Policy Reform, Market Stability, and Food Security

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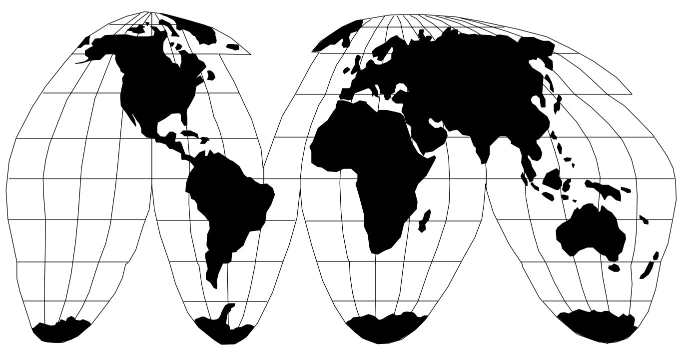

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World Cereal Price Instability and a Market Based Scheme for Managing the Risk of Developing Country Cereal Imports

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Introduction

The world cereal markets have entered a new era after the conclusion of the recent Uruguay Round (UR) of international trade negotiations under the auspices of GATT. The major thrust is toward more open national markets, and agreed restrictions on the type and magnitude of interventions allowed. The aims are on the one hand to bring domestic prices of agricultural products and cereals in particular more in line with world market prices, and also to allow more transmission of world market signals to domestic producers. The idea is that orderly adjustment in the domestic agricultural sectors of countries participating in the agreement and the WTO should be dictated by world market signals and not by artificially imposed, and many times unsustainable and distorting, domestic support policies. The OECD countries are particularly affected by the recent international agreement on agricultural trade (the GATT Agreement on Agriculture), as their agricultural sectors have seen extensive and costly interference via a variety of support mechanisms over the past thirty years.

Developing countries that are exporters of agricultural products participated extensively in the UR, anticipating the obvious potential benefits of more open markets, and increased prices. Low income food deficit countries (LIFDC) on the other hand would tend to lose from higher world food prices. However, since a large part of their imports are under some type of special arrangement (food aid, tied imports, etc.) and the anticipated average world cereal price rises after the implementation of the UR agreement are not expected to be large, they did not have a vital interest to participate actively and/or form strong bargaining coalitions.

LIFDCs are more concerned about world cereal market instability and the availability of cereal imports at reasonable prices. At times of low world cereal prices, food aid becomes more available and hence the total cost of imports becomes lower. In periods, however, of world scarcity and high prices, food aid availabilities lessen, and the cost of imports rises. If the needs of a LIFDC are higher in such periods, it is obvious that they suffer a considerable economic cost.

The issue of LIFDC food insecurity and ways to deal with international cereal price instability has been debated for years, and more so since the first world food crisis of 1973-74. Various international and national schemes have been proposed and a few even have been implemented (such as the International Monetary Fund (IMF) food import financing scheme of the Compensatory Financing Facility). Suggestions have included world price stabilization schemes, stockholding schemes by developed countries, more open trade by LIFDCs, more food aid, etc. While very few such arrangements have been implemented the discussions and attendant research have helped bring forth a wider awareness of what works and what does not. The problem, nevertheless, of vulnerability of LIFDCs to world cereal market instability remains as large today as ever before.

The purpose of this paper is three-fold. First a review will be made of the changing nature of world cereal market instability. The tendency for more opening of the national markets of several countries that has been the pattern in recent years should, ceteris paribus, lead to less world market instability. On the other hand, other factors such as declines in world cereal stock levels could lead to opposite effects. An assessment will be made of whether there has been an increase in world cereal price instability. The second objective of the paper is to review some of the options open to LIFDCs in dealing with world market instability. The third objective will be to discuss a specific instrument that could be implemented by developed countries to assist LIFDCs.

Section 2 below analyses the changing pattern of world cereal instability. Section 3 discusses the changing pattern of world cereal production and trade and the consequences for world instability. Section 4 discusses the options LIFDCs face in their effort to manage international and domestic food risks. Section 5 outlines a proposal for a market based instrument that can assist LIFDCs to cope with world market instability. The final section summarizes the conclusions.

The Changing Nature of World Cereal Market Instability

In this section we provide an analysis of the changing nature of uncertainty and instability in world cereal markets. The discussion is based on a paper prepared by the author for the FAO Commodities Division (Sarris, 1997a). Price and more generally market instability in cereal markets have been the concern of both private producers and consumers as well as governments for a long time. The reason is that market volatility, especially unforeseen price variations in response to exogenous or endogenous shocks can lead to sudden and large income transfers among various market participants. It is natural that such large income transfers are of concern to all those involved, including governments concerned with the welfare of their citizens. For instance the large cereal market price increases of the early 1970s led to large increases in the cereal import bills of developing countries and attendant concerns that food security for many vulnerable groups might be impaired from the increase in food prices. Similarly low prices in some years, in response for instance to bountiful harvests or decreased imports by traditional importers, might lead to bankruptcy for many farmers in exporting countries or large government subsidies.

It is natural that the concern with market and price instability becomes more acute whenever there is a general large price increase or decline. A large increase occurred in recent years, prompting a renewed interest in market instability. A relatively new focus of the more recent concerns is whether the nature of world market instability in cereals has changed over the last decade. There are several reasons which could suggest that possible changes are occurring in market instability. For instance, world trade has become more liberalized, and the role of governments in cereal market interventions has lessened. Several major producing countries (China, the Former Soviet Union, Eastern Europe) are undergoing significant economic restructuring. Technological changes in production might have induced more unstable cereal yields. The communications revolution has led to increased integration of regional markets.

It is useful before embarking on empirical analysis to settle some conceptual issues concerning instability. The first relates to the appropriate index with which to measure instability in a commodity and particularly a cereal market. A market has many participants, and many variables that drive it, on both the supply as well as the demand side. Nevertheless, it is well recognized that cereal markets are well developed, and integrated, in the sense that there are “focal” markets that provide lead signals for the world-wide state of the market. For instance for wheat the Chicago market is probably the most important one in the world, and lead prices such as the Chicago Board of Trade price of wheat cash and futures contracts are generally acknowledged as the major world-wide signals for the state of the wheat market. This does not mean that there are no other appropriate indicator prices. In the case of wheat, for instance, the US Gulf export price, is a lead price for the world wheat export market. Similarly in every country there are indicator prices for most commodities. These prices are in general related to the focal prices in the sense that they tend to have similar movements in response to important events (Mundlak and Larson, 1992). Of course, localized events can lead to temporary deviations of prices from the indicator prices.

The above discussion, brings into focus the fact that generally it is the price (spot and/or forward) that is regarded as the key signal for the state of a commodity market. This is appropriate, as prices are summary measures of the terms in which commodity market participants are willing to transact. While price might not be the appropriate summary measure of the state of a market in cases where other attributes of transactions might be important (such as for instance generally ill-observed conditions, like terms of financing), these are less important in commodity markets, where the product is relatively uniform or well distinguishable in terms of quality, and readily traded in various quantities in cash markets. In addition, world commodity markets have many participants, are quite liquid, and are characterized by much publicly and widely available information. Under such conditions, market participants can react fast to changing circumstances, and this is reflected immediately in changing prices. Hence price is generally a good summary indicator of the state of the market.

If prices are accepted as the summary measures of the supply/demand situation of a commodity market, then the question arises concerning the appropriate description of market instability. An easily computed measure is the period to period (daily, monthly or yearly) variation in price. This might be appropriate if all the change in the price from period to period is unanticipated and hence unknown. This is not, however, true, as for several periods price changes are expected in response to known market outcomes. For instance in a closed cereal market, it is expected that the price in the early harvest period will be lower than the price in the late part of the crop year. This type of seasonal price variation in the course of the year, cannot be regarded as part of price instability. One might attempt to account for the known influences on periodic price changes, in order to isolate the truly random unforeseen events, but this is not always easy, as these factors can change over time.

A related way to measure price instability is to try to construct a model of the underlying “trend” price. Instability can then be defined as the deviation of the observed price from the trend. The problem is, of course, that it is not easy to construct the trend. A trend for a period t should be defined as the market expectation of the price in period t, based on information up to some previous period (say s periods before). Since information at time t-s will be a function of t and s, namely will be changing from period to period, the trend price itself defined in this fashion, will be an unstable variable, and in addition will not be easily measurable.

The above point is subtle and important. Consider, for instance, the problem of defining a trend line for period t, given information up to period t-1. This trend line, if it is to summarize all information up to time t-1, should include the realized values of market related variables up to time t-1, such as the price at time t-1. On the other hand, if the trend is to include only "long run" and slowly changing events, such as technological changes etc., then it should not include the realized values of market variables at time t-1 and earlier, but rather values of other related variables that are not necessarily changing from period to period. Such a variable could, for instance, be a simple time trend. It is clear that the magnitude of instability will be assessed in a different fashion under the alternative definitions, and hence one should be careful to state clearly the assumptions involved in defining the "trend," or underlying "expectation," departures from which constitute instability. The modern theory of cointegration has made several efforts at defining and estimating "stochastic trends" but it appears that there is no consensus on the best practice (see the recent debate on this in the Economic Journal, articles by Granger (1997), Pesaran (1997), and Harvey (1997)).

The Inter-year Cereal Price Data and Trends

The issue in this section is whether the year to year price variability in world cereal markets has changed over the past twenty-five or so years. To analyze the problem monthly price data from indicator markets was utilized. The data is the following. For wheat the price for US No. 2 Hard Winter Ordinary fob Gulf is used. For coarse grains the price for maize US No 2 Yellow fob Gulf, and for rice the price for white Thai 5% broken fob Bangkok were utilized. All prices are in US$ per metric ton (mt). The US monthly consumer price deflator (which averages 100 for year 1983) was used to deflate the monthly data. The US CPI was divided by 100 so that the real cereal prices obtained are in 1983 US$ per metric ton (the base year, of course, does not matter). The use of the US CPI is justified firstly by the fact that a series of real prices is needed, as it is not desirable to count inflationary spurts as commodity instability, and secondly because monthly series of the US CPI are available for a very long period facilitating possible extensions of this work. Other deflators could potentially be used, such as the US wholesale price deflator etc., but as these deflators are closely correlated, they are not be expected to affect the results very much.

From the deflated monthly data two types of yearly simple averages were computed. One was for calendar years, and the second was for July-June crop years. A-priori, one would want to work with crop-year prices, as these seem to be more relevant for the bulk of world production and marketing of the cereals wheat and maize. The calendar year prices are highly correlated with the crop-year prices (simple regressions of calendar on crop-year prices gave coefficients in the neighborhood of 0.9 and corrected R squares in the range of 0.75 to 0.94). The various initial tests were conducted on both crop year as well as calendar year prices, and on both nominal and real prices, albeit the real ones are those of the main interest, hence on twelve price series. The subsequent analysis focuses on deflated crop year data. For all the econometric estimations the e-Views econometric package was used.

Figure 1 exhibits the plots of the three nominal crop year series, while Figure 2 exhibits the deflated series for the same prices that will be mainly analyzed in the sequel. It can be seen that the series are quite unstable, and the deflated series appear to have a downward trend. For all series the period 1973-75 appears to be one of considerable volatility, and does not seem to have been repeated since then.

Figure 1. Annual Series for Nominal World Prices of Cereals

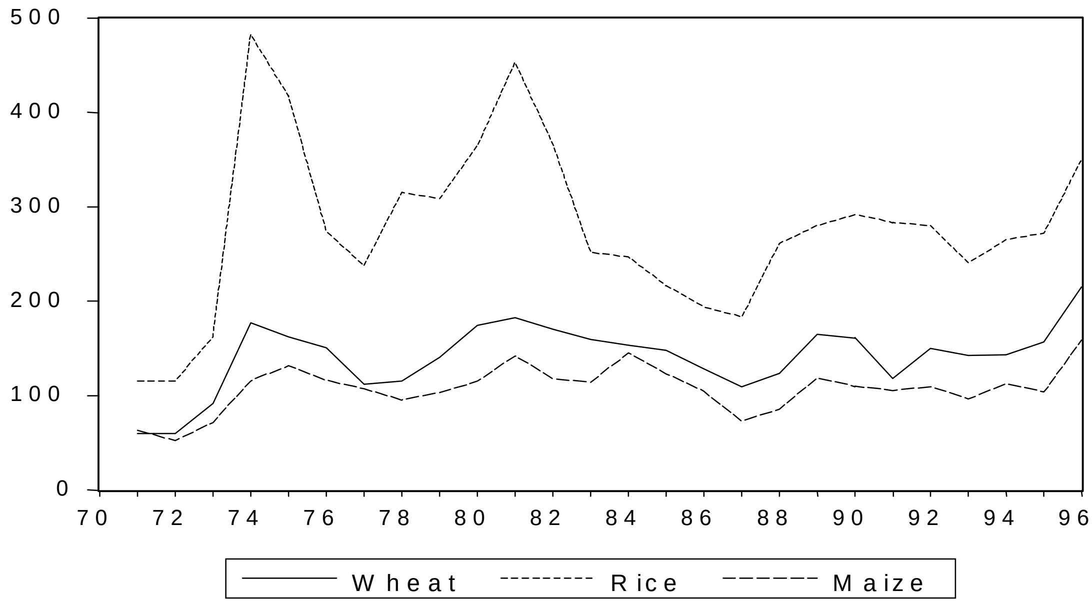

Figure 2. Annual Series for Real World Prices of Cereals

The initial investigation concerned the exploration of trends in the annual series. As indicated earlier it is deviations from appropriately defined trends that should be analyzed to examine issues of instability. It is important as a first step to investigate whether the series are trend stationary (TS) or difference stationary (DS). Trend stationary series are those that can be described as the sum of a deterministic time trend and a stationary process (the latter being a process whose mean and variance do not vary with time). Difference stationary, or unit root processes are those whose first difference is a stationary process. The major difference between the two, as has been outlined in several recent econometric textbooks, is that in TS processes disturbances tend to have temporary effects, namely do not lead to permanent shifts of the process, while in DS processes any shocks tend to leave permanent effects on the process (see e.g. Hamilton, (1994, Ch. 15) or Enders (1995, ch. 8)). This is, of course quite important to know for the world prices of cereals, since, if they can be characterized by DS processes, any temporary shocks to prices would have permanent effects.

To test whether the annual world prices of cereals are characterized by TS or DS processes a procedure outlined in Enders (1995, pp. 256-258)) is utilized. Denote an arbitrary time series by x_t , and by Δx_t the first difference of the series ($\Delta x_t = x_t - x_{t-1}$). The procedure consists of the following steps.

First estimate by Least Squares (LS) an equation of the form:

$$\Delta x_t = \alpha_0 + \alpha_2 t + \gamma x_{t-1} + \sum_i^n \beta_i \Delta x_{t-i} + \varepsilon_t \qquad (1)$$

where t denotes a linear time trend, ε_t denotes the error term, and the Greek letters denote coefficients. The size of the maximum lag n is determined by simple t-tests on the coefficients β_i .

Secondly perform an augmented Dickey-Fuller test (ADF) on whether the parameter γ that multiplies the undifferenced term is zero. Such tests have become common in recent years in the context of the so-called unit root revolution in econometrics (for detailed descriptions of the methods see Hamilton (1994) and Enders (1995)). If the test shows that the parameter is non-zero, then stop and conclude that the series does not contain a unit root, and hence is TS. If the test shows that γ is zero, then proceed sequentially to first test whether the coefficient of the trend term is zero, based on some specialized tests, and if it is, re-estimate the equation without the trend term, redoing the ADF test for testing the zero value of γ. Then test whether the constant term is zero and if it is, redo the ADF test in a re-estimated equation. At each step if it is found that γ is not zero, then one stops and concludes that the series does not contain a unit root. Otherwise one accepts the hypothesis of a unit root.

Table 1 exhibits the results of this type of test on all the initially estimated world price series for cereals, namely all twelve series. For all series, the maximum value of n in equation (1) was found to be equal to 1, and for most series the exclusion of the trend was not necessary. For almost all series, nominal or real, calendar or crop year based, the hypothesis of a unit root seems to be strongly rejected. From all the twelve series tested the only one for which the hypothesis of a unit root could not be rejected is the series for the real price of maize computed in a calendar manner. The results of similar tests where the corresponding series are the natural logarithms of the relevant prices are almost identical to the those of Table 1.

Table 1. Results of Testing for Unit Roots in Annual World Price Series

(The data is for the period 1970-1996. The entries in the table indicate whether the null hypothesis of a unit root is accepted and the degree of confidence)

	Type of Price Utilized			
	Calendar Year		Crop Year	
	Nominal	Real	Nominal	Real
Commodity				
Wheat	No** (1) (tr)	No*** (1) (tr)	No** (1) (tr)	No*** (1) (tr)
Maize	No* (1) ©)	Yes (1) (tr)	No** (1) ©)	No*** (1) (tr)
Rice	No** (1) (tr)	No*** (1) (tr)	No** (1) (tr)	No*** (1) (tr)

Notes. * Rejection of the unit root hypothesis at 10% significance level
** Rejection of the unit root hypothesis at 5% significance level
*** Rejection of the unit root hypothesis at 1% significance level
The number in the first parenthesis after each entry denotes the number of significant lags incorporated in the test regression. The second parenthesis denotes whether a constant drift plus trend (tr) was included in the test regression, whether simply a constant drift ©) was included or no drift and no trend (n) was included.

As considerable instability was exhibited in the period 1973-1975, as is indicated from Figures 1 and 2, it might be hypothesized that the trend behaviour of prices is different before and after this period. If years prior to 1976 are omitted from the series and the unit root tests are redone, as outlined above, then the unit root hypothesis is rejected again for the real crop-year annual prices of maize and rice, but is not rejected for wheat. If the tests on the logarithms of the real crop year prices are redone, then the unit root hypothesis cannot be rejected for any of the series.

Of course, the data in the series is not long enough to be able to discern statistical stationarity patterns that should normally be identified from long time series, and this makes the whole analysis of unit roots somewhat suspect. In fact one of the major criticisms of unit root tests is that they are have low power against stationary models with roots close to unity (Rudebusch, 1993), and are not robust against alternative specifications that include trends with breaks (Hendry and Neale, 1991). Leon and Soto (1995) found in their examination of long annual real commodity price series (1900-1992), that while standard unit root tests could not reject the hypothesis of unit roots for almost all series, once the possibilities of breaks was admitted, the unit root hypothesis was rejected for most series. In their analysis, using a test that is robust to structural breaks, they found that the long run behaviour of maize, wheat and rice price series did not contain a unit root, and they could best be described by TS processes. This is similar to the conclusion reached above, with admittedly shorter series. Given, however, the coincidence of the results on both short as well as long time series, it will be assumed in the sequel that the cereal price series that are analyzed (using crop year deflated data) are characterized by TS processes.

The admission of TS processes for the price series does not imply the lack of structural breaks. An attempt was made to test the trends for structural breaks. This is important, because one might mistake a structural break in a trend for an increase in the variance of the series. The procedure utilized was the following. First a linear trend was fitted to the data (in absolute or logarithmic form). The coefficients of this regression were tested for stability using a variety of tests. The tests included the plot of recursive residuals,[1] the CUSUM test, the CUSUM of squares test and the plot of recursive coefficients[2]. If these tests suggest that there is a break in the coefficients of the trend in some year, then a Chow breakpoint test was performed for that year. This test involved dividing the period into two sub-periods indicated by the breakpoint tests, estimating separate trends for each of the subperiods, and testing whether the coefficients from each of the regressions are the same.

The results of the tests were inconclusive, basically because of lack of sufficient degrees of freedom, namely number of years of observation. This was pointed out also by Leon and Soto (1995), who used much longer annual series and even then had difficulty finding an appropriate test, the standard tests utilized here being very weak. In general, it appears that there is some type of structural break after 1977, and the possibility of another after 1983, but again the degrees of freedom are too few for any conclusive results.

Instability in Annual Cereal Prices

Given the above results, it was decided to detrend the price series by simple linear trends in the levels. Figures 3-5 indicate plots of the actual series (using, of course, the crop year real data) the linear trend lines and the residuals. It is clear that after the period of instability in the early to mid 1970s, there does not appear to have been any period of excessive instability, namely departure from the trend. Interestingly, of course, all the trend lines indicate negative and highly significant real price trends. In real terms, even after the most recent world price rises, the real prices of cereals do not appear to be any higher than the depressed prices of the pre-1973 period. The recent price increases, when compared to the price increases of the mid-1970s appear to be not unusual departures from the trends.

Table 2 indicates the regression output from the simple linear time trends and the value of the Breusch-Godfrey serial correlation specification test. It is quite obvious that all trends are negative and significant. It is also quite evident that there exists serial correlation in the residuals of the trend regressions. Given this observation, standard Box-Jenkins identification techniques were used to specify appropriate autoregressive moving average (ARMA) models for the residuals of the trend regressions.

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[1] In recursive least squares the equation is estimated repeatedly, using increasingly larger subsamples of the data, starting with the minimum possible number of observations. From each regression the coefficient estimates are used to produce a one period ahead forecast. The difference between the actual value of the series and this one period forecast is the recursive residual.

[2] The CUSUM test involves plotting the cumulative sum of recursive residuals. The CUSUM of squares involves the plot of the cumulative sum of squared residuals. Parameter instability is indicated when the cumulative sums go outside a plotted significance area.

Figure 3. Plot of Actual, Fitted (Linear Trend), and Residual Real World Wheat Prices

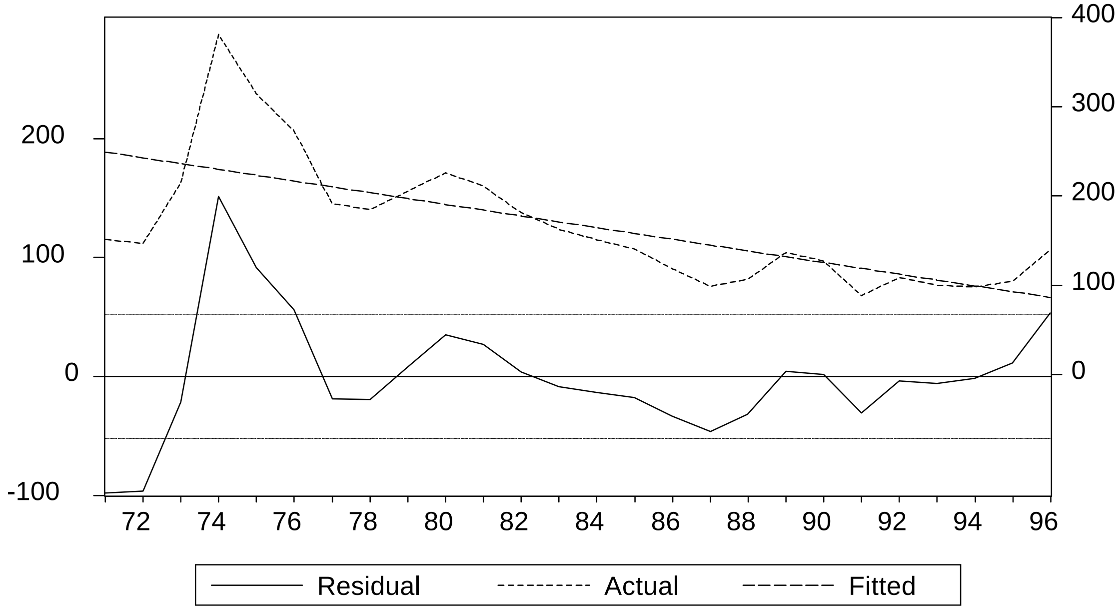


Figure 4. Plot of Actual, Fitted (Linear Trend), and Residuals of Real World Maize Prices

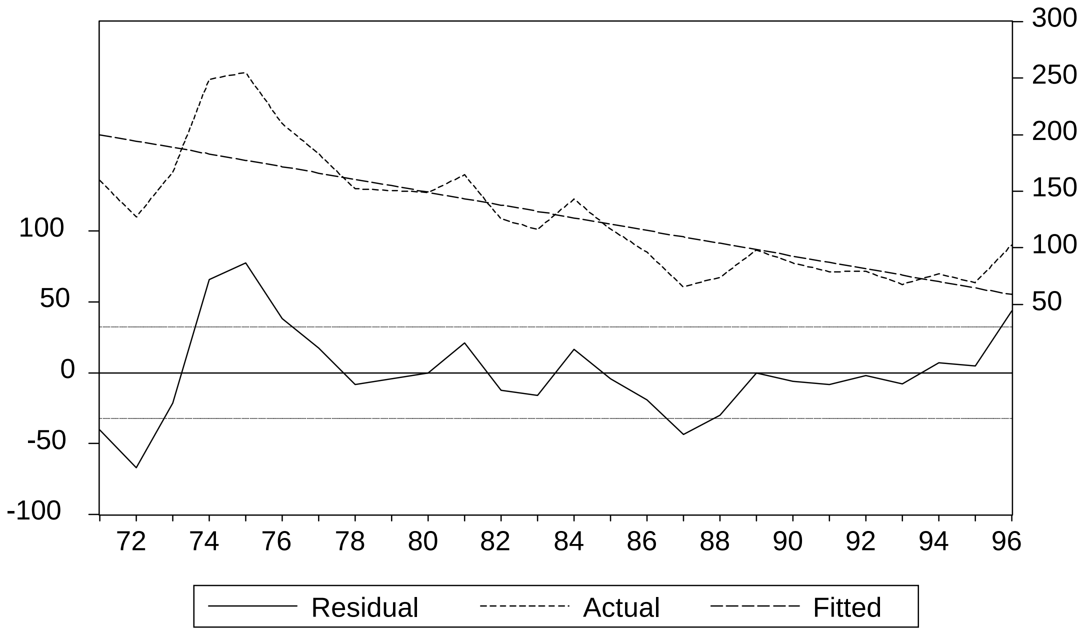


Figure 5. Plot of Actual, Fitted (Linear Trend), and Residuals of Real World Rice Prices

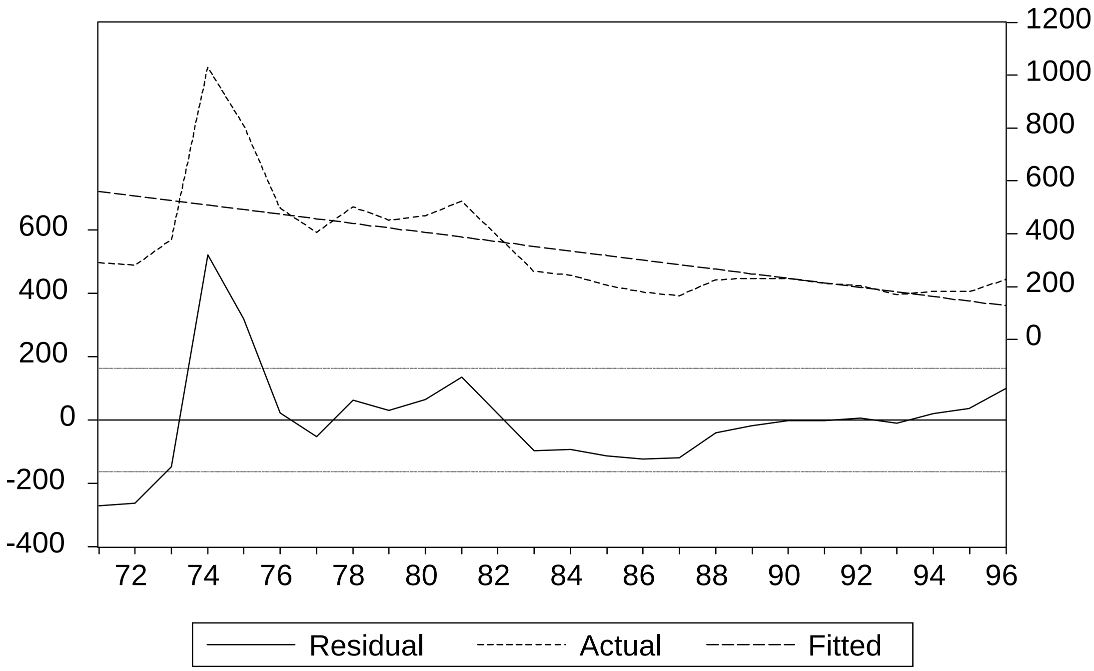


Table 2. Results of Linear Trend Regressions on The Annual Real Crop-Year Prices of Cereals

(Period of Estimation is 1971-96)

	Wheat	Maize	Rice
Constant	262.240***	211.150***	594.851***
Linear Time Trend	-6.519***	-5.642***	-17.326***
Corr. R^2	0.467	0.634	0.382
Durbin Watson Statistic	0.824	0.794	1.023
Breusch-Godfrey Serial Correlation LM Test[1]	8.595***	11.471***	5.593**

Notes. * denotes significance at the 10% level
** denotes significance at the 5% level
*** denotes significance at the 1% level

[1]This is the value of the F test. One, two or three stars (denoting significance at 10%, 5%, or 1% respectively) indicate that the null hypothesis of no serial correlation of residuals is rejected.

Table 3. Results of Linear Trend Regressions on Annual Real Crop Year Prices of Cereals with ARMA Errors

(Period of Estimation is 1971-96)

	Wheat	Maize	Rice
Constant	281.571***	232.107***	691.268***
Linear Time Trend	-7.353***	-6.707***	-22.479***
AR(1) 0.705***	0.768***	0.511**	
AR(2)	-0.578***	-0.508***	-0.402**
MA(1)	-0.399***		
MA(2)	0.984***		
Breusch-Godfrey Serial			
Correlation LM Test[1]	0.666	0.757	1.685
ARCH LM test Statistic[2]	0.992 (1)	1.959 (1)	0.425 (1)
White's Heteroskedasticity Test[3]	0.466	0.834	3.762**

Notes. * denotes significance at the 10% level
** denotes significance at the 5% level
*** denotes significance at the 1% level

[1]This is the value of the F test. One, two or three stars (denoting significance at 10%, 5%, or 1% respectively) indicate that the null hypothesis of no serial correlation of residuals is rejected.

[2]This is the value of the F test. One, two or three stars (denoting significance at 10%, 5%, or 1% respectively) indicate that the null hypothesis of ARCH type of Heteroscedasticity of residuals is rejected. The lag included in the ARCH regression is indicated next to the value of the test.

[3]This is the value of the F test. One, two or three stars (denoting significance at 10%, 5%, or 1% respectively) indicate that the null hypothesis of no Heteroscedasticity of residuals is rejected.

Table 3 indicates the results of linear trend regressions of world crop prices allowing for ARMA specification of the residuals. The models are of the following general type:

$$y_t = \alpha + \gamma t + u_t \tag{2}$$

where y is the price in year t, u is the error in year t that follows a ARMA(p,q) process of the type.

$$u_t + \sum_i^p a_i u_{t-i} = a_0 + \sum_i^q b_i \varepsilon_{t-i} \tag{3}$$

The basic criterion for specifying the models is that they are as low order as possible, and that the estimated models exhibit no more serial correlation. Furthermore, tests of normality indicate for all models that the residuals are normal. The table indicates the best models fitted, the values of the fitted parameters a_i and b_i with their levels of significance, and three residual tests. The first is the Breusch-Godfrey test for serial correlation, and the other two are tests for heteroscedasticity of residuals. The first of these tests for low order autoregressive conditional heteroscedasticity (ARCH), while the second tests for general type of heteroscedasticity. The ARCH models originally proposed by Engle (1982) assume that the conditional variance of a variable, namely the variance of a one period ahead forecast, given values of the variable in previous periods, is not constant, and instead depends on recent shocks. This type of model appears relevant for the study of world price instability as it assumes that recent events lead to some type of temporary instability that eventually dies out.

The results indicate that except for rice, the fitted ARMA models do not exhibit heteroscedasticity, meaning that the conditional variance of the series, namely the variance of a year's price, given information of previous years, does not appear to vary. This is also the case for rice, when the ARCH test is done, but it appears that with rice there is some other type of heteroscedasticity in the data. This is indicated by the significant value of the White F-test.

Figures 6-8 indicate the plots of the actual and fitted values of the real world prices of wheat, maize and rice respectively, as well as the residuals from the fitted equations. When these figures are compared with Figures 3-5, that do not adjust for the ARMA components, it becomes apparent from examination of the residuals that the variance of the error terms does not appear to vary much, and, if any, the larger variations are concentrated in the early period that coincides with the food crisis of the early 1970s. Nevertheless, it appears that there is some tendency of the residuals to veer off their normal levels in the very end of the period, namely around 1995-96. This suggests somewhat increased volatility in this period but not much outside normal levels.

The tests were redone using the logarithms of the annual prices. The conclusions were the same, and in fact even stronger in the sense that even for rice the White test for heteroscedasticity did not reject the hypothesis of no heteroscedasticity.

Therefore, the conclusion from this empirical examination, is that there does not appear to be an increasing degree of inter-year variability in world cereal markets. Recent events do not appear to manifest anything considerably unusual, or much outside the range of normal annual variations.

Intra-Year Price Variability

The next issue that is investigated relates to the degree of intra-year price variability. To this end the following manipulations to the data were done. First for each real commodity price, and each crop year, the variance of the 12 monthly prices included in the July-June crop year was calculated. This variance was divided by the average crop year price. The resulting numbers are the coefficients of variation of intra-year prices, and are unitless. These numbers are reasonable measures of the intra-year price variability of a commodity. The subsequent analysis has as objective to investigate whether there are any trends in these coefficients of variation.

Table 4 indicates the results of linear trend regressions in these coefficients of variation. Apart from the trend results, the table includes test statistics for serial correlation, ARCH and heteroscedasticity. The first observation is that for all three commodities the coefficients of the trend regressions are insignificant. Hence, there does not appear to be any tendency for the intra-year price variability to change. In fact, the coefficients of the trend regressions are all negative, albeit non-significant, implying that the tendency, if any, is for a reduction in the intra-year cereal price variability.

Table 4. Results of Trend Regressions of the Coefficients of Variation of Intra Crop-Year Prices

(Period of Estimation is 1971-96)

	Wheat	Maize	Rice
Constant	0.0938***	0.0849***	0.1155***
Linear Time Trend	-0.0014	-0.0007	-0.0011
Breusch-Godfrey Serial Correlation LM Test[1]	0.354	0.469	1.156
ARCH LM test Statistic[2]	10.977*** (1)	0.983 (1)	0.007 (1)
White's Heteroskedasticity Test[3]	10.476***	2.148	0.082

Notes. * denotes significance at the 10% level
** denotes significance at the 5% level
*** denotes significance at the 1% level

[1]This is the value of the F test. One, two or three stars (denoting significance at 10%, 5%, or 1% respectively) indicate that the null hypothesis of no serial correlation of residuals is rejected.

[2]This is the value of the F test. One, two or three stars (denoting significance at 10%, 5%, or 1% respectively) indicate that the null hypothesis of ARCH type of Heteroscedasticity of residuals is rejected. The lag included in the ARCH regression is indicated next to the value of the test.

[3]This is the value of the F test. One, two or three stars (denoting significance at 10%, 5%, or 1% respectively) indicate that the null hypothesis of no Heteroscedasticity of residuals is rejected.

Figure 6. Plot of an ARMA(2,2) Model of Annual Real World Wheat Prices

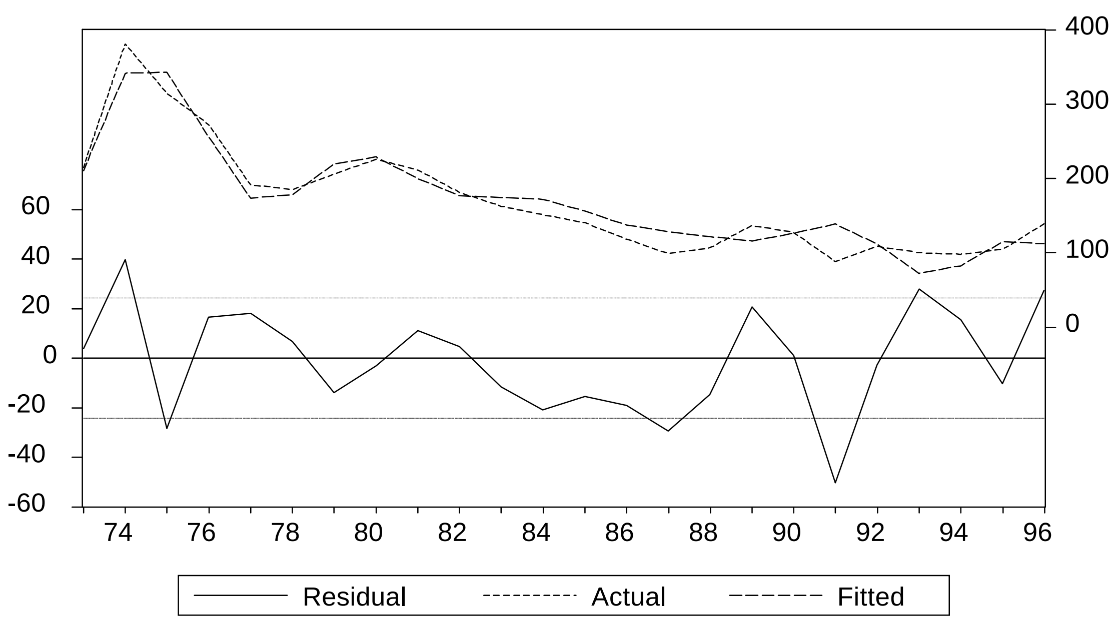


Figure 7. Plot of ARMA(2,0) Model of Real World Annual Maize Prices

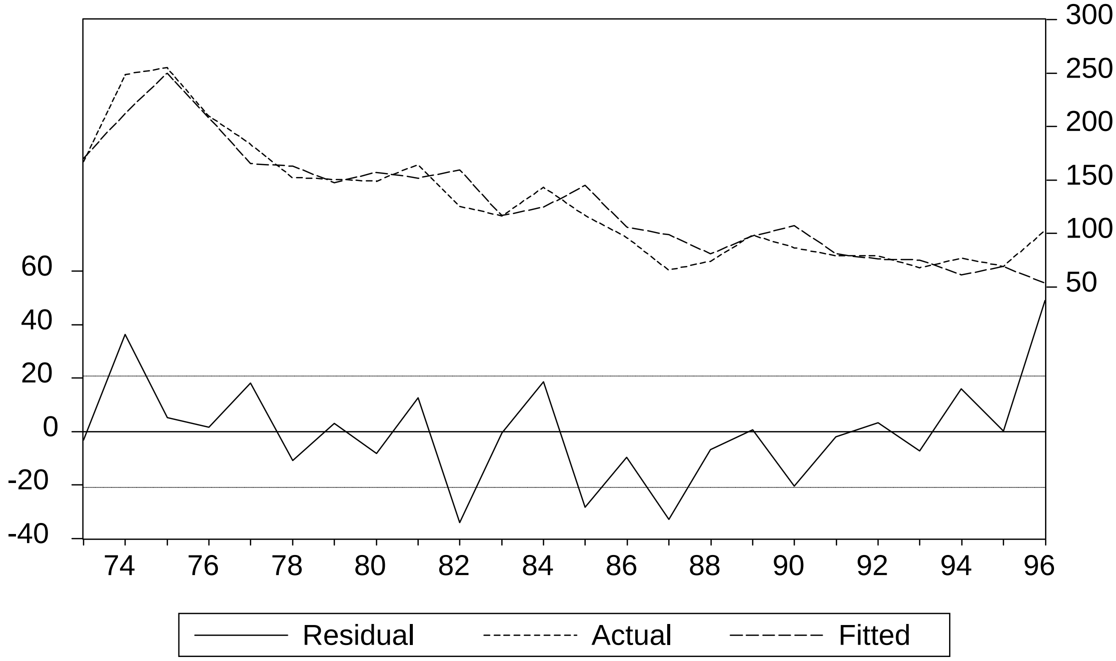
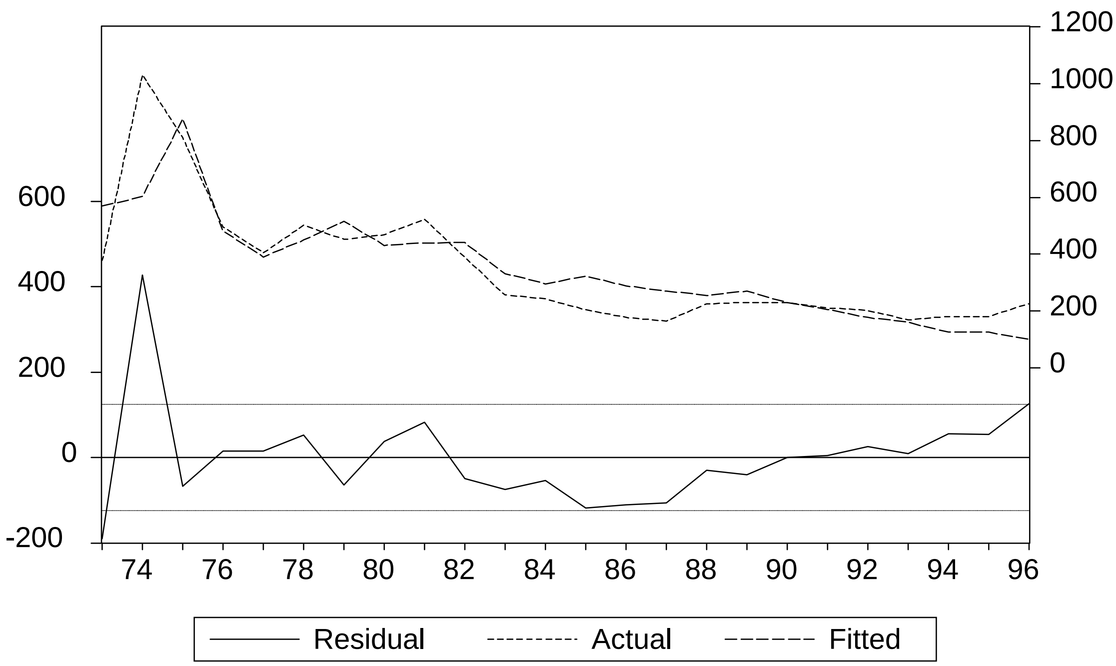


Figure 8. Plot of ARMA(2,0) Model of Real World Annual Rice Prices



The specification tests indicate that there is no serial correlation among intra-year price variabilities. The value of the ARCH and White tests, however, show that there seems to be some heteroscedasticity in the intra-year price variability of wheat, but not for the other two commodities. This means that while there does not appear to be any trend in the intra-year wheat variability, there might be some time variation of the magnitude of the instability, albeit not of the trend type.

Figures 9-11 plot the fitted trends and the residuals from these regressions. For wheat, it appears that there is increased variability in the period of the early 1970s, and then in the mid-1990s, and this might account for the heteroscedasticity noted above. For maize, there also appears to be some excess intra-year variability both in the beginning and last parts of the period, but as indicated in Table 5 they do not appear to be statistically significant. For rice, there does not appear to be any pattern to the intra-year variability.

The results, therefore, seem to support the conclusion that, apart from some periods of potential increased intra-year variation, there is no increasing trend in the intra-year variability of world cereal prices. This, of course, does not mean that the absolute values of intra-year variations do not change. In fact in a year of high average prices the monthly variations are expected to also be high, while the opposite is expected in a year of low average prices. This could be explained partly by the fact that years of high prices are normally associated with low volumes of stocks, and hence any news concerning the market developments tend to lead to larger reactions by market participants. The opposite is normally the case in years of low prices. The proper way to analyze volatility, however, is in relative terms as has done here, by using the coefficient of variation, and it is on the basis of analyzing such coefficients that the conclusion is that there has not been any trend in intra-year price volatility.

Figure 9. Plot of Intra-Year Coefficient of Variation of Real World Wheat Prices

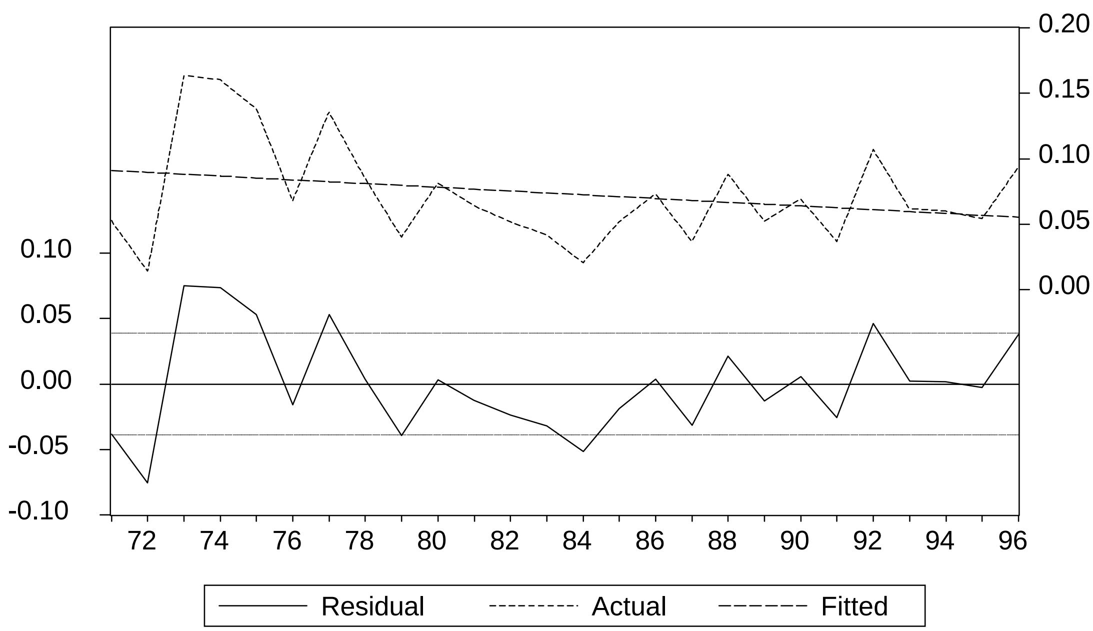


Figure 10. Plot of Intra-Year Coefficient of Variation of Real World Maize Prices

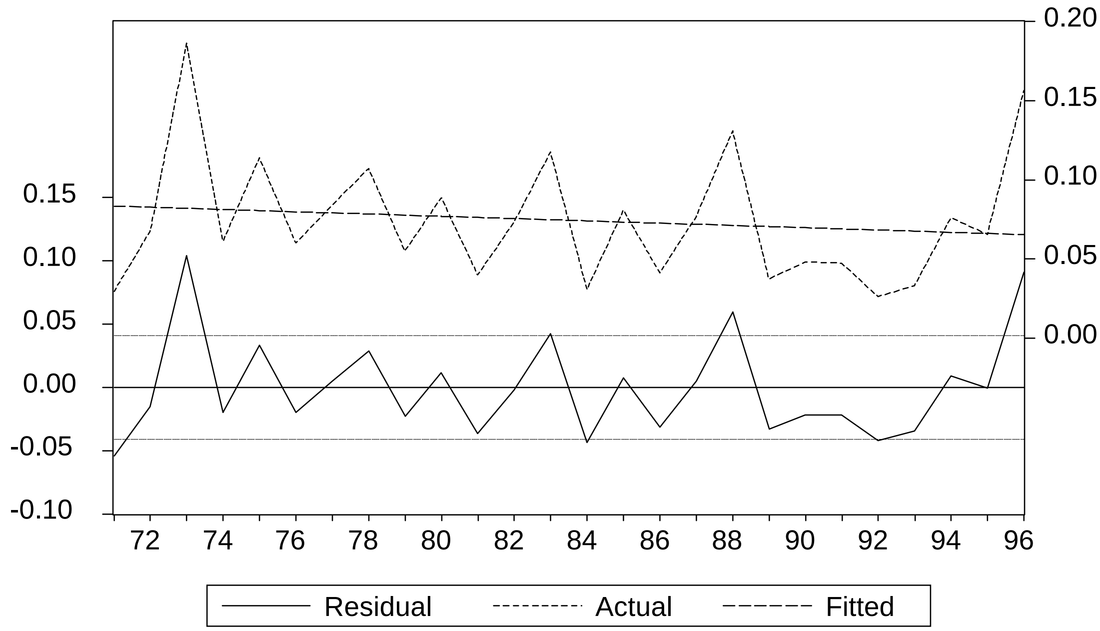
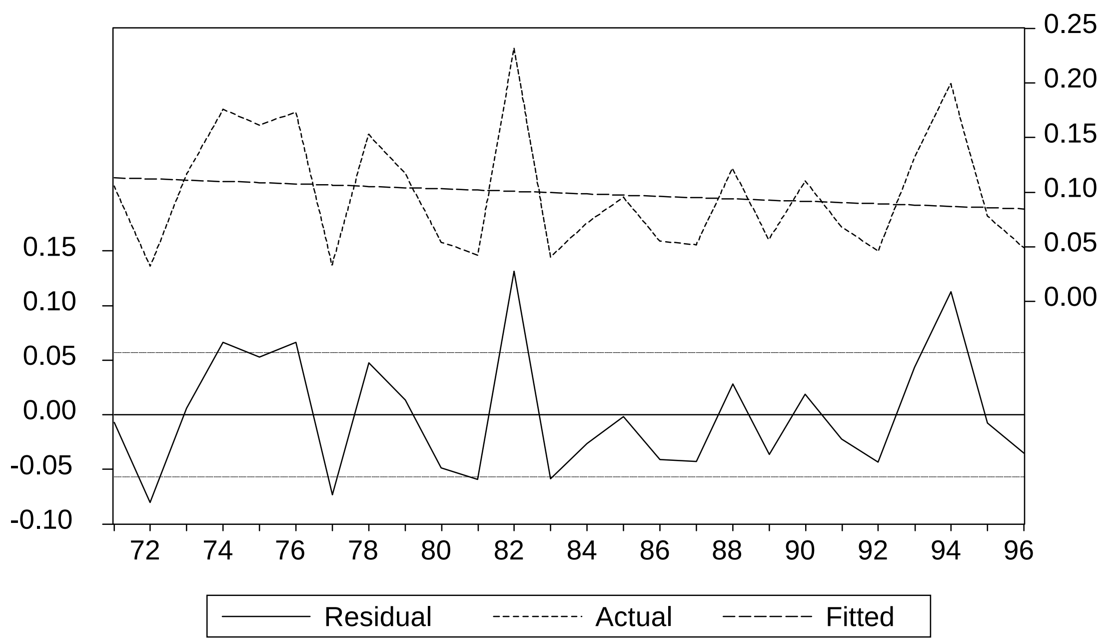


Figure 11. Plot of Intra-Year Coefficient of Variation of Real World Maize Prices



The observation, nevertheless, that in periods of high prices even the coefficient of variation seems to increase in some commodities (notably wheat) might suggest that in such periods the wheat demand might become very inelastic thus leading to this excess seasonal variation. This is a topic that might merit further research.

The Changing World Pattern of Cereal Production and Trade and Consequences for Instability

Over the past 30 years some significant changes in the world-wide pattern of cereal production have occurred, and the FAO study reveals them. As far as wheat is concerned, while total sown area in the world has not changed, the Former Soviet Union (FSU) has diminished its share by more than 10 percentage points, while Asia, mainly China and India have gained world wheat area shares. In terms of production this pattern is even more pronounced, with China and India doubling their world shares of world wheat production, while the share of the FSU has halved. Over the past three decades world wheat yields have almost doubled. Currently Canada and the US account for 16% of world wheat production, the EU15 for another 16%, the FSU for 13%, China for 18.4%, and India for 10.7%. The major other exporters Australia and Argentina account for less than 5% of world wheat production.

World rice area has expanded by 15% in the last three decades, while production has doubled. Area and production shares have not changed by much, with Asian countries accounting for 91% of world production. China alone accounts for 35% of world production, India for 22%, Indonesia for 9%, and Thailand for 4%. Among OECD members, only Japan is a major producer accounting for 2.5% of world production.

The world coarse grain market has not exhibited any major changes in the allocation of production. Total sown area has stayed constant, while production has increased by 60%. Among major producers, currently the US accounts for 28% of world coarse grain production, the EU15 for 11%, FSU for 9.5%, Brazil for 3.7%, China for 14%, and India for 3.6%.

World cereal yields have increased steadily over time, but do not seem to exhibit any pattern of increased variability, around the trends. This seems to counter those who have suggested that the introduction of some types of modern yield enhancing technology (such as, for instance, hybrid seeds) has increased yield variability.

Recognising that the world cereal markets are not characterised by free trade, and that the important thing for world instability is the degree to which various countries allow their domestic production disturbances to be transmitted to the international markets, Sarris (1997a) proceeded to estimate transmission coefficients for all the major countries and country aggregates that constitute the world cereals markets. Transmission coefficients (for a definition and first results see Blandford, 1983), measure the proportion of domestic production disturbances that are transmitted to world markets, by variations in net import volumes. These coefficients are influenced by domestic short run demand and supply price elasticities, by the behaviour of domestic stockholders, and most importantly by government policies regarding domestic price stability and stockholding. They are expected to be negative and smaller than one in absolute value.

Using a variety of methods and data Sarris (1997a) found that for most countries and regions the transmission coefficients were in the expected range and significant. On the basis of the estimations, transmission coefficients were assigned to all countries and regions producing cereals. Subsequently the magnitudes of the production variabilities transmitted to the world by each country and region and at five year intervals were estimated as follows. The estimated coefficients of variation of production for each country were multiplied by the average production of cereals for each five year period, and finally multiplied by the estimated transmission coefficients. Tables 5, 6, and 7 reproduce the results of this exercise for wheat, rice and coarse grains respectively from Sarris (1997a). In the bottom of the table the values of the estimated “transmitted standard errors of production” are summed and divided by the average volume of world imports. This overall indicator can be taken as a summary measure of world production variability transmitted to the world, and thus contributing to instability.

It can be seen from Table 5 that for wheat, after a period of high instability in the pre-1980 period the decade of 1980-90 was characterized by a lower overall degree of instability. This seems to have been reversed again in the 1990’s, with the index of instability rising again to levels similar to those of the turbulent 1970s. For rice the picture seems to be quite different, with the degree of instability in the 1990’s being at the lowest level compared to all the previous periods. For coarse grains, the instability situation in the 1990’s appears to be the worse compared even to the decade of the 1970s.

In interpreting the above results it must be kept in mind that the implicit assumption made in deriving the summary indicators is that the production variations are uncorrelated between countries or regions. This is not correct, as weather patterns tend to have cross country and cross regional influences. Nevertheless, it can be taken as a first step in the analysis of production variability transmitted to the world.

If production variability, as exhibited in transmitted variations, was the only factor affecting world cereal markets, then one would expect, on the basis of the above results that world prices should be more unstable in the 1990s in the wheat and coarse grain markets, compared with the earlier parts of the decade, while for rice the picture would be one of lower degree of instability. The FAO price analysis, however, did not support such a conclusion, although there were not enough degrees of freedom for a statistically significant statement.

It is well known, however, that production variations are only part of the factors affecting world cereal markets. In fact Mitchell (1987) in his simulations of world cereal markets found that about 50% of the world price variations were due to macroeconomic and other exogenous shocks (mainly the oil price shock), another 25% was due to agricultural policy shocks, and only 20-30 % of the variation was due to unexplained factors, presumably weather and model misspecifications. Of course, his analysis was conditioned to a large extent by the two oil shocks and the macro events that accompanied them. A more recent analysis by Sarris (1990), despite its aggregated nature, also found that a major part of the world cereal price instability was due to non-production factors. Nevertheless, the importance of production and agricultural policy variability, even for the tumultuous period that Mitchell examined, accounted for 40-50 percent of the world price variations.

Table 5. Wheat Production Variations Transmitted to World Markets (All figures are in thousand metric tons)

	1965-70	1971-75	1976-80	1981-85	1986-90	1991-96
North America						
Canada	1875.3	1676.4	2245.1	2111.3	2228.3	2381.6
USA	1508.8	1875.8	2238.9	3715.9	3083.1	3247.4
Europe						
EU15	1071.5	1242.1	1341.0	1630.8	1808.6	1951.7
EFTA	32.3	34.2	38.4	51.8	62.6	75.9
Transitional Econ.	737.3	946.9	1020.9	1553.8	1868.6	1529.1
Former Soviet Union	1382.7	1444.9	1620.1	1127.7	1322.0	1120.0
North Africa						
Egypt	83.0	109.7	109.4	153.4	237.7	392.1
Other North Africa	152.9	182.5	171.2	311.8	421.7	523.0
Gulf and Others	444.8	520.6	587.6	561.1	697.0	924.0
Non-Arab ME	530.3	671.7	902.9	657.4	730.9	735.9
Africa						
Nigeria	0.0	0.0	0.0	0.0	0.0	0.0
Sahel	0.0	0.0	0.0	0.0	0.0	0.0
Western Africa	0.0	0.0	0.0	0.0	0.0	0.0
Central Africa	0.0	0.0	0.0	0.0	0.0	0.0
East Africa	66.6	74.5	75.0	159.8	191.3	240.9
South Africa	114.9	191.2	206.0	308.5	372.6	287.4
Other South Africa	3.1	2.5	2.6	1.8	2.5	1.4
Latin America						
Mexico	110.4	115.3	139.3	181.5	184.4	163.0
Other Middle America	0.0	0.0	0.0	0.0	0.0	0.0
Brazil	217.3	427.3	600.9	1073.2	2227.9	1041.4
Argentina	1039.8	1151.2	1346.5	2097.0	1690.2	1932.5
Other South America	202.8	174.6	161.2	290.1	517.5	451.9
Pacific						
Australasia	1724.9	1718.7	2246.5	2627.5	2294.0	2413.8
Other Pacific	0.0	0.0	0.0	0.0	0.0	0.0
Asia						
China	1001.0	1399.8	1939.8	1596.5	1876.9	2126.8
India	651.7	1058.1	1374.0	787.4	922.7	1133.3
Japan	321.8	97.3	135.6	121.1	156.3	102.9
Indonesia	0.0	0.0	0.0	0.0	0.0	0.0
Thailand	0.0	0.0	0.0	0.0	0.0	0.0
Other South Asia	281.2	369.9	497.8	338.4	388.0	456.4
Other East-South Asia	0.0	0.0	0.0	0.0	0.0	0.0
Total Transmitted Variation	13554	15485	19001	21458	23285	23232
Average World Imports	54541	67493	81594	107900	109613	100814
Ratio Transmissions to World Imports (%)	24.85	22.94	23.29	19.89	21.24	23.04

Source: Sarris (1997a)

Table 6. Rice Production Variations Transmitted to World Markets

All figures are in thousand metric tons

	1965-70	1971-75	1976-80	1981-85	1986-90	1991-96
North America						
Canada	0.0	0.0	0.0	0.0	0.0	0.0
USA	58.6	66.9	83.0	110.6	114.3	148.3
Europe						
EU15	32.5	36.5	35.7	25.1	30.1	35.9
EFTA	0.0	0.0	0.0	0.0	0.0	0.0
Transitional Econ.	6.1	7.6	6.2	14.0	13.7	5.6
Former Soviet Union	0.0	0.0	0.0	0.0	0.0	0.0
North Africa						
Egypt	62.5	66.6	65.7	86.8	95.5	167.4
Other North Africa	0.0	0.0	0.0	0.0	0.0	0.0
Gulf and Others	45.7	50.6	55.2	78.8	88.7	110.5
Non-Arab ME	10.7	11.7	13.6	13.1	11.7	9.4
Africa						
Nigeria	21.7	33.4	44.6	73.2	124.7	160.8
Sahel	12.8	13.6	14.5	9.4	13.8	19.8
Western Africa	0.0	0.0	0.0	0.0	0.0	0.0
Central Africa	0.0	0.0	0.0	0.0	0.0	0.0
East Africa	62.4	72.9	78.9	88.7	105.2	110.2
South Africa	0.0	0.0	0.0	0.0	0.0	0.0
Other South Africa	0.0	0.0	0.0	0.0	0.0	0.0
Latin America						
Mexico	25.1	31.7	30.9	45.8	40.2	30.5
Other Middle America	16.9	23.2	32.1	24.8	22.6	23.3
Brazil	38.9	40.1	49.7	48.2	56.3	58.7
Argentina	18.8	20.2	20.3	38.7	42.1	73.1
Other South America	34.7	48.6	62.3	74.7	84.3	96.7
Pacific						
Australasia	18.4	27.9	46.3	64.7	66.3	91.9
Other Pacific	0.0	0.0	0.0	0.0	0.0	0.0
Asia						
China	127.0	157.6	177.1	287.7	308.6	333.0
India	0.0	0.0	0.0	0.0	0.0	0.0
Japan	0.0	0.0	0.0	0.0	0.0	0.0
Indonesia	172.2	231.6	281.1	200.2	236.6	275.0
Thailand	175.8	194.8	222.3	243.7	248.8	268.4
Other South Asia	198.7	212.7	246.9	159.6	177.6	198.7
Other East-South Asia	60.7	66.8	77.1	128.7	139.7	167.1
Total Transmitted Variation	1200	1415	1644	1817	2021	2384
Average World Imports	7535	7839	10092	11386	11853	17098
Ratio Transmissions to World Imports (%)	15.93	18.05	16.29	15.96	17.05	13.95

Source. Sarris (1997a)

Table 7. Coarse Grains Production Variations Transmitted to World Markets

All figures are in thousand metric tons

	1965-70	1971-75	1976-80	1981-85	1986-90	1991-96
North America						
Canada	507.0	638.4	648.7	693.8	694.5	692.0
USA	1290.3	1513.3	1790.8	4188.9	3911.4	4396.5
Europe						
EU15	421.1	513.2	545.3	650.3	652.9	615.2
EFTA	34.1	47.0	52.7	64.9	68.1	67.6
Transitional Econ.	385.0	469.9	510.3	1074.8	1016.2	916.2
Former Soviet Union	1531.6	1905.4	2206.7	2080.4	2418.7	1960.7
North Africa						
Egypt	39.1	41.6	45.7	70.7	81.3	105.5
Other North Africa	141.0	170.0	180.3	341.5	403.9	452.7
Gulf and Others	322.3	290.1	339.4	479.2	634.6	758.0
Non-Arab ME	165.5	167.8	198.9	233.9	258.6	275.2
Africa						
Nigeria	33.3	34.8	28.0	14.0	24.3	30.0
Sahel	53.0	46.9	56.5	75.2	97.7	121.5
Western Africa	14.5	16.6	16.3	22.7	28.1	35.1
Central Africa	27.2	30.9	30.6	32.9	38.6	47.0
East Africa	301.7	351.9	405.9	758.7	898.1	902.4
South Africa	1105.2	1527.0	1668.3	2291.7	2471.7	2336.3
Other South Africa	29.6	38.1	38.9	57.8	75.6	60.4
Latin America						
Mexico	516.1	577.7	692.9	1062.8	1016.4	1211.5
Other Middle America	62.7	66.5	76.8	138.9	179.4	167.7
Brazil	220.5	266.2	309.3	390.2	448.8	569.5
Argentina	1339.1	1823.4	1823.4	2276.3	1440.2	1626.2
Other South America	126.8	145.6	159.2	194.5	231.1	290.7
Pacific						
Australasia	552.0	813.9	921.5	1264.7	1228.6	1397.5
Other Pacific	0.0	0.0	0.0	0.0	0.0	0.0
Asia						
China	820.4	975.5	1194.1	1361.5	1530.2	1876.6
India	22.3	22.6	25.0	33.3	33.8	34.1
Japan	0.0	0.0	0.0	0.0	0.0	0.0
Indonesia	0.0	0.0	0.0	0.0	0.0	0.0
Thailand	0.0	0.0	0.0	0.0	0.0	0.0
Other South Asia	13.7	14.3	13.9	14.3	16.4	18.0
Other East-South Asia	0.0	0.0	0.0	0.0	0.0	0.0
Total Transmitted Variation	10075	12509	13979	19868	19899	20964
Average World Imports	45438	70032	100404	111353	107456	91120
Ratio Transmissions to World Imports (%)	22.17	17.86	13.92	17.84	18.52	23.01

Source: Sarris (1997a)

A caveat of the analysis and conclusions in Sarris (1997a) is that it was assumed that the transmission behaviour of countries is the same over the whole period of the last three decades. This is not necessarily a good assumption, as over this period there have been significant policy changes that could have affected behaviour. It was not possible to test for changing behaviour, however, with the limited time series data available.

Nevertheless, the above caveat does not invalidate the general conclusions reached concerning the transmission of production fluctuations. If transmission has increased in the 1980s, as one would expect given the general tendency for market opening of a number of economies, this would imply larger proportions of domestic variations that are transmitted internationally. This would increase the measures of instability for all commodities that were exhibited in Tables 5-7. With the exception of rice, this would not affect the overall conclusion that instability appears to have increased in the 1990s in the wheat and coarse grain markets, and in fact would make the conclusion stronger. For rice it could reverse the conclusion of decreasing instability.

The final analysis of the FAO study concerned the evolution of cereal stocks. It was found that the recent period has seen a decline in the geographical concentration of world cereal stocks. In other words more countries and regions now hold large end-of season stocks, compared to the early 1980s. This is a trend that would tend to mitigate world price instability. On the other hand the study also documented a declining trend in the ratios of stocks to apparent consumption, and a tendency for a larger share of stocks to be held by the private sector.

The upshot of the analysis is that while there are factors that would tend to increase the world instability of cereal markets, there are other counteracting factors that would tend to diminish it. The limited nature of the study did not allow it to proceed and estimate the contribution of all the different factors to world price instability. Nevertheless, the overall conclusion was that there does not seem to be a general trend toward increasing world cereal market instability.

Options of LIFDCs to Deal with Cereal Market Instability

Agriculture is a risky business, and has been so ever since the beginning of farming. While government intervention in agricultural markets is a relatively modern phenomenon (apart from Joseph's Egyptian buffer stock scheme, based on divine foresight and revelation), farmers have been able to cope with risk for a long time. In today's world many risk management policies for agricultural producers have been instituted in developed countries, but farmers in most developing countries still experience substantial amounts of risk. Situations like those faced by developing country farmers today are similar to those faced by farmers in now developed countries in the last and earlier centuries.

Strategies to cope with risk generally can be classified in two broad classes, namely those that deal with risk management or risk minimisation, and those that deal with risk coping or with loss management. Risk management strategies are those undertaken to minimise variability of incomes, and especially lessen the incidence of large negative income deviations. This is normally achieved by diversification of income sources. At the farm level this occurs through product diversification, varietal diversification of the same crop, land diversification by cultivating many parcels, etc. At the family level it occurs through diversification into non-farm types of employment and enterprises, etc. At the country level it occurs through a diversified source of export earnings and import needs.

Risk coping or loss management strategies are those that smooth consumption intertemporally through saving and dissaving for individual households, or through risk pooling. Intertemporal consumption smoothing can be obtained through borrowing and lending in formal or informal credit markets, and by accumulating and decumulating assets. Risk pooling can be obtained through formal insurance institutions of the type prevalent in all OECD countries, or through informal mechanisms like inter-household transfers (such as borrowing from family and friends). The difference between this type of strategies and the risk management ones is that the loss management ones become operational after an unfavourable "state of nature" is revealed, while the risk management ones pertain to actions before the state of nature is revealed. For instance a farmer will plan ahead his product mix, and might buy some crop insurance. If a storm destroys part of his crop he will claim compensation from his insurance, which in this case is his loss management strategy.

The basic strategy for LIFDCs to minimize adverse consequences of excessive food imports is to diversify their production structure. It has been shown, for instance (see e.g. Sarris, 1985) that there are very large expected gains to be made by reallocations of agricultural production structures in ways that minimize the country's exposure to international price risks. Some of these reallocations might run contrary to popular beliefs, those for instance, that claim that self sufficiency in basic food production is the best insurance strategy. Of course, every country's minimum risk exposure strategy will imply a different optimum production structure, given its resources and technology available.

Farmers in all LIFDCs have a variety of traditional strategies for both risk management as well as loss management. They include crop and income diversification, private stockholding, development of large social and clan networks for mutual assistance, etc. (For a review of these mechanisms see Platteau, 1991). These strategies are largely self financed. Governments in LDCs have not been able to provide viable alternatives to these self insurance mechanisms. For instance, in times of drought, low income food producers in LDCs lose purchasing power and would need to purchase food at low prices, but it is normally at such times that domestic prices are high, and this could occur because the government cannot import and distribute enough food to keep prices low, and supply those without adequate incomes or purchasing power.

There are three types of instruments that Varangis and Larson (1996) suggest can deal with commodity price uncertainty. One set aims at making commodity prices less variable. The other aims at smoothing income flows, while the third set tries to make prices and revenues or expenditures more predictable. Instruments of the first type include international commodity agreements, government support programs (commodity stabilisation funds, variable levies, etc.). International agreements do not seem to have worked, for reasons having to do with both the inherent market uncertainties, as well as the lack of adequate resources to stabilise the world market for a given commodity. Government programs are often designed for support and not for stabilisation, with the consequence that they quickly run into financial problems, unless backed with considerable resources.

Programs aimed at smoothing income or expenditure flows must provide resources to compensate for short run increases in expenditures. They tend to react to ex-post developments rather than provide ex-ante management and hence belong to the class of loss management tools. The IMF compensatory financing facility, and the EU STABEX programs belong to this class of instruments. Given, however, the time lags with which they both operate, they do not normally compensate a government or food deficit households within a country at the time of loss, and hence cannot serve the loss management function efficiently.

Instruments that try to make prices and revenues or expenditures more predictable are those based on commodity derivatives, such as futures, option, swaps and combinations of these. Such programs will not reduce the price risks faced by producers or governments, but will rather permit them to plan their risk exposure more rationally, and hedge the risks for an appropriate price. The problem with most of these instruments is that, besides the technical sophistication required for their application, they require considerable amounts of capital for proper implementation (margin requirements, cost of options etc.), something that is rather scarce in LIFDCs. While some governments have started using such market based instruments for offering better risk management to their farmers, (for instance the US, Canada, and Mexico), the resources required are still much beyond the reach of most LIFDCs.

Consider the government of a LIFDC that must take the structure of external markets as given (namely it is a small country by world market standards), and which does not have access to any short term compensatory aid in periods of excess foreign exchange needs, and cannot borrow externally to cover its short term foreign exchange needs. Periods of excess foreign exchange needs might result from sudden declines in export earnings and/or from sudden increases in import costs. What are the strategies that such a country can follow to lessen the impact of domestic and external variability?

Clearly in the absence of the possibility of external short term aid, or borrowing, the country must absorb all shocks by itself. There are thus two types of strategies. The first one has to do with minimising the risk exposure of the country to international and domestic fluctuations, while the other one involves some sort of intertemporal self insurance scheme. The first strategy is a long term one, and involves altering the domestic production structure. Such a strategy involves technological, public investment, and price policies, in order to provide the proper signals to domestic producers. Such policy choices are not always easy, and sometimes are not even well understood, but can be helped considerably by proper analysis that can point out the rational choices from a societal viewpoint. When externalities arise in the sense that there are deviations between private and social benefits, government intervention is in order in the form of some type of price or commercial import policy.

The second type of strategy involves an intertemporal public insurance system. Buffer funds and buffer stocks illustrate possible schemes. All of them require some saving in "good" times and dissaving in bad ones. Apart from the technical problems of how much to purchase or save, and when, most LDC governments have found it very difficult to "save" by these means, given the many pressing needs of their countries. This implies that they cannot provide a credible insurance instrument for their citizens, and this forces the citizens to self-insure themselves. This in turn tends to result in too large an amount of resources devoted to self insurance and much less for real investment and growth. In other words if governments could be rational in their buffer saving programs, this would lessen the need by private individuals to self insure, and in aggregate this would tend to devote fewer resources to liquid savings. The argument is similar to that required to show that financial intermediation is good for growth (see Bencivenga and Smith, 1991).

A possibility for the governments of such countries would be to provide for a cost the possibility of some type of disaster insurance to their vulnerable citizens, much like both governments as well as private companies in developed countries have tried to do with DC farmers. Such an insurance strategy could be reinsured by the government in international commodity markets by among others options or swaps. The problem is that to make such an insurance system viable requires considerable premiums. Also as governments and crop insurance companies in developed countries have found, the private domestic market for such type of insurance is small, even if the premiums are subsidised. If the premiums charged to domestic citizens are not large, then the government will have to incur large costs, and these will normally not be bearable by the governments of poor countries (for a discussion of insurance and other risk management instruments for farmers of developed countries see Sarris , 1997b). A-fortiori if the intended recipients of the insurance within a country are poor then the cost to the government will be even higher.

Consider now the extension of the above reasoning, in the case where the government can borrow for short term or long term. Clearly one option for the government is to try to guide the domestic production pattern so as to achieve a better exposure of the country to international risks, as discussed earlier. In addition, short term excess expenditure could be financed externally, with excess income in other periods used to pay back the loans. With the proper use of swaps, options and reinsurance such a loss management strategy can indeed be viable, if the country can master the resources for the premiums to do this in a non-subsidised manner. The IMF compensatory facility is intended to provide short term finance of this type with some element of subsidy, but the conditionalities applied with this seem to be resented by many LDCs.

Finally an option is that some foreign country or set of countries cover all the costs of excess food imports or other contingencies. Clearly this is an unrealistic situation except in very few cases, and most governments would not want to be so dependent in any case.

A Proposal for an Instrument to Assist the LIFDCs to Cope with World Market Instability

The idea outlined briefly here follows from the short discussion above. It is aimed at providing an instrument that could compensate the LIFDCs in periods of need. The initial assumption is that a LIFDC has undertaken domestic policies to restructure its production so as to be less exposed to world risks. This, as discussed earlier is a long term project, and one where development aid can contribute both with proper analysis, as well as by providing the inputs to the restructuring effort. This, however, is not necessary for the discussion below, or the proposed instrument. In the sequel it is assumed that the country in question is exposed to some given international commodity risk, because of the structure of its production and consumption.

The idea is basically that developed countries could organise a system whereby they could provide the LIFDC with a **call like option for cereal imports**. Recall that a call option in commodity markets provides the buyer of the option, for a premium equal to the price of the option, the possibility to purchase a long commodity futures contract, namely provides the buyer the option to buy a given quantity of the commodity at a prespecified price (the strike price), within a given period. If the actual price of the commodity at the time the buyer of the commodity wishes to purchase, is lower than the strike price, the buyer does not exercise the option and just loses the premium. If, on the other hand the actual price is higher then the buyer of the option "exercises" the option and gains the difference between the actual and the strike price. It seems clear that for planning purposes it would help the governments of many LIFDCs to have such options. The problem is that although such options are available in organised commercial exchanges, the premiums required are not trivial. Also many countries are too small to be able to do this themselves in terms of both technical expertise as well as credit worthiness.

The idea, therefore, is that the developed countries design some type of **fund, which would provide subsidies to LIFDCs for purchasing option like contracts (that would be offered by the fund) of the type discussed above**. The fund would make available the appropriate option like contract to the LIFDC, and would then try to reinsure its own risk exposure with commercial options or swaps, etc. In other words the fund would operate like a financial intermediary in an international context, with the proviso that it would have a given element of subsidy to make it attractive to the LIFDCs. Gradually, when the countries themselves become sophisticated enough or large to apply such instruments themselves, the element of subsidy could be reduced, and gradually phased out. The proportion of the premium for which the LIFDC would be liable would be a matter of negotiation between the fund and each country, and could vary by country.

The operation of the fund would be as follows. At any time, normally well before the start of a country's crop year, the fund would examine the world markets and would decide the premiums at which it would make purchase contracts available to the LIFDCs, and the time periods over which the contracts would be enforceable. The LIFDCs would then have the possibility to contract with the fund for this call option like contract. If the need arises for the country to purchase cereals in the world market, then if the world market price is below the strike price there would be no need to exercise the option like contract and the country would just import the amounts at the prevailing world prices. If, however, the world price is above the strike price, then the fund would pay the LIFDC the difference between the world price and the contract strike price. This would give a bonus to the country exactly at the time it needs it, namely when the world prices are highest. In essence the fund would act as an international food import insurance agency whose premiums would be subsidised.

The main advantage of a fund of this type (one could call it the Fund for International Commodity Income Risk Management, FICIRM) would be that it would achieve economies of scale both for financial intermediation, and also for risk pooling from the various LIFDCs). It should not be too expensive from the donor countries perspective, as much of the risk could be hedged in commercial exchanges. A fund of this type could be expanded and also help insure the risk of export commodity declines by providing **put like options** (namely options to sell, rather than buy, future contracts). The idea is similar to the one relevant for the call like options. In fact it seems that such a fund could come much closer to the original spirit of STABEX, than the current STABEX operation. An added major advantage of such a fund would be that it would be a pure financial instrument, and would not handle any physical commodity itself.

From the viewpoint of the LIFDCs, it would put the burden of decisions concerning timing and magnitude of any imports strictly on their hands, and would free them to plan better. Currently, when a crisis occurs many LIFDCs start scrambling internationally for funds and food aid, and it is only after considerable time, given the various bureaucratic procedures of the various governments and other bodies involved that the actual supplies arrive in the country, and many times after the crisis is past. A fund of the type described above would avoid all these problems because it would let the counties themselves decide on when and how much to purchase.

A fund of the type envisioned here, would provide the LIFDCs with internationally backed insurance against sudden excess import expenditures. The amount of insurance provided would be decided jointly by the country and the fund, and the amount of subsidy could vary depending on the amount that the country would like to insure. For instance if the country wants to buy excessive amounts of insurance, then the marginal subsidy could become lower.

From the developing country perspective a fund like this would provide it with considerable flexibility in terms of planning. It could combine it with the available short term financing facilities, in the sense that it could choose the share of risk to cover through the fund, with a subsidy and an up-front cost, and the share to leave uncovered, which might possibly cost more. However, it would guarantee the LIFDC that it has the option to purchase certain amounts at maximum prices, and hence would limit potential losses.

While commercial option contract are available for short periods, usually not longer than a year, the fund could try to make available to the LIFDCs multiyear option like contracts. These would amount to multiyear insurance against import needs, and could be covered by the fund by some type of swap like arrangement with commercial banks in developed countries. Again the premium for such contracts could be substantial and an element of subsidy would be in order.

It must be understood that a fund of this type would not guarantee to the LIFDC the amounts of foreign exchange needed to purchase extra food imports in periods of need. It would just guarantee that the amount of foreign exchange would not be too large because of large world price rises. This, of course might not be desirable from an insurance viewpoint from the LIFDC viewpoint, as the largest excess cost in a year of excessive food deficit normally comes from the need to import larger quantities and not from higher prices. One might think then to expand a fund of the type described above to include quantity risk, much like the disaster insurance programs operational in many developed countries. These programs, however, have many requirements, not the least of which is an assessment of the loss by independent assessors. While estimates of production losses are possible for individual producers, LIFDCs would normally need to insure against excessive imports. Estimates of import needs in a period of difficulty would be much more difficult to make, and would create problems of both data as well as assumptions about other adjustment mechanisms in the country. In any case since foreign exchange is malleable there would always be an incentive for the LIFDC government to overstate the need, in order to collect more insurance, and this would create problems. This implies that such a scheme would suffer from adverse selection and moral hazard problems, and would not be viable without a substantial amount of foreign subsidy. Hence in the short run, the best chances for success would be for a fund of the type described earlier.

Conclusions

The main points of the paper are the following. The analysis of the changing pattern of world cereal instability has led to several conclusions. First, it was demonstrated that annual cereal prices, whether on a calendar, or crop year basis, nominal or real seem to be described best by Trend Stationary (TS) time series processes. This implies that any temporary shocks to the world cereal markets do not leave permanent effects on prices. This is an important conclusion, and one that merits further investigation with longer time series. This, conclusion does not negate the possibility of structural breaks in the cereal markets, but it must be realized that structural breaks are once and for all events, that have permanence. Subsequent random shocks are not expected to lead to any permanent changes. The analysis of Leon and Soto (1995) is a good methodological step in the right direction. A topic for further research is a longer term analysis of world cereal prices, with the purpose to identify structural breaks in the series, and especially after 1973-75. That period has been considered by many as important for changing the world cereal market scene, but no-one has analyzed using modern time series tools the type of structural break that occurred then.

The analysis of inter-year price variability of cereals concluded that there does not appear to be an increasing degree of inter-year variability in world cereal markets. Recent events do not appear to manifest anything considerably unusual, or much outside the range of normal annual variations. It was observed that there appears to be some tendency toward increased volatility in the most recent period (1995-96) but it is difficult on the basis of very few observations to be definitive.

Finally the analysis of the intra-year price variability concluded that there does not seem to be any tendency for the coefficients of variation of monthly seasonal prices to increase over time, and if any, the tendency is towards a decline.

The overall answer then to the question of whether the world cereal markets have become more unstable recently is "No." This, of course does not answer the next logical question, which is whether these markets have become more stable. Trade liberalization and the opening of several hitherto closed or state controlled markets would suggest that this should be the case. The econometric tests, performed, are too weak for a conclusive test of this hypothesis, just as they are weak for the test of the increased instability hypothesis, and clearly more data is needed for a better analysis. Until such data becomes available, it is probably reasonable to accept that the structure of world price behaviour does not seem to have changed much in the last two decades.

Concerning issues of food security and risk exposure of developing countries, the LIFDCs can, by restructuring domestic production, go a long way towards minimising their risk exposure in international markets. Developed countries can provide technical assistance towards that end. There are probably too many resources devoted in LIFDCs by households to self-insurance, given the lack of publicly provided insurance schemes. This has the tendency to lower growth. The LIFDCs would probably benefit from internationally provided insurance.

The paper proposed the institution of a fund aimed at providing option like contracts to the LIFDCs, to insure that they would not incur excessive costs in times of need. The premiums of such contract could be subsidised by developed countries, as part of their overall aid. While such a fund would not provide full insurance against excessive food import bills, it would go part of the way toward such a goal. The cost to developed and developing countries alike would seem to be smaller than the cost of current arrangements, and the benefits would seem larger. These, of course, would need further study for proper implementation.

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