year. Maize production from northern Mozambique flows to Malawi when prices in that country are high. In the absence of that export market, production in this region historically remained within the region, due to the lack of a bridge over the Zambezi River[4]. Since 2009, when a modern bridge was constructed over the river, maize trade between the northern and central regions is possible though still not considered common. In the central region, maize from Manica and Sofala provinces moves primarily to southern Mozambique (especially to Maputo, the country's capital and largest urban center), while production in productive northern portions of Tete province moves into Malawi when prices are high there.

Maputo, the capital city and located in the south, is the largest market in the country. Maize from the central region flows primarily into informal markets and animal feed manufacturers of Maputo and other southern cities. Large maize millers in the south, due to concerns about low quality of grain and unreliable supplies from the local market, rely almost entirely on large volumes of imported maize from South Africa.

[4] The river forms the border between Sofala and Manica, on the south bank, and Zambezia and part of Tete on the north bank.

3.2. Insights from Analysis of Procurement Data

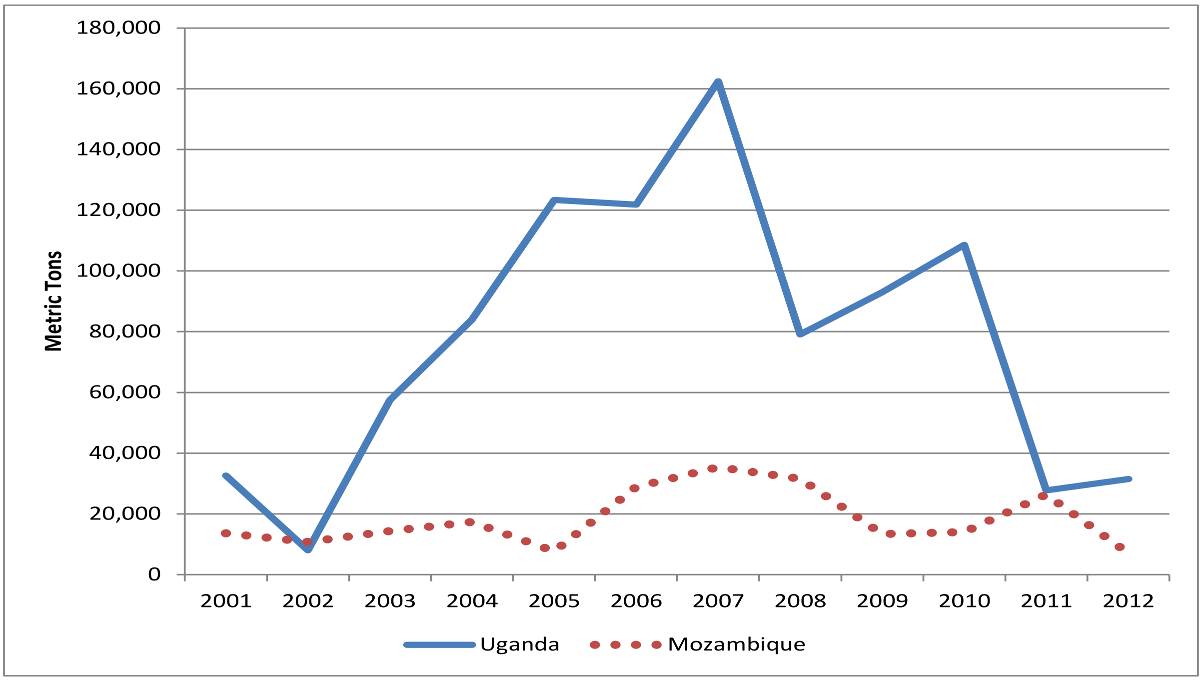
WFP provided detailed data at the level of tenders and vendors (individual winners of tenders, with typically more than one per tender). We use these data to characterize trends and patterns in quantities procured, the structure of procurement, and the destination of procured food aid.

3.2.1. Quantities, Structure, and Destination

Figure 1 showed that Uganda and Mozambique ranked first and second in the average share of maize marketed surplus purchased by WFP from 2001 to 2011, at about 12.5% and 7.5%, respectively. Aside from this, the two countries present large differences in the way that LRP has developed. Figures 5-9 present basic information on the levels, structure, and flows of locally procured maize in each country.

Uganda is well known as the country where LRP scaled-up to levels capable of having major impacts on local markets. This is seen clearly in the dramatic rise of LRP from less than 10,000 MT in 2002 to over 160,000 MT in 2007 (Figure 5). During the same period, Mozambique's procurement fluctuated below 20,000 MT through 2005 before rising sharply to nearly 29,000 MT in 2006 and over 35,000 MT in 2007. Since then, procurement in Mozambique has declined slightly while in Uganda it has dropped sharply; maize procurement was comparable in the two countries in 2011 before diverging again in 2012.

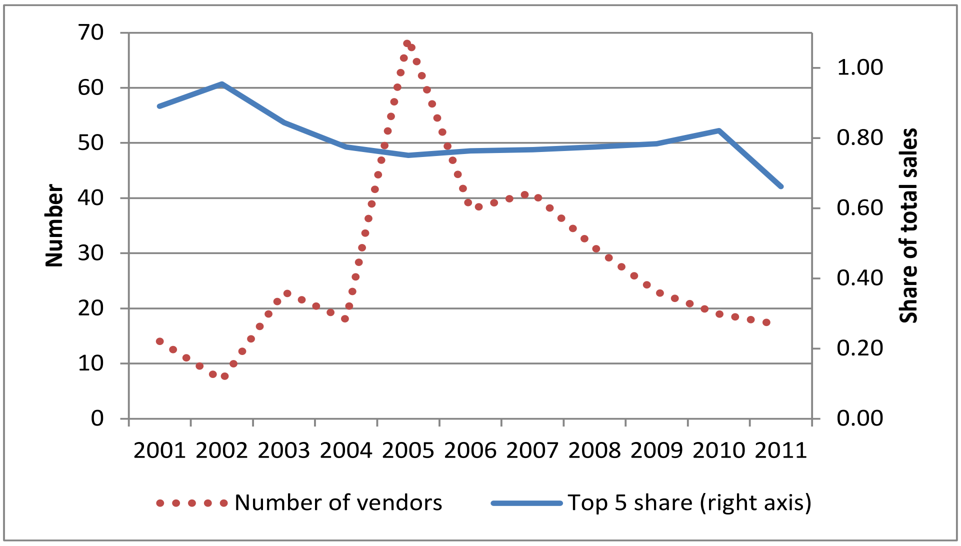
Figure 5. Volumes of Maize Procurement by WFP in Uganda and Mozambique, 2001 - 2012



Source: Authors' elaboration using data from WFP WINGS database.

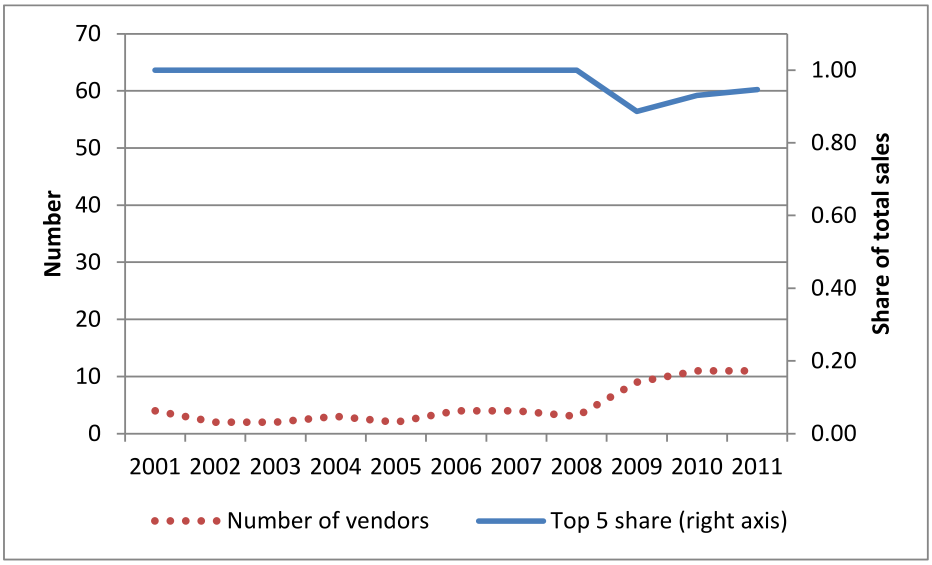
The concentration of sales, as measured by the number of vendors and share of the top five vendors in LRP sales, also differ dramatically across the countries (Figures 6 and 7). Uganda has never had fewer than seven vendors per year and averaged 27 annually over the period of analysis, while Mozambique has never had *more* than 11 and averaged five per year. Uganda's top five vendors during any year never accounted for more than 95% of sales and averaged 80% (with a slightly declining trend), while Mozambique's top five accounted for *all* sales every year until 2009 and averaged 98% of sales. In fact, the same *two* vendors in Mozambique accounted for all sales to WFP during every year from 2002 to 2005 and again in 2008. The structure of sales to WFP in Mozambique mirrored structural characteristics in the country's broader maize trade and had a major influence on the design of the country's Purchase for Progress (P4P) program; we come back to this issue later in this chapter.

Figure 6. Number of Vendors and Share of Top Five in Maize Sales to WFP in Uganda, 2001-2011



Source: Authors' elaboration using data from WFP WINGS database.

Figure 7. Number of Vendors and Share of Top Five in Maize Sales to WFP in Mozambique, 2001-2011



Source: Authors' elaboration using data from WFP WINGS database.
Notes: only two (2) vendors sold during 2002-2005 and 2008.

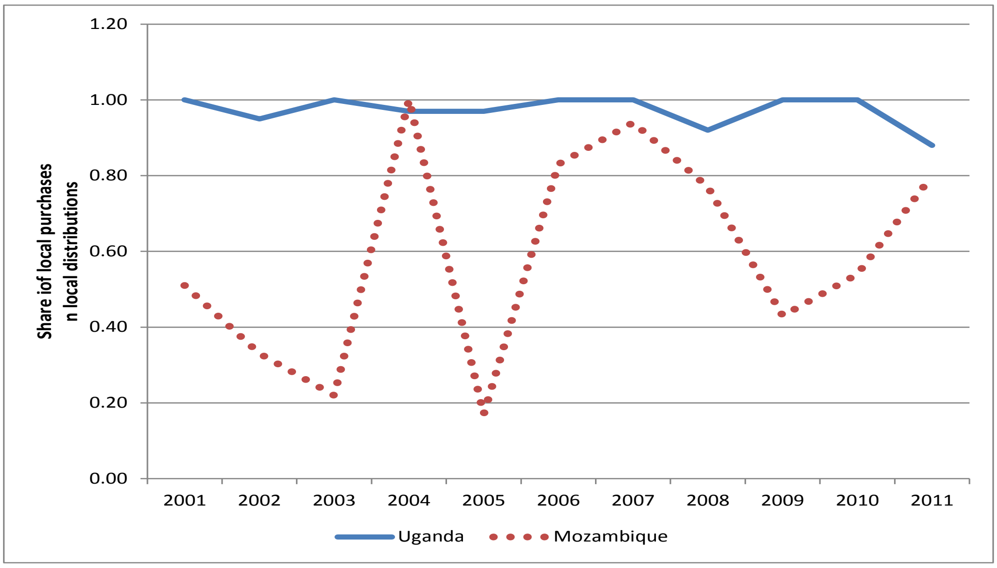
Note that the surge in the number of vendors in Uganda between 2005 and 2007 did not lead to any decline in the share of the top five vendors. Instead, the surge was associated with WFP/Uganda's push to involve farmer organizations in procurement, all of which supplied very small amounts and had no meaningful impact on the concentration of sales to WFP.

Uganda received much less food aid procured outside its borders than did Mozambique and sent more of its locally procured food outside its borders. Local procurement within Uganda accounted for an average of 97% (and never less than 88% during any year) of all the procured food aid (from any origin) distributed within the country during 2001 to 2011 (Figure 8); in contrast, purchases within Mozambique accounted for only 59% of its locally distributed procured food aid from any origin (41% came from outside), and its yearly share fluctuated widely. WFP in Uganda exported 30% of its locally procured food over the period compared to 18% for Mozambique (Figure 9).

We identify two key patterns from this review. First, food aid procurement in Uganda is now more dependent on demand outside Uganda. Figure 5 showed that WFP procurement of maize in that country rose rapidly to a peak in 2007 and has fallen sharply since that time. By 2011, maize procurement was higher only than in 2001 and 2002. This decline is partly related to the signing of the cease-fire agreement in 2006 to end the conflict in the north, and the gradual closure of the camps for Internally Displaced Persons (IDPs) since that time. From its peak of 1.8 million at the height of the conflict, the number of IDPs fell to about 30,000 by 2012, driving a sharp decline in the need for WFP purchases of Ugandan maize for use within the country.

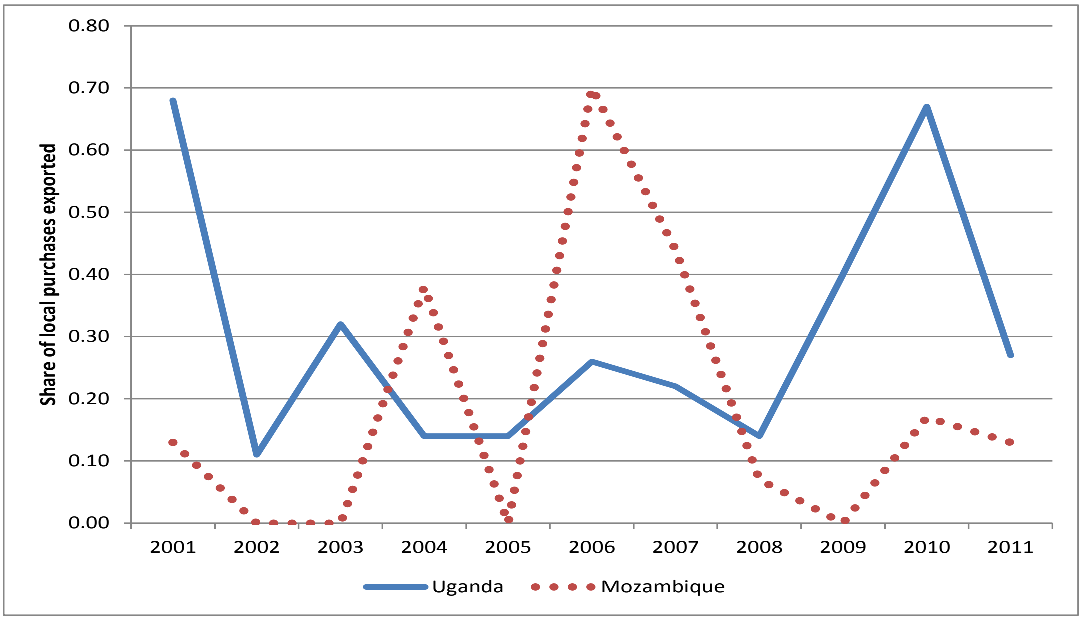
The drop in local food aid demand for Ugandan maize is reflected in trends in the share of WFP purchases in Uganda that were exported (Figure 9). From 2002 through 2008, the share of WFP maize purchases that were exported fluctuated between 10% and 31%, with no clear trend. This share then jumped to nearly 70% in 2010. Note that the drop in the export share in 2011 appears to have been driven mostly by the sharp drop in total procurement for any destination. As a result, WFP purchases in Uganda are now more dependent on regional food aid demand.

Figure 8. Share of In-country Maize Food Aid Distributions out of Procured Food Aid Covered by Local Procurement in Uganda and Mozambique, 2001-2011



Source: Authors' elaboration using data from WFP WINGS database.

Figure 9. Share of In-country LRP Exported from Uganda and Mozambique, 2001 - 2011



Source: Authors' elaboration using data from WFP WINGS database.

This pattern raises questions about the inter-annual variation in demand by WFP that Uganda is going to face over the coming years. Could WFP purchases become a destabilizing force in the local market, rising to high levels when regional demand is high, and falling when such demand is low? We will return to this issue in our concluding section of this chapter.

The second key pattern relates to the extremely high concentration of LRP sales of maize to WFP in Mozambique, which remains much higher than Uganda despite the recent entry of more tender competitors. In fact, still in 2010 and 2011 the two historically dominant firms – V&M and Export Trading – together accounted for 75% and 77%, respectively, of all maize sales to WFP. One large new entrant (Maviga, an international trading firm – see next section of this chapter for more detail) held 11% and 12% shares each year, and no one else held more than 3%. While it is possible that the entrance of one additional large seller could drive more competitive tender prices and more responsiveness with respect to WFP quality needs, it does not guarantee such improvements. Concentrated sales to WFP thus remain a concern in Mozambique.

3.2.2. Seasonal Pricing

Due to seasonality in agricultural production, maize prices at various levels of the supply chain fluctuate in predictable ways during the year, most often reaching a minimum during the harvest and then rising over the course of the year until the next harvest. These fluctuations can be quite pronounced in the types of production and marketing systems seen in our study countries, with small-scale production, inadequate storage capacity to minimize physical losses, poor information flows, and very high costs of credit. Analysis in Mozambique shows annual average maize price rises of between 85% and 90% in major markets of production areas over our study period. These compare to annual average rises of less than 20% in South Africa, which has similar seasonal variation in production but where the production, trading, storage, and financial sectors are far more developed (for the South

Africa figure see Tschirley et al. 2006, footnote 12, page 14 and Annex A). With two annual harvests helping to reduce seasonal variation, Uganda shows seasonal rises of 37% in Kisenyi and 50% in Masindi – lower than in Mozambique but still higher than in South Africa despite the single annual harvest in that country.

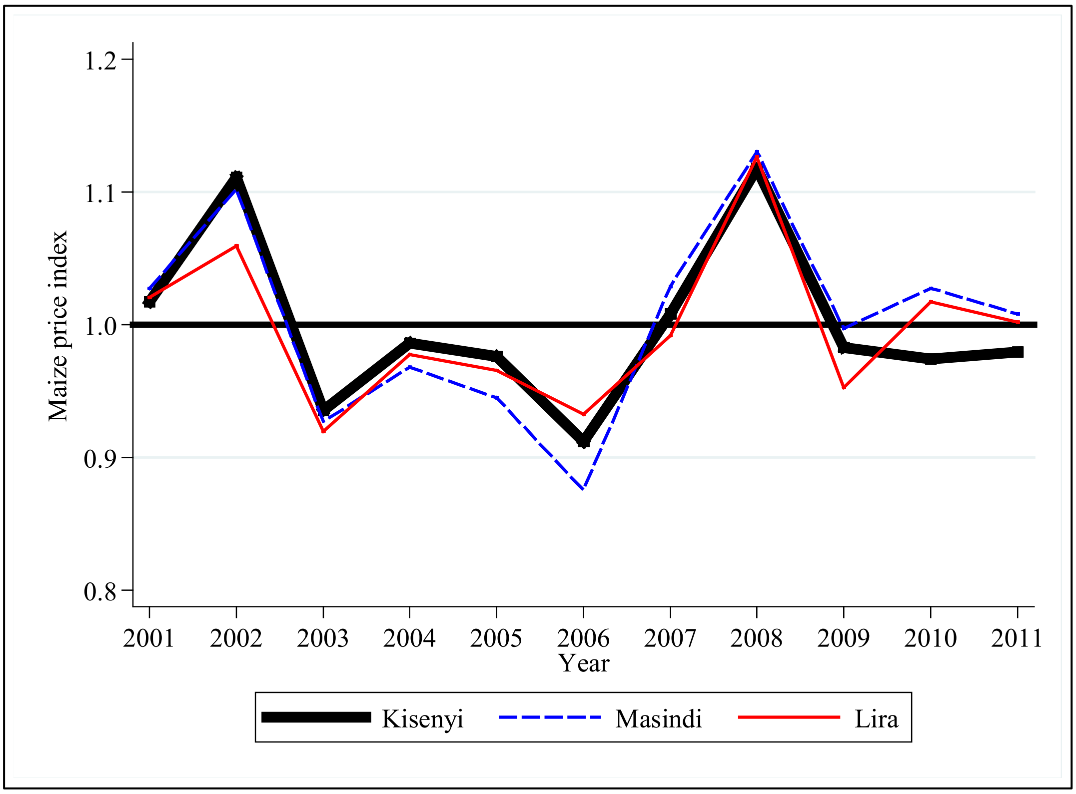
WFP may have two reasons to want to engage in counter-seasonal purchasing – preferentially purchasing its supplies during the low price season. First, because its borrowing costs and physical storage costs are low when compared to typical seasonal price changes, it could reduce total procurement costs by such a strategy. Second, because pronounced seasonality can impact the welfare of farmers and consumers (both urban consumers and rural net buying households), WFP may be able to increase overall welfare of the rural population by buying counter-seasonally and increasing prices during the harvest period rather than later in the season when supplies may be tighter. The likely benefits to rural households stem from the fact that smallholder farmer sales are heavily concentrated in the 2-3 months during and immediately after harvest, and their purchases are likely to occur later in the season.

Two factors could limit WFP's ability to take advantage of seasonal price movements. First, emergency needs are not always fully known months in advance, suggesting that some purchases are inevitably made when needs are revealed during high price months. Second, in the absence of access to the agency's FPF, LRP purchases can be made only when WFP has cash on hand from donors. We do not analyze the FPF in this report but do analyze the agency's seasonal buying pattern to provide insights into the potential gains from FPF. Specifically, we quantify the percent by which WFP has paid above or below a simple annual average price each year from 2001 to 2011 by comparing yearly average market prices weighted by WFP purchase volumes to simple averages of the same market prices.

We use market prices in our weighting – rather than prices paid by WFP – because they are the prices WFP needs to be referencing as they attempt to purchase in counter-seasonal fashion. The ratio of the weighted average prices to the simple average prices – which we call WFP's seasonal pricing indicator (SPI) – quantifies how counter- or pro-seasonal WFP's purchases were during that year: ratios above (below) 1.0 indicate the percent by which WFP average purchase prices exceeded (fell below) prices in a hypothetical seasonally neutral approach of buying equal amounts each month of the year.

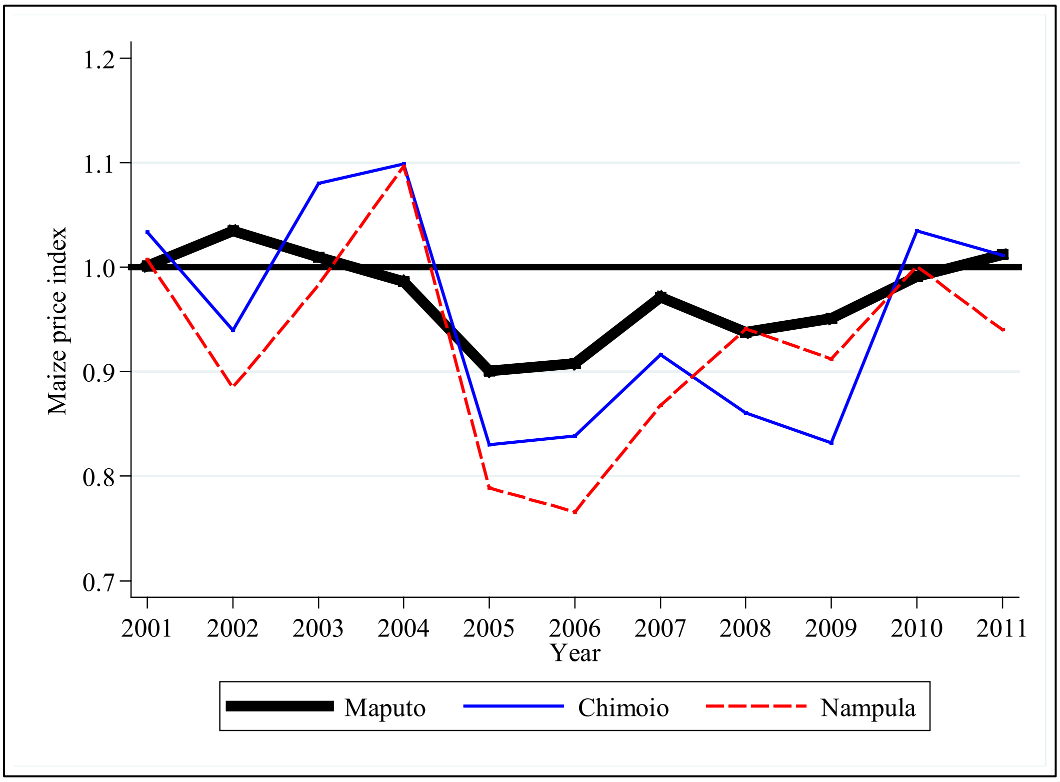
Results are shown in Figures 10 and 11 for Uganda and Mozambique, respectively. The solid bold line in the Uganda figure is based on Kisenyi wholesale market prices, given its importance as the key reference market in the country. The average SPI over all three markets and years in Uganda is 1.0, indicating that the agency paid prices exactly equal, on average, to what they would have achieved through equal quantity purchases each month. Year-by-year variation, however, was high: the average SPI for 2008 (the most pro-seasonal buying year) was 1.12, compared to 0.91 in 2006 (the most counter-seasonal buying year). If WFP/Uganda's seasonal purchase pattern in 2008 had been the same as in 2006, it would have reduced its average purchase price by 19%. Overall the SPI shows no clear trend, suggesting no clear trend in the seasonality of purchases over the years by WFP in Uganda.

Figure 10. WFP Seasonal Pricing Indicator for Maize in Uganda, 2001-2011



Source: Authors' elaboration using purchase data from WFP WINGS database and price data from FEWSNET/Uganda.

Figure 11. WFP Seasonal Pricing Indicator for Maize in Mozambique, 2001-2011



Source: Authors' elaboration using purchase data from WFP WINGS database and price data from SIMA/Mozambique.

Mozambique shows a different outcome. On average over all years and markets, its maize SPI was 0.95, indicating prices 5% lower than the hypothetical seasonally neutral buying pattern. Yet because WFP/Mozambique buys in producing areas of the central and northern regions, the SPIs for Chimoio and Nampula are better indicators of actual seasonal pricing patterns; these were 0.95 and 0.93, respectively. Chimoio and Nampula SPIs are also far more variable, reflecting the greater seasonality of prices in those areas compared to Maputo. During the two most counter-seasonal purchasing years (2005 and 2006) and focusing on the SPIs for Chimoio and Nampula, WFP/Mozambique paid on average about 36% less than it would have paid had it followed the purchase pattern of the most pro-seasonal purchasing year, 2004.

The most important implication from this section is that there is scope for WFP to reduce its own costs while likely improving the welfare of poor farmers and consumers through use of FPF to purchase more pro-seasonally, but that this scope varies across countries. Seasonal production patterns suggest that these opportunities would be greater in Mozambique than in Uganda. Compared to observed historical purchasing patterns, however, opportunities for improvement are greater in Uganda. More detailed analysis beyond the scope of this paper is needed to develop more refined estimates of potential gains.

3.2.3. Regional and Local Market Pricing Performance

Average prices paid by WFP in the two countries over the 11-year period were close, at US$242/MT in Uganda and US$254/MT in Mozambique. Comparing each to their regional neighbors[5], weighting prices by purchase quantities, and limiting our data to months in which maize was purchased in the country of interest and also somewhere in the region outside the country, we find that prices paid by WFP in Uganda (US$242/MT) were on average nearly identical to those paid in the rest of East Africa (US$244/MT) (Figure 12) Beyond this average, we see that prices in Uganda were very similar to those in the rest of the region throughout the period, sometimes a bit above, sometimes below, but never diverging for extended periods[6].

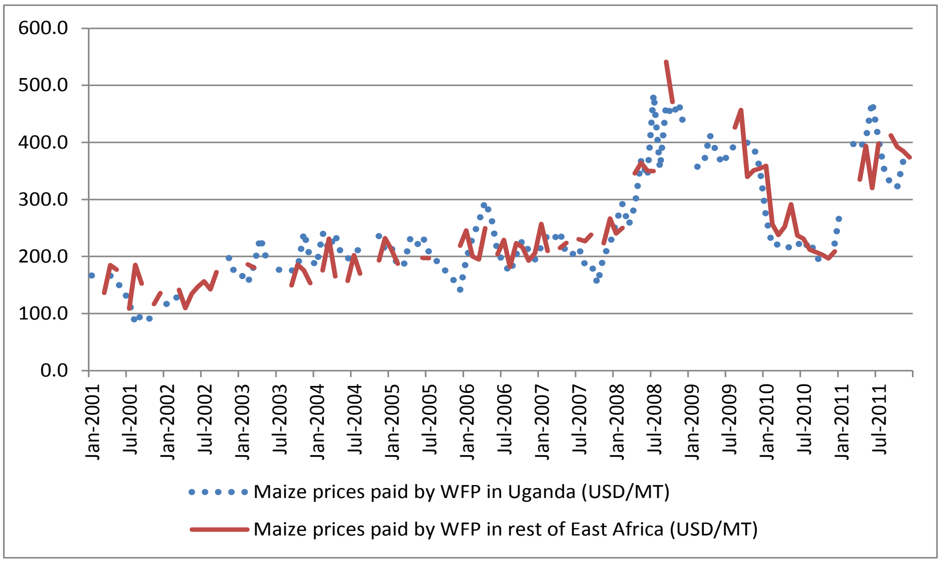
A similar comparison shows that WFP paid meaningfully higher prices in Mozambique than were paid in the southern Africa region, by an average of 10.6% over the entire period (US$254/MT compared to US$230/MT; (Figure 13). Prices paid in Mozambique exceeded average prices paid in the region in 69% of all purchase months. This pattern changed over time, however. Prior to June 2008, average maize prices paid by WFP were 11% higher in Mozambique than in the rest of southern Africa (US$209 versus US$189) and higher than every individual country in the region. Between June 2008 and May 2010, the difference between these two maize prices increased dramatically to 28%, with an average of US$360/MT compared to US$281/MT, and again WFP paid higher average prices in Mozambique than in every other country of the region. From May 2010 through December of 2011 – the bulk of the 2010 purchase season plus the entire 2011 purchase season – average prices paid by WFP in Mozambique were *below* those in the rest of the region, at

[5] We compared Uganda to Ethiopia, Sudan, Kenya, Somalia, Rwanda, Burundi, and Tanzania. Mozambique was compared to Malawi, Zambia, Zimbabwe, Swaziland, Tanzania, and South Africa.

[6] Note that prices in Uganda were most markedly below those in the region in 2007, the peak year of WFP maize purchases. Consistent with these relative prices, 2007 is also the year that Ugandan maize captured the largest percentage of the regional WFP market, with 35,056 MT (the all-time high to that point) accounting for 37% of that market, compared to previous highs that never exceeded 25%. Finally, 2007 was the high point for local distributions of locally procured maize, at more than 127,000 MT.

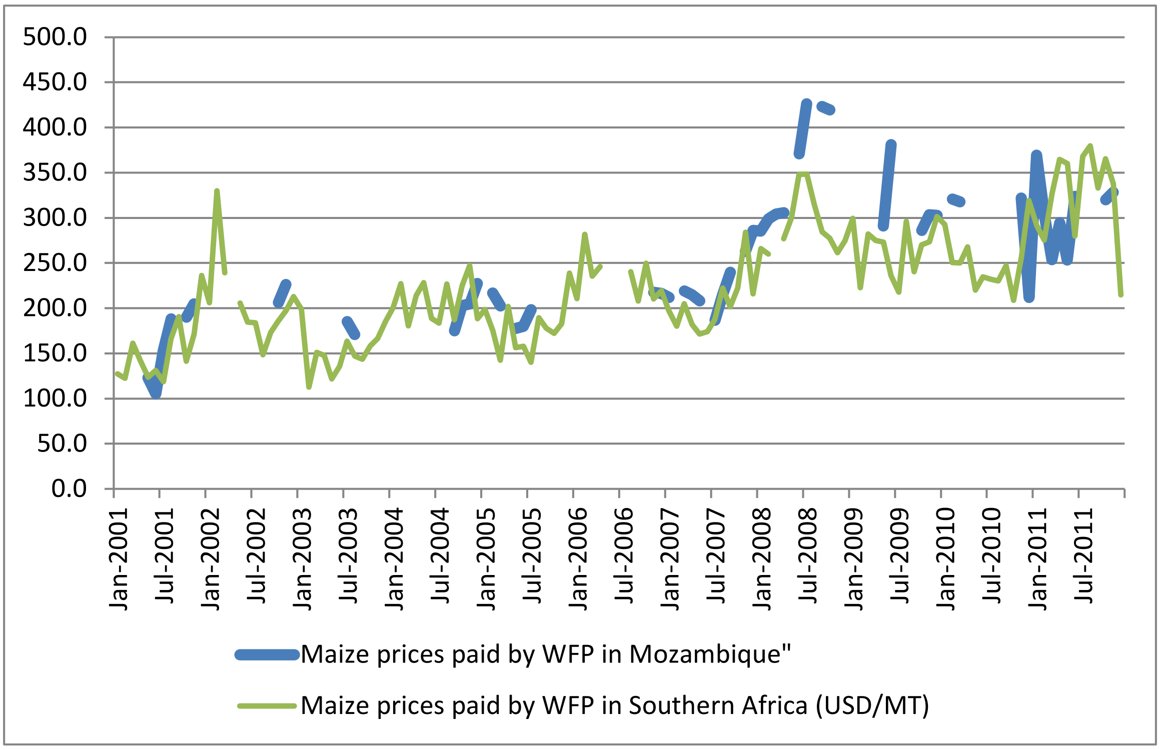
US$290/MT compared to US$310/MT. The pattern during this latter period, however, was driven by Malawi, where WFP paid extraordinarily high prices for maize; average prices paid in Mozambique were still higher than in every other country of the region with the exception of Malawi.

Figure 12. Prices Paid for Maize by WFP in Uganda and Rest of East Africa, 2001-2011 (US$/MT)



Source: Authors' elaboration using data from WFP WINGS database.

Figure 13. Prices Paid for Maize by WFP in Mozambique and Rest of East Southern Africa, 2001-2011 (US$/MT)

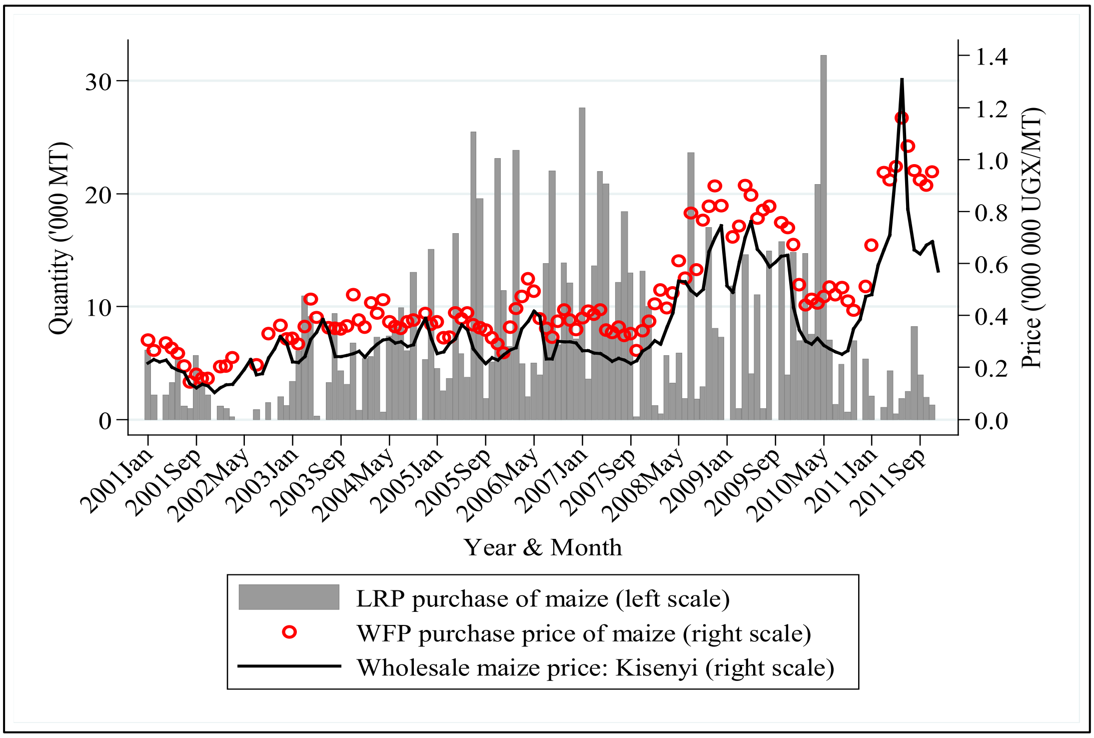


Source: Authors' elaboration using data from WFP WINGS database.

Figures 14 and 15 compare monthly prices paid by WFP to local wholesale market prices in Uganda and Mozambique, also showing monthly quantities purchased. Because Uganda has one wholesale market that serves as the reference market for price formation throughout the country – Kisenyi in Kampala – we present only Kisenyi prices in the Uganda graph. For months during which WFP purchased, their average purchase price exceeded market prices in Kisenyi by 32%, at US$242.5/MT compared to US$183.7/MT. Maize in Mozambique does not have a single dominant market, so we present the graph with Nampula in the northern region and Beira in the central region. Results are very similar to Uganda, with WFP paying average price premiums over wholesale of 27% in Beira and Nampula.

It is not clear how much of these price premiums are due to the higher costs of selling to WFP (more cleaning, lower moisture levels than typical in the trade, special bagging, and other costs). In discussions with traders in Uganda, their estimates for these costs were very close to the 32% premium that we computed. Traders in both countries repeatedly cited these higher costs and also persistently complained that WFP tenders were “too competitive” [7]. At the same time, several WFP officials doubt that the higher costs fully explain the price premiums, most traders do admit that the WFP market is profitable for them, and interviews make it clear that they work hard to remain in that market.

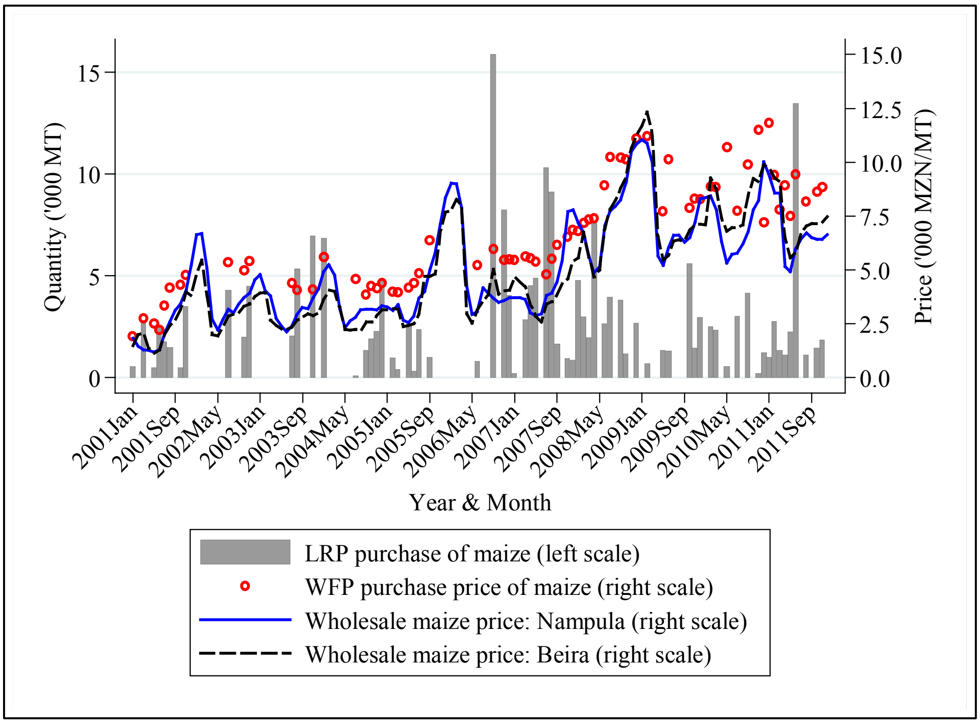
Figure 14. Monthly PO Quantities, Prices Paid by WFP, and Wholesale Market Prices, Maize in Uganda (2001-2011)



Source: Authors' elaboration using purchase and price data from WFP WINGS database and market price data from FEWSNET/Uganda.

[7] See the next section for reporting on trader interviews, including their perception of the competitiveness and other characteristics of the tendering process.

Figure 15. Monthly PO Quantities, Prices Paid by WFP, and Wholesale Market Prices, Maize in Mozambique (2001-2011)



Source: Authors' elaboration using purchase and price data from WFP WINGS database and market price data from SIMA/Mozambique.

We identify two main issues from this section on pricing performance relative to local- and regional price levels. First, WFP's purchasing behavior in Mozambique during the market peak of late 2008/early 2009 raises some questions. During the earlier market peaks of 2001/02 and 2005/06, WFP avoided purchasing locally in the country. Yet the agency did purchase in the midst of the very high market peak of 2008/09, and they paid much more locally than they were paying regionally at that time (see previous Figure 13). They also purchased in the midst of the market peak of 2010/11, but at that time prices paid in Mozambique were comparable to those paid in the rest of the region. Without further information we cannot fully evaluate the 2008/09 event, but raise the question of why WFP would purchase in the country at such high prices when prices paid in the region outside Mozambique were far lower.

Second, Mozambique was and remains a relatively high-cost supplier of maize in the region, generating lower prices than only one country (Malawi) and even then only in 2010 and 2011. Given the quality problems in the country (Mozambique's grain quality is clearly lower than South Africa and also Zambia, where better and more consistent seed is used), these pricing patterns suggest that the country is unlikely to be a regular supplier of maize to the region unless prices drop substantially.

3.3. Interview Results: Quality and Supply Chain Investment

All three authors visited Uganda during July, 2012, conducting interviews in Kampala before traveling to Mbale and Kapchorwa in Eastern region, Lira in Northern, and Masindi in Western. Kisenyi market was visited upon the return to Kampala. Working with a local consultant (Dr. Andrew Kizito), we interviewed a wide range of stakeholders in the private and public sectors, including small farmers, farmer associations, local traders and small-scale maize processors, large traders participating in LRP tenders with WFP, and selected public sector officials. See Annex A for the full itinerary and list of interviews. Following this trip and production of a detailed trip report, we interacted extensively with our consultant to further investigate specific issues that arose and required more in-depth assessment.

Two visits were conducted to Mozambique, in September, 2012 and again in May, 2013. Each trip involved travel throughout the central and northern parts of the country, but the second focused primarily on (a) interviewing small- and medium-scale traders that were not successfully interviewed during the first trip, and (b) understanding in more detail the evolution of the structure of the maize trade in the country over the past several years. Mozambique's geography and long distances meant that we required substantially more time per successful interview than we did in other countries.

The field visits to each country were designed to investigate two key questions. First, we wanted to understand what if any *systemic* effects WFP was having on the development of the maize markets in each country through the manner in which they went about their procurement. Quality improvement and achievement of operational efficiencies (partly through increased scale of operation) are two of the primary aspects of basic staple production and marketing systems that must improve over the course of development. Hypothesizing that, as a large-scale buyer insisting on high quality, WFP could potentially play a catalyzing role to move systems towards improved performance in this regard, we focused in particular on WFP's impact on quality procedures in the trade while also investigating any operational efficiencies that traders may have been able to generate through selling to WFP.

A second objective of the visits was to understand how competitive the maize markets were and to what extent they were integrated over space and over levels in the system. This information was pursued to provide insight into the likely effect of WFP LRP on local market prices and thereby to allow us to form expectations as to the effects we might find in the quantitative modeling. To investigate this we systematically asked all interview subjects whether they were aware when WFP tenders hit the market, what impact they believed these tenders had on the market in which they operated, and the role of various market centers in price formation in the country. We also organized supplementary price collection in Uganda at rural producer markets, to examine their correlation with wholesale prices in Kisenyi and Busia. In Mozambique, we took advantage of existing data at both these levels to examine the same question.

We organize this section into three subsections dealing with quality (these sub-sections also address the potential impact of WFP LRP on trader scale of operation and operational efficiency) and a final sub-section presenting participant perceptions of market competitiveness and integration, including the perceived effects of WFP on market prices.

3.3.1. Structural Factors Reducing Grain Quality

Maize quality at farm level is a major problem in both countries, with the burden of delivering acceptable quality grain falling almost entirely on traders. Uganda's bimodal rainfall pattern – and apparently greater unpredictability in recent years regarding when the rains will start, according to numerous persons interviewed – combines with very small scale of production to hinder the pursuit of high quality grain at farm level. While many production areas of southern Africa receive less than one inch of rainfall during at least three consecutive months of the cropping year, production areas of Uganda outside the southwest typically do not experience a single month with less than 2.5 inches of average rainfall. [8] Thus, harvests in Uganda typically take place when rain is falling. In the absence of mechanical drying capacity, achieving storable levels of humidity in maize (no more than 14%) becomes extremely difficult. The so-called first season is perceived as especially problematic in this regard, as the harvest occurs in June-July when, for example in the major production area of Masindi, an average of about four inches of rain falls each month, with even more in August. The small scale of maize marketing in Uganda exacerbates the weather problem by making it difficult for local traders to reliably generate the volumes needed to justify investment in mechanical drying capacity. Data from the 2005 Uganda National Household Survey and the 2009 Uganda National Panel Survey show that about 70% of all maize sales are of less than US$90, and over 40% fall below US$20. The extremely small scale of most sales means that farmers are not investing in any drying capacity beyond tarps or mats, and that even this practice is likely limited to a small minority.

Mozambique has a unimodal rainfall pattern and by about June is able to produce adequately dried maize from the farm without the need for mechanical drying. However, the country suffers from the same extremely small scale of production as Uganda and its production and marketing system is perceived by traders to be weaker than many other countries in several respects. First, several traders in Mozambique with experience in at least two other Sub-Saharan Africa (SSA) countries indicated that farmer knowledge is extremely low, leading to, among other things, large amounts of foreign matter in sold grain. They also report exceptionally low use of improved varieties (consistent with available empirical data), which leads to grains of varying size and a mixture of white and yellow, all of which reduces quality. Finally, the structure of Mozambique's trading system makes it very difficult to ensure the type of coordination needed to begin changing farmer practice. For example, Uganda (and Ethiopia for beans) has well-recognized markets frequented by farmers in nearly every town we visited; these may be specific market places or recognized areas of a town where various traders have their small stores and scales, typically nearly side-by-side. Under such circumstances, comparable information flows rapidly among traders and between traders and farmers. Mozambique, meanwhile, has a system in which literally thousands of small traders, many of them working as agents of large traders, fan out to rural areas to make purchases in villages; rural market towns are substantially less important in Mozambique than in Uganda. Information flow under such circumstances, even with the use of cell phones, is likely to be more fragmented. The result of these factors is that the burden of delivering acceptable quality grain falls entirely on traders, since farmers are not now and are unlikely for some time to pay meaningful attention to quality improvement.

3.3.2. Quality Perceptions and Practices at Local Level

Awareness of the need for improved quality proved to be surprisingly broad and strong among farmers and town traders in Uganda. There is also evidence in Uganda that traders sometimes pay price premiums for better quality (or discounts for poor quality), with most focus on moisture level. In both respects Mozambique showed less awareness of quality issues or use of quality premiums or discounts.

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[8] This discussion of rainfall patterns is based on country- and sub-location data from http://www.weather-and-climate.com/.

Interviews in Uganda consistently indicate that individuals at every level of the system – from very small-scale farmers to the largest traders – are acutely aware of the need for greater quality. Various market observers, while aware of the quality problems in the country and the need for much more progress, reinforced this finding, making statements such as “people have started to understand what quality means”, “there is a trend in Uganda and the region for quality”, and “some key players are seeing this and trying to adapt.” Farmers consistently indicated that traders do pay price premiums for quality, with a typical differential involving payment of 500-600 Ugandan Shillings (UGX) per kilogram (kg) for poor quality grain, and UGX800/kg for good quality grain. Farmers made statement such as “traders don’t buy half-dry grain” and “traders have always sorted grain and paid according to quality.”

Yet farmers also admitted that, when supplies are short and prices high, traders purchase without regard to quality; this tendency was also mentioned in many other interviews at all levels of the system, with a typical statements being “all maize has a market” and “maize at 15.5% may get the same price as maize at 13.5%”. The informality of much of the regional trade from Uganda reinforces this tendency. Traders in South Sudan have typically bought with little if any attention to quality, much of what Kenyan traders purchase goes to animal feed not maize meal, and we were told that purchases by traders from the DRC go largely into the small-scale milling sector where quality is not emphasized.

It is also unlikely that farmers with little or no training in proper grain handling and quality specifications will define good quality maize as rigorously as a formal trader would. Drying at farm and among local traders takes place entirely in open air, often on the ground, sometimes on cane mats, and very seldom on plastic tarpaulins or cement slabs. Farmers are thus dependent on dry weather to be able to dry their maize, and they frequently do not get such weather.

A mixed picture thus emerges at farm level in Uganda: farmers are aware of the need for quality and desire to produce it because (at least when supplies are not tight) they receive a premium, but they have imperfect understanding of what good quality is, sharply limited *ability* to produce it, especially during the first season harvest when intermittent rains often continue to fall, and frequently little *incentive* to produce it due to trader practices.
Small wholesale traders in local towns of Uganda have no mechanical drying capacity[9]. They adapt to this situation by (a) paying low prices for very wet maize to discourage its delivery (unless supplies are tight), (b) selling their maize quickly to larger traders that do have drying capacity, and (c) channeling the lower quality maize into the local milling sector. This latter strategy was mentioned frequently by local traders, suggesting that much of the lowest quality maize may remain in the small-scale, largely informal local trading and milling sector.

We found less evidence of any price differentiation in Mozambique even when supplies were not tight. Farmers consistently stated that “all maize has a market”, and traders repeatedly indicated that they buy all maize that comes to them at a single price, checking only for egregious violations such as the placement of rocks or additional moisture into sacks of maize. Two specific examples from interviews illustrate this pattern. First, when asked why they did not differentiate on price, trader agents we spoke with[10] cited the cell phone, and the

[9] Some traders operating nationally indicate that they have invested in drying capacity in production areas. Farmer-held installations such as the Kapchorwa Commercial Farmers’ Association and Masindi Seed Grain Growers’ Association also have some capacity. Yet together this capacity is miniscule relative to the amount of grain being marketed, and at least the farmer installations in Kapchorwa and Masindi are not used at capacity.
[10] See the next subsection for reference to the *many thousands* of such agents that operate in Mozambique.

fact that farmers, if offered a price they considered too low, would call contacts elsewhere to bargain. With villages typically having 20 and more small traders and agents competing against each other during the harvest season (Jayne et al. 2009), and in light of the poor quality of the great majority of maize on offer, there appears to be no room to insist on quality[11]. Second, DECA – a milling firm and major maize buyer in the central part of the country – began its buying in 2013 during the month of April, when maize was still quite humid, paying 8 Mozambique Metical (MZN) per kg. By late May – when maize was much drier but also when more maize was in the market – they had *reduced* their price to 7 MZN/kg.

Despite these differences between the two countries, the end-result of both is that larger traders in both countries receive poor quality grain and bear the burden of drying it (in Uganda) and cleaning it (in both countries) to standards specified by WFP. In addition, Mozambique may suffer from greater problems of variable color and grain size than Uganda.

3.3.3. WFP Quality Initiatives

WFP is by any measure the most stringent buyer of quality processed maize in both countries. Yet one stark difference emerged from interviews in the two countries: while complaining strenuously about WFP's quality *practices* in Uganda, traders uniformly, strongly, and typically unbidden by us, praised the quality *training* that WFP has provided. We found this same pattern – strong complaints about quality practices but strong praise for quality training – for HEPS in Ethiopia and Malawi and beans in Ethiopia. Yet in Mozambique not a single trader volunteered any comments about quality training from WFP, and when asked, they indicated that WFP had provided no such formal training. We return to this issue below.

Around mid-2010, WFP in Uganda began to tighten substantially its quality practices in an effort to purchase according to East African Community (EAC) standards. Prior to this time, the agency followed a fair average quality (FAQ) approach to grading.[12] FAQ is a flexible approach, being based on an assessment of the average quality of grain *in the market in which the buyer is operating*. Thus, the FAQ standard for Uganda could be, for reasons explained above, meaningfully lower than in countries with more pronounced dry seasons after harvest or larger scales of production and marketing that facilitate better quality practices at farm and post-farm. In contrast, EAC grades are based on specified quantitative limits on measureable parameters such as moisture content, percent foreign matter, *filth*, *total defective grains*, and others.[13] EAC in 2007 defined standards for three grades – EAC 1, EAC 2, and EAC 3 – and WFP moved to these grades in 2010. EAC 2, in addition to allowing double the amount of foreign matter and inorganic matter (1% and 0.5%, respectively, compared to 0.5% and 0.25% for EAC 1), allows up to 5% total defective grains compared to 4% for EAC 1. All three grades (EAC 1 through EAC 3) have the same requirements for moisture content, filth, and total aflatoxins: 13%, 0.1%, and 10 parts per billion, respectively. After initially moving

[11] Traders consistently noted that quality tended to be better in the center of the country, in Manica and western Sofala provinces. Yet this relative improvement should be interpreted against the backdrop of quite poor quality very broadly in the country.

[12] We received somewhat inconsistent feedback from WFP/Uganda as to whether they practiced a FAQ approach prior to 2010. We continue to characterize their practice as FAQ in large measure due to the clear sense from traders that they were previously not accustomed to meeting specified quantitative standards on a range of defined parameters, and that, as much as the higher standards themselves, the move to this more systematic approach created great difficulties for them.

[13] See UNBS 2011 for the detailed definition of EAC maize grades.

to an EAC 1 standard in 2010, WFP began to accept EAC 2 but says – and traders concur – that it insists on rigorous grading against that standard.

Quality standards such as those of the EAC cannot be instituted in a trading system without an inspection system that is properly trained and reliable. Firms currently providing this service in Uganda are Chemiphar and Intertek. These firms have received training from WFP but concerns remain about the quality of inspections, based on several incidents of grain being cleared for shipment to a WFP warehouse by the inspection company then judged by WFP, upon arrival, to not have met the declared standards.

The move from an FAQ approach to the use of EAC standards represented a fundamental shift for WFP, with major implications for traders. For one, it created a need for traders to invest in more cleaning and drying capacity. Above all, it required them to put *procedures* in place to monitor relevant parameters and ensure that it could provide the agency with the quality it was requiring. Cognizant of the significance of the change, WFP also offered extensive training to traders in how to ensure adequate quality grain.

Several of the large traders in Kampala that have competed for WFP tenders mentioned that this training was helpful, and some indicated that it had allowed them to dramatically improve their procedures. Yet it was clear from interviews with all these traders that the transition from FAQ to EAC standards was exceptionally difficult for many and still gave rise to strong opinions. Three themes were repeated in most of these interviews. First, traders still demonstrated a strong negative reaction to the more rigorous inspection standards and the perceived suddenness with which they were instituted – though WFP indicates that it introduced the new process gradually over one full year. We heard statements such as "traders don't trust WFP anymore" and "people no longer want to work with WFP."

Yet the second common theme was that many (not all) traders retained a great desire to continue operating in the WFP market, due in large part to the possibility it created for much greater operational efficiencies through large sales at known prices they can bid: winners of tenders can sell from 1,000 MT to 4,000 MT in each tender, far more than will be purchased at any one time by traders from South Sudan or Kenya or even large local buyers, and they can make these sales at a known price they can bid. Moving such large volumes under such circumstances allows operational efficiencies that reduce costs and improve the bottom line. Third, every large trader with whom we spoke indicated that they were expanding their cleaning and drying capacity. While many said they were doing this for the regional commercial trade, not just for WFP, two factors make it likely that WFP's changed practices played a major role in moving traders in this direction. First, regional trade continues to be largely informal and operates on a *de facto* FAQ basis, not the more stringent and precise EAC standards. Second, large-scale formal regional transactions such as with governments or large regional processors, which would require EAC standards, are too infrequent at this time – and local traders' confidence in winning them may yet be too low – to provide an adequate basis for investing in expensive cleaning and drying equipment only for that market.

As the largest single buyer of quality processed maize in the country, WFP has been in a position to drive investments and changed procedures that would have been much slower to emerge without their presence and that may, over time, allow the country to produce the kind of quality, in the short timeframes needed, to enter into these larger and more remunerative formal trading networks in the region. The training that the agency has done, its related efforts to improve quality knowledge and practices within its own staff, and its insistence on quality standards with traders are central to this effort. This finding represents clear progress compared to the early 2000s, when Wandschneider and Hodges (2005) and Coulter (2007) criticized the agency for not doing enough to drive the type of behavioral change needed to enter regional markets. The continuing bottleneck to achieving this objective – and one on which there appears to have been little progress since the earlier studies – is the lack of mechanical drying capacity outside of Kampala.

A major feature of maize procurement in Mozambique is the use of P4P to procure from small- and medium traders.[14] The explicit purpose for using P4P in this way was to try to reduce the heavy concentration that was apparent in the country's wholesale maize trade at the time that P4P was being conceived. Our previous section indicated that two traders – Export Trading and V&M Trading – dominated sales to WFP from 2001 through 2008. During this time, these two traders held a combined 86% share of all sales to WFP, and held at least 99% during five of the eight years. This concentration in sales to WFP mirrored the concentration in the commercial trade. With the exception of a brief period in the early 2000s during which Conagra operated in northern Mozambique, these two firms were the only large-scale buyers of domestically produced maize in the country. Furthermore, at some point in the late 1990s each began operating exclusively in one region of the country, leaving each without any large competitor in their region: Export Trading operated north of the Zambezi River and V&M south of it, in the center of the country. Concern over this situation led WFP, on advice from its Technical Review Panel, to use P4P to purchase from smaller traders to determine whether such a relationship could help these traders grow their business to provide greater competition to the two established firms.

As a result of this decision, P4P amounted to 32% of total maize procurement in 2009. Though these shares fell to 13.8% in 2010 and 10.1% in 2011, they remained high compared to most other countries. The P4P purchases drove a large jump in the number of sellers to WFP, from 2-4 every year between 2001 and 2008 to nine in 2009 (seven of which sold through P4P and only two – V&M and Export Trading – through LRP) and 11 each in 2010 and 2011 (eight- and seven of which sold through P4P, respectively). Yet the decline in P4P share – the quantity of trader P4P sales in 2011 was lower than in 2008 despite a doubling in total procurement quantities in 2011 – reflects the great difficulties that this policy encountered, especially with the medium- and small-scale traders. Five such traders sold maize to WFP in 2009, the first year of P4P, but only three did so in 2010 and only two in 2011.

Interviews with all these traders and with WFP suggest that WFP's experience with many of them has been quite difficult. The tenor of comments from some traders was quite strong and frustration on the WFP side is, likewise, apparent. At least three traders claim to have abandoned the idea of selling again to WFP, and at least two of these claim to be at risk of going out of business as a result of product being rejected by WFP due to poor quality. This difficult experience has several causes. First, these traders have operated entirely in the informal small-scale portion of the domestic and regional trade, where *quality inspection*, if any, is very flexible; they were entirely unprepared for the much higher standards and systematic testing required by WFP. V&M and Export Trading had for many years operated at large scale, selling to formal organizations regionally and even entering international trade at times. They thus had a much better understanding of quality assurance procedures than did the medium- and small traders. Second, these small traders had inadequate physical infrastructure to meet WFP tenders. For example, one trader who operated under P4P began

[14] P4P also purchased from farmer associations in Mozambique, as it primarily did in other countries. Because the focus of this study is not on P4P but on LRP, we did not investigate that process. We examined trader participation in P4P due to its explicit linkage to LRP.

construction of a warehouse of several thousand metric tons after he began working with WFP but has yet to finish it – product is stored in the warehouse with unfinished walls and no roof on one end; this trader and at least one other have only manual cleaning equipment. Most have inadequate transport capacity to handle WFP tender volumes efficiently. Finally, more even than large traders, these smaller traders are severely cash constrained and rely on rapid turnover of product to earn a profit. Yet WFP is an international development agency with relatively slow and inflexible procedures for many activities, which impose structural delays on getting from contract to delivery to payment. When the traders don't meet quality standards on first inspection or, even worse, on delivery, delays are even greater. Most of these traders simply cannot afford to suffer such delays.

A surprising fact that emerged from the interviews with these P4P traders in Mozambique is that none of them received any formal training in quality procedures. Most referred positively to individuals in WFP who, at the very start of P4P, provided them with guidance on what to do and who were available for consultation. Yet both of these individuals have now left Mozambique and the frequency of in-person interaction with the traders appears to have fallen. The absence of any formal training is a concern for two reasons. First, nearly all traders in other countries spoke in highly favorable terms about the formal training that they received from WFP, suggesting that such training would have been welcomed also in Mozambique. Second, the small- and medium-scale traders that were the focus of P4P in Mozambique were, without question, in even greater need of such training if they were to become capable of routinely meeting WFP tenders and using them – consistent with the agency's objectives – as a springboard to growing their business and becoming more competitive on a larger scale.

In the meantime, as WFP was conceiving and then implementing its P4P program, the structure of the maize trade, and of agricultural trade in general, dramatically transformed in response to changes in Mozambique's broader economy. We have already noted the highly concentrated structure of the wholesale maize trade through much of the 2000s. Starting late in the 2007 marketing season, new and much larger buyers began to appear. Among the new buyers known now to compete with Export Trading and V&M in the maize trade are the following:

- DECA, a large maize milling operation with mills in Chimoio, Tete, and Beira. DECA has recently moved into beef production with pasture, a slaughterhouse in Chimoio for 200 animals per day and a developing retail distribution network. DECA began operations in 2005 but became a large, noticeable market force for farmers in late 2007;
- Abilio Antunez, widely considered the country's largest poultry producer. Recognition by farmers of Antunez's market presence dates to at least 2008, and his purchases have grown rapidly since that time;
- Senwes, which is one of the largest agricultural trading firms in South Africa and now operates in central Mozambique through the former head of V&M;
- Frango King, a large poultry producer that buys maize (and soybeans) in Zambezia province;
- Novos Horizontes, another poultry producer in Zambezia known as a major buyer of maize and soybeans;
- The SAB/Miller plant in Beira, which buys high quality maize from ECA in Manica province and other providers;
- HIGEST, a feed manufacturing firm in southern Mozambique, which has been present in the country since prior to 2007 but who we are told has substantially expanded its operations in recent years;

- Maviga, a major international trading company headquartered in the UK. Dedicated primarily to pulses and sesame, it started operations in Mozambique in 2009 and added maize sales to WFP to its portfolio in 2010 (it does not trade maize outside of WFP); and
- ECA, which buys quality maize in Manica province for supplying, among other markets, SAB Brewers in Beira.

Other large trading and broader agricultural companies that are new to the sector but which do not currently buy maize include:

- H.S. Impex, a company about which we could learn little but which now operates at least in the central region;
- Corredor Agro, a Mauritian registered partnership between Rift Valley Holdings (www.riftvalley.com) and Matanuska Ltd, a diversified agricultural company engaged in smallholder promotion, direct production, and trade, both of Zimbabwe; and
- OLAM, one of the largest agricultural trading and processing companies in the world, active primarily in sesame and pigeon pea in Mozambique.

The main implication of this new market structure is that WFP/Mozambique should now be able to generate substantially more competitiveness in its maize tenders by engaging more of these large traders. At least through 2011, however, the top two sellers continued to account for nearly 80% of all maize sales to WFP. We cannot show analytically that prices paid by WFP in Mozambique have been affected by the dominance of Export Trading and V&M. Yet such an effect is at least consistent with the fact the prices paid in Mozambique have been persistently higher than in other countries of the region while quality has likely been among the poorest. The agency may be able to reduce its costs in the country – and potentially leverage more response from traders on quality improvement – by successfully engaging more of the large traders now operating there.

Most of the small- and medium - size traders who have been selling through P4P are unlikely to provide serious competition to these large players, though at least one of them may eventually be able to compete in open tenders for modest quantities. Our interviews suggest that, if WFP wants to make meaningful contributions to the professionalization of this sector through P4P, it must organize quality trainings along the lines of those seen in Uganda for maize, Ethiopia for beans, and Ethiopia and Malawi for HEPS.

3.3.4. Perceptions of Market Integration: WFP and Private Markets

In Uganda, all large- and medium sized maize traders interviewed in Kampala, Busia, Mbale, Lira, and Masindi believe that WFP purchases have an immediate positive impact on their local market prices. While they were not able to quantify the effect, they all stated that prices do respond and that the price impact occurs very rapidly (immediately after a tender is announced). Some traders suggested that buying from South Sudan and/or Kenya affects their local market prices even more than WFP purchases. However, these traders still believe that WFP purchases have a significant effect on price levels.

The fact that maize traders geographically dispersed throughout Uganda all believe there is a significant WFP-LRP effect on local prices, irrespective of the delivery point specified in the WFP contracts, suggests that markets are well integrated and price changes transmit consistently across regional markets. Indeed, all large and medium sized traders we interviewed are actively monitoring, and potentially arbitraging, prices across several regional markets. All are monitoring wholesale maize prices in Kampala (Kisenyi), most are also monitoring prices for the Kenyan trade in in the border market of Busia as well as prices paid by South Sudanese buyers, and all are monitoring local market and farm prices in the areas they purchase from. A lot of this monitoring is done through cell phone networks but many traders also visited the different areas periodically to get a better sense of the market. Some traders also mentioned radio as a source of market price information. All traders stated they have to adjust their prices immediately as prices in major markets change in order to stay competitive and keep business. This suggests that the effects of WFP-LRP purchases will be transmitted to markets throughout the country and not be felt only in Kampala or wherever the deliveries are taking place.

Interviews with very small traders operating out of lock-ups in small towns and selling primarily to retail buyers and to small local millers often revealed little knowledge of WFP or their buying activities. [15] As a result, many of these small traders could not answer the question about whether WFP purchases influence their prices. Many of these small traders also said they only monitor local prices, not prices in Kisenyi or Busia. Nevertheless, since interviews indicated that local market prices closely follow Kisenyi and Busia, it follows that even the prices paid and received by these small local traders are influenced by WFP purchases.

All interviews with traders and farmers pointed to strong and rapid price transmission down the supply chain to the farm level. Farmers said there are many buyers that come to the farm with trucks, each with different prices that change daily. If farmers do not like the price, they can sell to another buyer, or take their grain to town. For their part, traders said they have to continually adjust prices they pay to farmers based on price changes in major markets or they cannot remain competitive. Even farmers who complained about being “cheated by middlemen” acknowledged in discussion that it is difficult and costly to transport to market and they weren’t always sure what prices the middlemen were getting when they sold. Farmers clearly do not monitor major market prices as much as traders. But they do monitor local prices as much as possible and even some small farmers said they monitor Kisenyi and Busia prices via cell phone, though they complain the airtime charges are expensive and they cannot afford to do it as much as they would like. The apparent competitiveness at each level of the supply chain, and thus the likely effectiveness of price transmission through the supply chain down to the farm level, suggest that LRP effects on wholesale prices get transmitted quickly and effectively down to the farm level.

To further investigate price transmission to farm level, MSU commissioned the collection of three maize prices per week in producer markets of Mbale, Kapchorwa, Lira, and Masindi for six months spanning late 2012 and early 2013. We also obtained wholesale market maize prices in Kisenyi and Busia. Analytically testing the efficiency of price transmission is beyond the scope of this paper, but correlation coefficients in Table 2 are suggestive. Wholesale prices in Kisenyi are most correlated with producer prices, in order, in Masindi, Mbale, and Lira. This ordering reflects ease of transport to Kampala and, in the case of Masindi, its greater distance from other major markets. Busia, on the border with Kenya, is most correlated with producer prices in Mbale, Masindi, and Lira.

[15] Lock-ups are small shops, often in a single building divided into many such shops, out of which many traders and small millers in regional towns run their business. The name comes from the ability to lock the shop at the end of the day.

Table 2. Correlation Coefficients among Prices at Producer (Mbale, Kapchorwa, Lira, and Masindi) and Wholesale Levels (Kisenyi and Busia), Uganda, September 2012 – March 2013

	Kisenyi	Mbale	Kapchorwa	Lira	Masindi	Busia (FAQ)
Kisenyi	1.00					
Mbale	0.85	1.00	-	-	-	-
Kapchorwa	0.19[1]	0.44	1.00	-	-	-
Lira	0.80	0.78	0.04[1]	1.00	-	-
Masindi	0.91	0.90	0.35[1]	0.78	1.00	-
Busia (FAQ)	0.77	0.91	0.26[1]	0.83	0.87	1.00

Source: Authors' elaboration using data from FEWSNET/Uganda.
Note: 1 Not significant at <=10%. All others significant at this level or better. Prices were not deflated due to the short duration of price collection.

All these correlations are 0.80 or higher and statistically significant. Kisenyi and Busia at wholesale are significantly correlated at 0.77. Kapchorwa stands out for having a low correlation with all other markets.

We attribute this to this zone's late harvest, which occurs during September-October. Prices are thus going down in Kapchorwa at this time while they are moving up in other markets due to relative shortage there stemming from their earlier harvest.

After the harvest in Kapchorwa, its prices move much more closely with others: correlations rise from 0.19 to 0.46 with Kisenyi and from 0.26 to 0.59 with Busia when correlations start in November rather than September.

Our trader and farmer interviews in both countries raised two potential issues surrounding the WFP-LRP price effect. First, the speed with which market prices adjust to a tender announcement can create problems for traders and farmer groups bulking maize for sale to WFP. For traders, this problem was especially acute when there was a significant delay between the date of the tender and the date they receive payment. If a trader has not already purchased (and stored) all of the grain they are tendering for then they will have to buy additional amounts in the market to meet their tender quantity. But if the tender announcement increases market prices then this can sometimes lead to losses if price rises above the level the traders have tendered at before they can purchase the grain. And if traders have previously purchased (and stored) the grain in expectation of a WFP tender this can leave them exposed to downside price risk if the tenders are not forthcoming, or if they are not awarded a tender. This situation had clearly caused major problems (losses) in the past for some of the traders we interviewed.

For farmer groups, bidding on WFP tenders requires that they bulk grain. If market prices subsequently rise (perhaps in part due to the WFP purchases) then member farmers often sell on the market at a higher price rather than fulfilling their bulking commitment. This situation made it difficult for the cooperatives to deliver on the WFP contract.

The second issue surrounding the WFP-LRP price effect, raised by farmers, is related to the first. The most common marketing problem expressed by farmers was that the difficulty of on-farm storage, and the need for funds to pay for school fees and other consumption needs, requires them to sell grain immediately at harvest when prices are at their lowest. If WFP then enters the market later in the season (or other market forces come into play) and prices rise over the storage season then the farmers have missed an opportunity for higher prices, and perhaps even have to buy grain back later in the season at a higher price to meet consumption needs. They know they can generally get a better price by waiting but they cannot do it either because they don't have the storage facilities and/or because they need the cash. This suggests that the timing (seasonality) of LRP purchases can have a potentially important effect on farmers, as argued in Section 3.2.2. Purchases early in the harvest season could also make it more possible for farmers to commit to bulking and to maintain this commitment, thus driving operational efficiencies and reduced costs at this level.

Overall, our interviews in Uganda suggested a competitive grain marketing system with many traders, brokers, and assemblers operating at every level of the supply chain. All participants aware that WFP purchased maize in Uganda believe such purchases have an immediate and positive impact on wholesale market prices and that these price impacts are quickly felt down to farm level. Correlation coefficients between wholesale and producer, while not definitive evidence, lend further support to this contention. Given the effective price transmission, both inter-regionally and through the supply chain down to the farm, the impact of LRP at wholesale within Uganda is likely to influence prices throughout the country and at all levels of the supply chain.

We expect that maize price transmission in Mozambique during our period of study was, on average, less strong than in Uganda for several reasons. First, Mozambique lacks a dominant price-formation market such as Kisenyi or Busia in Uganda. In sharp contrast to Uganda, traders interviewed in Mozambique did not cite any single market as the clear reference market for maize prices. Gathering information on supply and demand conditions in Mozambique may therefore be more difficult than in Uganda, which might reduce the speed of price transmission between markets and through the supply chain. Second, the structure of wholesale maize marketing in Mozambique has historically been much more concentrated than in Uganda. As noted in the previous subsection, through most of the 2000s there were only two large maize traders in the country – V&M and Export Trading, with each operating in separate areas of the country. Such a concentrated market structure would be expected to have two effects. First, it could introduce a wedge between prices at wholesale (including sales prices to WFP) and prices at the farm level, so price effects at wholesale from LRP purchases might not be fully transmitted to farm level. Second, concentrated wholesale trading would be expected to exacerbate the problem of unclear market information highlighted in our first point.[16]

A third factor that may reduce price transmission in Mozambique is the separation of the northern region from the central and southern regions. Prior to August 2009, there was no bridge over the Zambezi River, except in Tete province to the west, creating a natural barrier to trade, especially for a low-value commodity like maize. While higher-value products such as beans flowed regularly from northern Mozambique to the central and southern regions (either using a ferry at the site of what is now a new bridge, or avoiding the ferry by transiting through Malawi), market observation and market information system data over many years indicates that this almost never happened with maize. We thus expect LRP that occurred in northern Mozambique prior to August 2009 to have modest effects in the central and southern parts of the country, but *greater* effects in the north since nearly all effects will be

[16] As noted in previous subsection, since about 2008, competition in Mozambique's maize market has increased dramatically.

concentrated there. Likewise, LRP that occurs in the central region is not expected to affect prices in the northern region, but only in the central and southern. A final factor is that P4P has been quantitatively more important in Mozambique, relative to traditional LRP, than it has been in Uganda. In Uganda, P4P purchases of maize from 2009 to 2011 ranged between 3% and 8.5% of total WFP procurement, while in Mozambique they ranged from 10% to 32%. Because P4P purchases do not involve public announcement of tenders to numerous traders, their price impact on the market is likely to be less rapid, and possibly less pronounced, than traditional LRP operating through a tendering system.

Trader interviews on this issue were inconclusive. While some indicated that WFP tenders have immediate but small impacts on the market, they also indicated that not all traders had knowledge of WFP tenders. Interviews with farmers suggested that they are not as informed about prices as are those in Uganda. Correlations of deflated prices using historical data at producer- and wholesale markets from Mozambique's national market information system (SIMA) delivers correlations between paired producer and wholesale markets of between 0.79 and 0.95. Though these are higher than in Uganda, they should not be directly compared because results in Mozambique are likely to be more affected by common seasonal patterns due to the much longer time series – a minimum of four years in each market pair compared to six months in Uganda. We conclude that price transmission clearly exists and is probably improving. Therefore, WFP purchases will influence prices across regions and throughout the supply chain but, for reasons outlined above, price transmission is likely to be less strong than in Uganda.

4. CASE STUDY RESULTS: BEANS IN ETHIOPIA

This chapter is divided in two sections. The first section describes trends and patterns generated from analysis of the WFP procurement data at tender and vendor levels, while the second discusses lessons we learned from interviews with farmers and traders.

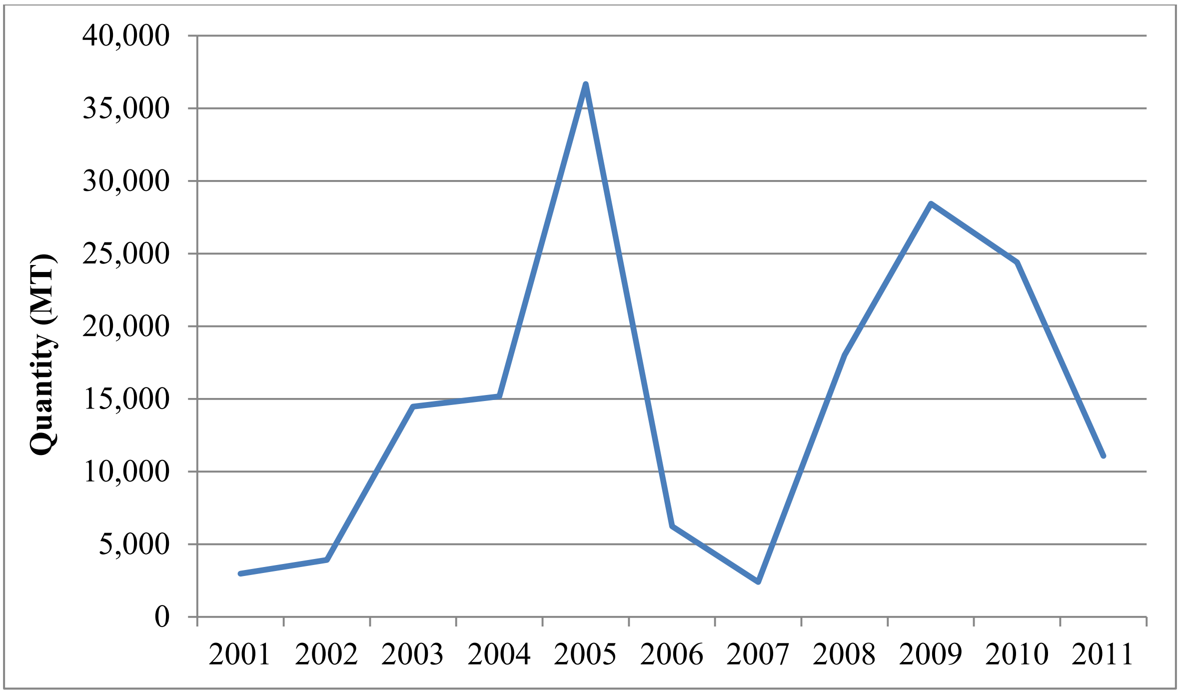
4.1. Insights from Analysis of Procurement Data

From 2001 to 2011, Ethiopia accounted for 31% of the total quantity of beans procured by WFP in East Africa, with an annual share ranging between 7% and 55%. Figure 16 shows annual volumes of beans procured in Ethiopia. WFP purchases reached a record high in 2005, increasing from about 3,000 MT in 2001 to 37,000 MT in 2005. After its high in 2005, WFP procurement of beans oscillated greatly, dropping sharply to about 2,000 MT in 2007, rising to nearly 30,000 MT in 2009, and dropping again to 11,000 MT in 2011.

The number of vendors winning WFP tenders for bean purchases has followed the trends in total bean procurement. The number of vendors rose sharply from two in 2001 to 17 in 2005 (first peak procurement year), fell with procurement totals the next two years, and then rose again (Figure 17). The share of local purchases accounted for by the top five vendors shows an overall downward trend, though it has risen each year since its low in 2008, from 64% that year to 85% in 2011.

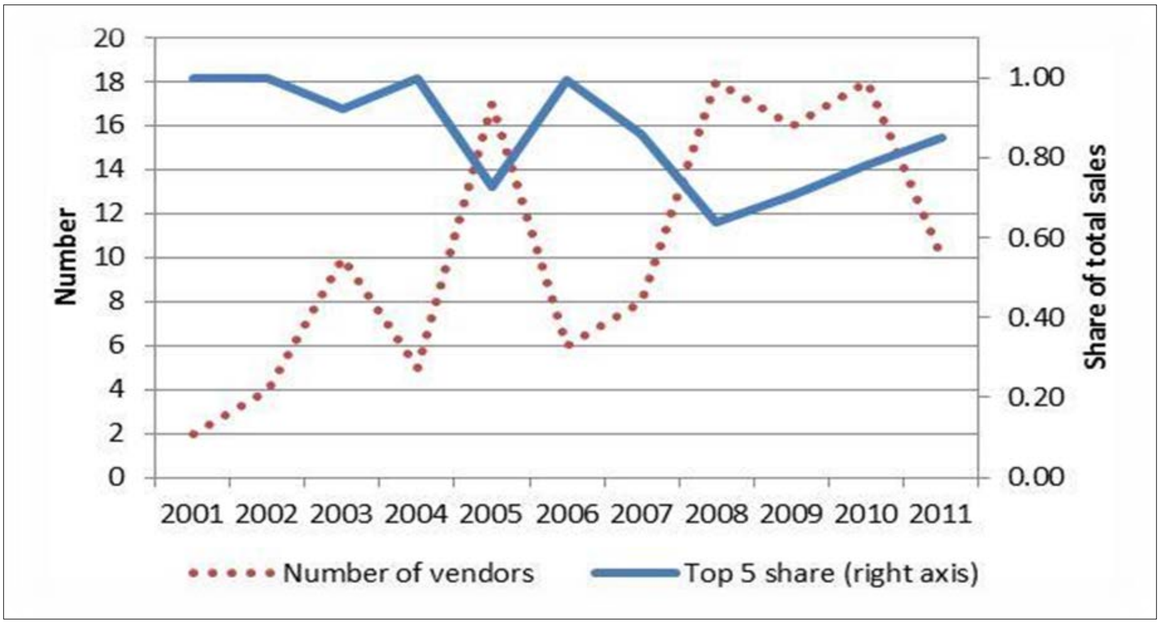
WFP in Ethiopia has never imported procured beans from other countries, and does export some of the locally procured beans to other countries (Figure 18). The share of locally purchased beans that were exported rose from 0% in 2001 to 83% in 2007. Since then, it has trended downward, dropping to 25% in 2008 and 15% in 2011.

Figure 16. Volumes of Total Bean Procurement by WFP in Ethiopia, 2001 – 2011



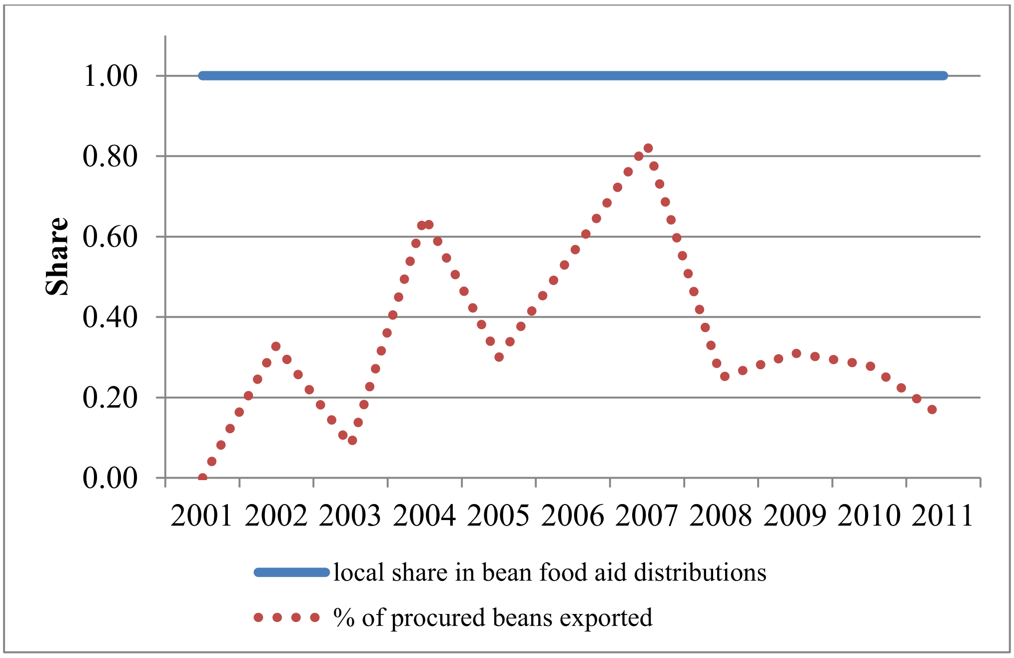
Source: Authors' elaboration using data from WFP WINGS database.

Figure 17. Number of Vendors and Share of Top Five in Bean Sales to WFP in Ethiopia, 2001-2011



Source: Authors' elaboration using data from WFP WINGS database.

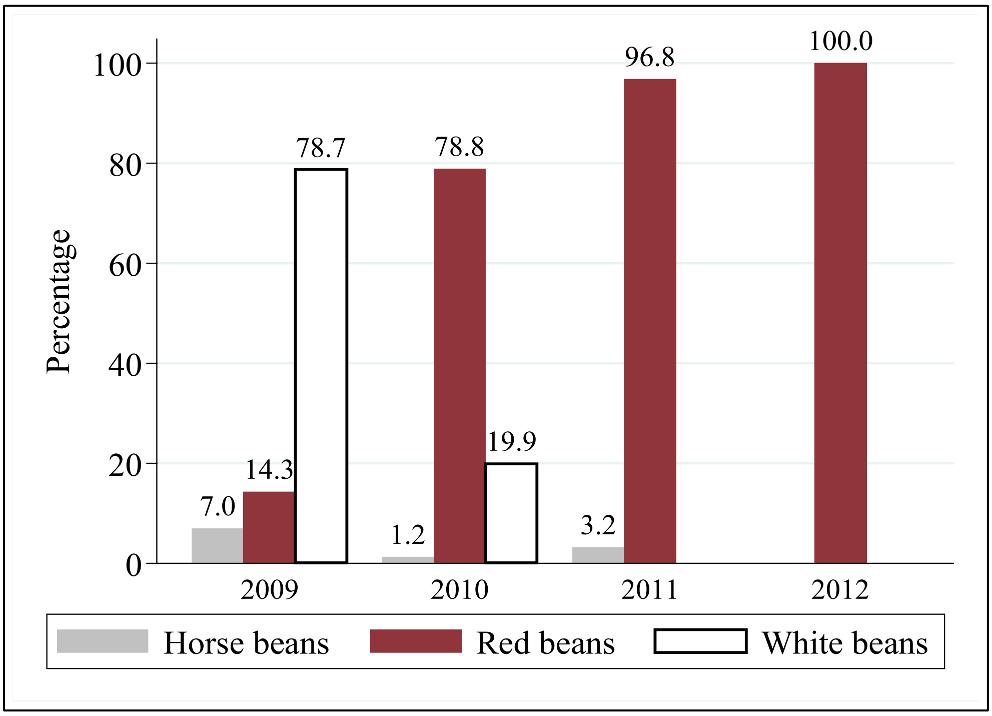
Figure 18. Locally Procured Beans in Ethiopia: Share in Local Distributions, and Percent Exported, 2001-2011



Source: Authors' elaboration using data from WFP WINGS database.

Ethiopia grows at least three different types of bean, each of which is supplied to different domestic and international markets and is affected differently by policy. White haricot beans are almost entirely exported to international markets (Europe, Middle East, and South Asia), while red haricot and horse beans are supplied to domestic and regional markets. Horse beans, however, are less traded by farmers than either of the haricot beans, each of which has a strong market.

Figure 19. Share of WFP Purchases of Bean in Ethiopia, 2009 - 2012



Source: Authors' elaboration using data from WFP WINGS database.

Fully understanding the impact of WFP on the bean market requires that procurement data be broken down by bean type. Prior to July of 2009, however, all bean purchases by WFP were registered simply as *beans* in the agency's Information Network and Global System (WINGS) database. Since that time, data are disaggregated by bean type.

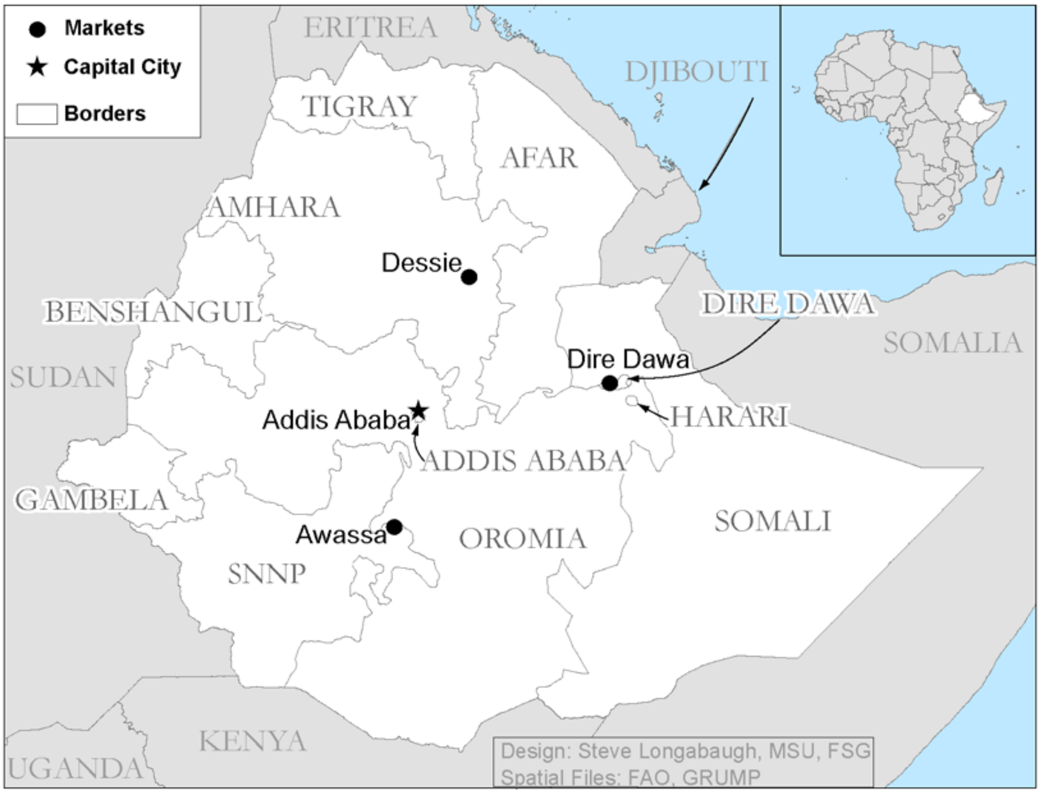
Using the more recent disaggregated data, we graph the share of each type of bean in total WFP bean purchases from July 2009 to July 2012 in Figure 19. The figure shows a dramatic shift in the types of beans that WFP has been buying. While white beans dominated during the last half of 2009, their share plummeted the following year and was zero in 2011 and 2012. Horse bean shares were very small each year through 2011 and zero in 2012. This dramatic shift from white beans to red beans was driven by the Ethiopian government's decision in 2010 that the Ethiopian Commodity Exchange (ECX) be the only channel through which private traders and exporters can trade white haricot beans. This issue will be discussed in the next section of the report.

4.2. Insights from Interviews

The MSU team visited Ethiopia in September 2012. The team and a local consultant (Dr. Tadesse Kuma Worako) interviewed a wide range of stakeholders in the bean sector operating in Addis Ababa, Adama, Awassa, and their surrounding areas. Annex A presents the itinerary and list of stakeholders interviewed.

Production of beans in Ethiopia is concentrated in three regions: Amhara, Oromia and Southern Nations, Nationalities and People (SNNP) (Figure 20). Together these three regions account for about 95% of total bean production in the country. All remaining administrative regions, dispersed around the country, are deficit producers.

Figure 20. Map of Ethiopia Showing Regions and Key Markets



Source: Authors' elaboration.

Five major findings stand out from our interviews. First, the contribution of WFP bean purchases to investments in the Ethiopia bean sector appears to be small. From our interviews, bean traders participating in WFP tenders have not made investments in drying and cleaning capacity in response to WFP purchases of beans. Some exporters have made large investments in cleaning and drying machinery and storage facilities to meet export demand in terms of quality standards and volumes, but these are not supplying to WFP and do not see WFP as their target market in the foreseeable future. Bean exporters with drying and cleaning capacity mentioned that they provide drying and cleaning services to traders competing for WFP tenders because those traders lack cleaning and drying capacity of their own. It is thus clear that WFP is at least contributing to higher use of existing drying capacity, and has conceivably contributed to indirect investment in such capacity.

Second, transmission of bean prices throughout the country appears to be fairly strong and LRP procurement of beans is reported to have a modest impact on bean prices. Bean marketing in Ethiopia is more similar to maize in Uganda than to maize in Mozambique. The trading system is well developed, with a long-established system of traders and brokers that constantly monitor recognized wholesale markets in Adama and Addis Ababa, as well as prices being paid by Kenyan traders for beans exported there. This system operates among large wholesalers in key market centers and among smaller traders in outlying towns. Brokers are a constant presence and tend to have strong and durable relationships with traders. We therefore expect that price signals are transmitted fairly rapidly throughout the country. Trader interviews indicated that WFP purchases of beans have clearly positive but modest impacts on market prices for beans.

We also expect price transmission to the farm level to be relatively strong for beans in Ethiopia, though this varies by type of farmer and area. Local markets are highly competitive as many traders are buying directly from farmers. Some farmers are linked with Adama and Addis Ababa markets through brokers operating in these markets. These farmers ship their bean surplus to brokers in Adama and Addis Ababa without receiving any advance payment from brokers. After selling the commodity, brokers send the proceeds back to farmers through bank transfers. This suggests that there are strong trust ties between brokers and farmers – and strong trade flows on the basis of relative prices. Some farmers are monitoring prices through cell phones and use them to obtain market information. Other avenues used by farmers to access price information include the ECX and other price information boards located in some markets. These price boards appear to have had a positive impact on farmers' bargaining power when selling their surplus. We heard statements from farmers like, "We are getting better prices now because we have access to market prices through price boards".

Third, WFP has raised quality awareness in the Ethiopia bean market. This might have contributed to strengthening the domestic beans sector's ability to enter export market in recent years, especially for white haricot beans. Over the years, WFP provided extensive training to traders on how to ensure quality. One of the large traders we interviewed stated that, "The contribution of WFP is very high. We learned about the details of quality dimensions from them. So, we were able to enter the export market, which requires even higher quality." Our interviews consistently reported that WFP has contributed to quality awareness, especially among traders, in the bean market when no other local market stakeholder was paying much attention to quality.

However, some wholesalers supplying beans to the export market felt that WFP had no impact on their practices to improve quality standards. These wholesalers stated that they have taken actions to improve quality in response to tightened quality demand from the export market and not in response to WFP. This stringent quality demand is, to a large extent, driven by importers in Europe, the Middle East, and South Asia because regional markets appear to place relatively less emphasis on quality. Farmers and traders we talked to indicated that Kenyan traders purchase Ethiopian beans, especially red haricot beans, with almost no attention to quality. Our interviews also suggested that volumes of beans exported, especially of white haricot beans, increased considerably in the last five years. Estimates from the Ethiopian Central Statistical Agency (CSA) indicate that exports of haricot beans – both white and red – have risen from 52,000 MT in 2006 to 108,000 MT in 2011 to 99,000 MT in 2012.

Fourth, assuring bean quality at the farm level is challenging. This is in part because farmers lack mechanical drying capacity and the bean harvest usually occurs in November / December when rains are still usually falling. Also, pressing cash needs force farmers to sell their beans right after harvest when levels of humidity are still high and prices are low. Farmers and small traders we interviewed indicated that immediately after harvest, many smallholder farmers give their beans surplus to local small traders without receiving any advance payment from traders. After selling the commodity, local traders pay back the farmers. This is happening because local small traders have greater and better storage capacity than smallholder farmers do, allowing local small traders to sell beans a few months after harvest when prices are higher. Investments in mechanical drying capacity by farmers are likely to be unprofitable due in part to their small scale of production.

With regard to quality awareness at farm level, a mixed picture emerged from our interviews. Some farmers do pay attention to quality by cleaning, sorting out foreign matter, and drying their bean production before selling it in the market, while others sell their harvest without regard to quality. In contrast to farmers, small and large traders are more quality conscious, but some small traders stated that they purchase beans with no attention to quality. They also indicated that they do not pay any price premium for quality beans.

Fifth, government policy creates uncertainty in the market. Although market liberalization in the late 1990s encouraged private sector participation in the market, public policy continues to play a central role in the way that markets function in Ethiopia. Rashid (2011) documented that in response to the 2008 food price crisis, the Ethiopian government put in place four measures: (1) a cereal export ban, (2) re-introduction of urban food rationing, (3) informal suspension of local procurement by WFP and others, and (4) direct government imports for open market sales and price stabilization. These and other government policies have had direct or indirect impacts on the way bean markets operate in Ethiopia. For example, due to government mandates, WFP did not purchase white haricot beans in 2011 and 2012, or maize in 2008 and 2009 in Ethiopia. Traders and farmers we spoke to also pointed out that the Ethiopian government periodically bans informal exports of red haricot beans to Kenya, which is a major destination for local production. These same traders indicated that the bans are not always strictly enforced even when announced, but *are sometimes* enforced and thereby raise costs and dramatically increase uncertainty.

ECX is another avenue through which the Ethiopian government participates in the market. In 2011 the government passed regulations requiring that, at all market levels, except at the farm, white haricot beans be traded only through ECX. This regulation also requires that white haricot beans transacted through ECX are to be exclusively supplied to the export market, eliminating the domestic market for white haricot beans. Though it appears that the local market for this bean was never large, this policy decision has entirely eliminated it, and also made it impossible for WFP to purchase white haricot beans.

From WFP's perspective, the main issue regarding ECX is now whether red haricot beans will also be brought under the exchange through a policy mandate. Though several traders explicitly said that they feared this, ECX indicated that there were no plans to do so. With white beans already eliminated as a target crop for WFP procurement due to the ECX mandate, a comparable mandate for red beans might further complicate the agency's ability to engage in effective procurement of beans in the country.

5. CASE STUDY RESULTS: HEPS IN ETHIOPIA AND MALAWI

Assessment of the impacts of WFP's HEPS procurement in Ethiopia and Malawi must be put in the context of two trends that are beginning to transform Africa's food systems: rapid urbanization and per capita income growth. Urban populations are growing more rapidly in Africa than in any other continent, at an average of about 3% per year. Since at least 2000, Africa has also had some of the world's best-performing economies as measured by real Gross Domestic Product (GDP) growth: seven of the top 20 growing economies of the developing world between 2001 and 2011 were in Sub-Saharan Africa. Ethiopia embodies both these trends, with rapid growth in urban populations (though from a very low base) and among the very highest GDP growth rates in the world, 8.5% per year over 10 years according to World Bank data. Malawi's economic growth has been slower, but it is urbanizing and is in the middle of a region with rapidly growing economies, such as Mozambique, Zambia, and Tanzania.

Together, rapid urbanization and per capita income growth will drive transformative changes in the patterns and levels of consumer demand. Among the items whose demand will grow most rapidly in quantity and diversity are processed food products. Already, international and regional corporations (e.g., East Africa Tiger Brands, one of the largest food processor / wholesalers in Africa) are investing in Ethiopia's food system in anticipation of robust growth. Less foreign investment is taking place in Malawi, but local firms are progressively moving into the local commercial processed food market, to compete with imports primarily from South Africa in what they also see as a growing market.

A key question in both these countries is to what extent local firms will be able to compete with large foreign firms in satisfying their own market and the neighboring regional market. A question then for WFP is whether it can make a meaningful contribution to this competitiveness through the way that it goes about its procurement of value-added products such as HEPS.

In addressing this question, one needs to examine trends in the *types* of HEPS that the agency is purchasing and how their processing and packaging requirements are evolving for these products. HEPS is in fact composed of a large and growing number of products. The basic distinction is between CSB, which is typically 70% maize and 30% whole soybeans that are milled, extruded, and blended, versus a wide range of nutritionally improved products. Historically CSB has been the dominant product in WFP efforts to provide more nutritionally valuable products to target populations. Beginning in the late 2000s, however, spurred by advancing knowledge regarding nutritional quality of foods and the human body's ability to use certain types of lipids and proteins (WFP 2010b; USAID 2011; Medicins Sans Frontieres 2012; WFP 2012), WFP began to take policy decisions to incorporate new products with enhanced nutritional profiles into their programs. These new products include Super Cereal (previously referred to as CSB+) and Super Cereal Plus (previously referred to as CSB++). Ready to Use Foods (RUFs) or Ready to Use Therapeutic Foods (RUTFs) are also product groups that have been in WFP's basket for some time but whose specific products are evolving and whose importance is likely to grow.

Super Cereal is produced as normal CSB with specific vitamin and mineral fortification and is used for children above 24 months and adults. Super Cereal Plus focuses on children 6-24 months of age and is produced with de-hulled soya (to improve the body's ability to use the protein), dried skimmed milk powder, sugar, vegetable oil, and vitamin and mineral premix

(UNICEF 2011; Salvignol 2012). RUFs and RUTFs include high-energy and high-lipid spreads such as Plumpy Nut and Plumpy Doz, high energy biscuits, and others.

WFP modified its WINGS database to track these new products more carefully starting in July 2009. Data prior to that time do not distinguish between traditional CSB, Super Cereal (CSB+), and Super Cereal Plus (CSB++), though they do distinguish between CSB (and related products that use wheat, sorghum, or rice rather than maize) and fortified and ready-to-use foods. The 2009 improvement to the database was close to the time that the agency began to move towards Super Cereal and Super Cereal Plus and away from CSB and related unfortified products. The overall database thus probably captures most of the trend in the rise of these two enhanced CSB products, though there may be some of these products purchased during 2008 and 2009 that the database does not capture.[17]

Figure 21 shows annual worldwide totals of procured HEPS through the end of 2009, classified as CSB and related products (all unfortified), Faffa, and Fortified and Blended Foods (FBFs) and RUFs. We classified the WINGS product codes into these three classes as shown in Table 3.[18] The figure shows the dominance of traditional CSB up to this time but also the growing procurement of FBFs and RUFs.

To examine data from July 2009, when WINGS has a clear breakout between CSB, Super Cereal, and Super Cereal Plus, we add these two products to the right-hand column in Table 3. To the extent that these were purchased prior to July 2009 they would have been classified as CSB. Note also that the data for 2009 start only in July, so do not reflect yearly figures.

Two key findings stand out from these data. First, WFP has moved decisively away from traditional CSB – worldwide volume for this and related products had fallen to just 23,000 MT by 2011, while the full range of fortified foods rose to over 150,000 MT in 2010 and over 300,000 MT in 2011 (Figure 22).

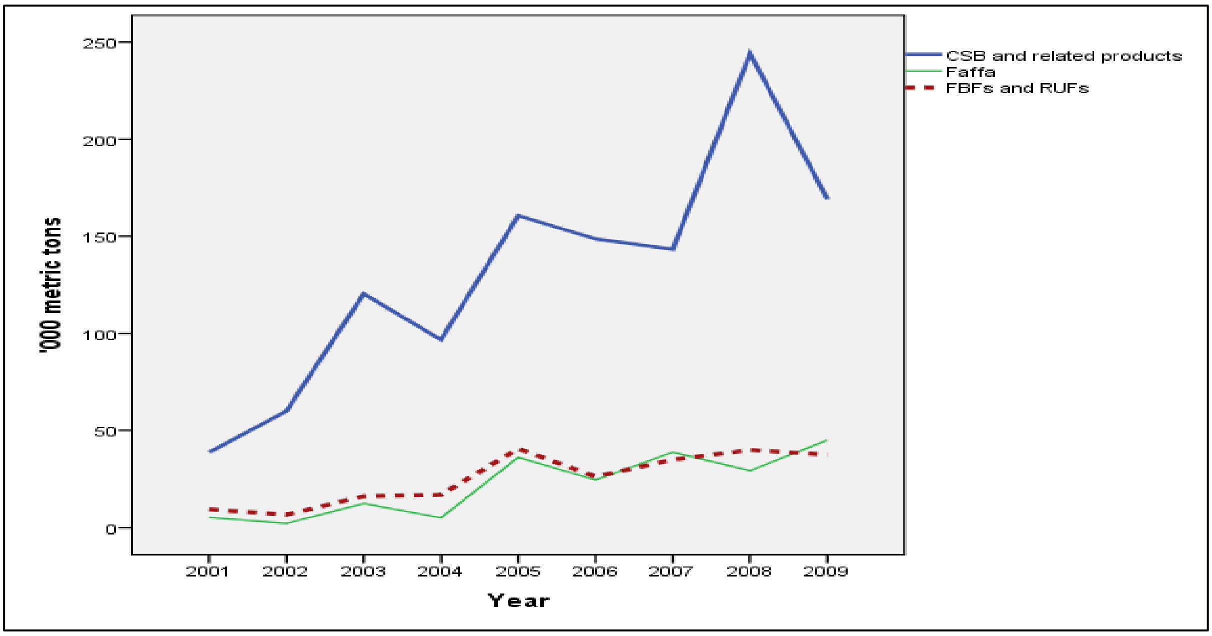
Table 3. Classification of WFP PROD Variable into CSB and Related Products, and FBFs and RUFs

CSB and Related Products	Fortified Blended Foods (FBFs) and Ready-to-Use Foods (RUFs)
Corn-soya blend	High energy biscuits
Mixed and blended foods	High protein biscuits
Likuni Phala	Wheat-soya milk
Pea wheat blend	Ready to use supplementary food
Wheat-soya blend	
Rice-soya blend	

Source: Authors' elaboration.

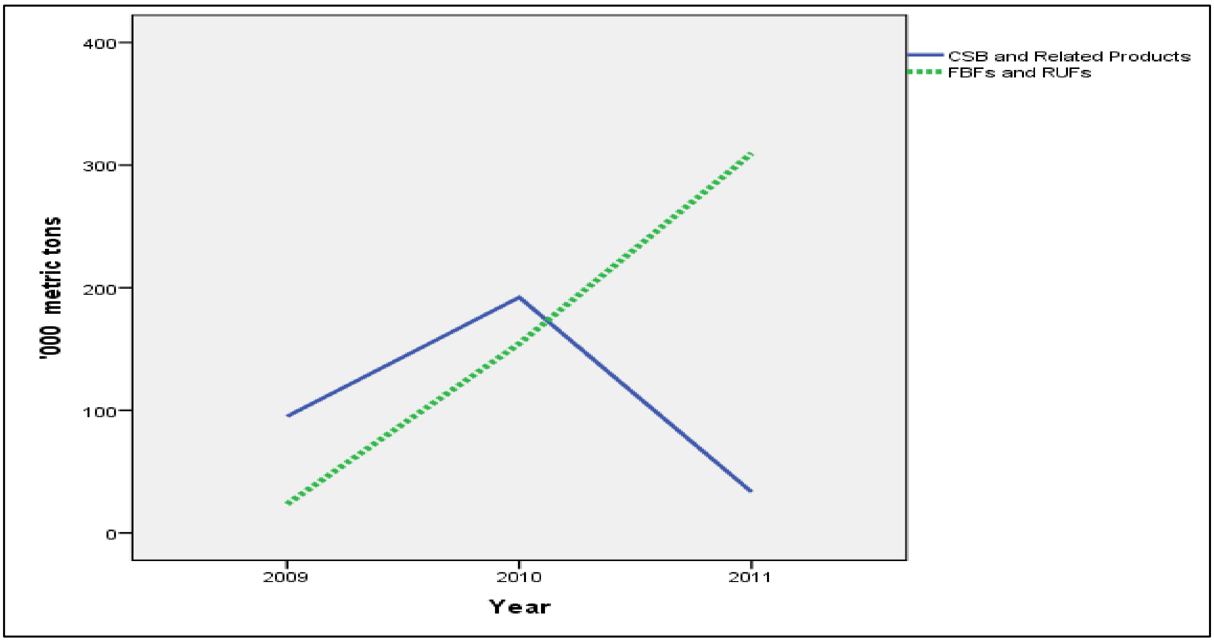
[17] Interaction with Roberta Romelli of WFP regarding the timing of guidance from Rome on replacement of CSB with Super Cereal also suggests that the change in WINGS caught most if not all of these purchases.
[18] We leave Faffa as a separate category due to some lack of clarity as to how it was handled in the WINGS database. In interviews in Ethiopia with Faffa company representatives and others, Faffa was consistently presented as CSB plus milk powder, vegetable oil, and vitamin and mineral supplements – nominally the recipe for Super Cereal Plus. The Faffa website confirms these ingredients. Yet the Faffa representative also stated that they “are considering” starting to produce Super Cereal Plus. WFP sometimes classifies Faffa as Faffa, sometimes as CSB, and sometimes as Super Cereal (Faffa). Never does it classify Faffa as Super Cereal Plus.

Figure 21. Worldwide WFP Procurement of All HEPS Products, by Category (2001-2011)



Source: Authors' elaboration using data from WFP/WINGS.

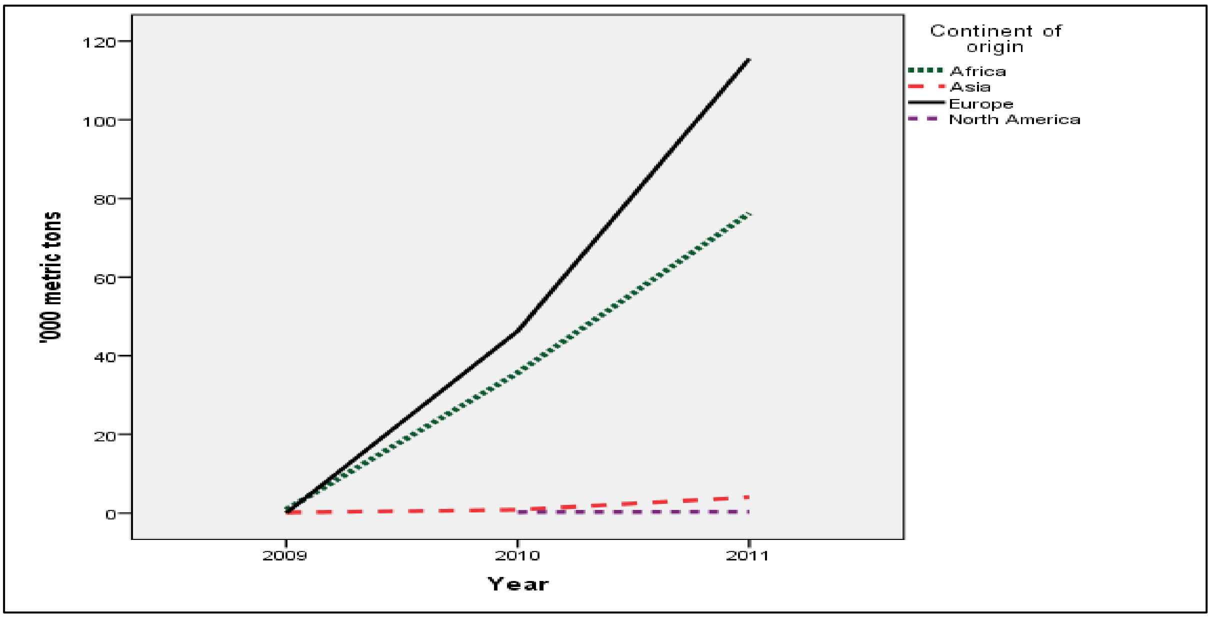
Figure 22. Worldwide Volumes of Unfortified Blended Foods and FBFs and RUFs Purchased by WFP, July 2009 – December 2011



Source: Authors' elaboration using data from WFP/WINGS.

Second, since the start of data availability in July 2009, the volume of nutritionally enhanced products arriving to Africa from Europe has grown much faster than the volume procured in Africa. From less than 1,000 MT procured in each location and destined for Africa during the last half of 2009, Europe's supplies of these products to the continent rose to over 115,000 MT by 2011, while procurement within Africa for Africa rose to about 76,000 MT (Figure 23).

Figure 23. Quantities of FBFs and RUFs Supplied to Africa, by Continent of Origin (July 2009-2011)



Source: Authors' elaboration using data from WFP/WINGS.

As a result, by 2011 Europe – led by Italy and Belgium – had for the first time exceeded Africa as a source of supply for HEPS to the continent. This dramatic change has been attributed by some in WFP to the difficulties in getting a sufficient number of African firms certified to required production standards to keep-up with the pace of WFP's move away from unimproved CSB (Salvignol and others, personal communication).

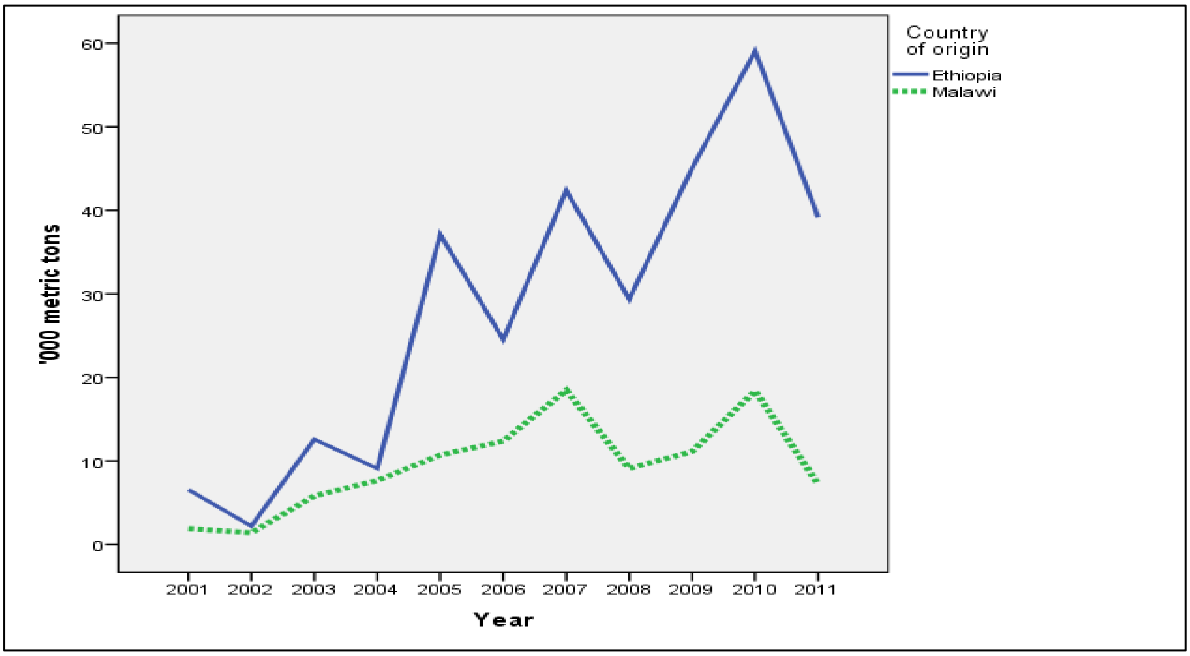
From a food system development perspective, which is the focus of this report, the key issue involving this move relates to the final point above: containing added vitamins, minerals, and lipids, the food safety standards for these new products (especially Super Cereal Plus and the RUFs) are far more demanding than for traditional CSB, and some require air-tight packaging. As WFP strengthens its production standards, how much help will African companies outside of South Africa need to meet those standards, and will they be able to meet them at a price that allows them to win WFP tenders? If not, will and should WFP take a flexible contracting approach with these companies as they improve procedures and reduce costs with the objective of fairly quickly becoming competitive? For example, should WFP be more flexible, during some defined establishment phase, in pricing, delivery terms, or other contractual aspects (while maintaining quality and safety standards) that will facilitate or hinder the firms' ability to sell to the agency?

Before turning to the results of our interviews with HEPS manufacturers in Ethiopia and Malawi, we generate insights from the country procurement data for HEPS in the two countries.

5.1. Insights from Analysis of Country Procurement Data

Total quantities of all HEPS procured over 2001-2011 peaked in Ethiopia in 2010 and in Malawi in 2007 (Figure 24). Growth in Ethiopia has been much faster than in Malawi, due mostly to the size of the internal food aid market in the former.

Figure 24. Volumes of Total HEPS Procurement by WFP in Ethiopia and Malawi, 2001 - 2011



Source: Authors' elaboration using data from WFP/WINGS.

Procurement of unimproved CSB dropped sharply in both countries in 2011 (to zero in Malawi), partially made-up for by procurement of FBFs and RUFs (Figures 25 and 26). The data indicate that these purchases began in 2010 in Malawi and 2011 in Ethiopia.

The number of HEPS vendors to WFP has increased in each country over the period but the share accounted for by the top five vendors has fallen only in Ethiopia (Figures 27 and 28). The number of vendors in Ethiopia increased from 2-3 in the early 2000s to 7-9 since 2008, with a related drop in the share of the top five from 100% each year through 2005 to less than 80% in 2011. The number of vendors in Malawi rose from 1-2 in the early 2000s to five by 2006, with a flat trend since that time, while the top five sellers accounted for all sales during every period of our analysis.

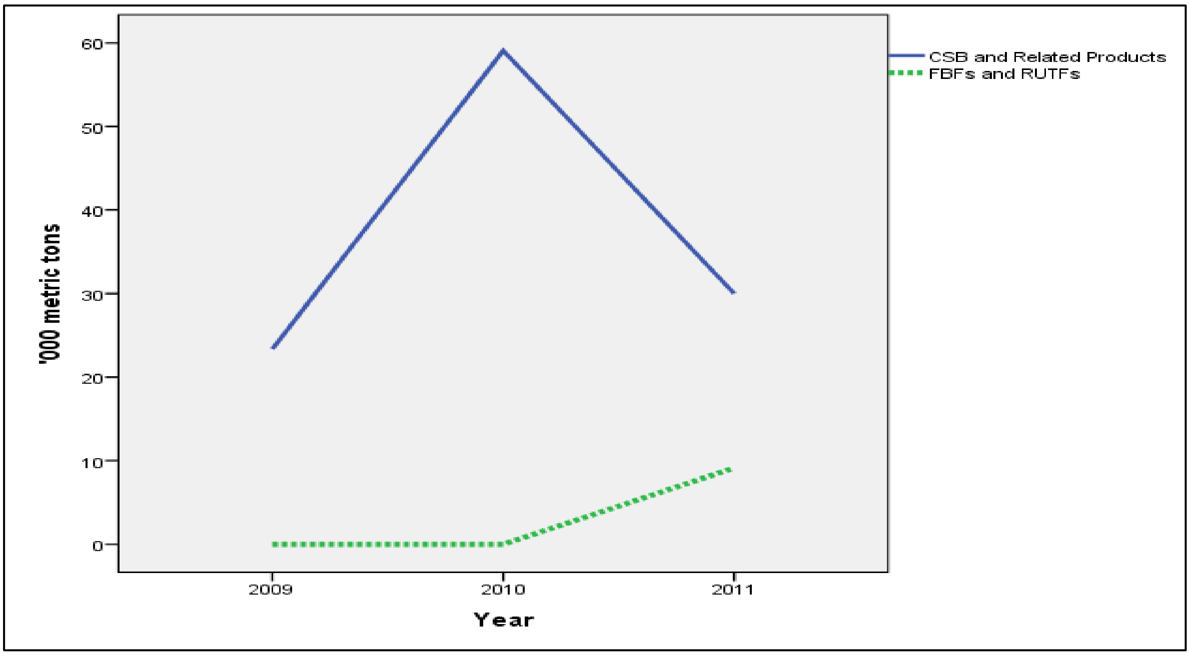
The concentration of sales among the top five vendors in each country is probably not a cause for concern from a pricing perspective. While Ethiopia is the largest single source of HEPS for the rapidly growing distributions in East Africa, Italy, South Africa, and Belgium are next in line, their share over 2001 to 2011 was about 50% higher than Ethiopia's share, and arrivals from these countries have been growing. Figure 29 shows that Ethiopian firms' share of all *locally* distributed HEPS has periodically fallen to 40%-50%, most recently in 2011; Italy, South Africa, and Belgium are the key foreign suppliers. The question in Ethiopia is less whether there is sufficient competition within the local market and more whether the local HEPS sector can be competitive within and outside Ethiopia.

In Malawi's case, WFP runs its HEPS tenders through the regional office, meaning that firms from Zambia, South Africa, and other countries are competing against the Malawian firms. The fact that Malawian firms have steadily increased their share of locally distributed HEPS, capturing all of that market every year since 2008 (Figure 29), suggests that they have competed well in this arena.

Figure 30 shows that Malawian HEPS firms have also competed well regionally: from zero in 2001 and 2002, the share of locally procured HEPS exported out of Malawi rose to about 70% in 2004 and has averaged about 50% since that time. Meanwhile, except for 2004 and (very slightly) 2007, WFP has not exported any Ethiopian HEPS outside the country.

Overall, this review suggests that the Malawian HEPS sector may be on a more sustainable footing than the Ethiopian sector. Firms in Malawi are less dependent on HEPS[19], less dependent on the food aid market in their overall (HEPS + other products) portfolio, have entirely replaced unimproved CSB with FBFs and RUFs, and have captured the entire Malawian WFP market while winning regional tenders and exporting (through WFP) roughly 50% of their production since 2004. The differing patterns in the two countries are a sharp counterpoint to what has to be considered the much more promising market setting in Ethiopia compared to Malawi: the former's population is dramatically larger and its economy has been growing far faster, providing rapidly growing commercial opportunities for local firms.

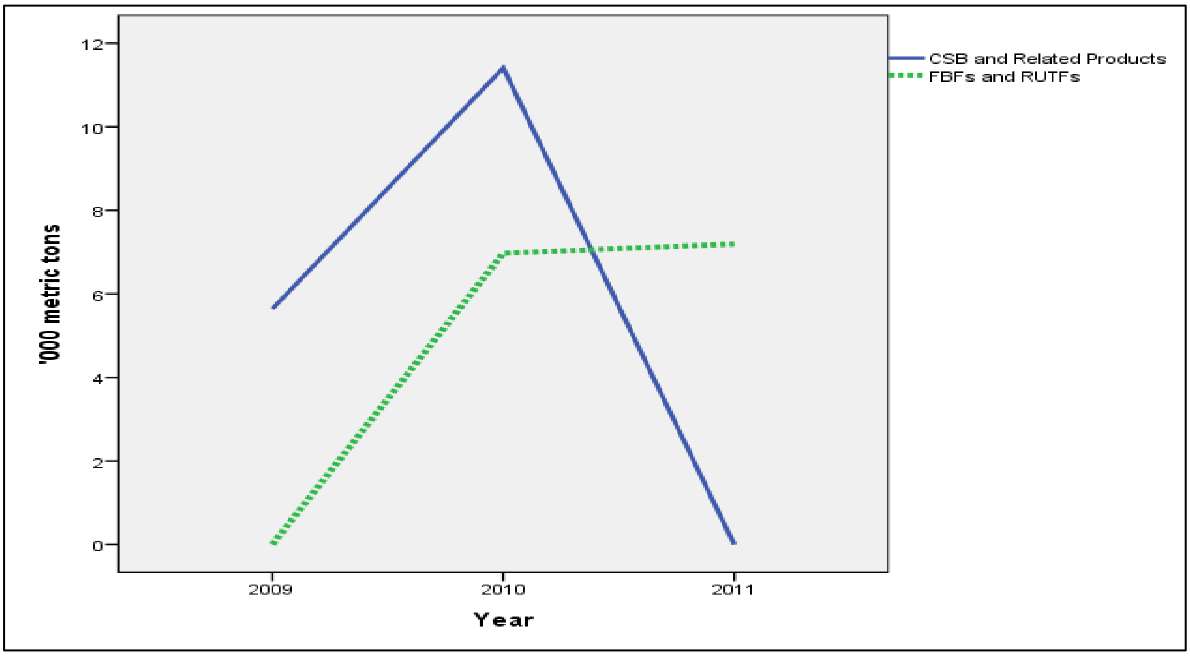
Figure 25. Volumes of HEPS Procurement by WFP in Ethiopia, Classified as CSB and Related Products, and FBFs and RUFs, 2001 – 2011



Source: Authors' elaboration using data from WFP/WINGS.

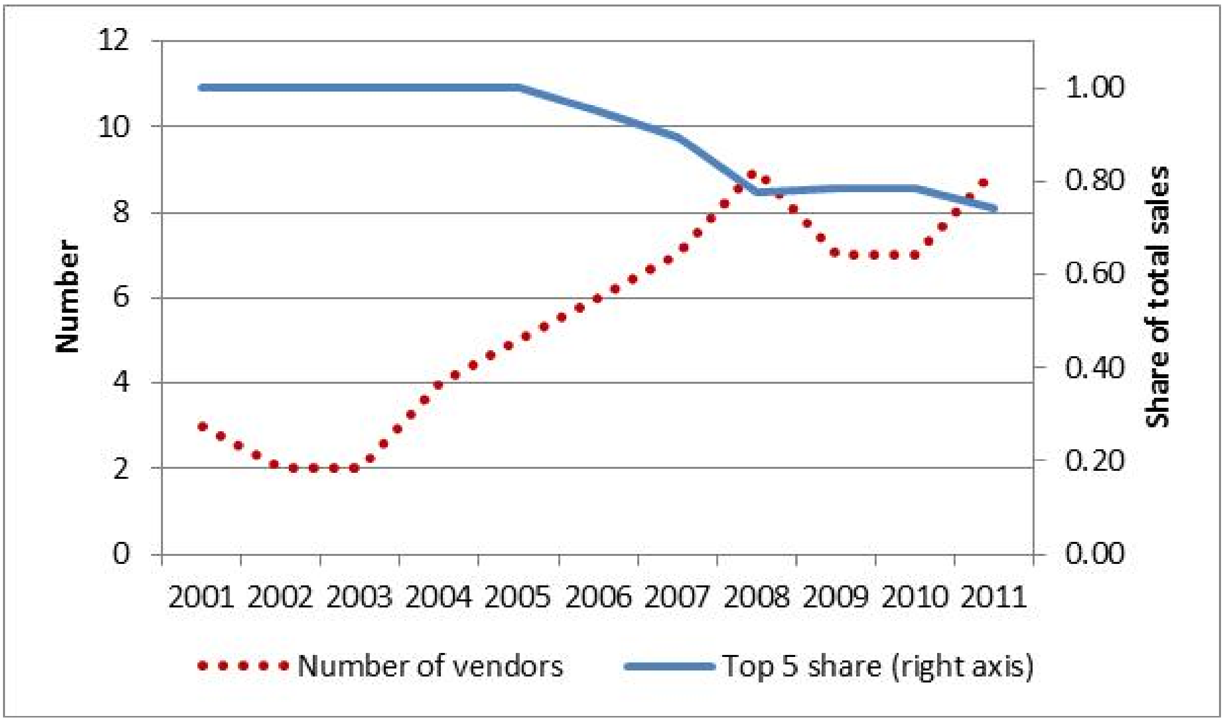
[19] This finding emerged in interviews in Malawi. See section 5.2. for more detail.

Figure 26. Volumes of HEPS Procurement by WFP in Malawi, Classified as CSB and Related Products, and FBFs and RUFs, 2001 – 2011



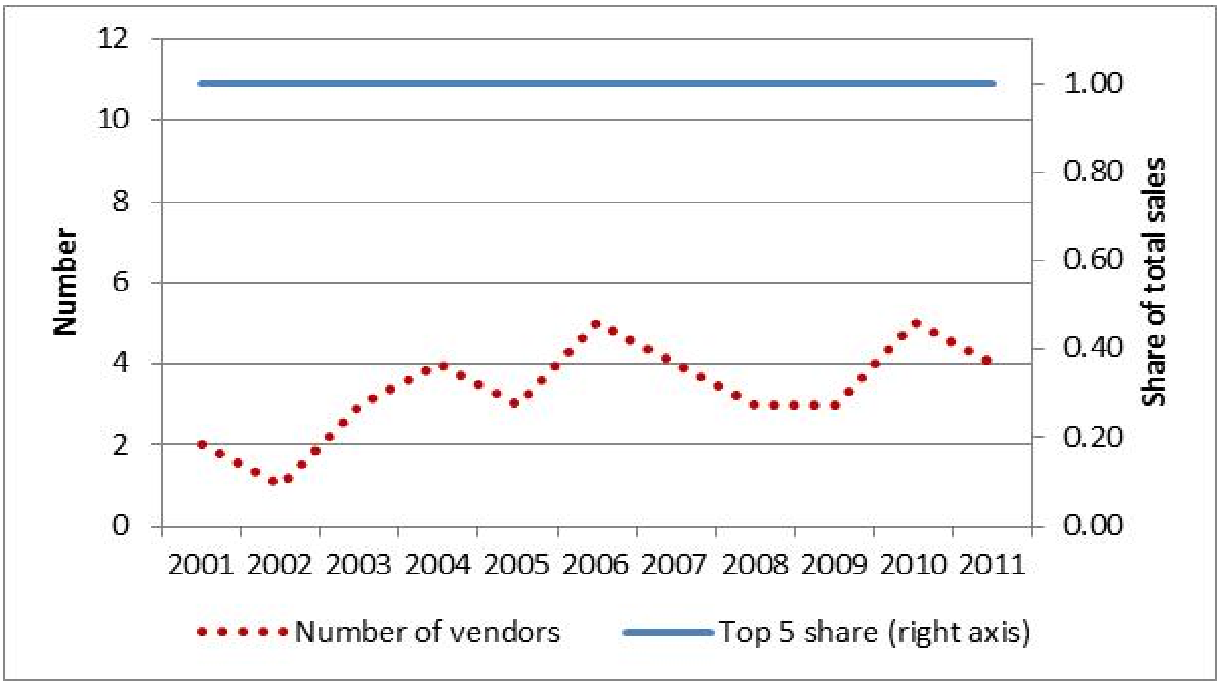
Source: Authors' elaboration using data from WFP/WINGS.

Figure 27. Number of Vendors and Share of Top Five in HEPS Sales to WFP in Ethiopia, 2001-2011



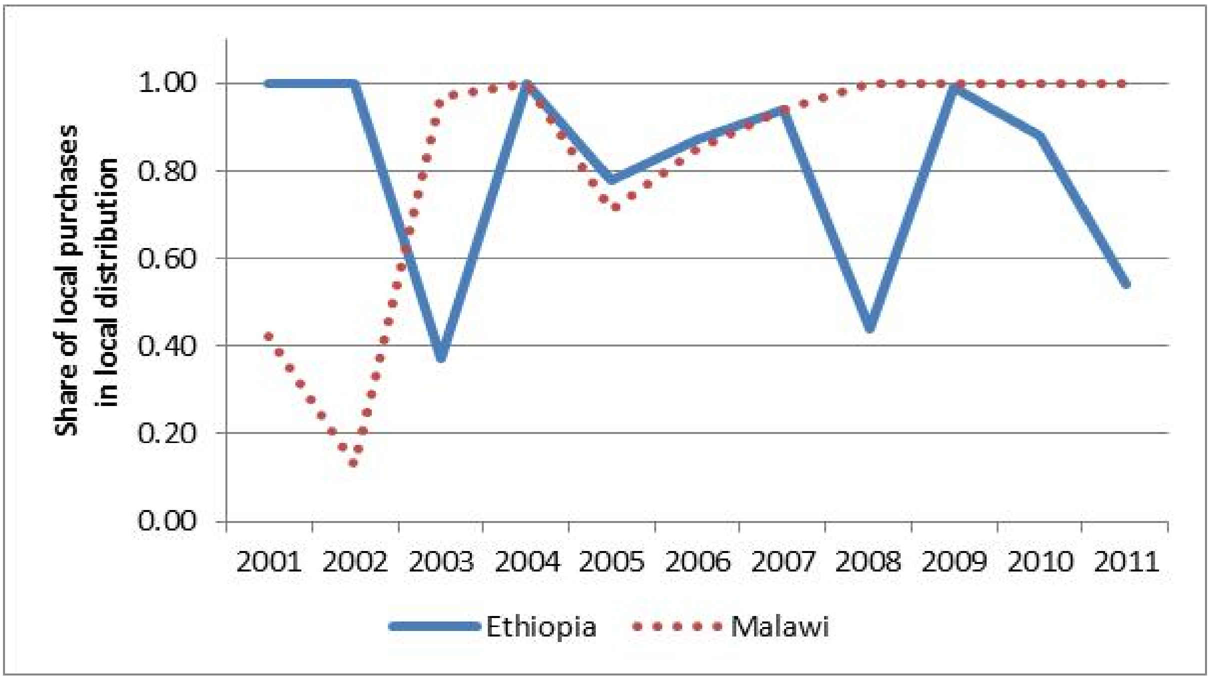
Source: Authors' elaboration using data from WFP/WINGS.

Figure 28. Number of Vendors and Share of Top Five in HEPS Sales to WFP in Malawi, 2001-2011



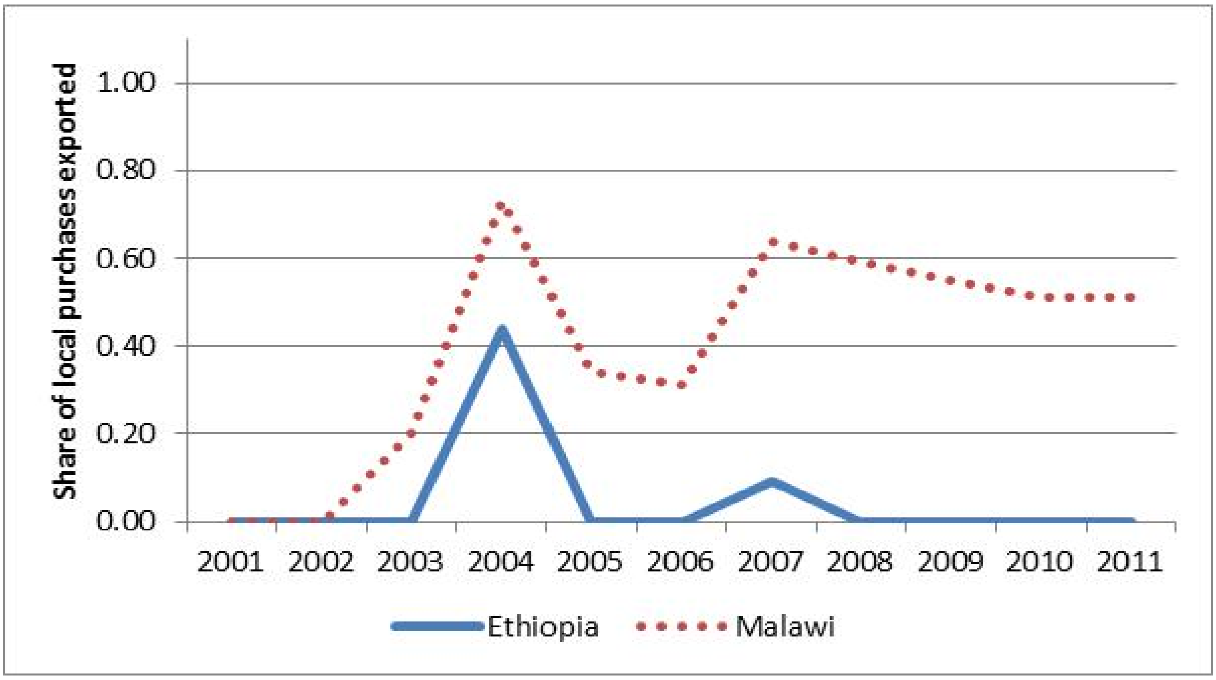
Source: Authors' elaboration using data from WFP/WINGS.

Figure 29. Share of In-country HEPS Food Aid Distributions out of Procured Food Aid Covered by Local Procurement in Ethiopia and Malawi, 2001-2011



Source: Authors' elaboration using data from WFP/WINGS.

Figure 30. Share of In-country HEPS LRP Exported from Ethiopia and Malawi, 2001 - 2011



Source: Authors' elaboration using data from WFP/WINGS.

These patterns also bring to the fore again the issue raised at the beginning of this chapter: how much help will African companies need to meet quality, safety, and packaging standards for these products, will they be able to do so at a price point that allows them to win WFP tenders on the basis of price, and if not, should WFP be flexible in their contracting approach with these companies until they can do so? Additionally, what can WFP do to get these companies, especially Ethiopian companies, into regional tenders? These questions go to the core of WFP's ability to drive positive systemic change in the food systems in which it operates. With Ethiopia's economy growing so rapidly, several firms we interviewed were investing for the commercial market and confident that the market "would be there for (them)." That same thinking, however, is drawing large multi-nationals to Ethiopia, each with the possibility of much larger scales of production than local firms and probably all with greater financial capacity to endure losses for some period of time while they establish themselves. WFP needs to consider carefully the range of contributions it can make to Ethiopian firms' development of cost-competitive production capacity in this setting.

5.2. Results from Interviews

The MSU team visited Ethiopia (Addis Ababa) in September 2012 and Malawi (Lilongwe and Blantyre) in April 2013. The team worked with local consultants – Dr. Tadesse Kuma Worako in Ethiopia and Mrs. Mercy Ngwira in Malawi – to conduct interviews with HEPS manufacturers and other stakeholders in the sector in both countries. The itinerary and the list of interviews for each country are presented in Annex A.

Two major findings emerged from the interviews of Ethiopia HEPS firms. First, WFP's presence has led to major investment in the sector, potentially positioning it for a robust response to emerging commercial opportunities in Ethiopia's rapidly growing economy. Faffa Food Share Company (Faffa FSC) was the first HEPS manufacturer in Ethiopia, founded in 1962 as a joint venture between the Ethiopian government and a Swedish food manufacturing company. For 30 years it was the only provider of such products to the food aid market. In the early 1990s, a long-time employee of Faffa FSC left the company to form Hilina Enriched Foods Processing Center. This was followed by the launch of Health Care Food Manufacturers PLC as a spin-off of Hilina around 1994. Over the past 6-7 years, many more firms have entered the sector, including GUTS Agro-Industry, Norish Food Manufacturers, East Africa Tiger Brands, and others. One of the grain trading companies we interviewed has plans to invest 42 million Ethiopia BIRR (about US$2.3 million) in a CSB factory that would depend primarily on the WFP market, at least to start. Currently the sector has capacity to produce approximately 300,000 MT per year, which is well beyond the current or any likely future size of the food aid market, even if WFP succeeds in getting Ethiopian firms competitive in regional tenders. From WFP's particular perspective, the large capacity in the sector is positive in that it creates the potential for greater competition and lower prices in tenders.

In contrast to Malawi (see below), none of the HEPS manufacturers we interviewed had broader food trade businesses; all were focused entirely on food manufacturing. In light of the current over-capacity when compared to the size of the food aid market, entering the commercial processed food market is central to the success of nearly every firm in the sector. Our interviews highlighted strong interest on the part of all firms to either enter or expand their presence in that commercial market, with several mentioning a range of commercial products they produce, including iodized salt, peanuts and peanut butter, Super Cereal Plus as a baby food, and soybean meal and oil. To date, the highest self-reported commercial engagement that we ascertained was from Faffa FSC, which claimed that 30% of its business, with a wide array of products, was in the commercial market. Several firms reported that they had no commercial presence at all but were working to develop it.

Second, WFP quality training has had a major positive impact on some of the newer companies in the sector. Over the past three to four years, WFP in Ethiopia has carried out at least three formal trainings that we are aware of: one on the development of the local and regional market, one on quality management systems, and one on the new WFP products. While the two most established firms (Faffa FSC and Hilina) felt that these trainings had not had a major impact on their business, some of the newer manufacturers were highly complementary regarding the trainings and the follow-up engagement and feedback through the inspection process, and asserted that they had a major impact on the firms' business. At the time of our visit, WFP had scheduled another visit by a food processing technologist from Rome to work with GUTS Agro-Industry, Faffa FSC, and perhaps other companies. A selection of quotes from newer manufacturers regarding these trainings includes:

- "WFP showed us the way on quality and food safety."
- "Practices and products are changing in the food industry due to WFP."
- "WFP technical assistance improved the productivity of our extrusion plant by 25%."

Note that this last statement was made by a representative of a company that, while new to Ethiopia, is a major regional food processor and distributor; this company's local affiliate nevertheless benefited from WFP training.

The major story in Malawi relates to simultaneously sharp criticism of WFP's quality requirements and strong praise for their quality training[20]. Criticisms related to the charge that on more than one occasion, winning tenders for HEPS in Malawi were based on prices that were *impossibly low* given the WFP recipe for the tendered product; these firms explicitly suggested that unapproved (and cheaper) ingredients had been used to reach the required protein content or possibly that expired vitamin and mineral mixes had been used. Traders indicated that "the best price wins regardless of quality, and quality is not tested at any rate." The MSU study team is not in a position to evaluate this claim but notes that it was independently raised, without instigation by us, by at least three firms.

The praise for quality training was equally strong and quite broad across companies. Quotes from firms included:

- "My data are now much more organized, which helps me to know what quality I have across the country."
- "We were doing many of the procedures but had not formalized and documented them."
- "The training reinforced what we were already doing and gave us more of a whole supply chain focus."
- "WFP training helped drive higher efficiency throughout our business, not just for the WFP and export markets."

These strong statements are perhaps surprising for firms who have long been involved in regional trade and presumably have had to guarantee some measureable level of quality in the past. In interviewing one of the inspection companies, we questioned whether WFP training could have had such a positive impact under these circumstances. We found their reply quite telling: "International buyers in the past might buy here and ship to RSA for further processing. So WFP insisting on quality really has had an impact by allowing local companies to capture more of this value-added." The firm also indicated that the quality training was, for them, an eye-opener and that companies have gradually improved their standards.

One particular element of the quality program was especially appreciated by the local firms: linking them with General Mills, one of the world's largest food companies, for technical assistance on processing procedures and quality maintenance. This assistance was made possible by a three year agreement between WFP and General Mills, through the Malawi P4P program, focused specifically on food processing firms in Malawi. The on-going interactions that several firms have had with the General Mills consultant has been especially valuable to them as they work to meet WFP standards and more generally to strengthen their quality procedures.

[20] In the course of our interviews in Malawi we became aware that WFP was purchasing much of its maize from the country's Agricultural Commodity Exchange (ACE). This approach is explicitly oriented by WFP's desire to promote institutional development within the supply chains it operates in. Though we interacted at some length with the long-time ex-pat CEO of ACE, we decided not to address the issue in this report because it is not central to our HEPS focus in Malawi and because the topic requires more detailed information than we were able to gather. We do note that the leadership of ACE appears to be committed, creative, and very interactive with private sector, government, and donors, but that the exchange – like all exchanges in Africa outside South Africa – faces major challenges trying to become sustainable. See Sitko and Jayne (2011) and Rashid, Winter-Nelson, and Garcia (2010) for in-depth treatment of these issues.

The number of firms in Malawi's sector has also increased since 2001. Though demand from WFP is not likely to be the only reason for this expansion, its relative reliability over the years makes it an attractive market and a potentially risk-reducing approach for a firm to invest, improve its practices, and eventually make its way into the commercial market.

In somewhat accentuated fashion, the findings on quality in Malawi –some frustration with WFP's move to strengthened standards, sometimes very strong criticism of particular aspects of implementation, but real praise for the quality training that WFP has done – echo feedback from maize traders in Uganda and bean traders in Ethiopia regarding WFP's quality practices and training. The consistency of this feedback across these countries leads us to believe that the positive quality findings of the interviews are robust. Full evaluation of the criticisms will have to be done by WFP as it continues to work with suppliers on these issues.

Looking across the two countries, it appears that WFP's procurement of HEPS has had important effects on expansion of both sectors and on improved quality practices of firms. Both effects bode well for the sectors' ability to expand into the commercial markets that are emerging as Africa's economies urbanize and as consumer purchasing power rises.

6. MARKET LEVEL EFFECTS

We use two modeling approaches to estimate the impacts of LRP on local market prices. First, a computational model (CM) is used to predict what economic theory has to say about the likely magnitude of LRP effects. The CM is a mathematical representation of supply, demand, and price determination in spatially connected markets based on parameters that use best available knowledge on the size and organization of relevant markets in the study countries. The CM is designed to answer the question: “Based on what we know about how responsive supply and demand are to changing prices, the pattern of observed LRP activity relative to the size of the markets in which purchases are made, and assuming that markets are well-integrated with effective spatial price transmission, what range of regional price impacts would we expect to find from LRP?”

Second, a vector autoregression (VAR) time series model is applied to generate econometric estimates of the impact of LRP on local market prices. The VAR does not make specific assumptions about how the underlying markets are structured and organized, and in this sense is more data-based than the CM approach. Therefore, the VAR approach is fundamentally empirical and answers a different question: “Without making any assumptions about the structure or performance of food markets in the country, what do the data tell us about how LRP affected price levels over a particular historical period?”

We view the two approaches as complementary because they use different information to investigate the same issue. CMs differ from VARs in three main ways. First, CMs are *structural* in the sense that they are based on underlying economic concepts such as supply and demand and their associated parameters, such as elasticities of supply and demand. The CM therefore requires assumptions about the economic structure of the underlying markets, and the quantitative magnitude of key parameters defining that structure. Sometimes the values of key parameters can be found from previous econometric studies, sometimes they can be estimated from observed data, and sometimes they have to be assumed based on knowledge of the underlying countries and markets. VAR models are typically not structural in the same sense as CMs because they are more data based and do not require assumptions about the underlying market structure and values of key structural parameters. Instead, VARs estimate historical correlations between LRP and local market prices and exploit those estimated correlations to make predictions about the path prices would have followed in the absence of LRP.

Second, the CM we use is *static* in that it computes the change from one equilibrium with the LRP to a new equilibrium after LRP has been reduced or eliminated. No attention is given to the path that prices follow from one equilibrium to the other. VAR models, in contrast, explicitly incorporate the dynamic adjustment path of prices to changes in LRP. As a result, the CM provides a single estimate of a *typical* LRP effect in a given situation after all adjustments to the change have occurred while the VAR simulates the full pattern of LRP effects over the selected period of analysis, including any dynamic adjustments to changes in LRP over the sample period. A summary measure of the typical LRP effect can be obtained from the VAR by averaging the period by period price effects over the sample period.

Finally, our CM assumes that all markets are competitive and well-integrated, so estimated LRP effects transmit readily across regional markets. The VAR model makes no such assumptions about market competitiveness and/or market integration, and in this sense is more data-based than the CM.

Technical details of the two modeling approaches can be found in Annexes B and C.

6.1. Expectations Regarding Price Effects from the Case Studies

We concluded in section 3.3.4. that we should expect relatively strong impacts of LRP purchases on maize prices at all levels of the maize supply chain and throughout Uganda. Combined with the large size of typical WFP tenders in Uganda, and the fact that information about these tenders hits the market immediately through emails to all qualified traders, this apparent price transmission suggests that WFP purchases have likely had immediate and meaningful impacts on maize markets in the country. Interviews with traders and others strongly supported this conclusion. Therefore it would appear that the assumptions of well-functioning and well-integrated maize markets, which are embodied in the CM, are appropriate for Uganda suggesting that the CM should provide meaningful results. Finally, the importance of LRP in Uganda, amounting to 14% of estimated marketed surplus on average, also suggests that the size of the LRP price effect should be economically meaningful.

We explained earlier why we expect maize price transmission in Mozambique to be less strong than in Uganda. These reasons included the lack of a dominant price-formation market such as Kisenyi and Busia in Uganda, the historically highly concentrated structure of wholesale maize marketing in Mozambique, and until 2009 when a bridge was built, the separation of the north of the country from the center and south. This last characteristic is captured in our CM, which separates the northern region from the southern and central. The first two factors, which would affect price transmission *within* each region, are not formally modeled in the CM.

These factors suggest several implications for modeling results on the effect of LRP on local maize prices. First, the lack of a single market as a recognized center for price formation may make LRP effects more difficult to capture in modeling. Second, the segmentation of the northern maize market from the central and southern, combined with lack of data on the location of LRP purchases, also makes modeling results less certain. Finally, LRP effects are likely to be more localized for a longer period of time, due to relatively poor information flows.

We noted in Chapter 4 that bean marketing in Ethiopia is relatively well developed, with a long-established system of traders and brokers with strong relationships, in which brokers constantly monitor wholesale markets as well as prices being paid by Kenyan traders. This finding and trader interviews both suggest that WFP purchases of beans should have discernible effects on market prices for beans. This same reasoning and evidence on the trust-based behavior of traders, brokers, and farmers also led us to believe that price transmission to the farm level should be relatively strong for beans in Ethiopia, though with some variation across type of farmer and area.

Like Uganda, then, we expect the CM to provide a good estimate of likely effects of LRP bean purchases in Ethiopia. Our model for Mozambique captures the separation of northern Mozambique from the southern and central, but results still rely on the assumption of effective price transmission within regions, as well as effective price transmission down to the farm level, which may be more questionable in this case. The VAR results can serve as a useful robustness check in this case because the VAR does not require any assumptions about the effectiveness of price transmission. Based on evidence regarding the volume of LRP relative to total marketed surplus in each country, we expect the level of price impact to be substantially larger in Uganda than in the other two countries.

6.2. Computational Model Set-Up and Results

There will always be some uncertainty about the magnitude of key parameters in the CM. Therefore, we first estimate a *base case* using our best estimates of these parameters to generate *preferred* estimates of the impact of LRP. We then use sensitivity analysis to vary these parameters within a range of what we consider to be reasonable values, thus establishing a reasonable range for the impacts of LRP under different market conditions. All results are presented as the average percent decline in prices predicted from eliminating LRP, using a base level of LRP that is consistent with historical LRP purchases in each country.

To implement the CM we break each of the three countries into regions based on their surplus or deficit situation and patterns of trade (see Figures 3 and 4 in Chapter 3 and Figure 20 in Chapter 4). In Uganda the deficit Central Region is dominated by the urban center of Kampala, with Kisenyi as the reference market. Eastern, Northern, and Western Regions all produce a maize surplus. Available data did not allow a meaningful distinction between Western and Northern regions, so we group these two together, giving a total of three regions: deficit Central, surplus Eastern, and surplus Western and Northern.

We also separate Mozambique into three regions: the northern region consisting of Niassa, Cabo Delgado, Nampula, and Zambezia provinces; central including Tete, Manica, and Sofala provinces; and the southern consisting of Inhambane, Gaza, and Maputo provinces. These three regions can be viewed as two market segments: a northern segment, which lies entirely north of the Zambezi River, consists of the northern region alone, and a southern segment consisting of the central and southern regions, south of the Zambezi River. As discussed earlier, prior to August 2009, there was no bridge over the Zambezi River in eastern Mozambique, which isolated northern maize markets from those in the central and southern parts of the country. So to investigate the historical effect of LRP (prior to August 2009) we assume maize markets in the northern region are segmented from markets in the central and southern. Northern Mozambique is modeled as a separate market segment (but integrated with southern Malawi via exports) while the southern and central regions form a separate southern segment with integration between the two regions (but not with the northern segment). This characterization is based on long market observations and market information system data showing regular flows of maize from the production zones in central Mozambique to markets in the southern. As noted in Chapter 3, northern and central regions are maize surplus producing areas, while the southern is deficit.

Note that Mozambique exports and imports maize regularly. Large volumes of maize are imported into Maputo in the southern region by millers from South Africa at the same time that maize flows across the border to southern region in Malawi from northern Mozambique. Hence, we have to account for maize imports in the southern region and maize exports in the northern region.

As noted in Chapter 4, 95% of bean production in Ethiopia takes place in Amhara, Oromia and SNNP. Oromia and SNNP are similar enough from a bean production and marketing viewpoint to be grouped as one aggregate surplus region, which we call Oromia-SNNP region. The other surplus region in our model is Amhara. All remaining administrative regions, dispersed around the country, are deficit producers. We group them as one aggregate deficit region.

As stated previously, the CM requires a set of values for key model parameters. Table 4 presents the base case parameters used for each country, organized nationally and by region as defined above. See Annex B for technical details on why these are the key parameters and an explanation of how the base parameter values were chosen.

CM results on the percentage price reduction from eliminating LRP, assuming the base case parameter values in Table 4, are presented in the left column of Table 5. The base case shares of LRP relative to total marketed surplus (14% for maize in Uganda, 7% for maize in Mozambique, and 3% for beans in Ethiopia) are the historical mean for these shares computed with data between 2001 and 2011.[21] The second and third columns of Table 5 show how sensitive the price effects are if we decrease the LRP shares to their historical lows over the data period (2%, 3%, and 1%, respectively), and increase them to their historical highs (25%, 13%, and 8%, respectively). We find that, at historical mean LRP levels, price impacts in Uganda were about 11% to 12%, between about 4% and 8% in Mozambique, and around 3% in Ethiopia. Impacts fall to about 1% in Uganda, 2% to 3% in Mozambique, and below 1% in Ethiopia when LRP is at its historical low, and rise to about 20% in Uganda, 6% to 13% in Mozambique, and 6% to 8% in Ethiopia with LRP at its historical high. As expected, we find little difference in effects across regions in each country.

We also conducted additional sensitivity analysis on how changing assumptions about supply and demand elasticities influence the estimated LRP price effects (Table 6). For these estimates we assume the share of LRP relative to total marketed surplus remains at its base level (historical average). As expected, the inelastic supply and demand scenario gives the largest impact: about 15% to 16% in Uganda compared to 11% to 12% in the base case, about 5% to 11% in Mozambique compared to 4% to 8% in the base case, and 4% to 5% in Ethiopia compared to about 3% in the base case. The elastic supply and demand scenario gives the lowest estimated impact, consistently 20% to 25% below the base case scenario. The intermediate cases of inelastic (elastic) demand and elastic (inelastic) supply deliver results that are not meaningfully different from the base elasticities.

[21] Due to modeling requirements, the method for computing marketed surplus in this chapter (explained in Annex B) differs from the approach we initially used in selecting study countries (described in Chapter 2). These two approaches thus provide a robustness check for our estimates. In the case of maize in Uganda and Mozambique, the two approaches generated similar results for LRP's share of the market: 14% versus 12.5% in Uganda, and 7% in Mozambique for each approach. For beans in Ethiopia, however, the two approaches generated very different results: 14% versus 3%. As explained in Chapter 2, our interviews in Ethiopia strongly suggested that 14% was a significant over-estimate of the LRP share. VAR analysis (showing small price effects) suggested the same. We believe the 3% figure used in this chapter to be the best estimate of WFP's share of Ethiopia's bean market.

Table 4. Base Case Parameters for the Computational Models: Maize in Uganda and Mozambique, Beans in Ethiopia

Parameter	Country/Region/Parameter value								
	Uganda			Mozambique North	Mozambique South and Central		Ethiopia		
National									
Share of LRP relative to total marketed surplus	0.14			0.04	0.11		0.03		
Share of net exports relative to total marketed surplus	0.15			0.17	-0.79		0.02		
Price elasticity of net export demand	-0.24			-0.24	0.00		-0.24		
	Uganda			Mozambique			Ethiopia		
Regional	Central (Deficit)	Northwest (Surplus)	Eastern (Surplus)	Northern (Surplus)	Central (Surplus)	Southern (Deficit)	Oromia + SNNP (Surplus)	Amhara (Surplus)	All Other Regions (Deficit)
Price elasticity of supply	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6
Price elasticity of demand	-0.8	-0.8	-0.8	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
Ratio of reference region price to prices in other regions	1.00	1.09	1.02	1.00	1.42	1.00	1.13	1.30	1.00
Regional purchases relative to total marketed surplus	0.33	0.27	0.11	0.79	0.72	0.96	0.57	0.36	0.02
Regional sales relative to total marketed surplus	0.36	0.43	0.21	1.00	0.94	0.06	0.57	0.39	0.04

Source: Authors' elaboration using literature review, WFP procurement data, and price data from each country.
Note: Shares of LRP, net exports, and imports in total market supplies are based on historical annual average data from 2001 to 2011. Shares of marketed surplus sold by region relative to total country-wide marketed surplus sum to one. Shares of consumption by region relative to total market supplies, plus share of LRP relative to total market surplus, plus share of net maize exports relative to total market supplies sum to one (see the adding up constraints in Equation (B11) of Annex B).

Table 5. Base Case and Sensitivity Analysis for Estimated Effects of LRP on Price Levels for Maize in Uganda and Mozambique, Beans in Ethiopia

Country and Region	Base Case (Historical mean LRP)[1]	Historical low LRP[2]	Historical high LRP[3]
	------------------ % impact ------------------		
Uganda			
Central	10.7%	1.1%	19.8%
Eastern	10.9%	1.2%	20.1%
Northwestern	11.7%	1.2%	21.6%
National Average	11.1%	1.2%	20.5%
Mozambique			
Northern	3.6%	1.5%	6.4%
Central	7.5%	3.1%	13.2%
Southern	5.3%	2.2%	9.3%
National Average	5.5%	2.2%	9.7%
Ethiopia			
Oromia + SNNP	2.8%	0.5%	6.6%
Amhara	3.2%	0.5%	7.6%
Deficit regions	2.4%	0.4%	5.9%
National Average	2.8%	0.5%	6.7%

Source: Authors' elaboration based on model results.
Notes: [1] 14% Uganda, 7% Mozambique, 3% Ethiopia; [2] 2% Uganda, 3% Mozambique, 1% Ethiopia; [3] 25% Uganda, 13% Mozambique, 8% Ethiopia

Overall, the CM analysis indicates that, under preferred market parameter estimates and average historical LRP levels, price effects on maize in Mozambique and beans in Ethiopia are modest. Under the most extreme cases – inelastic supply and demand and historically high LRP, which are not shown in the tables, effects might approach 10% in Mozambique and Ethiopia. While these are meaningful figures, they are likely to occur only if supply and demand are much more inelastic than we believe, and only then in the few periods when the LRP share of total marketed surplus is at historically high levels. In Uganda, on the other hand, even the base case scenario delivers economically meaningful estimated price changes of 11% to 12%, rising to 20% under the highest observed LRP, and beyond that if we assume that supply and demand are more inelastic than the base case.

Table 6. Sensitivity of LRP Effects to Changes in Supply and Demand Elasticities

Country and region	Scenario: Inelastic Supply and Demand[1]	Inelastic Supply, Elastic Demand	Base Elasticities[3]	Elastic Supply, Inelastic Demand	Elastic Supply and Demand[2]
	----------------------------		% effect		----------------------------
Uganda					
Central Region	14.5%	11.2%	10.7%	10.2%	8.5%
Eastern Region	14.8%	11.4%	10.9%	10.4%	8.6%
Northwestern Region	15.8%	12.2%	11.7%	11.2%	9.3%
National Average	15.0%	11.6%	11.1%	10.6%	8.8%
Mozambique					
Northern Region	5.3%	3.7%	3.6%	3.5%	2.7%
Central Region	11.3%	7.1%	7.5%	8.0%	5.6%
Southern Region	7.9%	5.0%	5.3%	5.6%	4.0%
National Average	8.2%	5.3%	5.5%	5.7%	4.1%
Ethiopia					
Oromia + SNNP	4.1%	2.8%	2.8%	3.3%	2.1%
Amhara	4.7%	3.2%	3.2%	3.8%	2.4%
Deficit regions	3.7%	2.5%	2.4%	2.9%	1.8%
National Average	4.2%	2.8%	2.8%	3.3%	2.1%

Source: Authors' elaboration based on model results.
Notes: [1] Inelastic supply and demand: 0.5 and -0.6 in Uganda; 0.4 and -0.4 in Mozambique and Ethiopia; [2] Elastic supply and demand: 0.9 and -1.0 in Uganda; 0.8 and -0.8 in Mozambique and Ethiopia; [3] Base elasticities: 0.7 and -0.8 in Uganda; 0.6 and -0.6 in Mozambique and Ethiopia.

6.3. VAR Model Set-Up and Results

We estimate VAR models for maize in Uganda and Mozambique and beans in Ethiopia, all with the same basic structure. See Annex C for full details on the model structure, estimation approach, and model validation statistics. In this section we focus on the simulation results from the VAR, presenting: (a) average estimated price effects of removing LRP over the entire VAR sample period; and (b) graphs comparing actual monthly prices (which were influenced by LRP) and simulated prices (which have the LRP effect removed) for each month in the sample.

To facilitate comparison to the computational model results, we first map the markets chosen for the VAR analysis into the regions defined in the CM (see Table 7). Markets for the VAR were chosen based on two criteria: data availability and a desire to represent surplus and deficit regions of each country while remaining parsimonious in the number of prices included. We chose major wholesale markets in surplus and deficit regions for Uganda but in Mozambique and Ethiopia these wholesale price series were too incomplete to be used in the VAR. In these countries we used retail market prices instead because more complete price series were available at this level.

Table 7. Mapping VAR Markets into Regions as Defined in Computational Model

Country and VAR Market	Computational Model Region	Market Level	Surplus or Deficit	Notes
Uganda				
Kampala (Kisenyi market)	Central	Wholesale	Deficit	Dominant wholesale market in country's largest city
Masindi	Northern + Western	Wholesale	Surplus	Major surplus market in northern portion of Western region
Lira	Northern + Western	Wholesale	Surplus	Major market in southern portion of Northern region. Strong links to Eastern
Mozambique				
Maputo	Southern	Retail	Deficit	Country's largest urban center
Nampula	Northern	Retail	Surplus	Largest city in northern region
Chimoio	Central	Retail	Surplus	Primary market in surplus production zone of central region
Ethiopia				
Dire Dawa	Deficit regions	Retail	Deficit	2nd largest city in country. Important center of trade between Addis Ababa and Djibouti
Awassa	Oromia + SNNP	Retail	Surplus	Major market in SNNP region
Dessie	Amhara	Retail	Surplus	One of the major markets in Amhara region

Source: Authors' elaboration.

In Uganda, prices from three local wholesale maize markets are included in the VAR—Kisenyi, Masindi, and Lira. Kisenyi is the main wholesale maize market for the capital city of Kampala, located in the Central region of the country. Large and medium-sized maize traders throughout the country monitor prices in Kisenyi and many of them trade there. Kisenyi is therefore viewed as the largest and most liquid market for price discovery. Masindi and Lira are two important markets in key maize surplus producing regions in Western and Northern Uganda. These two markets are key sources for maize flowing into Kampala and crossing the border into Kenya and South Sudan. Other market prices such as for Mbale and Kapchorwa could have been included, but lack of data precluded this. Therefore, we included three regional market prices in the VAR, but do not expect results to be sensitive to the inclusion or exclusion of additional regional price variables because of effective regional maize price transmission.

The markets used in Mozambique VAR are all the dominant markets in their respective region. Lack of complete wholesale market series, however, required that we use retail prices in the estimation. In central Mozambique, Beira is a larger city than Chimoio but is in a deficit portion of the surplus region. Chimoio is in the center of the surplus area and has historically been an important market, so we use Chimoio prices in the VAR.

Ethiopia's bean surplus regions are concentrated in the central highlands – large areas of Amhara, Oromia, and SNNP. We chose two markets to represent this area: Dessie in Amhara and Awassa in SNNP near Oromia. We don't include Addis Ababa because it cannot be clearly classified as either deficit or surplus in beans – the city is located in a major bean producing area yet is itself a major net consumer of beans. Dessie is one of the main bean surplus markets north of Addis Ababa while Awassa is the key bean surplus market in the south. Both these markets are important transshipment points for beans going to deficit areas, which are spread around the periphery of the country. While no single market will capture all these areas, we choose Dire Dawa, since it is second only to Addis Ababa in population and thus the most important market in the various deficit zones.

Technical details on the structure of the VAR, model estimation and validation, and the procedure for simulating a counterfactual price series in the absence of LRP, are provided in Annex C. Estimated average price level effects over the historical sample period – the average percentage reduction in prices from eliminating LRP – are reported in the first three columns of Table 8. Unlike in the CM, the VAR price impacts are statistical estimates subject to sampling error. Therefore we also computed 90% confidence intervals for the average price effects using procedures outlined in Annex C. The lower and upper bounds reported in the table are the lower and upper bounds for these 90% confidence intervals, while the mean column provides the preferred estimate using actual estimated parameter values.

Results for average price effects are broadly consistent with, though somewhat higher, than results from the CM (see the second column of Table 5, page 53). In Uganda the VAR estimates mean average price impacts ranging from about 13% in Kisenyi (deficit) to 16% in Lira (surplus). These results compare to a base case range of 11% to 12% from the CM and are consistent with our inelastic supply and demand scenario under historical average LRP in that model (see Table 6). Furthermore, the upper and lower bounds for the 90% confidence interval suggests that average price impacts of LRP are statistically different from zero and encompass the CM results under preferred elasticity estimates and average historical LRP shares of marketed surplus (i.e., the base case in Table 5).

Table 8. Estimated LRP Effects on Price Levels and Variability, VAR Model

	Average Price level effects			Price variability effects		
Market	Lower bound	Mean	Upper bound	Lower bound	Mean	Upper bound
Uganda						
Kisenyi	8.9%	13.4%	14.7%	-3.0%	1.3%	3.5%
Masindi	9.4%	14.0%	15.2%	-3.3%	0.8%	3.0%
Lira	11.0%	15.5%	16.9%	-5.7%	-1.3%	0.8%
Mozambique						
Maputo	3.4%	6.9%	9.9%	-3.8%	0.2%	1.9%
Chimoio	2.1%	5.5%	8.7%	-4.3%	-0.4%	1.3%
Nampula	-1.1%	2.2%	5.5%	-2.1%	2.0%	3.9%
Ethiopia						
Dire Dawa	1.9%	4.7%	5.6%	-5.2%	-0.9%	1.2%
Awassa	2.5%	5.2%	6.2%	-5.9%	-1.5%	0.7%
Dessie	1.0%	3.9%	4.9%	-4.8%	-0.6%	1.7%

Source: Authors' elaboration based on model results.
Notes: Price variability is measured by the coefficient of variation. Mean refers to percentage difference between historical (with LRP) and simulated (without LRP) prices. Lower and upper bounds refers, respectively, to lower and upper of bootstrapped 90% confidence interval (percentile-t) with 1,200 replications.

Mean estimated average price effects for Mozambique show larger effects in deficit Maputo and surplus Chimoio markets than in surplus Nampula. Upper and lower bounds for the 90% confidence intervals show that average prices effects are statistically different from zero for Maputo and Chimoio, but not for Nampula. Furthermore, as in the Uganda case, CM results under preferred elasticity estimates and historical average LRP share of marketed surplus lie within the 90% confidence interval from the VAR results (see Tables 5 and 8).

The relatively high effect in Maputo may appear surprising because no LRP purchases are made in that area of the country. But this finding is consistent with the fact that Maputo (and southern Mozambique in general) is a relatively small market for Mozambican maize grain. Most maize consumption in the southern region is from refined maize meal produced overwhelmingly with imported grain from South Africa. As a result, any reduction of marketable supplies in central Mozambique, which serves informal markets in the southern region, is expected to have a meaningful effect on the informal market prices for locally produced maize in Maputo. We believe, however, that this effect will have limited influence on the price of the refined maize meal produced with imported grain, given the much larger size of this latter market.

As a partial check on this assertion, we used SIMA retail data to compute correlation coefficients between retail maize grain across three markets in the southern region (Maputo, Maxixe, and Xai-Xai), refined maize meal across the same markets, and between maize grain and refined maize meal *within* each of these markets. Correlations for maize grain across spatially separated markets ranged from 0.74 to 0.80, while those for maize meal across the same markets ranged from 0.54 to 0.58. In contrast, correlations between grain and meal prices, even *within* the same markets, were lower, ranging from 0.35 to 0.46. We conclude that the impact of LRP on maize grain prices in Maputo is likely to have some, but limited effect on the maize meal that most consumers eat.

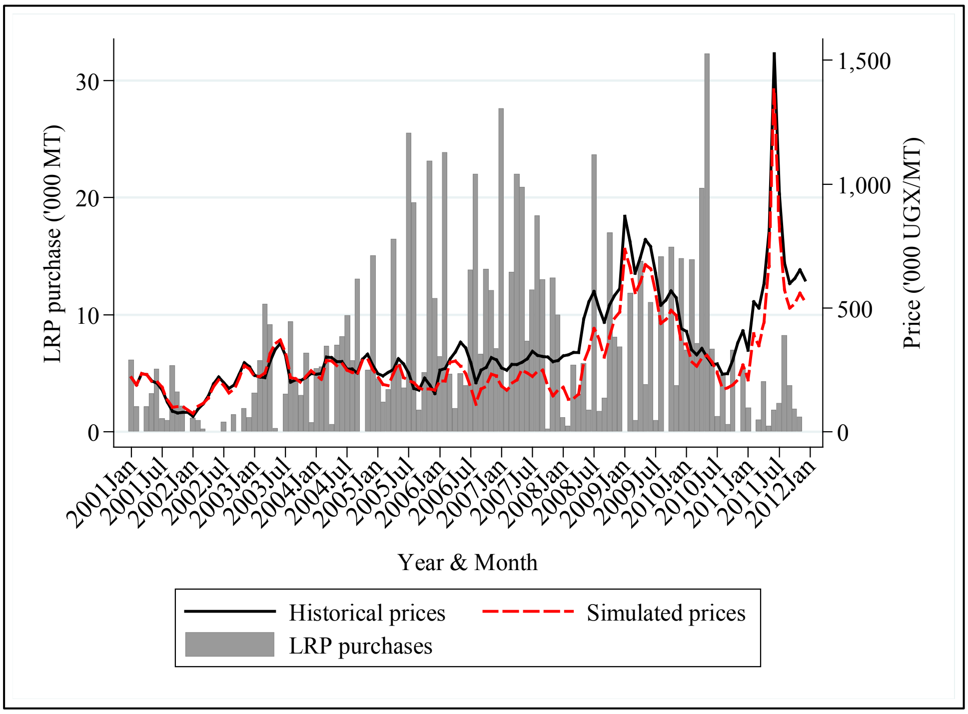
VAR mean average price effects for Ethiopia show slightly higher impacts than in the CM. Yet the estimated effects remain quite small, as expected, though statistically different form zero given that the 90% confidence interval does not contain zero. Like Uganda, there is no clear pattern between surplus and deficit areas. And like both Uganda and Mozambique, the 90% confidence interval for the average price effects encompass the CM estimate under preferred elasticities and historical average LRP share of marketed surplus. Results for average price effects from the CM and VAR are therefore quite consistent.

The last three columns of Table 8 contain estimates of LRP impacts on the coefficient of variation (CV) of prices over the sample period, which is a measure of price variability. The upper and lower bound estimates again show bounds for 90% confidence intervals for the CV computed using procedures outlined in Annex C. The results suggest that LRP has had no systematic or statistically significant effect on price variability in any country Table 8).

Figures 31 through 33 graph actual and simulated (no LRP) prices, along with associated LRP levels, for different markets over the sample period. Graphs for all markets in any country are quite similar so we only present one market for each country. A common pattern in each graph is that LRP shows little impact on markets for several months, then the effects become increasingly apparent.

The no LRP prices are simulated by setting LRP to zero starting in the first month of the simulation period and keeping it at zero throughout the remainder of the simulation. Prior to the first month in the simulation period, however, LRP is assumed to have been at its historical level in the data. Therefore, the simulated effects of eliminating LRP start out small (historical and simulated prices remain relatively close) as markets adjust to the elimination of LRP. Then over a period of months as the markets adjust, and no additional LRP is forthcoming, the magnitude of price effects generally rises.

Figure 31. Historical (with LRP) and Simulated (without LRP) Prices of Maize in Kisenyi Market, Uganda, 2001-2011



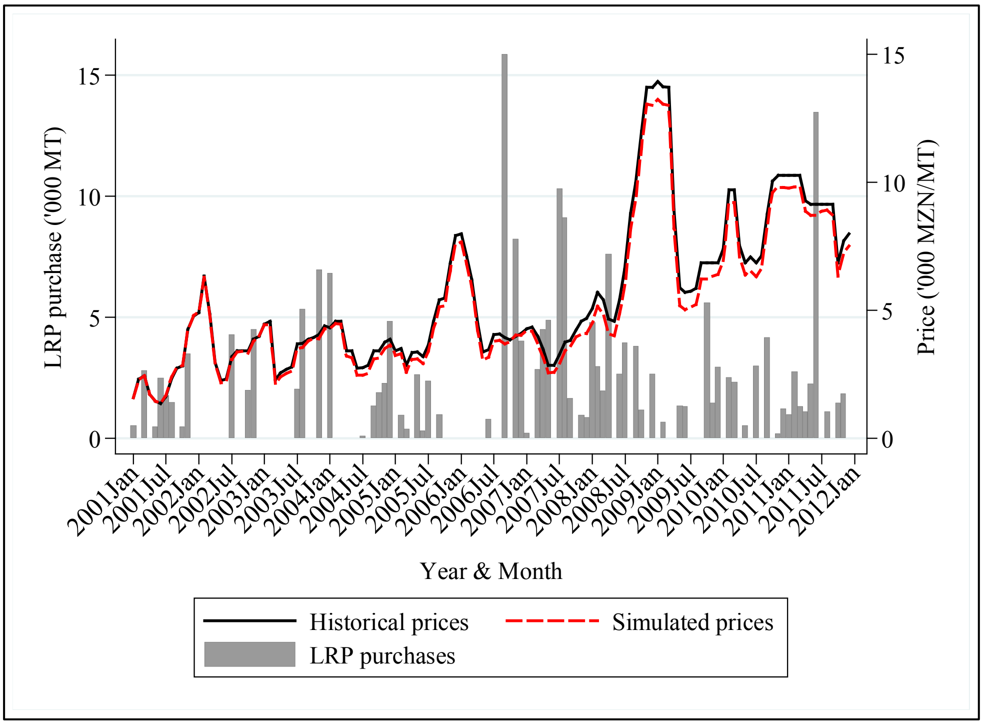
Source: Authors' elaboration using procurement data and price data from FEWSNET/Uganda.

We would expect that the magnitude of the price effects in any given month depend on the amount of recent LRP activity that took place, and results do reflect this general pattern. However, a one-to-one correspondence between higher LRP in any particular month and a larger price effect for that month should not necessarily be expected for two main reasons.

First, the VAR simulation allows prices to adjust dynamically over time in response to a change in LRP. In other words, when LRP is reduced there might be an immediate partial response but prices will continue adjusting to the change over several subsequent months. Therefore, the price effect in any one month is due not only to the elimination of LRP in that month but also to the fact that LRP was eliminated in all previous months as well.

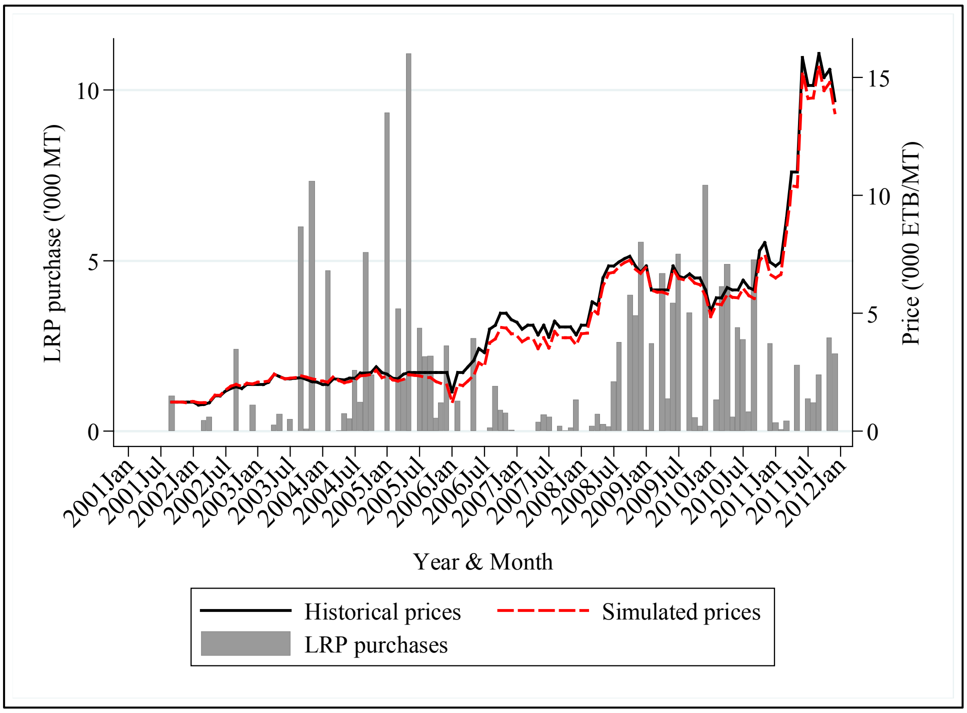
Second, the simulated no LRP prices reflect the effect of eliminating LRP assuming all other factors influencing prices continue to play the same role as they did historically. So some of the price effects occur in months in which underlying market conditions are quite different than in others. For example, for months in which domestic supplies are tight, say due to recent poor growing conditions, the effect of a given amount of recent LRP activity may have quite a different price effect than for months in which domestic supplies are plentiful.

Figure 32. Historical (with LRP) and Simulated (without LRP) Prices of Maize in Chimoio Market, Mozambique, 2001-2011



Source: Authors' elaboration using procurement data and price data from SIMA/Mozambique.

Figure 33. Historical (with LRP) and Simulated (without LRP) Prices of Horse Beans in Awasa Market, Ethiopia, 2001-2011



Source: Authors' elaboration using procurement data and price data from FEWSNET/Ethiopia.

Together, these two factors make it difficult to sort out the exact reasons why a given price effect is estimated for any one month, because there may be many factors (recent history of LRP activity, current market conditions, etc.) that go into explaining it. Nevertheless, the price effect graphs do provide a summary picture of the estimated net effects that eliminating past LRP would have had over the simulation period, given the path of underlying market conditions observed over the period.

Overall, the VAR analysis is quite consistent with the CM results and indicates modest LRP price effects for maize in Mozambique and beans in Ethiopia, but more economically meaningful effects on maize prices in Uganda. The 90% confidence intervals for the VAR average price effects encompass the CM results in all cases and, in all cases except the maize price effect in Nampula market (Mozambique), show that the price effect is statistically significant. There is no statistically significant effect on price variability in any of the estimated VARs.

7. HOUSEHOLD WELFARE EFFECTS

When LRP raises local market prices there will be a corresponding effect on the welfare of households that buy and/or sell commodities purchased under LRP. In this chapter we take the market level LRP price impacts estimated in the previous chapter and convert them into estimates of the resulting change in household welfare across a range of different household types. We do this using household level data so that we get estimates of how household welfare effects differ across region, across household market position (whether a household is a net seller or net buyer of the commodity), and across households with different income levels. Results provide information on how the welfare effects of LRP-induced price changes are distributed throughout the population of households in each study country.

The household welfare measure we estimate is the household's willingness to accept compensation for the price increase. More formally, we estimate proportional compensating variation, which is the percentage reduction in a household's income that would have to be made after the price increase to make them as well off as they were before the increase. If the compensating *reduction* in income is positive (income has to be taken away to make the household as well off as before) then the price increase must have improved the household's welfare. Similarly, if the compensating *reduction* in income is negative (income has to be provided to make the household as well off as before) then the price increase must have reduced the household's welfare. Hence, positive values of our welfare measure indicate a household's welfare was improved by the price increase and negative values indicate welfare was reduced. Proportional rather than actual compensating variation is used (i.e., the compensating payment is expressed as a proportion of base income) because this gives a more intuitive measure of *relative* welfare change that is not sensitive to the currency used to measure income and prices. Intuitively, positive values of the welfare measure can be interpreted as the maximum amount (as a proportion of income) the household is willing to pay for the positive effects of the price change, while negative values can be interpreted as the minimum amount (as a proportion of income) that the household would require to be compensated for the negative effects of the price increase. A less formal way of thinking about the welfare measure is as the proportional change in household real income brought about by the price change.

Full technical details of the welfare measure and our approach to calculating it across samples of households are provided in Annex D. Here we just highlight some key features of the approach. First, to compute the welfare effects we assume that LRP increases local market prices for LRP commodities but has no effect on wage rates or the local market prices of other commodities. In this sense our measure is partial equilibrium. However, the additional general equilibrium effects (which would take possible changes in wage rates and other commodity prices into account) are likely to be small in this application because there is limited substitution between major food staples and other commodities, and because wage rates are determined by many other factors besides the prices of a single staple food. So the partial equilibrium welfare measure should give a good approximation to the total welfare effect of the price increase.[22]

[22] Findings from Ivanic and Martin (2008) support this assertion. These authors estimated the impact of soaring global food prices on poverty in nine low-income countries using household-level data and found that a 10% increase in maize prices resulted, on average, in a 0.1 percentage points increase in poverty – in both rural and urban areas – with and without the induced wage impact on unskilled labor. In each of the nine low-income countries, there is no change in the magnitude or the sign of the estimated effects of the higher maize price on poverty when the induced wage impacts are accounted for.

Second, our welfare measure allows for the fact that households consume own-produced food by including the value of own consumption and own production in the calculation of expenditure and income shares. It is important to account for consumption of own-produced food because this is an important activity among many of the households in the study countries.

Third, our measure focuses on the effects of a price increase and takes no account of the welfare effects of changes in price variability or risk. It has been shown that changes in price variability and risk can have significant welfare effects (e.g., Bellemare, Barrett, and Just 2013; and Barrett and Dorosh 1996). However, results from the VAR analysis earlier in the report showed that LRP had no statistically significant effect on maize price variability in our study countries, and therefore presumably no significant effect on price risk. Therefore, we can appropriately focus on price level effects and assume any additional welfare change due to a change in price variability or risk is negligible.

Fourth, our welfare measure takes account of *second-order effects* whereby households may change their production and consumption decisions in response to the LRP-induced price change. As detailed in Annex D, we accomplish this by making an assumption about how responsive production and consumption decisions are to the price increase (i.e., about the magnitude of supply and demand elasticities). Many existing studies of household welfare effects of price changes assume no production or consumption response to the price change (i.e., they estimate *first-order effects* only) but including the second-order effects should lead to better estimates, especially if production and consumption respond significantly to changes in price.

7.1. Household Data Sets and Expectations Regarding Household Welfare Effects

Estimation of the effects of LRP-induced price changes on household welfare focuses on maize in Uganda and Mozambique. For Ethiopia there is no nationally representative household survey data suitable for implementing the required welfare analysis. Therefore, data limitations prevented us from assessing the impacts of LRP purchases of beans on household welfare in Ethiopia.

The most critical determinants of the welfare effects of a maize price increase are the share of total household income that comes from maize and the share of total expenditures devoted to maize. For Uganda and Mozambique, these shares are estimated from nationally representative household-level data from the Uganda National Panel Survey (UNPS) 2009/2010 conducted by the Uganda National Bureau of Statistics (UBOS) and the Household Budget Survey (IOF) 2008/09 administered by the Mozambique National Institute of Statistics (INE). Annex D describes how estimates of these income and expenditure shares are computed.

Other data required to estimate the welfare change includes: (1) the magnitude of the LRP-induced price effect; (2) elasticities of household supply and demand for maize; and (3) a measure of the household's risk aversion.[23] The measure of risk aversion used is relative risk aversion, which is a measure of the household's aversion to risk relative to the size of the investment they are undertaking.

[23] The role played by these factors is shown in the technical details in Annex D.

The first of these requirements, the size of the LRP-induced price effects, was estimated in the previous chapter and these same estimates are used here to calculate welfare effects. We assume the market level price effects of LRP transmit fully to changes in prices at the household level (the percentage increase in household prices is the same as the percentage increase in market prices). This assumption fits well for maize in Uganda where evidence suggests excellent price transmission from markets to farmers. There is more uncertainty about price transmission from markets to farmers in Mozambique, particularly in the earlier years of our analysis. However, we also do sensitivity analysis on the size of the price effect to illustrate how welfare effects may differ if household prices increase by smaller or larger proportions. The approach for selecting relevant supply and demand elasticities, and the degree of relative risk aversion, are outlined in detail in Annex D.

Because households are heterogeneous, different types of households may experience the welfare effects of increased maize prices very differently. In particular, a key determinant of whether a household is better off or worse off with the price increase is whether the household is autarkic, a net seller, or a net buyer of maize. Autarkic households experience no welfare change because the price increase does not change their situation or behavior. Net selling households will benefit from the price increase because their net sales now occur at a higher price. Net buying households will be hurt by the price increase because they now have to pay a higher price for net maize purchases. Higher income households might also be affected differently than low income households because they have different levels of income from and expenditure on maize, and because their base levels of income for computing proportional welfare effects are different. It is also expected that the household welfare impacts of a given percentage maize price increase will be greater in Mozambique than in Uganda because rural households in Mozambique rely more on maize for income and consumers (rural and urban) rely more on it for consumption, compared to Uganda.

Table 9 shows the distribution of households in each country data set broken down by regional location and maize marketing position. Northern Mozambique has the highest proportion of total households in the Mozambique sample (54%) while Northwest Uganda has the highest proportion of households in the Uganda sample (47%).

Table 9. Distribution of Households by Region and Maize Marketing Position in Mozambique and Uganda

		Maize marketing position (%)				
Region	Percentage of households	Autarky	Buy only	Buy and sell (net buyer)	Sell only	Sell and buy (net seller)
Mozambique						
Northern	53.7%	19.7%	21.3%	31.9%	12.5%	14.6%
Central	22.8%	16.6%	8.6%	44.9%	16.7%	13.2%
Southern	23.5%	39.7%	16.3%	17.1%	20.7%	6.2%
National	100.0%	23.7%	17.2%	31.4%	15.4%	12.3%
Uganda						
Eastern	32.8%	22.8%	35.9%	14.9%	10.3%	16.1%
Central	21.2%	17.1%	12.4%	34.8%	18.3%	17.5%
Northwest	46.0%	26.3%	21.7%	16.7%	24.8%	10.4%
National	100.0%	23.2%	24.4%	20.0%	18.6%	13.8%

Source: Author calculations based on IOF 2008 for Mozambique and UNPS 2009 for Uganda.

At the national level in both Mozambique and Uganda about 24% of households are autarkic, implying that LRP-induced maize price increases will have no impacts on the welfare of about one fourth of households in both countries. However, the proportion of autarkic households does vary across regions, ranging from about 17% in central Mozambique to 40% in southern Mozambique. There are also significant proportions of households in each region that are either sellers or net sellers (expected to gain from the price increase), and either buyers or net buyers (expected to lose). The regions with the largest proportion of households that only buy or are net buyers are central Mozambique (54%) and Eastern Uganda (51%). Central Mozambique and Central Uganda are the regions with the largest proportion of households that only sell or are net sellers (30% and 36%, respectively).

Because welfare effects depend critically on maize income and expenditure shares, we report mean shares across households for the national population, by region, by maize market position, by income tercile, and for urban and rural households (see Table 10).[24] A number of insights from the table stand out.

Table 10. Income and Expenditures Shares for Maize in Mozambique and Uganda

	Average maize income shares		Average maize expenditure shares	
	Mozambique 2008	Uganda 2009	Mozambique 2008	Uganda 2009
Region				
Eastern (Uganda), Central (Mozambique)	23.05%	6.48%	28.37%	9.65%
Central (Uganda), North (Mozambique)	10.94%	5.20%	14.59%	5.70%
Northwest (Uganda), South (Mozambique)	5.33%	4.20%	5.41%	4.02%
National	12.38%	5.01%	15.58%	5.76%
Maize market position				
Autarky	0.00%	0.00%	0.00%	0.00%
Buy only	0.00%	0.00%	12.53%	8.69%
Buy and sell (net buyer)	13.37%	4.47%	34.39%	14.80%
Sell only	21.21%	11.06%	0.00%	0.00%
Sell and buy (net seller)	39.92%	14.93%	21.32%	4.98%
Income category: national				
Lowest tercile	13.38%	6.88%	12.30%	10.98%
Middle tercile	12.31%	4.93%	19.20%	4.86%
Highest tercile	11.06%	3.37%	15.61%	1.77%
Income category: urban				
Lowest tercile	6.23%	1.23%	10.18%	11.75%
Middle tercile	5.48%	1.00%	11.52%	3.56%
Highest tercile	3.14%	1.10%	5.25%	0.83%
Total	4.71%	1.10%	8.55%	4.03%
Income category: rural				
Lowest tercile	15.20%	7.64%	12.84%	10.88%
Middle tercile	14.78%	5.58%	21.97%	5.08%
Highest tercile	17.50%	4.11%	24.03%	2.08%
Total	15.53%	5.82%	18.46%	6.12%

Source: Author calculations based on IOF 2008 for Mozambique and UNPS 2009 for Uganda.

[24] Income terciles are the sub-population of households that contain the lowest one third, middle one third, and highest one third income ranking.

First, maize accounts for, on average over the national sample, a much higher proportion of household income and expenditure in Mozambique than in Uganda (12% versus 5% for income share, 16% versus 6% for expenditure share). Relative to other regions, Central Mozambique and Eastern Uganda are the most dependent on maize in their respective countries. The average income share of maize ranges from 23% in Central Mozambique to 5% in the Southern, and from 6% in Eastern Uganda to 4% in the Northwest. Expenditure shares range from 28% in Central Mozambique to 5% in the Southern, and from 10% in Eastern Uganda to 4% in the Northwest. The heavier reliance on maize as a food staple in Mozambique means that, for a given percentage price increase and market position, we should expect welfare effects to be larger in Mozambique than in Uganda.

Second, for both Mozambique and Uganda average income and expenditure shares across the national sample are similar, but expenditure shares are slightly higher than income shares (16% expenditure versus 12% income for Mozambique and 6% expenditure versus 5% income for Uganda). This suggests that average welfare effects across the sample should be close to zero but slightly negative in both countries.

Third, households that only buy maize, or are net buyers, have the smallest maize income shares and highest maize expenditure shares, while those that only sell or are net sellers have the highest maize income shares and lowest maize expenditure shares. This pattern holds across both countries and is important because the greater the difference between income and expenditure shares the greater and more positive the welfare effects of a price increase will be. Hence, the pattern indicates that buyers and net buyers are more likely to lose from a price increase and sellers and net sellers are more likely to gain.

Fourth, in Uganda, maize income and expenditure shares are on average highest for low income households and lowest for high income households (see Table 10). Maize expenditure shares in Uganda average 11% for the poorest one third of households but only around 1% for the richest one third. Similarly, income shares average 7% for the poorest one third but only 3% for the richest one third. This pattern repeats when households are separated into urban and rural, though the actual size of the income shares for maize are much higher in rural than urban areas. In Mozambique, low income urban households also have higher maize income and expenditure shares than high income urban households. For rural households, however, income shares show no discernible pattern across different income terciles, while maize expenditure shares rise as income increases. This is likely due the differing mix of staple foods found in rural and urban areas of Mozambique. Cassava is widely produced in rural areas and is cheaper than maize, rice is not widely produced, and wheat not at all. In contrast, while cassava can be found in urban areas it is not nearly as commonly available as maize meal. Imported rice, bread made from imported wheat, and other staples are also far more readily available in urban areas than in rural areas. As a result, maize becomes the preferred staple as incomes rise in rural areas and households move away from cassava, while it becomes the least preferred staple in urban areas because households have access to the rice, bread, and other staples which displace coarse grains as incomes rise.

Fifth, urban households have maize expenditure shares that are on average higher relative to maize income shares than rural households. This pattern is to be expected, holds across both countries, and suggests that negative welfare effects of a maize price increase are likely, on average, to fall more heavily on urban households than rural households.

7.2. Welfare Estimation Set-Up and Results

In addition to income and expenditure shares, estimation of household welfare effects of a maize price increase also requires estimates of supply and demand elasticities and a measure of relative risk aversion. Supply and demand elasticities are assumed to be the same across all households in each country, using the same base elasticity values used in the CM (see Annex B). Income elasticities of maize demand were also assumed to be the same across all households and set at 0.4 for both Mozambique and Uganda. Finally, household relative risk aversion was assumed to be the same across all households and set at 1.0. Detailed explanations and support for these assumptions can be found in Annex D. However, sensitivity analysis revealed that estimated welfare effects change very little under a wide range of alternative assumptions about supply elasticities, demand elasticities and household risk aversion, so results are not sensitive to these assumptions.

Estimates of LRP-induced maize price increases vary slightly by region throughout each country (see the market modeling section of this report). Hence, when computing the welfare effects we also allow the price change to vary across regions. We use the estimated LRP-induced price increase from the CM as our base case to compute household welfare effects. This amounts to a 10.7% increase for Central Uganda; 10.9% for Eastern Uganda; 11.7% for Northwestern Uganda; 5.3% for Southern Mozambique; 7.5% for Central Mozambique; and 5.3% for Northern Mozambique. However, we also do sensitivity analysis to investigate the welfare effects of larger price increases (consistent with historically high levels of LRP) and smaller price increases (consistent with historically low levels of LRP). [25]

Summary statistics (mean, median, minimum, and maximum values across all households) for estimated welfare effects are shown in Table 11 for each country (nationally representative sample) and by region. The top panel shows estimates for the effect of a price change corresponding to the historical mean level of LRP in each country between 2001 and 2011. The middle and bottom panels then show how sensitive the welfare effects are to changes in the size of the price increase (corresponding to historically high and low levels of LRP). Results show that a maize price increase corresponding to historical mean LRP results, on average across all households, in a 0.18% and 0.12% loss in household welfare in Mozambique and Uganda, respectively. The average welfare loss drops to 0.07% in Mozambique and 0.01% in Uganda for a lower price increase, and increases to 0.34% in Mozambique and 0.28% in Uganda for a high price increase. All of these average household proportional welfare effects are quite small.

Even though the mean LRP-induced price increase is estimated to be larger in Uganda than Mozambique (about 11% compare to 6%) the average household welfare loss is slightly higher in Mozambique than Uganda. This occurs because maize is a more dominant food staple in Mozambique while Ugandan diets and production possibilities are more diverse. This means Mozambique households generally have higher maize expenditure shares than Ugandan households which results in higher welfare effects for a given proportional price increase.

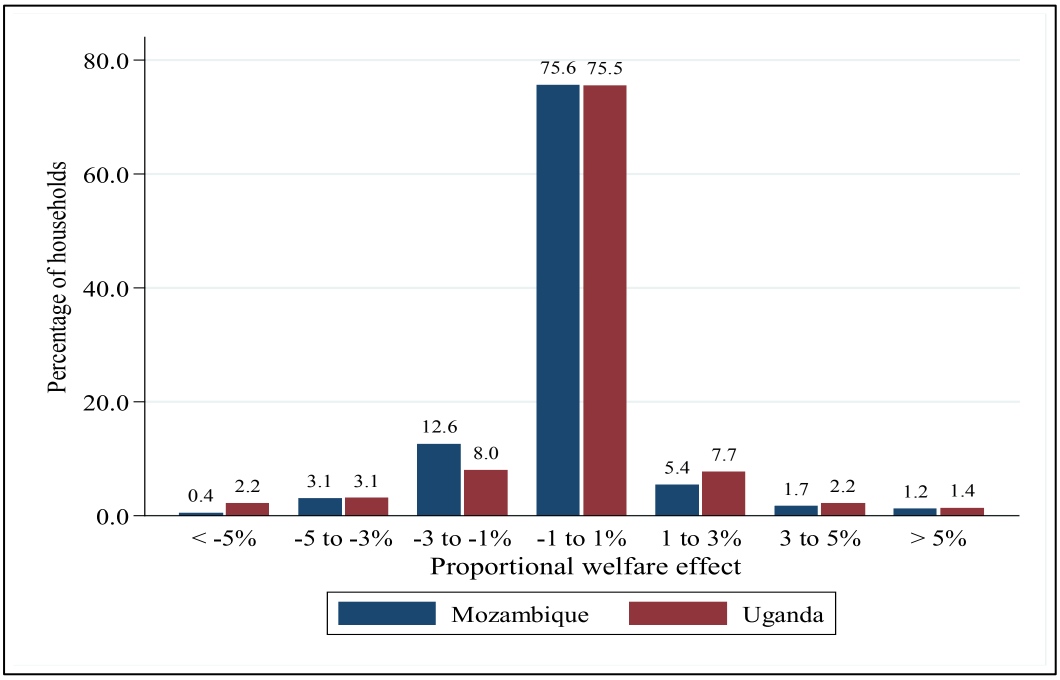
[25] Another option would have been to use the VAR mean estimates as the base and the 90% confidence intervals for the mean VAR estimates for sensitivity analysis. However, the mean estimated price effects from the VAR are similar to the CM base results so base welfare change estimates would be little different under the two methods for estimating the price change. Furthermore, the upper and lower bounds for the estimated CM price effects (under historical high and low LRP) encompass a wider range for the price effects than the 90% confidence interval from the VAR. Therefore, using the CM model price effect estimates to operationalize the welfare calculations allowed for a greater range of sensitivity analysis.

Table 11. Estimated Welfare Effects of LRP-induced Maize Price Increases for Mozambique and Uganda

	Mozambique (2008)				Uganda (2009)			
Region	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum
	--------------------- % effect ------------------							
	Historical Mean LRP							
Eastern (Uganda), Central (Mozambique)	-0.45%	-0.39%	-6.71%	7.61%	-0.40%	0.00%	-10.27%	7.71%
Central (Uganda), North (Mozambique)	-0.14%	-0.06%	-3.21%	3.63%	-0.09%	0.00%	-9.00%	10.80%
Northwest (Uganda), South (Mozambique)	-0.01%	0.00%	-3.75%	5.36%	-0.01%	0.00%	-9.62%	10.74%
National	-0.18%	0.00%	-6.71%	7.61%	-0.12%	0.00%	-10.27%	10.80%
	Historical High LRP							
Eastern (Uganda), Central (Mozambique)	-0.86%	-0.72%	-11.84%	13.55%	-0.83%	0.00%	-19.19%	14.22%
Central (Uganda), North (Mozambique)	-0.26%	-0.10%	-5.72%	6.48%	-0.22%	-0.01%	-16.87%	20.24%
Northwest (Uganda), South (Mozambique)	-0.03%	0.00%	-6.62%	9.47%	-0.07%	0.00%	-18.04%	20.02%
National	-0.34%	0.00%	-11.84%	13.55%	-0.28%	0.00%	-19.19%	20.24%
	Historical Low LRP							
Eastern (Uganda), Central (Mozambique)	-0.17%	-0.15%	-2.77%	3.12%	-0.04%	0.00%	-1.12%	0.85%
Central (Uganda), North (Mozambique)	-0.06%	-0.02%	-1.34%	1.50%	-0.01%	0.00%	-0.91%	1.09%
Northwest (Uganda), South (Mozambique)	0.00%	0.00%	-1.55%	2.21%	0.00%	0.00%	-0.97%	1.09%
National	-0.07%	0.00%	-2.77%	3.12%	-0.01%	0.00%	-1.12%	1.09%

Source: Author calculations based on IOF 2008 for Mozambique and UNPS 2009 for Uganda.

Figure 34. Distribution of Household Welfare Effects of LRP-induced Maize Price Increases for Mozambique and Uganda



Source: Authors' elaboration based on model results.

The distribution of average welfare effects across regions follows patterns that are consistent with the pattern of income and expenditure shares reported in Table 10 In particular, average welfare effects are more negative in regions with lower average maize income shares and higher average expenditure shares. At the national level, median welfare effects are zero in both countries, indicating that half the households lose from the price increase and half gain. Regional results show some variation in medians but they are close to zero in all regions.

Although the mean and median welfare effects in Table 11 are small, maximum and minimum values show quite a large range in estimated welfare effects across different households. A clearer picture of the distribution of effects across the sample emerges from a graph of the frequency distributions of the welfare effects for each country under base level price increases (see Figure 34.). We see that the majority of households (around 76% for both Mozambique and Uganda) are little affected by the maize price increase (gain or loss of less than 1%). However, there are a significant number of households that experience moderate welfare gains and losses (5% of households in Mozambique and 8% in Uganda experience gains of 1% to 3% while 13% in Mozambique and 8% in Uganda experience losses of that magnitude). There are also a very small proportion of households that experience major welfare gains or losses (greater than 5%). The large gainers are households that have very high maize income shares and low expenditure shares while the large losers are households with very high maize expenditure shares and low income shares.

Additional insight into who gains and loses is provided in Table 12, which shows average welfare effects broken down by household maize marketing position, income ranking, and rural/urban location. Effects in the table are estimated using base LRP-induced price increases for each country. As expected, autarky households are not affected by the price increase and buyer and net buyer households are hurt the most while seller and net seller households benefit the most.

Table 12. Estimated LRP Household Welfare Effects by Maize Marketing Position, Income Ranking, and Rural/urban Location for Mozambique and Uganda

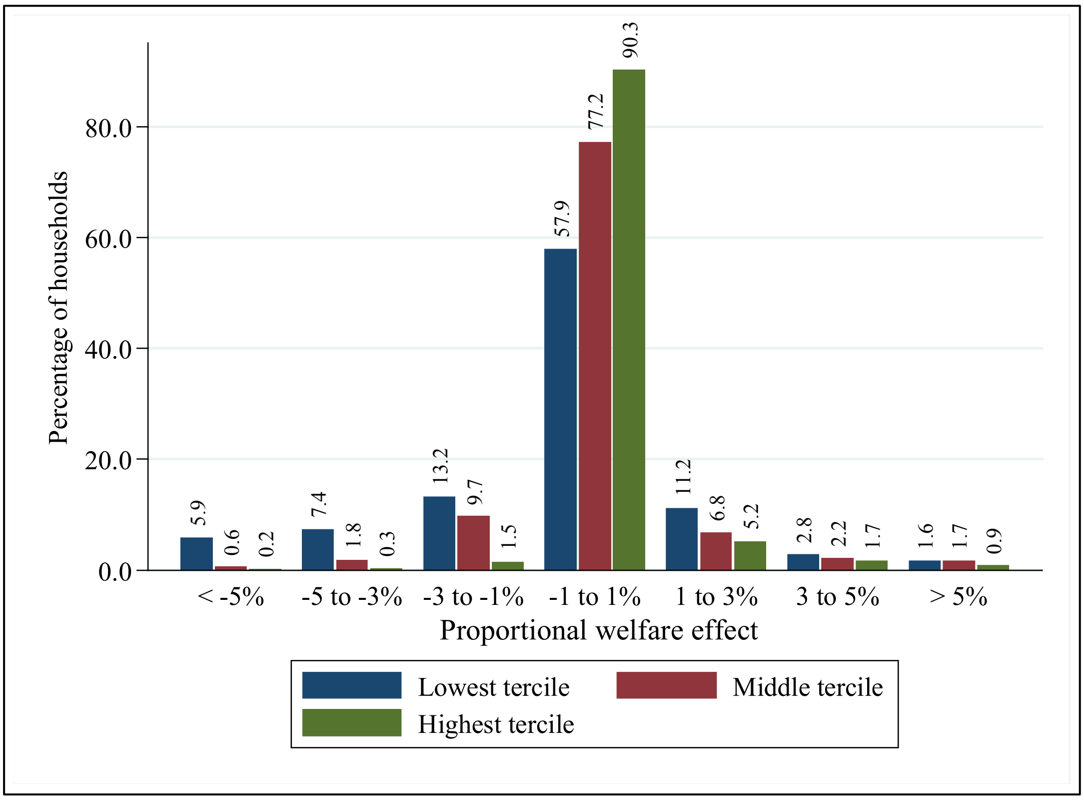
	Mozambique (2008)				Uganda (2009)			
	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum
	--------------------- % effect ------------------							
Maize Market Position								
Autarky	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Buy only	-0.57%	-0.34%	-6.38%	0.00%	-1.01%	-0.36%	-10.23%	0.00%
Buy and sell (net buyer)	-1.21%	-0.81%	-6.71%	0.00%	-1.22%	-0.57%	-10.27%	4.77%
Sell only	1.21%	0.38%	0.00%	7.61%	1.22%	0.50%	0.00%	10.61%
Sell and buy (net seller)	0.91%	0.41%	-0.11%	7.42%	1.03%	0.61%	-0.31%	10.80%
Income Category: National								
Lowest tercile	0.13%	0.00%	-5.27%	7.61%	-0.51%	0.00%	-10.27%	7.94%
Middle tercile	-0.41%	-0.12%	-6.38%	7.61%	-0.03%	0.00%	-7.00%	10.74%
Highest tercile	-0.33%	0.00%	-6.71%	6.72%	0.16%	0.00%	-7.60%	10.80%
Income Category: Urban								
Lowest tercile	-0.16%	0.00%	-4.91%	7.61%	-1.21%	-0.16%	-10.23%	2.16%
Middle tercile	-0.33%	-0.04%	-5.42%	7.42%	-0.30%	-0.21%	-7.00%	2.75%
Highest tercile	-0.13%	0.00%	-4.97%	5.93%	0.02%	-0.01%	-1.44%	5.57%
Total	-0.20%	0.00%	-5.42%	7.61%	-0.34%	-0.04%	-10.23%	5.57%
Income Category: Rural								
Lowest tercile	0.21%	0.00%	-5.27%	7.61%	-0.42%	0.00%	-10.27%	7.94%
Middle tercile	-0.44%	-0.15%	-6.38%	7.61%	0.02%	0.00%	-6.31%	10.74%
Highest tercile	-0.50%	-0.12%	-6.71%	6.72%	0.21%	0.00%	-7.60%	10.80%
Total	-0.17%	-0.02%	-6.71%	7.61%	-0.07%	0.00%	-10.27%	10.80%

Source: Author calculations based on IOF 2008 for Mozambique and UNPS 2009 for Uganda.

Results by income category show that in Uganda the average welfare effect across the poorest one third of households is a 0.51% loss, while the richest one third experience an average 0.16% gain. In Mozambique the pattern is reversed with the poorest one third experiencing an average 0.13% gain while the richest one third have an average 0.33% loss. The difference between the two countries is explained by earlier results on income and expenditure shares – expenditure shares on maize tend not to decline with increases in income in Mozambique, especially in rural areas.

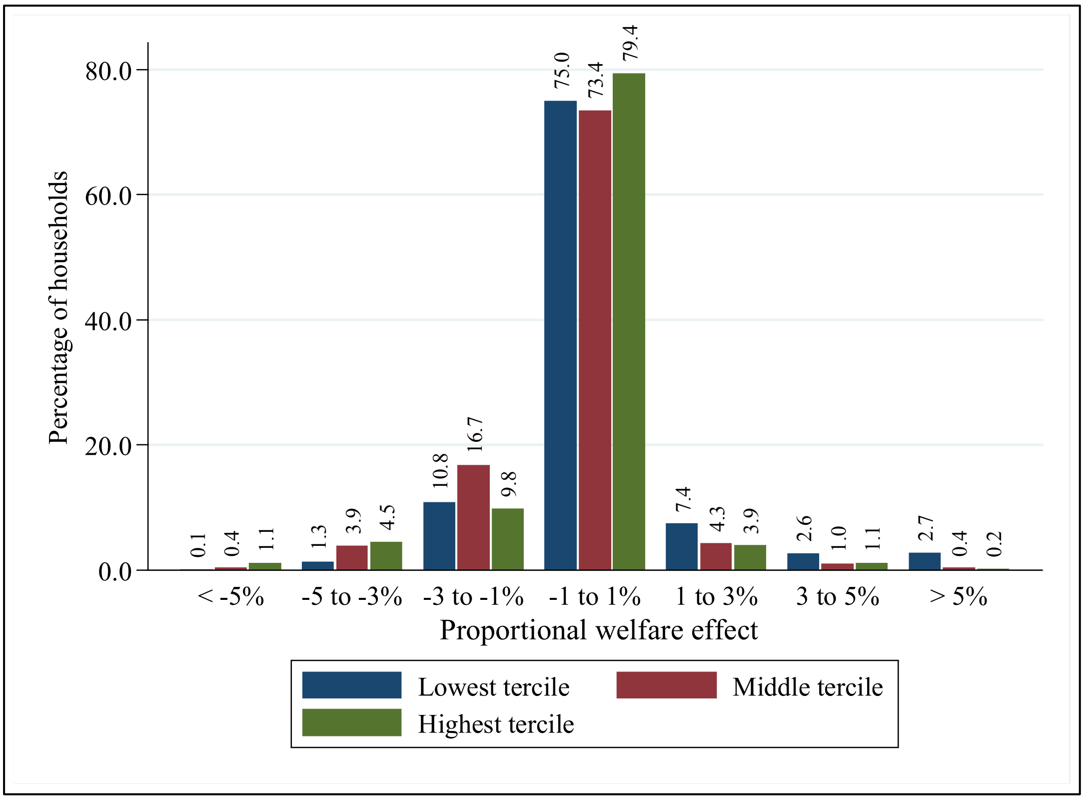
While these average effects do change across income categories they remain small (less than plus or minus 1%) in every income category, and maximum and minimum values across categories continue to show a wide range of welfare effects (see Table 12). More detail on the distribution of welfare effects across each income category are shown in Figures 35 (Uganda) and 36 (Mozambique). In Uganda the poorest one third of households has a larger proportion experiencing higher welfare losses (greater than 1%) compared to middle and high income households. However, the poorest one third also has a higher proportion of households that experience higher welfare gains (greater than 1%). The distribution of welfare effects is therefore less peaked and more spread out for the poorest one third of households compared to middle and high income households. The richest one third of households has a very peaked distribution with most members (90%) experiencing small welfare changes (between plus and minus 1%).

Figure 35. Distribution of Household Welfare Effects of LRP-induced Maize Price Increases in Uganda across Different Income Categories



Source: Authors' elaboration based on model results.

Figure 36. Distribution of Household Welfare Effects of LRP-induced Maize Price Increases in Mozambique across Different Income Categories



Source: Authors' elaboration based on model results.

In Mozambique the welfare distributions are very similar across income categories, indicating that the welfare effects are not distributed disproportionally across poorer households compared to richer households (see Figure 36).

Results for urban and rural households in Table 12 show that urban households in Uganda are more likely to experience greater welfare losses than rural households (an average 0.34% loss versus a 0.07% loss). Urban households also experience higher average losses than rural households in Mozambique (0.20% versus 0.17%). As expected, there continue to be a wide range of effects across different households within the urban and rural categories (see the maximum and minimum values for urban and rural households in Table 12).

In sum, there is a large group of households in both Mozambique and Uganda whose welfare is little affected by any reasonable estimate of LRP-induced maize price increases (less than a 1% welfare gain or loss). Furthermore, in both countries about as many households gain as lose from any price increase. However, there are still small proportions of households that experience greater welfare gains and greater losses. The households who gain more are net sellers whose income share from maize is high relative to their expenditure share. More of these households tend to be located in rural areas. The households that lose more are net buyers whose expenditure share on maize is high relative to their income share. More of these households tend to be located in urban areas. In Mozambique the distribution of welfare gains and losses is similar across different income categories, so there is no clear tendency for lower income households to be affected disproportionately by maize price increases. In Uganda, however, higher welfare losses tend to be more concentrated among low income households.

8. SUMMARY AND CONCLUSIONS

In this chapter we first synthesize the broad findings from this study and assess their possible implications for the orientation of future LRP. We then focus on issues particular to specific countries that emerged over the course of the study, before closing with a set of actions for WFP to consider.

8.1. Key Cross-Cutting Findings

Several broad findings stand out from this study. First, with the exception of Uganda, the average price effects of LRP are modest. Second, price effects are economically meaningful during the two years of highest maize procurement in Mozambique and during many years of maize procurement in Uganda. Because we chose countries with the highest LRP as a share of marketed surplus for the study, it is likely that LRP price effects in other African countries will be lower.

Third, welfare effects are small for the great majority of households in Uganda and Mozambique, despite sometimes meaningful price effects. Average welfare effects are less than a 1% loss for maize in both countries, and about three-quarters of all households experience impacts between 1% and -1%. Though we did not do the welfare analysis for beans, its lower shares in consumption and production and lower estimated price effects mean that its household level welfare effects will be even less substantial than they are for maize in Uganda and Mozambique.

Fourth, though very small on average and for most households, welfare effects are significant for some households. In Uganda, 8.9% of households are estimated to experience welfare gains or losses greater than 3%, while in Mozambique 6.9% experience such effects. Negative welfare effects are distributed relatively evenly across the income distribution in Mozambique – about as many poor as non-poor are directly harmed (and helped) by LRP. In Uganda, however, these negative effects are more concentrated among the poor, due to these households' greater reliance on maize for their consumption. Focusing on the bottom third of the income distribution in that country, over 13% had estimated losses of greater than 3%, and nearly 6% had losses greater than 5%. Again, both positive and negative effects will be smaller in countries with lower levels of LRP relative to marketed surplus. If price effects are generally modest and welfare effects are small for at least three-quarters of households and near zero on average, then the overall effect of LRP depends critically on the systemic effects that WFP is able to generate by the way in which it goes about its procurement. The case study chapters of this report focused on three such potential systemic effects: improved knowledge, practices, and investments regarding quality; operational efficiencies stemming from larger-scale transactions under less uncertain prices and quantities, which allow unit costs to be driven down; and effects on entry into sectors and on companies' and sectors' ability to compete in the commercial sector. These are the types of effects that, accumulating over time, drive transformational change in food systems over the course of development.

Our fifth broad findings is that WFP has positively influenced the *quality culture* on maize in Uganda, beans in Ethiopia, and HEPS in Ethiopia and Malawi. In all these cases, traders and processing companies have invested in new machinery and new practices to satisfy WFP's market. In Ethiopian beans and HEPS, and Malawian HEPS, companies repeatedly indicated that WFP's quality training – both formal training and ongoing interactions on quality matters – helped them in multiple ways: to focus more analytically on quality parameters, rather than assessing quality more qualitatively (and subjectively); to understand and implement practices to achieve and document these parameters; in this way to consolidate and spread within their company the good but inconsistent practices that they already had; and, for Malawian HEPS and Ethiopian beans, to use these improved practices to enter the export market more strongly.

The quality story is positive but inconclusive on maize in Uganda. WFP faced three major challenges in trying to improve quality in this country. First, Uganda's bimodal rainfall pattern means that maize comes off the farm with moisture levels too high for storage, necessitating mechanical drying capacity. Yet the small scale of production and local marketing make it difficult for small traders operating in production zones to invest in such capacity and, in fact, little private investment has taken place outside of Kampala. Second, even many of the larger maize traders in Uganda had little experience with international trade, being oriented towards local markets and the largely informal export markets of Kenya and, more recently, South Sudan and DRC. International trade is more formal and demanding in contracting procedures and quality guarantees, and companies must learn these skills if they are to compete; the lack of such experience in Uganda made WFP's challenge greater. Finally, and closely related to the previous point, local and regional markets provide robust demand with little if any insistence on quality, providing traders with strong sales options if WFP standards are too demanding.

The fact that the traditional regional maize market does not reward quality implies that the drive to improve quality in Uganda must be pursued in a regional context. EAC and the East African Grains Council (EAGC; see www.eagc.org/) provide an institutional framework for doing this. WFP has supported this framework by moving its purchases in Uganda to EAC standards and by participating in various fora sponsored by EAC and EAGC. Continued active engagement by WFP at this level will be needed as it works to further enhance the quality and reduce the cost of grain that it purchases

We documented WFP/Uganda's move from FAQ to EAC quality standards in this study. Though a very difficult transition, it resulted in substantial investment in cleaning and drying capacity by traders based in Kampala, and testimony by traders (amidst continuing complaints about the new rigors of quality assurance) as to the value of the training and the new procedures they had implemented. Yet poor quality grain re-emerged as a major problem late in 2012 exactly when WFP was attempting to use FPF to engage in larger, longer-term contracting with local firms for regional supplies. Interviews indicate that most of the maize awarded under tenders was rejected. This negative experience was a surprise to some, given the effort that had been put into improving quality since 2010 and the obvious and widespread trader response. Preliminary interviews suggest that, in addition to known structural factors, the problem was related to (a) unusually high rainfall during harvest, and (b) aggressive buying by some traders of very wet maize in the expectation, which was not fulfilled, of high prices.

WFP has had relatively little impact on quality practices in Mozambique, for multiple reasons: the highly dispersed marketing system that raises the cost of coordination for quality improvement, the dominant position of the two early trading firms who had no meaningful competition in supplying WFP, and the lack of any organized quality training program, even for the small- and medium-scale traders selling under P4P.

Sixth, traders are able to generate greater operational efficiencies selling to WFP, due to the relatively large size of tenders and the price that is known once a tender is won. Both factors were repeatedly cited by traders when asked why, despite WFP's strict and (for some) burdensome requirements, they wished to continue selling to the agency. If firms are able to use their WFP experience to increase their scale of operation more generally, then these efficiency gains will be long-lasting and generate high returns to the farmers and consumers operating in the local food system.

Finally, on the question of market entry, we found that WFP operations have spurred market entry in the Malawian and Ethiopian HEPS sectors, have facilitated greater commercial competitiveness of the Malawian HEPS and Ethiopian bean sectors, but have had limited effect on market entry in Mozambique's maize sector. By spurring entry into the Ethiopian HEPS sector, WFP has potentially facilitated a robust response by that sector to growing commercial markets, but that response has to date been limited, and WFP has not facilitated any entry by these firms into regional operations. As WFP moves now to include Ethiopian HEPS firms in regional tenders – as have done successfully for several years in Malawi – these companies may begin to be able to take broader advantage of the quality training they have received. In Mozambique, WFP has brought Maviga into its tendering process as a new, large seller. Maviga has not, however, expanded its commercial business into maize, remaining focused instead on its core trade in pulses. Interviews with Maviga did not reveal any intention to expand commercially into maize in the immediate future.

Looking ahead WFP faces at least three challenges as it attempts to drive systemic improvements in the food systems it operates in. The first is a knowledge challenge. We found in all countries that traders and (to a lesser degree in Mozambique) farmers are broadly aware of the need for higher quality grain, but many of them had only a very *general* understanding of what quality means and what they need to do to achieve it. What had been lacking is a full understanding of quality based on precise parameters that can be measured, and which traders and farmers can focus on achieving in their operations. WFP has addressed this problem aggressively at central level by developing a food quality and safety policy paper in 2010, naming a new Deputy Executive Director for Nutrition and Food Safety and Quality in 2011, and developing a Food Quality Manual, standard food quality and safety assurance procedures, and a food quality and safety training program (Savignol 2011; WFP 2010a). As our findings have shown, this program has been brought to bear with some success in Uganda, Ethiopia, and Malawi at the level of qualified LRP vendors. For reasons not fully understood by the study team, these materials have not been systematically applied in Mozambique. Yet even in the countries where the program has been brought to bear, the knowledge problem persists below the level of qualified LRP vendors (among smaller traders and farmers) and potentially continues with some of the vendors themselves.

The second challenge is that the quality of inspection services appears to be poor, with the potential exception of SGS in Malawi. As a result, traders in Uganda and Mozambique complained of shipping grain from their own warehouse to a WFP warehouse where it was rejected as below grade, despite the trader receiving a certification on the grain by the inspection company.

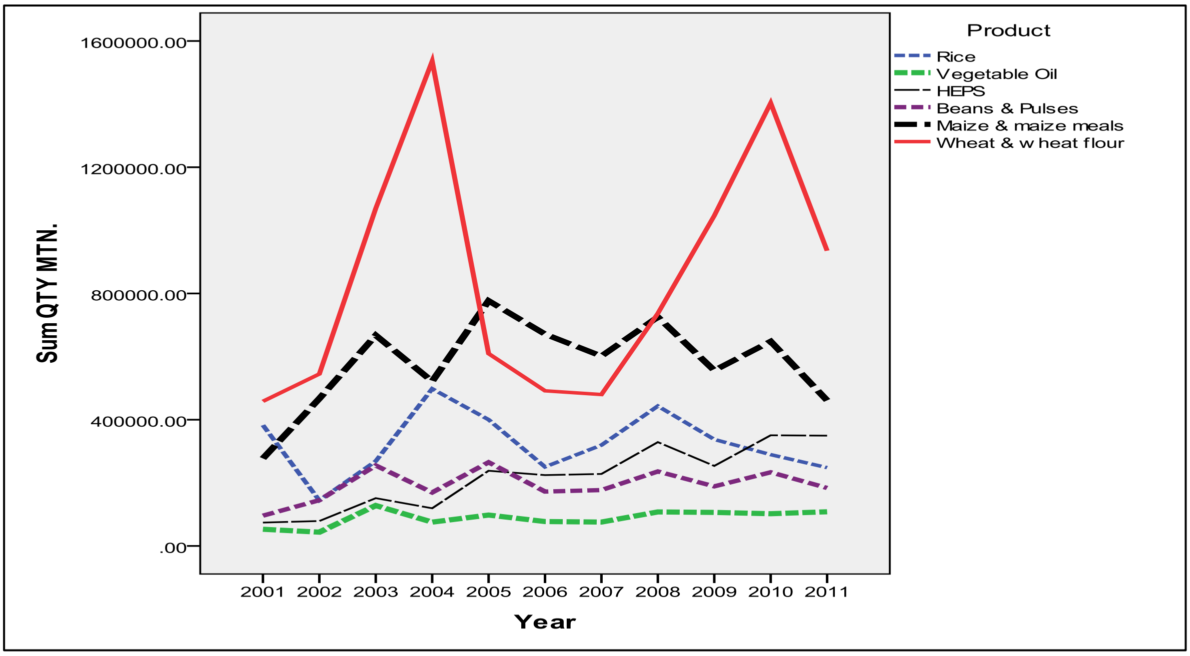
The third challenge that WFP faces in driving systemic improvements is its relatively small share of the market in any one country. While WFP may be "the biggest grain trader north of the Limpopo" (Coulter 2005), it is not the largest trader in any one country with the possible exception of Uganda during the agency's largest purchase years. And as we have seen, even in that country WFP averaged only a 14% share of total marketed maize between 2001 and 2011. Furthermore, the agency's purchases in Uganda fell dramatically from their high in 2007 to a 2011 share of only about 3% to 4% of total market surplus.

It should be noted that WFP is not just another buyer; its attractiveness as a buyer, as discussed above, gives it leverage for driving change that goes beyond its market share. Yet market share does matter: the case studies showed that WFP has had major impacts on the HEPS sectors in Malawi and Ethiopia because they essentially started the market, then companies (at least in Malawi) took advantage to diversify into regional tenders and, more importantly, into the commercial market. With the urbanization and economic growth that the continent is now experiencing (see Chapter V), demand for processed food stands to grow very rapidly, and WFP could make real contributions in helping these firms respond to this demand efficiently and with safe high-quality products. In the meantime, despite major efforts on maize quality in Uganda that have been met with meaningful trader response, this response has been largely limited to Kampala, has not addressed fundamental problems closer to the farm, and did not prevent the major quality problems in 2012 referred to above.

So we assert that WFP must have a market presence of meaningful size and perceived medium- or long time-frame to leverage change, and we ask how the agency can achieve this while not imposing excessive welfare costs on poor consumers. This question is particularly germane in light of the agency's goal of moving to 30% cash and vouchers by 2015, which will put continued downward pressure on LRP.

To answer the question of how to ensure meaningful market presence that can be leveraged for systemic change, we first review selected worldwide procurement trends. We highlight four patterns. First, as seen in Figure 37, the only products for which total worldwide volumes of procurement have clearly risen since 2003-2005 are HEPS and vegetable oil.

Figure 37. Worldwide Procurement Volumes by WFP, 2001-2011, by Product Category



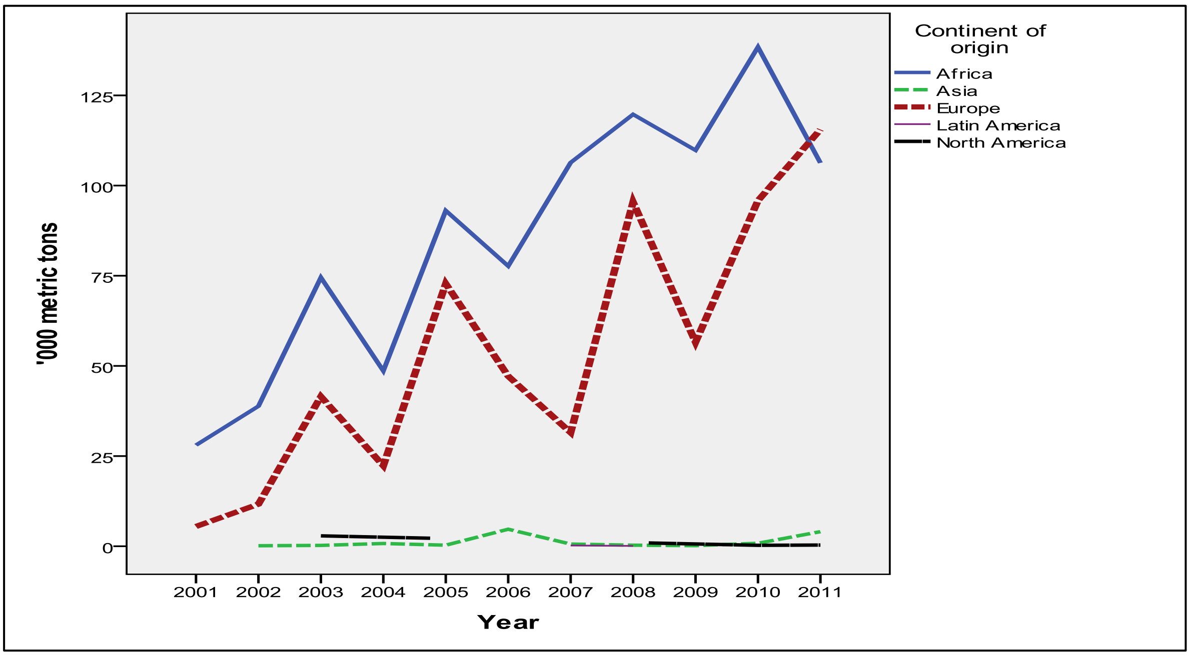
Source: Authors' elaboration using data from WFP WINGS database.

Second, while Africa is the leading worldwide source of HEPS at 40%, Europe follows closely at 35% and its share has been rising. As discussed earlier in this report and shown in Figure 38, Europe exceeded Africa in 2011 as a source of supply of HEPS to Africa, with the key driver of this trend being WFP's move to more enriched products such as Super Cereal Plus and the currently limited production capacity (at required levels of quality and safety assurance) for these products in Africa. Depending on the weight that WFP gives to goals of food system development in the countries in which they operate, this presents WFP with a major opportunity to drive increased local production of these fortified, value-added foods on the continent.

Third, Africa has only a 3% share in worldwide vegetable oil procurement, with no rising trend. Over 60% of vegetable oil procured worldwide by WFP came from Asia during the period; from 2009 to 2011 and looking only at oil distributed in Africa, Asia's share was 92%, nearly all of which was palm oil from Malaysia or Indonesia. Africa's share of vegetable oil distributed *in Africa* is not trivial, rising to 7%-10% from 2006 to 2008 before falling, then recovering again to 10% in 2011.

The fourth pattern is that Africa is the biggest *recipient* of vegetable oil, the vast majority of it palm oil from Asia. Depending on the agency's objectives, vegetable oil could be another area where WFP could drive growth and good practices in value-added food processing, with potentially important payoffs for the local food system. We do note, however, that palm oil presents social and environmental challenges that would not be found if WFP were to buy other oils in Africa.[26]

Figure 38. HEPS Distributions in Africa by Country Continent of Origin, 2001-2011



Source: Authors' elaboration using data from WFP WINGS database.

[26] Palm is most commonly produced on large mono-cropped plantations often owned by foreign firms (UNEP 2011). In the surge of agro-industrial investment on the continent since 2008, oil palm has received much attention, and WFP purchase of local palm oil would presumably encourage such investments. Oilseeds such as soy and sunflower, on the other hand, are dominantly produced by smallholder farmers in Africa and have a much smaller environmental impact.

Summarizing, our case studies and this review of procurement patterns suggest that WFP could maximize its systemic impact on African food systems through the following approaches:

- Emphasize local procurement of value-added products. Such an emphasis is especially timely now in Africa, as their food systems are beginning to transform and demand for value-added products is set to grow rapidly but is not yet as high as in Asia. As a result, WFP could, through its quality standards and training and, if at all possible, more forward planning in purchases through use of FPF, help drive investment and good quality practices at an early stage, with long-lasting payoffs for the food systems. Moreover, doing this in value-added products would allow it to largely avoid imposing negative welfare effects on some poor households when it procures large amounts of basic staples such as maize.
- Expanding HEPS procurement in Africa –and even avoiding a potential decline – will require investment by local companies in capacity to produce Super Cereal Plus and other more nutrient-dense foods. For this to happen, given that commercial markets for such products are still small (this means also that cash and vouchers will not, for some time, be an effective instrument for this item), WFP will have to provide some kind of assurance of purchase without being exposed to unduly high prices. If WFP can do this, then growth potential for these products is tremendous based on substitution for European imports.
- Continue to expand the use of FPF and use it to engage in larger purchases over longer planning horizons. Our study did not address FPF in detail but we did show that existing seasonal procurement patterns show room for reducing costs (and most likely improving farmer and consumer welfare) through increased counter-seasonal buying. We also note an implication if it is the case that staple food LRP in Africa is going to decline over time, as suggested by recent trends and by the agency's emphasis on cash and vouchers: FPF will likely drive more positive systemic change if it is focused on a limited number of countries that can provide relatively large quantities, rather than being spread over numerous countries, each supplying smaller quantities.
- As WFP does this, however, it must be mindful of the finding of this study, that purchases at the levels seen in Uganda during the years of highest LRP can impose meaningful welfare losses on poor households that rely on maize purchases for part of their consumption.
- Further enhance tendering transparency. The LRP tendering process makes WFP the most transparent buyer in any of the systems we assessed. By sending a clear signal for large pending purchases to multiple players at the same time, WFP sends strong price signals that likely enhance overall market transparency and price transmission over space and across levels in the system. In contrast, purchases by even large traders unrelated to WFP can be uncertain to many players, who have to infer events from price movements and their own informal system of contacts. Yet several steps could further improve WFP's purchasing transparency. First, country offices could be more consistent in sending regret emails to losing bidders; our case study found that some do not receive these. Second, WFP could standardize and ensure implementation of the existing (but inconsistently applied) practice of announcing winning prices on tenders; the transparency effect would be greatest if each individual winning price was announced. Finally, WFP could consider developing an SMS message and delivery list – additional to and separate from the tender invitation that goes only to qualified traders – that announces a tender without inviting bids. This may not be necessary in countries where large numbers (e.g., at least 10) traders have been

certified to bid on each tender. But where fewer have been certified, information about the tender announcement may take some time to reach traders who were not invited, putting them at a potential competitive disadvantage. If the system were to start with known smaller traders and farmer organizations but allow others to subscribe by sending their own SMS message to WFP, the impacts of the low-cost system would be maximized.

- If WFP decides to explore increased procurement of vegetable oil in Africa, it will need to make a strategic decision as to whether palm oil will be considered identical to any other oil for procurement purposes, with decisions driven by delivered cost, or whether it will include social and environmental considerations in its decision-making process.

ANNEX

ANNEX A. CASE STUDY CALENDARS AND MEETINGS

Uganda: 16-27 July, 2012 (D. Tschirley, B. Myers, H. Zavale, A. Kizito)

Date	Location	Type of organization	Name of organization	Name of Person
16/07/12	Kampala	Food Assistance	WFP Kampala	Sarah Laughton, Connie Muraa, Albertina, Vincent
16/07/12	Kampala	Government	Chairman National Planning Authority	Dr. Kisamba Mugerwa
16/07/12	Kampala	LRP Vendor	Premier Commodities Ltd	Dipak Bhojkar
16/07/12	Kampala	Trader	Kisenyi Millers Association	Hajji Badru Kawesi
17/07/12	Kampala	LRP Vendor	Sunrise Commodities and Millers	Vincent Monteiro
17/07/12	Kampala	LRP Vendor	Rubya Investors Ltd	Harold Referred to Julius Bagazonga
17/07/12	Kampala	LRP Vendor	Aponye Uganda Ltd	Apollo Nyegamehe and Behamya Baker
17/07/12	Kampala	LRP Vendor	Savannah Commodities Co. Ltd	Alfred Mwangi
17/07/12	Kampala	LRP Vendor	Farmgain Africa	David Luwandaga
18/07/12	Kampala	Government	Disposable Procurement Unit; Prime Minister's Office	Julius Kitinisa Head Procurement
18/07/12	Kampala	LRP Vendor	Export Trading	John Assimwe
18/07/12	Kampala	LRP Vendor	Tiny Mirrors Uganda Ltd	Nsubuga Zaidi
18/07/12	Kampala	Trader	Combined Energy	Alfred Serunjoji
19/07/12	Kampala	Early Warning	FEWSNET	Samuel Magara
19/07/12	Kampala	Food Assistance	WFP Kampala	Arben Caslli
19/07/12	Kampala	Government	Assistant Commissioner Agribusiness. Min. of Agriculture Animal Industry and Fisheries	Dues Muhwezi; Emmanuel Muhoozi
19/07/12	Kampala	LRP Vendor	KAM Suppliers and Contractors	Musisi Ishaka; Hajji Abudalah Kamira
19/07/12	Kampala	LRP Vendor	Damji Plantation	Samba Augustine and Gulama

Date	Location	Type of organization	Name of organization	Name of Person
				Richard
20/07/12	Busia	Trader / Border Monitor	Eastern Africa Grain Council (EAGC)	Henry Bwire
21/07/12	Mbale	Farmers	Busiu United Farmers' Marketing Cooperative Society Ltd (BUFMACS)	
21/07/12	Mbale	Farmers	Lwambogo Group Co-operative Society	Wanda Wilson (Secretary manager)
21/07/12	Mbale	Government-Local	District Agricultural officer; Mbale District Local Government	Julius Peter Ayo
21/07/12	Mbale	Government-Local	District Commercial Officer, Mbale District Local Government	Willy Wepukhulu
21/07/12	Mbale	Government-Local	Manager, Mbale District NGO FORUM	Aida Wetungu
21/07/12	Mbale	Traders	Mbale Produce Dealers Association	Kizito and Amidu Owour
21/07/12	Mbale	Traders	Nkoma Enterprises Association	Oliva Kayegi
22/07/12	Kapchorwa	Farmer Association	Kapchorwa District Commercial Farmers' Association (KCFA)	Visited Facility
22/07/12	Mbale	Farmers	Tuban Organic Farmers Association (TOFA)	
22/07/12	Mbale	Government-Local	District Commercial Officer, Kapchorwa District Local Government	Mwoko Musobo
22/07/12	Mbale	Traders	Maize Trader in Kapchorwa	Musobo Hassan
22/07/12	Mbale	Traders	Maize Trader in Kapchorwa	Lady trader in Kapchowa
23/07/12	Lira	Farmer Association	Lira District Farmers' Association	Gad Okello
23/07/12	Lira	Farmers	Dura East Estates	Okodi Angela
23/07/12	Lira	Trader	Lira Produce Buyers and General Traders	Hajji Issabirye Abu Azedi
24/07/12	Masindi	Farmer Association	Masindi District Farmers Association (MADIFA)	David Katende, Martin Jadrobi
24/07/12	Masindi	Farmers	Gukwatamanzi Farmers' Cooperative Society	Mugisa Edward
24/07/12	Masindi	Farmers	Pakanyi United Farmers' Cooperative Society	Baluku Andrew
24/07/12	Masindi	Farmers	MASGA (Masindi Seed Growers Association)	Kiiza Job
24/07/12	Masindi	Government-Local	Assistant District Commercial Officer, Masindi	Lema Charles

Date	Location	Type of organization	Name of organization	Name of Person
			District Local Government	
24/07/12	Masindi	Traders	AgroVet Trader	Manager of Karwemera Bernard
26/07/12	Kampala	Food Assistance	WFP Kampala	Sarah Laughton, Albertina Kakuba, Connie Muraa, Vincent Kiwanuka
26/07/12	Kampala	Trader	Afro-Kai Ltd.	Chris Kaijuka
27/07/12	Kampala	Development project	LEAD	Kelly Wanda, Irene Mbabazi
27/07/12	Kampala	Development organization	aBi Trust	Harriet Nsubuga, Gilbert Arinaitwe, Georges Ayivi-Houedo, and James Byekwaso

Ethiopia: 3-14 September, 2012 (D. Tschirley, H. Zavale, T. K. Worako)

Date	Location	Type of organization	Name of organization	Name of Person
3/09/12	Addis	Food Assistance	WFP Addis	
	Addis	Donor project	FEWSNET	Yaekob Mudasir
	Addis	Trader	Soreti International Trading	Dama Sheko
	Addis	Trader	Hawas Agribusiness Plc	Balbulla Tulla
4/09/12	Addis	HEPS manufacturer	Helina Food Company	Belete Beyene
	Addis	Trader	Bati Wotoye Dalecha Grain Trade	Bati Woteya
	Addis	HEPS manufacturer	Guts Agro Industry PVT Ltd Co.	Ato Engidu Legesse
	Addis	Diversified food company	East Africa Tiger Brands	Greg Bates
5/09/12	Addis	HEPS manufacturer	Health Care Food Mfg Plc	Zeraitsiyon Tsegaye
	Addis	HEPS manufacturer	Norish Business Plc	Mr. Tewolde
	Addis	HEPS manufacturer	Faffa Food Plc	Hailue G/giyorgis
	Addis	Trader	Kebir Hussein Wako Grain Trade Enterprise	Mr. Tahir
	Addis	HEPS manufacturer	Guder Agro-Industry	Kinfe Negesse
6/09/12	Adama (Nazareth)	Farmer Cooperative	Lume Adama Farmer's Cooperative Union	Tsige Bizu
	Adama (Nazareth)			Farmers and traders in Boset Woreda
	Adama (Nazareth)	Trader	Gonde Import and Export Enterprise	Mr. Bezu
7/09/12	Adama (Nazareth)	Farmer Cooperative	Bora Dembel Cooperative Union	Tamiru Gemechu
	Adama (Nazareth)			Farmers and traders in Alemtenna
	Adama (Nazareth)			Processor Dawiti Kidarie
	Adama (Nazareth)			Farmers and traders in Meki
8/09/12	Awassa	Farmer Cooperative	Sidama Elto Cooperative Union	Simret Simano
	Awassa			Farmers and traders in Boricha district
10/09/12	Adama (Nazareth)	Grain Trader	Engochu Bedane Grain Trade Enterprise	Jerman AMente
	Adama (Nazareth)	Grain Trading Agent		Kalid Beture
12/09/12	Addis	Market Analysts	ESSRP/IFPRI	Dr. Bart Minten
12/09/12	Addis	Commodity Exchange	Ethiopian Commodity Exchange (ECX)	Dr. Eleni Gebremaedhin

Date	Location	Type of organization	Name of organization	Name of Person
	Addis	Government	Agricultural Transformation Agency (ATA)	Pascal Oandi
13/09/12	Addis	WFP	WFP	WFP employees for briefing/ interaction
14/09/12	Addis	Trader	Oromia Market Center	Mr. Tamene
	Addis	WFP	WFP Quality Control official	Mr. Van Hoan

Malawi, 8-15 April, 2013 (D. Tschirley, H. Zavale, M. Ngwira)

Date	Location	Type of institution	Name of organization	Name of person
4/8/2013	Lilongwe	Food aid assistance	WFP	Philip Hovmand
	Lilongwe	LRP vendor	Export Trading Company	Paresh Kiri
	Lilongwe	Inspection company	Socotec	William Kumwenda
4/9/2013	Blantyre	LRP vendor	Rab Processors	Ahmed Sunka
	Blantyre	Trader/manufacturer	Rice Milling	Abbas Mukadam
	Blantyre	LRP vendor	Transglobe	Rashid Tayub
	Blantyre	Inspection company	SGS	Anthony Chikwiri, John Makondesa
4/10/2013	Lilongwe	LRP vendor	Universal Industries	Jean Pankuku
	Lilongwe	LRP vendor	HMS Food and Grains Limited	Venkat Raman Danda
	Lilongwe	LRP vendor	K.U. Distributors	Mayur Patel
4/11/13	Lilongwe	Food Aid Assistance	WFP	Philip Hovmand
	Lilongwe	Commercial arm of farmer organization and LRP vendor	NASComex	Mr. Makda
4/12/13	Lilongwe	Development agency	USAID	Vincent Langdon Morris
	Lilongwe	Commodity Exchange	AHCX	
	Lilongwe	Commodity Exchange	ACE	Kristian Moller
	Lilongwe	NGO	ACDI-VOCA	Rachel Sibande, others
4/15/2013	Lilongwe	Food aid assistance	WFP	Philip Hovmand
	Lilongwe	LRP vendor	Farmers World	Christos Giannakis
	Lilongwe	Poultry Association	Poultry Industry Association of Malawi	Mr. Chuma
	Lilongwe	Poultry producer	Central Processing (TBD)	Graham Henderson

Mozambique: 1st Visit, 17-28 September, 2012 (Helder Zavale, Orlando Gemo, Dolito Loganemio)

Date	Location	Institution visited	Major business	Contact person
17/09/12	Maputo	WFP	Food Assistance Agency	Billy Mwiinga
		USAID	Donor	Leonor Domingos
		National Directorate of Trade - MIC	Government	Gabriel Muinga
		Export Trading Lda	Trader	Guilhermo Machado
18/09/12	Maputo	PROMER	IFAD Project	Carla Honwana
		OLAM Moçambique Lda	Trader	Neves Macuacua
19/09/12	Nampula	IKURU SARL	S&M Trader	Gerson Daniel
		OLIPA	PROMER Service provider	Joao Chauque
		Maviga Mozambique Lda	Trader	Ram Reddy
		CIMPAN	Trader	Mr. Borges
20/09/12	Ribaue	Fórum das Associações de Produtores 1° de Maio	Farmers Organization	Januario Armando
	Alto Molocue	Federação de Agricultores de Alto Molocue	Farmers Organization	Damião Caixão
21/09/12	Gurue	Federação de Produtores de Gurue	Farmers Organization	Raimundo Muequela
		Fórum Celeste	Farmers Organization	Inacio Uane
22/09/12	Gorongosa	Agro-comercialização Barca e Filhos	Small-to-medium Trader	Amarildo Barca
		Associação de Agricultores de Tsiquir	Farmers Organization	Reje Camucamo
24/09/12	Barue	Associação Culima Cuacanaca	Farmers Organization	Inácio Nhambanje
		Associação Samora Machel	Farmers Organization	Simão Belo
		Associação Pescina	Farmers Organization	Robert Gilbert
	Chimoio	ECA-Empresa de Comercialização Agrícola	Small-to-medium Trader	Grant Taylor
		DECA	Miller	Mr. Micael
		Abílio Antunes	Trader	Abilio Antunes
25/09/12	Chimoio	Senwes Grainlink de Moçambique Lda	Trader	Andre Vonk
26/09/12	Maputo	Pita Damuchocho Chimpene	Small-to-medium Trader	Pita Damuchocho
27/09/12	Maputo	WFP	Food Assistance Agency	Billy Mwiinga
28/09/12	Maputo	Directorate of Economics - MINAG	Government	Lucia Luciano

Mozambique: Second Visit, 20-28 May, 2013 (D. Tschirley, Orlando Gemo, Dolito Loganemio)

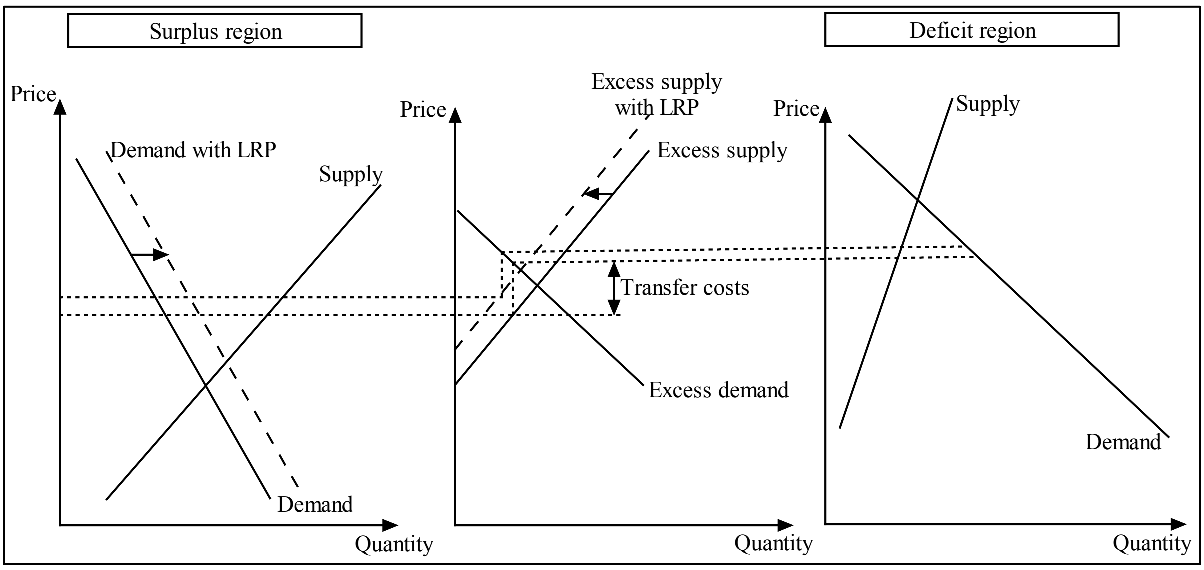
DATE	Location	INSTITUTION VISITED	MAJOR BUSINESS	CONTACT PERSON
20-May-13	Angonia	Fabrica de Processamento de Milho	Non WFP	Agostinho Simbine
	Angonia	Comercio Agrícola	S&MT	Victor Gaspar
21-May-13	Angonia	Mwana Mwana Comercial	S&M Trader	Jacob P. Benjamim
22-May-13	Chimoio	ECA-Empresa de Comercialização Agrícola	Non WFP	Grant Taylor
	Chimoio	DECA	Trader	Euan Kay
	Gorongosa	Pita Damuchocho Chimpene - Transport	S&MT	Pita Damuchocho
23-May-13	Beira	Intertek	Service provider	Dawie du Plessis
	Beira	SGS	Service provider	Ajay Potharaju
	Beira	WFP	WFP	Ivelina Nunez
24-May-13	Beira	Agro Comercializacao Barca and Filhos	Trader	Amarildo Barca
	Beira	MAVIGA	Trader	Chandra Kanyal
27-May-13	Nampula	IKURU	Trading wing of farmer	Gerson Daniel
	Nampula	Corredor Agro	Diversified agricultural production and trading company	Sami Saran
28-May-13	Maputo	WFP		WFP officials

ANNEX B. TECHNICAL DETAILS OF THE COMPUTATIONAL APPROACH

The computational approach to estimating the effects of LRP purchases on local markets is based on a mathematical model of supply, demand, and price determination in spatially connected markets. Once this model has been specified, key parameters including supply elasticities, demand elasticities, and the size of LRP purchases relative to the size of the market, are quantified using existing econometric elasticity estimates and current knowledge of the size and workings of markets in each country studied. The final step is to use the model, along with relevant parameter estimates, to quantify the effect of LRP purchases on outcomes of interest in local markets, which may include price levels, the supply of marketed surplus, and the amount of marketed surplus being consumed by households.

A simple graphical analysis of a country with two regions and no imports or exports provides intuition for the computational model (CM). In Figure B1 food staple supply and demand responses to price for the first region, assumed to be in surplus at prevailing prices, are shown in the left panel while supply and demand for the second region, assumed to be in deficit at prevailing prices, are shown in the right panel. The middle panel shows equilibrium occurs when excess supply in the surplus region equals excess demand in the deficit region, ensuring that total demand across both regions equals total supply. The equilibrium price in each region must differ by the cost of transferring the commodity from the surplus region to the deficit region (see the transfer cost differential in the middle panel of Figure B1). The solid lines in the figure show the initial equilibrium without LRP purchases. The dashed demand curve in the left panel shows that if LRP purchases take place in the surplus region they shift the surplus region demand curve to the right (i.e., LRP becomes an additional source of demand at every potential price level). This shift in demand then shifts the excess supply curve from the surplus region to the left (see the dashed line in the middle panel). The new equilibrium features higher prices in both regions, increased marketed supply in both regions, and decreased consumption out of the marketed surplus in both regions (see Figure B1). The decrease consumption out of the marketed surplus occurs because LRP withdraws a certain amount of the commodity from normal market channels, putting upward pressure on prices and downward pressure on consumption from market purchases.

Figure B1. Graph of Effects of LRP on Local Markets



Source: Authors' elaboration.

Of course, the LRP purchases are then distributed either domestically or in other countries in the region as food aid. However, the food aid will, in principle, be provided to those in dire need who do not have effective demand at prevailing prices. Therefore, these food aid distributions will have little, if any, effect on prices and quantities purchased through normal market channels.[27]

The magnitude of these various effects will depend on the price responsiveness of supply and demand in the two regions (i.e., elasticities of supply and demand), the size of transfer costs, and the magnitude of LRP purchases relative to the size of the market (i.e., the extent and nature of the shift in demand due to LRP).

It should be emphasized that this is a comparative static model, in the sense that we are comparing two equilibria, one with, and one without LRP. This approach does not account for any dynamic adjustment path between equilibria. The estimated effects should therefore be viewed as long-run outcomes after any dynamic adjustments between equilibria have occurred.

B.1. Mathematical Derivation

To operationalize the computational approach we need a mathematical representation that accounts for multiple regions in a country, inter-regional trade, cross-border trade, and other important features of markets in the commodities and countries of interest. Suppose there are *n* regions in a country and supply and demand in each region are represented by:

(B1) $S_i = f_i(P_i)$ for $i = 1,2,...,n$ (Supply)

(B2) $D_i = g_i(P_i)$ for $i = 1,2,...,n$ (Demand)

where S_i is quantity of marketed supply in region *i*, D_i is quantity of consumption purchases in region *i*, P_i is market price in region *i*, and f_i and g_i are regional supply and demand functions. Supply and demand may depend on other factors besides own price, for example input prices and prices of other competing outputs on the supply side and income and the price of other consumption goods on the demand side. However, in the following analysis we will be keeping these other factors constant so they do not need to be shown explicitly in the supply and demand functions.

We define region 1 with price P_1 to be the reference market for the commodity. The reference market is usually the most important and liquid market in the country where the majority of the price discovery takes place. Then for all other regions connected to the reference market through trade, spatial market equilibrium implies:

(B3) $P_i = P_1 - C_i$ for $i = 2,3,...,n$ (Spatial Price Relationships)

where C_i is the cost of transferring the commodity from region *i* to the reference market (or, if negative, the cost of transferring the commodity from the reference market to market *i*). If

[27] We realize that food aid targeting in practice is frequently imperfect but abstract from that here because any effects on market prices from food aid crowding out effective demand are likely to be small.

there is imperfect price transmission between markets we could assume a relatively high transfer cost or, at the limit, no trade between regions.

We also allow for exports to or imports from neighboring countries. Net export demand can be expressed as a function of the price in the reference market:[28]

(B4) $X = h(P_1)$ (Net Export Demand)

where X is net exports from the country (imports if negative) and h is a net export demand function. As in the case of the domestic regional supply and demand functions, this net export demand function may depend on other variables besides own price in the reference market (e.g., price in the neighboring country) but in the analysis that follows we keep these other variables constant and so do not include them explicitly in the equation.

The model is closed with a market clearing condition that requires total consumption purchases in all regions of the country, plus net exports, plus LRP purchases, to equal total marketed surplus in all regions of the country:

(B5) $\sum_{i=1}^{n} D_i + X + LRP = \sum_{i=1}^{n} S_i$ (Market Clearing)

Here we have allowed for LRP as an additional (exogenous) source of demand in determining equilibrium prices and quantities in each market.

If a region or set of regions is autarkic (no trade with other regions) then its prices will be determined completely by the equilibration of supply and demand in that region or group of regions. In this case, there will be separate equilibrium conditions of the form (B5) for each autarkic region or group of regions, and LRP purchases must be allocated among the regions or groups (see the discussion of the Mozambique case throughout this report).

To compute comparative static effects of a change in LRP on local market variables of interest we apply total differentiation to the model, holding transfer costs C_i and other supply and demand shift variables constant. Totally differentiating (B1) and (B2) gives:

(B6) $d \ln S_i = \alpha_i d \ln P_i$ for $i = 1, 2, ..., n$

(B7) $d \ln D_i = \beta_i d \ln P_i$ for $i = 1, 2, ..., n$

where the α_i and β_i are regional supply and demand elasticities, respectively. Similarly, totally differentiating the spatial price relationships (A3) we get:

(B8) $d \ln P_i = r_i d \ln P_1$ for $i = 2, 3, ..., n$

where $r_i = P_1 / P_i$ is the ratio of price in the reference region (region 1) to the price in region *i*. By definition $r_1 = P_1 / P_1 = 1$. Total differentiation of the net export demand function (A4) leads to:

[28] Net exports can be negative, in which case the country is importing the commodity.

(B9) $$d\ln X = \gamma\, d\ln P_1$$

where γ is the export demand elasticity with respect to the reference region price. Finally, totally differentiating the market clearing condition (A5), holding transfer costs constant[29], leads to:

(B10) $$\sum_{i=1}^{n} s_i^d\, d\ln D_i + s^x d\ln X + s^{LRP} d\ln LRP = \sum_{i=1}^{n} s_i^s\, d\ln S_i$$

where s_i^d is the share of each region's consumption purchases as a proportion of total country-wide marketed surplus, s^x is the share of exports (imports if negative) as a proportion of total country-wide marketed surplus, s^{LRP} is the share of LRP purchases as a proportion of total country-wide marketed surplus, and s_i^s is each regions share of marketed surplus as a proportion of total country-wide marketed surplus. Of course, adding up requires:

(B11) $$\sum_{i=1}^{n} s_i^d + s^x + s^{LRP} = \sum_{i=1}^{n} s_i^s = 1$$

Equations (B6) through (B10) constitute a set of simultaneous equations that can be solved to derive the proportional effect of a change in LRP on prices, supply of marketed surplus, and consumption of marketed surplus, all by region. The results, which can be computed recursively, are:

(B12) $$\frac{d\ln P_i}{d\ln LRP} = \frac{r_i s^{LRP}}{\sum_{i=1}^{n} s_i^s \alpha_i r_i - \sum_{i=1}^{n} s_i^d \beta_i r_i - s^x \gamma}$$

(B13) $$\frac{d\ln S_i}{d\ln LRP} = \alpha_i \frac{d\ln P_i}{d\ln LRP}$$

(B14) $$\frac{d\ln D_i}{d\ln LRP} = \beta_i \frac{d\ln P_i}{d\ln LRP}$$

Given parameter values for supply and demand elasticities, shares of marketed surplus, and regional price ratios, Equations (B12) through (B14) can be used to estimate the proportional effects of a change in LRP on local markets.

B.2. Application to Uganda

The application to Uganda focuses on the effects of LRP maize purchases on local maize markets. Maize is only one of many staple food crops in Uganda, unlike in many other countries in east and southern Africa where maize is the dominant food staple. WFP began purchasing maize in Uganda for LRP in the 1990s, and the country has since been second

[29] This assumes implicitly that changes in LRP have no effect on the cost of transferring the commodity between regions. If more LRP were to reduce (increase) transfer costs then LRP would have the additional effect of reducing (increasing) price differences between regions.

only to South Africa as a source of maize for LRP on the continent. As a share of total production, LRP purchases in Uganda have far exceeded those in South Africa or any other country in the region. Many observers consider that WFP purchases of maize in Uganda have been an important factor in turning the crop into a major traded good in the country. Because of these factors LRP purchases of maize in Uganda is an interesting case to examine.

To implement the CM we separated Uganda into three regions: Central, Eastern, and Western + Northern (see the map on page 6 and related discussion in Section 3.1). Case study interviews and examination of regional price series suggest that regional markets in Uganda are well integrated so it is reasonable to assume good spatial price transmission and regional price differences depending primarily on transfer costs. There also appears to be strong price transmission from retail and wholesale markets down to the farm level, so LRP effects on prices can be expected to flow through to farms and elicit a potential supply response.

Base parameter estimates used to operationalize the three-region model for Uganda are shown in Table 4, page 52 in the main body of the report. Regional supply elasticities are set at 0.7 based on existing maize supply response estimates in the literature, and knowledge of the country and its markets. Chhibber (1989) reviewed the empirical literature on supply response and found that supply elasticities in developing countries generally lie between 0.3 for countries with poor infrastructure and 0.9 for countries with advanced infrastructure. In land abundant developing countries with advanced infrastructure, Chhibber reports supply elasticities ranging from 0.7 to 0.9. For neighboring Kenya, Karanja et al. (2003) used maize supply elasticities ranging from 0.2 to 0.4 across different zones. For Uganda, Ulimwengu and Ramadan (2009) estimated price elasticity of supply for all cereals to be 0.367 for urban areas and 0.256 for rural areas. However, the supply of a particular cereal, such as maize, is likely to be more elastic than for cereals as an aggregate. Unfortunately, we could not find an empirical maize supply elasticity estimate for Uganda specifically. However, the marketed surplus supply of maize in Uganda is expected to be more price responsive than in many African countries because of widespread mixed cropping which presents opportunities for switching to and from competing crops. Based on all of this information, we chose a base supply elasticity of 0.7 for all regions in Uganda, but also examine how sensitive results are to a range of supply elasticities from 0.5 to 0.9.

Base regional demand elasticities for Uganda are set at -0.8 (see Table 4, page 52 in the main body of the report). Ulimwengu and Ramadan (2009) estimated price elasticity of demand for aggregate cereals in Uganda at -0.88. In neighboring Kenya Karanja et al. (2003) argued that maize demand elasticity ranges from -0.4 to -0.55 across districts. However, Uganda is less maize-dependent than Kenya so its demand for maize is expected to be more elastic. Indeed, an elasticity of -0.8 might seem too elastic for a staple food like maize in an African country. However, Ugandans have a diversified diet and can switch to and from other staple foods such as matoke, cassava, banana, beans, and rice in response to higher or lower maize prices. Nevertheless, we investigate the sensitivity of results to alternative demand elasticity assumptions over the range from -0.6 to -1.0 as well as using the base estimate of -0.8.

We could not find any existing empirical estimates of the maize export demand elasticity facing Uganda. However, since the main importing countries of Kenya and South Sudan have limited alternative sources of surplus maize to buy in the region, and domestic maize demand in these countries is likely to be more inelastic than domestic demand in Uganda, the export demand elasticity facing Uganda is likely to be more inelastic than domestic demand. We therefore use a base export demand elasticity estimate of -0.24. Because the share of exports in total marketed surplus is relatively small, reasonable changes in the magnitude of the export demand elasticity have little impact on the estimated effects of LRP on local markets. Therefore, we do not report any sensitivity results to changes in the export demand elasticity.

Base estimates for the shares of marketed surplus parameters for Uganda in Table 4 were estimated from household-level data. We estimated maize consumption purchases (maize grain and maize meal equivalent) using data from the UNPS 2008/09. Maize sales, also obtained from UNPS 2008/09, are used as our estimate of marketed supply. The UNPS is a nationally representative survey that collected data covering both cropping seasons of the 2008/09 agricultural season, and the results it gives are reasonable in light of knowledge of consumption and production patterns in the country. These marketed surplus and consumption data can be disaggregated by region. An estimate of total Ugandan maize exports is obtained from various annual Statistical Abstracts published by Uganda Bureau of Statistics and aggregate LRP purchases in Uganda were provided by WFP through their Information Network and Global System. Maize export and WFP procurement data span the period 2001 through 2011.

To compute regional shares of marketed surplus in Uganda we took the regional sales data and divided by the aggregate sales across the country. To compute the purchased consumption shares as a proportion of total marketed surplus we obtained a consistent estimate of total purchases by adding maize consumption purchases across regions, estimated from the household data, and then adding in exports and LRP. Each component (regional purchases, exports, and LRP) was then expressed as a share of the total. This procedure ensured that the adding up restrictions in equation (B11) hold for the estimated shares. The effects of LRP on local markets are likely to be most sensitive to the share of LRP in total marketed surplus (i.e., the size of LRP relative to the size of the market). Therefore, we conduct sensitivity analysis with respect to this parameter, over the range from 2% to 25%, which represents the range of annual maize LRP shares of marketed surplus observed in Uganda over the period 2001 to 2011. The base estimate of 14% is the mean of the LRP share over this period.

Price data for Uganda were obtained from Farmgain Africa. Farmgain Africa field-staff collect wholesale prices in major markets in several districts in Uganda by interviewing traders between Monday and Thursday. Then district average weekly prices are usually reported to Farmgain Africa headquarters in Kampala by Friday of each week. The price data on a weekly basis cover the period January 2001 to December 2011. We create monthly prices series for each market by averaging weekly prices. Uganda prices are reported in Ugandan Shilling per metric ton (UGX/MT). To compute price ratios we use prices for Kisenyi market in Kampala in the Central Region as the reference price. We then computed the ratio of average prices in Kisenyi to average price in other regional markets (Masindi and Lira in the Northern + Western Region, and Soroti in the Eastern Region) over the sample period and used the results as estimates of the base price ratios shown in Table 1. Because these price ratios are relatively stable, and because changing them will mainly influence LRP effects on regional price differences, not on the price level in the reference market, we did not conduct sensitivity analysis with respect to the price ratio parameters.

CM results for Uganda maize, expressed as the percentage reduction in prices that can be expected from a 100% reduction in LRP, are shown in Tables 5 and 6, pages 66 and 67, of the main body under a range of different assumptions about underlying parameters.

B.3. Application to Mozambique

The application to Mozambique focuses on the impacts of LRP maize purchases on local maize markets. Maize is the major staple food in Mozambique, accounting for about 25% of food expenditures. It is therefore of interest to investigate the effects of LRP maize purchases in a country where maize is the dominant food staple, unlike in Uganda where maize is only one of many staple foods. However, the size of LRP purchases relative to the size of the market (LRP share of total marketed surplus) is smaller in Mozambique than in Uganda, so this will have a major impact on results.

To implement the CM for Mozambique we separated the country into three regions: northern, central, and southern (see the map on page 6 and related discussion in Section 1.9). As explained in the main body of the report, prior to August 2009 the Mozambique maize market structure was heavily influenced by the lack of a bridge over the Zambezi River except in Tete province of the west, which isolated northern maize markets from those in the central and southern regions of the country. Therefore, in the CM for Mozambique we treat the northern region as a separate market segment that is trade isolated from central and southern. However, we allow for maize exports from northern Mozambique to southern Malawi and imports of South African maize to southern Mozambique (Maputo).

Tostão and Brorsen (2005) and Cirera and Arndt (2008) found evidence that maize markets in Mozambique are not well integrated, with limited price transmission due mainly to high transportation and transaction costs. However, much of the limited integration has been between the areas north and south of the Zambezi River, for reasons already explained. Within the northern and southern market segments, market integration and price transmission appears to be improving. We interviewed a large number of maize traders and farmers in Mozambique in late 2012. Our maize trader interviews indicated that medium- to large-sized maize traders are monitoring, and potentially arbitraging, prices in several key regional markets. This monitoring is done through cell phones, television, and web browsing. On the other hand, our interviews with farmers suggested uneven and imperfect price transmission from key market centers down to the farm level. Farmers appeared to have little knowledge of prices in key regional markets. This suggests that our modeling assumption of separated northern and southern market segments, with well-integrated markets within each segment, is a reasonable assumption on inter-regional price relationships for Mozambique. However, the questionable price transmission down to the farm level suggests that any LRP effects on prices at major market centers may not transmit well down to the farm level, which implies there may be limited supply response.

Base parameter estimates used to operationalize the two-market segment, three-region maize model for Mozambique are shown in Table 4, page 52 in the main body of the report. Regional supply elasticities are set at 0.6 based on available information, previous studies, and knowledge of maize markets in Mozambique. Zant (2012) argued for a maize supply elasticity of 0.4 for Malawi. However, we expect maize supply to be more elastic in Mozambique because farmers in Mozambique have a more diversified cropping portfolio than those in Malawi, suggesting that supply will be more responsive to relative price changes in Mozambique. In addition, population density is much lower in Mozambique than Malawi, suggesting maize cultivated area can be more easily adjusted to prices changes in Mozambique. However, maize supply is expected to be less elastic in Mozambique than in Uganda due to wider crop diversity in Uganda. Therefore, a base supply elasticity of 0.6 seems like a reasonable assumption.

Base regional demand elasticities are set at -0.6 for Mozambique. Karanja at al. (2003) argued that maize demand elasticity in Kenya was in the range of -0.4 to -0.55, and Mozambique and Kenya are similar in many ways with regard to maize consumption. So a base demand elasticity of -0.6 seems reasonable. Because results may be sensitive to supply and demand elasticity assumptions, we also investigated sensitivity to a range of domestic supply and demand elasticities for Mozambique ranging from 0.4 to 0.8 on the supply side, and -0.4 to -0.8 on the demand side.

We need two net export demand elasticities for the Mozambique application. First, there is the Malawi demand for exports from the North. We could not find existing econometric estimates of the Malawi demand elasticity for northern Mozambique maize exports. However, based on similar arguments used when specifying the demand for maize exports from Uganda, we set a base value of -0.24 for this parameter. Results for LRP effects on local markets are not very sensitive to the value of this parameter because the share of maize exports in total marketed surplus from the north is relatively small. Second, there is the southern Mozambique demand for South African maize imports. We set the price elasticity of southern Mozambique demand for South African maize imports to zero (demand is perfectly inelastic). This is a reasonable assumption because imports of South African maize to southern Mozambique are not very responsive to changes in prices for locally produced maize. The South African maize is imported by large millers due to concerns about low quality and poor reliability of supply in local markets, and the resulting maize meal is viewed as a different product in the market place than meal from locally produced maize. Since the market for the refined South African maize meal is differentiated from meal from locally produced maize, and because the demand for the refined South African maize is very inflexible, we assume that changes in local maize prices do not change the amount of South African maize imported.

Base estimates for the shares of marketed surplus parameters for Mozambique in Table 1 were computed from household-level data. Regional sales of marketed surplus are computed from the National Agricultural Survey 2008. In the northern market segment, there is only one region so the share of marketed surplus produced by the region is by definition 1.0. For the southern market segment, the shares of the Center and South regions were calculated as the regional proportions of total sales of marketed surplus in the both regions combined.

We estimate maize consumption purchases (consumption out of marketed surplus) in Mozambique using data from the IOF 2008/09. To compute the consumption shares required to operationalize the CM for Mozambique we take our estimate of total household consumption purchases and add LRP purchases and exports (subtract imports). This provides an estimate of total consumption out of the marketed surplus. The base proportions for regional consumption purchases, LRP, and exports in Table 1 are then calculated as a proportion of the total.

Annual data on Mozambique's maize (informal) exports (MT) were provided by the Famine Early Warming Systems (FEWSNET), while annual data on South African maize imports (MT) to Mozambique were obtained from the South Africa Grain Information Service (SAGIS). FEWSNET maize export data cover the period 2005 to 2011 and SAGIS maize import data span the period 2004 through 2011[30]. LRP purchase data from January 2001 to December 2011 were provided by WINGS. Because results are quite sensitive to the LRP

[30] See sagis.org.za and click on Historical Database for import data. FEWSNET export data come from the Southern African Informal Cross Border Food Trade Monitoring System, which are reported non-systematically in various FEWSNET publications. See fewsnet.net/Pages/default.aspx.

share of total marketed surplus, we undertake the analysis under a range of possible values for this parameter. Maize LRP shares of marketed surplus in Mozambique over the period 2001 to 2011 ranged from 0.05 to 0.18 in the southern region and from 0.02 to 0.07 in the northern region. We therefore use these historical LRP shares to evaluate how sensitive results are to the size of LRP relative to size of the market. The base estimates of 0.11 in the southern region and 0.04 in the northern region are the means of the LRP shares over this period.

To compute the price ratios for Mozambique in Table 4 we obtain retail maize prices from the Mozambique's Ministry of Agriculture Marketing Information System (SIMA). SIMA field staff interview traders in various markets three times per week (Monday, Wednesday, and Friday). Then, prices are transmitted to SIMA headquarters in Maputo. Daily maize prices from January 2001 through December 2011 were provided by SIMA. Daily prices were averaged to generate monthly price series. Mozambique prices are measured in Mozambique Metical per metric ton (MZN/MT). We use average prices for Maputo and Chimoio in the southern market segment to compute price ratios using Maputo as the reference market. Maputo is chosen as the reference market because it is the largest market hub in the South. For the northern market segment, we use Nampula as the reference market. Maputo, Chimoio, and Nampula are all large and liquid maize markets in their respective regions.

CM results for Mozambique maize, expressed as the percentage reduction in prices that can be expected from a 100% reduction in LRP, are shown in Tables 5 and 6, pages 66 and 67, of the main body under a range of different assumptions about underlying parameters.

B.4. Application to Ethiopia

The application to Ethiopia focuses on the impacts of LRP purchases of beans on local bean markets. Ethiopia is second only to Uganda as a source of beans for LRP among African countries and LRP share of marketed bean surplus is higher in Ethiopia than in Uganda. Ethiopia is therefore an interesting case for studying the local market effects of LRP bean purchases.

To implement the CM for Ethiopia we separated the country into three regions: Oromia-SNNP region, Amhara, and an aggregate deficit region (Figure 20 and related discussion in Section 4.2). Based on trader and farmer interviews and regional price data, the degree of integration among regional bean markets in Ethiopia appears high. Case study interviews suggested that bean price transmission from major markets down to the farm level is uneven but improving. Therefore, we operationalize the CM by assuming strong regional price transmission and allowing for a farm level supply response to any change in prices brought about by changes in LRP.

Base parameter estimates used to operationalize the three-region bean model for Ethiopia are shown in Table 4 (page 52) in the main body of the report. We assume regional supply elasticities of 0.6 and regional demand elasticities of -0.6. These elasticities are based on existing estimates from the literature as well as knowledge of the country and its markets (e.g., Tefera, Demeke, and Rashid 2012; and Zant 2012). Beans are not a major food staple in Ethiopia and only accounted for 6% of total cultivated area in 2011/2012. It can be expected that marketed bean surplus in Ethiopia would be less responsive to price changes than marketed maize surplus in Uganda because many farmers in Uganda produce maize as a cash crop while beans are dominantly grown for self-consumption in Ethiopia. This suggests a lower supply elasticity in Ethiopia, which we set to 0.6 for the base case.

On the demand side Tefera, Demeke, and Rashid (2012) uses the Ethiopian Rural Household Survey panel data, with four waves between 1994 and 2009, to estimate the demand elasticity for pulses in Ethiopia at -0.99. In addition, given that diets are considerably more diversified in Uganda than in Ethiopia, we would expect that demand for beans in Ethiopia will be more inelastic than demand for maize in Uganda. We therefore set beans demand and supply elasticities in Ethiopia at lower values in absolute terms than maize demand and supply elasticities in Uganda. Because results may be sensitive to supply and demand elasticity assumptions, we also investigated sensitivity to a range of supply and demand elasticities ranging from 0.4 to 0.8 on the supply side, and -0.4 to -0.8 on the demand side.

We could not find any existing empirical estimates of the bean export demand elasticity facing Ethiopia. Similar to the case of maize in Uganda, however, we would argue that bean export demand from Ethiopia is more price inelastic than local demand, leading us to use a base export demand elasticity estimate of -0.24. However, because the share of bean exports in total marketed surplus across the country is relatively small, results are not very sensitive to alternative reasonable values for this parameter.

Share parameters were estimated from a variety of sources. Annual data on volumes of Ethiopian beans (MT) exported to Kenya, South Sudan, and Djibouti are obtained from the Ethiopia's CSA. Export data covers the period from 2004 to 2009. Aggregate LRP purchases of beans in Ethiopia during the period 2001 to 2011 are provided by WFP through WINGS.

Regional supply and demand shares of total marketed surplus were estimated from household level data. Bean production is estimated from the Agricultural Sample Survey 2011/12. Based on Ferris and Kaganzi (2008), we then assume 30% of bean production is sold in the market. Regional marketed surplus data are then divided by total marketed surplus to get the share of marketed surplus supply coming from each region. Bean consumption purchases computed from Household Income, Consumption and Expenditure Survey 2004/05 are used to estimate domestic purchases from the marketed bean surplus. Similar to the case of Ugandan maize, we compute the consumption shares by first adding consumption purchases across regions, estimated from the household data, to exports and LRP purchases. This provides an estimate of total consumption out of the marketed surplus. Then each component (regional purchases, exports, and LRP) are expressed as a share of the total. This procedure ensures that the adding up restrictions in equation (B11) hold for the estimated shares. The effects of LRP on local bean markets are likely to be most sensitive to the share of LRP in total marketed surplus (i.e., the size of LRP relative to the size of the market). Therefore, we conduct sensitivity analysis with respect to this parameter, over the range from 1% to 8%, which represents the range of annual bean LRP shares of marketed surplus observed in Ethiopia over the period 2001 to 2011. The base estimate of 3% is the mean of the LRP share over this period.

Ethiopia retail prices for horse beans are obtained from the CSA. Prices are collected by the CSA field staff that interview traders in various markets in the country, and then transmit prices to the CSA headquarters in Addis Ababa. The CSA reports monthly average retail prices, measured in Ethiopian BIRR (ETB) per quintal. We convert Ethiopia prices into ETB/MT by multiplying them by 10. Price data cover the period September 2001 through December 2011. Annual average prices for Dire Dawa in the aggregate Deficit Region, Addis

Ababa in the Oromia-SNNP Region, and Dessie in the Amhara Region are used to compute price ratios and Dire Dawa was chosen as the reference market.

CM results for Ethiopian beans, expressed as the percentage reduction in prices that can be expected from a 100% reduction in LRP, are shown in Tables 5 and 6, pages 66 and 67, of the main body under a range of different assumptions about underlying parameters.

ANNEX C. TECHNICAL DETAILS OF THE VAR APPROACH

The computational model outlined in Annex B relies heavily on economic theory and assumptions about elasticities, shares of marketed surplus, and regional price ratios, to estimate the effects of LRP purchases on local markets. It would be a valuable complement to also have a more databased approach using modern econometric methods to investigate this issue. One possibility would be to build a structural econometric model of supply, demand, and price determination relationships, and then estimate all parameters and LRP effects econometrically using a sample of historical data. As in many developing countries, however, this approach is impractical in the countries we focus on in this study because the required data are simply not available. In particular, detailed historical data *are* available on maize and bean prices from various markets, the quantity of food aid provided, and LRP purchases. However, consumption data, storage data, data on factor prices, and data on the prices of other competing commodities are available only sporadically or not at all.

The vector autoregression (VAR) approach is an alternative databased method that has proven useful when data are not available on all of the variables required to build a full structural econometric model. The philosophy of the VAR approach is that, instead of estimating structural supply and demand equations, a reduced form relationship between the main variables of interest (in our case, LRP purchases, food aid, and local market prices) is estimated. The reduced form cannot identify all of the economic interactions and supply/demand pathways through which the LRP effects are occurring. However, the VAR can estimate historical correlations between past-observed food aid, LRP purchases, and local prices. These historical correlations are then exploited using minimal identification restrictions to estimate the net effect of LRP purchases on local prices.

In addition to requiring data on fewer variables, the advantage of the VAR approach is that it imposes few structural over-identification restrictions typically used to estimate traditional supply and demand functions. In this sense, results are more data-dependent than in many structural econometric models. However, VAR models have the disadvantage that they generally do not include all of the other factors besides LRP that might be influencing local price levels. Therefore, results cannot be interpreted in the usual *ceteris paribus* sense of other factors held constant. Rather, VAR measures of the impact of LRP on local market prices should be interpreted as the effect of LRP given that all other variables not included in the model (e.g., weather, incomes, other prices, etc.) continue to play the same role in price determination that they have done historically over the data observation period. This means that results from VAR models have to be interpreted differently than in traditional econometric testing environments.

C.1. Modeling Procedures

We estimate VAR models for each country but all of them have the same basic structure which will be outlined here. Two types of variables are included in the models. First there are WFP choice variables consisting of food aid deliveries FA_t in month *t* and LRP purchases LRP_t in month *t*. These variables are chosen by WFP on the basis of food aid needs and local food availability and prices. Second there are *n* local price variables $P_{1t}, P_{2t}, \ldots, P_{nt}$ representing prices in different local markets in month *t*. The relationship between the WFP choice variables and local price variables is captured with a flexible dynamic model specification. Assuming a recursive structure and three local market prices ($n = 3$) the model takes the form:

$$\text{(C1)} \qquad FA_t = \qquad + \mu_{1t} + lags(\boldsymbol{a_1}) + u_{1t}$$

$$\text{(C2)} \qquad LRP_t = b_{21}FA_t + \qquad + \mu_{2t} + lags(\boldsymbol{a_2}) + u_{2t}$$

$$\text{(C3)} \qquad P_{1t} = b_{31}FA_t + b_{32}LRP_t \qquad + \mu_{3t} + lags(\boldsymbol{a_3}) + u_{3t}$$

$$\text{(C4)} \qquad P_{2t} = b_{41}FA_t + b_{42}LRP_t + b_{43}P_{1t} \qquad + \mu_{4t} + lags(\boldsymbol{a}_4) + u_{4t}$$

$$\text{(C5)} \qquad P_{3t} = b_{51}FA_t + b_{52}LRP_t + b_{53}P_{1t} + b_{54}P_{2t} \qquad + \mu_{5t} + lags(\boldsymbol{a_5}) + u_{5t}$$

where the μ_{it} 's are deterministic components (a constant and, if necessary, deterministic trend and seasonal components), the u_{it} 's are uncorrelated error terms representing unanticipated (i.e., unpredictable based on explanatory variables in the model) shocks to each variable, the $\boldsymbol{a_i}$ and b_{ij} are parameters to be estimated, and the $lags(\boldsymbol{a_i})$ terms are linear combinations of *k* lags of all variables in the system:

$$\text{(C6)} \quad lags(\mathbf{a_i}) = \sum_{j=1}^{k} a_{i,j}FA_{t-j} + \sum_{j=1}^{k} a_{i,k+j}LRP_{t-j} + \sum_{j=1}^{k} a_{i,2k+j}P_{1,t-j} + \sum_{j=1}^{k} a_{i,3k+j}P_{2,t-j} + \sum_{j=1}^{k} a_{i,4k+j}P_{3,t-j}$$

for equations $i = 1, 2, ..., 5$. Including the lags allows for a wide range of flexible dynamic interactions between all of the variables in the system.

The VAR specification takes a recursive form ordered $FA_t \rightarrow LRP_t \rightarrow P_{1t} \rightarrow P_{2t} \rightarrow P_{3t}$. This implies FA_t does not respond to changes in *current* values of any variables in the system (though, of course, it remains potentially responsive to changes in past values of all variables through the lagged terms). This seems like a reasonable assumption because food aid needs are usually determined ahead of food aid deliveries, and food aid delivery is not likely to be much influenced by current (i.e., within the distribution month) local market conditions. The recursive ordering also implies LRP_t responds to changes in current values of FA_t, and lagged but *not current* prices. This also seems like a reasonable assumption because it makes sense that LRP purchases respond immediately to changing food aid needs. And although LRP choices are undoubtedly sensitive to local prices, the length of the tender process is such that LRP deliveries in any month are mainly determined by past prices and have little flexibility to be changed immediately in response to a current market price changes. On the other hand, we let all prices be influenced by current as well as past food aid distributions and LRP. This provides maximum opportunity for local prices to respond immediately to changes in WFP food aid and LRP decisions. A logical recursive ordering for the prices is to place the largest and most liquid local market first in the price ordering and other less important market prices lower in the ordering. This is because most price determination is likely to take place in the larger liquid market, with effects then filtering down to other local markets.

The recursive ordering is important because it provides identification of the u_{it} 's as uncorrelated food aid, LRP, and price shocks. In turn, it is this identification that allows simulating the effects of alternative food aid and LRP paths on local market prices (assuming local price shocks follow their historical estimated path). Alternative recursive orderings are possible, as are more general approaches to identification that do not rely solely on a recursive structure (see Stock and Watson 2001). However, the recursive ordering described above fits well with the structure of WFP decisions on food aid and LRP, as well as with the economics of price determination in local markets. It therefore seems like a reasonable way to achieve identification in the current application.

The recursive VAR can be estimated by collecting a sample of data and applying ordinary least squares (OLS) to each equation (C1)-(C5) in the system. If testing reveals some of the variables are nonstationary and cointegrated then the VAR is sometimes restricted to a vector error correction (VEC) form and estimated with maximum likelihood. Imposing VEC restrictions can lead to more efficient parameter estimates and improved statistical inference when included variables are nonstationarity and cointegrated. However, as asserted by Sims, Stock, and Watson (1990) and Hamilton (1994), even with nonstationary and cointegrated variables OLS estimates of the VAR form of the model will be consistent, although conventional OLS standard errors will be biased and inconsistent so standard statistical inference and hypothesis testing procedures are generally not applicable.

After the VAR has been estimated, LRP effects on local market prices are estimated by simulating the VAR over the estimation period. For the simulation, food aid is set to its actual historical value throughout the sample period. This is because we want to simulate the effect of eliminating the LRP on local market prices, but under the assumption that exactly the same amount of food aid would have been provided. In other words, when undertaking the simulation we assume that food aid would have remained at its historical values, so any reduction in LRP purchases would have been made up by additional WFP purchases outside the country, without any change in local food aid deliveries. This seems like the most sensible assumption for the simulation because we want to estimate the effect of LRP, not the effect of changing the amount of food aid delivered. Next we set LRP to zero starting at the first month in the sample and continuing right through the entire sample period. Using the estimated VAR parameters we then undertake a dynamic forecast of the local price variables, given historical food aid deliveries but no LRP, over the entire sample period. For the simulation we use the same price shocks that were identified using the recursive ordering in the VAR (i.e., we assume that setting LRP to zero does not alter the historical market price *shocks*, although clearly there will be a response in the price levels themselves). The result is a set of counterfactual simulated values for local market prices that represent the estimated path that prices would have taken over the sample period if food aid deliveries had stayed the same and the markets were subject to their historical supply and demand forces, but there had been no LRP purchases. Comparing the simulated counterfactual prices with actual historical prices highlights the estimated effect of the LRP activity over the sample period.

After estimation of impacts of LRP purchases on local market prices through simulation, we also use bootstrap simulations to estimate the range of maximum and minimum estimates of LRP effects. To construct bootstrapped confidence intervals for the LRP effects, we use the method outlined in Benkwitz, Lutekpohl, and Neumann (2000) and Berkowitz and Kilian (2000). This method consists of five steps. First, after estimation of the VAR, we compute residuals using the estimated VAR parameters. Second, from these residuals, we draw with replacement a sample of residuals equal to the difference between the number of time periods in the sample period and the number of lags in the VAR specification. Third, using these sampled residuals and estimated VAR parameters, we recursively construct a vector of pseudo data and re-estimate the VAR parameters using the generated pseudo data.

Table C1. Dropped Simulations Required to Generate Bootstrap Replications

Country	Number of dropped simulations
Uganda	8,574
Mozambique	2,645
Ethiopia	2,380

Source: Authors' elaboration.

Fourth, we calculate the LRP effects using the simulation procedure explained in the previous paragraph using the new set of VAR parameters obtained from the pseudo data. Finally, steps one through four are repeated 1,200 times to compute a 90% confidence interval for the LRP effects using the percentile-t approach (see, for example, Efron 1979; and DiCiccio and Efron 1996) . We choose the percentile-t approach to construct the confidence bounds because the resulting confidence bounds are not dependent on distributional assumptions unlike the ones obtained from the normal approximation approach. When bootstrapping the confidence intervals, we drop simulated price paths that lead to negative simulated prices, which is equivalent to placing probability zero on negative simulated prices. Including the negative price simulations would have distorted the results because we know a priori that prices cannot be negative. The number of dropped simulations required to generate 1200 bootstrap replications for the confidence intervals are shown in Table C1.

C.2. Application to Uganda

The application to Uganda focuses on maize. Prices from three local wholesale maize markets are included in the VAR—Kisenyi, Masindi, and Lira. Kisenyi is the main wholesale maize market for the capital city of Kampala, located in the central region of the country. Large and medium-sized maize traders throughout the country monitor prices in Kisenyi and many of them trade there. Kisenyi is therefore viewed as the largest and most liquid market for price discovery. Masindi and Lira are two important markets in key maize surplus producing regions in Western and Northern Uganda. These two markets are key sources for maize flowing into Kampala and crossing the border into Kenya and South Sudan. In the recursive form of the VAR we order these prices $\text{Kisenyi} \rightarrow \text{Masindi} \rightarrow \text{Lira}$. Other market prices could potentially have been included. For example, Mbale and Kapchorwa are major maize producing areas in Eastern Uganda. These markets are also key sources of Ugandan maize exported to Kenya. However, while some maize price data are available for Mbale market, there were too many missing observations to include this price in the VAR. And no maize price data are available for Kapchorwa market. Therefore, we only included three regional market prices in the VAR, but we would not expect results to be sensitive to the inclusion or exclusion of additional regional price variables because of effective regional maize price transmission in Uganda.

C.2.1. Data and Preliminary Testing

The Ugandan maize VAR was estimated using monthly data from January 2001 through December 2011. Monthly data on maize food aid distributions and LRP purchases in Uganda measured in metric tons (MT) were obtained from WFP. The WFP competitive tendering process involves four steps: (i) the tender is announced; (ii) suppliers submit bids; (iii) bids are reviewed and winners are chosen; and (iv) contracts are awarded and purchase orders are

issued. It takes about two to three weeks from the date tenders are announced to the date purchase orders are typically issued. Interviews we conducted in Uganda, Ethiopia, and Mozambique in late 2012 revealed that markets may begin to respond to LRP purchases soon after tenders are announced. After tender announcements, some traders immediately enter the market to start assembling grain under the expectation that contracts will be awarded to them. Hence, tender dates would be the most desirable date to use in constructing monthly LRP purchase quantities. However, given tender dates are not available, only purchase order dates, we aggregate the daily procurement data into monthly series by summing LRP purchases (MT) that had purchase order dates in that month. Given the monthly aggregation the distinction between tender date and purchase order date becomes less important.
Food aid data were provided by the International Food Aid Information System, which was developed by WFP. Food aid is reported based on the date shipments arrived in a given food aid recipient country. We aggregate the food aid deliveries in each month to create a monthly food aid series for Uganda, measured in MT.

Weekly maize prices for the three wholesale markets were obtained from Farmgain Africa (see Annex B for description of how the data were collected). The weekly prices were averaged to get an estimate of monthly prices. All prices are measured in Ugandan Shillings per metric ton (UGX/MT). All price series included in our VAR specification have missing observations: 3% in Kisenyi, 2% in Masindi and 4% in Lira during the entire sample period. We impute missing observations using best subset regressions. This approach consists of regressing wholesale maize prices in each location on wholesale maize prices in all markets for which price data are available. Then, predicted prices from the regressions are used to fill in missing observations. In addition to the three markets included in our VAR specification, the following markets were included as explanatory variables in the best subset regressions: Arua, Kabale, Masaka, Mbarara, Nakawa, Owino, Soroti, and Tororo. The effects of this procedure for imputing missing observations are unknown. However, as argued by Myers (2013), imputation of missing observations using best subset regressions is likely to have little impact on the dynamic relationships between prices because the specifications of the best subset regressions do not take dynamics into account (no lags of the wholesale prices are included in the specifications).

Summary statistics over the sample period for the five variables included in the Uganda VAR are reported in Table C2. During the sample period, WFP distributed on average 5.8 thousand MT of maize per month and bought an average 6.8 thousand MT per month in Uganda. This indicates that not all LRP bought in Uganda was distributed in Uganda. The maximum LRP purchase in any month over the sample period was 32.2 thousand MT. Both food aid distributions and LRP purchases fluctuated considerably over the sample period. Table B2 also shows that average prices are highest in Kisenyi, as expected. Over the same period, wholesale monthly maize prices in all three markets show considerable variability and strong co-movement, consistent with strong spatial price transmission between these markets.

Table C2. Descriptive Statistics for the Uganda VAR Variables

Variable	Mean	Standard deviation	Maximum	Minimum
Maize food aid deliveries (MT)	5,837	7,718	41,957	0
LRP maize purchases (MT)	6,804	6,957	32,251	0
Kisenyi wholesale maize price (UGX/MT)	357,092	191,248	1,307,500	103,583
Masindi wholesale maize price (UGX/MT)	311,891	186,524	1,250,000	63,750
Lira wholesale maize price (UGX/MT)	342,273	204,115	1,525,000	64,000

Source: Authors' elaboration using WFP procurement data and price data from FEWSNET/Uganda.

The choice to estimate in VAR or VEC form depends on the stationarity and cointegration properties of the data. Table C3 contains results from augmented Dickey-Fuller and Phillips-Perron tests for nonstationarity (unit roots) in each variable. The evidence is mixed, depending on which statistic is used and whether a time trend is included. Because OLS estimation of the VAR form remains consistent even under nonstationarity and cointegration, and because the primary goal here is policy simulation not hypothesis testing, we chose not to impose VEC restrictions and instead to estimate the model as an unrestricted VAR in the levels of all variables.

Table C3. Nonstationarity Tests for the Uganda VAR Variables

	H_o: Unit root H_1: Stationary process		H_o: Unit root H_1: Stationary process with trend	
	Dickey-Fuller	Phillips-Perron	Dickey-Fuller	Phillips-Perron
	Level			
Kisenyi wholesale maize price	-3.047	-2.269	-4.875	-3.470
	(0.0308)	(0.1823)	(0.0003)	(0.0428)
Masindi wholesale maize price	-2.958	-2.267	-4.720	-3.490
	(0.0390)	(0.1829)	(0.0006)	(0.0405)
Lira wholesale maize price	-2.824	-2.609	-4.248	-4.101
	(0.0549)	(0.0911)	(0.0038)	(0.0063)
Maize LRP quantity	-2.785	-9.502	-2.681	-9.688
	(0.0605)	(0.0000)	(0.2442)	(0.0000)
Maize food aid delivery	-2.854	-11.237	-2.838	-11.193
	(0.0510)	(0.0000)	(0.1833)	(0.0000)
	First difference			
Kisenyi wholesale maize price	-6.700	-9.664	-6.671	-9.615
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Masindi wholesale maize price	-4.862	-9.610	-4.894	-9.569
	(0.0000)	(0.0000)	(0.0003)	(0.0000)
Lira wholesale maize price	-8.627	-11.862	-8.602	-11.812
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Maize LRP quantity	-13.157	-27.322	-13.150	-27.297
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Maize food aid delivery	-9.258	-27.984	-7.304	-27.909
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Source: Authors' elaboration using data from FEWSNET/Uganda.
Notes: Numbers in parentheses under the statistics are p-values. The number of lagged price differences included in the augmented Dickey-Fuller tests varies by variable. The procedure used to choose the number of lags was to start with zero and add lags until there was no evidence of autocorrelation in the residuals from the Dickey Fuller regression.

Various criteria are used to determine the appropriate lag length for VARs, each with their advantages and disadvantages. Information criteria, such as final prediction error, Akaike's information criterion, and Schwarz's Bayesian information criterion are often used, along with likelihood ratio (LR) tests for the null hypothesis that one more lag is needed. Another key criterion for adequate lag length is to ensure that none of the residuals from any equation show evidence of autocorrelation. In the application to Uganda we applied both information criteria and likelihood ratio tests but unfortunately the results were contradictory. The information criteria suggested relatively short lag lengths of 1-2 months while the LR tests suggested very long lag lengths of 20 or more months were needed. Because very long lag lengths can lead to over-parameterized models we used a procedure of starting with the lower lag length suggested by the information criteria and testing the residuals for autocorrelation. If statistically significant evidence of autocorrelation was found in any residual we then increased the lag length by one and repeated the procedure. When no additional autocorrelation was found that is the lag length we chose. In the Uganda model the lag length chosen using this procedure was five months.

We also did sensitivity analysis to see if the simulated LRP effects were sensitive to the choice of lag length. Unfortunately, in the Uganda model these simulation results were quite sensitive to lag length (small changes in lag length often led to major changes in simulated LRP effects). Therefore, while the results we report in the main body of the report for the five lag model are our preferred estimates, we acknowledge that simulation results for LRP effects on local prices appear quite sensitive to the choice of lag length.

There are two growing seasons in Uganda so it was expected that data, especially prices, would have a strong seasonal component. So in addition to a constant term we included a seasonal component in the deterministic part of the VAR. The seasonal component was represented as a Fourier approximation to an unknown seasonal pattern (i.e., as a linear combination of sine and cosine functions with different frequencies). This provides a very flexible representation for an underlying seasonal pattern in the VAR variables. The resulting seasonal component was statistically significant and followed a logical pattern (prices were lowest after each harvest and then increased during the maize growing season to reach a peak just prior to the next harvest, only to fall again). There was mixed evidence of time trends in the data over some sample sub-periods. However, given that the evidence is mixed, and that it has been argued that VAR policy models are best estimated without explicit time trends, we exclude a time trend from the deterministic component.

C.2.2. Results

Most of the estimated parameters from the VAR do not, by themselves, have an economic interpretation or individual economic significance. Therefore we do not report a full set of estimation results for all parameters. However, in Table C4 we provide model evaluation statistics for the Uganda VAR. The R^2 values are coefficients of determination giving a summary measure of the goodness of fit of each equation, and show that the VAR fits the price data reasonably well. However, there is a lot of unexplained variation in the food aid and LRP data. This is to be expected because there are many other considerations besides lagged food aid, LRP, and prices that go into determining WFP food aid and LRP choices.

Tests for autocorrelation in the residuals of each equation in the VAR strongly support the hypothesis residuals are not autocorrelated, which suggests the use of five lags in the Uganda VAR is appropriate (see Table C4).

Table C4. VAR Model Evaluation Statistics for Uganda Maize

Statistic	Equation				
	Food aid distributions	LRP purchases	Kisenyi price	Masindi price	Lira price
R^2	0.318	0.324	0.893	0.984	0.951
AR(1)	0.031	0.024	0.073	0.056	0.051
	(0.859)	(0.878)	(0.787)	(0.814)	(0.821)
AR(6)	1.284	1.666	2.543	1.461	1.676
	(0.973)	(0.948)	(0.864)	(0.962)	(0.947)
AR(12)	6.738	10.643	6.310	14.467	6.402
	(0.874)	(0.560)	(0.900)	(0.272)	(0.894)
ARCH(1)	1.690	1.401	44.513	0.322	0.051
	(0.194)	(0.236)	(0.000)	(0.571)	(0.822)
ARCH(6)	5.227	4.958	47.377	4.041	5.797
	(0.515)	(0.549)	(0.000)	(0.671)	(0.446)
ARCH(12)	7.732	12.506	47.469	16.990	11.815
	(0.806)	(0.406)	(0.000)	(0.150)	(0.461)
Seasonal component	0.721	2.552	4.746	14.502	1.299
	(0.697)	(0.279)	(0.093)	(0.001)	(0.522)

Source: Authors' elaboration.

Notes: AR(*i*) indicates Portmanteau (Q) statistics for testing the null of no autocorrelation against the alternative of *i*th degree autocorrelation in the residuals. ARCH(*i*) indicates Portmanteau (Q) statistics for testing the null of no autocorrelation against the alternative of *i*th degree autocorrelation in the *squared* residuals (a test for conditional heteroscedasticity). The seasonal component is a Chi-square statistic for testing the null of no seasonal component. Numbers in parentheses under statistics are associated p-values.

Tests for autocorrelation in the squared residuals (a test for conditional heteroscedasticity) show evidence of conditional heteroscedasticity in the Kisenyi price equation. However, OLS estimation of the VAR remains consistent in the presence of conditional heteroscedasticity, and since we are using the parameter estimates for simulation not hypothesis testing we do not explicitly model the conditional heteroscedasticity. Tests on the seasonal component support the conclusion that the seasonality is significant in the Kisenyi and Masindi price equations but not in the food aid, LRP or Lira price equations. Overall, the model evaluation statistics indicate that the Uganda VAR does a good job of capturing historical correlations in the food aid, LRP, and local price data.

The policy simulation was undertaken as explained in the methods section above and results for Uganda maize are reported, along with other country application results, in Table 8 and Figures 31 through 33 on pages 57, and 58 through 60, respectively in Chapter 6.

C.3. Application to Mozambique

The application to Mozambique focuses on the effects of maize LRP on local maize prices. Prices from three domestic maize markets are included in the VAR: Maputo, Chimoio, and Nampula. The capital city of Maputo is a major consumption center in the South.

Because this is a major liquid market where a lot of price discovery takes place, we put the Maputo price first among prices in the recursive order for the VAR. Chimoio is the major market in the central region, so we include this market and order it second among the prices. The more distant and isolated northern market of Nampula is placed last in the recursive VAR order.

C.3.1. Data and Preliminary Testing

The Mozambique maize VAR was estimated using monthly data from January 2001 through December 2011. Monthly maize food aid distributions and LRP data were constructed from information provided by WFP, as explained in the Uganda application above. Price data for Mozambique are from SIMA and constructed as explained in Annex A. Prices are measured in Mozambique Metical per metric ton (MZN/MT). Missing observations occur in all price series included in the VAR. The proportions of missing observations in Maputo, Chimoio and Nampula prices are 2%, 4%, and 6%, respectively. As in the application to Uganda, missing observations are imputed using best subset regressions. The following markets are included as controls in the best subset regressions: Maputo, Manica, Chimoio, Tete, Nampula, and Lichinga.

Summary statistics for the five variables in the Mozambique maize VAR are provided in Table C5. Over the sample period WFP distributed an average 2,000 MT of maize per month as food aid and bought an average 1,618 MT through LRP. On average, food aid distributions therefore exceeded LRP purchases. The maximum LRP maize purchase in Mozambique during any month was 15,879 MTs. Clearly, there was considerable variation in both maize food aid distributions and LRP over the sample period. Average maize price over the sample period was highest in Maputo (as expected). All prices were quite variable over the sample period and, although not shown in the summary statistics, there was considerable price co-movement especially between Maputo and Chimoio prices. Maputo prices do seem less variable than prices in other markets, perhaps because the South depends on maize imports from South Africa, while the central and northern parts of the country rely almost solely on domestically produced maize.

Table C5. Descriptive Statistics for the Mozambique VAR Variables

Variable	mean	Standard deviation	Maximum	Minimum
Maize food aid distributions (MT)	2,000	2,708	19,249	0
LRP maize purchases (MT)	1,618	2,651	15,859	0
Maputo retail maize price (MZN/MT)	7,809	3,338	13,196	2,571
Chimoio retail maize price (MZN/MT)	5,490	2,916	13,943	1,371
Nampula retail maize price (MZN/MT)	5,612	2,577	13,571	1,330

Source: Authors' elaboration using procurement data from WFP and price data from SIMA/Mozambique.

Preliminary tests for nonstationarity in all variables included in the Mozambique maize VAR model are reported in Table C6. The evidence suggests all variables are stationary when a time trend is excluded, while prices show evidence of nonstationarity when a time trend is included. Given the mixed results, the fact that OLS estimates of the unrestricted VAR form remain consistent under nonstationarity and cointegration, and the desire to maintain a consistent estimation framework across the three country applications, we estimated the Mozambique maize VAR in the levels of all variables.

Table C6. Nonstationarity Tests for the Mozambique VAR Variables

	H_o: Unit root H_1: Stationary process		H_o: Unit root H_1: Stationary process with trend	
	Dickey-Fuller	Phillips-Perron	Dickey-Fuller	Phillips-Perron
	Level			
Retail maize price in Maputo	-1.717	-1.503	-3.876	-3.456
	(0.4222)	(0.5320)	(0.0131)	(0.0443)
Retail maize price in Chimoio	-2.834	-2.443	-4.410	-3.459
	(0.0536)	(0.1299)	(0.0021)	(0.0440)
Retail maize price in Nampula	-3.120	-2.856	-4.537	-3.862
	(0.0251)	(0.0507)	(0.0013)	(0.0137)
LRP volume in Mozambique	-7.041	-11.390	-7.146	-11.504
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Maize food aid delivery	-7.653	-12.487	-7.621	-12.445
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	First difference			
Retail maize price in Maputo	-6.353	-9.369	-6.326	-9.329
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Retail maize price in Chimoio	-5.921	-7.413	-5.901	-7.381
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Retail maize price in Nampula	-6.393	-8.928	-6.630	-8.897
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LRP volume in Mozambique	-7.328	-30.071	-7.290	-29.958
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Maize food aid delivery	-5.855	-31.869	-5.795	-31.728
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Source: Authors' elaboration using procurement data from WFP and price data from SIMA/Mozambique.
Notes: Numbers in parentheses under the statistics are p-values.

Results from the information criteria suggested that 1 lag is required for the Mozambique VAR while LR tests indicated that 15 or more lags were needed. Similar to Uganda, the lag length was chosen by starting from the lowest lag length suggested by the information criteria and adding lags until autocorrelation was eliminated from all of the VAR residuals. This procedure suggested that three lags were appropriate for the Mozambique model. Results from sensitivity analysis showed that the estimated LRP effects on prices are not very sensitive to the lag order for the VAR model. Like the Uganda model, the deterministic part of the Mozambique maize VAR model includes a constant and a seasonal component but no time trends.

C.3.2. Results

As in the case of Uganda, the Mozambique VAR parameters do not have individual economic or policy significance. Therefore we do not report a full set of estimation results for the model. However, results from model specification tests for the third-order VAR are presented in Table C7. R^2 values suggest that the VAR with 3 lags fits the price data well but there is a lot of unexplained variation in food aid distributions and LRP purchases (as expected). Tests for autocorrelation in the residuals from each equation show no evidence of residual autocorrelation in the model, implying that the VAR with 3 lags is appropriate. Tests for conditional heteroscedasticity suggest these effects are not present except perhaps in the Nampula price equation.

Table C7. VAR Model Evaluation Results for Mozambique

	Equation				
Statistic	Food aid delivery	LRP purchase	Maputo	Chimoio	Nampula
R2	0.103	0.121	0.953	0.953	0.932
AR(1)	0.004	0.163	0.013	0.019	0.016
	(0.949)	(0.687)	(0.911)	(0.889)	(0.901)
AR(6)	4.690	1.326	6.613	1.590	1.639
	(0.584)	(0.970)	(0.358)	(0.953)	(0.950)
AR(12)	10.253	7.846	11.175	14.003	7.116
	(0.594)	(0.797)	(0.514)	(0.300)	(0.850)
ARCH(1)	0.330	0.057	3.089	0.496	16.717
	(0.566)	(0.811)	(0.079)	(0.481)	(0.000)
ARCH(6)	9.550	0.662	5.867	3.149	20.118
	(0.145)	(0.995)	(0.438)	(0.790)	(0.003)
ARCH(12)	10.941	7.893	8.629	5.350	25.756
	(0.534)	(0.793)	(0.734)	(0.945)	(0.012)
Seasonal component	0.221	2.491	7.413	7.402	14.067
	(0.895)	(0.288)	(0.025)	(0.025)	(0.001)

Source: Authors' elaboration.
Notes: AR(*i*) indicates Portmanteau (Q) statistics for testing the null of no autocorrelation against the alternative of *i*th degree autocorrelation in the residuals. ARCH(*i*) indicates Portmanteau (Q) statistics for testing the null of no autocorrelation against the alternative of *i*th degree autocorrelation in the *squared* residuals (a test for conditional heteroscedasticity). The seasonal component is a Chi-square statistic for testing the null of no seasonal component. Numbers in parentheses under statistics are associated p-values.

However, given that evidence of conditional heteroscedasticity was only found in one equation, and that OLS estimates of VAR parameters remain consistent under conditional heteroscedasticity, we do not model this phenomenon explicitly. Tests for seasonality suggest a significant seasonal component in all prices, but not in maize food aid distributions or LRP.

The policy simulation was undertaken as explained in the methods section above and results for Mozambique maize are reported, along with other country application results, in Table 8 and Figures 31 through 33 in Chapter 6.

C.4. Application to Ethiopia

For the application to Ethiopia we focus on LRP effects on retail horse bean prices. Horse bean prices were used because price data on red and white haricot beans are not available over a sufficiently long period. WFP Ethiopia Office has provided LRP beans purchases broken down by type from July 2009 to July 2012. However, data on disaggregated WFP beans purchases by type prior to July 2009 are not available. These data limitations make it difficult to evaluate the impacts of LRP disaggregated by bean type. However, horse bean prices and aggregate LRP bean purchases are available monthly from January 2001 to December 2011 so these are the data used in the Ethiopia VAR. Examining the relationship between prices for haricot beans and horse beans in Dessie over the part of the sample period where both are available suggests a strong relationship between wholesale prices of haricot beans and horse beans. Given this observed co-movement between haricot bean prices and horse bean prices, we argue that a model based on horse bean prices only can provide a reasonable estimate of the effects of LRP aggregate bean purchases on local bean prices.

Horse bean prices from three local markets are included in the VAR: Dire Dawa, Dessie, and Awassa. Dire Dawa is second only to Addis Ababa as the largest city in Ethiopia, generating a large demand for beans. Hence, we assume Dire Dawa is the main market for price discovery and order it first among prices in the recursive structure for the VAR. Addis Ababa price is not included in the VAR because Awassa would be a better representation of a bean surplus market in the Oromia-SNNP region than Addis Ababa would be. Although Addis Ababa is located in a major bean producing area in the country, high population density and urbanization creates sizeable demand for bean in Addis Ababa, making Addis Ababa behave more like a deficit market than a surplus market. Dessie is one of the main bean surplus markets in the Amhara region, while Awassa is the key bean surplus market in the SNNP region. Both Amhara and SNNP regions are key sources of bean flowing to deficit areas, especially to the outskirts of Ethiopia. Dessie was put before Awassa in the recursive ordering because compared to Dessie, Awassa is a more important bean surplus market.

C.4.1. Data and Preliminary Testing

Monthly data from September 2001 through December 2011 are used to estimate the Ethiopia bean VAR. Monthly bean food aid distributions and LRP purchases were constructed from data provided by WFP, as described in detail for Uganda case above. Monthly retail prices for horse beans are from the Ethiopian CSA, as described in Annex A. Prices are reported in ETB per quintal. We converted prices into ETB/MT by multiplying them by 10. The Ethiopian VAR includes the following markets: Dessie, Awassa, and Dire Dawa. Over the sample period, 8%, 9% and 8% of the price observations in Dessie, Awassa, and Dire Dawa are missing.

Table C8. Descriptive Statistics for the Ethiopia VAR Variables

Variable	Mean	Standard deviation	Maximum	Minimum
Bean food aid distributions (MT)	4,800	8,878	44,500	0
LRP bean purchases (MT)	1,306	2,058	11,058	0
Dire Dawa retail bean price (ETB/MT)	4,904	3,280	16,000	1,433
Dessie retail bean price (ETB/MT)	3,847	2,788	13,333	767
Awassa retail bean price (ETB/MT)	4,693	3,359	16,000	1,133

Source: Authors' elaboration using procurement data from WFP and price data from FEWSNET/Ethiopia.

As in the applications to Uganda and Mozambique, we imputed missing observations using best subset regressions. In addition to these three markets, we include the following markets in the best subset regressions: Asossa, Asayita, and Bahir Dar.

Table C8 provides summary statistics for the five variables included in the Ethiopian VAR. Over the sample period an average 4.8 thousand MTs of beans per month were distributed as food aid in the country, while 1.3 thousand MTs were purchased as LRP. On average, the amount of beans being distributed in Ethiopia as food aid has been about four times higher than LRP. Bean food aid distributions have been as high as 44.5 thousand MT in a single month and monthly LRP purchases have been as high as 11.1 MT. There is also considerable variability in both monthly bean food aid distributions and monthly bean LRP.

Monthly horse bean prices averaged 4,900 ETB/MT in Dire Dawa over the sample period. As expected, bean prices in Dire Dawa are generally higher than in other markets. There is also considerable variation over time in bean prices, and strong co-movement across markets. The latter is consistent with the assumption of effective spatial bean price transmission across regional markets in Ethiopia.

Preliminary tests for nonstationarity (unit roots) in all five variables in the Ethiopia VAR are reported in Table C9. Results support nonstationary behavior in all three price variables, but that bean food aid distributions and LRP are stationary. This suggests there may be an improvement in efficiency and hypothesis testing performance from estimating the model in VEC form. However, because OLS estimates of the unrestricted VAR parameters remain consistent under nonstationarity, and because there is some value in applying consistent modeling procedures across all three country applications, we follow the same procedure used in the Uganda and Mozambique maize models and estimate the unrestricted VAR form of the model.

Information criteria suggested that 1 to 2 lags are needed for the Ethiopia bean VAR while LR tests indicated that very long lag lengths of 15 or more were required. Given this inconsistency we chose the lag length by started with the 2 lags suggested by the information criteria and kept adding higher lags until autocorrelation in all residuals was eliminated. Using this procedure, we chose a lag order of three months for the Ethiopia bean VAR. However, sensitivity results showed that the estimated LRP effects on prices were quite sensitive to the lag order of the model (small changes in the lag length resulted in major changes in the estimated LRP effect).

Table C9. Nonstationarity Tests for the Ethiopia VAR Variables

	H_o: Unit root H_1: Stationary process		H_o: Unit root H_1: Stationary process with trend	
	Dickey-Fuller	Phillips-Perron	Dickey-Fuller	Phillips-Perron
	Level			
Retail bean price in Dire Dawa	-0.761	0.537	-3.020	-1.477
	(0.8305)	(0.9860)	(0.1266)	(0.8367)
Retail bean price in Dessie	-1.491	-0.290	-3.337	-1.991
	(0.5379)	(0.9269)	(0.0604)	(0.6065)
Retail bean price in Awassa	2.102	0.467	-2.565	-1.531
	(0.9988)	(0.9838)	(0.2965)	(0.8185)
LRP bean purchases	-2.992	-11.950	-3.016	-12.081
	(0.0357)	(0.0000)	(0.1277)	(0.0000)
Bean food aid distributions	-7.269	-11.478	-7.449	-11.622
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	First difference			
Retail bean price in Dire Dawa	-4.042	-9.479	-3.119	-9.579
	(0.0012)	(0.0000)	(0.1019)	(0.0000)
Retail bean price in Dessie	-5.635	-10.416	-5.616	-10.443
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Retail bean price in Awassa	-2.565	-12.355	-3.749	-12.525
	(0.2965)	(0.0000)	(0.0194)	(0.0000)
LRP bean purchases	-13.166	-36.938	-13.111	-36.754
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Bean food aid distributions	-8.488	-33.491	-8.466	-33.347
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Source: Authors' elaboration using procurement data from WFP and price data from FEWSNET/Ethiopia.
Notes: Numbers in parentheses under the statistics are p-values. The number of lagged price differences included in the augmented Dickey-Fuller tests varies by variable. The procedure used to choose the number of lags was to start with zero and add lags until there was no evidence of autocorrelation in the residuals from the Dickey Fuller regression.

The deterministic part of the Ethiopia bean VAR contains a constant and a seasonal component to account for seasonal patterns in bean prices. No time trend was included for the same reasons as explained in the other country applications.

C.4.2. Results

As in the other country applications, the Ethiopia bean VAR parameters do not have individual economic or policy significance. Therefore we do not report a full set of estimation results for the model. However, results from model specification tests for the third-order

VAR are presented in Table C10. Similar to the country applications, R^2 values suggest that the VAR model fits the price data well but there is a lot of unexplained variation in food aid distributions and LRP purchases (as expected). Tests for autocorrelation in the residuals from each equation show no evidence of residual autocorrelation in the model, implying that the VAR with 3 lags is appropriate. Tests for conditional heteroscedasticity suggest these effects are in all equations except food aid. Nevertheless, since OLS estimates of VAR parameters remain consistent under conditional heteroscedasticity we do not model this phenomenon explicitly. Tests for seasonality suggest a significant seasonal component in Dessie prices, but not in other variables in the model. A joint test on the combined seasonal components in all equations suggests they are jointly significant, so we included a seasonal component in the deterministic part of each equation in the VAR.

The policy simulation was undertaken as explained in the methods section above and results for Ethiopia beans are shown, along with the results for the other country applications, in Table 8 and Figures 31 through 33 in Chapter 6.

Table C10. VAR Model Evaluation Statistics for Ethiopia Beans

	Equation				
Statistic	Food aid distributions	LRP purchases	Dire Dawa Price	Dessie Price	Awassa Price
R^2	0.192	0.196	0.989	0.984	0.987
AR(1)	0.000	0.151	0.112	0.062	0.065
	(0.993)	(0.698)	(0.738)	(0.803)	(0.799)
AR(6)	2.475	12.135	2.989	5.635	3.728
	(0.871)	(0.059)	(0.810)	(0.465)	(0.713)
AR(12)	8.591	15.514	10.872	9.048	11.454
	(0.737)	(0.215)	(0.540)	(0.699)	(0.491)
ARCH(1)	0.003	0.230	4.489	0.001	45.475
	(0.957)	(0.632)	(0.034)	(0.975)	(0.000)
ARCH(6)	0.599	30.070	17.827	19.588	55.103
	(0.996)	(0.000)	(0.007)	(0.003)	(0.000)
ARCH(12)	0.898	32.811	30.248	33.366	57.361
	(1.000)	(0.001)	(0.003)	(0.001)	(0.000)
Seasonal component	4.778	0.855	3.131	8.645	2.919
	(0.092)	(0.652)	(0.209)	(0.013)	(0.232)

Source: Authors' elaboration.

Notes: AR(*i*) indicates Portmanteau (Q) statistics for testing the null of no autocorrelation against the alternative of *i*th degree autocorrelation in the residuals. ARCH(*i*) indicates Portmanteau (Q) statistics for testing the null of no autocorrelation against the alternative of *i*th degree autocorrelation in the *squared* residuals (a test for conditional heteroscedasticity). The seasonal component is a Chi-square statistic for testing the null of no seasonal component. Numbers in parentheses under statistics are associated p-values.

ANNEX D. TECHNICAL DETAILS OF THE HOUSEHOLD WELFARE EFFECTS ESTIMATION

To quantify the impacts of a price change on household welfare we use a proportional compensating variation approach (see Friedman and Levinsohn 2002 and Mghenyi, Myers, and Jayne 2011). Proportional compensating variation is the proportional reduction in a household's income that would have to be made in order to make them as well-off after the price change as they were before it. Starting with the pioneering work of Deaton (1989), first-order and second-order approximations of compensating variation measures have been employed extensively in the literature to assess the welfare effects of price changes, especially after the spike in global food prices in 2008 (Friedman and Levinsohn 2002; Mghenyi, Myers, and Jayne 2011; Vu and Glewwe 2011; Azzam and Rettab 2012; Ferreira et al. 2013).

More formally, consider the indirect utility function for household i, $V_i[p_i; y_i + \pi_i(p_i)]$, as an ordinal measure of household utility given commodity price p_i and assuming the household makes utility maximizing consumption choices and profit maximizing production choices. Here $\pi_i(\cdot)$ is profit from commodity production and y_i is other income (excluding income from production of the commodity). The household is implicitly assumed to sell all of its commodity production at price p_i and to buy back its consumption choice at that same price. Therefore, $\pi_i(\cdot)$ is the total profit from all production of the commodity (whether own-consumed or not).

A proportional compensating variation measure of the welfare effect of a change in the household's price from p_i^0 to p_i^1 is defined implicitly by an *m* that satisfies:

(D1) $$V\left[p^0; y + \pi\left(p^0\right)\right] \equiv V\left\{p^1; (1-m)\left[y + \pi\left(p^1\right)\right]\right\}$$

where we have dropped the i subscript to simplify notation. By definition, *m* is the proportional reduction in income that would have to be made after the price change to make the household as well off as it was before the change (positive when the price change increases welfare and negative when the price change decreases welfare). It has been shown that *m* is a theoretically consistent cardinal money metric measure of welfare change for binary comparisons (e.g., with and without the price change); see Deaton (1989). Following Mghenyi, Myers, and Jayne (2011), and others, we take a second-order Taylor series approximation of the left-hand side of (D1) around $(p^0, m) = (p^1, 0)$ to get:

(D2) $$V\left(p^1\right) + \left[V_p + V_y \pi_p\right]\left(p^0 - p^1\right) + \frac{1}{2}\left\{V_{pp} + 2V_{py}\pi_p + V_{yy}\left(\pi_p\right)^2 + V_y \pi_{pp}\right\}\left(p^0 - p^1\right)^2$$

where subscripts denote derivatives with respect to the subscripted variable evaluated at the post-change price p^1. Similarly, defining $y^1 = y + \pi(p^1)$ and taking a second-order Taylor approximation of the right-hand side of (D1) at $m = 0$ gives:

(D3) $$V\left(p^1\right) - V_y y^1 m + V_{yy}\left(y^1\right)^2 m^2$$

The term in m^2 is of higher order and can be ignored in the context of a second-order linear approximation. Imposing this restriction, equating (D2) and (D3), and solving for m we obtain:

$$\text{(D4)} \qquad m \approx -\left\{ \frac{V_p}{V_y y^1} + \frac{\pi_p}{y^1} \right\} \left(p^0 - p^1 \right) - \frac{1}{2} \left\{ \frac{V_{pp}}{V_y y^1} + \frac{2V_{py}\pi_p}{V_y y^1} + \frac{V_{yy}\left(\pi_p\right)^2}{V_y y^1} + \frac{\pi_{pp}}{y^1} \right\} \left(p^0 - p^1 \right)^2$$

Using Roy's identity and Hotelling's lemma, and making some simplifying assumptions, the first term in (D4) can be expressed as:

$$\text{(D5)} \qquad \left(s^s - s^d \right) \lambda$$

where s^s is the share of maize production in total income; s^d is the share of maize consumption expenditures ; and $\lambda = \left(p^1 - p^0 \right) / p^1$ is the change in price expressed as a proportion of the post-change price.
It can be shown (see Newbery and Stiglitz 1981; and Myers 2006) that terms in (D4) can be expressed as:

$$\text{(D6)} \qquad \frac{V_{yy}\left(\pi_p\right)^2 \left(p^1\right)^2}{V_y y^1} = -\left(s^s\right)^2 R$$

$$\text{(D7)} \qquad \frac{V_{yp}\pi_p \left(p^1\right)^2}{y^1 V_y} = s^d s^s \left(R - \xi^{dy} \right)$$

$$\text{(D8)} \qquad \frac{V_{pp}\left(p^1\right)^2}{V_y y^1} = -s^d \left[s^d \left(R - \xi^{dy} \right) + \xi^{dp} \right]$$

$$\text{(D9)} \qquad \frac{\pi_{pp}\left(p^1\right)^2}{y^1} = s^s \xi^{sp}$$

where R is the coefficient of relative risk aversion; ξ^{dy} is the income elasticity of demand; ξ^{dp} is the price elasticity of demand; and ξ^{sp} is the price elasticity of supply. Substituting (D5) through (D9) into (D4) and collecting terms then give:

$$\text{(D10)} \qquad m \approx \left(s^s - s^d \right) \lambda - \frac{1}{2} \left[s^s \xi^{sp} - s^d \xi^{dp} \right] \lambda^2 + \frac{1}{2} \left\{ \left(R - \xi^{dy} \right) \left[\left(s^d \right)^2 - 2 s^d s^s \right] + \left(s^s \right)^2 R \right\} \lambda^2$$

Equation (D10) gives proportional compensating variation measured as a proportion of base income. The welfare formula is second-order in the sense it allows for the household's production and consumption response to the price change. The first term in (D10) is the standard first-order welfare effect (no allowance for production or consumption responses), while remaining terms capture the second-order welfare effects (additional welfare change due to supply and demand responses).

D.1. Application to Uganda

For the application to Uganda, we use data from the Uganda National Panel Survey 2009/2010 to compute household-level estimates of the share of expenditures that households devote to maize and the share of total income that comes from maize production. Our measure of total household income consists of crop income (total value of crop production), livestock income (gross value of sales of livestock and livestock products), income from formal and informal labor employment of household members, revenues from medium-to-small enterprises operated by household members, and remittances and pensions received by household members. We use median district-level maize prices, estimated from the household data, to value maize production and consumption. We estimate expenditure on maize by adding expenditures on purchases from the market and implicit expenditures on consumption from own production. To compute the maize income and expenditure shares, we took income from maize production and total expenditure on maize and divided by total household income.

As in the computational model, we set supply and demand price elasticities at 0.7 and -0.8, respectively. We could not find any empirical estimates of the maize income elasticity of demand in Uganda. Following the approach of Mghenyi, Myers, and Jayne (2011) in the neighboring country of Kenya, we set the base value of income elasticity of demand for maize at 0.40 in our application to Uganda. Estimates of the coefficient of relative risk aversion in developing countries are rare in the literature. Myers (1989) generated point estimates of between 1.6 and 3.1 for U.S. farmers. Hansen and Singleton (1983) estimated values ranging from 0.0 to 2.0 for U.S. consumers. Therefore, we set the base parameter of relative risk aversion at 1.0. Mghenyi, Myers, and Jayne (2011) and Bellemare, Barrett, and Just (2013) argue that a value of one is reasonable and use the same value in their studies. Elasticities and relative risk aversion are assumed to be the same across all households. Sensitivity analysis showed that estimated welfare effects are not sensitive to a wide range of alternative assumptions about supply and demand elasticities, and relative risk aversion rates.

D.2. Application to Mozambique

For Mozambique, our estimates of maize income and expenditure shares are drawn from household-level data from the IOF 2008/09. Given that IOF 2008/09 is an expenditure survey that does not collect household income, we use total household expenditure as our estimate of total household income. Total household expenditure is made up of four components: consumption of food, non-food, durable goods, and housing. As in the case of Uganda, we obtain maize expenditures by multiplying the quantity of maize consumed by each household by the median district-level maize price. Maize expenditure consists of expenditures on maize consumed by the household whether purchased or from own production. Median district-level maize prices are computed from the household-level data. We estimate income from maize production by multiplying maize production by median district-level maize price. Maize income and expenditure shares are calculated as the ratio of income from maize production and expenditure on maize to total household expenditure, respectively.

Following the computational model we set supply and demand elasticities at 0.6 and -0.6, respectively. As in the application to Uganda, income elasticity of maize demand is set at 0.40 and the coefficient of relative risk aversion at 1.0, and results are not sensitive to these assumptions.

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