Are Staple Food Markets in Africa Efficient? Spatial Price Analyses and Beyond

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5 January 2010

Paper to be presented at the Comesa policy seminar
"Food price variability: Causes, consequences, and policy options"
on 25-26 January 2010 in Maputo, Mozambique
under the Comesa-MSU-IFPRI African Agricultural Markets Project (AAMP)

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Acknowledgements

This study was funded by African Agricultural Markets Project (AAMP). The AAMP is funded by the World Bank, administered by the Common Market for Eastern and Southern Africa (COMESA) and implemented by Michigan State University and the International Food Policy Research Institute.

Table of Contents

Introduction **1**

Understanding market efficiency and market integration **3**

.1 Key concepts 3

.2 Measuring spatial market integration and efficiency 3

.3 Market efficiency and public policies 5

Food market integration in sub-Saharan Africa **9**

.1 Western Africa 9

.2 Eastern Africa 10

.3 Southern Africa 11

.4 Summary 13

Marketing costs in sub-Saharan Africa **14**

.1 Comparison of marketing costs in Africa 14

.2 Trends in marketing costs 15

Determinants of market efficiency **17**

.1 Infrastructure 17

.2 Institutions and information 17

.3 Competition 18

.4 Policy induced factors 20

Summary and implications **25**

.1 Summary 25

.2 Implications for policy 26

.3 Implications for future research 27

..... **29**

List of Tables

1. Characteristics of traders in 6
2. Key indicators of grain trading activities in 7
3. Characteristics of methods of analyzing market 8
4. Cost of long-distance 14
5. Grain marketing costs in selected 15
6. Indicators of contract enforcement efficiency in African 18
7. Competition and credit relationship in Ugandan maize 19
8. Summary of government interventions in staple food 21

List of Figures

Figure 1: Illustration of trade and price transmission through a third market location……..26
Figure 2: Effect of macroeconomic policy on wheat prices in Ethiopia……..27

1 Introduction

Variation of commodity prices between locations and over time is a natural market phenomenon. In fact, price variation is necessary for the existence of a market, as it creates the incentives that attract market actors to engage in trade. Thus, it is not the spatial differences in of prices *per se* that should be of concern to the policy makers, but rather excessive variability and, in some cases, *no or little* variability of staple food prices across space. Excessive variability of prices, to a large extent, is a reflection of a lack of market integration across space. On the other hand, *no or little variability* in prices has often been the outcome of policy interventions, such as pan-territorial pricing, which was common in African countries in the 1970s and 1980s and continues to be practiced in some developing countries today.

Market locations across space often lack integration due to inadequate provision of public goods (such as infrastructure), inefficient flow of information, imperfect competition, and incomplete or missing institutions for risk management like credit and insurance—all of which qualify as sources of market failures. Historical evidence suggests that these forms of market failures have been an important causes of food insecurity, including famine in extreme cases. Economic theory tells us that policy interventions are justified, in the sense that they may increase aggregate welfare, if the interventions are properly designed and implemented to address those market failures in the short run; and to alleviate them all together in the long run. This implies that the policy objectives should focus on improving infrastructure, providing access to information, promoting competition, and developing risk management institutions.

The underlying objective of market integration analysis is to provide better understanding in implementation of such short- and long term policy interventions. Understanding the degree of market integration and the total transfer costs between pairs of markets can help diagnose problems in agricultural commodity markets. For example, if market margins are significantly larger than the cost of transporting the commodity from one market to the other, this may indicate lack of market information, trade barriers, or credit constraints. Alternatively, if the costs of transportation are much higher between two markets than for other market pairs or in nearby countries, this may suggest that road quality, imperfect competition in the transport sector, or excessive checkpoints are an issue.

In addition, knowledge of spatial market integration can also help better design social safety net programs, which are essential interventions irrespective of level of development of given country. For instance, food vouchers for the poor is one of the common safety net programs in many industrialized countries. In developing countries, there has been a long standing debate over the adverse effects of food aid distributed to the poor under emergencies and safety net programs. While has been no denying about the importance of safety net programs, it is often argued that cash transfer instead of food can lead to better outcome because food distribution can depress market price and have disincentive effects on farmers. However, the policy decision to give food or cash depends partly on the efficiency of markets where beneficiaries live. If markets are integrated, cash transfers are often better because they create demand that maintains incentives for local food production. On the other hand, if markets are not integrated, then food transfers will

generally work better. If markets lack integration, a local scarcity and subsequent price hike may not result in flow of food from the surplus region that may add to human suffering.[5] Furthermore, it may be difficult for the public agencies to mobilize resources and in case of emergencies if markets lack integration. This is the rationale for holding strategic food reserves in less accessible regions of a country.

The main objective of this paper is to examine whether the staple food markets in Africa are efficient. It does so by outlining a conceptual framework for understanding spatial food price variation, summarizing the results from existing studies in market integration in sub-Saharan Africa, and providing evidence from recently conducted surveys on the determinants of market efficiency. The paper is organized following this sequence and concludes with a summary and policy implications.

[5] Historical evidence suggests that most food security crisis emerge from distribution & entitlement failure rather than production and availability of food (Sen, 1981).

2 Understanding market efficiency and market integration

2.1 Key concepts

Although market integration and market efficiency often used interchangeably, they are conceptually different, and understanding the differences is important for drawing policy implications. Thus, it is useful to begin by defining these terms and several related expressions.

Market integration refers to a situation in which a) the prices in different markets move together, b) there is trade between the markets, or c) both (Barrett, 2001). In practice, most studies of market integration use price data, so in most cases, market integration is said to exist when price changes in one market are reflected in price changes in other markets. There are several types of market integration, depending on the types of "markets" being compared. *Vertical market integration* refers to the relationship between prices at different points in the supply chain, such as wholesale and retail prices. *Spatial market integration* refers to the integration of prices for the same commodity in different locations.

Market efficiency, on the other hand, refers to the degree to which markets minimize costs and match supply with demand. More specifically, there are two types of market efficiency: exchange efficiency and operational efficiency. *Exchange efficiency* (also called arbitrage efficiency) means that there are no unexploited opportunities for mutually beneficial trade. To illustrate, consider two market locations, say A and B, where prices of a staple food commodity are and , respectively, with market location A being surplus. Suppose the transfer cost[6] between the locations given the transportation and communication infrastructure of the country at a given point in time is . Then exchange efficiency implies that

- If there is trade, then - =
- If - < , then there is no trade

In contrast*, operational efficiency* implies that there is no room for reducing transfer costs below the current level. Short-run operational efficiency refers to the inability to reduce transfer costs in the short run, though changes in procedures or policies, while long-run operational efficiency refers to the inability to reduce transfer costs through investments, such as roads and communications networks. In practice, operational efficiency is a relative term, measured by comparing costs in different regions or countries.

2.2 Measuring spatial market integration and efficiency

Since the onset of the structural adjustment program, considerable attention has been given to reaching a better understanding of agricultural market performance, especially for staple food crops. The increased interest in the subject is primarily due to the shift in policy focus towards market-led development, which envisaged rapid growth with reduced government intervention and private sector led market development. However, the early

[6] Transfer cost refers to the full cost of moving the commodity from one location to another, including the transportation costs, the cost of loading and unloading, overhead, the opportunity costs of the owner (including time to identify a buyer and negotiate a price), risk premium, and normal profits.

experiences had been mixed. There are studies to suggest that early reforms were not successful in boosting production in some developing and transition economies (Kherallah, et. al. 2002; Eicher 1999; and Seppala 1997). Theoretical studies provide link between output reduction and market performance. The central idea of this literature is that the emergence of healthy systems of market exchange takes time, as traders need to learn arbitrage skills and build market relationships (Blanchard 1997, McMillan 1995) before the full potentials of private sector led market development can be exploited.

A substantial body of literature has evolved attempting to measure market integration in order to answer the broad policy reform and market performance question. The empirical methods have involved from simple price correlation between market locations in the 1970s to early 1980s, to lagged regression methods in the late 1980s and 1990s (Ravallion, 1986), to cointegration methods in the 1990s (Alderman, 1992; Goletti and Babu, 1994). Cointegration methods take into account the fact that prices be non-stationary, which causes standard regression analysis to give misleading results[7]. It also provides information on the long-run relationship between prices and the speed of adjustment toward that long-run relationship. However, standard cointegration methods do not take into account the fact that prices may not move together because the transfer cost is too high to justify trade.

Two recent approaches attempt to take into account transfer costs and the fact that prices in different markets should not be expected to move together if the price difference is less that the marketing cost between them. They key features of these two models can be summarized as follows:

- The parity bounds model (PBM) estimates the proportion of the time a market pair is in each of three trading regimes: 1) when the price differences is equal to marketing costs, implying competitive trade and co-movement of prices, 2) when the when the differences is too small to generate trade, implying no co-movement of prices, and 3) when the price difference exceeds marketing costs, implying either temporary disequilibrium or market imperfections (Baulch, 1997). The original version of PBM estimates transfer costs (under strong assumptions), while an extension of PBM uses outside information on transfer costs and market flows (Barrett and Li, 2002).
- The threshold autoregressive (TAR) model estimates a threshold in the price margin between two markets, above which trade is profitable, and we expect co-movement of prices and below which trade is not profitable and we do not expect co-movement. The TAR model has been used to study transfer costs between markets (van Campenhout, 2007 and Meyers, 2008) and asymmetry in price response to shocks (Abdulai, 2000). As with PBM, the "threshold" can be estimated within the model or it can be fixed based on outside information.

However, even these new methods have been criticized. For instance, the PBMs are criticized for being bivariate analyses (involving just two markets) of variables that emerge from a multivariate context (Gonzalez-Rivera and Helfand, 2001; Fackler, 2004). In addition, PBM results are sensitive to underlying distributional assumptions (Fackler, 1996; and Barrett and Li, 2002), and PBM assumes shocks are serially independent and hence failing to

[7] Non-stationary variables do not have a constant mean or variance over time, one example being the "random walk" which has no tendency to return to a central value. This violates one of the assumptions behind regression analysis. The result is that regression analysis of non-stationary variables will often show a "relationship" where none exists.

explain dynamic adjustments (Fackler, 2004). On the other hand, the cointegration methods are criticized because integration is neither necessary nor sufficient for spatial market efficiency (McNew and Fackler, 1997; and Fackler and Goodwin, 2001). Although the TAR model explicitly accounts for transfer costs, it does so in a bivariate context, and statistical tests for the two-threshold version of the TAR have not been developed (Meyers, 2008).

In the next section, we illustrate some of these issues along with a discussion on the additional information needs for market integration analyses to be useful for policy guidance.

2.3 Market efficiency and public policies

While there have been significant improvements in methods and data availability, the market integration analyses have not been of much use in policy decision. The older set of methods couldn't go beyond answering whether different markets are integrated or not. Recent methods, PBM and TAR, provide additional insight in the sense that they are able detect equilibrium and disequilibrium. However, even the analyses with the latest methods are not conclusive about efficiency, as they rely on prices only because of the unavailability of actual data on transfer costs; and they do not offer specific guidance for policy makers to adopt. We explain these using two illustrative examples below.

Exchange efficiency without market integration

Is it possible for efficient markets not to be integrated? Yes. Recall that exchange efficiency is defined as a situation in which there are no unexploited possibilities for mutually beneficial exchange, while integration between markets is defined in terms of market flows, co-movement of prices, or both. If the transfer cost between the two markets is greater than the difference in prices between them, then trade between the two markets is not profitable. In this case, the markets may be efficient in the sense of there being no unexploited opportunities for trade; in this case, trade would cost more than the benefits, so there is no mutually beneficial trade. And because there is no trade, changes in the price in one market will have no effect on prices in the other market, so the two markets are not integrated.

Thus, cointegration analysis provides information on whether market prices are linked, the nature of the relationship, and the speed of adjustment over time, but the lack of market integration does not necessarily imply market inefficiency. While knowing whether markets are integrated provides a broad guideline, it does not tell us much about what causes transfer costs to be so high and what can be done to reduce the transfer costs, which is more useful to policy makers.

This point has been made by Harriss (1979), Baulch (1997), and Barrett (2001), among others. In spite of this, economists and others continue to infer, implicitly or explicitly, that lack of market integration implies market inefficiency.

Market integration without market efficiency

Conversely, it is also possible to have market integration without market efficiency. For example, suppose that transfer costs are twice as high as they could be, either because of collusion among traders, regulated transportation rates, or a large number of check-points where "informal payments" must be made. If the price difference between the two markets is large enough, there will be trade between the markets, co-movement of prices, and

perhaps even rapid adjustment to changes in the other market, even though the market is not efficient.

Another example concerns the case when there is a third market, call it market C, and that commodity trade occurs first from A to B and then from B to C, but not directly from A to C, implying an additional transaction costs and hence increase in the price of the commodity in the market location C. This may occur for several reasons: lack of capital to finance the longer trip, lack of trust (social capital) between traders in markets A and C, or language differences. To make it a bit more complicated we could possibly add a few more stops between A and C and still argue that trade flow between the two locations is possible because price difference could be larger than sum of the transfer costs from one market to another between the two terminal locations.

Two important questions arise from this illustration: (i) how would a market integration analysis, irrespective of the methods used, characterize this situation? and (ii) is this scenario realistic for African or any other developing country markets? The answer to the first question is straightforward: given that the conditions of market integration are satisfied, (i.e., prices move together and commodity flows from A to C), an empirical market integration analysis would concluded these markets to be integrated. However, these markets are not efficient because commodity transfer is not taking place at minimum cost for the given level of infrastructure and information network of the country. In other words, additional market efficiency can be achieved by facilitating trade between markets A and C.

To address the second question, we examine two agricultural market surveys, one in Ethiopia and the other in Uganda, conducted by IFPRI. Table 1 presents data from the Uganda survey showing the trading radius of the sampled maize traders. The estimates on the distance between trading premise and both purchase and sales markets clearly supports the main point above: that is, given Ugandan traders carry out transactions within a radius of 60-65 kilometers, it is unlikely for two market locations to be efficient even when a price transmission analysis concludes to be so. Rashid (2004), which found Kampala and Masindi to be integrated, two market locations that are 220 kilometers apart. If the grain traders between Kampala and Masindi operate only within 60 kilometers, it would take several stops before maize from Masindi reach the country's capital city Kampala, which is probably not efficient given the costs of loading and unloading.

Table 1. Characteristics of traders in Uganda

Regions and Districts	Years in agricultural trading	Distance from trading premise to:	
		Purchase markets (Kms)	Sales markets (Kms)
Central Region	6.22	74	35
Eastern Region	6.31	55	45
Northern Region	5.95	50	84
Western Region	5.72	80	77

The second set of data comes from a recent survey of grain traders in Ethiopia. Although the sampled traders were engaged primarily in trade in food grains, mainly maize, teff, and wheat. For a sample of recent transactions, the survey collected data on components of transactions costs, credits, and distance from purchase locations to sales locations (see Table 2). Except for Addis Ababa, which included mainly retailers, the estimates tell the

similar story as Uganda. The grain traders in Amhara, Oromya (merged with SNNP), and Tigray regions operate within a radius of 66 to 84 Kilometers, with Oromya and SNNP showing the largest trading radius. Thus, when we find market integration between Addis Ababa and Desse in the northern Ethiopia, which are more than 400 kilometers apart, it would be meaningless to assume direct trade and efficient arbitrage between the two locations. Yet, it is not uncommon to find these locations to be efficient in empirical market efficiency literature. For instance, Negassa and Myers (2007) finds Addis Ababa and Desse to be efficient (with more than 65 percent probability) after 1999; and Dercon (1995) finds integration between Addis and Dire Dawa, which is more than 500 kilometer to the east of Addis Ababa.

Table 2. Key indicators of grain trading activities in Ethiopia

Trading Activities	Tigray	Amhara	Oromya Dire Dawa	Addis Ababa	Total
Distance Traveled and Transaction Size					
Distance transported (km)	66.27	72.68	84.43	16.75	66.75
Storage duration (days)	43.52	25.03	21.17	11.56	26.88
Purchase lot size (tons)	5.20	6.42	8.03	6.17	6.52
Sale lot size (tons)	3.93	5.37	6.87	5.51	5.44
Transactions carried out through (%)					
Personal travel	23.77	20.54	32.09	1.59	22.02
Purchase through intermediaries	54.04	36.84	31.54	6.25	35.82
Sales through intermediary	5.65	6.35	24.22	1.59	10.12
Number of observations	**124**	**190**	**136**	**64**	**514**

Source: Authors' construction based Gabre-Madhin and Negassa, 2004.

A summary of the characteristics of each method of market integration is presented in Table 3. The older methods were not able to go beyond saying whether or not markets were integrated, and even in this task the results were biased when prices were non-stationary. Cointegration methods address the problem of non-stationarity, but do not take into account the fact that prices will be unconnected if the price differences is small enough. The newer methods, PBM and TAR, can distinguish among equilibrium, autarky, and disequilibrium, but a number of questions remain unanswered. Even the new approaches cannot identify market inefficiency (unless transfer cost information is available) or the causal factors. The discussion above clearly points to the fact that more detail data are needed to better understand the agricultural markets of countries in Africa and other developing world. In particularly, there is a need for more detailed information on the size, composition, and variability in transfer costs between market pairs.

Table 3. Characteristics of methods of analyzing market integration

Characteristics	Analytical method					
	Correlation analysis	Regression analysis without lags	Regression analysis with lags	Co-integration analysis	Parity bounds method (PBM)	Threshold auto-regression (TAR)
Measures co-movement of prices	Yes, but biased for non-stationary variables	Yes, but biased for non-stationary variables	Yes, but biased for non-stationary variables	Yes	Yes	Yes
Can include more than two markets	No	Yes	Yes	Yes	No	No
Can measure speed of adjustment	No	No	Yes	Yes	Only indirectly	Yes
Takes into account transfer costs	No	No	No	No	Yes	Yes
Can make use of info on marketing costs	No	No	No	No	Yes	Yes
Can identify market inefficiency and causes	No	No	No	No	No, unless transfer costs available	No, unless transfer costs available

3 Food market integration in sub-Saharan Africa

Having established the strengths and weaknesses of market integration analysis, this section examines the empirical results of these studies in the analysis of stale food markets in sub-Saharan Africa. Below, we present the results of selected studies, organized by region.

3.1 Western Africa

Several studies of spatial market integration have been carried out in Ghana and Benin. An early study of grain markets in Ghana used both the Ravallion model and cointegration methods to examine the relationships between maize, sorghum, and millet prices in three markets (Alderman, 1992). The study uses monthly wholesale prices over the period 1970-1990 in two markets: Techiman, a maize zone in the center, and Bolgatanga, a sorghum-millet zone in the north. The author finds that maize markets are relatively well integrated and that there are links between the markets for maize, sorghum, and millet. On the other hand, the speed of transmission was rather slow, with full adjustment taking three months.

Badiane and Shively (1998) examine the degree of integration and the speed of adjustment in Ghanaian maize prices. The study uses monthly wholesale maize price data over the period 1980-1993 for three markets: Techiman, a surplus zone in the center, Accra, a deficit market in the south, and Bolangtanga, a maize-deficit market in the extreme north of the country. The analysis is carried out with an autoregressive model in price levels, as well as a model of price variability. The authors find that maize prices in both deficit markets are relatively well integrated with maize prices in Techiman, the surplus market. However, the relationship is closer between Techiman and Accra than between Techiman and Bolangtanga, presumably due to the shorter distance between them. Furthermore, they find that the economic reforms introduced in 1983, including agricultural market liberalization, reduced the level and volatility in maize prices in wholesale markets, though the degree of seasonality is still high.

Abdulai (2000) uses a threshold cointegration model to examine the relationships among maize prices in the same three markets in Ghana. The analysis uses monthly wholesale maize data over 1980-1997 for Accra, Techiman, and Bolgatanga. The study finds that prices in Accra respond more quickly to changes in Techiman than do prices in Bolgatanga, reflecting the fact that Accra is closer and a more active market. Half of the full adjustment in prices back to the long-run relationship occurs in 4-7 weeks. In addition, the results indicate that an increase in the maize price in Techiman is more quickly transmitted to the two deficit markets than a decrease; in other words, the marketing margin is more quickly corrected when it is compressed than when it expands. This could occur as a result of collusion among traders, changes in inventory, and search costs. Overall, the study finds that maize prices in different markets are relatively well integrated.

Lutz et al (1994) examines the impact of agricultural market liberalization on maize price behavior in seven markets in Benin. The data consist of maize prices from the seven markets at 4- and 7-day intervals over the periods 1987–9 and 1998–2001. The seven markets include three urban centers (Cotonou, Parakou, and Bohicon) and four rural centers (Ketou, Glazoué, and Azové). The Johansen rank test is used to identify the number of common trends found among the seven markets. In the first period, all seven markets were cointegrated with each other, indicating that they followed a common trend. In the second

period, only six of the seven markets followed a common trend, the prices in Ketou not having a long-run relationship with prices in the other markets. In addition, the study compares at the speed of adjustment to the long-run equilibrium in the two periods. It finds that there is no consistent pattern: the adjustment seems to be more rapid in the second period for some of the markets, but prices in Cotonou, Parakou, and Azové adjusted more slowly in the second period. Overall, the authors conclude that the most of the markets in Benin are integrated in the sense that they follow a common trend, but there is no evidence of improvement in the degree of integration or the speed of adjustment to shocks.

Kuiper et al (2003) focuses on the issue of price leadership between retail and wholesale prices in Benin in order to test the common assumption that retail prices follow the wholesale prices in the same market. They use retail and wholesale price data from periodic markets operating every four day in five markets Cotonou, Bohicon, Azové, Dassa, and Kétou. The tests for cointegration indicate that retail and wholesale prices are strongly co-integrated. The coefficient on the long-run relationship implies that retail prices are 2-18% above the wholesale price in the same city. The study then examines whether wholesalers or retailers are "price leaders" using the Granger causality test. It finds that in three of the four markets, the wholesale price in each period is significantly affected by the retail price in the previous period, but not the other way around. These markets include the two large urban areas: Cotonou and Bohicon. In only two markets do wholesalers play a price leader role. The authors interpret this to mean that wholesalers can only influence prices when they carry out inter-city trade and thus have alternatives to selling to retailers.

3.2 Eastern Africa

Ethiopia has been the subject of several market integration studies. Dercon (1995) used cointegration analysis to examine the impact of market reforms on price transmission in markets for teff in Ethiopia. The analysis showed that the number of markets integrated with Addis Ababa increased following the reforms. This suggests that the reforms had the effect of reducing marketing margins between Addis Ababa and teff surplus zones.

Negassa (1998) uses various methods, including Granger causality analysis, to examine the relationships of teff, maize, and wheat prices across numerous markets in Ethiopia. He tests for causality in 28 commodity-market-pair combinations. In only one case was there no causation. In 14 cases, there was two-way causation between the market price in Addis Ababa and the other market. And in the remainder there was one-way causation. Overall, the study concludes that there were "strong causal relationships" between the cereal wholesale prices in Addis Ababa and those in other selected markets.

Negassa and Meyers (2007) reexamine Ethiopian price data using an extended version of the parity bounds method (PBM). It is extended to allow the probability of each type of regime to gradual change in response to changes in policy. The model is tested on monthly data on wheat and maize prices in Ethiopia during a period when the Ethiopian Grain Trading Enterprise was relieved of its responsibility to stabilize prices and made to operate as a commercial enterprise. The policy change causes a statistically significant shift in the PBM parameters in only a few of the market pairs tested. Maize markets were characterized by price differences below marketing costs even though flows were observed, suggesting trading losses. In contrast, wheat price differences often exceeded transfer costs, implying excess profits.

Jaleta and Gebremedhin (2009) consider the relationship among wheat and teff prices in six market towns in Tigray region in northeast Ethiopia. The analysis is carried out using semi-monthly prices from May 2006 to October 2008. The authors test the cointegration of wheat and teff prices for each of the 15 pairs of markets. Wheat prices are cointegrated in 13 of the 15 market pairs, indicating that they follow common trends. Similarly, teff prices are cointegrated in 12 of the 15 market pairs. The town of Abi Adi is the least integrated of the six towns, appearing in three of the six market pairs that were not cointegrated. This is not surprising given that it is located more than 50 km from the nearest paved road; in contrast, four of the others are located on a paved road and the fifth is within 20 km.

In a study of market integration in Uganda, Rashid (2004) examines the effect of market liberalization on maize price movement. The study compares the behavior of maize prices before and after market liberalization which occurred in the mid-1990s. The analysis is based on weekly maize price data for eight districts over 1993-94 and 1999-2001. The analysis examines how many of the markets are co-integrated (that is, follow a common trend) in the two periods, as well as the direction of causality in pairs of markets. The results indicate that market integration has improved markedly between the early 1990s and the end of the decade. In 1993-94, only four of the eight markets were co-integrated, meaning that they followed a common trend. In contrast, seven of the eight markets were following a common trend in the 1999-2001 periods. At the same time, the maize markets in the northern districts of Gulu and Arua remain relatively disconnected from the other maize markets in the country. This is explained by the insurgency in the north makes trade with the rest of the country both risky and costly. In addition, there cross-border trade between the northern districts of Uganda and southern Sudan, so that prices in the north reflect, to some degree, market conditions over the border.

Van Campenhout (2007) analyzes the relationship between maize prices in seven markets in Tanzania using weekly price data over the period 1989-2000. He uses a threshold auto-regressive (TAR) model which allows pairs of prices to be linked only when the difference between them exceeds a threshold. The study finds that the implied marketing cost is 2-11% of the mean of the two prices, depending on the market pair being analyzed. Generally, the markets that are close to each other, such as Iringa and Mbeya, have a small threshold, while those that are farther, such as Iringa and Dar es Salaam, have a larger threshold. The study measures the half-life of the adjustment process, that is, the number of weeks it takes for half of the full adjustment to take place. Across the six pairs of markets analyzed, the half-life of adjustment was between 4 and 12 weeks. The analysis also shows that the speed of adjustment has decreased over the 11-year period, the decline being statistically significant in four of the six market pairs. In addition, the threshold decreased 8-55%, implying a reduction in marketing costs between markets and a closer link between maize prices in different cities.

3.3 Southern Africa

In southern Africa, several studies have examined spatial market integration in Malawi. Goletti and Babu (1994) use cointegration methods to examine the behavior of maize prices in Malawi before and after market liberalizations. They use monthly retail data for eight markets over the period 1984-1991. They test the cointegration of each market pair. Before liberalization, 18 of the 48 market pairs were co-integrated, but after market liberalization 34 pairs were co-integrated. This indicates that the market liberalization in

1987 improved the transmission of price changes from one market to another. On the other hand, they find that the transmission is only partial and can be slow. The average adjustment to an initial shock took 5.7 months. Finally, the study examines the symmetry of adjustment. They find little evidence that price increases and price decreases are transmitted any differently in Malawi.

Meyers (2008) provides a more recent study of maize markets in Malawi. The analysis uses weekly maize prices from ten markets over the period 2001-2008, focusing on the difference in price within nine pairs of markets. The price spreads are quite volatile and often turn negative, suggesting that the trade flows are not steady and that there may even be trade reversals. The study finds strong evidence of a long-run relationship in six of the ten market pairs tested. Half of the full adjustment back to the long-run equilibrium occurs within 1-2 weeks for all market pairs. This adjustment is more rapid than estimated by earlier studies of Malawi maize markets by Goletti and Babu (1994) and Chirwa (2000), suggesting an improvement in market efficiency over time. It is also comparable to the speed of adjustment of maize and soybean markets in the United States, estimated to range between 0.2 and 3 weeks (Goodwin and Piggot, 2001). The estimated threshold above which price transmission occurs ranged from 0.5 Malawi kwacha/kg to 6.4 MK/kg across the nine market pairs studied, equivalent to US$ 5 to 61 per ton at December 2004 exchange rates. For most of the pairs, the threshold estimates appear to correspond with estimates of the marketing cost, but for two pairs, the threshold seem to large given the short distance between the markets.

Tostao and Brorsen (2005) examine market integration in Mozambique using monthly retail prices of maize over 1994-2001 and estimates of transfer costs. They use the parity bounds method (PBM) which distinguishes among three regimes: competitive trade (when the price difference is equal to the transfer cost), non-trading markets (when the price differences is smaller than the transfer cost), and disequilibrium (when the price difference exceeds transfer cost). A measure of the level of the integration of a market pair is the proportion of the time they are in the first two regimes. The results suggest that markets within southern Mozambique are efficient (by this definition) 55% of the time, while those in central Mozambique are efficient 84% of the time. Southern and central Mozambique are relatively well integrated, but the transfer costs between northern Mozambique and the rest of the country are too high to justify maize trade. These findings are supported by data that indicate maize trade flows within southern and central Mozambique, but little trade between northern Mozambique and the rest of the country. A vector-autoregression (VAR) analysis confirmed that prices in each of the six main markets were linked to prices in one or two of the other markets.

Moser, Barrett, and Minten (2009) examine rice markets in Madagascar using four quarters of data on prices and transportation cost for almost 1400 communes. They apply the parity bounds model which distinguishes among the three trading regimes, as described above. At the sub-regional level, 69% of the communes appear to be in competitive trading markets, 21% are in non-trading (or segmented) markets, and 10% are in disequilibrium. At the regional and national level, however, markets are more likely to be either segmented (due to high transportation costs) or in disequilibrium, possibly indicating imperfect competition.

Finally, in one of the few studies that examines cross-border market integration in Africa, Mutambatsere et al (2007) uses the extended parity bounds model to examine maize

market integration among five southern African countries: Botswana (Gaborone), South Africa (Gauteng), Malawi (Blantyre), northern Mozambique (Mocuba) and southern Mozambique (Maputo). The PBM is extended by using outside estimates of transfer costs and trade flows among the five markets. The model distinguishes among six regimes: each of the three PBM regimes with or without trade. The results suggest that there is trade from South Africa to Botswana, though price differences often exceed estimated transfer costs most of the time. A very similar pattern is observed in trade from South Africa to southern Mozambique and from northern Mozambique to Malawi. Finally, about half the time, the price in southern Mozambique is high enough to justify transporting maize from northern Mozambique, but this trade does not occur. In each of these cases, the reverse flow is unprofitable and rarely occurs. Overall, trade flows are predictable based on price differences, but either transfer costs are underestimated or trade is sub-optimal. One possibility is that estimated transfer costs exclude (or underestimate) the profit and risk premia necessary to motivate long-distance cross-border trade.

3.4 Summary

Overall, these studies suggest that markets function relatively well, following the rules of spatial arbitrage in the long run but with significant deviations in the short run. Market integration breaks down when markets are separated by long distances and poor infrastructure, though this does not necessarily indicate imperfect competition in food markets.

Economic theory and the empirical evidence indicate that marketing costs (or transfer costs) play a critical role in the spatial patterns in staple food prices. In the next section, we examine some of the evidence regarding marketing costs in sub-Saharan Africa.

4 Marketing costs in sub-Saharan Africa

This section examines the cost of transporting staple foods between markets in Africa, the trends in these marketing costs, and the factors that influence the size of marketing costs.

4.1 Comparison of marketing costs in Africa

A recent study by the World Bank demonstrates that the average cost of transportation tends to considerably higher in sub-Saharan Africa than in other regions. As shown in Table 4, the cost of long-distance transportation in sub-Saharan Africa ranges between US$ 0.06 and US$ 0.11 per kilometer-ton, compare to rates of US$ 0.02-0.05 per km-ton in other regions. Because of low wages, the daily labor component of transportation costs in Africa are low by international standards. However, this is more than offset by higher fuel costs, higher fuel consumption, and higher maintenance costs. The higher fuel consumption and higher maintenance costs are both the result of the fact that trucks tend to be older and the roads in poorer condition in sub-Saharan Africa (Teravaninthorn and Raballand, 2009).

Table 4. Cost of long-distance transportation

Location	Cost (US$ per km-ton)
Pakistan	0.02
Brazil	0.03
United States	0.04
China	0.05
France	0.05
Durban-Lusaka	0.06
Lome-Ouagadougou	0.07
Mombasa-Kampala	0.08
Douala-N'Djamena	0.11

Source: Teravaninthorn and Raballand, 2009

A trucker survey carried out as part of the study revealed that variable costs represent two-thirds to three-quarters of total cost of road transport. Of variable costs, fuel is the most important category, representing 50-80% of variable costs in most countries, followed by tires (10-40%). The costs of bribery were relatively low in East and southern Africa (0-2%), but much higher in western Africa (6%) and central Africa (12-27%). Among the fixed costs, labor and depreciation were the main components[8]

Another study examining the cost of agricultural marketing in eastern Africa estimated the cost of marketing over shorter distances, including from the farm to local markets (World Bank, 2009). The results, shown in Table 5, indicate that short-distance marketing has a much higher cost on a per kilometer-ton basis. The marketing cost between secondary and wholesale markets was US$ 0.11 to US$ 0.18 per km-ton, while the cost from the farm-gate to the local market was US$ 0.30 to 1.50 per km-ton. The higher cost of short-distance marketing is presumably related to the use of smaller vehicles on poorer roads.

[8] Labor and depreciation were classified as "fixed" costs because they do not vary with the distance traveled, although one could argue that depreciation is a function of distance.

The market integration study by Tostao and Brorsen (2005) made use of estimated marketing costs between various pairs of main markets in Mozambique. The marketing costs between the 24 market pairs were in the range of US$ 0.02 to US$ 0.10 per km-ton, depending largely on the quality of the road. The average cost across all market pairs was US$ 0.07 per km-ton.

Finally, a study of the transport sector in Tanzania estimated the cost for international road shipments to be US$ 0.06 to US$ 0.085 per km-ton and US$ 0.03 to US$ 0.04 per km-ton for domestic shipments (Meeuws, 2004).

Table 5. Grain marketing costs in selected countries

Countries / Indicators	Farm gate to primary	Primary-secondary	Secondary-wholesale	Total or average
Ethiopia				
Distance travelled (km)	28.48	61.32	67.76	158.0
Transport cost (US$/km-mt)	0.30	0.20	0.18	0.15
Transport as % of total	15%	17%	30%	--
Kenya				
Distance travelled (km)	6	67	300	373.0
Transport cost (US$/km-mt)	0.30	0.30	0.11	0.15
Transport as % of total	19%	65%	39%	--
Tanzania				
Distance travelled (km)	3	50	80	461.0
Transport cost (US$/km-mt)	0.40	0.27	0.12	0.16
Transport as % of total	94%	77%	45%	--
Uganda				
Distance travelled (km)	16	100	345	133.0
Transport cost (US$/km/mt)	1.5	0.33	0.15	0.25
Transport as % of total	60%	79%	46%	--

Source: Ethiopia numbers are from Rashid and Negassa (2009) and the other country numbers are computed from World Bank (2009).

4.2 Trends in marketing costs

What are the trends in marketing costs in sub-Saharan Africa? It is difficult to generalize because of the diversity of experience, but there are a number of studies suggesting that marketing margins have declined.

A dramatic example is provided by the cost of shipping freight from Mombasa to Kigali. The cost was more than US$ 700 per ton in 1990 (in 2009 dollars) but declined to less than US$ 100 per ton in 2006. Much of the decline occurred between 1993 and 1995 as a result of deregulation. Before 1994, STIR, a parastatal trucking company had a monopoly on long-distance road transport. After the war ended, the trucking industry was deregulated, leading to a rapid recovery in the size of the fleet as well as a sharp reduction in transport costs (Teravaninthorn and Raballand, 2009).

Tostao and Brorsen (2005) note that the road network has recently been improved between Maputo and Chimoio and between Maputo and Maxixe. They use this fact to explain the

low level of efficiency in those market pairs, since the PBM was comparing price differences over 1994-2001 and the marketing cost in 2001. Since the (older) price differences were larger than the (recent) marketing cost, giving the misleading impression that the markets were not efficient.

In addition, a number of market integration studies indicate an increase in the number of integrated market pairs and/or a reduction in time required for one market to adjust to price changes in another market. As mentioned above in section 3:

- In Malawi, Goletti and Babu (1994) found an increase in the number of market pairs that were integrated increased between the mid-1980s and the early 1990s.
- In Tanzania, Van Campenhout (2007) found speed of adjustment of maize prices in one market to changes in maize prices in other markets increased over the 1990s, the increase being statistically significant in four of the six market pairs. In addition, the threshold decreased 8-55%, implying a reduction in marketing costs between markets and a closer link between maize prices in different cities.
- In Uganda, Rashid (2004) found that the number of market pairs that were integrated increased markedly between 1993-94 and 1999-2001.
- And in Ethiopia, Negassa and Jayne (1997) examine the price margins between pairs of markets in Ethiopia before and after liberalization. They find that grain price differences decreased in 23 of 24 market pairs examined. Dercon (1995) comes to a similar conclusion using cointegration analysis.

Of the studies reviewed here, only two found no significant change during a period of market liberalization, a study of Benin by Lutz et al. (1994) and one of Ethiopia by Negassa and Meyers (2007).

In summary, there is fragmentary but widespread evidence that marketing costs and price margins have declined in sub-Saharan Africa over the past few decades. This is the result of road building and improvement projects, reduction in barriers to cross-border trade, and deregulation of agricultural marketing and the transport sector as part of economic reforms.

5 Determinants of market efficiency

Price-based market integration analyses essentially assume a given state of the market fundamentals—such as infrastructure, information, institutions, and policies—that facilitates market exchanges. Transactions costs associated with these market fundamentals are the key determinants of market efficiency. We present some empirics on the determinants of market efficiency under the three subsections below.

5.1 Infrastructure

As already mentioned, the market is a complex institution and its performance depends on numerous factors. One of the most important factors is the quality of transportation infrastructure. Teravaninthon and Raballand (2009) list the ways that poor roads increase transport costs: higher fuel consumption, higher maintenance costs, faster depreciation of vehicles, tire replacement costs, and lost time due to lower speeds. Several studies have quantified the effect of road quality on transport costs and market integration. Loveridge (1991) showed that a road improvement project in southwestern Rwanda reduced price differences between two markets and increased the correlation of their prices over time. Minten and Kyle (1999) found that the cost of transportation was twice as high on poor roads compared to paved roads in Zaire (now Democratic Republic of the Congo). The higher cost of transport on poor roads resulted in lower prices received by farmers selling their crops.

Naturally, the higher cost of transport associated with poor roads reduces the volume of trade and eventually household income. Buys et al (2006) uses a gravity model to predict the level of trade among African countries as a function of distance, road quality (as measured by the percentage of roads paved), membership in regional agreements, and other factors. The results indicate that a 1% increase in road quality leads to a 2% increase in trade between countries. Simulations revealed that increasing road quality across sub-Saharan Africa could expand international trade from US$ 10 billion to US$ 29 billion per year. Coulibaly and Fontagné (2004) use a similar gravity model on western African data and also find a significant effect of road quality on trade volume.

5.2 Institutions and information

One component of marketing costs is transaction costs: the cost of finding a buyer or seller, negotiating the transaction, carrying out the exchange, and enforcing the terms of the transaction. Institutions and information are two key determinants of transaction costs and thus market efficiency. Personalized market transactions take place due to incomplete or missing institutions. In the presence of functioning institutions strong governance, transactions are impersonal and rules of the game are self-enforcing. And information is critical for locating a buyer/seller and settling on a price. If prices in large terminal markets are known to the farmers and small traders, it will increase their bargaining power and increase their shares in the value chain, reducing the possibility of market manipulation by a few and enhancing overall market efficiency.

The rapid expansion in the use of mobile phones in sub-Saharan Africa creates an opportunity to measure the impact of improved market information on marketing margins. Akers (2005) uses the spread of mobile phones over 2001-2006 in Niger to evaluate the

impact. She estimates that mobile phone usage reduced the grain price spread between markets by at least 6.4% and reduced inter-seasonal price differences by 10%. Furthermore, the effects of mobile phone use was greater in more remote areas and areas with poor roads.

Another determinant of marketing costs is the effectiveness of the legal system in resolving commercial disputes. Table 6 shows three indicators of contract enforcement: processes involved in resolving disputes, number of days it takes to settle a dispute, the cost of dispute settlement as percentage of debt recovered. These data are compiled for the formal and registered companies or agencies in the respective countries and hence are not really representative of the staple food markets, where transactions are largely informal. However, despite this caveat, the numbers show broad patterns, as well the complications of contract enforcement in each of these countries. In terms of the number of procedures, these countries are not much different from the OECD countries. However, in terms of times the African countries take to settle a dispute is much longer and the costs of recovering debts are much higher. In Ghana, it takes more than two years to settle and in Malawi, a company has to spend almost 36 percent more than what it recovers after a dispute is settled. If this is the state of contract enforcement in formal private sector, one can imagine the risks of a typical maize trader whose transactions are largely informal.

Table 6. Indicators of contract enforcement efficiency in African countries

Indicators	Ethiopia	Ghana	Kenya	Malawi	Zambia	Uganda	OECD
No. of Procedures	30	22	25	40	21	19	22
Days to process	690	730	360	337	404	484	252
Cost as % of debt recovered	14.8	12.7	41.3	136.5	28.7	35.2	11.2

Source: World Bank, 2009.
Note: Numbers are for 2006 or most recent year.

In fact, the absence of the formal contract enforcement options is probably one of the main reasons that transactions are personalized and credit markets are so thin for staple food marketing in these countries.

5.3 Competition

Markets work best in generating optimal[9] outcomes when they are competitive, meaning that there are many buyers and sellers, none of which is large enough to affect the market price. Although it is widely believed in developing countries that "middle-men" are able to earn excessive profits through market power, few studies have been able to demonstrate market power in domestic grain markets in sub-Saharan Africa. As mentioned above, Abdulai (2000) found asymmetry in price transmission in Ghana, suggesting some market power, but Goletti and Babu (1994) did not find this asymmetry in Malawi. Osborne (2005) used transaction level data from Ethiopia to test for imperfect competition. She found evidence of imperfect competition among wholesalers in smaller markets that were isolated from the main cities, but no evidence in the larger markets. Even so, the impact of the

[9] In this sense, optimal refers to Pareto optimality, in which no one could be made better off without making someone worse off. It does not imply a broader social optimality of the outcome, taking distributional issues into account.

imperfect competition in the smaller markets was modest, reducing producer prices by just 3%.

Estimates from the Uganda grain traders' survey are presented in Table 7, which shows the average number of years in trading, changes in the level of competition over time, and the percentage of transactions on credit. Two points from this table deserve highlighting. First, only a small percentage of traders in the district towns of Uganda carry out transactions on credit, suggesting that credit is a risky business for the grain traders. As a result, the traders engage in credit transactions only if the trade partners are known to each other and there are social networks that can help settle dispute or renegotiate contract terms. Second, although the level of competition is increasing, grain markets are still thin. Consider the case of Masindi, a large maize growing district, where an average maize trader had been in business only for about 2.5 years; and only 32 traders operated in the markets. Thus, one can argue that, although there are price transmissions across market locations, there is still much to be done to increase competition and market efficiency.

Table 7. Competition and credit relationship in Ugandan maize markets

Regions and Districts	Years in the agricultural trading	Number of competitors		Percent of transactions on credit
		When started business	In the year 2000	
Central Region				
Kampala	5.1	59	109	34
Luwero	6.5	84	49	22
Masaka	5.3	37	55	28
Mpigi	6.7	30	40	18
Mukono	7.6	55	42	24
Eastern Region				
Busia	3.0	7	50	45
Iganga	6.3	70	119	14
Jinja	9.0	91	193	15
Kamuli	6.8	15	26	21
Mbale	7.5	34	106	17
Pallisa	5.2	36	80	16
Tororo	5.6	46	90	14
Northern Region				
Apac	4.5	15	32	6
Arua	4.1	13	25	18
Lira	11.7	24	97	19
Gulu	6.7	9	12	13
Kitgum	2.8	19	21	20
Nebbi	4.5	37	81	25
Pader	0.0	30	30	
Western Region				
Bushenyi	3.9	105	150	12
Kabale	8.2	24	22	29
Kabarole	4.1	14	21	30
Kasese	9.4	24	44	28
Masindi	2.6	26	32	18
Mbarara	6.8	11	16	26
Rukungiri	9.3	49	43	1

Source: Rashid (2004) based on IFPRI agricultural market survey 2000-2002

A study of the transport sector in eastern Africa revealed a wide variety of freight rates, both across and within countries (Anyango, 1997). The cost for domestic truck transport between cities ranges from US$ 0.08-0.12 per km-ton in Kenya, US$ 0.09-0.16 per km-ton in Uganda, and US$ 0.13-0.19 per km-ton. The report argues that freight rates are determined more by level of truck and rail competition and the availability of backhaul than by distance. It also attributes the lower rates in Kenya to more intense competition.

In summary, there is some evidence that large city markets are more competitive and efficient than small markets, and that marketing costs are lower in areas with dense demand for transport services compared to remote areas where demand is less dense.

5.4 Policy induced factors

Public policies directly and indirectly affect staple food market performance. Examples include regulation of transport and agricultural marketing, price stabilization and buffer stock policies, trade policy, and macroeconomic policy. In this section, we discuss the links between such policies and market performance.

Regulation of transport sector

In extreme cases, a parastatal trucking enterprise maintains a legal monopoly over road transport. This was the case in Rwanda before 1994, as discussed above, and resulted in very high transport costs. Following the economic reforms in many African counties in the 1980s and 1990s, this is much less common than it used to be.

In other cases, freight rates are regulated by a government body. Often these regulatory bodies are "captured" by the industry they regulate, and set shipping rates above market rates. According to Teravaninthon and Raballand (2009), regulated shipping rates are not common in East and southern Africa but are still used in some countries of western and central Africa.

Another common type of regulation are rules that favor the domestic trucking industry over transport companies from other countries. In severe cases, this type of regulation can force trucks to unload their product at the border and have it reloaded onto local trucks on the other side. More commonly, these regulations increase the administrative burden associated with crossing international borders. Recently, an African business association prepared a set of recommendations for lowering transport costs. It proposed a common truck license for the different regional associations in sub-Saharan Africa and a reduction of the fees imposed on trucks from other countries (ESABMO, 2008).

In addition, the practice of setting up check-points can contribute to higher marketing costs. According to one study, checkpoints and border controls added four to seven days to the three-day trip between Douala (Cameroon) and Bangui (Central African Republic). Furthermore, a loaded truck pays a total of US$ 580 in fees (formal and informal) to make this route. Another study found up to seven checkpoints per 100 km of road in some western African countries (Buys et al, 2006).

Teravaninthon and Raballand (2009) argue that administrative costs and delays are a larger contributor to high marketing costs in sub-Saharan Africa than poor road quality, particularly in western and central Africa. Based on this, they recommend that streamlining

administrative procedures and deregulation would be, in the medium term, a more effective way to reduce marketing costs than road improvement.

Public interventions in staple food markets

Governments in many African countries continue to intervene heavily in their grain markets. These interventions are carried out by state enterprises such as the Ethiopia Grain Trading Enterprise (EGTE), the National Cereals and Produce Board (NCPB) of Kenya, the Agricultural Development and Marketing Corporation (ADMARC) in Malawi, and the Food Reserve Agency in Zambia. Typically, they maintain grain stocks for emergency use, attempt to stabilize grain prices, and provide grain to remote deficit areas (see Table 8). Purchases by these grain trading state enterprises have been an estimated 15-57 percent of the domestic marketed maize output in Kenya, 3-32 percent in Malawi, and 12-70 percent in Zambia (Jayne and Tshirley, 2009).

Table 8. Summary of government interventions in staple food markets

Country	Summary of interventions in food markets
Ethiopia	Level of interventions has increased in recent years. Maintained a strategic reserves of 430 thousand tons; large emergency operation, large food aid inflow
Kenya	Food logistic agency (NCPB) is a dominant player in maize markets, capturing 10-20% of marketed maize. Price setting is unpredictable—sometimes NCPB prices are above import parity and sometimes they're lower than domestic market and government has to force farmers to sell. Frequent changes in import tariff rates through the port of Mombasa.
Malawi	Has active food logistic agency (ADMARC), a strategic grain reserve programs, and discussion underway to intensify interventions (more details later). Maize export bans and periodic waivers of the import tariff are common. Malawi banned private trade in August of 2008 and then imposed fixed buying and selling prices on the private sector in September 2008.
Mozambique	Low level of government intervention in staple food markets. No active market participation in buying or selling; no price mandates; trade (imports and exports) encouraged usually (some exceptions). WFP Purchase for Progress is active in maize and beans, in addition to other WFP local purchase activities. import tariff of 17-20% on imported maize, which can be rebated if the buyer mills the grain directly but doesn't resell the grain.
Uganda	Government intervention is low. However, WFP purchase under LRP is high—some years exceeding more than 15 percent of total maize production in the country.
Tanzania	Relatively little intervention in domestic staple food markets. Strategic Grain Reserve has capacity for 150 thousand tons, but usually buys and sells much smaller quantities. Maize can be exported, particularly to the south, but maize exports are banned when there is food insecurity in the country, which is often.
Zambia	Zambia's Food Reserve Agency (FRA) is the single largest players in the country's domestic maize market, purchasing 25% of national production and over 90% of smallholder marketed volumes since 2006. The Zambian government controls trade in maize and wheat through a system of quantitative restrictions regulated under the Control of Goods Act. Both imports and exports require government permits stipulating the allowable quantities traded. In recent years, the Food Reserve Agency has received the bulk of the trading permits for both the import and export of maize. Export bans and periodic waivers of the import tariff are common. Inter-district taxes on grain movement was officially abolished earlier in 2009

If these interventions are driven by political economy considerations rather than policy rationale, such as addressing market failures, the likely outcome is reduced market efficiency. However, these state grain trading enterprises generally operate in competition with private traders, and the state enterprises do not have a large enough market share to fix prices. Thus, staple food prices rise and fall largely as a result of market conditions, and studies indicate that market integration still occurs. However, government intervention can and does have a short-term impact on grain prices and can introduce considerable uncertainty for private traders.

ADMARC is one of the more active grain trading enterprises, though its influence and activities in Malawi have waned over the past ten years. Using weekly maize price data in ten markets locations during 2001-2008, a recent study concludes that there has been an improved in maize market efficiency in the country, as indicated by more rapid adjustment. In response to the food crisis, the government severely restricted private trade in maize in August 2008, but this was too recent to be picked up by the analysis (Myers, 2008).

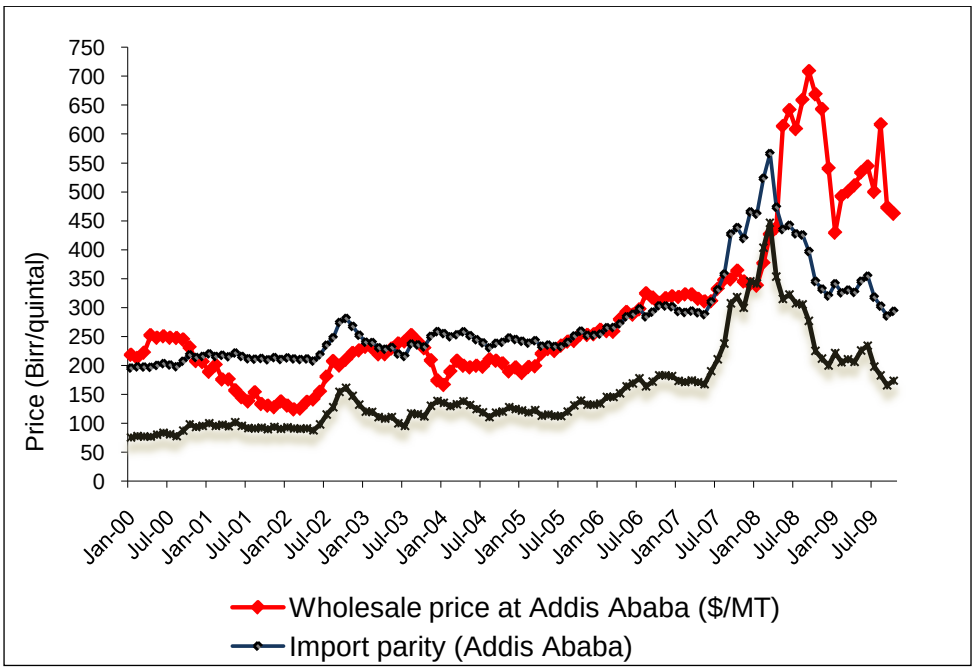
Similarly, Ethiopia had received roughly 700 thousand tons of food aid per year during 1995/96 to 2004/05. Simple calculations suggest that this amount of food aid inflow could depress domestic prices of wheat between 13 to 26 percent depending on the assumption about price elasticity (Rashid, et al., 2009). Yet, empirical market integration analyses with data from the same period suggest that market pairs such as Addis Ababa-Nekampt (327 Km apart) and Dire Dawa-Shashamene (572 Km apart) are efficient (Negassa and Myers, 2007). Another study found that markets in Addis Ababa and Jimma (346 Km apart) are integrated, as are those in Addis Ababa and Shashamene (275 Km apart) (Rashid and Gabre-Madhin, 2008).

Macroeconomic and Trade Policies

Both macroeconomic and trade policies of a nation can directly affect staple food markets. The example of Ethiopia demonstrates how macroeconomic policy misalignment can destabilize cereal markets. With trade, the import parity price serves as an upper bound for domestic prices. If domestic prices go above it, this will induce imports which will push domestic prices down. On the other hand, if domestic prices remain below import parity and above export parity, there will be no international trade of that commodity. Figure 2 shows that domestic wheat prices, which have historically been around or below import parity, shot up in the middle of 2009 and remain above import parity. In June-July of 2008, the domestic price of wheat was more than US$ 200 per ton above import parity, meaning that a private trader could make a US$ 200 per ton profit on importing. Why, then, didn't private traders import? The reason is that, in early 2008, the high cost of fuel imports led to a balance of payments crisis[10]. Rather than allowing the currency to depreciate, the government chose to ration foreign currency. Therefore, grain imports were being carried out through the Ethiopian Grain Trading Enterprise (EGTE), and food aid grain by World Food Programme.

[10] Ethiopia did not increase domestic gasoline prices even when world price hit US$147 a barrel. As a result subsidy bills reached roughly US$700 million.

Figure 2: Effect of macroeconomic policy on wheat prices in Ethiopia



A second example is the 2001-03 food crisis in Malawi. ADMARC had just sold off most of its stock when it became apparent that the next harvest would be poor. The private sector was reluctant to import maize in the belief that ADMARC would soon do so and would sell the maize at a subsidized price. The government delayed importing maize, initially in the belief that the shortage was not serious. By the time the import order was placed, the domestic price of maize had spiked far above the import parity price (Jayne et al, 2005). This example illustrates the effect of government involvement in international trade in reducing or eliminating the incentives for the private sector to trade.

Another example is the East African Community (EAC). Despite the declarations of reducing trade barriers and implementing a policy of "maize without borders," EAC member countries often adopt trade-impeding policies. Tanzania has followed a practice of banning food exports following poor harvest to ensure that local supplies go to deficit areas within the country. Kenya maintains high import duties on maize from outside the EAC, and has imposed temporary restrictions on maize imports from EAC countries to protect its farmers. And the most liberalized country in the region, Uganda, has had serious problems with maize market collapse in early 2000. After two consecutive years of good harvests, Uganda accumulated a large maize surplus in 2001. However, due to an import ban in Kenya and reduced procurement by WFP, maize markets collapsed and prices in Kampala dropped to as low as US$ 50 per metric tons in August 2001. When prices go that low, surplus farmers and traders face serious hardships. The government of Uganda invited several heads of the states to discuss how to deal with the situation, which resulted in averting the crisis by exporting about 40 thousand tons of maize to Zambia under a government backed credit guarantee scheme (Minot and Rashid, 2008).

Jayne et al (2005) list a number of interventions in maize markets by the government that raise costs and risks for private trade, potentially increasing the volatility of food prices.

- Maize export bans, implemented by Kenya, Zambia, and Tanzania, among others, at different times.
- Unpredictable changes in import tariffs, including cases in which the maize import tariff was changed just for a few days.
- Government importation of food and sale to selected buyers.
- Import licenses required for cross-border trade, which can be a significant administrative burden since the licenses usually must be obtained in the capital city.

Thus, food marketing costs are influenced by a range of factors including the quality of transportation infrastructure, access to market information, regulation of agricultural marketing and transport, government intervention in food markets, macroeconomic policy (particularly related to availability of foreign exchange), and trade policy. Unpredictable changes in policy are particularly harmful because they raise the cost of doing business for traders, which is eventually reflected in the lower prices in surplus regions and higher prices in deficit areas.

6 Summary and implications

6.1 Summary

Market integration refers to the co-movement of prices in markets and/or flows between them. This may refer to two levels in the same supply chain (vertical integration) or two locations for the same commodity (spatial integration). In contrast, market efficiency refers to minimizing cost and not leaving any opportunities for mutually beneficial trade unexploited.

It is possible for efficient markets not to be integrated if the price difference between the two markets is less than the marketing cost between them. In other words, segmented markets may well be efficient. At the same time, spatially integrated markets may not be efficient if marketing costs are higher than normal due to imperfect competition, lack of information, or other reasons. A special case of this is when trade is fragmented into numerous short segments with the commodity changing hands several time. This could occur due to limited access to credit, social capital, or language differences.

The methods for measuring market integration have improved over time, taking into account exogenous factors, lagged effects, and the problem of non-stationary variables. Cointegration analysis takes non-stationary into account and allows measurement of the long-run relationship and the speed of adjustment, but it does not distinguish between lack of integration because of market inefficiency and lack of integration because the price difference is too small. Threshold autoregression (TAR) and the parity bound method (PBM) address this problem, particularly if outside information on transfer costs can be obtained.

Based on our review of studies of the spatial integration of food markets in sub-Saharan Africa, we can draw four conclusions:

- Food grains prices in most of the markets within each country are co-integrated, though the degree of integration varies with distance and road quality. Markets that are not co-integrated are usually those that are more remote or off the main roads.
- The speed of adjustment varies widely across studies, ranging from just one week to six months. However, recent studies that use weekly price data indicate that half of the full adjustment takes place within 1-4 weeks.
- There is no consensus on the symmetry of price transmission. Abdulai (2000) found asymmetry in Ghana, possibly indicating trader collusion, but Goletti and Babu (1994) found symmetric price transmission in Malawi.
- Most of the studies that examine the impact of market liberalization find statistically significant evidence of improved market integration after reforms. The exception (Benin) represents a case in which pre-reform food markets were not heavily regulated.

The cost of transport is significantly higher in sub-Saharan Africa than elsewhere, due to a combination of poor roads, high fuel prices, and administrative procedures which cause delays. The cost is US$ 0.04 - 0.10 per km-ton for long-distance road transport and US$ 0.10 - 0.40 per km-ton for shorter-distance, lower-volume transport. In contrast, the cost of road transport is US$ 0.03 - 0.04 in Pakistan and OECD countries. Transport costs vary widely

within Africa as well, being lowest in southern Africa and highest in western and central Africa.

There is fragmentary but widespread evidence that transport costs have declined over the past decade due to market liberalization, infrastructure investments, and better access to information thanks to mobile phones.

The efficiency of food markets is affected by a variety of factors:

- Barriers to trade in agriculture. District-level taxes, check points, tariffs, and non-tariff barriers to trade raise the cost of food to remote deficit areas and landlocked countries.
- Degree of competition in the transport sector. Countries and areas within countries with less dense demand for transport services tend to have lower transport costs, due in part to lower competition.
- Access to information. Although difficult to measure, one study showed that the adoption of mobile phones cut spatial price margins by 6%.
- Effectiveness of the legal system. The difficulty of enforcing contracts in developing countries results in additional marketing costs as traders personally inspect their purchases and carry out face-to-face transactions.
- Quality of transport infrastructure. Studies show that poor-quality roads can double the cost of transportation, reduce trade volumes, and reduce the prices farmers receive.
- Regulation of the transport sector. Marketing costs are generally increased by state transportation monopolies, administratively-set freight rates, regulations favoring domestic transporters, and the proliferation of check points.
- Government interventions in food markets. Pubic stocks are necessary to meet emergency needs, but unpredictable purchases and sales by the government introduce uncertainty into grain markets, raising costs and often increasing price volatility.
- Trade and macroeconomic policy. Grain prices have spiked above import parity due to foreign exchange controls, high tariffs, and uncertainty about public-sector import intentions.

Overall, it appears that grain markets are reasonably efficient given the difficult environment in which they operate, but they are constrained by poor infrastructure, administrative and tariff barriers, a high degree of risk and uncertainty, and limited information. In some cases, price differences may be significantly higher than transfer costs, particularly in remote areas, but the best way to reduce margins is to address the root causes (poor infrastructure, risk, and lack of information) rather than by regulating prices or having state enterprises compete with traders.

6.2 Implications for policy

From the results summarized above, what can we conclude about the types of policies and investments that will make agricultural markets more efficient? It should be noted that none of the studies reviewed provide a cost-benefit analysis that would be needed to demonstrate beyond a doubt the value of these measures. However, they do provide information on the types of policies that would reduce marketing costs and further integrate markets.

- Continue the process of agricultural market liberalization. Five of the seven studies examining this issue concluded that agricultural market liberalization had improved spatial market integration or reduced marketing margins.
- Streamline administrative border procedures. One of the most comprehensive studies of the transport sector in sub-Saharan Africa concluded that administrative barriers are at least as important an obstacle as poor roads, particularly in western and central Africa. One such step would be to explore the feasibility of regional or continent-wide uniform truck registration.
- Promote competition in the transport industries. Marketing costs are lower in countries and regions where the demand for transport services is dense, leading to more competition. Competition can be promoted by reducing administrative and regulatory barriers to entry into the transport industry and eliminating protection for local trucking companies.
- Improve market information, particularly with the use of information and communication technology. Strong evidence from Niger suggests that mobile phones can improve market efficiency, and economic theory favors subsidizing the provision of public goods such as market information.
- Strengthen institutions that facilitate contract enforcement. The objective could be pursued by a) establishing small-claims courts, b) establishing a commercial code of conduct and peer-review mechanisms, or c) promoting mediation through trader associations.
- Improve transportation infrastructure. This is less important where there are still high administrative and policy barriers to trade, but becomes more important as these barriers are reduced or eliminated.
- Make government intervention in staple food markets predictable and modest. Any government intervention creates some uncertainty, but this can be minimized by adopting rule-based interventions, such as price-triggers for purchase and sale operations. Transparency about public stocks and planned interventions would also be useful.
- Reduce barriers to international and cross-border grain imports. Sharp price hikes in Ethiopia, Kenya, and Malawi could have been avoided by reducing barriers to food imports by private traders.
- Seek regional agreements to limit food export bans. Many African countries implemented food export bans during the 2007-08 food crisis. These policies were not successful in keeping food prices down and exacerbated the crisis in landlocked countries. Although it is politically difficult for an individual country to allow food exports when prices are high, African countries have a collective interest in maintaining open borders. For this reason, this policy objective needs to be tackled at a regional level.

6.3 Implications for future research

This report also identified a number of information gaps that need to be addressed in future research on spatial variation in prices.

- More information on transport and marketing costs. As noted above, price-based spatial integration studies can identify co-movement, but cost information is needed to distinguish between lack of integration due to inefficiency and lack of integration due to small price differences.
- Better data on cross-border trade in food grains. Efforts to date by the RATES project and the Famine Early Warning Systems Network (FEWSNET) have been useful but limited in time and scope. Reducing trade barriers would facilitate more accurate trade flow data collection because there would no incentive for traders to to hide or underestimate the flows.
- Wider availability of price data. Although almost all African countries collect agricultural price data, the information is not widely available and is thus underused. Regional organizations could play a role in gathering and disseminating food price data for analytical and commercial purposes.
- Capacity building in price and market integration analysis. Government analysts, journalists, and policymakers would benefit from the ability to adjust price data for inflation and calculate price margins, while policy researchers would benefit from applied time-series econometrics.
- More research on the impact of alternative policies and investments on marketing margins and spatial integration. The existing research provides some information on the policies and investments needed to improve agricultural marketing efficiency, but does not provide the cost-benefit analysis or comparative return information that would be needed to prioritize investments.

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