SD Publication Series
Office of Sustainable Development
Bureau for Africa

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Technical Paper No. 39
December 1996

USAID

Productive Sector Growth and Environment Division
Office of Sustainable Development
Bureau for Africa
U.S. Agency for International Development

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Publication services provided by **AMEX International, Inc.**
pursuant to the following USAID contract:
Project Title: Policy, Analysis, Research, and Technical Support Project
Project Number: 698-0478
Contract Number: AOT-0478-C-00-6066-00

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Foreword

Since Congress established the Development Fund for Africa (DFA) in 1987, the U.S. Agency for International Development (USAID) has been challenged to scrutinize the effectiveness and impact of its projects in Africa and make needed adjustments to improve its development assistance programs. At the same time, structural adjustment reforms have been adopted by many sub-Saharan African countries with some significant progress in market liberalization.

As donor agencies face severe cutbacks and restructuring, and less assistance becomes available to developing countries (not just in sub-Saharan Africa), new ways must be found to channel declining resources to their most effective and productive uses. The USAID Africa Bureau's Office of Sustainable Development, Productive Sector Growth and Environment Division (AFR/SD/PSGE) has been analyzing the Agency's approach to the agricultural sector in light of the DFA and the experience of recent policy reform programs in sub-Saharan African countries.

For African agricultural productivity to improve, governments and donors must invest in programs and policies that will improve the incentives and capacity of farmers to increase farm productivity and soil fertility while protecting the environment. With rapid population growth, agriculture must rapidly intensify if African farmers are to meet the rapid growth in demand for food and fiber.

This document—*Trends in Real Food Prices in Six Sub-Saharan African Countries*—is the product of research led by Michigan State University. USAID mission personnel and personnel at the respective ministries of agriculture were helpful in providing data. SD/PSGE staff provided direction and reviewed the draft document.

The objectives of this research were to assess the direction and magnitude of food prices since the implementation of food sector policy reforms, to identify the major factors affecting such changes, and to assess the resulting effects of food system reforms on household-level food security in East Africa, Southern Africa, and West Africa.

The report highlights several conclusions: grain and grain meal prices have declined in five of the six countries studied. In the sixth country, government subsidies on maize meal depressed prices during the pre-reform period; with subsidies removed, maize meal prices to consumers rose, but by a smaller amount than the former subsidy. In four cases, the negative effect of eliminating food subsidies on low-income consumers has been partially or wholly compensated by accompanying reforms that have raised consumer access to less expensive food products formerly suppressed by regulation. The findings from the six countries studied generally provide support for the notion that real food prices have fallen in numerous Africa countries. The evidence indicates that consumers—especially urban consumers—have in most cases benefited from the food pricing and marketing reforms initiated in the countries examined.

This report is important to USAID field missions, African governments, and many others in Africa, providing insights, ideas, and approaches to food security strategies and agricultural sector activities.

Curt Reintsma
Division Chief
USAID/AFR/SD/PSGE

Executive Summary

BACKGROUND

The effects of structural adjustment and food market reform on agricultural productivity and household food security continue to be strongly contested. The United States Agency for International Development's (USAID's) Development Fund for Africa (DFA) Report presents evidence of a broad economic turnaround in Africa and, in particular, finds support for increased agricultural productivity growth, in contrast to the gloomier picture commonly painted about stagnating African agriculture. Macroeconomic and agricultural sectoral reform are identified as major factors explaining the rise in productivity growth. The DFA report indicates that "real food prices have fallen in numerous African countries. These price changes are only explicable in the face of substantial increases in production" (p. 48).

OBJECTIVES

The objectives of the present study are threefold: (1) to assess the direction and magnitude of changes in real staple food prices since the implementation of food sector policy reforms in Africa; (2) to identify the major factors affecting changes in these food prices; and (3) to assess the resulting effects of food system reform on household food security. The report focuses on six countries: two from East Africa (Kenya and Ethiopia); two from Southern Africa (Zimbabwe and Zambia); and two from West Africa (Mali and Ghana).

FINDINGS

The report highlights three conclusions:

- Grain and grain meal prices have declined in five of the six countries examined: Ghana, since 1984; Zambia, since 1987; Ethiopia, since 1990; Kenya, since 1988; and Mali, since 1982 (Table 4.1).
- In the sixth country, Zimbabwe, frequent government subsidies on maize meal artificially depressed prices during the pre-reform period. When the subsidies were removed, maize meal prices to consumers rose, but by a smaller amount than the former subsidy, because of lower marketing and processing costs achieved through maize market reform.
- In four cases (Kenya, Zambia, Mali, and Zimbabwe), the negative effect of eliminating food subsidies on low-income consumers has been partially or wholly compensated by accompanying reforms that have raised consumers' access to less expensive food products formerly suppressed by regulation.

The major factors associated with the decline in real consumer food prices in these countries have been (a) better transmission of declining real world prices into the domestic economies by removal of trade barriers (Mali, Ghana); (b) increased food aid flows in the reform period (Mali, Ethiopia); and (c) increased competition and lower costs in food marketing and processing, which reduces marketing margins (Zambia, Zimbabwe, Mali, and Kenya).

In the countries for which downstream marketing margin information is available (Zimbabwe, Zambia, Kenya, and Mali), mill-to-retail marketing margins appear to have fallen since the major aspects of the reforms were initiated (Table 4.1). This has, other factors remaining constant, passed on tangible ben-

efits to food consumers and/or producers. Declining producer-to-wholesale price spreads were also observed in the two countries where such data were available (sorghum and rice in Mali and maize in Kenya).

The findings from the six countries, in general, provide support for the DFA Report's conclusion that real food prices have fallen in numerous African countries. The weight of the evidence indicates that consumers, especially urban consumers, have in most cases benefited from the food marketing and pricing reforms initiated in the countries examined. However, the analysis in this paper does not generally support the DFA's premise that "these price changes [downward] are only explicable in the face of substantial increases in production" (p. 48). Available data indicates that per capita food production has declined in the post-reform period in at least three of the six countries examined.

However, this is not necessarily indicative of a welfare loss, since in several cases production levels during the pre-reform period were buoyed by large state transfers to agriculture, which had effectively shifted the costs of maintaining the pre-reform food systems from one social group to others. The complex distributional effects associated with food market reform (benefiting farmers and consumers in some regions while imposing greater costs on farmers and consumers in other regions) underscore the major difficulty and controversy associated with normative assessments of the effects of food marketing and pricing reform.

A future challenge for food policy is to refocus the emphasis from the liberalization of food markets to the promotion of productivity growth throughout the entire production and marketing portions of the food system, through the development and strategic coordination of markets—most notably for commodities, inputs, and finance, in a financially sustainable way.

Glossary of Acronyms and Abbreviations

AMC	Agricultural Marketing Corporation (Ethiopia)
CPI	consumer price index
DFA	Development Fund for Africa
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GMB	Grain Marketing Board (Zimbabwe)
NAMBOARD	National Agricultural Marketing Board (Zambia)
NCPB	National Cereals Produce Board (Kenya)
NGO	nongovernmental organization
OPAM	Mali state marketing board
USAID	U.S. Agency for International Development
AFR/SD/PSGE	Bureau for Africa / Office of Sustainable Development / Productive Sector Growth and Environment Division

1. Introduction

The objectives of this report are threefold:

- assess the direction and magnitude of changes in real staple food prices since the implementation of food sector policy reforms in Africa;
- identify the major factors affecting changes in these food prices; and
- assess the resulting effects of food system reform on household food security.

The report focuses on six countries: two from East Africa (Kenya and Ethiopia); two from Southern Africa (Zimbabwe and Zambia); and two from West Africa (Mali and Ghana). In all cases except Ghana, major food marketing and pricing reforms were implemented over the past decade. In Ghana, the food marketing system has been primarily affected through macroeconomic and trade policy reform.

The effects of structural adjustment and food market reform continue to be hotly contested. The United States Agency for International Development's (USAID's) Development Fund for Africa (DFA) Report[1] presents evidence of a broad economic turnaround in Africa and, in particular, finds support for increased agricultural productivity growth, in contrast to the gloomier picture commonly painted about stagnating African agriculture. Macroeconomic and agricultural sector reform have been identified as major factors explaining the rise in productivity growth. The DFA report indicates that "real food prices have fallen in numerous African countries.... These price changes are only explicable in the face of substantial increases in production" (p. 48).[2] Moreover, the DFA report indicates that food market liberalization has "resulted in reduction in marketing margins, decreases in real food prices for consumers, increased market participation by farmers and traders, and improved incentives for farmers" (p. 12).[3]

Some analysts have questioned whether these disparate pieces of information are really indicative of increasing agricultural productivity growth and, even if so, whether the conclusions can be considered representative of the continent as a whole. Analyses supported by UNICEF, the Food and Agriculture Organization (FAO), and other donor agencies have strongly questioned the effects of structural adjustment and/or food sector reform on agricultural productivity growth and, in particular, on household food security (see, for example, Cornia and Helleiner, 1994; Jones, 1994; Lele, 1990). The objectives of USAID/AFR/SD/PSGE in supporting further research on real food prices are, *inter alia*, to reassess the evidence regarding the impact of structural adjustment and food market restructuring on household food security and real food prices paid by low income consumers.

This report has five sections. Section 2 discusses the notion of "real" food prices and examines the consistency of selected deflators for examining

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1 United States Agency for International Development (USAID). 1993. "Africa: Growth Renewed, Hope Rekindled: A Report on the Performance of the Development Fund for Africa, 19881992." Washington D.C.: USAID, Office of Development Planning, Bureau for Africa.

2 Analysis in support of this conclusion is drawn from numerous country studies by the Cornell Food and Nutrition Policy Project and others (see, for example, Sahn and Sarris, 1991).

3 Other evidence in support of agricultural productivity growth in parts of Africa include econometric analysis of FAO data that indicate impressive growth in total factor productivity since 1983 in Africa (Block, 1994), and microlevel studies indicating that "farm families are releasing substantial amounts of labor to nonfarm activities and that farm labor is not increasing nearly as fast as the population; in other words, labor productivity is increasing" (USAID, 1993 p. 48).

changes in real prices over time. Section 3 briefly describes the nature of the reforms implemented in the six countries. Section 4 assesses the basic trends in consumer price index (CPI) deflated food prices in the six countries during three distinct periods through which each country transitioned: a pre-reform period, a period of ongoing and/or partial reforms, and a period where decisive reforms were taken, which led to increased reliance on the private sector to perform key distribution, processing, and storage functions in the food system. Section 5 presents the econometric model used for assessing the determinants of food price trends before and after reform. Price-dependent, linear spline functions were specified to examine the effects of structural changes on price levels and trends after controlling for selected exogenous and lagged endogenous factors. The results of the analyses are discussed in Section 6, and the report's conclusions and implications for policy are discussed in Section 7.

The report highlights three main conclusions:

- CPI adjusted grain or grain meal prices have declined since the initiation of food market reforms in five of the six countries examined (Ghana, since 1984; Zambia, since 1987; Ethiopia, since 1990; Kenya, since 1989; and Mali, since 1982). However, after controlling for seasonal trends, rainfall, and other factors affecting real food prices (e.g., food aid, world prices, and prices of substitute food commodities), a statistically significant decline in the average post-reform prices of selected food crops was observed for only Ethiopia and Ghana. However, fixing an "effective date" for grain marketing reform is difficult in most countries, as the reforms have been a process rather than a onetime event. Hence, the disentangling of price effects attributed to policy reform versus other factors can be sensitive to the "effective dates" chosen.

- The major factors associated with the decline in real food prices in these countries have been (a) better transmission of declining real world prices into the domestic economies due to trade barrier removal (Mali, Ghana); (b) increased amounts of food aid during the reform period (Mali, Ethiopia); and (c) increased competition and lower costs of food marketing and processing, which reduces marketing margins (Zambia, Kenya, and Zimbabwe). In four countries examined (Kenya, Zambia, Mali, and Zimbabwe), the negative effect on low income consumers of eliminating food price subsidies has been partially or wholly compensated by accompanying food market reforms that have raised consumers' access to less expensive food products formerly suppressed by regulation.

- In the countries for which marketing margin information is available (Zimbabwe, Zambia, Kenya, and Mali), mill-to-retail marketing margins have fallen since the major aspects of the reforms were initiated. This has allowed tangible benefits to be passed on to food consumers and/or producers, other factors remaining constant. Declining producer-to-wholesale price spreads were also observed in the two countries where such data were available (sorghum and rice in Mali, and maize in Kenya).

In general, the findings from the six countries provide support for the DFA report's conclusion that "real food prices have fallen in numerous African countries" (p. 48). Descriptive evidence indicates that post-reform grain prices have declined in most cases, from their pre-reform levels in the 1980s. In some cases falling retail prices are due to lower marketing margins, especially at the processing stage. While market reform has apparently contributed to decreasing post-reform consumer food prices, other factors have also been shown to be important, such as weather and food aid.

However, the analysis in this paper does not generally support the DFA's premise that "these price changes [downward] are only explicable in the face of substantial increases in production" (p. 48). In fact, available data indicate that per capita food production has declined in the post-reform period in three of the six countries examined. However, this is not necessarily indicative of a welfare loss, since in several cases production levels during the pre-reform period were buoyed by large state transfers to agri-

culture, which effectively shifted the costs of maintaining the pre-reform food systems from one social group to others. The complex distributional effects associated with food market reform (benefiting farmers and consumers in some regions while imposing greater costs on farmers and consumers in other regions) underscore the major difficulties and controversy associated with normative assessments of the effects of food marketing and pricing reform. Nevertheless, with regard to household food security, the weight of the evidence indicates that consumers, especially urban consumers, have benefited, in most cases, from the food marketing and pricing reforms initiated in the countries examined.

A future challenge for food policy is to refocus the emphasis from the liberalization of food markets to the promotion of productivity growth throughout the entire food system, through the development and strategic coordination of markets—most notably for commodities, inputs, and finance—in a financially sustainable way.

2. Measurement and Meaning of Real Food Prices

The term "real price" represents the nominal price of a good in relation to some numeraire. There is no single real price that is relevant for all groups in a particular country. For purposes of examining changes in the affordability of food over time, the desired numeraire is an index of the consumers' purchasing power. There is a large number of relevant purchasing power indices, each corresponding to the income of one of the various socioeconomic groups in the country. Since the data to construct these indices do not exist in most African countries, the typical alternative is to use the consumer price index (i.e., the general price level of a basket of basic goods and services assumed to represent some composite of the purchasing patterns of different social groups in different regions).

The quantity weights normally used for consumer price index series are often based exclusively on urban consumption surveys. Rarely do different CPIs exist for different regions within African countries, yet the cost of living certainly varies across regions. Regional CPIs are essential to determine the real price levels for different socioeconomic groups within an economy. Similarly, different groups consume different goods. Engel's law, stating that consumption patterns vary with income, has been confirmed through abundant empirical research; so it makes sense to have different indices for households in different wealth classes.

Another practical difficulty with using the CPI to assess real price trends is how to deal with the potential substitutability of staple foods. To what extent are these substitutes in consumption correlated over time? In many countries, structural changes in food markets have caused substantial substitution in consumption among staple commodities. For example, in Kenya and Zimbabwe, food market reform has resulted in a shift in consumption from relatively refined maize meal to less expensive, whole maize meal. An assessment of changes in the affordability of staple food items must take into account these consumption shifts.

CORRELATION BETWEEN THE CPI AND OTHER POTENTIAL DEFLATORS

To determine the consistency between the CPI and other potential indicators of purchasing power, we calculated the statistical correlation between the CPI and the following deflators, where data were available: (a) agricultural wage rate; (b) urban wage rate; (c) real exchange rate; and (d) gross domestic product (GDP) deflator. The indicators were first-differenced to remove long-term trend components of the data.

In cases where data on these alternative indicators were available (Kenya, Mali, and Zimbabwe), there was a high degree of correlation between the first-differenced CPI and other deflators, with the exception of the real exchange rate.[4] Table 2.1 presents selected findings for Kenya and Mali. In all the countries examined, the correlation coefficient between the first-differenced CPI, the agricultural wage rate, and the GDP deflator ranged from .75 to .99. This indicates that movements in the CPI tend to move roughly in sync with other potential deflators. Yet there still is a great potential for contradictory conclusions regarding the trend in real food prices, at least over short periods, owing to the use of different

[4] The "real exchange rate" is defined as $ER*CPI_g/CPI_i$, where ER is the number of local currency units per US$, CPI_g is the global price deflator, and CPI_i is the domestic consumer price index.

deflators (for example, see Figure 6.16, for the 19821984 period). While recognizing that the choice of deflator involves taking a particular perspective as to which socioeconomic group(s) are to be assessed, the remainder of the study focuses mainly on the CPI as a composite indicator of the general price level in the country.

Table 2.1 Correlation Coefficient between First Differences in Alternative Annual Deflator Indices, Kenya, 1973-1994; Mali (in parentheses) 1982-1994; and Zimbabwe [in brackets] 1975-1992

	Agricultural Wage Rage	Urban Wage	GDP Deflator Rate	Real Exchange Rate
CPI		(.87)	(.75) [.92]	[.81]
Agriculture			[.69]	-.09
Wage Rate				[.52]
Urban Wage Rate			(.77)	
GDP Deflator				[.63]

Source: Computed by authors using data from Kenya Central Bureau of Statistics (CBS 1995); DNSI (1995); and Central Statistical Office (CSO) (various issues).

3. Changes in Food Marketing and Pricing Policy Environment

The basic implementation of the food sector reforms undertaken in the six countries is described in Table 3.1. In most cases (with the exception of Ethiopia), food marketing and pricing reforms occurred in a sequenced manner over several years, sometimes involving a reimposition of the controls relaxed earlier in the reform period, as in Zambia and Kenya. For this reason, it will be useful to distinguish between three phases during the policy reform process, to evaluate changes in real food prices.

The first phase was the pre-reform period. The food systems of all six countries under analysis were officially controlled through state trading monopolies and numerous restrictions on private trade. These controls were largely effective in securing the bulk of marketed grain in the highly controlled, single-channel marketing systems of Zimbabwe, Kenya, and Zambia. These countries also pursued a similar state-led approach of supporting selected farm groups through expansion of state crop-buying stations, generally favorable producer prices, and large-scale disbursement of credit and inputs to smallholders, often at subsidized rates. The controls were effective to a lesser extent in Ethiopia and Mali (Staatz, Dione, and Dembele, 1988; Legesse, Asfaw, and Franzel, 1992) and almost irrelevant in Ghana, where little attempt was made to enforce official pricing and marketing regulations (Alderman, 1991). In Mali and Ethiopia, the states' intentions were not primarily to raise food production but rather to capture a certain share of it for distribution to politically influential groups at subsidized prices, mainly urban consumers, the military, and public service agencies. This approach took the view that it was possible to tax agriculture and force sales to the state without depressing agricultural production over the long term. By contrast, the pre-reform period in Kenya and Zimbabwe was marked by substantial state investments and subsidies to support some farm groups. The common view that state marketing boards taxed grain producers to support a cheap food policy was generally not appropriate in these countries.

The second phase was characterized by initial government attempts to liberalize the food system, including legalizing some aspects of private grain trading or processing. However, in most cases, private trade was legalized before government pricing policy had sufficiently changed to provide the incentives for private trade. For example, subsidies conferred through the official marketing system (through narrowing the margins between marketing boards' buying and selling prices so that private traders could not effectively compete against them) continued to some extent after the reforms were initiated in Kenya, Zimbabwe, Zambia, and Mali. The transfers conferred through state pricing policy kept selected producers and agro-business firms, primarily large millers, wedded to the state marketing system, even in a deregulated trading environment. These policies ran counter to the official intentions of the reforms and, in the case of Zimbabwe, Kenya, and Zambia, greatly exacerbated the states' financial losses associated with maize trading. In general, only after the elimination of these direct and indirect transfers through state pricing policies did realistic incentives for private distribution emerge. This environment characterized Phase 3 in our taxonomy. It is important to recognize, however, that these reforms are fragile and subject to pressures to reversals in some countries, especially where food prices are highly unstable. Incentives for private investment in the grain marketing system undoubtedly continue to be affected within this uncertain policy environment.

Table 3.1 Sectoral Policy Environment, Pre-Reform and Post-Reform Periods

Phase 1: Pre-Reform Food Marketing and Pricing Policies	Phase 2: Initial Policy Reforms	Phase 3: Decisive Policy Reform
Ethiopia: Agricultural Marketing Corporation (AMC) sets quotas to enforce smallholder delivery of grain at fixed, below-market prices. Private interdistrict grain movement prohibited.		AMC was restructured into Ethiopian Grain Trading Enterprise to act as price stabilizer. Quota delivery requirements abolished. Controlled prices abolished at all levels in the food system. Interdistrict grain trade legalized, but informal taxes on cross-district trade still remain.
Kenya: National Cereals Produce Board (NCPB) purchases and sells maize at controlled, pan-territorial and pan-seasonal prices. NCPB marketing margins insufficient to cover costs, thus restricting the range of profitable trading possibilities for private sector. Millers obliged to purchase maize from NCPB at controlled prices through quota system. Maize meal pricing and distribution regulated by government.	Phased increase in permitted purchases by mills from private sources. Limits on unlicensed trade across district boundaries relaxed. Deregulation of informal hammer milling. Phased closure of NCPB depots. Further relaxation of interdistrict movement restrictions (but tightened in response to 1992 drought).	Abolition of quotas forcing millers to purchase from NCPB. Indirect subsidies on refined maize meal through official marketing system abolished. All controls on interdistrict maize trade abolished.
Mali: State marketing board (OPAM) has statutory monopoly over cereals' marketing and pricing. Private trade illegal, though	Partial deregulation of cereals trade.	OPAM's commercial purchasing and selling functions abolished.

Table 3.1 Sectoral Policy Environment, Pre-Reform and Post-Reform Periods (continued)

Phase 1: Pre-Reform Food Marketing and Pricing Policies	Phase 2: Initial Policy Reforms	Phase 3: Decisive Reform
Ghana:		
Little Direct intervention in domestic food markets. Macro and trade policies affecting agriculture included overvalued exchange rate, quantitative imports restrictions, urban consumer subsidies, and heavy taxation of agricultural exports.	Nine currency devaluations between 1983 and 1986. Grain imports quotas and tariffs reduced.	Price controls on food crops, largely undefended, were eliminated in 1985. Quantitative import restrictions and tariffs further relaxed.
Zambia:		
National Agricultural Marketing Board (NAMBOARD) and/or state-affiliated cooperatives purchased grain from farmers and sold to millers at controlled prices. Marketing margins insufficient to cover costs, thus restricting the range of profitable trading possibilities for private sector. Nationalization of grain mills. Expansion of state marketing infrastructure and credit disbursement to smallholder areas in 1970s and 1980s. Large consumer subsidies on refined maize meal distributed through official marketing channel.	Legalization of private interdistrict maize trade. Abolition of NAMBOARD. Transfer of maize marketing functions to Cooperative Federation. Deregulation of informal, small-scale milling. Removal of most restrictions on external trade.	Consumer subsidies on maize meal distributed through official market-system abolished. Official producer and selling prices abolished.
Zimbabwe:		
Grain Marketing Board (GMB) purchased grain from farmers and sold to millers at controlled prices, uniform across regions and seasons. Private grain movement into urban and commercial farming areas illegal. Marketing margins insufficient to cover costs, restricts private trading incentives. Expansion of state marketing infrastructure, credit disbursement, and input subsidies to smallholders in 1980s. Periodically large consumer subsidies on refined maize meal distributed through official marketing channel.	Gradual reduction in state grain collection points and state-disbursed credit to smallholders, 1986-1992. Official producer prices decline in real terms 1985-1992. Removal of trade controls between communal areas. Relaxation of informal barriers to urban milling.	All controls on domestic, private maize trade abolished. Maize meal subsidies through official marketing system abolished.

4. Trends in Real Food Prices, Pre-Reform and Post-Reform

Table 4.1 presents indices of real food price levels during the three phases of food marketing and pricing described above. The retail CPI-deflated price of whole grain in the capital city during the pre-reform period (Phase 1) was indexed at 100. In cases where the market was strictly controlled, the index price was the marketing board's ex depot (selling) price of grain.[1]

The average level of prices during the two phases of food market reform—relative to the CPI-deflated price of whole grain during the pre-reform period—is reported in the two right columns of Table 4.1. Numbers lower (greater) than 100 denote a decline (rise) in the average price levels relative to the pre-reform period.

During the initial phase of the reform processes (Phase 2), the CPI-deflated prices declined in about half of the cases of the food commodities examined (maize in Zambia and Kenya; rice in Mali; maize and sorghum in Mali) and rose in the other cases (maize in Zimbabwe; millet, yams, and cassava in Ghana; and sorghum in Mali). However, after the decisive reforms of Phase 3, retail grain prices in the urban markets examined were lower than their pre-reform average in five of the six countries examined.

Producer price information for the entire period was available only for Zimbabwe, Kenya, and Zambia. In one case (Zimbabwe), producer prices rose in the regions for which data were available. In Zambia, producer prices were markedly lower. In Kenya, the direction of producer prices varied considerably but in general appeared to be slightly lower than their pre-reform levels.

Consumer price information was available in Kenya, Zambia, and Zimbabwe for refined meal marketed through the official marketing systems (rows d, k, and q) and for whole meal custom-milled by informal marketing channels, which has become increasingly accessible to urban consumers since the reforms (rows f, n, and t). The data indicate that prices of refined meal rose in Zimbabwe and declined in Zambia and Kenya during both phases of the reform period. When the explicit consumer subsidies on refined meal are added to the prices to more accurately account for the cost of producing meal through the official marketing systems, prices declined even further in Zambia and Kenya (rows g and l) but still rose in Zimbabwe (row r). The reasons for this are described in more detail below.

One possible explanation for falling real food prices, where this has in fact occurred, is an outward shift in the supply function due to expansion in per capita grain production. In fact, however, per capita production appears to be declining in several of the countries mentioned above, where real prices have fallen in the post-reform period (Table 4.2). While production is subject to wide fluctuations due to drought and may be sensitive to the beginning and ending year for the period in question, this problem is addressed to some extent by smoothing abnormal weather seasons over several years by use of moving averages. The data in Table 4.2 report three-year, centered, moving averages. For all the countries presented, per capita grain production has declined even in the short post-reform periods. However, as noted in the DFA report, the uncertain quality of food production data in some of these countries warrants caution in forming strong conclusions about production trends.

It is important to note that these price comparisons between the three periods do not control for changes in exogenous variables affecting food prices over time (weather, direct and indirect subsidies conferred through policy, changes in world prices, etc.). The purpose of the next two sections is to assess price changes after controlling for some of these exogenous factors.

Table 4.1 Index of Real Prices in Pre-Reform and Post-Reform Periods

		Phase 1: Pre-Reform	Phase 2	Phase 3
Mali	sorghum, retail, Bamako	100	116	79
	rice, retail, Bamako	100	99	84
Ghana	maize, whole, average of 3 markets[a]	100	84	71
	sorghum, wholesale, average of 3 markets	100	82	62
	millet, wholesale, average of 3 markets	100	103	79
	yams, wholesale, average of 3 markets	100	126	104
	cassava, wholesale, average of 3 markets	100	133	93
Ethiopia	teff white, retail, Addis Ababa	100	---	83
	maize, retail, Addis Ababa	100	---	89
	wheat white, retail, Addis Ababa	100	---	97
	barley white, retail, Addis Ababa	100	---	94
Kenya	b. maize grain, official exdepot, Nairobi	100	80	83
	c. maize grain, official producer price, Kakamega	58	55	54
	d. refined meal, official retail, Nairobi	134	127	131
	g. refined meal, official retail plus subsidies, Nairobi	161	138	----
	e. maize grain, retail, Nairobi markets	101	89	72
	f. whole meal, hammer-milled, Nairobi markets	---	---	82
Zambia	h. maize grain, official exdepot, Lusaka	100	70	---
	i. maize grain, official producer	97	72	---
	k. roller meal, official retail, Lusaka	143	113	137
	l. roller meal, official retail plus subsidies, Lusaka	199	179	137
	m. maize grain, retail, Lusaka markets	---	---	76
	n. whole meal, hammer-milled, Lusaka markets	---	---	93
Zimbabwe				
	o. maize grain, official exdepot	100	71	121
	p. maize grain, official producer	82	69	102
	q. roller meal, official retail	129	150	199
	r. roller meal, official retail plus subsidies	170	210	214
	s. maize grain, retail, Harare markets	---	---	130
	t. whole meal, hammer-milled, Harare markets	---	---	144

Notes: [a] unweighted average of Bolgatanga, Techiman, and Kumasi

Table 4.1 Index of Real Prices in Pre-Reform and Post-Reform Periods (continued)

Data for Pre-Reform, Phase 2, and Phase 3 periods based on the following periods:

	Phase 1: Pre-Reform	Phase 2	Phase 3
Mali	1970.10-1981.09	1981.10-1985.09	1985.10-1994.12
Ghana	1980.01-1983.09	1983.10-1985.08	1985.09-1990.12
Ethiopia	1980.01-1990.05	---	1990.06-1994.12
Kenya	1980.01-1988.06	1988.07-1993.12	1994.01-1995.09
Zambia	1980.04-1986.03	1986.04-1993.03	1993-04.1995.08
Zimbabwe	1980.04-1991.05	1991.06-1993.05	1993.06-1995.09

Table 4.2 Trends in Coarse Grain Production Per Capita, Area, Yield, and Net Exports, Selected Countries

		Production Per-Capita (tons) (1)	Area (000 ha) (2)	Yield (tons/ha) (3)	Net Exports (000 tons) (4)
		three-year centered moving average			
Zimbabwe	1970-74	340	1,286	1.32	628
	1975-79	285	1,262	1.18	429
	1980-84	267	1,758	1.06	205
	1985-89	266	1,697	1.33	314
	1990-92	162 (184)[a]	1,366	1.12	-228
	1993-94	144 (179)[a]	1,545	1.00	49
Zimbabwe (smallholder sector)	1970-74	116	993	.55	
	1975-79	117	1,031	.54	
	1980-84	127	1,538	.59	
	1985-89	177	1,542	.98	
	1990-92	108 (131)[a]	1,266	.82	
	1993-94	91 (117)[a]	1,393	.65	

Table 4.2 Trends in Coarse Grain Production Per Capita, Area Yield, and Net Exports, Selected Countries (continued)

		Production Per-Capita (tons) (1)	Area (000 ha) (2)	Yield (tons/ha) (3)	Net Exports (000 tons) (4)
		three-year centered moving average			
Zambia	1970-74	224	577	1.51	-78
	1975-79	160	626	1.22	-94
	1980-84	188	989	1.03	-181
	1985-89	235	848	1.56	-161
	1990-94	173 (193)[a]	836	1.46	-239
Malawi	1970-74	328	1,071	1.13	14
	1975-79	286	1,049	1.14	-05
	1980-84	267	1,144	1.16	.59
	1985-89	228	1,185	1.13	.98
	1990-94	182 (196)[a]	1,322	1.03	.82
Kenya	1970-74	102	1,129	.93	77
	1975-79	133	1,222	1.22	71
	1980-84	132	1,247	1.71	59
	1985-89	126	1,381	1.81	120
	1990-94	92 (99)[a]	1,337	1.87	-102
South Africa[b]	1970-74	327	4,250	1.77	2,435
	1975-79	332	4,393	1.97	2,909
	1980-84	311	4,235	2.19	3,069
	1985-89	206	3,947	1.81	1,428
	1990-94	204 (242)[a]	3,437	2.27	1,090

Sources: Jayne and Jones (1996)

Notes: The share of maize in the total coarse grain production during the 1980-89 period is estimated at 91 percent in Zimbabwe, 98 percent for Malawi, 95 percent for Zambia, 92 percent for Kenya, and 94 percent for South Africa (USDA, 1993).

[a] Figures in parentheses exclude the 1992 drought year.

[b] Figures for South Africa are for maize only.

5. Model and Data

THE MODEL

One approach to modeling price effects would be to build a structural econometric model consisting of behavioral equations to explain the supply and demand decisions of all participants in the market, including producers, consumers, traders, and state agencies involved in food marketing. However, this would require a large model that would embody many overidentifying restrictions drawn from economic theory. These restrictions usually take the form of excluding variables from particular equations in order to motivate a particular economic interpretation for the model. Of course, it is not necessary to work with large systems, because there are methods for estimating individual structural equations embedded within a larger system. However, estimating price effects in individual equations only provides information on the effects of price on the behavior of the particular agent being modeled (e.g., on producers, if a supply equation is being estimated). A structural approach to estimating the effects of market reform on equilibrium prices would require structural equations for all market participants at each stage in the system, from production to marketing to consumption.

A potential problem with large-scale structural models is that the restrictions used to identify the model may not be valid. A multi-market structural model of a vertical marketing chain is complicated, particularly when it involves international trade. Economic theory often only provides weak guidelines, however, on how identification can be achieved. For example, Sims (1980) showed that if expectation variables enter an equation, then it is almost impossible to exclude any relevant variable that is known at the time expectations were formed, because these variables will enter through the expectations term. If incorrect identification restrictions are imposed, then the model can provide misleading results (Jayne and Myers, 1994; Tomek and Myers, 1993; and Sims, 1982).

An alternative is to directly specify a reduced form model for equilibrium food price levels. Such a model would include variables that might be included in structural models drawn from economic theory, but otherwise the model is left relatively unrestricted. Data availability also will affect what can be feasibly estimated. Historical price correlations are summarized by including lagged variables, and statistical criteria are used to determine how many lags to include (Judge et al., 1985, chapter 16). The advantage of this approach is that the minimal restrictions applied to the reduced form provide flexibility, which allows the model to be consistent with a wide range of alternative economic structures (Tomek and Myers, 1993). The disadvantage of this model is that structural information regarding the effects of price on supply or demand decisions made by the particular market participants is not available. Nevertheless, the main goal of the present study is confined to estimating the *net* effect on CPI-adjusted price levels during the pre- and post-reform periods, summarized by the average price trends during the two regimes. A reduced form approach is very well suited to this task.

To test for statistical differences in the trend of real food prices before and after structural change, price-dependent spline functions are specified. Spline functions are a class of models that allow for a continuous function to be estimated, but they can take on a different slope after structural change. If linearity is assumed, such a model is called a piecewise linear regression, and in this case it consists of two straight-line segments that are continuous at the point of

structural change (Pindyck and Rubenfeld, 1986). This approach is in contrast to models that result in a discontinuity in the function before and after structural change (using, for example, slope and intercept shifters). Assuming that food prices are not discontinuous but that their relationship to exogenous and lagged-endogenous variables may nevertheless be altered under structural change, a spline-function approach would be appropriate.

The basic model used for country-level estimation is $P_t = b_0 + b_1*X_t + b_2*TREND_t + b_3*D_t*(TREND_t\ REFORM_{t0}) + \_t$ where P_t is the deflated price of the food commodity; X_t is a vector of predetermined variables hypothesized to affect P_t; $TREND_t$ is a time trend; $REFORM_{t0}$ is the value of the time trend variable when the structural break occurs (a constant); and D_t =1 if $t > REFORM_{t0}$ otherwise.

For the years before, and including the structural break, $D_t = 0$, and $E(P_t) = b_0 + b_1*X_t + b_2*TREND_t$.

After the structural change, $D_t = 1$, and $E(P_t) = b_0 + b_1*X_t + b_2*TREND_t + b_3*TREND_t\ b_3*REFORM_{t0}$ or *(4)* $E(P_t) = (b_0\ b_3*REFORM_{t0}) + b_1*X_t + (b_2 + b_3)*TREND_t$

Note that before structural change, the average monthly change in price levels is given by b_2. After structural change, the average monthly price change shifts to $b_2 + b_3$. As shown in more detail by Pindyck and Rubenfeld (1986), there is no discontinuity in the relationship. Equation (1) is estimated using monthly data for Ethiopia, Ghana, Mali, and Kenya. Since the food market reform process in Zimbabwe and Zambia has occurred in substance only since 1993, there are insufficient post-reform data points to allow for econometric analysis of this type, and only descriptive assessments are made.

The vector X_t in (1) includes country-specific variables specified in Table 5.1.

Several limitations of the spline-approach model are underscored. The most serious problem regards capturing the cumulative and gradual effects of policy change. While the use of dummy variables to model structural change has been widespread and standard in the literature, this approach is not able to adequately capture the cumulative effects of structural change, which are almost never felt immediately. Relatedly, food market reform in some countries has involved a series of sequenced and phased policy changes, some of which were only partially implemented or were reversed for a time before being reintroduced. Hence, in reality there were numerous differentiated stages of reform within each of the broad phases of the reform process described above. For reasons of tractability, the approach taken above implicitly models the pre-reform and reform periods in a somewhat aggregated manner. A third limitation is that the reduced-form equation (1) is not explicitly derived from any particular structural model; it is widely consistent with a number of structural interpretations. As a result, structural information is not available regarding the effects of price on the supply or demand decisions of particular market participants. However, this is not a major drawback, as the main goal of the present study is to estimate the *net* effect of various factors hypothesized to influence CPI-adjusted price levels during the pre- and post-reform periods.

DATA

The sources of the data used in this analysis are as follows:

- *Ghana:* Commodity rice price information (Alderman and Shively, 1994, using data from the Ministry of Agriculture); consumer price index (Alderman and Shively, 1994), using data from the Ministry of Finance); exchange rate, gross domestic product, and population (International Monetary Fund, 1995); world price information (FAO Quarterly Bulletin of Statistics, various issues); shipping rates (World Bank Commodity Trade and Price Trends, 1992); rainfall (National Oceanographic and Atmospheric Administration, 1995).
- *Zimbabwe:* Commodity price information (Grain Marketing Board data files); monthly maize meal

Table 5.1 Estimation Period, Estimation Procedure, and Explanatory Variables in Equation (1) for Kenya, Ethiopia, Ghana, and Mali

	Kenya	Ethiopia	Ghana	Mali
Estimation Period:	1979.01-1994.08	1987.01-1994.12	1980.01-1990.07 and 1984.10-1990.07	1982.01-1994.12
Estimation Procedure:	OLS	SURE	SURE	OLS
Dependent Variables:	retail market prices for maize in Nairobi, Central Region and Western Region markets (deflated by CPI)	retail market prices for maize, white wheat, mixed wheat, white teff, and white barley, Addis Ababa (deflated by CPI)	wholesale price of maize, millet, yams, and cassava, Techiman market (deflated by CPI)	retail price of sorghum and rice, Bamako market (deflated by CPI)
Explanatory Variables:				
three-month moving average of rainfall (mm/month)	X	X		
drought dummy (1983)			X	
drought dummy (1983/84 and 1991/92)				X
monthly dummies	X	X	X	X
real per capita GDP			X	
three-month moving average of food aid arrivals at Eritrean ports		X		
substitute food crop market prices	X	X	X	X
lagged dependent variable	X	X	X	X
lagged marketing board official exdepot price for maize	X			

prices and gross margins (Chisvo, 1995); consumer price index, exchange rate, gross domestic product, and population (International Monetary Fund, 1995); world price information (FAO Quarterly Bulletin of Statistics, various issues); shipping rates (World Bank Commodity Trade and Price Trends, 1992); state subsidies on maize meal (Government of Zimbabwe [GOZ], 1994); rainfall (Masters, 1994).

- *Kenya:* Commodity price information (Central Bureau of Statistics, 1995); consumer price index, exchange rate, gross domestic product, and population (International Monetary Fund, 1995); world price information (FAO Quarterly Bulletin of Statistics, various issues); shipping rates (World Bank Commodity Trade and Price Trends, 1992); state subsidies on maize meal, rainfall (Central Bureau of Statistics, 1995).
- *Zambia:* Commodity price information (Howard et al., 1995 (to 1994); Lusaka Agricultural Commodity Exchange for 1994/95)); consumer price index, exchange rate, gross domestic product, and population (International Monetary Fund, 1995); world price information (FAO Quarterly Bulletin of Statistics, various issues); shipping rates (World Bank Commodity Trade and Price Trends, 1992); state subsidies on maize meal, rainfall (Zambia Federation of Cooperatives, 1995).
- *Ethiopia:* Commodity price information (Ethiopian Grain Trading Enterprise, 1995); consumer price index, exchange rate, gross domestic product, and population (International Monetary Fund, 1995); world price information (FAO Quarterly Bulletin of Statistics, various issues); shipping rates (World Bank Commodity Trade and Price Trends, 1992); rainfall (National Meteorological Statistical Agency, Government of Ethiopia, 1995).
- *Mali:* Commodity price information (Ministry of Finance and Plan, Direction Nationale de la Statistique et Informatique (DNSI), 1995, and Market Information System); exchange rate (International Monetary Fund, 1995); wage rate data (DNSI, 1995); weather and CPI data (Aldridge and Staatz, 1995).

STATIONARITY TESTS

Unit root tests were performed on the deseasonalized, monthly price data to examine stationarity, an assumption that is required in the derivation of standard inference procedure for regression models. Nonstationary regressors invalidate many standard results and require special treatment, such as differencing the data to remove the effects of the unit root. Tests of stationarity of the data were undertaken using augmented Dickey-Fuller tests, which are reported in Table 5.2. The results support the hypothesis of stationarity at the 5 percent level in most cases (exceptions are noted with an asterisk). We proceeded with analyzing the data in levels, rather than first-differences, recognizing that, in the case of millet and yams in Ghana and sorghum in Mali, the hypothesis of non-stationarity could not be rejected at the 5 percent level. It is important to note that the Dickey-Fuller test is somewhat biased in favor of indicating non-stationarity. Unit roots are almost never present in annual data, and therefore the tests were not applied for the Zambia and Zimbabwe data.

Table 5.2 Augmented Dickey-Fuller Unit Root Tests

		Statistics	McKinnon 5% Critical Value
Kenya	maize grain, Nairobi, market retail (3)	-4.679	-3.438
	maize grain, Kakamaga, market retail (2)	-5.355	-3.441
	maize grain, Rift Valley, market retail (3)	-3.619	-3.438
Ethiopia	maize, Addis Ababa, market retail (3)	-4.115	-3.468
	white teff, Addis Ababa, market retail (3)	-4.265	-3.466
	white barley, Addis Ababa, market retail (3)	-3.923	-3.473
	white wheat, Addis Ababa, market retail (3)	-3.710	-3.481
Mali	rice Bamako, market retail (3)	-4.071	-3.440
	sorghum, Bamako, market retail (3)	-2.410	-3.440*
	sorghum marketing margin, Bamako-Zngasso (1)	-6.502	-3.453
Ghana	maize, Techiman, market wholesale (2)	-3.961	-3.448
	sorghum, Techiman, market wholesale (2)	-3.525	-3.448
	millet, Techiman, market wholesale (3)	-3.228	-3.449
	cassava, Techiman, market wholesale (2)	-4.017	-3.448
	yams, Techiman, market wholesale (2)	-3.195	-3.448

All Dickey-Fuller tests were run on deseasonalized data and included a constant and time trend. Numbers in parentheses denote the number of dependent-variable lags, determined from Box-Pierce Q-tests, specifying the number of lags necessary to purge the residuals of auto-correlation.

* Indicates rejection of hypothesis of stationarity.

6. Results

KENYA

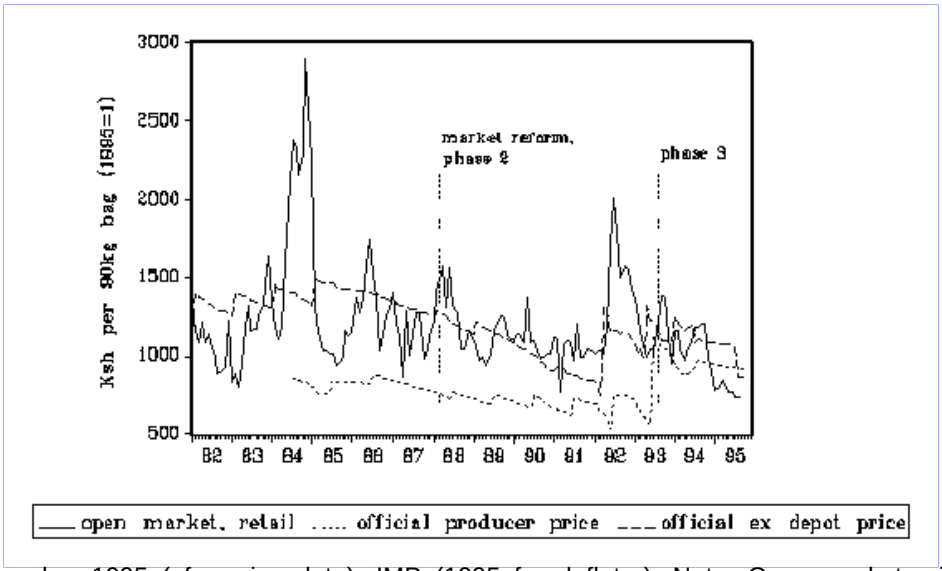
The Kenyan government has been involved in marketing maize and maize products for the last 65 years. The common practice was to defend politically-chosen price levels through measures like movement controls, milling quotas, subsidies, international trade controls, and other regulatory measures which varied very little over time. The marketing system that evolved from these controls became extremely costly during the last decade, accounting for more than 20 percent of the public-sector budget deficit by 1992.

In 1988, the Kenyan government embarked on a program of reform in the food market that involved the relaxation of most market controls. However, the reform process had a stop-go format until the end of 1993, when virtually all direct controls on the food market were abolished in favor of a competitive market, and direct subsidies on sifted maize flour were eliminated, causing its price to rise by 51 percent. Following the initiation of reforms, the government often expressed concern over the possibility of higher food prices, especially maize meal, if subsidies conferred through the official marketing system were abolished. However, as early as 1989, analysis indicated that maize distribution and processing costs were likely to fall with the elimination of controls on inter-district trade (Odhiambo and Wilcock, 1989).

Price Trends

Figure 6.1 presents the pre- and post-reform retail prices for maize in Nairobi's informal markets. The retail price of maize grain decreased by an average of 0.5 Kenyan shillings (Ksh) per month (6 Ksh per-year, in constant 1995 Ksh) between July 1983 and

Figure 6.1 Kenya Official and Open Market Maize Grain Prices, 1982-1995



Source: Mukumbu, 1995 (for price data): IMP (1995 for deflator). Note: Open market prices refer to Nairobi markets.

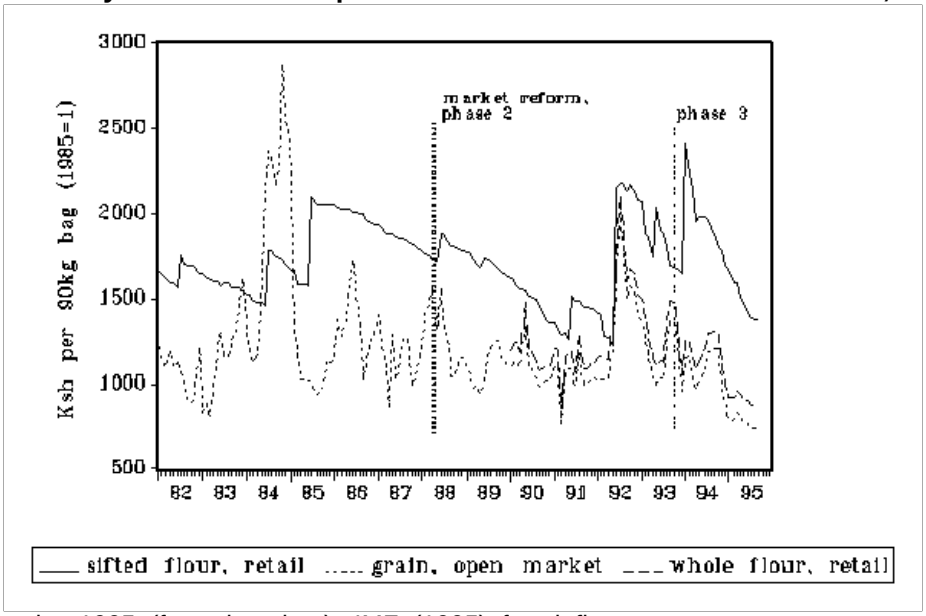
June 1988. Between 1988 and 1994, the average price decline increased to -14.7 Ksh (about 1 percent) per year. However, the change in slope was not significant at the 10-percent level.

When controlling for lagged rainfall, seasonal dummies, the controlled *ex depot* official price of maize set by government, and GDP, the spline function results indicated that retail maize prices in Nairobi, Central Region, and Western Region markets exhibited no significant linear trend after the 1988 reforms (Tables A1-A3). Between 1988 and February 1995, Nairobi's open-market maize prices increased by 12.6 Ksh per year (in 1995 Ksh) (i.e., 0.8 percent per-year), other factors held constant, but these results were not significant at the 5 percent level. Introducing two structural breaks to separate the effects during Phases 1 and 2 also yielded positive but insignificant effects for each period.

In spite of a lack of significant change in informal-market maize prices during the post-reform period, a large proportion of low-income consumers have actually paid lower prices for their staple maize meal since the market reforms (Figure 6.2 and Table 4.1, columns d and f). Prices for maize meal have declined since the early 1990s because the reforms have facilitated the development of lower-cost informal maize milling networks, which were previously blocked by policy from operating in urban areas. Market reform has allowed greater availability of grain supplies in urban and grain-deficit rural areas, thus facilitating the manufacture and consumption of less expensive, whole maize meal. Prior to food market reform in 1988, consumption of maize meal, the primary staple in the country, was predominantly in the form of refined sifted flour in urban areas. Since the early 1990s limited, private grain trade has given urban consumers the option of buying grain and custom-milling it into whole meal. Surveys in 1993 indicated that whole meal accounted for about 30 percent of maize meal consumption in Nairobi and about 50 percent for the lowest income quintile (Jayne, Lupi, and Mukumbu, 1995). The proportion of urban households consuming whole meal has increased to about 40 percent since the removal of subsidies on sifted flour through the official marketing system in December 1993 (Argwings-Kodhek and Jayne, 1996).

Figure 6.2 presents trends in the prices of sifted flour (through the official marketing channel), retail informal maize prices, and whole meal prices in Nairobi markets. In all years since 1990, except for

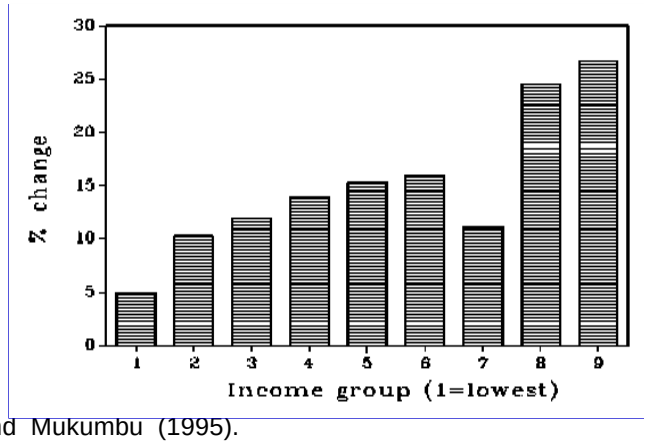
Figure 6.2 Kenya Official and Open Market Retail Prices for Maize Meal, 1982-1995



Source: Mukumbu 1995 (for price data); IMF (1995) for deflator.

Note: Open market prices refer to Nairobi markets.

Figure 6.3 Percentage Change in Expected Total Expenditures on Maize Flour by Income Group After Elimination of Subsidies on Sifted Flour, Nairobi, Kenya, 12/94 to 3/95



Source: Jayne, Lupi, and Mukumbu (1995).

Note: Results based on March 1994 (post-reform) prices of sifted flour and whole meal compared to December 1993 (pre-reform) prices for the same product.

the drought year of 1992, the imputed consumer cost of whole meal was well below the average price of sifted maize flour during the pre-reform period.[1] This finding is particularly important, considering that the price of sifted flour was indirectly subsidized through the official marketing system, and thus raised the competitiveness of sifted flour *vis a vis* the informal marketing system.

In December 1993, the Kenyan government eliminated the subsidy on sifted flour, causing its price to increase by 53 percent. Strong concerns were voiced as to whether low-income consumers could maintain their access to food under such a sudden and large surge in the price of the major staple.

Jayne, Lupi, and Mukumbu (1995) simulated the net change in expected consumer expenditures on maize products, by income group, that resulted from the elimination of the subsidy on sifted flour. For the pre-reform expenditure levels, the baseline expected demands were evaluated at the prices that prevailed prior to reform, Ksh 16.32/kg for sifted and Ksh 13.5/kg for whole flour. The post-reform expected expenditures were evaluated using the prices prevailing three months later in March 1994, Ksh 25/kg and 14/kg for sifted and whole flour, respectively. These quantities were calculated for nine different income categories. For each income category, all other household variables were evaluated at their mean within that group.

On average, the removal of the subsidy led to a 14-percent rise in expected expenditures on maize flour (Figure 6.3). But for the lowest two groups, the increase in expenditures on maize was expected to be only 8 percent of total maize expenditures and less than 1 percent of household incomes. The relatively small impact on the poor is because of their higher baseline consumption of less-expensive whole meal and because of a greater estimated shift to whole flour when the price of sifted rises. This contrasts with a 25-percent increase in expenditures on maize flour for the highest income group. The expected change in maize expenditures relative to income was less than 1 percent for all income groups. This compares with a savings to the public treasury of more than Ksh 1.4 billion per year, or 2 percent of Kenya's GDP, from the elimination of the subsidy.

These results may appear surprising in light of the strong concerns among some policy makers that the elimination of the subsidy would create great hardship for urban consumers. Substantial adversity to low-income consumers would indeed be expected if consumption habits were rigid. For example, consider the change in expected expenditures if substitution was not taken into account. Holding the proportions of sifted- and whole-flour purchases fixed at pre-reform levels for each income group, the change in maize expenditures after subsidy elimination would have been expected to be 37 percent on average and 25 and 45 percent for the

lowest- and highest-income groups, respectively. Here the change in expenditure for the highest-income group was almost as large as the 53-percent change in the price of sifted flour purchases, because most of the households in this group consume sifted flour. The change in expenditures for the lowest-income group would be overestimated by a factor of five. This example clearly illustrates the importance of allowing for potential product substitution *within* a particular commodity group.

These findings indicate that the subsidy on sifted maize flour was untargeted and that its benefits were actually inversely related to household incomes. A 53-percent increase in the price of sifted flour, *ceteris paribus*, is estimated to have increased maize flour expenditures by 7 percent for the lowest household income quartile in Nairobi, as compared with 25 percent for the highest income quartile. This is because low-income consumers have a greater likelihood of consuming less expensive whole maize flour, and, for those who do purchase sifted flour, they appear more likely to shift to whole flour when the price of sifted rises. Removal of the subsidy is predicted to raise expected household maize flour expenditures by less than 1 percent of a household's income for all income groups. Perhaps as a result, the elimination of the subsidy has produced virtually no resistance after 18 months.

Maize Milling Margins

This section presents emerging evidence on changes in mill-to-retail marketing margins in the post-food market reform period. The margin between the retail price of maize meal and the marketing board selling price of maize accrues to millers and distributors in the official marketing system. The formula used to calculate the mill-to-retail margin was:

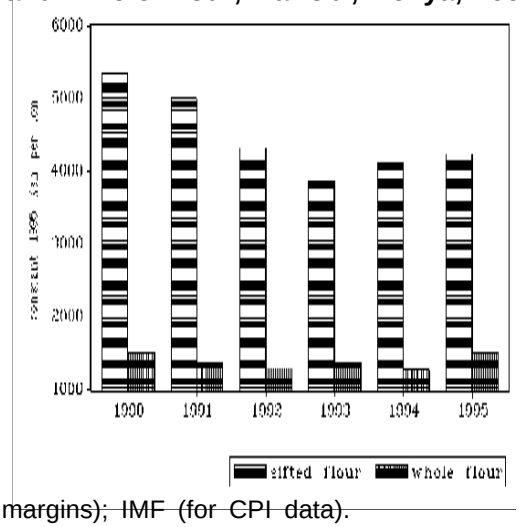
$$(5)\quad PMM - PS/z + PB/z + S = \text{mill-to-retail margin}$$

where *PS* is the selling price (the price at which millers buy maize grain from the marketing board); *PMM* is the retail price of maize meal; *z* is the average extraction rate (i.e., tons of meal produced from one ton of grain, 0.80 in the case of Kenya sifted flour); *PB* is the value of maize by-product per ton; and *S* is the direct subsidy given to millers, if applicable. The mill-to-retail margin thus represents the margin that millers, distributors, and retailers receive for manufacturing one ton of maize meal from one half tons of grain and then distributing the meal to retail shops.

The mill-to-retail margin has accounted for about 50 percent of the retail value of sifted maize flour during the past decade. Since the initiation of partial reform measures in 1986/1987, the mill-to-retail margin in the official marketing channel has declined 20 percent since 1990, from about 5,000 Ksh per ton to about 4,200 Ksh per ton (in constant 1995 Ksh) (Figure 6.4). The evidence suggests that declining margins are at least partially due to increased competition from informal grain marketing systems (Jayne et al., 1995). Hammer mill margins have been considerably lower over the period, although this margin does not include packaging or distribution to retail shops. This margin is simply the fee paid by the consumer for custom-milling her grain at local hammer mills. Custom-mill charges at Nairobi's hammer mills have been relatively constant in real terms since 1990 (Figure 6.4).

Our general assessment is, therefore, that maize prices in Kenya's informal grain markets have exhibited a slight increasing trend since 1988 (after controlling for seasonal variation, official marketing board prices, weather, and real per capita GDP). Official retail prices for sifted maize meal have remained at their pre-reform levels. Whole maize meal, which now accounts for about 40 percent of the total maize meal consumption in Nairobi, has been available at about 60 percent to 70 percent the cost in real terms of the average price for sifted flour during the 1980-1988 pre-reform period. Consumption of this commodity appears to be concentrated disproportionately among low-income consumers (Jayne, Lupi, and Mukumbu, 1995). The evidence therefore indicates that the majority of low-income urban consumers in Kenya has probably enjoyed lower staple maize-flour prices in the post-reform period, despite cutbacks in food subsidies conferred through the official marketing channel.

Figure 6.4 Gross Margins for the Manufacture of Sifted and Whole Flour, Nairobi, Kenya, 1990-1995



Source: Mukumbu (for gross margins); IMF (for CPI data).

Note: 1995 prices through May; 1995 inflation rate assumed at 26 percent; margins for sifted flour include packaging and distribution to retail shiops; margins for whole meal are for custom-mill charge only.

ZIMBABWE

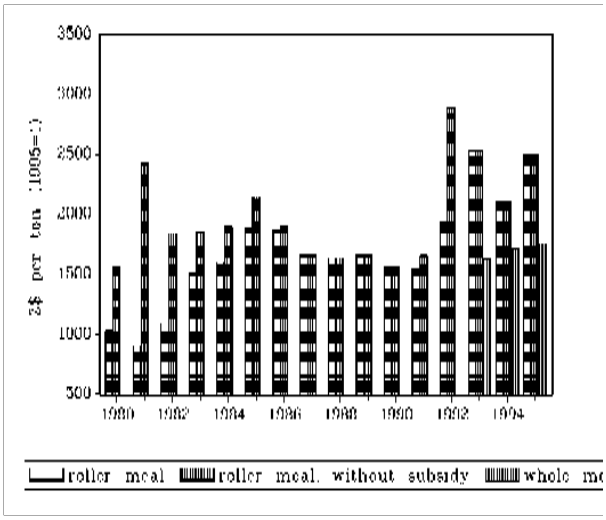
Decisive reforms were implemented in 1993 in the maize market, with the elimination of controls on smallholder grain movement into urban areas and elimination of explicit subsidies on refined meal distributed through the official marketing system. Partial restructuring of the maize market occurred in 1991 and again in 1992, but these steps did not address the major policy barriers to grain marketing, and even these partial steps were further mitigated by a severe drought in 1992. The 1993 harvest was the first experienced under meaningful food market liberalization in Zimbabwe since the early 1930s.

The price of refined maize meal distributed through the official marketing system indeed rose in both the Phase 2 and Phase 3 periods of reform (Table 4.1; row q), due to the elimination of subsidies on refined maize meal in June 1993. However, as in Kenya, market reform has expanded the availability of grain for purchase in urban areas, in contrast to the pre-reform period when urban grain supplies were tightly controlled by the state. The availability of informally marketed grain has facilitated the development of informal hammer mills in urban areas and, as in Kenya, has allowed consumers a wider range of maize meal procurement options (Jayne and Rubey, 1993; Rubey, 1995).

Since the implementation of significant grain market reforms in June 1993, which expanded urban consumption of whole meal, the price of this product has ranged from 50 percent to 70 percent that of maize roller meal, the main maize product manufactured by the formerly oligolistic, large-scaling milling industry prior to reform (Figure 6.5). Since market reform, the price of whole meal obtained through informal channels has been roughly equal to the pre-reform price of refined roller meal available through the official marketing system prior to reform (Figure 6.5). This is especially noteworthy, considering that during the pre-reform period, roller meal distributed through the official, marketing system was typically subsidized either directly through payments to millers and/or indirectly through operating losses on the state marketing boards' trading margin. These subsidies, if eliminated and passed on to consumers, would have inflated official, maize meal prices in the pre-reform period by an average of 57 percent (compare rows q and r in Table 4.1).

Hence, while consumers have not experienced lower maize meal prices in the post-reform period to date, market reform has reduced milling costs and has

Figure 6.5 Zimbabwe Prices for Roller Meal (With and Without Subsidies) and Custom-Milled Whole Meal



Source: Ministry of Agriculture data files (for price data); IMF (for deflator)

Note: Custom-milled whole meal prices are derived as informal market prices for maize grain plus observed custom-milling fee; does not include bagging and time cost of milling grain, and as such is not strictly comparable to roller meal prices, since the latter do account for these costs. Informal market prices refer to Harare markets.

shielded the poor from substantial price increases that otherwise would have occurred due to subsidy elimination. Recent survey evidence indicates that about 50 percent of urban Zimbabweans now consume whole meal procured and milled through informal grain marketing channels (Rubey et al., 1995). As in Kenya, the Zimbabwe experience indicates that treasury losses associated with maintaining the dominance of the official marketing channel during the pre-reform period have been reduced substantially without adverse effects on household food security.

Although much maize trade now bypasses the Grain Marketing Board, maize producer prices continue to be set by the state and are still likely to influence informal market prices. For this reason, there is very little that can be concluded about the effects of the recent liberalization measures on equilibrium producer- price levels. However, as indicated in Table 4.1, row p, and in Figure 6.6, maize producer prices have increased in since 1993. This has been largely driven by government pricing response to the droughts of 1992 and 1995.

Maize Milling Margins

As in Kenya, maize milling and retailing margins in Zimbabwe have accounted for about one-half of the total financial cost of maize meal prices for consumers during the past 15 years. The mill-to-retail margins of large-scale millers were calculated based on equation (5). The data indicate that the mill-to-retail margins in the official marketing channel have been four to six times greater than margins for the informal small-scale milling sector (Figure 6.7).

Table 6.1 shows the evolution of roller meal prices (produced by the large-scale commercial processing firms) and custom-milled whole meal (produced by small-scale informal mills) in Harare, Zimbabwe. The data indicate that the real cost of roller meal has declined since maize market reform in 1993, due to both favorable harvests in 1993 and 1994, and in-

Table 6.1 Comparison of Roller Meal and Whole Meal Costs in Zimbabwe, 1992-1994

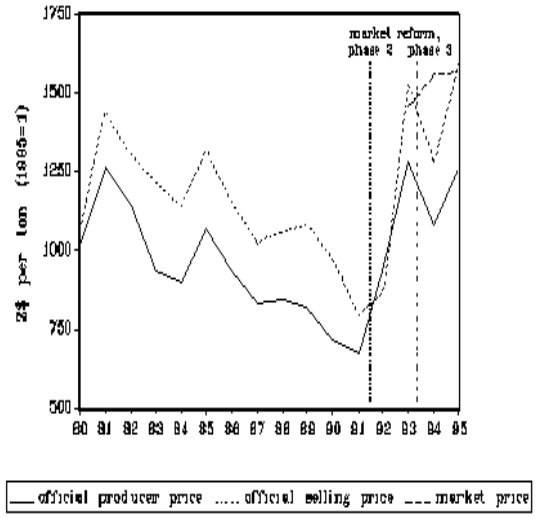
Year	Type of (a)	Cost of Meal (Z$/t)* (b)	Consumer Price Index (1994=1)** (c)	Deflated Maize Meal Cost (1994 Z$/mt) (d)=(b)/(c)	Exchange Rate (Z$/US$) (e)	Maize Meal Cost (US$/mt) (f)=(b)/(e)
1992	Roller meal	1,775	0.64	2,773	8.0	222
	Whole meal (custom milled)		na	na		na
1993	Roller meal	1,810	0.80	2,262	8.0	226
	Whole meal (custom milled)	1,156	0.80	1,445	8.0	145
1994	Roller meal	2,050	1.00	2,050	8.2	250
	Whole meal (custom milled)	1,406	1.00	1,406	8.2	171

* Cost of roller meal represented by retail price of meal plus direct subsidy to millers.
Cost of whole meal (custom milled) is the informal retail price of maize grain in Harare plus milling fee; the figures used were:

1993: Z$16.50 per-16kg bucket maize grain plus Z$2.00 per-bucket milling fee = Z$18.50 per-16kg-bucket, or Z$1,156 per ton
1994: Z$20.00 per-16kg bucket maize grain plus Z$2.50 per-bucket milling fee = Z$22.50 per-16kg-bucket, or Z$2,406 per ton

creased competition from the informal milling sector. Table 6.1 (column d) also shows that, for Zimbabwean consumers, the monetary cost of purchasing maize grain and then custom-milling it at a local hammer mill was substantially cheaper than the price of roller meal in 1993 and 1994.[2]

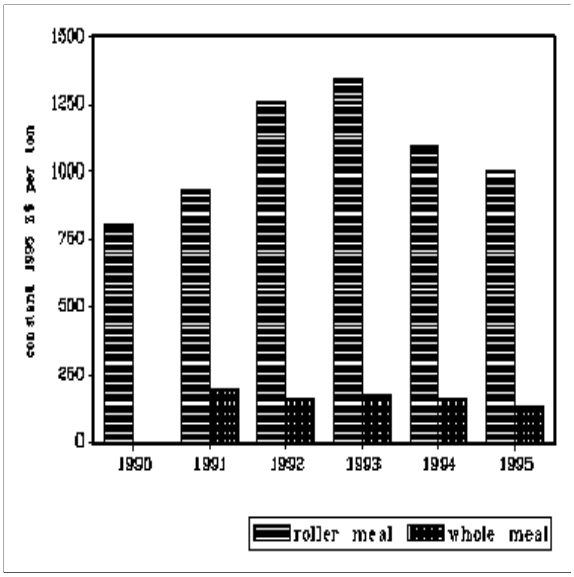
Figure 6.6 Zimbabwe Official and Informal Maize Grain Prices, 1980-1995



Source: Ministry of Agriculture data files (for price data); IMF (for deflator).

Note: Informal market prices refer to Harare markets.

Figure 6.7 Gross Margins for Roller Maize Meal Produced by Large-Scale Mills and Whole Maize Meal (Custom Hammer-Milled), Constant 1995 Z$ per ton, Harare, 1990-1995



Source: Chisvo.

Note: 1995 prices through May; 1995 inflation rate assumed at 23 percent; margins for roller meal include packaging and distribution to retail shops; hammer mill margins are for custom milling only, and do not include packaging or the opportunity cost of consumer's time to mill grain.

ETHIOPIA

Figures 6.8, 6.9, and 6.10 present the monthly retail prices for maize, white wheat, and white teff, deflated by the consumer price index, in Addis Ababa's markets. Linear time trends are calculated for the periods before and after grain market liberalization. Addis Ababa's real prices for white wheat, mixed wheat, white teff, barley, and sorghum have exhibited a downward trend since market liberalization in 1990. White and mixed wheat have especially declined in the post-reform period. Maize prices, which increased by 8.2 percent per year on average from 1987 to 1990, increased by only 1.7 percent per year from 1990 to 1994.

Spline function estimation also indicated a significant (at the 10-percent level) downward trend in white wheat, maize, and barley prices in Addis Ababa since grain market liberalization in 1990, after controlling for rainfall, food-aid arrivals, seasonal trends, and lagged own- and lagged substitute-grain prices (Tables A4-A8). Post-reform price trends for white teff and mixed wheat also were downward but were not significant at the 10-percent level. The conclusion that post-reform grain prices have declined supports earlier findings by Dercon (1993).[3] However, grain market reform coincided roughly with the end of the civil war, making it difficult to isolate the effects of market liberalization through the use of categorical variables.

Effects of Food Aid on Market Prices

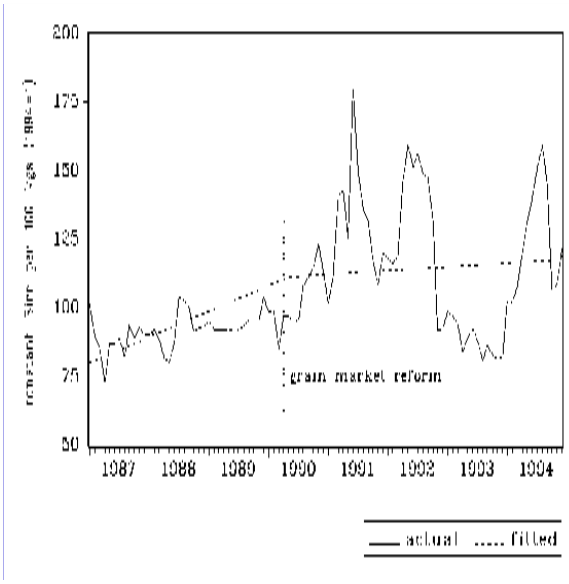
There has been a long-standing concern regarding the possible disincentive effects of food aid, specifically the effects of food aid on market prices and production incentives (see Singer, 1989; Owusu, 1989; Dearden and Ackroyd, 1989; Fitzpatrick and Story, 1989; and Lavy, 1990). The frequently voiced prospect that imported food aid is disrupting food markets and depressing domestic food production has raised concerns that Ethiopia is becoming increasingly dependent on food aid and increasingly unable to feed itself on a recurring basis.

It is widely believed that of the 6 to 7 million tons of cereal produced in Ethiopia, about 15 to 25 percent is sold and traded in world markets. This would imply an annual marketed volume of about 1 to 1.75 million tons, depending on the harvest. By contrast, the annual volume of cereal food aid has fluctuated from 200,000 to about 1.2 million tons over the 1984-1993 period. About 90 percent of this cereal aid has been in the form of wheat. In a normal year, the volume of cereal food aid could account for 25 percent or more of the total marketed cereal supply in Ethiopia. Depending on the manner in which the food aid is distributed, a cereal supply addition of this magnitude could be expected to exert some influence on food market prices. In a drought year, food aid may account for up to 50 percent or more of the total marketed cereal supply.

Figure 6.11 presents the average monthly volume of cereal food aid destined for Ethiopia arriving at the ports of Massawa, Assab, and Djibouti during the period of 1987-1994. Interviews with several non-governmental organizations (NGOs) indicate that there has been an approximate 6- to 8-week time lag between the arrival of the food aid at the ports and its distribution to recipients in Ethiopia. While the highest volume of food aid might be expected to arrive shortly before the lean season (September-November) when many households have depleted their own grain stocks, the data indicate very little seasonal variation. To the extent that food aid is released immediately after the main post-harvest months (January-March), potentially adverse effects on farm production incentives might be expected.[4]

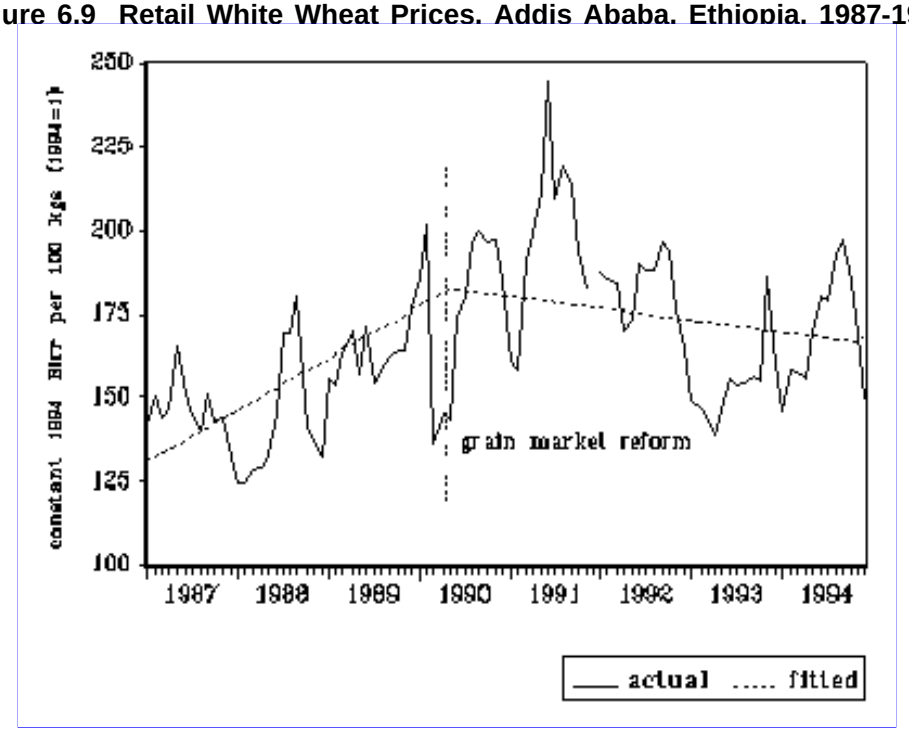
Spline function results indicate that the two-month moving average of food-aid arrivals at Eritrean ports destined for distribution in Ethiopia was negatively associated with local maize and white barley prices (statistically significant at the 2- and 6-percent levels, respectively). These results should be interpreted cautiously, as they depend on the assumption of market integration between Addis Ababa and at least some of the regional markets where emergency food-aid operations have been undertaken. The conventional wisdom in Ethiopia is that regional food markets are only weakly integrated. However, these results indicate that, even under the assumption of weakly transmitted price signals, food aid may be of a sufficient magnitude in Ethiopia to affect food prices in Addis, as well as numerous other markets not included in this assessment.

Figure 6.8 Retail Maize Prices, Addis Ababa, Ethiopia, 1987-1994



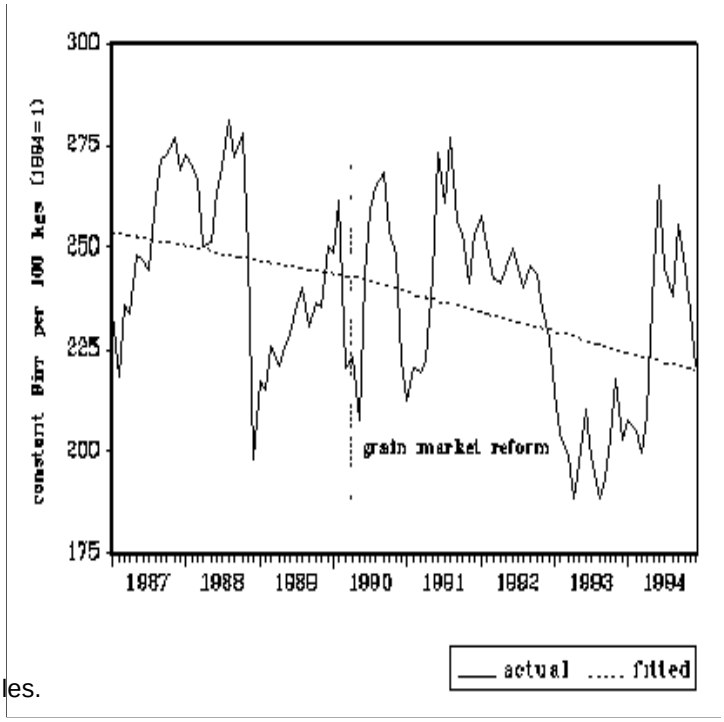
Source: EGTE data files.

Figure 6.9 Retail White Wheat Prices, Addis Ababa, Ethiopia, 1987-1994



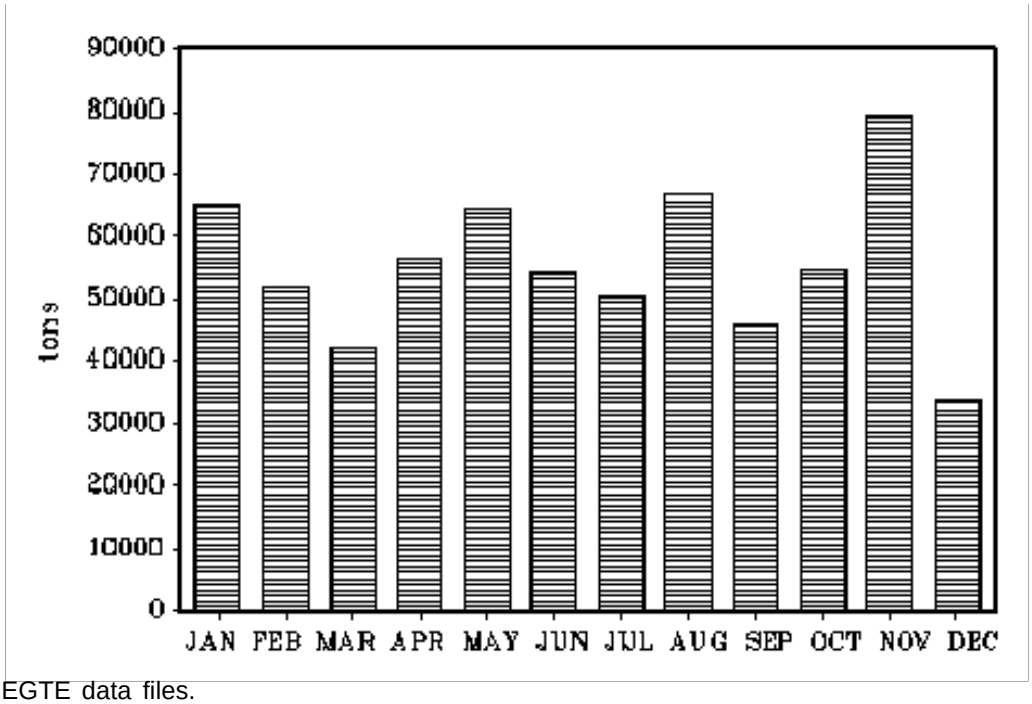
Source: EGTE data files.

Figure 6.10 Retail White Teff Prices, Addis Ababa, Ethiopia, 1987-1994



Source: EGTE data files.

Figure 6.11 Seasonality of Food Aid Arrivals at Eritrean/Djibouti Ports Destined for Ethiopia, 1987-1994



Source: EGTE data files.

There was no significant effect of lagged food-aid arrivals on Ethiopian white wheat prices. This may be because the quality of food-aid wheat is perceived to be inferior to that of local wheat and is perhaps of limited substitutability with local wheat. The crops most affected by food aid appear to be those consumed by the poorer groups in Addis: maize and barley. However, it is believed that a substantial portion of food-aid wheat is sold by recipients to obtain cash to buy less expensive foodstuffs. To the extent that this occurs on a widespread basis, the effect of food aid on local cereal prices would be complex.

GHANA

Structural adjustment began in 1983 in Ghana. According to the World Bank, however, reforms in agriculture were implemented later than in other sectors and in fact have continued into the 1990s (Leechor, 1994). Above all, food prices throughout the country were significantly affected by the drought that began in late 1982 and continued until mid-1984 (Figures 6.12 and 6.13). If dates are chosen such that the pre-adjustment period ends during the drought, while the post-adjustment period begins during the drought time-series analysis would undoubtedly conclude that food prices increased in the former period and decreased in the latter. Comparisons of price levels and rates of change are quite sensitive to the choice of the periods "before" and "after" adjustment.

In 1979, the Rawlings government in Ghana tried to control prices by implementing stricter price controls and harassing marketers to reduce marketing margins. Accra's central market was razed in 1979, and Rawlings launched moral campaigns against "antisocial profiteers" (Alderman, 1991, p. 74). Not surprisingly, these campaigns proved to be ineffective in controlling agricultural prices.

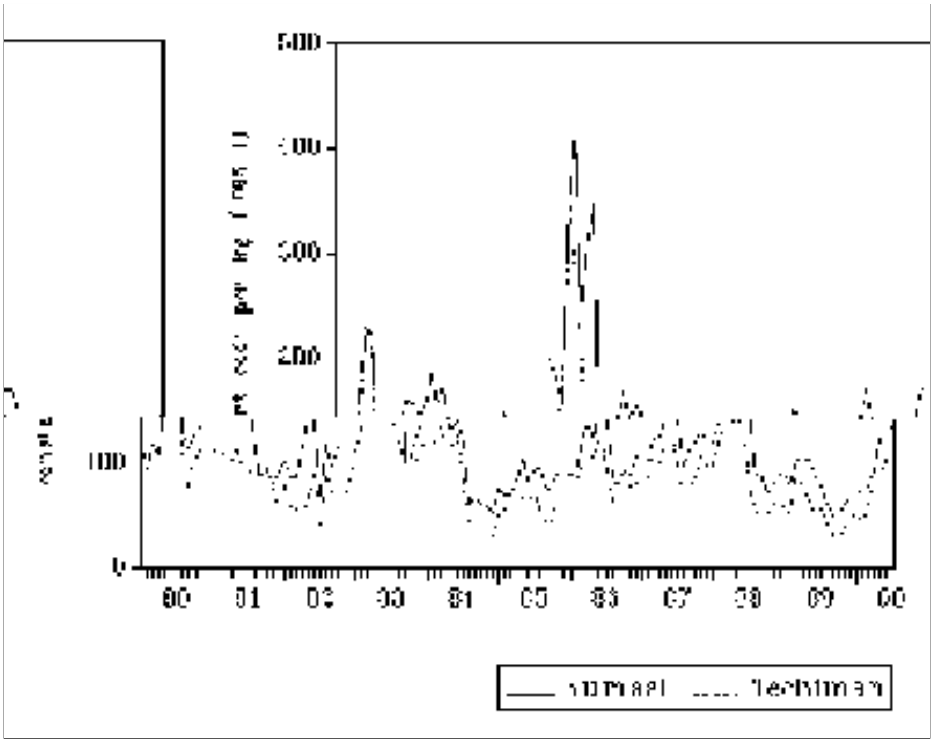
According to Bates (1981), government policies were oriented toward the urban and industrial sectors, to the neglect of agriculture. These policies included a vastly overvalued exchange rate, quantitative import restrictions, urban consumer subsidies, and heavy taxation of agricultural exports. As a result, both exports and growth rapidly declined: Between 1970 and 1982, the real per capita GDP fell by 30 percent. The collapse of producer incentives led to decreased production and decreased investment, especially in the perennial crops, such as cocoa, which had earned the vast majority of foreign exchange receipts. The terms of trade also shifted away from cocoa toward food crops (Asuming-Brempong, 1994).

In marketing, the Ghana National Trading Company was given a monopoly on trade in "essential" food commodities (including wheat, maize, rice, and sugar). Import and price controls were introduced; these commodities subsequently became scarce at controlled-price outlets but were diverted to the black market and sold for "at least five times the controlled price" (Stryker et al., 1990). In practice, however, the government seldom, and then only selectively, intervened in food crop pricing. Minimum support prices for producers have been largely irrelevant to the majority of farmers. The floor price for maize has almost always been below the market price. During the late 1980s, the guaranteed price exceeded the market clearing price, and those few farmers who were able to sell to the government received a considerable economic rent.

Price Trends

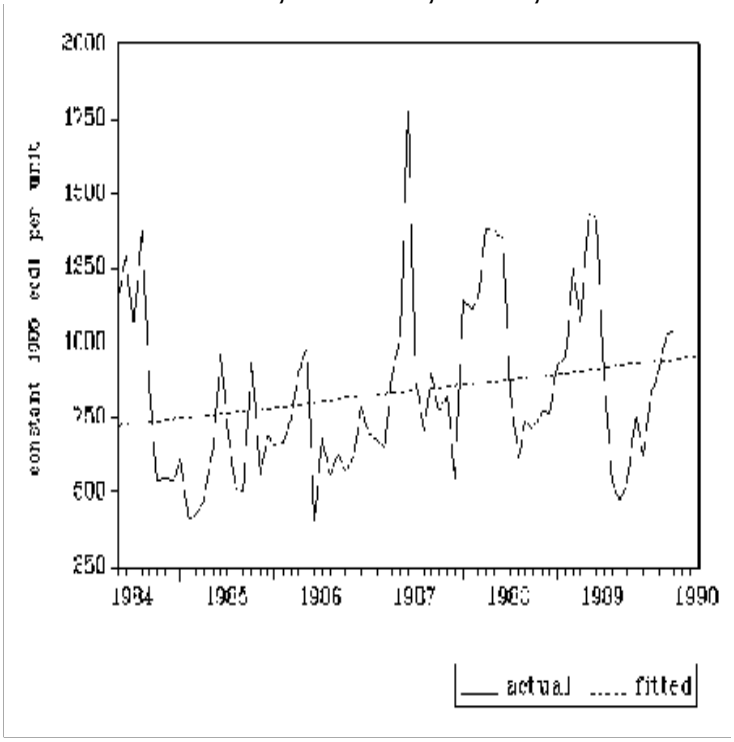
Spline function estimates indicate that during the pre-reform period, the trend in maize, sorghum and millet prices at Techiman's market (a major surplus production region) rose at a rate of 2.1, 2.0, and 0.8 percent per year during the 1980.01 to 1983.10 period. Even after controlling for the effects of the 1983 drought and other supply and demand shifts, this upward trend was significant at the 5-percent level. Since 1984, there has been a significant (at the 5-percent level) decline in maize and millet prices, after controlling for rainfall, seasonal trends, real GDP, and lagged market prices. For example, maize prices in Techiman have declined, on average, by 4 percent per year between 1984 and 1990. Millet prices have declined, on average, by 5 percent per-year. For yams, the trend is downward but has not been significant at the 10-percent level. For cassava, prices have

Figure 6.12 Wholesale Maize Prices, Techiman and Kumasi, Ghana, Constant 1994



Source: Lundberg (1995).

Figure 6.13 Wholesale Yam Prices, Techiman, Ghana, Constant 1994 Cedis per ton



Source: Lundberg (1995).

risen by 3 percent per year over the 1984-1990 period but again has not been significant at the 10-percent level (Tables A9-A12). Estimates for market prices at Kumasi and Bolgatanga (major urban areas) reveal results consistent with those calculated from Techiman.

To entirely remove the effects of the 1983 drought, we reestimated equation (7) for prices of maize, cassava, yams, and millet during the period November 1984 to December 1990. Results from this estimation are contained in Tables A13-16. The results again showed a declining trend for maize and millet during this period. The trend in yam and cassava prices at the Techiman market was positive but not significant at the 10-percent level.

The evidence presented here, while not providing a uniform picture, generally indicates that the real prices have declined for most staple food commodities in Ghana since the implementation of the Economic Reform Program of 1983. This conclusion is consistent with findings by Alderman and Shivley (1994) and Sarris (1992). However, maize production remained roughly constant between 1985 and 1990 after a major surge in production during 1984 (Lundberg 1995). On the basis of this information, it is difficult to conclude that falling real maize prices have been achieved through expanded domestic production. Rather, it is likely that food prices declined because marketing margins were lower following increased investment in transportation infrastructure and the removal of import restrictions on fuel and machinery following the initiation of structural adjustment (Lundberg, 1995). This interpretation is consistent with the negative and generally significant coefficient on the trend variables after structural adjustment in the Ghana grain price regressions (i.e., the slope shift variables) (Tables A9-16).

MALI

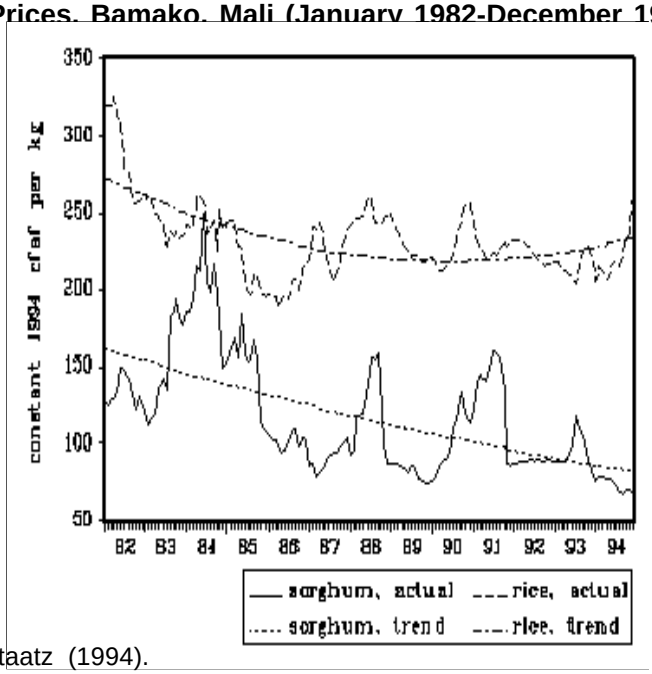
Real retail prices for sorghum and rice have fallen from 1982 through 1994 in Bamako. Fixing an "effective date" for grain marketing reform in Mali is difficult, as the reforms have been a process rather than a onetime event. Hence, disentangling, in an econometric sense, what has been attributable to policy reform versus other factors is difficult.

Policy reform in Mali has been supported by the multi-donor-financed Cereals Marketing Reform Project, known by its French acronym, PRMC. The reforms embodied in the PRMC were based on the idea of using food aid to finance market liberalization. In exchange for a series of promised reforms, 10 major international agencies and donors pledged multi-year shipments of program food aid. The food aid was sold, with the reflow money going into a common fund used to finance specific market restructuring actions agreed to by the donors and the Malian government.[5]

The PRMC was launched in 1981 when legislation was signed to abolish the official monopoly of the grain marketing board, OPAM. The PRMC initially emphasized reducing OPAM's operating deficit and improving the food-aid management rather than facilitating private trade. The main effects of market liberalization were not felt for millet and sorghum until the 1985 harvest. Delays in dismantling the restrictions on private grain trading and a severe drought, which greatly reduced the marketable surplus, sharply limited the impact of the market reforms on private traders prior to that time. Hence, in the econometric results presented here, October 1985 is taken as the "effective date" of the reforms.

Reforms in domestic rice marketing came even later, as rice producers in the major irrigated, rice-producing zone, the Office du Niger, were obligated to sell all paddy to the government mills through 1986. The Office du Niger maintained an official support price for paddy through 1992, in contrast to coarse grains, for which official producer prices were abandoned in 1986. However, since the liberalization of rice milling in 1987, small private rice mills have increasingly displaced the large mills operated by the Office du Niger. Between 1987 and mid-1992, the number of small mills operating in the Office zone increased from 18 to 383 (Diarra,1994, p. 8), and by 1995 they had effectively shut down the Office's mills by out-competing them for supplies of paddy. The small mills did this through lower processing costs, thereby driving down the margins earned on milling. The experience was analogous to that of the

Figure 6.14 Actual and Quadratic Trends in CPI-Deflated Rice and Sorghum Prices, Bamako, Mali (January 1982-December 1994)



Source: Aldridge and Staatz (1994).

introduction of small hammer mills for maize milling in the urban areas of Zimbabwe and Kenya, discussed earlier.

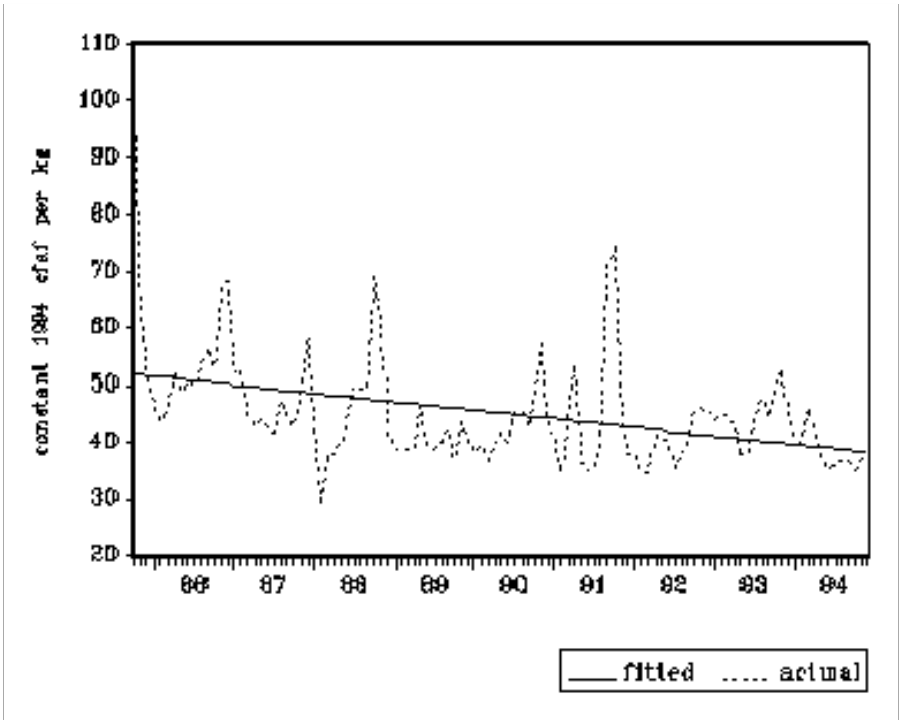
Figure 14 presents trends in the deflated, monthly rice and sorghum prices in Bamako markets. Prices were deflated by the CPI. During the post-reform period, real prices have declined by 3 percent per year, on average. However, because the beginning of the post-reform period followed a major drought, the derived trend may be somewhat influenced by the weather. In addition, rice prices fell sharply in the early 1980s, as Mali was rewarded with substantial drought relief (in the form of food-aid rice) for having agreed to undertake market reforms.

Using the spline function approach presented in Section 3, pre- and post-reform price trends were estimated, controlling for a drought dummy, seasonal dummies, and lagged prices. The results indicated that sorghum and rice prices have experienced a declining trend during both the pre- and post-reform periods, but that the trend was somewhat flatter during the "effective" post-reform period (Tables A17-A18). This reflects in part the impact of the large food-aid shipments accorded Mali in the drought of the early 1980s, when the reforms had been adopted in principle but had not yet been fully implemented. On average, annual sorghum prices declined by 4 percent per year from January 1982 to September 1984 and by 1.5 percent per year from October 1985 to December 1994, other included factors held constant. However, the declining trends for both rice and sorghum prices were not significant at the 10-percent level in either the Phase 2 reform period (October 1981 to September 1985) or the Phase 3 reform period (October 1985 to December 1994).

Marketing margin trends were also estimated for the margin between Zangasso sorghum-producer prices and Bamako retail sorghum prices. Zangasso is a major assembly market in southern Mali. Data on these margins were only available from January 1985 to December 1994, so only a segment of the trend in post-reform margins could be estimated. The results indicated a statistically significant decline of approximately 2.7 percent per year, or 27 percent in the average marketing margin over time, even when seasonal fluctuations and drought were taken into account (Figure 6.15 and Table A19).

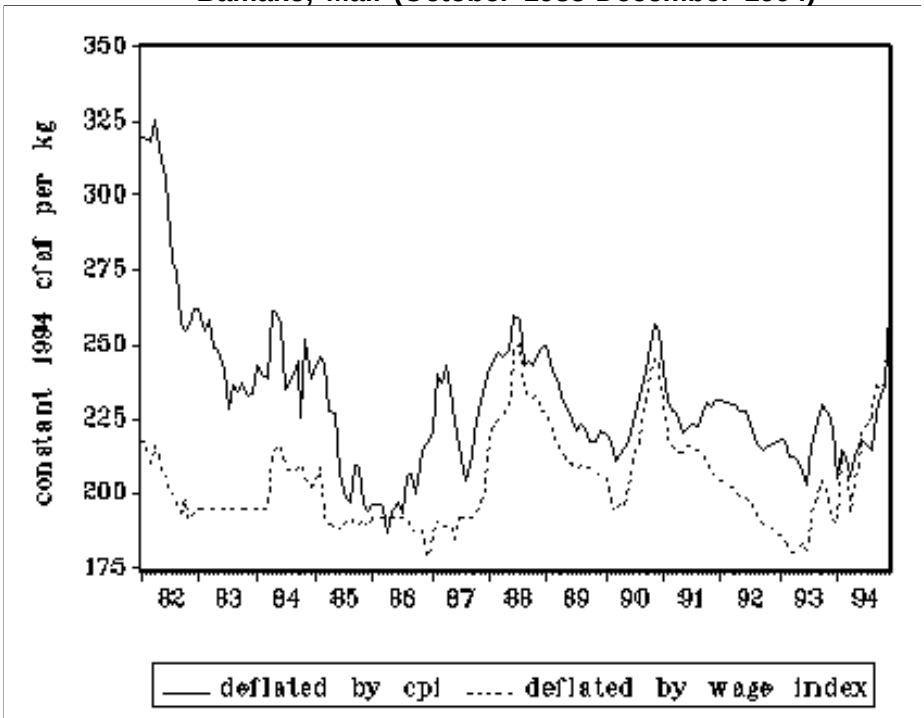
In summary, the information available from Mali provides evidence of a declining trend in inflation-adjusted sorghum prices during the period under re-

Figure 6.15 Marketing Margin of Sorghum from 1985.10 to 1994.12



Source: Aldridge and Staatz (1994).

Figure 6.16 Rice Prices Deflated by CPI and Civil Service Wage Index, Bamako, Mali (October 1985-December 1994)



Source: Aldridge and Staatz (1994).

view, with price declines in sorghum being less during more recent years than during the early years of the reforms, when food-aid shipments were the greatest. Marketing margins have declined, both for rice (Diarra, 1994) and sorghum, results likely attributable to the reforms.

In addition, the data from Mali illustrate that the perceptions one has of whether real prices have declined depends on the choice of deflator one uses. Figure 6.16 compares the "real retail price" of rice in Bamako between 1982 and 1994 using two different deflators: the CPI and an index of civil servant salaries. While prices showed a significant downward trend, particularly in the early years, when deflated by the CPI, the trend was slightly upward when deflated by the average, civil servant wage. This may help explain the political resistance of civil servants to market reform. The reforms shift the terms of trade away from producers of nontraded goods, such as government services, thus lowering the real incomes of civil servants. So while staple food prices may fall relative to a general basket of goods, they may not be getting any cheaper for many government employees, especially if they had access to subsidized supplies prior to the reforms. For these people, discussion of falling real prices may ring hollow.

ZAMBIA

Maize is planted on 70 percent of the total crop area and 84 percent of the total cereals area in Zambia. Zambians consume more than 170 kgs of maize per person annually. Despite favorable land and available improved technology for maize, the growth of food production has been erratic in Zambia since the 1970s and has not kept pace with the country's population growth (see Table 4.2). Zambia has been a net importer of maize in most years since 1970. This is partly due to unfavorable weather conditions in some years but has been more importantly due to the policy and organization environment. There were three key elements of the pre-reform maize marketing and pricing environment: (1) a policy of pan-territorial pricing of maize, operationalized through expansion of state crop-buying infrastructure throughout the country; (2) subsidies on the production and distribution of maize meal; and (3) subsidies on the production and distribution of fertilizer, along with state-disbursed credit for input purchases.

Pan-Territorial Pricing and Expansion of State Marketing Infrastructure

Following independence in 1964, the state invested heavily in crop-buying depots, first through the National Agricultural Marketing Board (NAMBOARD) and later through the Zambian Cooperative Federation and its member societies. The intent of the subsidies was to guarantee marketing services to smallholders throughout the country. A large proportion of the subsidies was used to compensate the marketing board and cooperative societies for their financial losses. Some of these losses occurred because NAMBOARD and the cooperatives were forced to provide marketing services to remote areas at pan-territorial prices and so could not recover their transportation and handling costs. However, many losses were also the result of poor management in NAMBOARD and the cooperatives. Subsidies rose eightfold in 10 years, from ZK 4 million in 1965 to ZK 34 million in 1974 (Nakaponda, 1992; Sipula, 1993).

The pan-territorial pricing policy effectively cross-subsidized smallholder maize production in the more remote areas by depressing prices in the areas facing lower transportation costs (mainly along the rail lines). While stimulating production among smallholders in the more remote regions, this pricing policy also depressed maize production in the areas of greater comparative advantage along the rail lines. Those farmers switched from maize to less-controlled commodities. In more recent years, farmers have also become increasingly discouraged by the deteriorating level of services provided by the government, resulting in late input delivery and late payment for products (Howard, Nakaponda, and Ferris, 1995).

Subsidies on Consumer Maize Meal

Consumers were the main beneficiaries of the government-controlled pricing regime which predominated until the early 1990s (Jansen, 1988; Howard, 1994). Maintaining a low consumer maize-meal price was considered critical to the preservation of urban political stability (Jansen, 1988). Retail prices paid by consumers for maize meal were as little as 40 percent of import parity in the early 1970s. Domestic consumer prices briefly approached parity with world prices in the mid-1980s, when the IMF pressured the government to remove subsidies, but subsequent urban riots in December 1986 over the meal price increase led the government to dissolve its agreement. These policies encouraged consumers to substitute away from traditional foods toward consumption of ever-greater amounts of maize meal. Consumption of maize meal rose from an average of 145 kgs per person in the early 1970s to more than 170 kgs in the late 1980s (FAO, 1994).

Until the early 1990s, urban maize-meal distribution was dominated by the large-scale parastatal millers linked to the official marketing system. Competition from private traders and millers, although legalized after 1986, was largely deterred through pricing policy, since the large subsidies on maize meal distributed through the official marketing system typically left traders with an insufficient and sometimes negative trading margin.

Beginning in the late 1980s, under pressure from a growing budget deficit and international donors, the Zambian government took steps to liberalize maize input and product markets, and discontinued consumer subsidies on maize meal. Consumer subsidies were eliminated in 1993.

Input, Credit, and Technology Policy

Adoption of fertilizer was seen as a crucial step in getting small farmers to engage in commercial agriculture. Beginning in 1971-1972, fertilizer subsidies were introduced, cutting prices by an average 30 percent of the landed cost. The introduction of pan-territorial pricing in 1974 provided a further incentive for fertilizer use in more remote areas. By 1982, the average subsidy was 60 percent of the landed cost (Jansen, 1977, 1988). In 1988-1989, the direct price subsidy was discontinued completely, although the government continued to subsidize fertilizer transportation (Government of the Republic of Zambia [GRZ] 1990).[6]

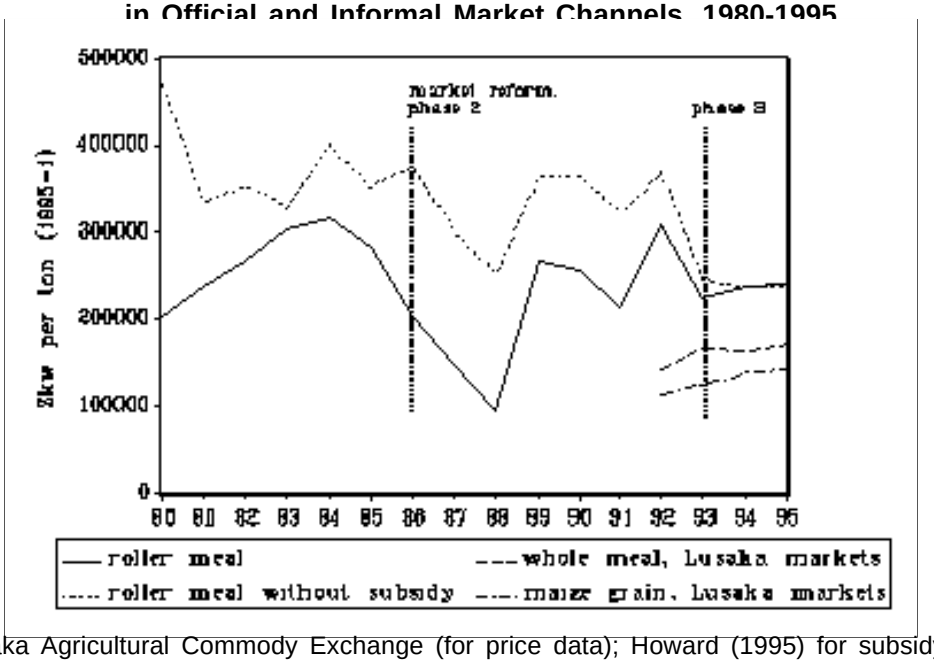
As important as the direct subsidy, the distribution network was expanded during the early 1970s to make fertilizer more accessible to farmers in remote areas. Expansion of credit programs further eased farmer access to inputs, with the debt collection co-ordinated with the cooperative marketing system (GRZ, 1990). About 90 percent of the credit extended to small-scale farmers was used for maize inputs (GRZ, 1991). The combination of credit supply, fertilizer subsidies, and state output market expansion contributed to the rapid adoption of new hybrid varieties and increased fertilizer usage during the mid- and late 1980s (Howard, 1994).

Since the removal of fertilizer price subsidies in 1988, the use of fertilizer in Zambia has declined considerably, from a high of about 90,000 tons of nutrient in the late 1980s to about 70,000 tons in 1994. Hybrid seed sales have declined from roughly 12,000 to 15,000 tons in the late 1980s to 5,000 to 8,000 tons since 1993. While production is highly variable in Zambia, it appears that maize production has declined from the level attained in the mid- to late-1980s and has clearly declined in per capita terms (Howard 1994).

Price Changes in the Pre-Reform and Post-Reform Period

Figure 6.18 presents trends for the prices of roller meal (formerly distributed through the official marketing system) and whole meal distributed through informal markets in Lusaka since 1993, when market liberalization greatly increased informal grain supplies in urban areas. Perhaps surprisingly, considering the magnitude of state subsidies withdrawn from the maize sector in recent years, the prices paid by urban consumers for whole grain and hammer-milled

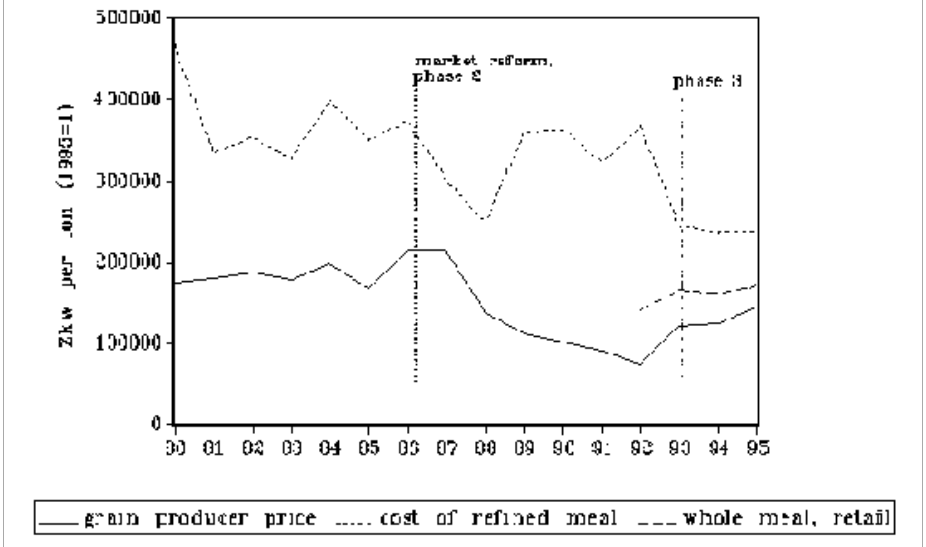
Figure 6.17 Zambia Retail Prices (With and Without Subsidies for Maize Meal in Official and Informal Market Channels, 1980-1995



Source: Lusaka Agricultural Commody Exchange (for price data); Howard (1995) for subsidy rates; and IMF (1995) for deflator.

Note: Open market prices refer to Lusaka; subsidies refer to direct state payments on consumer subsidies only, and do not include transfers associated with pan-territorial pricing, macroeconomic and exchange rate policy, and other indirect transfers.

Figure 6.18 Maize Producer Prices and Retail Maize Meal Costs, Lusaka, 1980-1995



Source: Lusaka Agricultural Commody Exchange (for price data); Howard (1995) for subsidy rates; and IMF (1995) for deflator.

Note: Open market prices refer to Lusaka. The costs of retail, refined meal refer to the weighted average of breakfast meal (.35) and roller meal (.65), representing the approximate share in consumption, plus direct state transfers for consumer subsidies, but not including other indirect transfers; whole meal prices refer to Lusaka open-market prices for maize grain, plus the observed custom-milling hammermill margins.

whole meal are actually lower than those for whole grain and refined meal during the pre-reform period (Table 4.1).

As in Kenya and Zimbabwe, the major contributor to lower costs for urban consumers has been the rapid increase in the development since the reforms of lower-cost, small-scale mills, which have reduced the marketing margin between the prices of maize grain and maize meal. As can be seen in Figure 6.18, the margin between maize producer prices and retail costs of maize meal have declined markedly since the initiation of Phase 3 reforms in 1993.

7.Conclusions

The effects of food market restructuring over the past decade are difficult to assess for three main reasons. First, the effects of the reforms are difficult to isolate from other processes affecting the broader economy, especially broader macroeconomic adjustments and extreme weather conditions, which often occurred concurrently with the reforms. Second, the pattern of reform, as described above, has been partial, in some cases subject to reversals, and in almost all the cases, critical reform measures have been implemented only very recently. Third, with only weak and partial data on production and factor productivity, the welfare implications of particular production trends in the food sector are unclear. Not withstanding these caveats, there appear to be several consistent trends emerging out of the market reform experiences in the six African countries examined here.

SUMMARY OF FINDINGS

The report highlights three main conclusions:

- CPIadjusted grain prices have declined in five of the six countries examined (Ghana, since 1984; Zambia, since 1993; Ethiopia, since 1990; Kenya, since 1989, and Mali, since 1982). However, after controlling for seasonal trends, rainfall, food aid, world prices, and the prices of substitute food commodities, a statistically significant decline in the average postreform prices of selected food crops was observed for only Ethiopia and Ghana. Sectoral and/or macroeconomic reform have influenced these trends through lower marketing costs in some cases.
- In three of the six countries examined (Kenya, Zambia, and Zimbabwe), the effect on consumers of eliminating food price subsidies has been partially or fully compensated for by accompanying food market reforms that have raised consumers' access to lessexpensive food products, the supply of which was formerly suppressed by regulation.
- In the cases for which downstream, marketing margin information is available (maize in Zimbabwe, Zambia, and Kenya and rice in Mali), market reform has caused a reduction in marketing costs, particularly at the processing and retail distribution stages. When counting former state subsidies to millers, processing and retail distribution costs in the official marketing systems have declined by more than 20 percent in Kenya and Zambia during the reform periods, apparently due to increased competition from informal millers and traders. Evidence from Kenya and Mali indicates that the removal of the controls on private grain movement has reduced grain distribution costs in selected longdistance trade routes due to greater economies of scale in transportation. This has passed on tangible benefits to food consumers and/or producers. In Mali, sorghum marketing margins have declined by 2.7 percent per year on average between a major production area and the capital, Bamako, over the 1985 to 1994 period. These findings were statistically significant at the 5 percent level.

On the positive side, the evidence suggests that reforms have had a measurable impact in reducing food marketing (primarily processing) costs to urban areas and have brought about marked changes in the

urban maize consumption patterns, with beneficial effects on urban food security. This has resulted from the rapid emergence of traders and smallscale food processors following liberalization, and the curtailment of state marketing activities. However, the reforms have so far achieved less success in relation to other objectives. First, in most cases, growth has been limited or negative in cereal yields and per capita food production. This reflects, in part, cutbacks in government transfers to farmers under the formerly controlled systems, and limited successes in overcoming input/credit/output coordination problems. The exception is Mali, where rice yields have increased rapidly.[5] Second, the general movement toward structural food deficits has continued in Eastern and Southern Africa, in spite of falling consumer prices made possible through a reduction in marketing costs (refer to Table 4). This is partly due to recent droughts but, more importantly, is due to cutbacks in state transfers to the grain sector (e.g., state credit, cropbuying stations, and input subsidies) to reduce treasury deficits or as a deliberate policy objective to reduce the size of the state's grain stockpiles. Third, reducing the state's fiscal cost of marketing interventions has proved extremely intractable, and in some countries the failure of price reform has had devastating macroeconomic consequences (Jones, 1994; Jansen, 1988).

The findings from the six countries, in general, provide support for the DFA Report's conclusion that "real food prices have fallen in numerous African countries" (p. 48). Descriptive evidence indicates that postreform grain prices have, in most cases, declined from their prereform levels in the 1980s. In some cases, falling retail prices are due to lower marketing margins, especially at the processing stage. While market reform has apparently contributed to falling postreform consumer food prices, other factors have been shown to be important, such as weather and food aid.

However, the analysis in this paper does not generally support the DFA's premise that "these price changes [downward] are only explicable in the face of substantial increases in production" (p. 48). In fact, per capita food production has clearly declined in the postreform period in three of the six countries examined. However, this is not necessarily indicative of a welfare loss, since in several cases production levels during the prereform period were buoyed by large state transfers to agriculture, which effectively shifted the costs of maintaining the prereform food systems from one social group to others. The complex distributional effects associated with food market reform (benefiting farmers and consumers in some regions while imposing greater costs on farmers and consumers in other regions) underscore the major difficulty and controversy associated with normative assessments of the effects of food marketing and pricing reform. Nevertheless, with regard to household food security, the weight of the evidence indicates that consumers, especially urban consumers, have, in most cases, benefited from the food marketing and pricing reforms initiated in the countries examined.

BEYOND FOOD MARKET LIBERALIZATION[6]

The empirical record of food marketing reforms in the six countries (Kenya, Mali, Zambia, Ghana, Zimbabwe, and Ethiopia) highlights the importance of building upon the real achievements gained through food market liberalization, and in particular enhancing the supply response to the new set of economic incentives made possible through reform. The key is to move beyond the liberalization of markets and focus more on identifying and developing institutional arrangements that are sustainable, both financially and politically, and capable of coordinating and integrating food, financial, and input marketing tasks. Market liberalization is certainly not an end in itself. Schultz's "efficient but poor" observation of

5 Rice yields in Mali have risen in part because of changes in the management of irrigation perimeters that were introduced in conjunction with food market reform.

6 This section draws from Jayne and Jones (1996).

lowresource farmers also describes the functioning of marketing systems in many developing areas (Shaffer et al., 1985). Marketing margins may approximate costs, but these costs may be high, and the system may lack the needed coordination to encourage rapid private investment and productivity growth in the food system.[7] While private food trade has grown in the countries reviewed and has brought important tangible benefits, especially to urban consumers, the evidence so far suggests that the anticipated stimulus to food production growth has been weak.

Food marketing and food security policy strategies will need to change their emphasis from the liberalization of food markets to the promotion of productivity growth throughout the entire food system, through the development and coordination of markets—most notably for commodities, inputs, and finance (Boughton et al., 1994). It is generally agreed that the catalyst for broadbased productivity growth in Africa will involve some set of "green revolution" technologies in agriculture.[8] The major portion of staple maize meal costs to the consumer in Africa, as in most parts of the world, is typically accounted for by marketing costs.[9] This implies that productivity gains within the marketing system that would reduce marketing costs by 10 percent, for example, would have a larger impact on the cost of food to consumers than a 10percent reduction in farm production costs brought on by new farm technologies. Perhaps more importantly, lower marketing costs and more reliable coordination of input delivery, farm finance, and output sales would increase the ability and incentives to adopt costreducing farm technologies, thereby raising productivity growth and food security (Mellor, 1976; Staatz, 1994).

The experience of Zimbabwe, Zambia, and Kenya demonstrates that we know how to temporarily promote farmlevel productivity growth for smallholder farms. The former statecontrolled systems often addressed the coordination problem, successfully from the standpoint of many farmers, by offering credit, supplying needed inputs, and tying repayment to the sale of the harvested crop. However, these programs usually involved subsidies on inputs and credit, low repayment rates, and losses for the marketing board trading operations, which basically amounted to shifting costs and risks from one group to other groups, rather than reducing the total costs of the food system for society as a whole. Eventually, the farm production gains, experienced disproportionately by wellequipped farmers in highpotential areas, became unsustainable as the budgetary transfers eventually provoked decisive internal and external opposition. Moreover, the subsidized controlled systems also inhibited the development of a possibly more efficient and sustainable coordinated, private input/credit/output marketing system.

The challenge for the future is to design an integrated and financially sustainable system of input delivery, farm finance, and reliable output market access to provide both the incentives and ability to increase cash input use (fertilizer and hybrid seed) and other productivityenhancing investments on the farms themselves. So far, liberalization and privatization appear to have replaced often unreliable and highcost centralized forms of state marketing for smallholder farmers with a private system that is competitive but often poorly integrated with other key activities. Market transactions mainly involve sales by private negotiation in a context of poorly functioning credit markets.[10] Farmers do not have reliable access to spot markets in which a high level of trade occurs on standardized quality, quantity, and contract term. Out of such spot markets, more sophisticated market forms may emerge that allow hedging

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7 The food system refers to the various stages and modes of coordination required to produce food and put it on consumers' tables, including input supply, farm production, distribution, processing, and retailing (Shaffer, 1980).

8 A dissenting view is presented by Spencer (1995), who argues that the Asian green revolution path is not open to Africa.

9 For example, farmgate maize prices over the period 19851994 accounted for only 37 percent, 43 percent, 40 percent, and 32 percent of the total value of commercial maize roller meal in Zimbabwe, Zambia, Kenya, and South Africa, respectively.

10 Microlevel data regarding the precise terms on which market transactions occur remain weak.

of price risks and reductions in transaction costs. The other route by which problems of market coordination may be solved is through privately coordinated market interlinkage (for instance between credit and input and output marketing). These topics are beyond the scope of this assessment but clearly are fertile areas for productive future research.

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Appendix A

Country Tables

Table A1: Kenya

LS // Dependent Variable (Y_1) is Nairobi's open-market, retail maize price (Ksh/mt).
SMPL range = 1979.05 - 1994.08
Number of observations: 163

VARIABLE	COEFFICIENT	T-STATISTICS
C	-111.38	-0.46
Trend (Phase 1)	-2.17	-2.51
Trend (Phase 2 and 3)	3.55	2.16
3-month MA Rainfall(-1)	96.23	-3.54
OCT	176.73	1.07
NOV	139.20	1.97
DEC	224.01	1.56
JAN	121.72	2.37
FEB	154.97	1.24
MAR	213.90	1.55
APR	265.12	2.34
MAY	308.48	2.99
JUN	350.29	3.31
JUL	82.78	3.75
AUG	0.79	0.90
Y_1(-1)	0.35	8.42
NCPB Ex Depot Maize Price(-1)	0.35	1.93

R^2 = 0.75
Adj R^2 = 0.72
F-Statistic = 28.29
DW = 1.94

Table A2: Kenya

LS // Dependent Variable Y_2) is the retail price for maize grain in the Central Region markets (Ksh/mt).
SMPL range = 1979.05 - 1993.12
Number of observations: 158

VARIABLE	COEFFICIENT	T-STATISTICS
C	-268.63	-1.39
Trend (Phase 1)	-1.24	-2.19
Trend (Phases 2 and 3)	3.13	2.24
3-month MA Rainfall(-1)	-0.87	-2.10
OCT	6.46	0.09
NOV	129.70	1.95
DEC	158.20	2.47
JAN	57.15	0.87
FEB	38.20	0.59
APR	116.34	1.79
MAY	126.45	1.96
JUN	148.28	2.32
JUL	255.20	3.58
AUG	51.11	0.73
SEP	59.19	0.93
Y_2(-1)	0.85	7.70
NCPB ex depot maize price(-1)	0.38	2.46

R^2 = 0.84
Adj R^2 = 0.82
F-Statistic = 48.70
DW = 1.85

Table A3: Kenya

LS // Dependent Variable (Y_3) is the retail maize price in the Western Region markets (Ksh/mt).
SMPL range = 1979.05 - 1993.12
Number of observations: 152

VARIABLE	COEFFICIENT	T-STATISTICS
C	52.18	0.18
Trend (Phase 1)	-2.55	-2.79
Trend (Phases 2 and 3)	4.75	2.39
3-month MA Rainfall(-1)	-0.81	-1.79
OCT	163.02	1.79
NOV	216.05	2.38
DEC	227.70	2.51
JAN	221.54	2.27
FEB	232.39	2.32
MAR	313.53	2.93
APR	313.23	2.81
MAY	163.03	1.62
JUN	250.74	2.87
JUL	234.84	2.76
SEP	92.19	1.02
Y_3(-1)	0.64	9.75
NCPB exdeport maize price(-1)	0.33	1.67

R^2 = 0.67
Adj R^2 = 0.63
F-Statistic = 17.42
DW = 1.52

Table A4: Ethiopia

SYS - Interative SUR // Dependent Variable (Y_1) is the retail maize price in the Addis Ababa markets (Birr/quintil).
SMPL range: 1987.01 - 1994.12.
Number of observations: 84

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	10.52	0.64
3-month MA Food Aid	-7.42	-2.33
APR	2.83	0.76
MAY	7.79	1.90
JUN	8.74	2.08
JUL	10.54	2.32
AUG	11.74	2.12
SEP	15.76	2.12
OCT	11.74	1.51
NOV	7.59	1.27
DEC	4.65	1.17
JAN	-0.50	-0.12
FEB	-0.00	-0.00
3-month MA Rainfall(-1)	-0.06	-2.18
Trend (Phase 1)	0.12	0.78
Trend (Phase 3)	-0.10	-1.98
$Y_1(-1)$	-0.16	-1.52
$Y_2(-1)$	0.08	0.61
$Y_3(-1)$	0.86	10.66
$Y_4(-1)$	0.02	0.34
$Y_5(-1)$	0.08	1.07

R^2 = 0.84
Adj R^2 = 0.79
F-Statistic = 3.16
DW = 1.64

Table A5: Ethiopia

SYS - Iterative SUR // Dependent Variable (Y_2) is the retail white wheat price in the Addis Ababa markets (Birr/quintil).
SMPL range: 1987.01 - 1994.12
Number of observations: 83

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	64.11	3.12
3-month MA Food Aid(-1)	-1.97	-0.48
APR	2.83	0.76
MAY	7.79	1.90
JUN	8.74	2.08
JUL	10.54	2.32
AUG	11.74	2.12
SEP	15.76	2.12
OCT	11.74	1.51
NOV	7.59	1.27
DEC	4.65	1.17
JAN	-0.50	-0.12
FEB	-0.00	-0.00
3-month MA Rainfall(-1)	-0.02	-0.67
Trend (Phase 1)	0.24	1.17
Trend (Phase 3)	-0.52	-2.00
$Y_1(-1)$	0.24	2.41
$Y_2(-1)$	0.23	1.32
$Y_3(-1)$	0.39	2.79
$Y_4(-1)$	-0.14	-1.51
$Y_5(-1)$	0.03	0.33

R^2 = 0.72
Adj R^2 = 0.63
F-Statistic = 8.18
DW = 1.98

Table A6: Ethiopia

SYS - Iterative SUR // Dependent Variable (Y_3) is the retail mixed wheat price in the Addis Ababa markets (Birr/quintil).
SMPL range: 1987.01 - 1994.12
Number of observations: 83

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	22.57	1.34
3-month MA Food Aid(-1)	-3.93	-1.83
APR	2.83	0.76
MAY	7.79	1.90
JUN	8.74	2.08
JUL	10.54	2.32
AUG	11.74	2.12
SEP	15.76	2.12
OCT	11.74	1.51
NOV	7.59	1.27
DEC	4.65	1.17
JAN	-0.50	-0.12
FEB	-0.00	-0.00
3-month MA Rainfall(-1)	-0.03	-1.25
Trend (Phase 1)	0.24	1.46
Trend (Phase 3)	-0.21	-2.05
$Y_1(-1)$	-0.10	-0.96
$Y_2(-1)$	0.09	1.17
$Y_3(-1)$	0.78	5.85
$Y_4(-1)$	-0.02	-0.38
$Y_5(-1)$	0.07	0.93

R^2 = 0.85
Adj R^2 = 0.80
F-Statistic = 17.84
DW = 2.07

Table A7: Ethiopia

SYS - Iterative SUR // Dependent Variable is (Y_4) is the retail price for white teff in the Addis Ababa markets (Birr/quintil).
SMPL range: 1987.01 - 1994.12
Number of observations: 84

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	75.65	3.56
3-month MA Food Aid(-1)	-3.51	-0.92
APR	2.83	0.76
MAY	7.79	1.90
JUN	8.74	2.08
JUL	10.54	2.32
AUG	11.74	2.12
SEP	15.76	2.12
OCT	11.74	1.51
NOV	7.59	1.27
DEC	4.65	1.17
JAN	-0.50	-0.12
FEB	-0.00	-0.00
3-month MA Rainfall(-1)	-0.04	-1.22
Trend (Phase 1)	-0.50	-2.24
Trend (Phase 3)	-0.44	-1.60
Y_1(-1)	0.02	0.18
Y_2(-1)	-0.01	-0.09
Y_3(-1)	0.15	1.50
Y_4(-1)	0.63	6.44
Y_5(-1)	0.05	0.56

R^2 = 0.76
Adj R^2 = 0.68
F-Statistic = 10.22
DW = 1.69

Table A8: Ethiopia

SYS - Iterative SUR // Dependent Variable (Y_5) is the retail price for white barley in the Addis Ababa markets (Birr/quintil).
SMPL range: 1987.01 - 1994.12
Number of observations: 81

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	10.99	0.50
3-month MA Food Aid(-1)	-8.41	-1.88
APR	2.83	0.76
MAY	7.79	1.90
JUN	8.74	2.08
JUL	10.54	2.32
AUG	11.74	2.12
SEP	15.76	2.12
OCT	11.74	1.51
NOV	7.59	1.27
DEC	4.65	1.17
JAN	-0.50	-0.12
FEB	-0.00	-0.00
3-month MA Rainfall(-1)	-0.08	-2.45
Trend (Phase 1)	0.28	1.26
Trend (Phase 3)	-0.46	-2.04
$Y_1(-1)$	-0.03	-0.25
$Y_2(-1)$	0.33	1.79
$Y_3(-1)$	-0.06	-0.59
$Y_4(-1)$	0.09	0.92
$Y_5(-1)$	0.58	5.26

R^2 = 0.70
Adj R^2 = 0.60
F-Statistic = 7.13
DW = 1.86

Table A9: Ghana

SYS - SUR // Dependent Variable (Y_1) is the wholesale price for maize in the Techiman market (Cedi/mt).
SMPL range: 1980.01 - 1990.07
Number of observations: 118

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	-406.67	-1.69
JUL	-24.96	-2.06
AUG	-15.02	-1.20
SEP	-12.18	-0.90
OCT	-6.75	-0.49
NOV	-5.18	-0.38
DEC	-9.91	-0.75
JAN	-11.20	-0.83
FEB	-20.72	-1.63
MAR	-5.52	-0.44
APR	0.90	0.07
MAY	-6.38	-0.52
Trend (Phase 1)	1.90	1.53
Trend (Phase 2 and 3)	-2.57	-1.88
$Y_1(-1)$	0.69	7.12
$Y_2(-1)$	-0.13	-2.15
$Y_3(-1)$	-0.00	-0.36
$Y_4(-1)$	0.06	1.61
Drought 83	43.97	3.24
Real per capita GDP(-1)	1425.62	1.95

R^2 = 0.76
Adj R^2 = 0.72
F-Statistic = 17.25
DW = 1.84

Table A10: Ghana

SYS - SUR // Dependent Variable (Y_2) is the wholesale price for millet in the Techiman market (Cedi/mt).
SMPL range: 1980.01 - 1990.07
Number of observations: 118

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	-589.69	-1.53
JUL	-24.96	-2.06
AUG	-15.02	-1.20
SEP	-12.18	-0.90
OCT	-6.75	-0.49
NOV	-5.18	-0.38
DEC	-9.91	-0.75
JAN	-11.20	-0.83
FEB	-20.72	-1.63
MAR	-5.52	-0.44
APR	0.90	0.07
MAY	-6.38	-0.52
Trend (Phase 1)	2.13	1.05
Trend (Phase 2 and 3)	-3.20	-2.27
$Y_1(-1)$	0.23	1.48
$Y_2(-1)$	0.47	4.78
$Y_3(-1)$	-0.00	-0.06
$Y_4(-1)$	0.12	1.78
Drought 83	61.49	2.62
Real per capita GDP(-1)	2090.12	1.78

R^2 = 0.73
Adj R^2 = 0.68
F-Statistic = 14.17
DW = 2.24

Table A11: Ghana

SYS - SUR // Dependent Variable (Y_3) is the wholesale price for cassava in the Techiman market (Cedi/mt).
SMPL range: 1980.01 - 1990.07
Number of observations: 118

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	804.14	2.06
JUL	-24.96	-2.06
AUG	-15.02	-1.20
SEP	-12.18	-0.90
OCT	-6.75	-0.49
NOV	-5.18	-0.38
DEC	-9.91	-0.75
JAN	-11.20	-0.83
FEB	-20.72	-1.63
MAR	-5.52	-0.44
APR	0.90	0.07
MAY	-6.38	-0.52
Trend (Phase 1)	-3.59	-1.75
Trend (Phase 2 and 3)	5.12	2.02
$Y_1(-1)$	0.04	0.26
$Y_2(-1)$	0.33	3.32
$Y_3(-1)$	0.02	1.65
$Y_4(-1)$	0.53	7.81
Drought 83	22.25	0.94
Real per capita GDP(-1)	-2522.82	-2.13

R^2 = 0.67
Adj R^2 = 0.61
F-Statistic = 10.92
DW = 2.19

Table A12: Ghana

SYS - SUR // Dependent Variable (Y_4) is the wholesale price for yams in the Techiman market (Cedi/mt).
SMPL range: 1980.01 - 1990.07
Number of observations: 118

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	-890.29	-0.40
JUL	-24.96	-2.06
AUG	-15.02	-1.20
SEP	-12.18	-0.90
OCT	-6.75	-0.49
NOV	-5.18	-0.38
DEC	-9.91	-0.75
JAN	-11.20	-0.83
FEB	-20.72	-1.63
MAR	-5.52	-0.44
APR	0.90	0.07
MAY	-6.38	-0.52
Trend (Phase 1)	8.94	0.77
Trend (Phase 2 and 3)	-8.72	-0.61
$Y_1(-1)$	3.24	3.51
$Y_2(-1)$	0.21	0.38
$Y_3(-1)$	0.44	5.46
$Y_4(-1)$	0.36	0.92
Drought 83	701.95	5.11
Real per capita GDP(-1)	2319.47	0.35

R^2 = 0.76
Adj R^2 = 0.71
F-Statistic = 16.57
DW = 2.18

Table A13: Ghana

SYS - SUR // Dependent Variable Y_1) is the wholesale prize of maize in the Techiman market (Cedit/mt).
SMPL range: 1984.01 - 1990.07
Number of observations: 70

VARIABLE	COEFFICIENT	T-STATISTICS
Constant	-32.65	-0.56
JUL	-26.78	-2.06
AUG	-15.12	-1.13
SEP	-12.44	-0.87
OCT	-5.68	-0.39
NOV	-3.75	-0.26
DEC	-4.83	-0.35
JAN	-6.40	-0.45
FEB	-12.83	-0.96
MAR	3.03	0.23
APR	5.80	0.44
MAY	-5.44	-0.42
Trend	-0.30	-2.11
$Y_1(-1)$	0.78	7.94
$Y_2(-1)$	-0.12	-1.95
$Y_3(-1)$	0.00	0.48
$Y_4(-1)$	0.05	1.27
Real per capital GDP(-1)	265.86	1.26

R^2 = 0.74
Adj R^2 = 0.69
F-Statistic = 16.86
DW = 1.79

Table A14: Ghana

SYS -SUR // Dependent Variable (Y_2) is the wholesale price for millet in the Techiman market (Cedi/mt).
SMPL range: 1984.01 - 1990.07
Number of observations: 70

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	-163.62	-1.69
JUL	-26.78	-2.06
AUG	-15.12	-1.13
SEP	-12.44	-0.87
OCT	-5.68	-0.39
NOV	-3.75	-0.26
DEC	-4.83	-0.35
JAN	-6.40	-0.45
FEB	-12.83	-0.96
MAR	3.03	0.23
APR	5.80	0.44
MAY	-5.44	-0.42
Trend	-0.70	-2.70
$Y^1(-1)$	0.35	2.15
$Y_2(-1)$	0.48	4.86
$Y_3(-1)$	0.00	0.65
$Y_4(-1)$	0.10	1.46
Real per capita GDP(-1)	765.13	2.13

R^2 = 0.70
Adj R^2 = 0.64
F-Statistic = 13.73
DW = 2.31

Table A15: Ghana

SYS - SUR // Dependent Variable (Y_3) is the wholesale price for cassava in the Techiman market (Cedit/mt).
SMPL range: 1984.01 - 1990.07
Number of observations: 70

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	166.26	1.73
JUL	-26.78	-2.06
AUG	-15.12	-1.13
SEP	-12.44	-0.87
OCT	-5.68	-0.39
NOV	-3.75	-0.26
DEC	-4.83	-0.35
JAN	-6.40	-0.45
FEB	-12.83	-0.96
MAR	3.03	0.23
APR	5.80	0.44
MAY	-5.44	-0.42
Trend	0.68	1.64
$Y_1(-1)$	0.03	0.23
$Y_2(-1)$	0.30	3.05
$Y_3(-1)$	0.02	1.96
$Y_4(-1)$	0.52	7.39
Real per capita GDP(-1)	-662.52	-1.86

R^2 = 0.66
Adj R^2 = 0.60
F-Statistic = 11.53
DW = 2.10

Table A16: Ghana

SYS - SUR // Dependent Variable (Y_4) is the wholesale price for yams in the Techiman market (Cedi/mt).
SMPL range: 1984.01 - 1990.07
Number of observations: 70

VARIABLE	COEFFICIENT	T-STATISTIC
Constant	1166.20	1.99
JUL	-26.78	-2.06
AUG	-15.12	-1.13
SEP	-12.44	-0.87
OCT	-5.68	-0.39
NOV	-3.75	-0.26
DEC	-4.83	-0.35
JAN	-6.40	-0.45
FEB	-12.83	-0.96
MAR	3.03	0.23
APR	5.80	0.44
MAY	-5.44	-0.42
Trend	-0.94	-0.98
$Y_1(-1)$	4.29	4.38
$Y_2(-1)$	0.03	0.05
$Y_3(-1)$	0.56	6.68
$Y_4(-1)$	0.21	0.48
Real per capita GDP(-1)	-4229.06	-1.94

R^2 = 0.71
Adj R^2 = 0.66
F-Statistic = 14.55
DW = 2.13

Table A17: Mali

LS // Dependent Variable (Y_1) is the retail price for sorghum in the Bamako markets.
SMPL range: 1982.02 - 1994.12
Number of observations: 155

VARIABLE	COEFFICIENT	T-STATISTIC
Drought(-1)	6.34	2.21
Trend (Phase 1)	-0.17	-1.88
Trend (Phase 2 and 3)	0.14	1.34
Jan	9.65	2.13
Feb	12.86	2.89
Mar	14.84	3.35
Apr	11.62	2.63
May	15.63	3.55
Jun	17.68	4.02
Jul	14.04	3.20
Aug	15.91	3.63
Sep	15.31	3.49
Oct	7.83	1.78
Dec	5.82	1.32
Sorghum price (-1)	0.89	25.52
C	7.81	1.07

R^2 = 0.92
Adj R^2 = 0.92
DW = 1.97
F = 112.45

Table A18: Mali

LS // Dependent Variable (Y_1) is the retail price for rice in the Bamako markets.
SMPL range: 1982.02 - 1994.12
Number of observations: 155

VARIABLE	COEFFICIENT	T-STATISTIC
C	7.21	0.27
Wage index	42.1	1.53
Real Exchange Rate	-0.03	-1.33
Trade	-4.00	-2.36
Rainfall(-9)	-0.016	-1.30
Rice Price (-1)	0.870	19.55
JAN	6.50	2.18
FEB	7.57	2.51
MAR	6.30	1.95
APR	7.29	1.98
MAY	9.49	2.20
JUN	6.88	1.87
AUG	5.57	1.84
SEP	9.26	3.04
OCT	4.78	1.61
NOV	9.21	3.10
DEC	7.51	2.52
Trend (Phase 1)	-0.402	-1.87
Trend (Phase 2 and 3)	0.432	2.02

R^2 = 0.85
Adj R^2 = 0.83
DW = 1.90
F = 40.12

Table A19: Mali

LS // Dependent Variable is the marketing margin between the producer price of sorghum in Zangesso, and the retail price of sorghum at Bamako markets.
SMPL range: 1985.11 - 1995.01
Number of observations: 110

VARIABLE	COEFFICIENT	T-STATISTIC
C	64.18	4.67
JAN	2.44	0.95
MAR	2.22	0.86
APR	3.97	1.32
MAY	1.89	0.60
JUN	1.03	0.32
JUL	2.61	0.81
AUG	4.81	1.48
SEP	8.28	2.56
OCT	11.54	3.60
NOV	11.16	3.60
DEC	7.04	0.95
DROUGHT	3.27	1.12
TREND	-0.09	-3.01
RICE PRICE (-1)	-0.07	-1.19

R^2 = 0.50
Adj R^2 = 0.42
F-Statistic = 6.31
DW = 1.55

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