Grain Market Research Project

THE RESPONSE OF ETHIOPIAN GRAIN MARKETS TO LIBERALIZATION

Asfaw Negassa
T.S. Jayne

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EXECUTIVE SUMMARY

The objective of this paper is to determine how liberalization of Ethiopia's grain marketing system in March 1990 has affected the level and volatility of wholesale prices and price spreads between major regional cereal markets. The paper also identifies issues and problems needing attention to guide future policy decisions with the aim of reducing costs in the food system and thereby promoting the welfare of grain producers and consumers in Ethiopia.

The major findings of the report are as follows:

- Cereal price spreads (the difference between wholesale prices in major regional markets) in Ethiopia have generally declined since liberalization in 1990. In 24 market pairs covering maize, white teff, and white wheat, average price spreads declined in 22 cases after liberalization. Prices in the major surplus-producing areas for which data are available have risen by 12% to 48%, while prices in deficit regions have declined by 6% to 36% in eight of nine cases for which data were available.

- The volatility of wholesale cereal prices has generally declined since liberalization. The volatility of cereal price spreads between different markets has also declined since liberalization in 23 of the 24 cases for which data are available.

- The general decline in cereal price spreads is not due to rainfall, seasonality, or other exogenous factors. Econometric results, which hold these factors constant, indicate that liberalization was associated with a decline in cereal price spreads in 16 of 19 cases, with the effect being statistically significant in 10 cases.

- Despite these gains, there remains substantial opportunity to further reduce costs within the grain marketing system. Grain checkpoint ("kella") tariffs between five major grain trading routes surveyed in August 1996 ranged from 20% to 33% of the price spreads observed between regional markets and from 5% to 11% of the prices received by producers for these cereals. While these taxes are a source of fiscal revenue for government, they impede grain production, incentives to use productivity-enhancing inputs, and household food security in Ethiopia.

- The correlation between wholesale market prices (extent to which price changes in one market are associated with price changes in other markets) has risen in 17 of 24 market pairs examined since liberalization in 1990. While correlation coefficient are an imperfect indicator of market integration, the results indicate that changes in wholesale grain prices in one market are transmitted to other markets more rapidly and to a greater extent since liberalization. The degree of market integration between producer prices and wholesale prices is still a major unknown. Information on price transmission from

producer to wholesale and retail levels are especially important for the design of local purchase programs designed to raise producer prices through purchasing grain from wholesalers.

- Based on preliminary findings from the 1996 GMRP/CSA household-level survey, the estimated marketed cereal output from the 1995/96 meher harvest is as follows:

    maize: 506,439 tons, or approximately 30% of total maize production
    teff: 409,799 tons, or approximately 31% of total teff production
    wheat: 233,904 tons, or approximately 28% of total wheat production
    total cereals: 1,634,440 tons, or approximately 26% of total cereal production

    These volumes and percentages clearly fluctuate from one year to the next as production fluctuates. However, these estimates from the 1995/96 meher season provide an order of magnitude estimate of marketed cereal output in a good harvest year for use in deciding how much commodity should be purchased through support price operations, local purchase programs, and/or food aid releases to help stabilize prices at desired levels.

- The volume of imported food aid wheat since the mid-1980s has significantly affected cereal prices for wheat and teff in some major wheat-producing areas (e.g., Hosaenna) and in areas where substantial food aid has been distributed (e.g., Mekele, Tigray). The volume of imported food aid wheat has ranged from 0.3 to over 1.1 million tons since 1985, accounting for an estimated 20 to 50 percent of national annual marketed cereal output. Econometric results indicate that food aid released in a particular region was associated with a decline in white teff and white wheat prices in six of 10 cases. In these cases, wholesale prices in a given region and a given month declined by 2 to 5 birr per quintal for every additional 30,000 quintals of food aid released within that region over the prior three-month period. By contrast, the importation of food aid wheat has not significantly affected maize prices in any of the markets examined, presumably due to less substitutability in consumption between maize and wheat. The welfare effects of lower grain prices (due to food aid) on food production incentives, input use, and rural livelihoods are complex and clearly differ among different types of rural households (e.g., those that are net purchasers of cereal vs. those that are net sellers).

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1. INTRODUCTION

A major role of agricultural policy is to identify policy changes that may induce technological innovation and productivity growth throughout the food system,[1] in order to increase the living standards of people who must relate to it in one way or another. Marketing costs account for 40% to 60% of the price that consumers pay for staple cereal commodities in Ethiopia (GMRP 1997). Therefore, the reduction of these costs is a critical means to improve farm production incentives and household food security in Ethiopia.

Over the past 15 years, the controlled food marketing systems of many African countries have been liberalized. In some cases, the reforms have been initiated locally (as in Ethiopia, for the most part). In many other cases, liberalization occurred under pressure from international lenders and donors as part of economywide structural adjustment programs (see Jayne and Jones 1996 for a survey). Advocates of food market reform have encouraged liberalization as a means to reduce costs in the marketing system, thereby raising and stabilizing farm incomes, promoting farmers' incentives to use productivity-enhancing inputs, and reducing poor households' dependence on food aid for their survival. While food market reform has been subject to contentious and often emotional debate over the last decade in Africa, the debate has generally been over assumptions about how food markets work in reality as opposed to theory, and how markets actually respond to particular forms of policy change.

The objective of this study is to assess how Ethiopia's grain marketing system is evolving and responding to the liberalization of food marketing in 1990. Particularly, the study examines how grain market liberalization has affected (1) the level and volatility of cereal prices; (2) the level and volatility of price spreads between major wholesale markets; and (3) the extent of correlation between prices in selected regional markets over time. The paper also estimates the effects of imported food aid wheat on cereal market prices , after controlling for other exogenous factors such as rainfall and seasonality. Concerns have arisen both from Government and donors over the potential adverse effects of food aid on market prices, but a dearth of strong empirical information has limited informed discussion on the topic. Finally, the paper identifies issues and problems needing attention in order to reduce cereal marketing costs and guide future food security policy in Ethiopia.

The remaining sections of this paper are structured as follows: Section 2 briefly describes the evolution of Ethiopia's cereal marketing system since the early 1970s. Section 3 presents the conceptual framework and methods on which the findings of this paper are based. A description of the markets and commodities included in this analysis and the sources of data are presented in Section 4. Section 5 presents the results of descriptive and econometric analysis measuring the

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[1] 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 (see Shaffer 1980).

effects of market liberalization, food aid, and other factors on cereal prices and price spreads. Finally, Section 6 discusses the policy implications and main conclusions of the study.

2. EVOLUTION OF CEREAL MARKETING POLICY: 1974 - 1996

For 16 years until 1990, Government policy in Ethiopia has suppressed private grain marketing. A revolution in 1974 introduced a socialist-oriented government that directly engaged in wholesale and retail trade. The Agricultural Marketing Corporation (AMC) was created in 1976, initially with World Bank support, to buy grain from farmers and sell to urban consumers and state organizations. AMC's mandate was ostensibly to stabilize prices of basic commodities and protect the interests of the majority of the population. Interregional private trade was restricted but not eliminated. Traders were forced to sell a portion of their supplies to the AMC at specified prices. Farmers also had to deliver between 10 to 50 percent of their grain harvest as a quota to the AMC (Lirenso 1995). The fixed AMC prices were consistently below market prices in most areas. Prices were uniform irrespective of region from 1980/81 onward (Dercon 1994). Despite stated policy objectives, the policy of forcing smallholders to grow and sell particular grains at below-market prices was not designed 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.[2] 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 run.

It is generally concluded that the quota policy at low fixed prices, combined with restrictions on private grain trade, had three main effects: (1) depressing rural incomes; (2) transferring resources from rural households to a relatively small group of urban households through artificially cheap food prices; and (3) depressing cereals production in Ethiopia (Lirenso 1995; Dercon 1994; Franzel et al. 1989). Low farm gate prices were a deterrent to the use of improved inputs and consequently, population growth rapidly outstripped cereal production, contributing to the country's chronic food crisis during the 1980s.

In March 1990, grain marketing policy was changed radically. Quotas and fixed grain prices were abolished. Subsidies on wheat for urban consumers were abolished in 1992. The ensuing Transitional Government of Ethiopia reaffirmed that all controls on interregional grain movement were lifted and the private sector was permitted to operate in a free market environment. However, grain checkpoints, or "kellas," have remained in place as a mechanism for the regional administrations to collect tax revenue on grain passing along roads (Howard et al 1995).

In 1992, the AMC was downsized substantially and renamed the Ethiopian Grain Trading Enterprise (EGTE). The role of the EGTE was revised to stabilize producer and consumer prices and maintain buffer stocks.[3] Yet in actuality, the EGTE has played only a minor role in the grain

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[2]The Government Food Corporation received 51% of AMC's cereal sales, while the Ministry of Defense and other state agencies received 24%. Government ration shops received 17%.

[3]Regulation No. 104/1992. EGTE's current objectives as stated in their 1994/95 Agenda are: (1) to stabilize markets and prices to farmers to encourage them to increase their output; (2) to stabilize grain

marketing system since liberalization. The eight zonal offices were closed, the branch offices were reduced from 27 to 11, and the grain purchase centers shrank from 2,013 to 80. Since this downsizing, the EGTE has played only a minor role in procuring grain. EGTE's annual average grain purchases from smallholder farmers and traders has declined from 258,719 tons during the 1984/85 - 1989/90 period to 50,608 tons during the 1990/91 to 1995/96 period.[4] In the 1995/96 season, in which EGTE was explicitly mandated to support producers' maize and wheat prices, its combined purchases of these two cereals from farmers at the stated support price was 12,373 tons. EGTE purchased less than 45,000 tons on maize and wheat from traders at negotiated market prices.

Accurate information on cereal production and the volume of cereals marketed is very important in designing effective price stabilization and food assistance programs. In light of this, the GMRP has carried out a survey in collaboration with Central Statistical Authority in 1996 to estimate total grain production and sales by the peasant sector. Preliminary results are given in Table 1. The proportion of maize, wheat and teff marketed by smallholders is about 30%, 31% and 28% of production, respectively. Total cereal sales (including teff, maize, wheat, barley, sorghum and millet) from the 1995/96 meher season was estimated at over 1.6 million tons, about 26% of total cereal production (GMRP 1996). Oilseeds are mostly produced for the market as their sale accounted for 78% of the total production.

These results indicate that under the current policy environment, private traders now account for over 95% of the cereals marketed by peasants in the country. Despite a stated mandate to stabilize cereal prices, it is unlikely that EGTE's purchases in recent years have been sufficient relative to the total volume of trade to significantly influence market prices.

3. CONCEPTUAL FRAMEWORK AND METHODOLOGY

Generally, the elimination of delivery quotas, fixed prices, controls on interregional grain movement and the reduction of barriers to entry in grain marketing can be expected to increase competition and reduce costs in the grain marketing system. If the markets are made more competitive, the profit motives of economic agents (farmers, traders, transporters, etc.), which drive them to reduce their costs to the extent possible, are often asserted to increase the overall productivity of the system. However, it is not always true that market liberalization automatically leads to such idealistic situations and it is important to assess how the grain marketing system is responding to the new liberalization policy. Such information provides feedback to policymakers as to where bottlenecks persist and where adjustments are necessary to promote intended national

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prices and markets to protect consumers from unfair price increases; (3) when necessary to export grain to the world market to generate foreign exchange; (4) to maintain buffer stock for market liberalization; and (5) to engage in any other related activity for the attainment of its objectives. It has been mandated that EGTE perform these functions in a self-financing manner. However, very few marketing boards in developed or developing countries have succeeded in appreciably influencing market price levels without incurring substantial financial losses.

[4]Prior to liberalization, AMC also procured 100,000 to 300,000 tons of grain annually from state farms, mainly wheat and maize, for supply to the state mills.

objectives.

The analysis is undertaken in two steps. As a preliminary step, historical price data are divided into two periods (before and after liberalization) and descriptive statistics are generated for various crops and markets. Price correlation analysis, though with well established weaknesses, is also used to provide preliminary insights into the changes in market integration as a result of liberalization. In the second step, econometric analysis is undertaken to estimate the effect of liberalization on equilibrium market prices, after controlling for other factors such as rainfall, food aid, and seasonality.

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 which embodies many over identifying 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. But economic theory often only provides weak guidelines on how identification can be achieved. For example, Sims (1980) has shown that if expectation variables enter an equation then it is almost impossible to exclude any relevant variable which is known at the time expectations are formed, because these variables will enter through the expectations term. If incorrect identification restrictions are imposed then the model can provide misleading results (Tomek and Myers 1993; Sims 1982; Jayne and Myers 1994).

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 will also 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 is that structural information on the effects of price on the supply or demand decisions of 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.

Before the various grain price series are subjected to econometric analysis, time series properties such as stationarity of the different price series are investigated using the standard procedures. First, the deseasonalized real price series are obtained as a residual from the regression of real price series on seasonal dummy variables. Residual series are obtained from the following OLS regression:

$$P_{ij,t} = \alpha + \sum_{n=1}^{11} \beta_n D_n + \varepsilon_{ij,t} \tag{1}$$

where $P_{ij,t}$ is the price of jth grain for the ith market at time t, α is a regression constant, D_n is a monthly seasonal dummy variable for the nth month, β_n is a coefficient on the seasonal dummy variable and $\varepsilon_{ij,t}$ is a regression residual which represents the deseasonalized real price series at time t for the jth grain in i^{th} market. Stationarity tests on deseasonalized real price series and price spreads were performed using the augmented Dicky-Fuller (ADF) and Philips-Peron (PP) tests.

The stationarity test results on price levels are presented in Appendix 4. The results reject the hypothesis of non-stationarity in 9 of 16 cases using the PP test and in 8 of 16 cases using the ADF test at *P<0.10.[5] Both tests provide strong evidence of stationarity in the all cereal prices for the central terminal market in the country, Addis Ababa. Assuming that there is some long-run relationship between Addis prices and prices in other regional markets, this would then require an assumption of stationarity among the other market price series as well. Given the unlikelihood of no long-term relationship between prices in the central market in the country and other major wholesale markets, even in a country with relatively weak infrastructure such as Ethiopia, it would appear from the data that the most reasonable assumption to make is one of stationarity, even though the hypothesis of non-stationarity could not be rejected for all markets.

The results of unit root tests on price spreads are given in Appendices 5 to 7. The results here clearly support the hypothesis of stationarity. In light of these results, the models for both price levels and price spreads are specified in levels.

Equilibrium cereal prices in each market were hypothesized to be affected by a set of factors including seasonality, grain market liberalization, food aid released in the region, and rainfall. For each commodity, prices were estimated as a system, using a Seemingly Unrelated Regression (SURE) estimation process. Iterative SURE is a maximum likelihood estimator that increases

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[5] This finding is in contrast to Dercon (1994) who concluded that at least teff prices in Ethiopia were non-stationary over the 1985-93 period. A potential cause of the different finding is that we deseasonalized the price data to account for seasonal effects before testing for unit-roots. Since grain prices typically exhibit clear seasonal effects, it would seem to us important to purge the data of this effect before testing for unit-roots. Without doing so, there may be a tendency to accept the hypothesis of non-stationarity when in fact this may not be so, which would then motivate for different model specifications that would not be appropriate if in fact the data were stationary.

estimation efficiency by exploiting information in the cross-equation error covariance matrix. This estimation procedure takes into account the effects of random price shocks in different markets on the price level in a particular market. The decision to use the SURE model was also based on the test of contemporaneous correlations of the residuals from the SURE model. If the coefficient of contemporaneous correlation between the different residuals is not significant it implies that the random price shock in one market has no effect on the price level in another market. Under this condition there is no gain in the efficiency of estimating the various coefficients using SURE in that SURE estimates are not different from that of OLS estimates and OLS can be used (Judge et al. 1985).

The manner in which variables are specified in the model is sensitive to assumptions about the degree of spatial market integration. If markets are assumed to be fully integrated, then prices in location i would not just be affected by local rainfall and food aid but rather by movements in these variables all over the country, which would motivate for some national-level indicators. On the other hand, under the assumption of weak market integration, it would be reasonable to use region-specific rainfall and food aid variables that vary across equations.

Under the assumption that grain markets are integrated, the SURE model used to analyze the effects of various factors on the levels of the real price of a given grain for a given number (n) of markets is formulated as follows:

$$P_t = \mu + \Pi D + \Phi DLIB + \Omega RF + \lambda FAID + \gamma P_{t-1} + V_t \tag{2}$$

where P_t is a nx1 vector of real prices of a given grain for different markets at time t, μ is a nx1 vector of regression intercepts, Π is a nx11 matrix of coefficients on monthly seasonal dummy variables, D is 11x1 vector of monthly seasonal variables, Φ is a nx1 vector of coefficients on liberalization dummy variable $DLIB$, Ω is a nx1 vector of coefficients on rainfall variable RF, λ is a nx1 vector of coefficients on food aid variable $FAID$, γ is a nx1 vector of coefficients on nx1 vector of own lagged price values, and V_t is a nx1 vector of the disturbance term at a time t.

Under the assumption that regional markets are only weakly integrated, the SURE model is specified in the same way as in (2) above except for the rainfall and food aid variables. These variables, instead of being a scalar, are now vectors with a dimension of nx1 for n different markets. Since it is generally believed that Ethiopian grain markets are not fully integrated and suffer from numerous infrastructural and coordination problems, we adopt the latter specification in which region-specific food aid and rainfall variables are used to estimate equilibrium prices for markets in their respective regions. Rainfall and food aid in each region affects market prices in other regions indirectly through the residual terms in the SURE system estimation procedure.

The expected sign for each variable in (2) are discussed briefly:

Seasonality: There are clear seasonal patterns in Ethiopian grain prices due to different volumes hitting the market in different months, and also due to costs of storing grain over time. The coefficients on months following harvest seasons are expected to be lowest, gradually rising to a peak before harvest.

Policy change: If market liberalization reduces the costs associated with grain distribution, this is expected to decrease grain prices in deficit markets and increase grain prices in the surplus markets. The coefficient on DLIB is thus expected to be positive in surplus markets and negative in deficit markets. DLIB takes the value of 0 for the pre-liberalization period, values ranging from zero to 1 during a transition period and the value of 1 when the full effects of liberalization have been felt. This specification assumes that the effect of liberalization is a gradual process having its full effect after certain period. A grid-search procedure is used to determine the length of the transition period, choosing from a range of 6-month periods between 6 and 36 months. A transition period of 12 months was found to maximize the value of the likelihood function.

Rainfall: Rainfall may have complex lagged effects that differ over the short and long run. The overall effect of good rain conditions is to reduce grain price levels. The rainfall variable used in the model is the unweighted 3-month moving average of rainfall, lagged one month, for the markets considered in the analysis. This allows prices in the current period, for example, to be affected by cumulative rainfall conditions over the previous one to three months.

Food aid: Food aid may affect market prices both by reducing the amount of grain that recipient households may otherwise have purchased in the market (thus reducing demand), and by potential sales of food aid onto markets, thus increasing market supplies). The food aid data used in this analysis is disaggregated region-specific monthly food aid distribution from the National Disaster Prevention and Preparedness Committee (DPPC). After the food aid reached the recipients it is also assumed that it takes some time before food aid recipients potentially dispose of some part of the food aid they received on the market or to change their decision whether to buy from the market. To take into account these lagged effects, a three- month moving average of food aid volume lagged by one month is used in the SURE model estimation. The effect of food aid on market price levels is expected to be negative.

The specification of (2) may also be used to consistently estimate the effects of exogenous factors on price spreads, through their effect on equilibrium price levels. In this approach, any two price equations in the system (2) can be used to construct the price spread *(PS$_{ij}$)* for any two markets *i* and *j*, through subtraction:

$$P_{i,t} - P_{j,t} = PS_{ij,\,t}$$

By subtracting the right-hand sides of any two price equations in (2), the price spread between these two markets can be specified as follows (assumption of weakly integrated markets):

$$PS_{ij,t} = (\mu_i - \mu_j) + \sum_{n=1}^{11} (\pi_{ni} - \pi_{nj})D_n + \lambda_i FAID_i - \lambda_j FAID_j + \Omega_i RF_i - \Omega_j RF_j + \gamma_i P_{i,t-1} - \gamma_j P_{j,t-1} + z_{ij,t} \quad \textbf{(3)}$$

where *PS$_{ij,t}$* is the marketing margin between ith and jth market at time *t*, the other coefficients and variables are as defined before, and $z_{ij,t}$ is the disturbance term. The coefficients on each variable are derived directly from estimation of (2). The standard errors for the coefficients in (3) are also derived from (2) as:

$$VAR(C_i\text{-}C_j) = VAR(C_i) + VAR(C_j) - 2\,COV(C_i, C_j)$$

where VAR and COV stands for variance and covariance respectively and C_i and C_j are the coefficients on a given variable for the ith and j^{th} market. The standard error can be found by taking the square root of the variance.

4. MARKETS AND SOURCES OF DATA

Three grain crops (maize, white tef, and white wheat) and eight markets are considered in this analysis. Markets are chosen based on the availability of continuous time series price data covering at least three years before and after market liberalization. The descriptive statistics cover the period January 1986 to July 1996. However, the estimation period for the econometric analysis covers the period from January 1986 to December 1993 due to the unavailability of regionally-disaggregated food aid data after this time.

For maize six markets are considered, Addis Ababa, Dire Dawa and Mekele which are mainly deficit markets for maize and Bako, Shashamane and Jimma which are surplus markets. For white teff also six markets are analyzed: Addis Ababa, Dire Dawa and Mekele which are deficit markets for white tef and Bako, Bahir Dar and Hosaenna which are surplus markets. In the case of white wheat four markets are studied: Addis Ababa, Dire Dawa and Mekele which are deficit markets and Hosaenna which is a surplus market.

The price data for the markets used in this analysis is obtained from the Ethiopian Grain marketing Enterprise (EGTE) collected for selected markets in Ethiopia. For Bako market the price data collected by Bako Research Center is used. Prices were deflated using the non-food consumer price (1996=100) for Addis. The rainfall data for all markets except Bako market is obtained from the National Meteorological Station of Ethiopia; for Bako area the rainfall data is obtained from Bako Research Center. The food aid data is from the World Food Program (WFP) data files and DPPC.

5. RESULTS

Descriptive Analysis of Grain Market Response to Liberalization

Changes in price levels and volatility

Summary statistics of real prices of grains for several markets in Ethiopia for the pre- and post-market liberalization periods are provided in Table 2.[6] Average grain prices increased for all markets in nominal terms (See Figure 1, 2 and 3). However, the average real price for maize, white teff and white wheat increased after liberalization for the cereal-surplus areas of Shashamane, Bako, Jimma, and Hosaenna, and decreased in the cereal-deficit markets of Addis Ababa, Mekele, and Dire Dawa, with one exception (maize in Dire Dawa). Across all commodities, real cereal prices increased in the grain-surplus areas in 7 of 7 cases. By contrast, real prices in the grain-deficit areas declined in 8 of 9 cases. Prices in the surplus-producing areas have risen by 12% to 48%, while prices in deficit regions have declined by 6% to 36% in eight of nine cases. An unexpected result is observed for Dire Dawa market in that real maize prices increased by 10% in the post-liberalization period.

The variability of monthly real price of maize for different markets as measured by the standard deviation (SD) and coefficient of variation (CV) is presented in Table 2.[7] The volatility of wholesale cereal prices has generally declined since liberalization. This is especially true for the deficit markets, where the SD declined in all 9 cases across maize, teff and wheat. In the surplus markets, the SD actually increased from 1% to 11% in 5 cases, and declined in only 2 cases. Similar results obtain for the CV measure of instability.

The above analyses indicate that the wholesale prices in the surplus producing markets increased since liberalization, but became slightly more variable. Higher cereal prices in these areas have most likely contributed to production growth and incentives to use productivity-enhancing inputs in these areas.

However, it is not clear that price increases at wholesale level automatically translate into higher prices to producers. Conclusive evidence on the extent to which producer and wholesale prices move together requires time series information on producer prices, which unfortunately are only sparsely available. However, using limited data from CSA and EGTE, data presented in Tables 3 and 4 are used to derive the producer share of the value of selected cereals at retail level. Before liberalization under the fixed price system, the producers' share of consumers' price ranged from 44% to 61% (Table 3). On the other hand, the limited data for the period after market liberalization suggests that the producers' share of the retail price increased slightly from

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[6] Within-year monthly price variability for different grains over the years from 1985 to 1996 is also given in Appendices 2 to 4. The changes in monthly price variability from year to year is very dramatic for most of the grains and markets.

[7] The standard deviation is a measure of absolute price variability while the coefficient of variation is a measure of price variability relative to the mean level of prices. While both measures are relevant, the measure of absolute price variability (SD) may be most relevant for comparing the level of instability in the pre-liberalization and post-liberalization periods.

the pre-market liberalization period levels (Table 4). For maize the producers' share of consumers' price in Addis Ababa increased by 11% to 12% and for white teff it increased by 1% to 6% while the share decreased for white wheat by 1%. On-going analysis by GMRP is assessing in more detail the degree of price transmission at retail, wholesale, and farm level.

Changes in price spreads and volatility

Higher prices in surplus-producing areas and simultaneously lower prices in deficit areas indicate that market liberalization has been associated with a reduction in average wholesale price spreads (the difference between wholesale prices in surplus and deficit regions). This is confirmed by direct computation of price spreads for major trade routes in Ethiopia during the pre-liberalization and post-liberalization period (Table 5). Cereal price spreads have declined during the post-liberalization period in 22 of 24 cases for which data is available. The decline in price spreads was especially large for white teff and wheat, the cereals that figured most prominently in the former AMC's forced grain procurement system during the control period. For white teff, average wholesale price spreads across all market pairs declined by 81 birr per quintal (in 1996 Birr) from 149 birr per quintal during the pre-liberalization period, to 68 birr per quintal during the post-liberalization period. White wheat price spreads similarly declined by 41 birr per quintal after liberalization (from 95 birr per quintal to 54 birr per quintal), and maize price spreads declined by 12 birr per quintal (from 52 to 40 birr per quintal).

The only exception has been between the maize price spread between Addis Ababa and Dire Dawa, which has risen slightly in the post-liberalization period. The increase in the price spread between Addis Ababa and Dire Dawa may be due to taxes on grain movement between these markets, which can be seen from the relatively heavy taxation of grain at grain checkpoints on this route (averaging 15 birr per quintal) as compared to other routes. The issue of grain checkpoints is discussed later in this section.

While differences in weather conditions may partially account for changes in price *levels* in the pre- and post-liberalization periods, favorable weather during the post-liberalization period cannot serve as an explanation for why prices in surplus-producing markets rose at the same time that prices in deficit markets declined. Reasons forwarded for the decline in inter-regional marketing spreads during the post-liberalization period include (1) lower transactions costs in grain trading from the reduction or elimination of smuggling, bribery, and illegal grain movement (Franzel et al 1990); (2) the restoration of peace in the country after a civil war during the 1980s that disrupted commercial trade especially in the northern regions (Dercon 1994); (3) the cessation after liberalization of forcing traders to sell part of their produce to the state at below-market prices, which may have forced them to recoup losses by offering reduced prices to farmers and higher prices to retailers; and (4) lower levels of uncertainty associated with EGTE's curtailed grain trading activities during the post-liberalization period.

The absolute volatility of cereal price spreads between different markets has also declined since liberalization in 23 of the 24 cases for which data are available (Table 5). These findings suggest that the transfer costs charged by traders for distributing cereal from one region to another have not only declined but have also become more stable in absolute terms during the post-liberalization period. However, when considering the lower level of absolute variation in price

spreads relative to the lower average prices spreads during the post-liberalization period (i.e., the coefficient of variation), the instability of cereal prices relative to mean cereal price levels has declined in only 12 of 24 cases.

It is important to note that price instability is not necessarily indicative of price unpredictability. Some variation in cereal prices is predictable and actually necessary, such as intra-seasonal price increases after the harvest in order to induce incentives for grain storage for consumption later in the year. Also, variations in cereal prices between regions are also important to provide the incentives for private traders to transport grain from surplus to deficit regions. Future efforts to improve the performance of grain markets through price stabilization will be more effective if they do not remove the predictable and useful forms of price variation, both spatial and temporal, that are necessary to induce private traders to undertake critical storage and transportation functions.

Changes in market price correlation

The extent to which grain prices at different markets are correlated is important in the design of appropriate market development, stabilization, and food security strategies. For example, if a price increase in one market is not associated with an associated price increase in another market linked by trade, this may (but not necessarily) be because of poor infrastructural links between these markets, lack of competition in grain distribution, or other problems that inflate costs in the food system. As an initial step to assess the extent to which grain markets are spatially integrated, correlation coefficients are computed and presented between different pairs of markets which are linked by trade (Table 6). The coefficients are computed for both prices in levels and first differences.[8] While there are well-established limitations of examining market integration through correlation analysis, it can be said that low price correlation between markets is generally indicative of relatively high costs and/or weak transmission of information within the marketing system.

Across all commodities and market pairs, price correlation increased after liberalization in 17 of 24 cases. Of the six cases in which price correlations declined, five of them involved Mekele market. On-going analysis is examining the reason for the apparent disconnection between Mekele, the largest city in Northern Ethiopia, and the rest of the country. Correlation coefficients in the price differences also increased in 17 of the 24 cases. These initial descriptive statistics indicate that cereal market liberalization has generally increased the extent to which prices in the country move together. Such a result generally (but not necessarily) indicates an improvement in market efficiency and reduction in marketing costs, other factors constant. These findings are also consistent with those of Dercon (1994).

Results of grain checkpoint survey

Much controversy has surrounded the issue of grain checkpoints. The newly formed regional governments have used tariffs on grain transported across road checkpoints as a means to raise public revenues. The conventional wisdom in Ethiopia is that these tariffs constitute a tax on

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[8]The correlation coefficient for levels indicate that to what extent price levels in different markets are related while the correlation coefficient for first differences indicate that how the changes in price levels for different markets are related to each others.

traders. However, the magnitude of these checkpoint charges and their effects on prices received by producers and prices paid by consumers (i.e., who ultimately pays the tax) is very unclear. To overcome this information gap, enumerators were hired to ride on trucks carrying grain across five major cereal trade routes: Addis to Harar; Addis to Mekele; Nekempt to Addis; Shashemene to Addis, and Jimma to Addis. Enumerators rode on five different trucks on each trade route during August 1996, and recorded information on the number of checkpoints encountered, time spent at each checkpoint, and the tariff charges incurred, both registered and unregistered.

The number of checkpoints observed on each grain trading route varied from 8 to 18 and at each check point the transporters were detained on average for about ten minutes (Table 7). The total time taken for all checkpoint inspections from departure to destination varied from one hour to three hours. The transporters paid 7.2 birr per quintal on average as check point taxes. There was substantial variation in the magnitude of checkpoint taxes along different routes, being as low as 3.8 birr per quintal from Shashemene to Addis, and as high as 15.0 birr per quintal from Addis to Harar (including both official and unofficial charges). The checkpoint charges accounted for 20% to 33% of average price spread observed on these major grain trading routes.

The checkpoint charges are also considerable in terms of the prices received by the farmers, accounting for roughly 10% of the price received by farmers for maize in Shashamene, and about 5% and 6% of the price received by farmers for teff and wheat in Dejene and Hosaenna respectively for the months of July to August 1996.[9]

While the taxes support other government objectives, they increase grain marketing costs and work against government efforts to stimulate incentives to use productivity-enhancing farm technology. Other research has shown the value-cost ratio of fertilizer use on maize could be increased by 8% in key producing regions if the elimination of checkpoint tariffs were half passed on to producer prices (Mulat, Ali and Jayne 1996). Moreover, since the poor spend a comparatively large proportion of their income on food, the taxation of grain is likely to be regressive.

Results of Econometric Analysis

Changes in price levels due to liberalization and food aid releases

The analysis so far considered only the effect of liberalization on price levels and marketing spreads without controlling for changes in other factors likely to affect price levels. In the following sections the results of SURE estimations are presented to estimate the effect of liberalization and food aid releases holding constant the influence of other factors.[10]

The effects of various factors affecting the maize price levels in six markets (Addis Ababa, Bako,

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[9] The producer prices are based on the new MIS data base run by GMRP.

[10] The results of SURE model estimation under the different market integration assumptions are very similar; here only the results under the assumption of weak market integration are discussed while the results under the assumption of full market integration are given in Appendices 8 to 13.

Shashamane, Dire Dawa, Mekele and Jimma) is estimated as a system using SURE model and the results are given in Table 8. For all the maize markets considered except Mekele the signs of the coefficients on the liberalization dummy variable is found to be positive, implying that market liberalization has increased the maize price levels in real terms. However, the increases are significant only in the major surplus-producing areas of Shashamane and Bako markets. In these markets, equilibrium maize prices have been 11 and 4 birr per quintal higher (in constant 1996 birr) in the post-liberalization period. For the deficit market of Mekele, market liberalization was associated with a significant decline of 28 birr per quintal (constant 1996 birr) in equilibrium maize price levels. These results may also be due to the ending of the civil war, which occurred a year after liberalization occurred, and was especially disruptive in the northern part of the country (Dercon 1994).

The impact of food aid on maize price levels was insignificant in all six markets for which data were available. Given the magnitude of imported food aid wheat over the estimation period, these results are perhaps surprising, but may be plausible if wheat and maize are not close substitutes in consumption. The effect of rainfall on maize price levels is found to be, as expected, negative in all cases. The impact of rainfall was statistically significant at a probability of less than 1% only for Shashamane, at a probability of less than 5% for Addis Ababa and Mekele markets and at a probability of less than 10% for Dire Dawa. Surprisingly, the effect of rainfall on maize price level in the heavy rainfall areas like Bako and Jimma is not significant.

In the case of white teff, the effect of liberalization is negative in all three deficit markets and positive in all three surplus markets. However, the effects of market liberalization is statistically significant only for the surplus areas of Hosaenna and Bahir Dar at a probability of less than 1%. In these markets, market liberalization was associated with a 25 b/q and 17 b/q rise in equilibrium teff prices. Market liberalization was associated with a decline in teff prices (from 1 to 48 birr per quintal) in the deficit markets of Addis Ababa, Dire Dawa and Mekele. The impact of liberalization was statistically significant at the 1% level only for Mekele market.

A statistically significant seasonal effect is also observed for all the markets considered, January through April being months of lower price for most of the markets (Table 9). The effect of rainfall is negative for all markets considered. However, the effect is statistically significant only for Addis Ababa, Bako and Mekele markets at a probability of less than 1%.

The volume of food aid released is negatively associated with white teff prices in four of six cases, being statistically significant at the 5% level for Addis Ababa and Mekele markets. For these two areas, wholesale prices in a given region and a given month declined by 2 to 5 birr per quintal for every additional 30,000 quintals of food aid released within that region over the prior three-month period. The volume of imported food aid wheat has ranged from 0.3 to over 1.1 million tons since 1985, accounting for an estimated 20 to 50 percent of national annual marketed cereal output. In some cases such as Tigray, the volume of food aid was of such a magnitude to depress wholesale teff prices by 15% to 25%, other factors constant. The welfare effects of lower grain prices (due to food aid) on food production incentives, input use, and rural livelihoods are complex and clearly differ among different types of rural households. A large percentage of rural households are net buyers of cereal on an annual basis (in 1995/96 this percentage was almost 50% nationwide); these households directly benefit from lower staple food prices. However, lower prices due to food aid may impede input use and cereal production by rural households who

grow certain cereals as a cash crop. Also, the potentially destabilizing effect of food aid on market prices may introduce additional risks and costs for private traders, who are likely to pass these costs onward to producers and consumers.

SURE results for white wheat are presented in Table 10. Market liberalization has been associated with a 12 birr per quintal increase in the price of white wheat in the surplus-producing area of Hosaenna. This result was significant at the 5% level. For the deficit markets, liberalization is associated with lower real prices in two of three cases. However, only in Mekele was the effect statistically significant at the 1% level. In this market, equilibrium wheat prices have been 42 birr per quintal lower in the post-liberalization period, after controlling for other factors in the model.

The impact of imported food aid wheat on white wheat price were significantly negative in one of four cases (Mekele). Mekele is situated in Tigray Region, which has received a large proportion of total food aid distributed in the country over the sample period. Therefore, it is not surprising to find a significant negative effect of food aid on prices of both wheat and teff in this market. The results indicate that equilibrium wholesale prices in Mekele declined by 2.7 birr per quintal for every additional 30,000 quintals of food aid released within that region over the prior three-month period.

Changes in price spreads

Table 11 shows the various factors affecting maize price margins between different markets, the coefficients and statistical test statistics in the maize price margins analysis are derived based on the estimates from the SURE model. Market liberalization has significantly ($p<5\%$) reduced the maize price spreads between Addis Ababa and Mekele and Addis Ababa and Shashemene. The spread between other markets either increased or decreased but the changes are not statistically significant. The effects of seasonality on maize price margins are not as pronounced as in maize price levels, because prices in both surplus and deficit markets appear to follow a roughly similar seasonal pattern. The effect of rainfall on maize price spreads is found to be significant in most of the cases while the effect of food aid is not significant.

Table 12 shows the impact of various factors affecting white teff price spreads. Seasonal differences in price spreads are observed only between Addis Ababa and Mekele, October to March representing months of lowest margin. Market liberalization was associated with lower price spreads for all market pairs considered. The white tef spreads between Addis Ababa and Bahir Dar, Mekele and Addis Ababa, Dire Dawa and Hosaenna and Addis Ababa and Hosaenna have declined significantly at a probability of less than 1% while the margins between Dire Dawa and Bahir Dar reduced significantly at a probability of less than 5%. Equilibrium white teff price spreads have declined by 1 to 48 birr per quintal in the post-liberalization period.

Food aid is also found to have significant but often complex effects on cereal price spreads. In the case of teff price spreads between Bahir Dar and Addis, for example, food aid released in the region comprising Addis is found to significantly reduce Addis prices (the deficit market), which, other factors constant, reduces the size of the price spread between these markets. Food aid released in the region comprising Bahir Dar also negatively affects teff prices in this major

surplus-producing region (but statistically insignificant at 10%), which, other factors constant, increases the price spread between these two markets. For every market pair examined, the impact of food aid released in the region of the given deficit market was to depress the teff price spread between these market-pairs, significantly in four of eight cases at the 5% level.

In the case of white wheat, market liberalization has been associated with lower white wheat price spreads between all the different market pairs considered (Table 13). The effect was significant at the 5% level for Mekele-Addis Ababa, Dire Dawa-Hosaenna , and Mekele-Hosaenna. The volume of food aid released in the regions of the surplus and deficit markets has had ambiguous effects on white wheat price spreads, depending on the effect on price levels in the different markets considered.

6.   SUMMARY AND POLICY IMPLICATIONS

The Effects of Seasonality

The effect of seasonality on the price levels of the grains considered in this study is significant for most of the markets. Based on household-level information on farmer grain selling patterns, most of the farmers in Ethiopia dispose their grain to the market just after harvest due to distress sales when the prices are not favorable (see, for example, Legesse and Asfaw 1989). A preliminary report from GMRP household survey indicates that about 83% of the grain sale transactions by the farmers occurs between January and May. Most farmers are not in a position to take advantage of seasonal price differences because of limited income to cover their financial commitments which in most cases have to be settled soon after harvest, and possibly because the returns to storage are not high under prevailing smallholder conditions.

The effect of seasonality on marketing margins between different markets is not significant in most of the cases. Most of the factors affecting seasonal price rises are comparable in magnitude across markets, hence the price spread between them has little seasonal pattern. This implies a fairly constant margin being charged by private traders throughout the marketing season. This result might suggest that there is limited incentive for private temporal arbitrage. However, a recent survey of 219 private grain traders throughout Ethiopia in 1996 indicated that over half stored grain for an average of over two months (Gebremeskel 1997).

The Effects of Market Liberalization

The effect of market liberalization on equilibrium grain price levels varied by the type of grains and markets considered. Market liberalization has been associated with lower real cereal price levels in six of nine cases involving markets in deficit regions. These findings were statistically significant at the 10% level in three of these nine cases after controlling for other factors affecting cereal prices such as rainfall, food aid, and seasonality. Market liberalization has been associated with higher real cereal prices in each of the seven cases involving markets in surplus regions (statistically significant in five cases).

The benefits to consumers during the post-liberalization period have been most evident in Mekele. Real prices for white teff, white wheat, and maize in Mekele declined by 49, 42, and 27 birr per quintal (in 1995 birr) in the post-liberalization period after controlling for other factors. However, some of these gains to consumers are likely to be due also to the ending of the civil war, which disrupted commerce especially in the northern part of the country (Dercon 1994).

The benefits to surplus cereal producers during the post-liberalization period have been evident in almost all markets examined and for each of the three cereals. For example, wholesale wheat prices in Hosaenna, a major wheat growing area, have risen by 10 birr per quintal in the post-liberalization period, other factors constant. Wholesale teff prices in Bahir Dar, a major teff growing area, have risen by 17 birr per quintal in the post-liberalization period, other factors constant. For the major maize producing areas of Bako and Shashemene, real prices have risen by 4 and 11 birr per quintal, respectively, other factors constant. Data is not available to clearly assess the extent to which increases in wholesale prices have been passed along to farmers in the form of higher producer prices. Yet to the extent that higher prices at wholesale level have been transmitted to producers, liberalization has positively affected cereal production growth and incentives to use fertilizer and other productivity-enhancing inputs.

One of the reasons for the differential effects of market liberalization could be the difference in the development of marketing infrastructure linking these surplus markets to the deficit regional markets. A considerable part of the food price instability problem in Ethiopia is related to the high cost of transportation, which creates a major wedge between import and export parity prices. For example, when areas of Southern Ethiopia are in grain surplus, prices are depressed by high transport costs that limit grain export opportunities. When these areas are in grain deficit, prices are driven upward by the high cost of transporting grain to these areas from other regions. Government and donor support for improved road infrastructure and lower transport costs — both within Ethiopia and between Ethiopia and its regional neighbors -- would contribute to both the productivity and stability of the food system and further increase the benefits of market liberalization.

Cereal price spreads between wholesale prices in different markets decreased after the initiation of grain market liberalization in 23 of 24 cases examined. This implies that the margins charged by traders for moving grain from one region to another has declined, which has conferred important benefits to both surplus-producing farmers and grain-purchasing households in deficit regions. Changes in cereal price spreads between regional surplus and deficit markets are generally explained by changes in the costs and/or margins for transportation, storage, crop finance, and related transactions costs involved in trading.

Despite these gains, however, the grain marketing system in Ethiopia still suffers from a number of constraints that inflate costs in the food system. Tariffs on grain movement add an additional 20% to 33% onto observed price spreads between surplus and deficit regions, and thus inflate the wedge between producer and consumer prices. While tariffs on cereal transport may raise revenue for the regional governments, these taxes work against government efforts to support producer prices in surplus-producing regions and keep consumer prices low in deficit regions. To the extent that the poor spend a greater portion of their income on basic staples, taxes that raise the price of these goods are borne disproportionately by the poor. Grain checkpoint tariffs, by increasing the risks and uncertainties of regional grain movement, also decrease the regional

interdependence among the surplus and deficit regions for grain supplies and thus affecting national food security.

Other research on the behavior of wholesale traders indicates the scope for significant reduction in handling and transaction costs if improvements in cereal grading and standards could be achieved (Eleni, forthcoming). For example, inadequate grading procedures cause grain to be un-bagged and re-bagged for quality inspection each time grain changes hands. These findings are indicative of an emerging body of empirical evidence on policy reform in Africa suggesting that, while some reforms have been critical to promote economic growth, they are insufficient by themselves to generate leaps in productivity growth and require associated improvements in key market institutions, infrastructure, and broader nurturing of civil society (Gordon 1996).

Volatility, as measured by SD, of grain price levels declined in 11 of 16 cases examined while the volatility in price spreads declined in 23 of the 24 market pairs examined. These findings suggest that the transfer costs charged by traders for distributing cereal from one region to another have not only declined but have also become more stable in absolute terms during the post-liberalization period.

Price stability is one of the important factors affecting farmers' decision-making process. Under highly variable (unpredictable) price conditions farmers may be reluctant to make important investments such as the use of fertilizer. Variability in grain marketing margins also represents one of the risk factors for the private grain traders increasing the uncertainty of the amount of income they derive from grain trading. This also affects traders' decision to make investments which increase the efficiency of the grain marketing system.

Results of price correlation analysis strongly indicate that wholesale cereal prices have become much more highly correlated in the post-liberalization period. The correlation between wholesale market prices has risen in 17 of 24 market pairs examined since liberalization in 1990. This provides a rough indication that grain markets have become more spatially integrated since liberalization, at least at the wholesale level. This finding is to be expected since the costs and risks of transporting grain across regions has declined substantially since liberalization. Integration between producer prices and wholesale prices is still a major unknown, since compatible price information at the producer, wholesale, and retail level was not collected under the EGTE price collection system, and has only just begun in August 1996 under the new GMRP/EGTE/MEDAC system. The integration between producer and wholesale cereal prices is a key issue for the design of local purchase programs designed to raise producer prices through purchasing grain from wholesalers.

The goal of raising and stabilizing farm revenues can be promoted by improving the efficiency of the grain marketing system. A more efficient marketing system would help pull grain quickly out of surplus areas, thus relieving the localized gluts that depress farm prices, and more quickly deliver grain to deficit areas. Examples of investments that are likely to improve the efficiency of the grain marketing system include more timely and widely disseminated market information, improved road infrastructure, and removing barriers that raise the costs of moving grain from one region to another. The continuation of competitive local purchase operations during large harvest years, guided by timely information on marketed supplies and prices, could also stimulate private investment in the food system, promote competition, and reduce grain and input marketing costs

over the longer run. These market-oriented approaches may prove to be more cost-effective over the long-run in stabilizing producers' revenues and promoting farm technology adoption and production than administered fixed price policies.

The Effects of Food Aid

The depressing effect of food aid on grain prices is observed in 7 of the 16 cases examined for the three commodities. Food aid negatively affected the prices of maize in Jimma, white tef in Addis Ababa, Dire Dawa, Bahir Dar and Mekele markets and the price of white wheat in Hosaenna and Mekele markets. However, the effect of food aid on grain prices in surplus markets is found to be either positive or negative but not significant in most of the cases. While these results should be interpreted cautiously, they suggest that food aid distribution over the 1987-1993 period, at least to some extent, was substituting for local market purchases or was being sold onto markets. The fact that market prices have apparently become more integrated since liberalization implies that leakages of food aid in one regional market may now affect prices to a greater extent in other regions as well.

Policy Options for Consideration

In general, while liberalization may have improved allocative efficiency and reduced marketing costs related to policy restrictions, there may be substantial scope to improve technical efficiency of marketing activities through strengthening of market institutions. This implies an important positive role for government in the following areas:

1. *improved road, rail, port, and communication infrastructure.* Investment in market infrastructure reduces costs and risks across a broad range of commodities and inputs in contrast to expenditures confined to particular crops (e.g., crop subsidies). Donor support in this area would make the market liberalization measures they advocated more successful. Improved market infrastructure also requires further policy change to remove remaining import tariffs on vehicles and spare parts.

2. *Removal of taxes on grain at regional road checkpoints:* While taxes on the movement of grain support fiscal objectives of the regions, they increase grain marketing costs and work against government efforts to stimulate incentives to use productivity-enhancing farm technology. Other research has shown the value-cost ratio of fertilizer use on maize could be increased by 8% in key producing regions if the elimination of checkpoint tariffs were half passed on to producer prices (Mulat, Ali, and Jayne 1996). Also, since the poor spend a comparatively large proportion of their income on food, the taxation of grain is likely to be regressive.

3. *improved public market information systems* to accelerate both private and public response to supply gluts and shortages. The timely dissemination of market information can also help policy makers to better monitor the evolving effects of market liberalization, identify problems that require mid-course correction, and to respond to impending supply fluctuations in a more timely way.

4.   *nurturing the political and legal foundations of marketing systems* (e.g., strengthened mechanisms of specifying and enforcing contracts, raising the costs of contract non-compliance, and more pluralistic procedures for developing the rules governing market activity). A well-functioning legal and political framework for market activity reduces the risks and transactions costs of private trade. These measures are important adjuncts to developing reliable markets, and inherently involve strengthening the regulatory abilities of the state rather than "getting the state out of market regulation." In general, this means a reorientation of the state from "control" activities to "facilitation" activities designed to reduce farmers' and traders' costs of transacting across inputs, credit, and commodities.

5.   *Invest in local analytical capacity:* Lasting policy change depends critically on governments' actual belief in the analysis supporting the reforms. There is ample evidence that governments that have reluctantly undertaken reform programs have reversed them and reimposed the old system on price and trade controls as soon as a drought or other shock has occurred. Local analytical units are often seen as more neutral and sensitive to domestic policy concerns than analysis conceived and driven by donor interests using expatriate analysts. The demand for, and credibility of, food policy analysis to guide market development is enhanced by a collaborative research process driven by local researchers and government analysts who take "ownership" of the research agenda and findings.

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Table 1.   National estimates of production and sales of major grains for 1995/96 season by the farm households in Ethiopia

Grain	Total quantity of grain produced	Total quantity of grain marketed	Proportion of grain marketed out of total grain produced	Total quantity of grains purchased by EGTE[*]	Proportion of EGTE's grain purchase out of total grains marketed
	(tons)	(tons)	(%)	(tons)	(%)
Maize	1,696,801	506,436	29.8	29,825	5.9
Tef	1,313,035	409,799	31.2	9,468	2.3
Wheat	836,250	233,904	28.0	22,223	9.5
Barley	853,979	217,661	25.5	420	0.2
Sorghum	1,342,251	228,613	17.0	2,315	1.0
Millet	200,230	38,027	19.0	70	0.2
Pulses	583,346	244,080	41.8	2,849	1.2
Oil Seeds	148,956	115,975	77.9	4,435	3.8
Total	6,974,848	1,994,495	28.60	71,605	3.59

Source: GMRP (1996) and EGTE (1996)

Note: [*]Over the periods from July 1 1995 to June 2 1996 the EGTE purchased 6,079 tons of maize and 6,294 tons of wheat from the farmers at the support price (GMRP, 1996).

Table 2   Summary statistics of real prices of grains for several markets in Ethiopia

Markets	Before market liberalization (85:01 to 90:03)			After market liberalization (90:04 to 96:06)			Change		
	Mean	SD.	CV(%)	Mean	SD	CV(%)	Mean	SD.	CV(%)
Maize									
Surplus areas:									
Bako	61.18	20.79	33.98	90.14	31.95	35.44	28.96	11.16	1.46
Shashamane	66.29	13.89	20.95	97.79	22.17	22.67	31.50	8.28	1.72
Jimma	85.43	37.19	43.53	95.65	28.69	29.99	10.22	-8.50	-13.54
Deficit areas:									
Addis	120.23	48.89	40.66	113.55	24.66	21.72	-6.68	-24.23	-18.95
Dire Dawa	145.08	50.13	34.55	154.63	30.74	19.88	9.55	-19.40	-14.67
Mekele	218.28	63.01	28.87	149.75	17.55	11.72	-68.53	-45.46	-17.15
White Teff									
Surplus areas:									
Bako	142.34	22.10	12.71	173.82	25.55	17.95	31.48	3.45	5.24
Hosanna	155.34	22.97	12.11	189.65	23.93	15.37	33.94	0.96	3.26
Bahir Dar	158.16	15.77	7.60	207.63	25.55	16.15	49.47	9.78	8.56
Deficit areas:									
Addis	281.90	64.05	26.84	238.62	20.29	7.20	-43.28	-43.76	-19.64
Dire Dawa	330.97	68.42	23.99	285.23	26.38	7.97	-45.74	-42.04	-16.02
Mekele	422.32	73.26	27.04	270.94	15.12	3.58	-151.40	-58.14	-23.46
White Wheat									
Surplus areas:									
Hosanna	110.96	20.40	18.39	136.07	16.18	11.89	25.11	-4.22	-6.49
Deficit areas:									
Addis	183.49	55.40	30.19	169.21	20.68	12.22	-14.28	-34.72	-17.97
Dire Dawa	238.97	49.34	20.65	225.70	22.60	10.01	-13.27	-26.74	-10.63
Mekele	270.30	46.06	17.04	197.59	29.05	14.70	-72.71	-17.01	-2.34

Table 3   EGTE's fixed grain purchasing and selling prices (birr/qt) under controlled marketing system in terms of 1995 prices (1984/85 to 1989/90)

Grain	Farmers delivery price to EGTE or Cooperatives (a)	Cooperatives and traders selling price to EGTE (b)	EGTE's selling price to official buyers including tax ©	Official retail selling price to consumers (d)	Farmers' share of official retail price (%) (a/d x 100)
White tef	94.72	104.91	143.62	156.54	61
Mixed tef	80.45	90.64	127.77	133.41	60
Red tef	72.29	82.49	118.72	124.35	58
White wheat	71.30	81.49	117.60	123.24	58
Mixed wheat	63.14	73.34	108.53	114.17	55
Black wheat	61.11	71.30	106.25	111.89	55
White barley	59.07	67.22	101.76	106.90	55
Mixed barley	54.99	63.14	97.20	102.84	53
Maize	42.76	50.91	91.32	96.96	44
White sorghum	57.03	65.18	106.44	112.08	51
Mixed sorghum	48.88	57.03	90.42	96.05	51

Source: Extracted from EGTE (1988).

Table 4   The producers' share of consumers' price in Addis Ababa market for maize,
            white tef and white wheat (November 1994 to February 1996)

Grain	Local market	Producers' price[1] (birr/qt) (a)	Assembler spread[2] (birr/qt) (b)	Wholesaler spread[3] (birr/qt) (c)	Retailer spread (birr/qt) (d)	Retailer price for Addis Ababa (birr/qt) (e)	Producers' share of consumer price (%) (a/e)x100
Maize	Bako	80.80	Na	Na	34.30	144.77	56
	Shashemene	79.85	15.51	15.13	34.30	144.77	55
White teff	Bako	180.73	Na	Na	32.28	271.64	67
	Bahir Dar	168.25	56.16	14.94	32.28	271.64	62
	Hosaenna	180.44	10.05	48.87	32.28	271.15	66
White wheat	Hosaenna	123.71	6.50	25.54	66.39	222.15	57

Source: CSA, EGTE and Bako Research Center.

Note: [1]The producers' price are prices received by the farmers at the first point of sale and is collected by the CSA for different zones of each regional states: Bako and Shashemene fall in zone 1 and zone 4 of Oromya Regional state respectively, Bahir Dar falls in zone 2 of Amhara Regional State and Hosaenna falls in zone 3 of Southern Nations, Nationalities and Peoples Regional State.

[2] The assembler spread is the difference between the price received by the farmers and the regional wholesale price, wholesaler spread is the price difference between regional wholesale price and the wholesale price for Addis Ababa and the retailer spread is the difference between wholesale and retail prices in Addis Ababa market.

[3]The wholesale prices for maize, white teff and white wheat for Addis Ababa market are 110.47, 239.36 and 155.75 birr/quintal respectively .

Table 5　　　Summary statistics of monthly grain price spreads between different markets in Ethiopia

Pair of markets	Before market liberalization (85:01 to 90:03)			After market liberalization (90:04 to 96:06)			Change		
	Mean	SD.	CV(%)	Mean	SD	CV(%)	Mean	SD.	CV(%)
Maize									
Addis-Bako	40.57	20.22	49.84	23.40	15.80	67.52	-17.17	-4.42	17.68
Addis-Dire Dawa	35.05	32.46	92.61	41.08	22.33	54.36	6.03	-10.13	-38.25
Addis-Jimma	18.62	26.87	144.31	17.90	14.64	81.79	-0.72	-12.23	-62.52
Addis-mekele	100.60	51.18	50.88	40.34	23.61	58.53	-60.26	-27.57	7.65
Addis-Shashamane	31.92	14.36	44.99	15.76	11.48	72.84	-16.16	-2.88	27.86
Dire Dawa-Bako	76.19	44.17	57.97	64.49	23.51	36.46	-11.70	-20.66	-21.52
Dire Dawa-Jimma	54.82	34.75	63.39	58.98	28.39	48.14	4.16	-6.36	-15.25
Dire Dawa-Shashamane	58.37	19.29	33.05	56.84	23.25	40.90	-1.53	3.96	7.86
White Teff									
Addis-Bako	116.46	41.16	35.34	65.40	19.98	30.55	-51.06	-21.18	-4.79
Addis-Bahir Dar	93.93	22.23	23.67	28.33	18.07	63.78	-65.60	-4.16	40.12
Addis-Dire Dawa	59.01	32.13	54.45	47.72	18.57	38.91	-11.29	-13.56	-15.53
Addis-Hosanna	96.26	36.67	38.10	48.97	17.36	35.45	-47.29	-19.31	-2.64
Addis-Mekele	116.56	58.67	50.34	36.71	22.33	60.83	-79.85	-36.34	10.49
Dire Dawa-Bako	175.12	58.34	33.31	111.52	27.65	24.79	-63.60	-30.69	-8.52
Dire Dawa-Bahir Dar	144.64	33.94	23.47	74.23	21.15	28.49	-70.41	-12.79	5.03
Dire Dawa-Hosanna	146.60	36.19	24.69	95.68	25.52	26.67	-50.92	-10.67	1.99
Mekele-Bako	227.03	74.47	32.80	98.17	32.70	33.31	-128.86	-41.77	0.51
Mekele-Bahir Dar	224.23	45.29	20.20	63.38	32.23	50.85	-160.85	-13.06	30.65
Mekele-Hosanna	239.00	44.04	18.43	83.03	28.08	33.82	-155.97	-15.96	15.39
White Wheat									
Addis-Hosanna	51.96	47.54	91.49	29.13	12.63	43.36	-22.83	-34.91	-48.14
Addis-Dire Dawa	71.62	35.79	49.97	56.49	26.01	46.04	-15.13	-9.78	-3.93
Addis-Mekele	87.17	75.13	86.19	33.12	32.56	98.31	-54.05	-42.57	12.12
Dire Dawa-Hosanna	114.90	36.65	31.90	87.75	24.31	27.70	-27.15	-12.34	-4.19
Mekele-Hosanna	150.10	164.93	109.88	62.67	27.54	43.94	-87.43	-137.39	-65.94

Table 6   Correlation Coefficients of price levels (first differences) between different markets in Ethiopia

Pair of markets	Levels			First differences		
	Before Liberalization	After liberalization	Change	Before liberalization	After liberalization	Change
Maize						
Addis-Bako	0.85	0.91	0.06	0.34	0.60	0.26
Addis-Dire Dawa	0.42	0.64	0.22	0.44	0.02	-0.42
Addis-Jimma	0.81	0.92	0.11	0.09	0.63	0.54
Addis-mekele	0.28	0.44	0.16	0.43	-0.10	-0.53
Addis-Shashamane	0.03	0.88	0.85	-0.11	0.65	0.76
Dire Dawa-Bako	0.28	0.78	0.50	0.01	0.16	0.15
Dire Dawa-Jimma	0.38	0.61	0.23	-0.21	0.12	0.33
Dire Dawa-Shashamane	0.40	0.64	0.24	0.16	0.28	0.12
White Teff						
Addis-Bako	0.59	0.73	0.14	0.45	0.23	-0.22
Addis-Bahir Dar	0.27	0.75	0.48	-0.08	0.41	0.49
Addis-Dire Dawa	0.44	0.70	0.26	0.51	0.37	-0.14
Addis-Hosanna	0.07	0.79	0.72	0.24	0.42	0.18
Addis-Mekele	0.37	0.23	-0.14	0.07	0.41	0.34
Dire Dawa-Bako	0.08	0.51	0.43	0.18	0.25	0.07
Dire Dawa-Bahir Dar	0.05	0.72	0.67	-0.23	0.35	0.58
Dire Dawa-Hosanna	0.51	0.51	0	0.14	0.19	0.05
Mekele-Bako	0.40	-0.07	-0.47	0.29	0.18	-0.11
Mekele-Bahir Dar	0.40	-0.08	-0.48	0.30	0.48	0.18
Mekele-Hosanna	0.42	0.14	-0.28	0.36	0.18	-0.18
White Wheat						
Addis-Hosanna	-0.73	0.73	1.46	-0.27	0.55	0.82
Addis-Dire Dawa	0.74	0.16	-0.58	0.22	0.12	-0.10
Addis-Mekele	-0.73	0.09	0.82	-0.04	0.04	0.08
Dire Dawa-Hosanna	-0.65	0.25	0.90	-0.26	0.04	0.30
Mekele-Hosanna	0.61	0.38	-0.23	-0.11	0.29	0.40

Table 7   Cereal check point charges and other transfer costs per quintal on selected routes, August 1996

Items	Routes				
	Jimma Addis	Nekempt Addis	Shashemene Addis	Addis Mekele	Addis Harar
Distance (km)	346	327	251	783	526
Major grain in the route	Maize	Maize	Teff	Tef	Tef
Number of check points	12	8	10	10	18
Average time spent at each check point (minutes)	14.49	6.80	6.74	8.91	10.47
Total time spent at check points (minutes)	166.87	62.75	61.62	89.65	185.42
Total check point charges (birr/qt)	5.36	4.44	3.77	7.39	15.04
-Official	5.36	4.23	1.10	7.11	11.55
-Unofficial	0.00	0.21	2.67	0.28	3.49
Transport cost -bir/qt	9.20	14.20	6.80	30.00	20.80
-birr/qt/km	0.0266	0.0434	0.0271	0.0383	0.0395
Other costs (birr/qt)[1]	5.07	5.07	5.07	5.07	5.07
Total cost (birr/qt)	19.63	23.71	15.64	42.46	40.91
Average price spread[2]	21.00	16.50	11.50	37.28	48.63

Source: GMRP survey data.

Note   [1]The other costs include the charges for loading, unloading, broker fee and weighing grain which are very standard across the routes studied. [2] The average is taken from January to August, 1996 for the grain indicated to be the major during the check point survey.

Table 8   SURE estimates of the effects of seasonality, grain market liberalization, rainfall and food aid on maize price levels based on the assumption of weak market integration (1984:10 to 1993:12)

Independent variables	Markets					
	Addis Ababa	Bako	Shashemene	Dire Dawa	Jimma	Mekele
Constant	29.67^a	8.57^b	35.52^a	43.66^a	17.23^a	90.99^a
Mar	4.65	-0.86	3.81	8.28	10.03	-10.80
April	-0.97	-0.17	3.25	3.62	0.15	-35.61
May	8.31	6.09	12.63^b	7.36	1.36	-6.33
Jun	4.91	10.46^b	18.50^a	7.30	4.68	17.05
July	13.60^b	6.60	14.17^b	18.15^b	1.18	72.27^a
Aug	9.90	3.81	4.30	7.34	-1.53	53.97^b
Sept	17.30^c	5.35	5.29	6.96	1.88	57.71^b
Oct	10.63	-4.09	-5.37	0.20	-9.80	62.80^b
Nov	5.14	-7.19	3.13	2.07	-9.82	27.82
Dec	1.16	-2.79	3.64	-5.89	-6.63	-7.62
Jan	1.21	-1.81	1.05	1.87	0.97	-29.08
Dlib12	4.39	3.87^c	10.93^a	5.77	2.94	-27.52^b
RF	-0.06^b	-0.03	-0.10^a	-0.11^c	-0.00399	-0.62^b
FAID	0.00015	0.0009	0.000568	0.00028	-0.013	0.00018
P_{t-1}	0.69^a	0.87^a	0.51^a	0.63^a	0.79^a	0.62^a
Diagnostics						
R2	0.71	0.89	0.77	0.70	0.77	0.56
JB	5.33^c	0.14	2.73	21.50^a	45.75^a	0.62
Q-S	9.61	17.08^b	12.75	12.88	10.73	2.57

Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Table 9	SURE estimates of the effects of seasonality, grain market liberalization, rainfall and food aid on white teff price levels based on the assumption of weak market integration (1984:10 to 1993:12)					

Independent variables	Markets					
	Addis Ababa	Hosaenna	Dire Dawa	Bako	Bahir Dar	Mekele
Constant	46.88[a]	89.66[a]	99.26[a]	18.03[b]	51.85[a]	127.00[a]
April	0.05	10.92	2.51	0.05	11.29[c]	21.55[c]
May	17.55[a]	11.14	6.44	8.22[c]	5.32	39.45[a]
June	22.59[a]	23.32[a]	13.50	15.33[a]	13.41[c]	59.10[a]
July	23.85[a]	20.93[b]	16.64	10.10[c]	15.48[b]	59.65[a]
Aug	28.20[a]	24.44[b]	26.83[b]	7.20	20.07[c]	43.25[a]
Sept	31.83[a]	19.03[c]	8.53	7.70	24.20	61.09[a]
Oct	36.88[a]	17.88[c]	3.34	16.02[b]	18.01	48.56[a]
Nov	17.64[b]	11.23	10.23	8.70	20.14[c]	36.13[a]
Dec	5.51	-5.46	-4.48	-3.12	24.37[a]	17.94
Jan	1.67	-3.39	19.60[c]	-9.92[b]	1.53	-6.83
Feb	2.17	-3.06	5.91	-5.08	10.74	13.86
Dlib12	-0.47	24.96[a]	-5.05	2.89	16.69[a]	-48.83[a]
RF	-0.10[a]	-0.06	-0.03	-0.06[a]	-0.05	-0.33[a]
FAID	-0.000518[b]	0.009156	-0.000166	0.0022	-0.0000606	-0.000148[b]
P_{t-1}	0.80[a]	0.37[a]	0.65[a]	0.89[a]	0.62[a]	0.69[a]
Diagnostics						
R2	0.83	0.66	0.54	0.87	0.73	0.95
JB	1.06	5.54[c]	9.34[a]	1.08	2.55	0.35
Q-S	5.19	11.30	5.38	4.47	5.65	11.94[c]

Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Table 10   SURE estimates of the effects of seasonality, grain market liberalization, rainfall and food aid on white wheat price levels based on the assumption of weak market integration (1984:10 to 1993:12)

Independent variables	Market			
	Addis Ababa	Hosaenna	Dire Dawa	Mekele
Constant	54.52^a	34.84^c	140.27^a	119.27^a
Dec	-9.95	-10.35	-7.40	0.43
Jan	-6.15	-2.65	9.35	-29.56^a
Feb	-7.64	-0.25	-8.56	-9.71
Mar	-15.49	1.62	-6.67	-2.97
Apr	-11.25	9.39	1.85	-6.55
May	-3.20	11.97	3.34	8.63
Jun	-2.26	15.8^b	-10.98	20.23^c
Jul	8.53	6.85	-8.70	20.94^c
Aug	8.68	4.80	-3.20	10.30
Sep	12.78	8.85	1.63	29.37^a
Oct	8.86	11.38^c	-1.71	5.06
Dlib12	2.16	11.68^b	-9.24	-41.99^a
RF	-0.05	-0.04	-0.00259	-0.19^a
FAID	0.000258	-0.000817	0.000431^c	-0.000274^a
P_{t-1}	0.70^a	0.67^a	0.28^a	0.67^a
Diagnostics				
R2	0.69	0.68	0.07	0.92
JB	58.57^a	4.09	2.76	0.55
Q-S	12.03	10.41	97.91^a	5.26

Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Table 11   SURE estimates of the effects of seasonality, grain market liberalization, rainfall and food aid on maize price spreads based on the assumption of weak market integration (1984:10 to 1993:12)

Independent variables	Margins					
	Addis[1] Shashemene[2]	Addis[1] Jimma[2]	Mekele[1] Addis[2]	Dire Dawa[1] Addis[2]	Addis[1] Bako[2]	Dire Dawa[1] Shashemene[2]
Constant	-5.85	12.44	61.32[b]	13.99	21.10[a]	8.14
March	0.84	-5.38	-15.45	3.63	5.51	4.47
Apr	-4.22	-1.12	-34.64	4.59	-0.80	0.37
May	-4.32	6.95	-14.64	-0.95	2.22	-5.27
Jun	-13.59[b]	0.23	12.14	2.39	-5.55	-11.20
July	-0.57	12.42	58.67[b]	4.55	7.00	3.98
Aug	5.60	11.43	44.07[c]	-2.56	6.09	3.04
Sept	12.01	15.42	40.41	-10.34	11.95	1.67
Oct	16.00[c]	20.43	52.17[c]	-10.43	14.72	5.57
Nov	2.01	14.96	22.68	-3.07	12.33[c]	-1.06
Dec	-2.48	7.79	-8.78	-7.05	3.95	-9.53
Jan	0.16	0.24	-30.29	0.66	3.02	0.82
Dlib12	-6.54[b]	1.45	-31.91[a]	1.38	0.52	-5.16
RF^1	0.06[b]	-0.06[b]	-0.62[b]	-0.11[c]	-0.06[b]	-0.11[c]
RF^2	0.10[a]	0.00399	0.06[b]	0.06[b]	0.03	0.10[a]
$FAID^1$	0.00015	0.00015	0.00018	0.00028	0.00015	0.00028
$FAID^2$	-0.000568	0.013	-0.00015	-0.00015	-0.0009	-0.000568
P^1_{t-1}	0.69[a]	0.69[a]	0.62[a]	0.63[a]	0.69[a]	0.63[a]
P^2_{t-1}	-0.51[a]	-0.79[a]	-0.69[a]	-0.69[a]	-0.87[a]	-0.51[a]

Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Table 12   SURE estimates of the effects of seasonality, grain market liberalization, rainfall and food aid on white teff price spreads based on the assumption of weak market integration (1984:10 to 1993:12)

Independent variables	Market							
	Addis[1] Bako[2]	Addis[1] Bahir Dar[2]	Dire Dawa[1] Addis[2]	Dire Dawa[1] Bako[2]	Dire Dawa[1] Bahir Dar[2]	Dire Dawa[1] Hosaenna[2]	Addis[1] Hosaenna[2]	Mekele[1] Addis[2]
Constant	-16.03	-4.97	52.38[c]	81.23[a]	47.41	9.60	-42.78[b]	80.12[b]
April	1.95	-11.24	2.46	2.46	-8.78	-8.41	-10.87	21.50[c]
May	-6.22	12.23	-11.11	-1.78	1.12	-4.70	6.41	21.90[c]
Jun	-13.33[b]	9.18	-9.09	-1.83	0.09	-9.82	-0.73	36.51[a]
July	-8.10	8.37	-7.21	6.54	1.16	-4.29	2.92	35.80[a]
Aug	-5.20	8.13	-1.37	19.63	6.76	2.39	3.76	15.05
Sept	-5.70	7.63	-23.30[c]	0.83	-15.67	-10.50	12.80	29.26[c]
Oct	-14.02	18.87	-33.54[a]	-12.68	-14.67	-14.54	19.00	11.68
Nov	-6.70	-2.50	-7.41	1.53	-9.91	-1.00	6.41	18.49
Dec	5.12	-18.86[b]	-9.99	-1.36	-28.85[b]	0.98	10.97	12.43
Jan	11.92[c]	0.14	17.93[c]	29.52[b]	18.07	22.99[c]	5.06	-8.50
Feb	7.08	-8.57	3.74	10.99	-4.83	8.97	5.23	11.69
Dlib12	-0.89	-17.16[a]	-4.58	-7.94	-21.74[b]	-30.01[a]	-25.43[a]	-48.36[a]
RF[1]	-0.10[a]	-0.10[a]	-0.03	-0.03	-0.03	-0.03	-0.10[a]	-0.33[a]
RF[2]	0.06a	0.05	0.10[a]	0.06[a]	0.05	0.06	0.06	0.10[a]
FAID[1]	-0.000518[b]	-0.000518[b]	-0.000166	-0.000166	-0.000166	-0.000166	-0.000518[b]	-0.000148[b]
FAID[2]	-0.002	0.000606	0.000518[b]	-0.002	0.000606	-0.009156	0.009156	0.000518[b]
P[1]$_{t-1}$	0.80[a]	0.80[a]	0.65[a]	0.65[a]	0.65[a]	0.65[a]	0.80[a]	0.69[a]
P[2]$_{t-1}$	-0.89[a]	-0.62[a]	-0.80[a]	-0.89[a]	-0.62[a]	-0.37[a]	-0.37[a]	-0.80[a]

Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Table 13   SURE estimates of the effects of seasonality, grain market liberalization, rainfall and food aid on white wheat price spreads based on the assumption of weak market integration (1984:10 to 1993:12)

Independent variables	Market				
	Addis[1] Hosaenna[2]	Dire Dawa[1] Addis[2]	Mekele[1] Addis[2]	Dire Dawa[1] Hosaenna[2]	Mekele[1] Hosaenna[2]
Constant	19.68[a]	85.75[a]	64.75[a]	105.43[a]	84.43[a]
Dec	0.40	2.55	10.38	2.95	10.78
Jan	-3.50	15.70	-23.41	12.20	-26.91[c]
Feb	-7.39	-0.92	-2.07	-8.31	-9.46
Mar	-17.11	8.82	12.52	-8.29	-4.59
Apr	-20.64	13.10	4.70	-7.54	-15.94
May	-15.17	6.54	11.83	-8.63	-3.34
Jun	-18.06[c]	-8.72	22.49	-26.78b	4.43
Jul	1.68	-17.23	12.41	-15.55	14.09
Aug	3.89	-11.89	1.61	-8.00	5.50
Sep	3.93	-11.13	16.59	-7.20	20.52[c]
Oct	-2.52	-10.57	-3.80	-13.09	-6.32
Dlib12	-9.52	-11.40	-44.15[a]	-20.92b	-53.67[a]
RF^1	-0.05	-0.00259	-0.19[a]	-0.00259	-0.19[a]
RF^2	0.04	0.05	0.05	0.04	0.04
$FAID^1$	0.000258	0.000431[c]	-0.000274[a]	0.000431[c]	-0.000274[a]
$FAID^2$	0.000817	-0.000258	-0.000258	0.000817	0.000817
P^1_{t-1}	0.70[a]	0.28[a]	0.67[a]	0.28[a]	0.67[a]
P^2_{t-1}	-0.67[a]	-0.70[a]	-0.70[a]	-0.67[a]	-0.67[a]

Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Appendix 1   Within-year monthly variability of maize price for different markets (1995=100)

Market	Statistics	Year											
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Bako	Mean	-	71.63	43.94	47.81	81.41	59.74	82.43	106.31	62.14	118.35	96.01	49.28
	SD	-	19.76	5.30	15.01	24.00	10.10	13.38	25.26	4.89	40.07	20.73	7.30
	CV (%)	-	27.59	12.06	31.40	29.48	16.91	16.23	23.76	7.87	33.86	21.59	14.81
Addis Ababa	Mean	217.24	122.16	86.39	100.62	103.26	93.91	119.63	133.23	90.91	126.24	114.23	79.48
	SD	47.07	16.57	5.99	15.74	7.19	11.87	15.86	23.23	4.27	23.66	17.34	3.94
	CV(%)	21.67	13.56	6.93	15.64	6.96	12.64	13.26	17.44	4.70	18.74	15.18	4.96
Dire Dawa	Mean	226.12	200.31	106.80	121.99	123.25	130.47	171.60	170.70	114.59	168.60	152.85	143.60
	SD	45.38	61.99	14.77	19.22	7.79	14.30	19.44	20.78	5.89	42.87	3.96	10.02
	CV(%)	20.07	30.95	13.83	15.76	6.32	10.96	11.33	12.17	5.14	25.43	2.59	6.98
Jimma	Mean	124.09	121.21	54.89	68.49	112.13	63.25	84.66	108.33	72.10	115.32	111.35	58.61
	SD	4.05	40.87	13.00	20.17	35.65	12.68	8.02	27.28	6.11	25.34	29.74	9.62
	CV(%)	3.26	33.72	23.68	29.45	31.79	20.05	9.47	25.18	8.47	21.97	26.71	16.41
Shashamene	Mean	-	66.35	53.27	70.42	70.28	67.85	97.26	106.10	78.02	116.76	98.49	73.33
	SD	-	19.09	5.88	17.77	9.48	6.22	21.63	19.37	5.74	21.18	19.41	2.80
	CV(%)	-	28.77	11.04	25.23	13.49	9.17	22.22	18.26	7.36	18.14	19.71	3.82
Mekele	Mean	303.21	220.84	181.83	200.98	211.43	-	-	154.11	136.86	161.23	155.92	132.64
	SD	18.02	57.27	22.05	68.20	6.80	-	-	18.91	15.33	13.74	13.42	5.40
	CV(%)	5.94	25.93	12.13	33.93	3.22	-	-	12.27	11.20	8.52	8.61	4.07

Appendix 2   Within-year monthly variability of white teff price for different markets (1995=100)

Market	Statistics	Year											
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Bako	Mean	-	145.21	116.29	139.26	148.40	159.47	166.45	195.11	151.91	181.14	187.10	138.90
	SD	-	21.10	9.20	20.92	17.01	18.04	11.87	13.00	10.96	30.42	19.95	10.10
	CV (%)	-	14.53	7.91	15.02	1.15	11.31	7.13	6.66	7.21	16.79	10.66	7.27
Addis Ababa	Mean	403.21	295.65	253.15	280.42	239.74	234.46	248.26	248.55	214.99	245.13	240.57	221.03
	SD	42.17	45.09	22.81	15.84	9.02	18.93	21.56	5.75	11.45	26.24	5.19	7.98
	CV(%)	10.46	15.25	9.01	5.65	3.76	8.07	8.68	2.31	5.33	10.70	2.16	3.61
Dire Dawa	Mean	472.84	397.62	304.08	321.25	275.27	297.55	298.13	292.70	248.86	288.37	295.61	290.44
	SD	25.40	62.58	42.31	18.44	18.02	18.31	24.97	22.53	8.76	27.20	11.08	8.13
	CV(%)	5.37	15.74	13.91	5.74	6.55	6.15	8.38	7.70	3.52	9.43	3.75	2.80
Hosaenna	Mean	-	-	168.07	145.94	149.98	162.08	189.86	198.99	174.11	204.30	194.90	150.77
	SD	-	-	19.00	15.98	20.10	30.99	19.23	8.50	9.74	33.87	13.41	12.59
	CV(%)	-	-	11.30	10.99	13.40	19.12	10.13	4.27	5.59	16.58	6.88	8.35
Bahir Dar	Mean	-	157.13	165.22	166.51	149.89	149.07	-	209.40	184.66	220.93	228.71	177.26
	SD	-	13.23	11.27	10.37	15.49	19.94	-	8.29	11.31	32.15	14.93	6.08
	CV(%)	-	8.42	6.82	6.22	10.33	13.38	-	3.96	6.12	14.55	6.53	3.43
Mekele	Mean	477.72	483.88	381.29	405.05	325.77	-	-	273.52	276.84	278.16	258.86	265.35
	SD	35.31	102.07	22.16	52.63	24.46	-	-	21.07	11.10	15.54	10.45	4.79
	CV(%)	7.39	21.09	5.81	12.99	7.51	-	-	7.70	4.01	5.59	4.04	1.81

Appendix 3   Within- year monthly variability of white wheat price for different markets (1995=100)

Market	Statistics	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
												Year	
Addis Ababa	Mean	279.38	189.61	137.25	163.42	175.34	162.05	186.64	179.64	156.13	176.51	155.03	148.38
	SD	48.98	37.03	6.01	44.88	25.19	24.33	24.94	17.04	8.83	16.88	5.34	1.40
	CV (%)	17.53	19.53	4.38	27.46	14.37	15.00	13.36	9.49	5.66	9.56	3.44	0.90
Dire Dawa	Mean	306.88	300.38	208.79	232.09	231.10	216.82	234.36	225.26	190.68	238.47	229.98	240.52
	SD	41.40	72.32	17.39	27.61	26.46	15.63	16.53	19.36	4.91	19.48	10.01	9.66
	CV(%)	13.50	24.08	8.33	11.90	11.45	7.21	7.05	8.59	2.57	8.17	4.35	4.02
Hosaenna	Mean	-	-	120.88	113.75	114.05	67.60	-	139.26	129.69	150.31	132.49	117.14
	SD	-	-	2.55	18.52	16.72	0.59	-	12.78	9.19	22.18	7.61	4.59
	CV(%)	-	-	2.11	16.28	14.66	0.88	-	9.18	7.09	14.76	5.74	3.92
Melele	Mean	278.93	285.61	277.20	270.54	180.69	-	-	176.80	181.10	218.98	192.04	224.10
	SD	38.66	29.61	32.17	52.14	8.35	-	-	13.34	8.92	40.38	18.28	7.33
	CV(%)	13.86	10.37	11.61	19.27	4.62	-	-	7.55	4.93	18.44	9.52	3.27

Appendix 4   Results of unit root tests for different prices series[1]

Grain	Market	Level		First Differences	
		ADF	PP	ADF	PP
Maize	Bako	-2.21	-2.16	-7.06^a	-9.23^a
	Addis Ababa	-2.82^c	-2.84^c	-8.57^a	-10.89^a
	Dire Dawa	-2.34	-3.28^b	-9.10^a	-16.08^a
	Jimma	-2.55	-2.81^c	-7.62^a	10.50^a
	Shashemene	-2.44	-2.41	-11.16^a	11.71^a
	Mekele	-4.28^a	-3.35^b	-7.90^a	-6.92^a
White Teff	Bako	-2.84^c	-2.53	-8.31^a	-10.37^a
	Addis Ababa	-2.60^b	-2.67^c	-7.23^a	-10.02^a
	Dire Dawa	-3.19^b	-3.67^a	-9.90^a	-15.05^a
	Hosaenna	-2.37	-2.71^c	-7.79^a	-13.43^a
	Bahir Dar	-1.64	-1.78	-7.25^a	-11.64^a
	Mekele	-1.68	-1.30	-5.65^a	-5.85^a
White Wheat	Addis Ababa	-3.41^b	-3.30^b	11.64^a	-10.11^a
	Dire Dawa	-3.24^b	-4.27^a	-10.79^a	-15.61^a
	Hosaenna	-2.33	-2.00	-7.36^a	-8.96^a
	Mekele	-1.62	-1.70	-6.19^a	-7.19^a

[1]The unit root tests are conducted for the period 1986:07 to 1996:06 for maize and from 1987:07 to 1996:06 for   white teff and white wheat.
Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Appendix 5   Results of unit root tests[1] for maize prices spreads among different markets

Spreads	Level		First Difference	
	ADF	PP	ADF	PP
Addis - Shashemene	-3.83[a]	-4.54[a]	-9.97[a]	-13.36[a]
Addis - Jimma	-3.17[b]	-4.70[a]	-9.48[a]	-15.54[a]
Mekele - Addis	-4.56[a]	-3.28[b]	-7.97[a]	-6.32[a]
Addis - Bako	-3.80[a]	-3.76[a]	-9.66[a]	-11.93[a]
Dire Dawa - Shashemene	-4.32[a]	-6.45[a]	-11.02[a]	-18.97[a]
Dire Dawa - Addis	-3.70[a]	-5.80[a]	-9.90[a]	-18.94[a]
Dire Dawa - Bako	-3.05[b]	-5.49[a]	-9.53[a]	-19.59[a]
Dire Dawa - Jimma	-3.43[b]	-4.50[a]	-9.09[a]	-15.06[a]

Not   [1]The unit root tests are conducted for three time periods: period I is from 1986:07 to 1991:03, period II is from 1991:04 to 1996:06 while the whole series is from 1986:07 to 1996:06.

Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Appendix 6   Results of unit root tests[1] for white teff prices spreads among different markets

Spread	Level		First Differences	
	ADF	PP	ADF	PP
Addis - Bako	-2.58[c]	-2.02	-9.08[a]	-11.23[a]
Addis - Bahir Dar	-1.57	-1.50	-8.02[a]	-13.19[a]
Dire Dawa - Addis	-4.61[a]	-5.92[a]	-11.14[a]	-17.69[a]
Dire Dawa - Bako	-3.37[b]	-2.61[c]	-9.59[a]	-13.48[a]
Dire Dawa - Bahir Dar	-2.33	-2.23	-9.41[a]	-15.66[a]
Dire Dawa - Hosaenna	-2.98[b]	-2.81[c]	-9.69[a]	-14.18[a]
Addis - Hosaenna	-2.45	-2.42	-8.50[a]	-13.21[a]
Mekele - Addis	-2.09	-1.81	-5.52[a]	-[b] 6.34[a]
Mekele - Bako	-1.69	-1.26	-6.06[a]	-6.34[a]
Mekele - Bahir Dar	-1.62	-1.13	-4.85[a]	-5.31[a]
Mekele - Hosaenna	-1.27	-1.03	-5.40[a]	-6.67[a]

Note   [1]The unit root tests are conducted for three time periods: period I is from 1987:07 to 1991:03, period II is from 1991:04 to 1996:06 while the whole series is from 1987:07 to 1996:06.

Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Appendix 7   Results of Unit root tests for white wheat prices spreads among different markets

Spread	Level		First Differences	
	ADF	PP	ADF	PP
Dire Dawa - Addis	-3.92[a]	-5.10[a]	-10.85[a]	-15.65[a]
Mekele - Addis	-1.48	-1.46	-5.75[a]	-7.39[a]
Dire Dawa - Hosaenna	-2.77[c]	-3.21[b]	-10.39[a]	-12.89[a]
Mekele - Hosaenna	-1.80	-1.59	-7.30[a]	-7.73[a]
Addis - Hosaenna	-2.89[c]	-2.77[c]	-6.62[a]	-8.47[a]

Note   [1]The unit root tests are conducted for three time periods: period I is from 1987:07 to 1991:03, period II is from 1991:04 to 1996:06 while the whole series is from 1987:07 to 1996:06.

Note: a, b, and c indicate statistical significance at a probability of less than 1%, 5% and 10% respectively.

Figure 1 Maize price trends in nominal terms
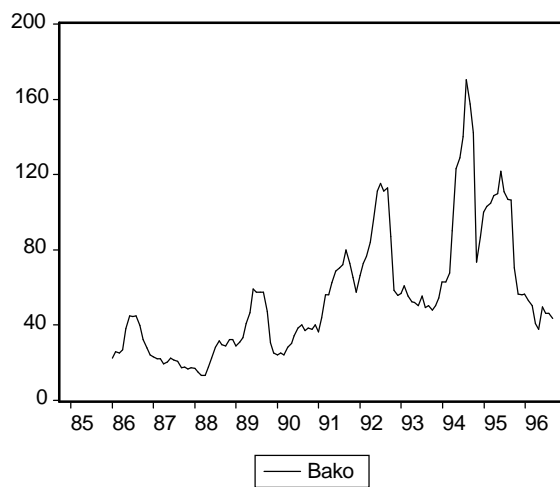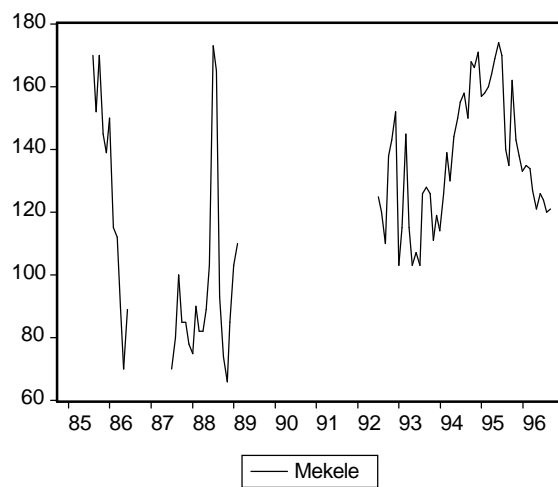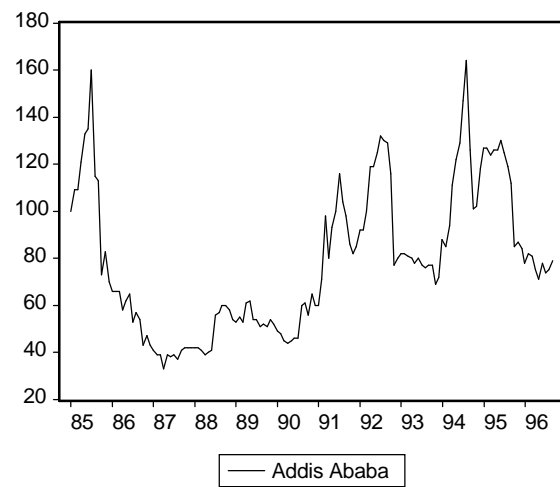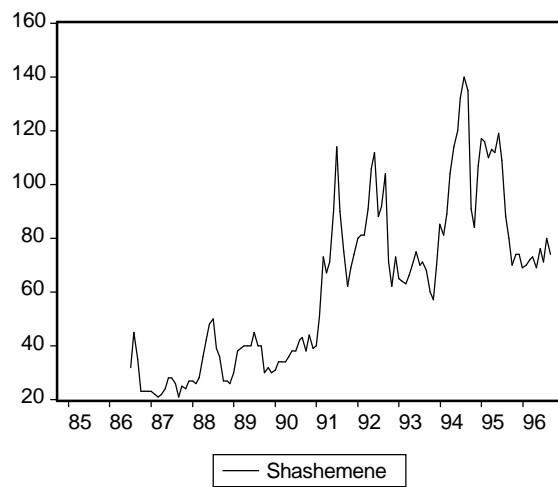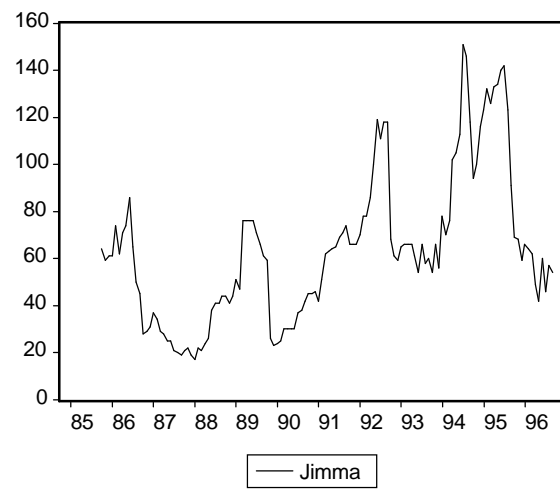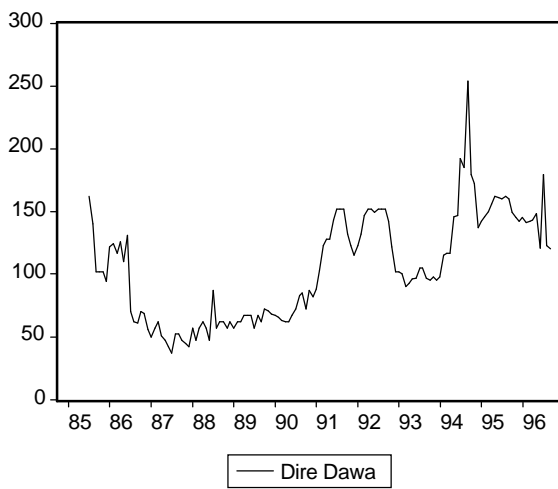
Figure 3 White wheat price trends in nominal terms
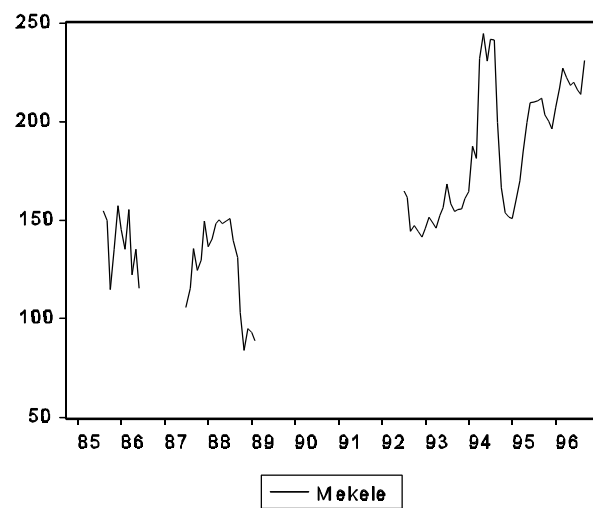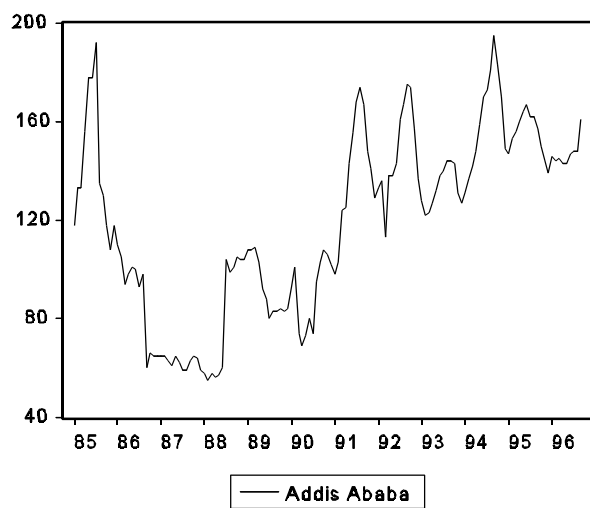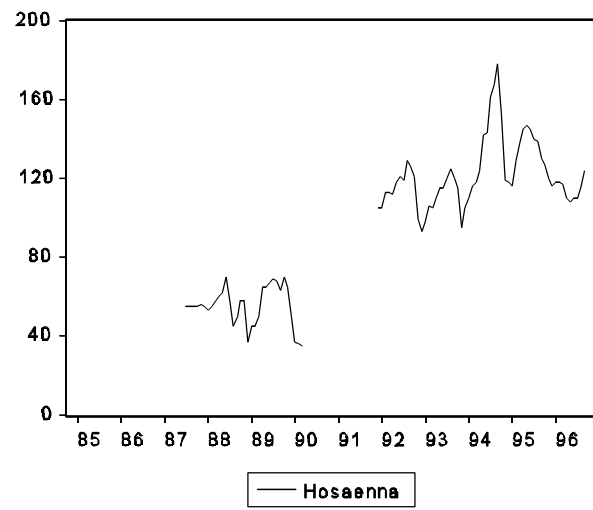
Figure 3 White wheat price trends in nominal terms
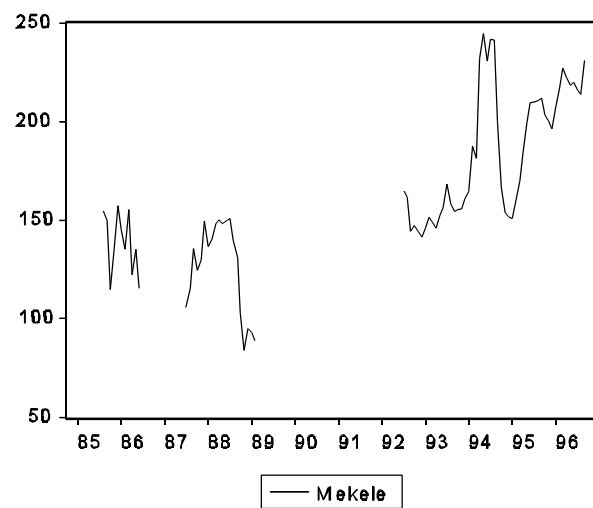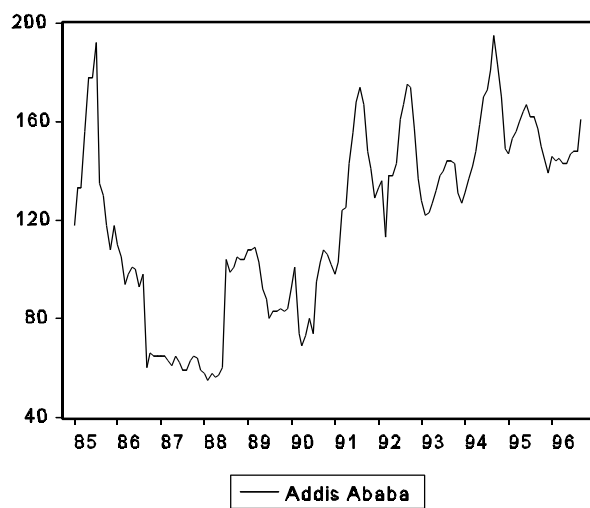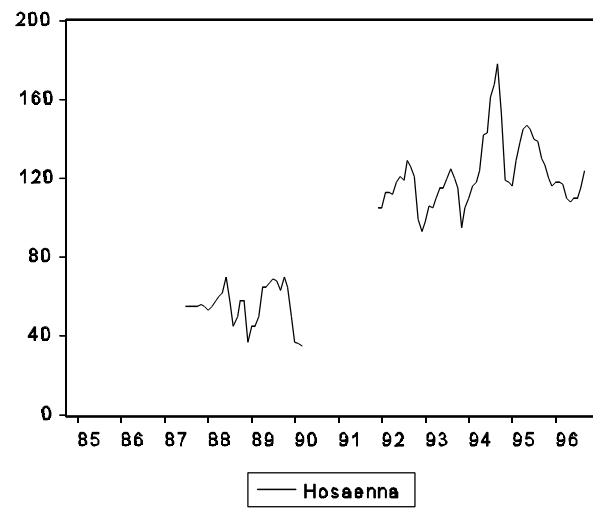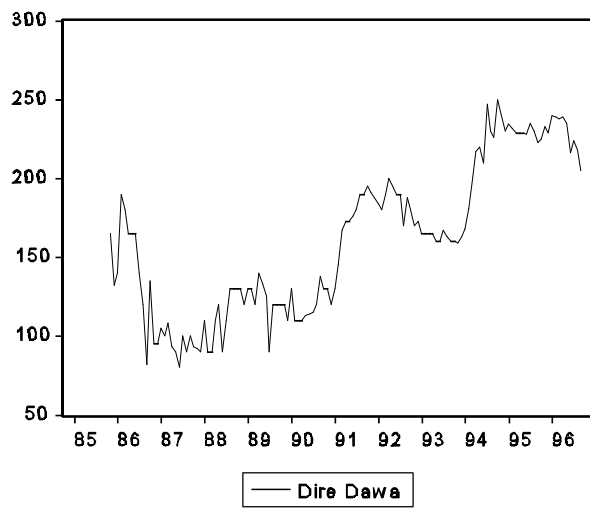
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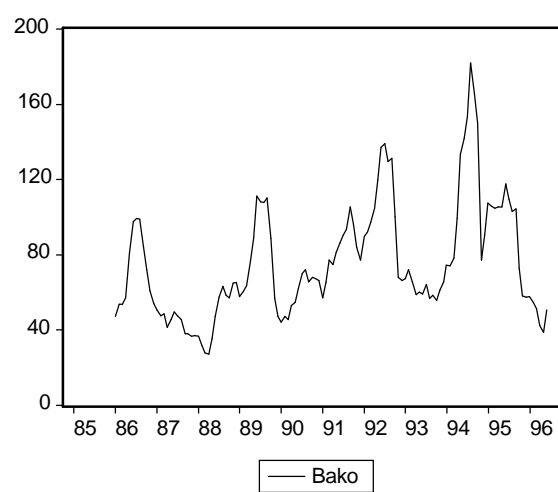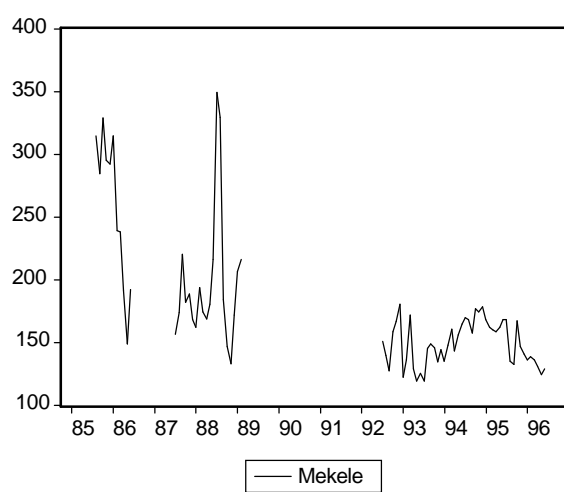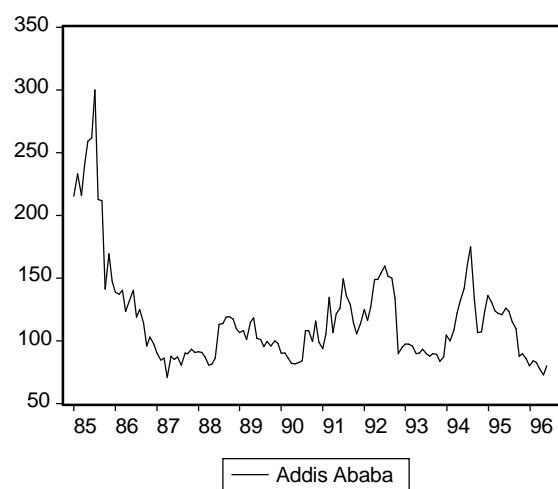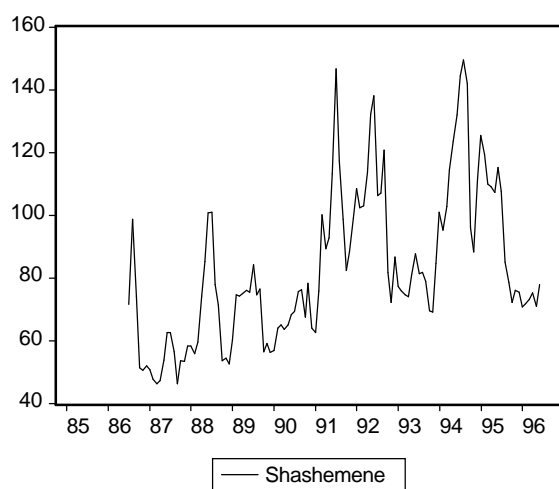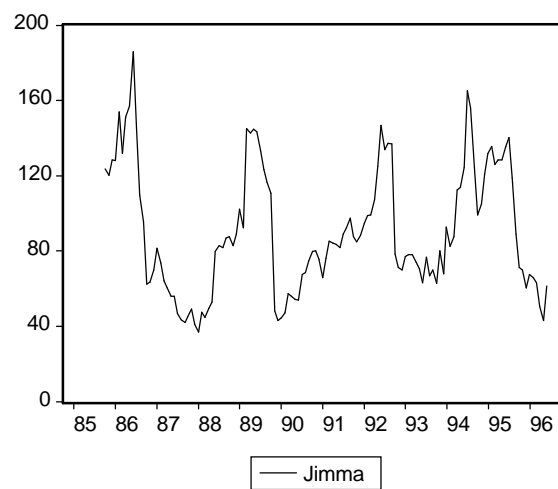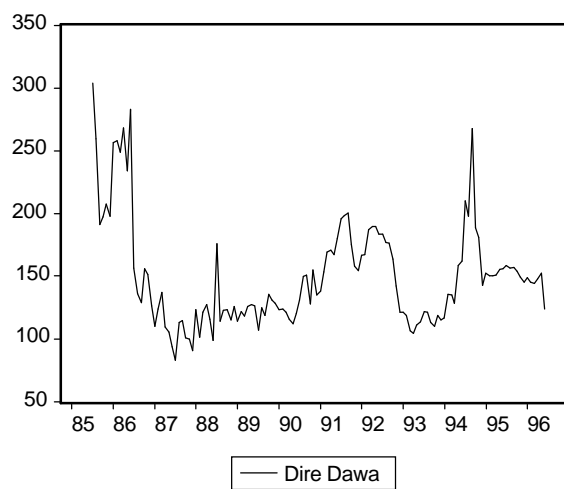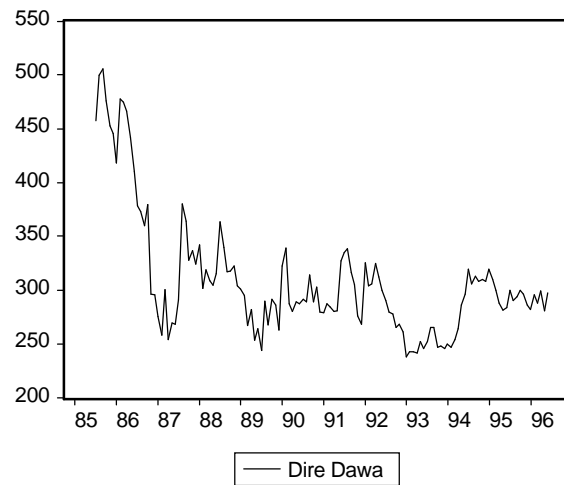
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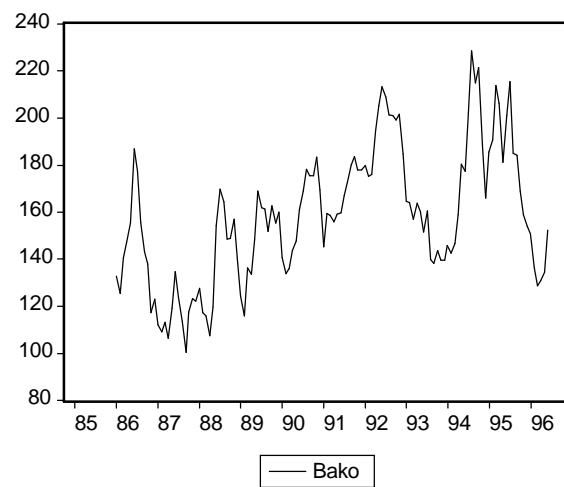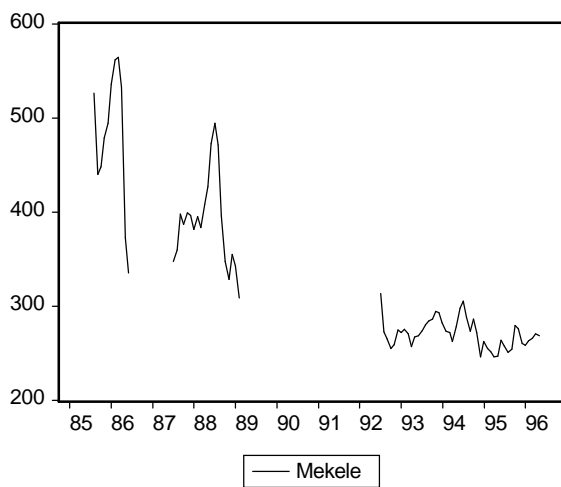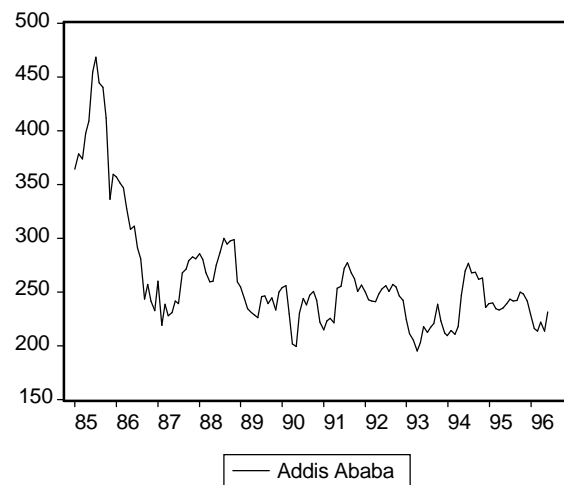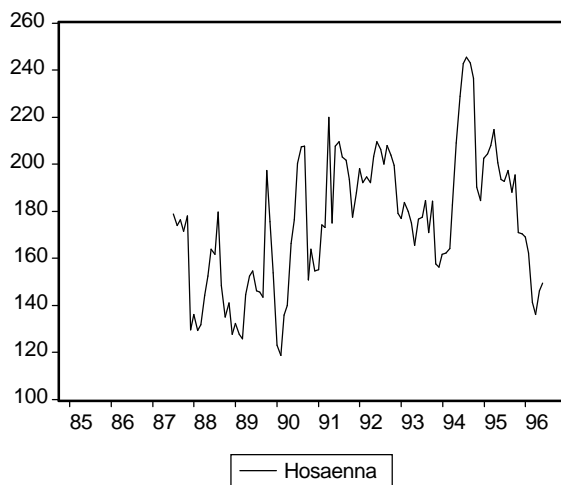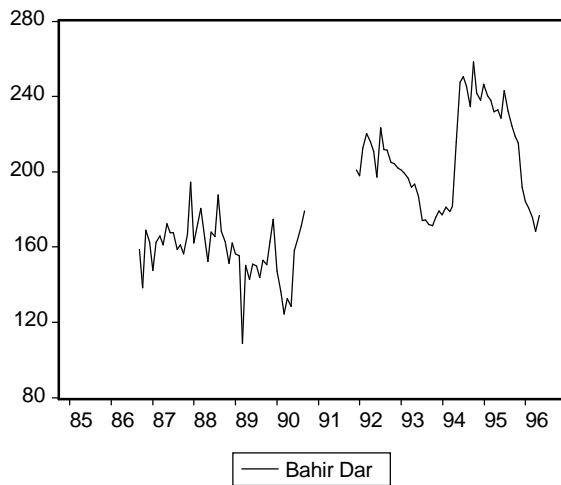
Figure 6 White wheat price trends in real terms (1995=100)