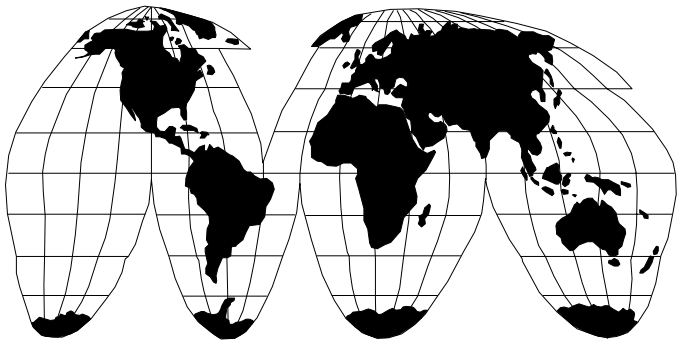
Policy Reform, Market Stability, and Food Security

Proceedings of a Conference of the
International Agricultural Trade Research Consortium



Edited by Robert Paarlberg and Terry L. Roe

September 1999

The International Agricultural Trade Research Consortium

Policy Reform, Market Stability, and Food Security

Proceedings of a Conference of the
International Agricultural Trade Research Consortium
(June 26-27, 1998)

Edited by Robert Paarlberg and Terry L. Roe

September 1999

Paarlberg, Robert and Terry L. Roe, editors (1999). Policy Reform, Market Stability, and Food Security. St. Paul Minnesota: University of Minnesota, Department of Applied Economics, International Agricultural Trade Research Consortium.

Additional copies are available from the
International Agricultural Trade Research Consortium's web site:
<http://www.umn.edu/iatrc>

Preface

The International Agricultural Trade Research Consortium (IATRC) is a group of 160 economists from around the world who are interested in fostering research and providing a forum for the exchange of ideas relating to international trade of agricultural products and commodities. Each summer the IATRC sponsors a symposium on a topic related to trade and trade policy from which proceedings are published.

This volume contains the main papers that were presented at an IATRC symposium which focused on **Policy Reform, Market Stability, and Food Security**. It was held June 26-27, 1998 in Alexandria, Virginia and was co-sponsored by the Center for International Food and Agricultural Policy, Department of Applied Economics, University of Minnesota. For this conference, the IATRC also received support from the US Agency for International Development. The program was organized by Robert Paarlberg, Wellesley College, and Terry Roe, University of Minnesota. David Orden, Virginia Polytechnic Institute and State University, served as IATRC Executive Committee Liaison.

Long-term support of IATRC activities are provided partially by the Economic Research Service and the Foreign Agricultural Service of the US Department of Agriculture, from Agriculture and Agri-Food Canada, and from the IATRC members' home institutions.

The IATRC and the editors acknowledge the assistance of Laura Bipes of the University of Minnesota in arranging the symposium and the contribution of her time by the Department of Applied Economics. We also recognize the contributions of the discussants and other participants whose comments are reflected in the final versions of the papers. Our sincere appreciation is extended to Susan Pohlod who provided editorial assistance and prepared the camera-ready copy for this publication.

All authors participated as private individuals, and the views expressed should not be taken to represent those of the institutions to which they are attached, the IATRC, or its funding agencies.

A complete list of past IATRC conferences and related publications, including proceedings, commissioned papers and working papers, is available on the IATRC web site: <http://www.umn.edu/iatrc>

Table of Contents

List of Contributors

1. Christopher B. Barrett
   Department of Agricultural, Resource
   and Managerial Economics
   351 Warren Hall
   Cornell University
   Ithaca, NY 14853-7801

2. Cheryl Christensen
   United States Department of Agriculture
   ERS/MTED
   1800 M Street, NW
   Washington, DC 20036-5831

3. John Lewis
   Office of Agriculture and Food Security
   U.S. Agency for International Development
   Room 2.11 RRB
   Washington, DC 20523-2110

4. Alex McCalla
   The World Bank
   Rural Development
   1818 H Street NW, Room S-8055
   Washington, DC 20433

5. Robert Paarlberg
   Department of Political Science
   Wellesley College
   Wellesley, MA 02181

6. Bonnie Raquet
   Cargill, Inc.
   1101 15th Street, NW, Suite 1000
   Washington, DC 20005

7. Mark Ravallion
   The World Bank
   1818 H Street NW, Room S-8055
   Washington, DC 20433

8. Claudia Ringler
   International Food Policy Research Institute
   Environmental and Production
   Technology Division
   2033 K Street NW
   Washington, DC 20006

9. Mark Rosegrant
   International Food Policy Research Institute
   2033 K Street NW
   Washington, DC 20006

10. Alexander Sarris
    Department of Economics
    University of Athens
    8 Pesmazoglou Street
    Athen, GR-10559, Greece

11. G. Edward Schuh
    Hubert H. Humphrey Institute
    Public Affairs
    University of Minnesota
    301 19th Avenue S.
    Minneapolis, MN 55455

12. Jerry Skees
    Department of Agricultural Economics
    Room 310 Ag Eng Bldg.
    University of Kentucky
    Lexington, KY 40546

13. T. N. Srinivasan
    Department of Economics
    Yale University
    28 Hillhouse Avenue
    New Haven, CT 06511

14. Peter Timmer
    HID, Room 504
    Harvard University
    1 Eliot Street
    Cambridge, MA 02138

Foreword

The symposium focused on the world market for food in an environment where many of the major food exporting countries are allowing market forces to increasingly influence producer incentives, an environment where public and private stocks of food grains are at all time lows, an environment characterized by the apparent decline in resources to provide food aid to impoverished nations, and an environment in which many nations seem increasingly vulnerable to world market shocks. Faced with the uncertainties this new environment presents, concern has surfaced that in spite of the commitments made by wealthy nations in the November 1996 World Food Summit, food deficit nations may reconsider their willingness to open their economies to world markets.

The symposium was divided into six sessions. The first dealt with world food markets and food aid. In the lead paper, Mark Rosegrant and Claudia Ringler explore the impacts of the Asian economic and financial crisis on global food supply, demand, and trade and food prices. The analysis is carried out based on IFPRI's IMPACT global food model - which covers world food production and consumption for 18 agricultural commodities - to compare three scenarios through 2020. The baseline scenario reflects the economic trends prevailing before the onset of the crisis. In the severe Asian-crisis scenario, the short-term effects seen so far in Asia are assumed to worsen significantly. In the moderate Asian-crisis scenario agricultural commodity prices rise to half the severe-scenario levels and income growth rates almost recover to pre-crisis levels. They find that the effects of long-term trends on global food demand and supply are relatively robust to changes in the Asian economies, although trade patterns are affected by the crisis. Under the baseline, developing countries are expected to be the major source of growth in food demand. The authors estimate that, by 2020, a full 84 percent of the increase in global cereal consumption and nearly 90 percent of the increase in global meat demand will come from developing countries. Moreover, Asia emerges as a major player in global cereal and livestock markets in the coming decades. This role is unlikely to be threatened by the current economic crisis in the region. In terms of the pattern of trade, they find that a severe and long lasting Asian crisis is likely to have a relatively large global impact on world livestock markets with China and several Southeast Asian countries shifting from import to export positions in livestock. Moreover, the severe crisis case is expected to lower the export earnings from food by $12 billion for the case of the United States and by $10 billion for Western Europe and other developed food exporters. The most devastating impact of a severe crisis would be on the food security of Asian countries. For Asia as a whole, an additional 16 million children will likely be malnourished in 2020, compared to the baseline scenario.

The second paper focused on the new policy environment for food aid with special attention to Sub-Saharan Africa. In this paper, Cheryl Christensen suggests that food aid decisions are being made in a new policy environment. As opposed to government-to-government programs, which typified food aid from the late 1950s through approximately the Uruguay Round of trade negotiations that concluded in the mid 1990s, the new environment includes a large number of non-government organizations all of which face rather stringent budget constraints. She traces out the evolution of this change by showing that food aid now plays a small role in world grain markets. Moreover, food aid is no longer linked to agricultural programs in the major food exporting countries, and it is no longer a significant instrument affecting the well being of US or European farmers. Thus, the role of these historically important interest groups in encouraging food aid has greatly diminished. Nevertheless, food aid needs are not declining. Chronic food insecurity threatens Sub-Saharan Africa

as a result of consistent human conflict and persistent droughts. As a result, food aid requirements in this region are likely to double over the next decade. Because food aid is now given mostly in times of emergencies, the major distributors of food aid are non-governmental organizations. Also, given the recent Administration's budget reduction program, the actual quantity of food aid provided depends not only on the appropriated outlay but also on the price of commodities. She concludes that it is conceivable that in times of high prices, a given food aid budget may well translate into smaller quantities of delivered commodities. Thus, the future effectiveness of food aid programs will be increasingly determined by the design of programs which deal effectively with both soft and tight international markets, and programs that can be smoothly interfaced with other strategies for managing risk in a more open world market environment.

The second session of the symposium focused on nutritional deprivation, its incidence and alleviation. The first paper in this session was by T.N. Srinivasan, the second by C. Peter Timmer. Srinivasan focused on poverty and under nutrition in South Asia. He began by pointing out that in 1993, nearly half a billion people, accounting for 43 percent of the population of South Asia, were poor and consumed less than $2 a day. Moreover, the majority of the poor reside in rural areas. He suggested that while this is a striking statistic, the drawbacks of using aggregate international and national poverty measures are that they are poorly linked to measures of health and minimal nutritional status and are poor guides for policy formulation. He discusses in substantial detail the problems with many of the common measures of health and nutritional status, and suggests alternative measures that are instead linked to energy requirements and life cycles. Srinivasan observes that South Asian governments have intervened in food markets, and they have instituted several anti-poverty programs such as subsidized public distribution of food and employment generation projects linked to food. However, he finds the efficiency of these programs in reaching the poor is low and many are costly in that they spend far more resources in transferring than the resources transferred to the poor. He concludes that the only approach to the eradication of poverty within a reasonable time is to adopt development strategies that accelerate growth, keeping in mind that the character of growth, not merely the rate of growth, determines whether or not the poor benefit. Thus, what is needed is a growth strategy that focuses on human capital accumulation, i.e., investment in education and health while ensuring the efficiency of the economy by pursuing sound trade and capital market policies in a more open world environment.

Timmer's paper deals with the macro dimensions of food security, giving particular attention to economic growth, equitable distribution of income, and food price stability. He introduces his paper by pointing out that understanding the factors that cause widespread hunger and vulnerability to famines, and the mechanisms available to alleviate their impact, remain important challenges. He suggests that rather than asking how to cope with hunger and famine, the question might be how to escape their threat altogether. To guide discussion, Timmer briefly outlines his conceptual approach. The approach begins with agriculture and the rural economy being greatly influenced by policies and outcomes in the rest of the economy where agriculture must compete for economy wide resources. He links economic growth to the policy environment and technological opportunities. Important in this structure is achieving economic growth with equity, and attaining stability in both the economic and the political environment. Reasoning from this framework, he argues that escape from hunger and famine can be accomplished through one or a combination of three approaches. First, incomes can grow with no change in income distribution. Second, income distribution can improve with no change in average incomes per capita. Third, the domestic food economy can be stabilized to

eliminate shocks that result in unstable prices which in turn encourage farmers to diversify instead of realizing economies associated with specialization. He suggests that these alternatives rule out the overcoming of hunger in the short run by keeping food prices low, or by the redistribution of income since they destroy the incentives and structures needed to obtain economic growth. The strategies that offer more hope are economic growth with unchanging income distribution, the so called "trickle-down growth," and growth with redistribution. To illustrate, he characterizes India as an example of the former and Asia as an example of the latter. The latter encourages balanced growth to create non-farm employment opportunities while investing in rural infrastructure, education and agricultural research. He notes that Africa poses a special challenge. Relative to Asia, Africa is characterized by greater heterogeneity and complexity of production systems, institutions and cultural relations. This greatly complicates agricultural research, and the application and adoption of best farm practices. He concludes that by largely solving their food problem, Asian governments learned both the appropriate role of government in this process and the careful management of the economic environment required to bring it about. This leaves Africa with a daunting challenge as its population continues to growth and regional conflicts continue to evolve unchecked.

The third session considered the political economy of food. Robert Paarlberg led the session with his paper titled Word Food Markets and Food Security: Uncertain Connections. He introduces his paper with the uncommon view that world grain markets are a poor indicator of food insecurity. The importance of this observation is shown by noting the various concerns raised by the World Bank and others about food security in poor countries being triggered by disturbances in world food markets. In particular, he notes that at the convening of the World Food Conference in Rome in November of 1974, the Director General of FAO described the situation as "grave" even though evidence of below-trend consumption among poor countries was scant at the time. He supports this view by first examining recent per capita cereal consumption trends during times of both high and low world market prices. He finds that per capita consumption in poor countries tends not to respond to world market prices. He goes on to observe that neither the instability nor the unreliability of world grain markets has discouraged food insecure poor countries from depending on these markets more heavily. He then examines what he suggests are the more important non-market sources of transitory food insecurity, sources which are often not given major consideration by agricultural economists, or even by Sen in his influential 1981 book on poverty and famine. These include political malfunctions such as violent civil conflict, policy errors made be non-accountable governments, and natural disasters. He concludes that violent internal conflict is increasingly the most important of the non-market factors affecting transitory food insecurity. He notes that where violent conflict is absent, international food relief in the face of drought is possible and often successful. He qualifies this point by expressing concern that in spite of growing real per capita incomes in the major food exporting countries, their commitment to providing future food aid seems to have declined as agricultural policies have become more market oriented. In this indirect way, the relative scarcity of food in world markets may have significant impacts on food deficit households in poor countries.

The fourth session narrowed to regional dimensions of market stability and food security in order to provide more detailed and region specific insight into these issues. The first paper by Alexander Sarris dealt with the regional dimensions of world cereal price instability and market based schemes for managing the risk of developing country cereal imports. He begins by noting that the conclusion of the Uruguay Round leaves food deficit countries at the vagaries of the world market. He points out that while various international and national schemes have been proposed to help

insulate the poor from these uncertainties, few have been implemented. In this regard, special mention is made of the International Monetary Fund's food import financing scheme of the Compensatory Financing Facility. He first measures the changing nature of year to year world cereal market instability. The general and somewhat surprising conclusion drawn from a careful empirical analysis of the time series on cereal prices is that (a) there does not appear to be an increasing degree of inter-year variability in world cereal markets, and (b) recent events, such as the completion of the Uruguay Round, do not appear to manifest variability that can be considered unusual, or much outside the range of normal annual variations in cereal prices. He then turns to intra-year price variability. His results support the conclusion that, apart from some period of potential increased intra-year variation, there is no evidence to support an increasing trend in the intra-year variability of world cereal prices. He does find that in years of high average prices, the monthly variations in prices also tend to be higher than are the variations associated with years when average prices were lower. He relates these results to the observation that world markets for cereals tend to be thinner when prices are high than when they are low. Sarris then turns to considering the changing world pattern of cereal production and trade and the implications these changing patterns may have on future cereal market instability. He shows that while the total area planted to cereals has not changed, the location of production has changed with a decline in the area in the Former Soviet Union and an increase in the area planted in India and China. To assess how this changing pattern of production might affect instability, he estimates price transmission and production transmission coefficients linking countries to their trade pattern. On the basis of this, he then estimates the proportions of domestic fluctuations transmitted to international markets. The results suggest that in recent years the magnitude of domestic production variations transmitted internationally has increased. This, however, has not resulted in larger world price variability. He concludes his paper with a proposal for an instrument to assist the poor food deficit countries cope with world market instability. The proposal is that developed countries organize a system whereby they provide poor countries with a call like option for cereal imports. That is, to provide poor countries with the option to purchase a long commodity futures contract at a prespecified strike price within a given period. The role of the developed countries is to provide a fund which would subsidize a food deficit country's purchase of an option like contract. It is likely that the level of the total subsidy would be less than the cost of food aid.

The second paper in the session was given by Martin Ravallion. He focused on agricultural policy reform, food prices and poverty in India. He begins his paper by noting the concerns expressed by policy makers regarding the effects on India's poor of higher food prices stemming from the country's recent or proposed policy reforms. The most frequently cited evidence is the strong positive correlation between the relative price of food and India's poverty rate. The purpose of the paper is show that there are many other factors affecting the plight of India's poor, many of which are just circumstantially associated with the rise in food prices. He suggests that focusing on this correlation could actually lead to policies which further exacerbate the plight of the poor. The empirical thrust of the paper is to unravel the mystery behind the positive correlation (about 0.79) between the rural poverty rate and the relative price of food. The first empirical result is that the food price - poverty correlation vanishes in measures of relative poverty (such as the Gini index of overall inequality). This result also implies that the positive effect of higher food prices on the incidence of absolute poverty is transmitted through average consumption, not via the worsening of the distribution of consumption. The next question is whether the correlation is due to the method of deflation? The analysis of this question reveals another puzzle: namely, that higher food prices for the main

agricultural output leads to lower average rural living standards. How is this possible, given that the rural economy as a whole must be a net supplier of food, in which case average consumption expenditure on all goods should rise with higher food prices. Further investigation reveals that this correlation is spurious, i.e., the data cannot be used to support the view that a sustained increase in the relative price of food will hurt the rural poor. Is it possible that the positive correlation is due to "third" variables? The logic is the following. Is it possible that in good agricultural years rural living standards rise and fall in bad years? At the same time the price of food will tend to be higher in bad agricultural years, and fall in good years. In this case, a positive correlation between a rise in price and a rise in the poverty rate will emerge, but it is spurious, being instead attributable to a common third variable, farm output. The analysis of the data largely confirm this result, although additional "third" variables are suggested. One of these appears to be the savings behavior of households in inflationary periods which tend to correspond with high food prices. Overall, Ravallion concludes that the analysis casts considerable doubt on the policy implications otherwise drawn from the positive correlation between the price of food and rural poverty. While in the short run there may well be some negative effects on the poor caused by reforms that lead to higher food prices, the data do not support such a conclusion in the longer term.

The fifth session focused on food aid and capital markets as food policy instruments. The first paper by Christopher Barrett deals with the question: does food aid stabilize food availability? The second paper by Jerry Skees addresses the role of capital markets in dealing with natural disasters and whether these markets might be used to resolve at least part of the food security puzzle. To address the question of his paper, Barrett explored the empirical relationship between food aid flows per capita from the United States' PL480 programs and non concessional food availability per capita in PL480 recipient economies. If food aid stabilizes food availability, then per capita food aid flows should be inversely related to recipients' per capita non concessional food availability in terms of levels, deviations from trend, or both. He used data over 124 different recipient economies representing all PL 480 recipients during the period 1961-95 other than Japan and developed European economies. In summarizing the data he observes that over the sample, PL 480 flows rarely comprise more than a negligible proportion of total food availability in recipient countries. This suggests that food aid can play, at best, a very limited stabilizing role. He finds that across the 124 PL 480 recipient countries, the median annual growth rate in per capital cereals production was -0.2 percent. The data suggest that commercial cereals imports were used to make up for the average annual decline in production. His analysis of trend growth rates in production supports the intuitive hypothesis that faster growth in cereals productivity tends to bring with it greater stability in per capita production. He also finds that while commercial cereals trade plays a crucial role in stabilizing food availability in low and middle income countries, binding foreign exchange constraints appear to nonetheless limit the capacity of poorer countries to dampen food supply volatility through commercial markets. Evidence in this regard is the result that the standard deviation of non concessional food availability remains more than three times the world standard deviation around trend. Of the 124 countries, 122 experienced more variable non concessional food availability than the global rate. He then turns to an analysis of the responsiveness of PL 480 to food needs. He begins by noting that there are at least four reasons to be skeptical about the effectiveness of PL480 food aid in dampening variability in recipient country food availability. First, previous studies suggest that food aid appears to be driven by geopolitical considerations, that PL480 flows have shown greater persistence over the years than is consistent with the claim that they respond to transitory non concessional food availability shortfalls, that PL480 flows have proved pro-cyclical in aggregate, not

counter-cyclical, and fourth, until quite recently, few good early warning systems existed to anticipate emergencie3s accurately so food aid deliveries are largely reactive and often ill-timed. The empirical results largely support the view that PL480 food aid has contributed negligibly to aggregate food availability in food recipient economies. Some evidence supports the view that PL480 has been distributionally progressive, but not that it has stabilized food availability. He concludes that improving food security and nutritional outcomes around the world will require dampening the extraordinary variability in per capita food availability in low income economies. Improved food productivity and commercial international trade appear far more useful than PL 480 food aid in achieving that objective.

The final paper by Jerry Skees evaluates market based mechanisms for dealing with the consequences of natural disasters, such as drought, that reduce domestic food supplies. As a point of departure, he observes that, effectively, farmers are paying an insurance premium when they diversify and thus give up higher expected income in order to reduce the variation of income. Likewise, if the firm decides to limit the use of credit below a level that may be optimal, the opportunity to borrow funds will be open in the event of a major disaster. Again, there is an opportunity cost associated with maintaining a credit reserve for major disasters. If farmers do not have the means to manage catastrophic risk from natural disasters, bankers will be forced to internalize these risk in some fashion. Effectively, the presence of risk leads to the allocation of resources in a way that tends to forego higher resource returns. The challenge is to invent alternative mechanisms to minimize these otherwise foregone returns. In the second part of his paper he reviews briefly the various attempts governments have made to manage risks caused by natural disasters, and notes the many problems that often encountered in such programs. The third part of the paper considers the advantages of using index contracts to insure natural disasters. One index contract that receives detailed consideration is a rainfall index. He suggests that a rain index contract may be preferred to in the case of many countries because they likely have better statistics on rainfall shortfalls or excess rain than they do on crop yields. Second, it is less costly to set up a system to collect rainfall for specific locations than it is to develop a reliable yield estimation procedure. He points out and then analyzes in more depth three basic alternatives that merit serious consideration: 1) a zero-one contract that pays all liabilities when cumulative rain is at or below a specified level (presumably, a level corresponding to complete crop failure in a particular region or country), 2) a layered contract that pays an additional fixed amount depending on the degree to which a particular producer is affected within a region or country, and 3) a percentage contract that pays based on percentage below the level corresponding to varying degrees of crop failure in a region or country. He concludes that the case for using a rainfall index in developing countries rather than traditional crop insurance is strong. Among the more important advantages is the absence of moral hazard and adverse selection.

The symposium was concluded with a panel discussion by Alex McCalla, of the World Bank, Bonnie Raquet, of Cargill, Inc., John Lewis, of the US Agency for International Development, and G. Edward Schuh, Regents Professor, University of Minnesota.

Asian Economic Crisis and the Long-Term Global Food Situation

Mark W. Rosegrant & Claudia Ringler

Introduction

After a decade or more of rapid economic growth, many of the countries of East and Southeast Asia are now facing serious economic and financial problems. Between mid-1997 and the spring of 1998, the currencies of four Southeast Asian nations (Indonesia, Malaysia, the Philippines, and Thailand) and of South Korea have fallen by 40-80 percent against the U.S. dollar, precipitating a financial and economic crisis whose full impacts on global food markets are still unknown. Between July of 1997 and March of 1998, the Indonesian currency depreciated by 67 percent in real terms, and is still spiraling downwards; the Malaysian currency depreciated by 35 percent by January 1998, to apparently stabilize at a rate about 25 percent below the pre-crisis level around March 1998; the Philippine currency dropped by 24 percent by January 1998, before strengthening to around 17 percent below pre-crisis levels in March 1998; the Thai currency fell by 33 percent by January 1998, to recover to about 15 percent below pre-crisis levels by March 1998; and the South Korean exchange rate fell by 36 percent by January 1998, and apparently stabilized at about 26 percent around March of 1998 (Liu et al. 1998a,b). The exchange rate in Japan fell significantly during June 1998, and pressure on China to devalue has increased.

As a consequence of the crisis, the growth rate expectations for gross domestic product (GDP) for East and Southeast Asian countries have been sharply revised downwards: in the most recent estimates, Indonesia's 5 percent GDP growth rate in 1997 is expected to decline to -8.8 percent in 1998; South Korea's rate of 6 percent is expected to decrease to -0.8 percent, and Thailand's growth rate is projected to drop from about 2.5 to -6.0 percent (Radelet and Sachs 1998). The changes in exchange rates and income growth may significantly alter the international pattern of trade competitiveness. Whereas the internal demand in the affected Asian countries is expected to decline substantially, their recovery will be based, in part, on successful increases in exports to some of the larger developed markets, like the United States and Western Europe. Developed countries are also expected to be negatively affected by developments in Asia, with the severity of the impact depending on their respective trade and financial links with Asia and on their relative economic and financial pre-crisis positions.

Due to its higher protection rates, the agriculture sector is not expected to be as strongly affected, in terms of value and volume, as other sectors. Nevertheless, substantial shifts in the trade regimes, net exporting and importing positions, patterns of crop and livestock production, and even the dietary patterns in some Asian crisis countries can be expected. So far, evidence on agricultural production and trade impacts of the crisis is scant and focused on short-term outlooks. The United States Department of Agriculture, for example, expects agricultural exports of the United States to

decline by 3-6 percent over the next two years due to the effects of the Asian crisis. The largest share of the expected US$2 billion export decline in fiscal year 1998 will be in high-value commodities, such as horticultural products, red meats and poultry, and processed products, which are more price- and income-sensitive than bulk commodities. However, in fiscal year 1999, the negative effect on bulk commodity exports is expected to become more pronounced (USDA 1998). San, Rosegrant and Perez (1998) explore potential consequences of the financial crisis on Indonesian crop and livestock production, based on an integrated grain and livestock sector partial equilibrium model. Their results indicate that the economic crisis could severely slow the process of diversification of Indonesian diets and growth in food consumption if income effects are prolonged into the next century.

Liu et al. (1998b) analyze the effects of the Asian crisis based on a computable general equilibrium (CGE) model consisting of 17 regional models, each with 14 sectors (3 of them agriculture), and five primary factors of production. The authors find that the major changes take place in the manufacturing and service sectors that are less regulated than the agriculture sector. The results show that the greater part of the external adjustment comes from declines in imports rather than increases in exports and that the increase in net exports tends to be concentrated in labor-intensive manufactures. The traded-goods sectors in developed economies, on the other hand, are hit by falling demand in Asia for exports and rising competition from Asia for their domestic-import competing sectors.

This paper focuses on the potential long-term global agricultural impacts of the Asian financial crisis, exploring possible impacts on developments in global food markets and trade, and on regional agricultural supply and demand.[1] The long-term effects of the crisis on income growth and real exchange rate depreciations are highly uncertain at this point, making it difficult to assess their potential impacts on global food markets and food security. Therefore, in this paper, possible impacts are examined through a comparison of three alternative scenarios using IFPRI's IMPACT global food model. The baseline scenario reflects the conditions prevailing prior to the onset of the crisis. In the second scenario, the "severe Asian crisis scenario," it is postulated that the short-term effects seen so far in Asia will significantly worsen, causing long-term real currency devaluations and sharp drops in long-term income growth rates in the region. In the third "moderate Asian crisis scenario" it is assumed that the final devaluation will be smaller, and that the long-term income growth rates will recover to closer to pre-crisis levels.

After a brief description of IMPACT, the assumptions governing the three scenarios are specified; then, the results for growth in cereal and meat demand, production, world prices, and international trade to the year 2020 are presented. The impacts on food security are examined through projections of the number of malnourished children under the three scenarios.

---

[1] It is assumed that the crisis will have persistent real effects. For an elaboration of this "fundamentalist" perspective, see Liu et al. 1998b.

IFPRI's IMPACT Global Food Model

The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) covers 37 countries and regions (which account for virtually all of world food production and consumption), and 18 commodities, including all cereals, soybeans, roots and tubers, meats, milk, eggs, oils, oilcakes and meals. The model is specified as a set of country-level supply and demand equations. Each country model is linked to the rest of the world through trade. World food prices are determined annually at levels that clear international commodity markets. Demand is a function of prices, income and population growth. Growth in crop production in each country is determined by crop prices and the rate of productivity growth. Future productivity growth is estimated by its component sources, including crop management research, conventional plant breeding, wide-crossing and hybridization breeding, and biotechnology and transgenic breeding. Other sources of growth considered include private sector agricultural research and development, agricultural extension and education, markets, infrastructure and irrigation. The basic methodology of IMPACT is described in detail in Rosegrant, Agcaoili-Sombilla, and Perez (1995).

The results presented here are generated from a revised and updated version of IMPACT. The updated model incorporates additional features in its structure and input data that improve its projections capability on both the supply and demand sides. Modifications of the model structure are reflected primarily in the supply and demand equations. In the supply equation, the marginal contribution of further expansion of irrigated area is incorporated in the area function through potential increases in cropping intensities, and in the yield function through the addition of a yield differential between irrigated and non-irrigated crops, that represents the improvement that will be realized with the conversion of farm areas into irrigated ecosystems. The demand side of IMPACT incorporates the dynamic adjustment of income elasticities with respect to growth in income. Adjustments have also been made to some of the elasticities, based on recent studies and surveys. In addition to the modifications in the model structure, the baseline data on which the projections are made is updated from 1990 to 1993. This enables the model to reflect more accurately the most likely trends of commodity markets, incorporating the effects of policies implemented from the late 1980s to the present. The revised IMPACT also includes the November 1996 revised population projections from the United Nations (UN 1996), and updated information on investment in agricultural research (see also Rosegrant et al. 1997).

Specification of Scenarios

In the scenario simulating a severe Asian crisis, domestic agricultural commodity prices due to the exchange rate depreciation are assumed to increase in 1998 by 10 percent for South Asia, by 30 percent for some Southeast Asian countries (Indonesia, Malaysia, the Philippines, and Thailand), by 20 percent for the other Southeast Asian countries, by 10 percent for China, by 30 percent for South Korea, and by 20 percent for other East Asian countries. Agricultural commodity price effects of the currency depreciation under the moderate Asian crisis scenario are assumed to be one-half of

these levels. These additional wedges between international and domestic prices are assumed to be maintained throughout the projections period to 2020.

The income assumptions for Asian countries under the alternative scenarios are shown in Table 1. Under the severe crisis scenario, the average effective income growth rate in 1998-2020 is assumed to be one-half of the baseline income growth rates prior to the crisis. Under the moderate crisis scenario, income growth rates are set as follows: in China to 5.5 percent compared with the baseline value of 6.0 percent per year; in Indonesia to 4.5 percent compared with 6.5 percent per year; in Malaysia to 5.0 percent compared with 6.5 percent per year; in South Korea to 3.5 percent compared with 5.0 percent per year; in Thailand to 5.0 percent compared with 7.0 percent per year; and in India to 5.0 percent compared with 5.5 percent per year in the baseline.

Table 1: Projected annual growth rate in income, 1998-2020, baseline, severe and moderate Asian crisis scenarios

Country/Region	Baseline	Severe crisis	Moderate crisis
		(percent per year)	
Japan	2.8	1.4	2.0
India	5.5	2.8	5.0
Pakistan	5.0	2.5	4.5
Bangladesh	4.5	2.3	4.5
Other South Asia	5.0	2.5	4.5
Indonesia	6.5	3.3	4.5
Thailand	7.0	3.5	5.0
Malaysia	6.5	3.3	5.0
Philippines	5.0	2.5	5.0
Viet Nam	5.0	2.5	5.0
Myanmar	4.0	2.0	4.0
Other Southeast Asia	4.0	2.0	4.0
China	6.0	3.0	5.5
South Korea	5.0	2.5	3.5
Other East Asian countries	2.4	1.2	2.4

Source: IFPRI IMPACT Simulations

These changes in underlying assumptions have a number of effects within the projections model, many of which act in opposite directions. The income scenarios are implemented by shocking non-agricultural GDP. The decline in non-agricultural GDP for Asian countries directly reduces demand for those agricultural commodities that have a positive income elasticity and increases demand for those commodities with negative income elasticities. This reduction also leads to a decrease in area (numbers) and yield growth for crops and livestock through a multiplier effect that represents the change in the rate of investment in agriculture due to the change in non-agricultural GDP. The slowdown in agricultural production growth in turn reduces the growth rate in agricultural

GDP. The increase in domestic prices of agricultural commodities due to the exchange rate depreciation directly increases production and reduces demand for these commodities, and increases agricultural GDP (which introduces some upward pressure on demand). The increase in production and decline in demand for Asian countries in turn tends to reduce real world commodity prices, introducing a downward effect on Asian domestic prices and agricultural GDP. The outcomes of these various effects on supply, demand, and prices are determined through global annual market-clearing equilibria for each of the commodities. These results are presented in the following sections of the paper.

Projections of Cereal and Meat Demand

Projected Demand for Cereals

In the baseline scenario, total cereal demand will increase by 42 percent, from 1,773 million metric tons (mt) in 1993 to 2,511 million mt in 2020 (Figure 1). Among the cereals, maize will show the largest increase in demand, at 265 million mt, followed by wheat, 221 million mt, and rice, 135 million mt. The developing countries are expected to account for 84 percent of the increase in cereal demand and the Asian developing countries alone are projected to account for half of the total increase: China for 21 percent, India, 13 percent, and other Asian developing countries, 15 percent (Figure 2). Global cereal demand for human consumption is projected to grow by 354 million mt or 39 percent over 1993 (Table 2). Cereal food demand will more than double in Sub-Saharan Africa and will increase by more than 50 percent in South Asia and the West Asia and North Africa region. However, growth in demand will be slower than in the recent past, mainly due to a relative shift in consumption away from staple cereals in the diet structures in the rapidly growing developing economies (reflected in declining income elasticities of demand for cereals) and slowing population growth rates over the projections period.

Global per capita cereal food consumption will be virtually constant over the projections period, with slightly declining consumption of cereals at higher income levels balancing slightly increasing demands of lower-income countries. Increases in per capita cereal food demand are highest for South Asian countries at around 8 percent between 1993 and 2020, because of strong income growth and relatively high income elasticities of demand in this low-income region (Table 2). Global growth in per capita food demand for wheat will slow down at 0.08 percent per year during 1993-2020, compared with 0.32 percent per year during 1982-1990 but growth is still faster than for other cereals. Continued growth in per capita food demand for wheat in South and Southeast Asia, at 0.74 and 1.32 percent per year, respectively, will be driven by growth in income and the relative shift in diets from rice to wheat. The dietary transition spurs continued declines in rice demand: developing countries as a group will reduce per capita food demand for rice from 72 kilograms in 1993 to 67 kilograms in 2020. Developing country per capita food demand for maize and other coarse grains (barley, millet, oats, rye, and sorghum) will also continue to be declining or stagnant

Figure 1. Total Demand for Cereals, 1993 and Projected 2020

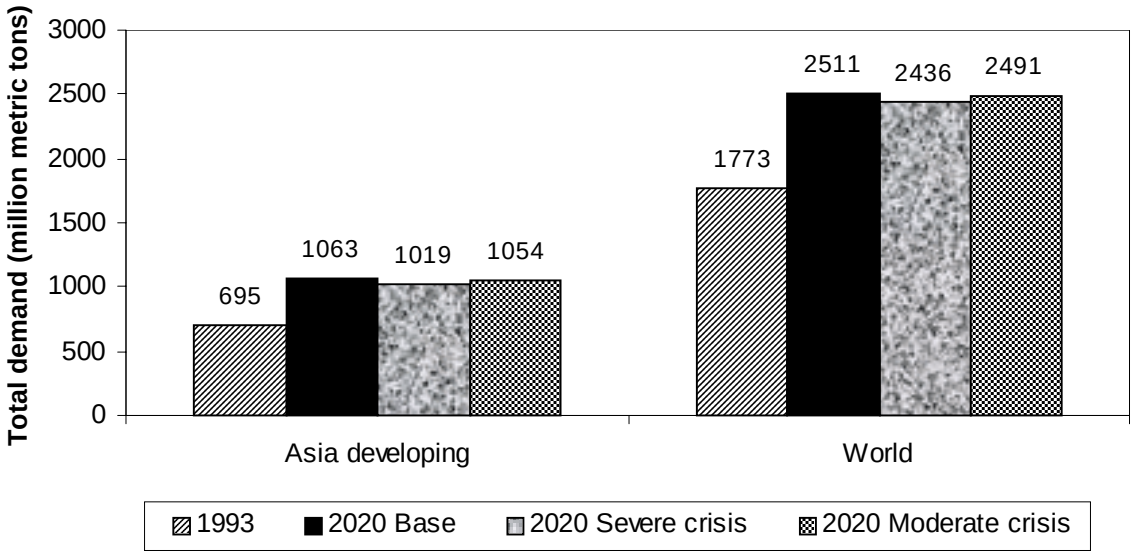
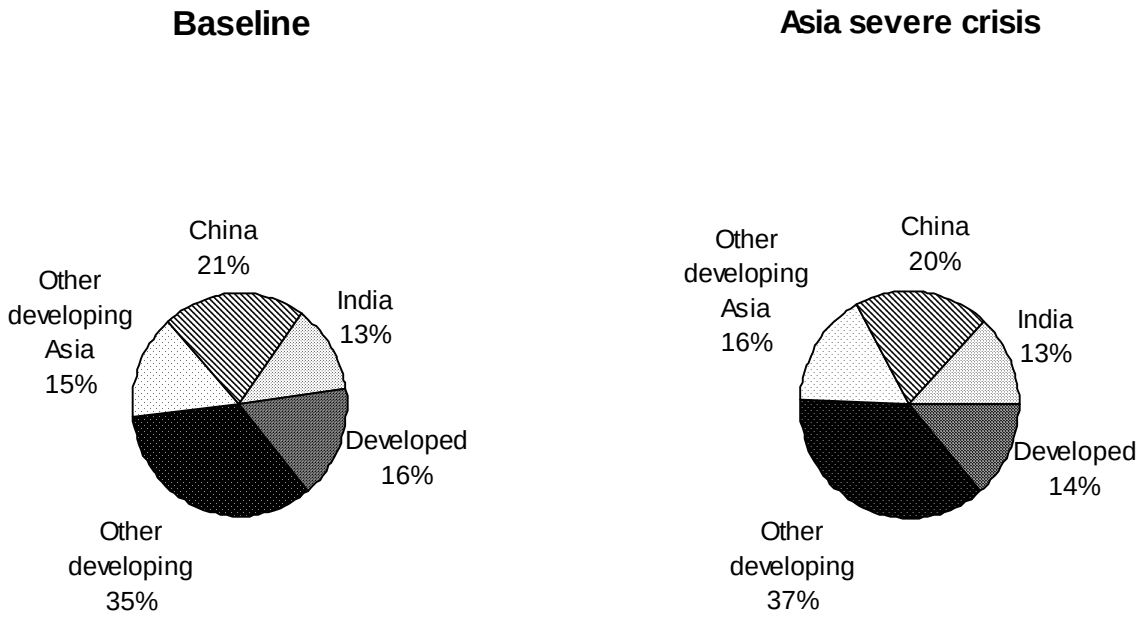


Figure 2. Share of Regions in Cereal Demand Increase, 1993 to 2020



at -0.43 and 0.24 percent per year, respectively, during 1993-2020 compared to 0.57 and -2.48 percent per year during 1967-82 and 0.45 and -1.96 percent per year during 1982-94.

Table 2: Per capita and total cereal food demand, baseline, severe and moderate Asian crisis scenarios

	Per Capita Food Demand				Total Food Demand			
	1993	2020			1993	2020		
		Base-line	Severe crisis	Moderate crisis		Base-line	Severe crisis	Moderate crisis
	(kilogram per capita)				*(million metric tons)*			
China	214	205	208	206	251.2	292.7	296.1	293.4
Other East Asia	157	148	152	149	15.2	17.9	18.4	18.0
India	163	176	170	175	147.1	225.4	217.0	223.6
Other South Asia	159	171	163	170	45.7	85.4	81.5	84.5
Southeast Asia	169	170	168	169	78.4	111.5	110.3	111.3
Latin America	128	129	129	129	58.9	84.7	85.1	84.9
WANA	214	210	210	210	79.0	134.4	134.3	134.1
Sub-Saharan Africa	112	118	120	119	57.4	123.4	125.3	124.6
Developing	172	170	169	170	733.5	1,076.4	1069.1	1,075.5
Developed	144	141	140	140	184.2	195.3	193.8	194.9
USA	133	132	131	132	34.8	42.5	42.2	42.4
World	165	165	163	164	917.7	1,271.7	1,262.9	1,270.5

Source: IFPRI IMPACT Simulations

A crucial emerging trend in Asia and other developing regions is the rapid growth in demand for maize and other coarse grains for animal feeds (Table 3). Cereal feed demand in developing countries is expected to expand by a rapid 2.88 percent per year in 1993-2020 (compared to the 0.65 annual expansion in developed countries). This fast growth is due to the strong expansion of the livestock industry, especially in the more rapidly growing developing economies, where consumption of meat will increase dramatically. Developing Asia as a group will account for 48 percent of the increase in feed demand. In China, demand for maize and coarse grains as feeds will increase by 3.57 and 3.02 percent per year, respectively. Thus, the stagnant or declining per capita demands for these cereals as food items will be more than compensated for by rapidly growing feed uses in developing countries.

Under the Asian crisis scenarios, relatively small decreases in global cereal demand are projected: global cereal demand in 2020 is expected to decline by 74 million mt (3.0 percent) in the severe crisis scenario and by 19 million mt (0.8 percent) in the moderate scenario, compared with the pre-crisis baseline scenario results (Figure 1). In Asia, the decline in total cereal demand will be 44 million mt (4.1 percent) in the severe and 9 mt (0.9 percent) in the moderate crisis scenario. The shares of the regions in the increase of cereal demand will change only slightly (Figure 2). Global food demand for cereals also changes very little (by negative 0.7 percent in the severe crisis scenario)

(Table 2). In both alternative scenarios, per capita cereal demand for food in 2020 would increase in some Asian countries and regions (China, other East Asian countries) and decline in others (South and Southeast Asia) compared to the baseline (Table 2). The increase in per capita cereal food demand in China and other East Asian countries is due to increases in the consumption of rice, maize, and other coarse grains (all of which have negative income elasticities of demand) brought about by the slowdown in the income-driven demand transition caused by the crisis. In Sub-Saharan Africa, the decline in world cereal prices induced by the Asian crisis results in an increase in cereal consumption.

Table 3: Cereal feed demand, baseline, severe and moderate Asian crisis scenarios

	1993	2020		
		Baseline	Severe crisis	Moderate crisis
	(million metric tons)			
China	72.6	183.2	154.3	178.0
Other East Asia	11.2	19.3	20.4	20.2
India	3.7	14.8	11.5	13.7
Other South Asia	1.7	3.7	3.2	3.6
Southeast Asia	14.7	31.6	30.4	29.8
Latin America	53.5	93.0	87.5	92.4
WANA	34.3	66.8	65.0	66.3
Sub-Saharan Africa	2.2	5.3	5.2	5.4
Developing	193.9	417.7	377.5	409.3
Developed	442.3	527.0	507.2	518.8
USA	158.2	203.0	202.0	202.1
World	636.1	944.7	884.7	928.1

Source: IFPRI IMPACT Simulations

Changes are larger for cereal feed demand (Table 3). Under the severe Asian crisis scenario, global cereal feed demand in 2020 will decline by 60 million mt, and even in the moderate crisis scenario by 17 million mt compared to pre-crisis levels. Latin America's cereal feed demand will decrease by 6 percent and West Asia and North Africa's by 3 percent under the stronger crisis assumptions. In Asia, China's cereal feed demand will decline by 16 percent, India's by 23 percent, Indonesia's by 5 percent, the Philippines' by 8 percent, and Thailand's by 2 percent. However, feed demand in Malaysia and South Korea is projected to increase by 6 and 9 percent, respectively. In the moderate scenario, feed demand will decrease by 2 percent in Malaysia, but still grow by 6 percent in South Korea, compared to the baseline scenario. The increase in feed demand in these two countries is due to the increase in domestic prices of livestock caused by the currency depreciation; this induces an increase in livestock production that is slightly higher than the investment-induced reduction in production as a result of slower long-term income growth. This countervailing price effect also dampens the reduction in cereal feed demand in other Asian countries.

Projected Demand for Livestock Products

In the coming decades, demand for livestock products is projected to continue to grow rapidly, albeit at lower rates than in the recent past. This demand is driven by changing dietary patterns, especially in the rapidly growing developing economies, causing a shift to more diversified diets with higher per capita consumption of meat, milk and milk products, fruits, and vegetables, and lower (or very slowly growing) per capita consumption of cereals. In the pre-crisis baseline scenario, global meat demand is expected to increase by 64 percent from 188 million mt in 1993 to 309 million mt in 2020 (Figure 3), at an annual rate of 1.86 percent, compared to 2.99 percent per year during 1982-93. Developing countries will account for 87 percent of the increase in meat demand, and developing Asia on its own will account for 61 percent (Figure 4). China will experience the most dramatic increase in meat demand during 1993-2020, accounting for 42 percent of the total growth in demand. Twenty-four percent of the increase in meat demand will be contributed by beef, 41 percent by pigmeat, and 31 percent by poultry. In India, meat demand will grow by 3.04 percent per year during 1993-2020 (from a very low base level of consumption); in other South Asian countries by 3.29 per year; in Latin America by 2.18 percent per year; in Sub-Saharan Africa by 3.41 percent per year, and in West Asia and North Africa by 2.68 percent per year. All Southeast Asian countries are expected to experience annual increases in meat demand above 3 percent, ranging from 3.26 percent in Malaysia to 3.76 percent in Indonesia. As a consequence, the group of developing countries will dominate global demand for livestock products: whereas in 1993 they accounted for less than half of world demand, by 2020 they will account for more than 60 percent. In developed countries, on the other hand, meat demand will increase only slowly as high consumption levels have already been achieved in the past decades.

As can be seen in Table 4, per capita meat demand will grow particularly rapidly in China and other East and Southeast Asian countries. In the pre-crisis baseline, China's per capita meat demand is projected to almost double from 33 kilograms in 1993 to 62 kilograms in 2020. This level of consumption is substantially higher than the level projected for Japan (49 kilogram per capita), and is closing the gap to the consumption levels of the developed countries, where per capita consumption levels are stagnant or increasing only slightly. Per capita demand for beef and poultry will more than double in China, but the biggest absolute increase will be in pigmeat, from 25 kilograms per capita in 1993 to 45 kilograms per capita in 2020. Among other East Asian countries, South Korea's per capita demand for poultry is expected to almost triple, from 9 kilograms in 1993 to 26 kilograms in 2020, and its per capita demand for pigmeat will increase from 18 kilograms in 1993 to 45 kilograms in 2020. For developing countries as a group, per capita meat demand is projected to increase from 21 kilograms in 1993 to 31 kilograms in 2020, reaching little more than one third of developed-country meat consumption levels. The increases in per capita demand will be fastest for poultry, at 1.71 percent per year, followed by pigmeat at 1.47 percent per year, and beef at 1.33 percent per year. In developed countries, per capita demand for beef and pigmeat has declined since 1982, with a relative shift in demand to poultry. Per capita poultry demand grew at a strong 2.23 percent per year during 1982-93, and is expected to continue to increase at 0.69 percent per year during 1993-2020. With growth in poultry consumption offset by declining beef and pigmeat consumption, per capita consumption of meat has been virtually constant in the group of developed countries since 1982 and is expected to increase only slightly, from 78 kilograms in 1993 to 83 kilograms in 2020.

Figure 3. Total Demand for Livestock Products, 1993 and Projected 2020

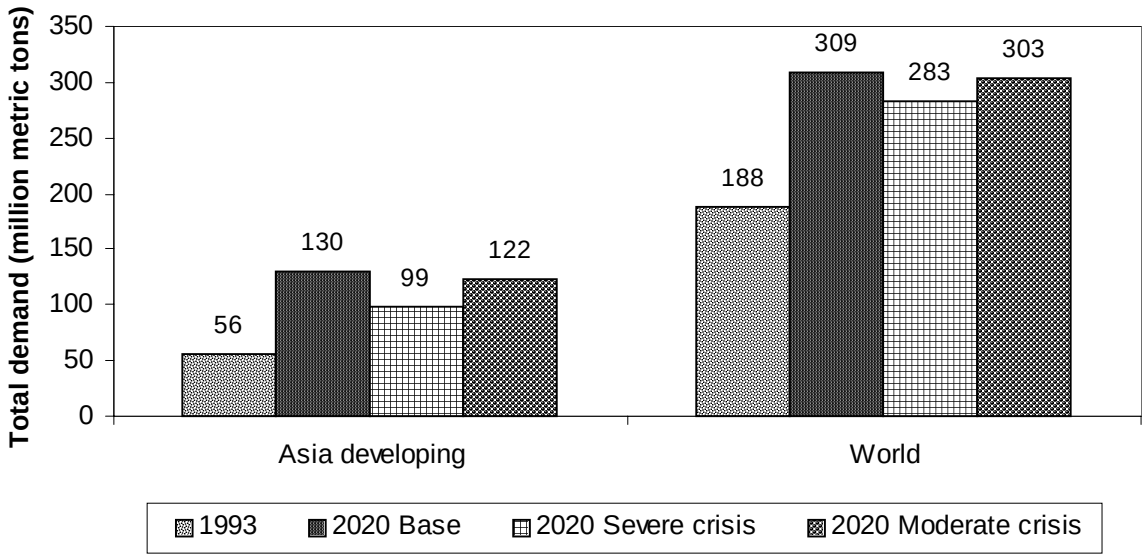


Figure 4. Share of Regions in Meat Demand Increase, 1993 to 2020

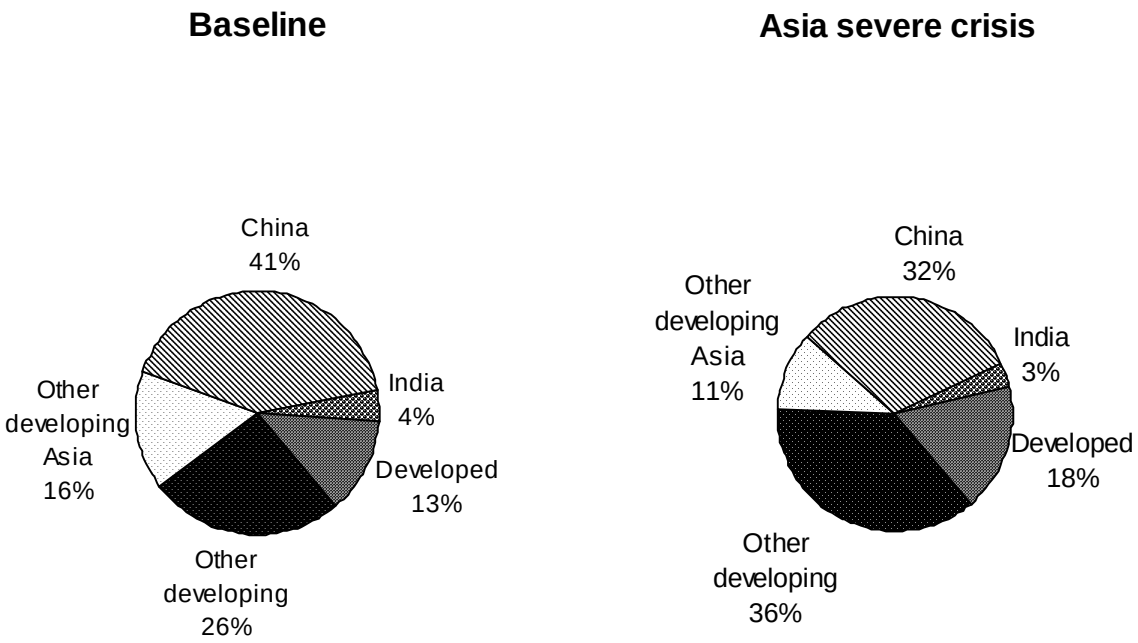


Table 4: Per capita demand for livestock products, 1993 and projected 2020, baseline, severe and moderate Asian crisis scenarios

	1993	2020		
		Baseline	Severe crisis	Moderate crisis
		(kilograms per capita)		
China	33	62	48	60
Other East Asia	44	79	55	67
India	4	7	6	6
Other South Asia	7	10	9	10
Southeast Asia	15	27	19	24
Latin America	46	58	61	59
WANA	20	23	24	24
Sub-Saharan Africa	9	11	11	11
Developing	21	31	26	30
Developed	78	83	84	83
USA	118	121	121	121
World	34	40	37	39

Source: IFPRI IMPACT Simulations

The locus of the biggest demand shifts resulting from the Asian crisis will be in livestock products, which are more price- and income- sensitive than cereals. In the alternative Asian crisis scenarios, livestock demand will contract considerably: global demand for meat will decline by 8 percent to 283 million mt in the severe crisis scenario, and by 2 percent to 303 million mt in the moderate crisis scenario (Figure 3). The countries in developing Asia will be hit hardest by the effects of the crisis: China's meat demand will plunge by 23 percent (and by 4 percent even in the moderate crisis scenario) from a pre-crisis value of 88.9 million mt in 2020. Meat demand in both Indonesia and the Philippines will decrease by 32 percent in the severe crisis scenario, and by 21 and 7 percent, respectively, in the moderate crisis scenario. South Korea's meat demand will drop sharply, by 39 percent in the severe and by 26 percent in the moderate crisis scenario, from a pre-crisis value of 4.7 million mt in 2020. China's share in the increase in global meat demand between 1993 and 2020 will drop to 32 percent in the severe, and to 40 percent in the moderate crisis scenario (Figure 4). The share of other Asian developing countries will drop from 20 percent in the baseline to 14 percent in the severe, and to 17 percent in the moderate crisis scenario. Consequently, the share of the developed countries in the increase in meat demand will grow from 13 percent in the pre-crisis scenario, to 18 percent in the severe crisis scenario, and 14 percent in the moderate crisis scenario. In the group of developing countries, the biggest drop in livestock demand in the severe crisis scenario will be for pigmeat (19 percent), followed by poultry (13 percent), and beef (8 percent).

As can be seen in Table 4, per capita demand for livestock products in 2020 will also contract most markedly in Asian countries, led by other East Asian countries - mainly South Korea - from 79 kilograms in the baseline to 55 kilograms in the severe and 67 kilograms in the moderate crisis scenario; and China, from 62 kilograms in the baseline to 48 kilograms in the severe and 60 kilograms

in the moderate crisis scenario. However, despite the sharp declines in meat demand due to the Asian crisis, growth in meat demand will remain relatively strong in Asia: under the severe Asian crisis scenario, developing Asian countries will still account for 35 percent of global meat demand in 2020, and under the moderate Asian crisis scenario for 40 percent, compared with the 42 percent in the pre-crisis scenario. Thus, although the contraction of demand in Asia due to the Asian crisis could be large, it will not threaten Asia's increasingly important role in the growth in global food markets. In addition, global meat demand will still be dominated by developing countries. In the severe crisis scenario, the group of developing countries will account for 59 percent of global meat demand in 2020, and in the moderate crisis scenario for 62 percent.

Projections for Crop and Livestock Area/Number and Yields

Projected Production, Area, and Yield Growth for Cereals

The increase in global cereal demand projected for the 1993-2020 period will have to be met through increases in harvested area or yield. Under the pre-crisis baseline scenario, world wheat production is projected to accelerate at an average annual rate of 1.26 percent during 1993-2020, compared to the 1.20 percent achieved during 1982-94. This is mainly due to a recovery from low growth in developed countries that had been induced by price declines for cereals in world markets and policy changes in some developed regions. Growth in maize production is projected to slow down to 1.52 percent annually in 1993-2020, compared to 1.93 percent per year in 1982-94; growth in rice production is also expected to decline to 1.19 percent annually in 1993-2020, compared to 1.94 percent per year in 1982-94. Production of other coarse grains will recover from negative growth in 1982-94 to 1.11 percent per year in 1993-2020.

Growth in area will contribute little to future cereal production growth: under the baseline scenario, global cereal crop area will continue to increase between 1993 and 2020, but only by 49 million hectares, at an annual rate of 0.25 percent, compared with the annual rate of 0.37 percent during 1967-82 and the negative trend of 0.24 percent per year during 1982-94 (Figure 5). Sixteen percent of this increase will be allocated to wheat, 35 percent will go to maize, 40 percent to other coarse grains, and only 8 percent to rice. Developing countries are projected to account for 87 percent of the expansion in cereal crop area, almost two-thirds of which will be in Sub-Saharan Africa, where crop yields are very low. In developing Asia, on the other hand, only 5 million hectares will be added to the existing cereal crop area.

With global cereal crop area barely increasing, growth in crop yield rates will account for most of the projected production increases. However, although yield growth rates vary by commodity and country, there will be an overall decline in the rates of growth in crop yields compared to the already reduced rates in the post-Green Revolution period of 1982-94 (Table 5). The global annual cereal yield growth rate is projected to continue to decline from 2.24 percent in 1967-82, and from 1.51 percent in 1982-94 to 1.04 percent in 1993-2020. Continued improvement in yield growth, but at lower levels, is projected for the group of developing countries, at 1.22 percent per year during 1993-2020. In some Asian countries, increased intensity of land use has already led to substantially higher input requirements in order to sustain yield gains (Rosegrant and Pingali 1994; Morris and Byerlee 1996). This will make increases in yield gains in this region even more challenging. For the group

of Asian developing countries, the cereal yield growth rate is projected to drop by half from the annual trend of 2.40 percent during 1982-94 to 1.20 percent in 1993-2020. In India, growth in yields is expected to sharply decline from 3.25 percent per year in 1982-94 to 1.47 percent in 1993-2020; in China, the decline will be from 2.46 percent to 1.01 percent; and in Southeast Asia, from 1.88 percent to 1.35 percent per year in the same periods. Yield growth is also projected to decline in developed countries: from the annual trends of 1.69 percent in 1967-82 and 1.30 percent in 1982-94 to 0.89 percent in 1993-2020.

The prospects for production, area, and yield growth will change significantly under the crisis scenarios, leading to further yield slowdowns among the Asian countries. In the severe crisis scenario, growth in global cereal production will slow to 1.18 percent per year (compared to 1.30 percent per year under the pre-crisis baseline scenario), and in the moderate crisis scenario to 1.27 percent annually. Wheat will experience the biggest drop, and grow only at 1.12 percent per year in 1993-2020 (compared to the 1.26 percent per year in the baseline).

Global cereal crop area in 2020 will decline by 8 million hectares in the severe crisis scenario compared to the baseline projection, a 16 percent decline in the projected 1993-2020 increase of 49 million hectares (Figure 5). This decline will be evenly shared between the group of developed and developing countries. Among the developing countries, West Asia and North Africa will experience the biggest drop in cereal crop area, from 60 million hectares in the pre-crisis scenario to 58 million hectares. In contrast to other countries and regions, cereal crop area in Asian developing countries will increase slightly, by 362 thousand hectares in the severe and by an even higher 449 thousand hectares in the moderate crisis scenario, compared to the pre-crisis baseline scenario. In this region, the currency depreciation-induced domestic price increases more than compensate for lower international prices and income-induced reductions in investment in crop production.

In the severe crisis scenario, the global annual cereal yield growth rate in 1993-2020 will drop to 0.97 percent, and in the moderate scenario to 1.03 percent, compared with the baseline growth of 1.04 percent (Table 5). India, China, and other South Asian countries will be hit hardest in both scenarios, whereas growth in yields is projected to improve in South Korea and the group of Southeast Asian countries due to higher domestic prices from the currency depreciations. In the moderate scenario, the annual yield growth for the Asian developing countries would recover to the pre-crisis rate.

Projected Production, Numbers and Yield Growth for Livestock Products

Driven by the rapid increases in demand for livestock products, meat production is expected to increase much more rapidly than cereal production in the coming decades. However, similar to the case of cereals, growth in global meat production will slow down compared to past trends, at 1.86 percent per year in 1993-2020, compared to 2.96 percent annually in 1982-94. In developing countries, the rate of growth of meat production will decline from the rapid 5.96 percent per year in 1982-94 to a still strong annual 2.79 percent in 1993-2020, which will be accounted for mainly by pigmeat (45 percent) and poultry (27 percent). Global meat production is projected to increase by 121 million mt, from 188 million mt in 1993 to 309 million mt in 2020 (Figure 6). Production will

Figure 5. Area Harvested for All Cereals, 1993 and 2020

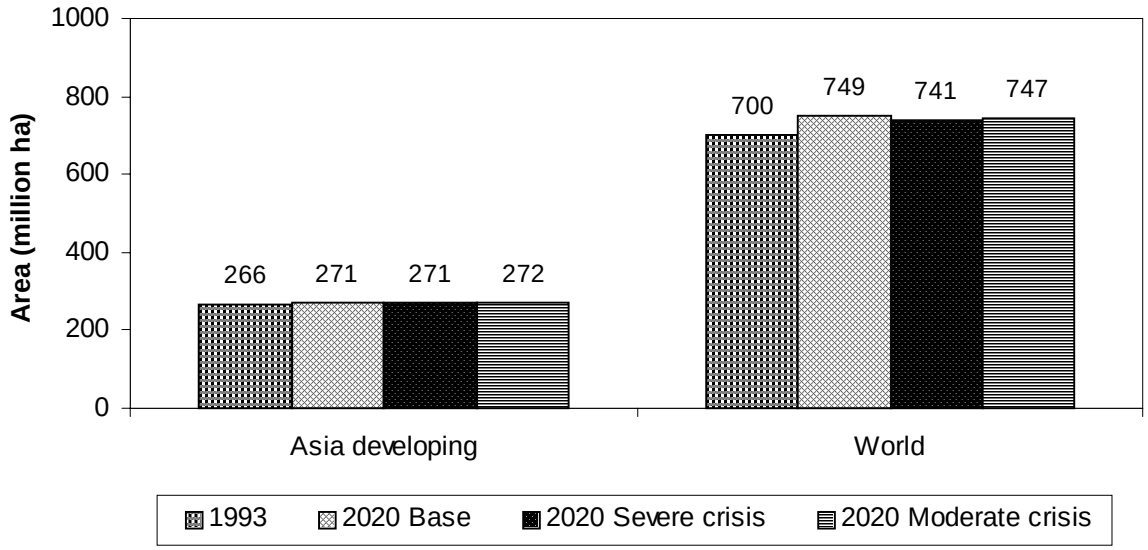


Figure 6. Total Meat Production, 1993 and 2020

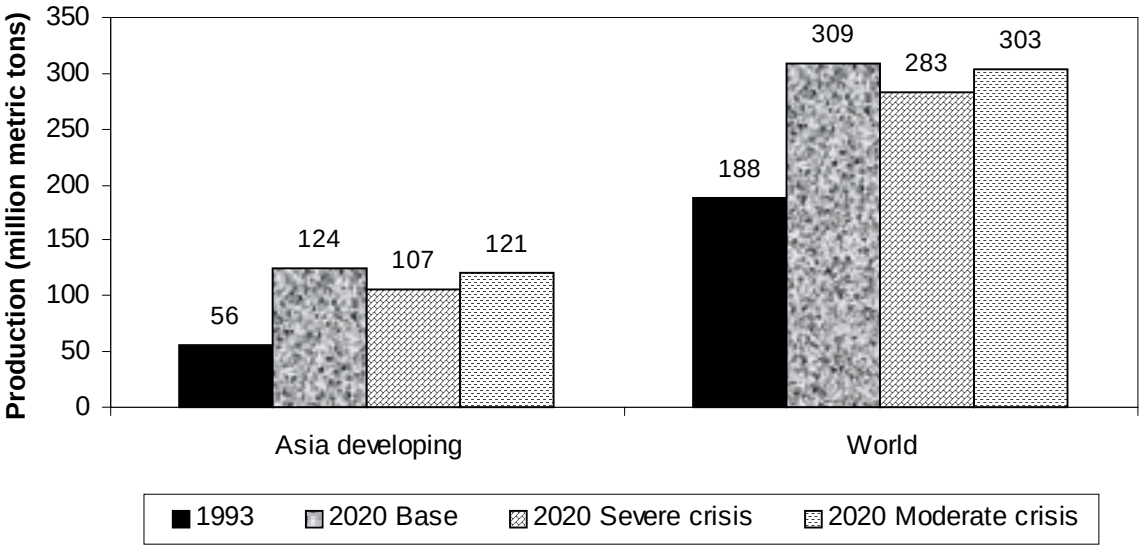


Table 5: Yield growth rates, all cereals, 1967-2020

	1967-82	1982-94	1993-2020		
			Baseline	Severe crisis	Moderate crisis
			(percent per year)		
China	3.88	2.46	1.01	0.93	1.00
Other East Asia	2.45	-0.29	0.87	0.95	0.93
India	2.69	3.25	1.47	1.34	1.45
Other South Asia	1.96	1.42	1.54	1.43	1.53
Southeast Asia	2.96	1.88	1.35	1.39	1.39
Asian developing countries	3.14	2.40	1.20	1.12	1.20
Developing	2.87	1.87	1.22	1.15	1.21
Developed	1.69	1.30	0.89	0.81	0.86
World	2.24	1.51	1.04	0.97	1.03

Source: Historical growth rates, FAOSTAT, FAO 1997; projected growth rates, IFPRI IMPACT Simulations

be particularly strong in the Asian developing countries, more than doubling from 56 million mt in 1993 to 124 million mt in 2020. In the group of developed countries, production will increase only relatively slowly, by 24 million mt from 100 million mt in 1993. More than two-thirds of the increase in global production during 1993-2020 will be accounted for by growth in the numbers of livestock slaughtered (Table 6), mainly due to the domination of numbers growth (1.86 percent per year) in the expansion of developing-country production. China and Southeast Asia will experience the highest growth in the numbers of livestock slaughtered, at 2.17 and 2.07 percent per year, respectively. In developed countries, on the other hand, weight growth (carcass weight per animal) will drive production at 0.52 percent annually during 1993-2020.

In the severe Asian crisis scenario, global meat production will plunge by 26 million mt (8.4 percent) and in the moderate crisis scenario by 6 million mt (1.9 percent); in the group of developing Asian countries, meat production will fall by 17 million mt (14.0 percent) and 3 million mt (2.5 percent) respectively, compared with the pre-crisis values (Figure 6). Both numbers and yield growth will contribute to this decline in production. However, the extent to which production will decline (or even increase for a few countries) under the Asian crisis scenarios will vary considerably depending on an interplay of prices, supply and demand elasticities, and the intersectoral investment multipliers. As can be seen in Table 6, the global annual numbers growth rate during 1993-2020 will decline to 0.99 percent in the severe and to 1.20 percent in the moderate crisis scenario, compared with the baseline rate of 1.26 percent; and the annual yield growth rate will drop to 0.53 and 0.57 percent, respectively, compared with 0.59 percent in the baseline scenario. India and China will experience the biggest declines in both number and yield growth rates, whereas the Southeast Asian countries are less affected. In South Korea, the domestic price impact of the currency depreciation on production will outweigh the dampening effect of the income/investment multiplier, and the annual growth rates for livestock numbers and yield will improve under both scenarios, from 2.21 and 0.47 percent in the baseline scenario to 2.59 and 0.54 percent in the severe and 2.44 and 0.50 percent in

Table 6: Number and yield growth for livestock products, 1993-2020, baseline, severe and moderate Asian crisis scenarios

	Number growth			Yield growth		
	Baseline	Severe crisis	Moderate crisis	Baseline	Severe crisis	Moderate crisis
			(percent per year)			
China	2.17	1.62	2.08	0.86	0.67	0.83
Other East Asia	1.49	1.67	1.63	0.76	0.78	0.77
India	1.37	1.10	1.34	1.46	1.13	1.39
Other South Asia	0.98	0.89	1.00	1.68	1.33	1.60
Southeast Asia	2.07	2.02	2.07	1.06	1.04	0.98
Latin America	1.25	1.09	1.23	0.93	0.93	0.95
WANA	1.60	1.60	1.59	0.89	0.85	0.88
Sub-Saharan Africa	1.92	1.85	1.92	1.39	1.37	1.46
Developing	1.84	1.54	1.80	0.93	0.82	0.92
Developed	0.27	0.08	0.19	0.52	0.50	0.51
USA	0.54	0.41	0.48	0.63	0.59	0.61
World	1.26	0.99	1.20	0.59	0.53	0.57

Source: IFPRI IMPACT Simulations

the moderate crisis scenario, respectively. North Africa and West Asia's livestock production is little affected by the crisis. In Latin America, however, numbers growth will decrease significantly due to the decline in world prices.

Projections for World Prices and International Trade of Cereals and Meats

Projected Cereal and Meat Prices and Trade in the Pre-crisis Baseline Scenario

The baseline projection results of IMPACT indicate that global food production will grow fast enough for real world prices of food to continue to fall, but at much slower rates than in the past two decades. Over the 27-year period, world wheat prices are projected to decline by 6.1 percent, compared to the much bigger drop of 28 percent between 1982 and 1995, and rice prices will fall by 3.5 percent, compared to the previous decline of 42 percent (Figure 7). Prices for other coarse grains will experience the biggest decline, 9.8 percent over 1993 values. Maize prices will actually increase over the projections period by 1.6 percent, compared to the 43 percent drop between 1982 and 1995. The weighted average price for all cereals will decline by 4.3 percent by 2020. Moreover, projected real cereal prices will be particularly strong through the year 2010. Aggregate cereal prices are projected to increase by 4.9 percent through 2010, wheat prices by 2.0 percent, maize prices by 3.2 percent, rice prices by 11.5 percent, and only the price for other coarse grains will decline by 1.6 percent. It is only after 2010 that the combination of continued declines in the rate of population growth and declining income elasticities for cereals, will reduce demand growth enough to cause real cereal prices to drop more sharply.

Prices for livestock commodities will also remain relatively strong throughout the projections period, with price declines in the range of 5 to 8 percent (Figure 8). The average meat price will decline by 7.4 percent between 1993 and 2020. Both beef and pigmeat prices declined by 22 percent between 1982 and 1991, but will decline by only 7.6 and 5.6 percent, respectively, during 1993-2020. The price for sheep and goat meat is expected to decrease by 7.2 percent during 1993-2020, compared to a drop in the proxy price of lamb of 33 percent between 1982 and 1991. The price of poultry is expected to decrease by 6.0 percent, compared to a decline of 18 percent between 1982 and 1991. Livestock prices will decline more smoothly over the projections period, compared with cereal prices, with the price of beef declining by 5.6 percent by 2010; pork by 2.9 percent; sheep and goat meat by 3.6 percent, and poultry by 5.8 percent.

The slow decline in cereal and livestock prices will be accompanied by rapidly increasing world trade in food, with the primary impetus for expanded trade being generated by the group of developing countries increasing its food imports from developed countries. In the pre-crisis baseline scenario, world trade in cereals is projected to increase by 137 million mt, from 185 million mt in 1993 to 323 million mt in 2020 (Figure 9). Among the cereals, wheat imports will show the biggest absolute increase, 66 million mt, from 91 million mt in 1993 to 156 million mt in 2020. Net cereal imports by developing countries will increase by nearly 150 percent (Figure 10), with Asia accounting for the largest increase (70 percent), followed by West Asia and North Africa (26 percent).

Net cereal imports in Asian developing countries will increase by close to 350 percent over the projections period, from 27 million mt in 1993 to 122 million mt in 2020 (Figure 9). The details of this rapid increase are shown in Figure 11. China will lead Asia in net cereal imports, accounting for over one-half of the increase in cereal imports, followed by South Asian countries other than India - mainly Pakistan - at 19 percent. India, and the other East Asian countries - mainly South Korea - will both account for 11 percent of the increase in net imports of cereals. Japan's net cereal imports, on the other hand, are expected to barely grow over the projections period, from 29 million mt in 1993 to 33 million mt in 2020, because of slow growth in demand.

A major beneficiary of increased cereal import demand from developing countries will be the main cereal exporters, particularly the United States, whose cereal exports are expected to increase by nearly 60 percent, from 85 million mt in 1993 to 135 million mt in 2020. In addition, Eastern Europe and the former Soviet Union are expected to take advantage of the increased import demands in developing countries, shifting from a large net importing position of 27 million mt in 1993 to become large net exporters (of 33 million mt) by 2020.

Under the pre-crisis baseline scenario, world net trade in livestock products will expand proportionally even more rapidly than cereal trade, although from much lower levels. Global net trade is projected to increase from 8.1 million mt in 1993 to 15.9 million mt in 2020, an increase of 95 percent over 1993 levels. Developing countries will dramatically increase their imports of livestock products. Asia will be the primary importer of meat products by 2020, at 5.8 million mt, followed by West Asia and North Africa, at 3.4 million mt, and Sub-Saharan Africa, at 0.5 million mt (Figure 12). Latin America, on the other hand, will improve its exporter status, from 0.6 million

Figure 7. Changes in Projected Real Prices for Cereals, 1993-2020

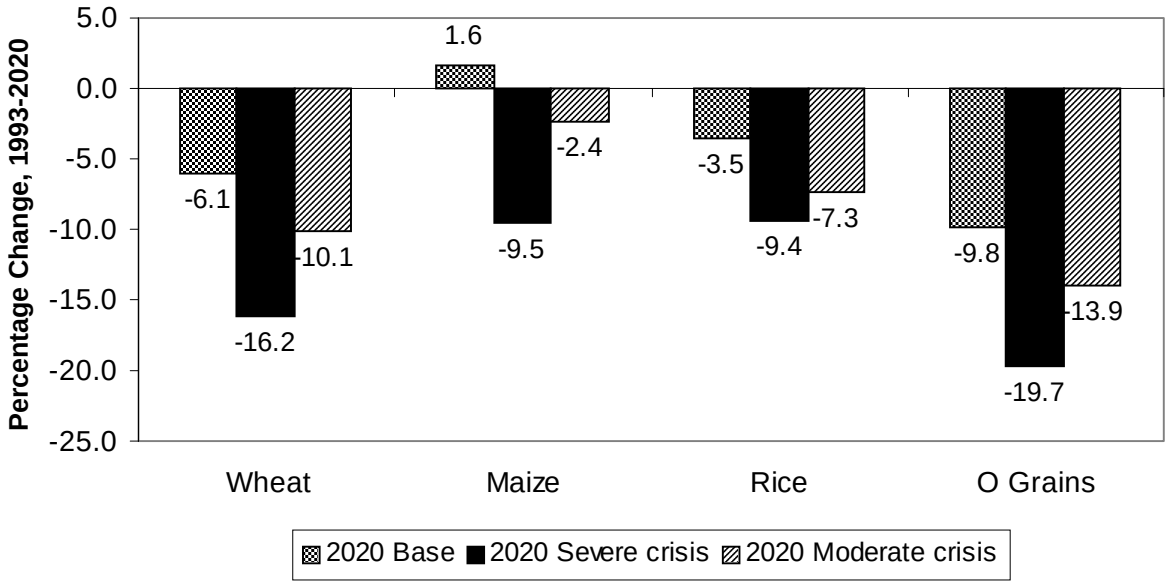


Figure 8. Changes in Projected Real Prices for Meats, 1993-2020

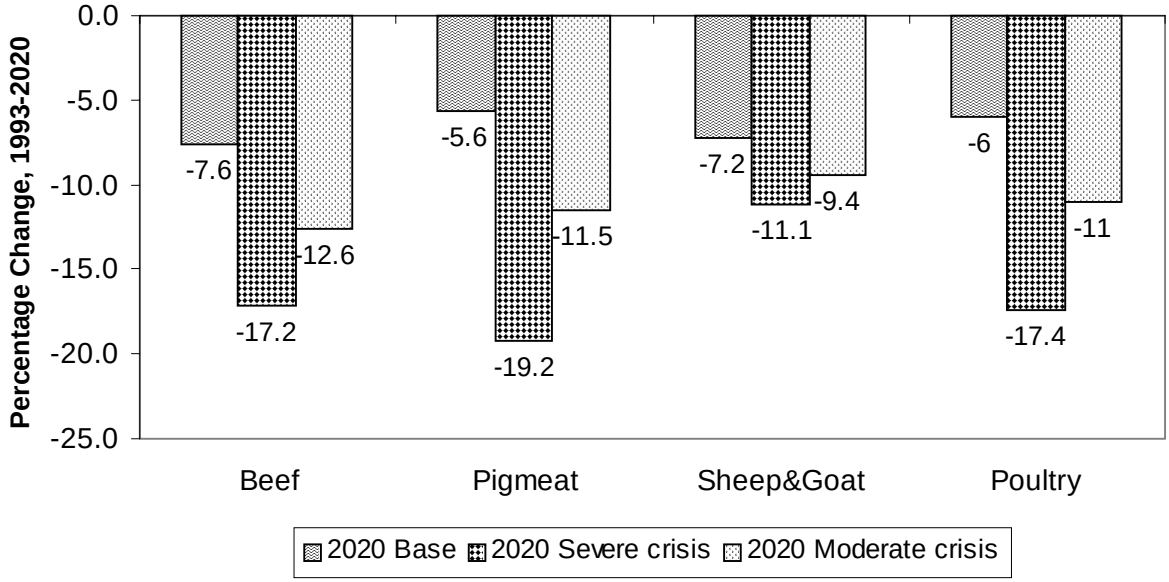


Figure 9. Cereal World Trade and Net Imports of Developing Asia, 1993 and 2020

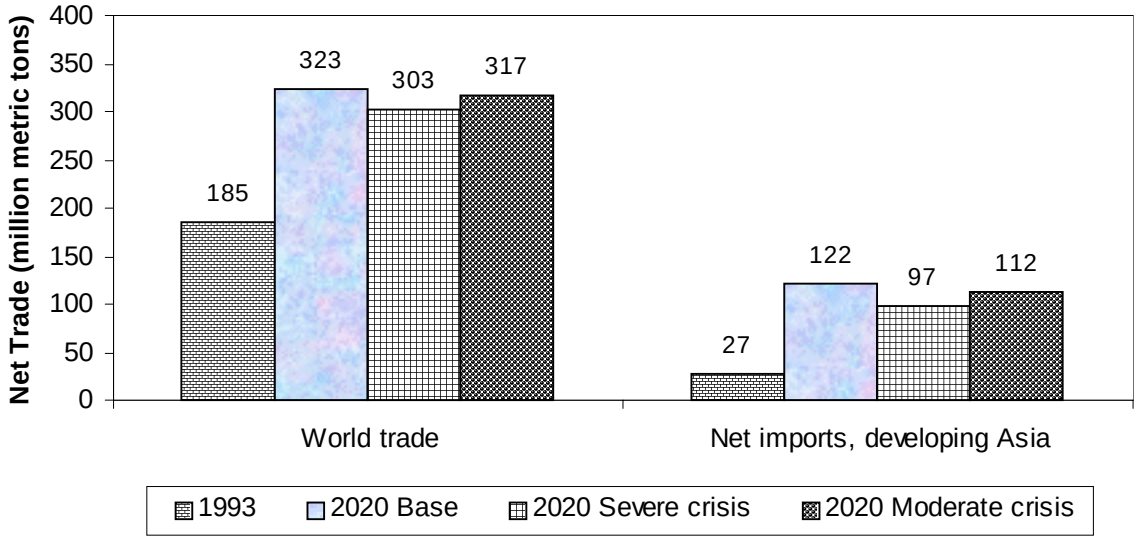


Figure 10. Net Cereal Imports of Major Developing Regions, 1993 and Projected 2020

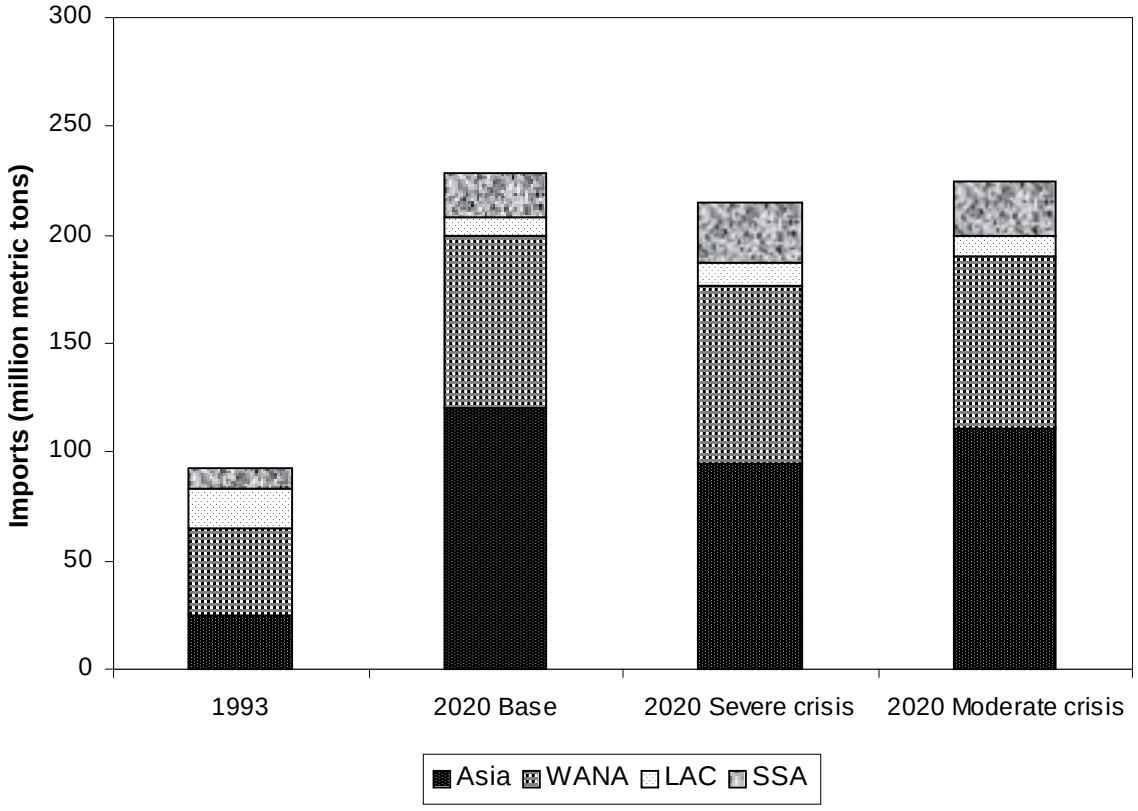


Figure 11. Net Cereal Imports of Developing Asia, 1993 and Projected 2020

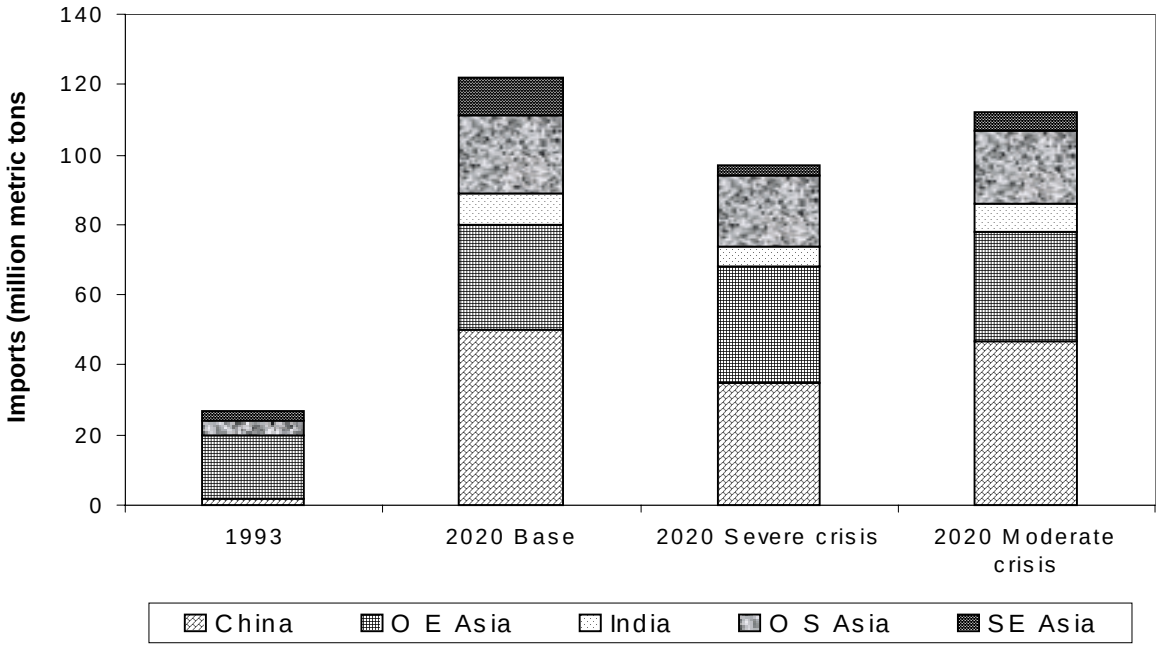
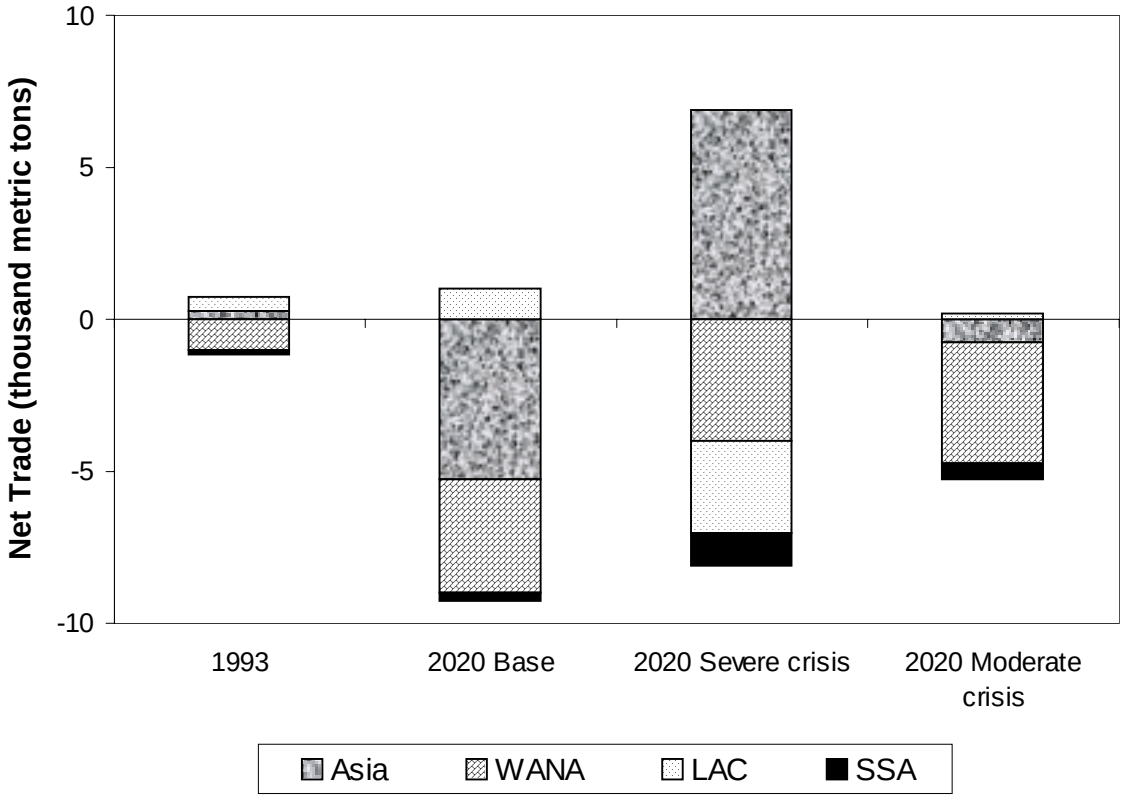


Figure 12. Net Trade in Livestock Products of Major Developing Regions, 1993 and Projected 2020



mt in 1993 to 1.2 million mt in 2020. Again, the developed countries will satisfy most of the increased importing demands, led by the United States, at 3.4 million mt, closely followed by Western Europe at 3.3 million mt, and Australia, at 2.2 million mt.

The Impact of the Asian Economic Crisis on World Cereal and Meat Prices and Trade

The Asian crisis scenarios have significant impacts on world prices and trade. Due to the dramatic declines in developing-country food demand due to the crisis, prices are expected to decline sharply compared to the pre-crisis scenario. Between 1993 and 2020, wheat prices will decline by 16.2 percent in the severe and by 10.1 percent in the moderate crisis scenario, maize prices by 9.5 and 2.4 percent, rice prices by 9.4 and 7.3 percent, and prices for other grains by 19.7 and 13.9 percent, respectively (Figure 7). The drop in livestock prices will be even stronger. The pigmeat price would be most affected with a price drop of 19.2 percent in the severe and 11.5 percent in the moderate crisis scenario (Figure 8). Beef prices will decline by 17.2 and 12.6 percent, and poultry prices by 17.4 and 11.0 percent, depending on the severity of the crisis.

Global net cereal trade will decline by 20 million mt in the severe and by 6 million mt in the moderate Asian crisis scenario (Figure 9). Net imports by developing countries will decline by 13 million mt in the severe and by 3 million mt in the moderate crisis scenario, compared with the pre-crisis baseline scenario (Figure 10). Among the developing countries, Asia's net cereal imports will experience the biggest drop in the severe crisis scenario at 26 million mt, importing at a level 21 percent below the pre-crisis value. Among the Asian developing countries, China will experience the biggest absolute decline in net cereal imports, 16 million mt in the severe and 3 million mt in the moderate crisis scenario (Figure 11). In relative terms, however, net cereal imports will contract most in Southeast Asia, by 55 percent (6 million mt) in the severe and 46 percent (5 million mt) in the moderate Asian crisis scenario over projected pre-crisis imports. The contraction in Asian cereal imports will directly affect the traditional cereal exporting countries. Cereal exports of developed countries will fall by 13 million mt, or 5.4 percent under the severe crisis scenario. Combined U.S. and European cereal exports in 2020 would contract 7 percent from 171 million mt to 158 million mt. Under the moderate crisis, however, changes in developed country exports will be relatively small.

Livestock trade patterns will undergo significant shifts in the crisis scenarios. The biggest impact will be again in Asia, whose substantial projected net importing position of 5.8 million mt projected in the baseline scenario will shift to an exporting position of 7.6 million mt in the severe Asian crisis scenario (Figure 12). The increase in domestic livestock prices in Asia due to the depreciation exacerbates the slowdown in growth in demand for livestock due to the fall in income growth. The increase simultaneously dampens the slowdown in production growth that is caused by the investment effects of slower income growth. The result of these changes is the shift from importer to exporter status for many of the Asian countries seen in Figure 13. China leads the change in the livestock trade pattern, shifting from a projected slight import position of 0.3 million mt in 2020 in the pre-crisis baseline scenario to become a large net exporter, mainly for pigmeat and poultry, at 3.5 million mt in the severe crisis scenario. In the moderate crisis scenario, China reverts back to 1993 import and export levels. Southeast Asia will experience a similar shift in its trading position, from importing 1.5 million mt in the pre-crisis scenario to exporting 3.5 million mt in the severe crisis

scenario. Only South Asian countries other than India will maintain their net importing status in the severe crisis scenario.

Declining world prices of livestock will also cause substantial changes in the trade patterns of other regions. The combined region of West Asia and North Africa and Sub-Saharan Africa will both increase their net imports of livestock products in the two crisis scenarios (Figure 12). Imports in the former region will increase by 0.7 million mt in the severe and by 0.4 million mt in the moderate crisis scenario, and in the latter by 1.0 million mt and 0.2 million mt, respectively. Due to the large price declines in the severe crisis scenario, Latin America will shift from projected exports of 1.2 million mt of livestock products in the baseline scenario to net imports more than twice the size, 2.6 million mt, in the severe crisis scenario. In the moderate crisis scenario, the region will resume a slight net exporting position in 2020. Combined U.S. and European meat exports would plunge by 87 percent, from 6.7 million mt under the pre-crisis scenario to 0.9 million mt in severe crisis scenario. In the moderate crisis scenario, U.S. and European exports of livestock products are projected to be 4.1 million mt.

In addition to the dramatic changes in trade volumes under the severe Asian crisis scenario, financial implications would be enormous for the traditional net exporters. As shown in Table 7, combined with substantial price declines due to decreased Asian demand, the gross value of net trade for the agricultural commodities included in IMPACT would drop significantly in these countries. For the United States, the value of net trade across all IMPACT commodities would decline by US$12.3 billion annually under the severe Asian crisis scenario and by US$5.6 billion per year even

Table 7: Gross value of net trade across IMPACT commodities for selected countries, 1993 and 2020, baseline, severe and moderate Asian crisis scenarios

	1993	2020		
		Baseline	Severe crisis	Moderate crisis
		(thousand US$)		
United States	18,416	38,292	25,969	32,721
Western Europe	-2,981	4,936	-2,360	2,321
Other developed countries*	12,947	15,027	12,084	13,760
Japan	-9,305	-12,100	-10,633	-11,262
China	434	-11,166	2,285	-8,137
Other developing Asia	-881	-18,210	6,221	-8,563

*includes Australia, Canada, Israel, New Zealand, and South Africa.
Note: Agricultural commodities included in IMPACT are beef, pork, sheep&goat meat, poultry, eggs, milk, wheat, maize, other coarse grains, potatoes, sweet potatoes and yams, cassava and other roots and tubers, high quality indica rice, standard rice, japonica rice, soybeans, meals, and oils.

Source: IFPRI IMPACT Simulations

Figure 13. Net Trade in Livestock Products, Asian Developing Countries, 1993 and Projected 2020

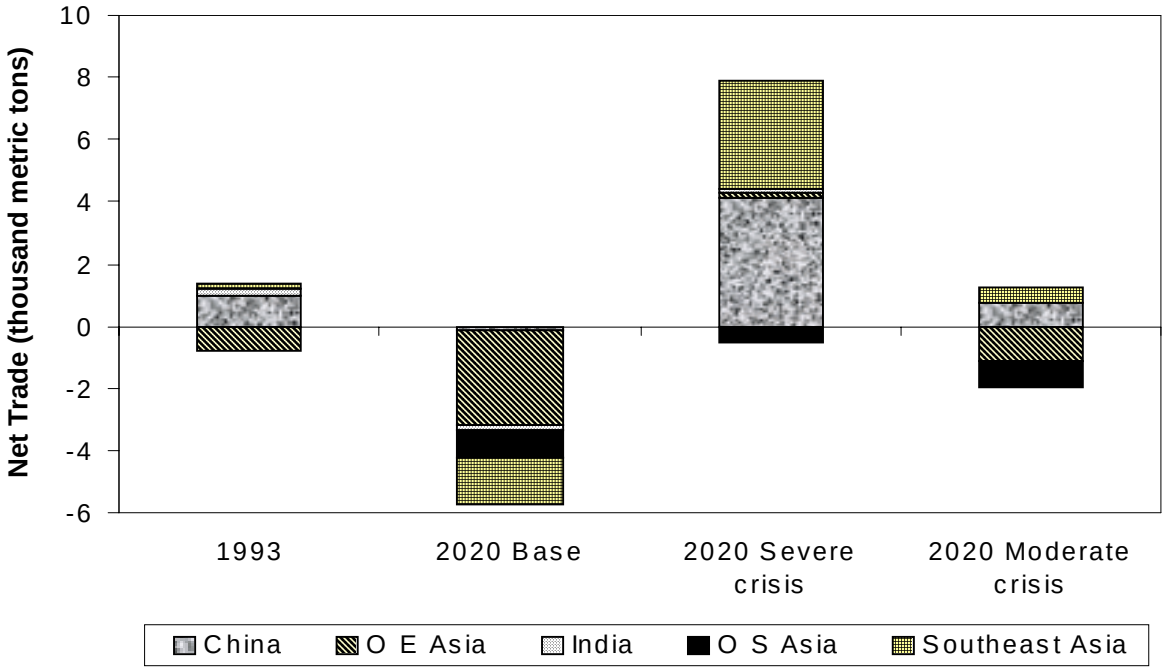
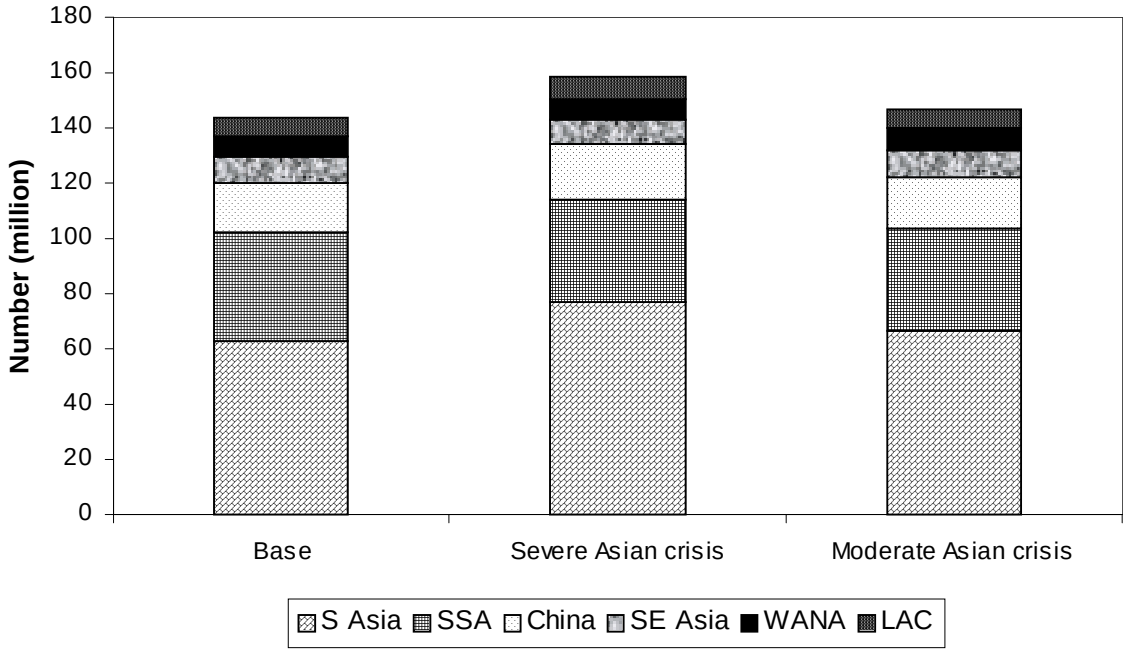


Figure 14. Projected Number of Malnourished Children in 2020, Baseline, Moderate and Severe Asian Crisis Scenarios



under the moderate scenario, from a baseline value of US$38.3 billion. For Western Europe, the annual declines would be US$7.3 billion and US$2.6 billion per year, depending on the severity of the crisis, compared with a gross value of exports US$4.9 billion in the pre-crisis scenario. In the severe crisis scenario, Western Europe would have a trade deficit for IMPACT commodities. As described above, under the severe crisis scenario, Asian countries will take up part of the slack in international trade, taking advantage of their improved exporting positions.

Calorie Consumption and Malnutrition

Worldwide, per capita availability of food is projected to increase by around 10 percent between 1993 and 2020, from about 2,700 calories per person per day in 1993 to about 2,900 calories (Table 8). Improvement in per capita food availability is projected for all major regions. The largest absolute increase is expected in China and the lowest in Sub-Saharan Africa. The projected average food availability of about 2,360 calories per person per day in 2020 for Sub-Saharan Africa, however, is only slightly above the minimum required for a healthy and productive life. In addition, developing-country calorie availability per person per day will only reach 85 percent of the developing-country level by 2020.

Table 8: Daily per capita calorie availability, 1993 and 2020, baseline, severe and moderate Asian crisis scenarios

	Calories per capita per day			
	1993	2020		
		Baseline	Severe crisis	Moderate crisis
Latin America	2,730	3,030	3,088	3,054
Sub-Saharan Africa	2,199	2,355	2,383	2,372
West Asia and North Africa	3,030	3,165	3,205	3,179
South Asia	2,370	2,800	2,582	2,747
Southeast Asia	2,525	2,938	2,647	2,808
China	2,680	3,141	2,881	3,087
South Korea	3,223	3,362	3,240	3,280
Developing	2,523	2,852	2,714	2,818
Developed	3,223	3,369	3,400	3,379
USA	3,585	3,753	3,813	3,777
World	2,684	2,945	2,838	2,919

Source: IFPRI IMPACT Simulations

The Asian crisis will negatively affect global calorie availability. The overall daily per capita calorie availability in 2020 is projected to drop from 2,945 calories to 2,838 calories in the severe and to 2,919 calories in the moderate crisis scenario. In the group of developing countries, daily per capita calorie availability will drop from 2,852 to 2,714 calories in the severe, and to 2,818 calories

in the moderate crisis scenario. The developed countries will experience an increase in per capita calorie availability, from 3,369 calories in the pre-crisis scenario to 3,400 calories in the severe and 3,379 calories in the moderate crisis scenario. Among the developing countries, as would be expected, Asia will experience the biggest drop in calorie availability. Southeast Asian countries will be hit hardest in the severe crisis scenario, with a decline of 291 calories per person per day, a 10 percent reduction; followed by China, with a drop of 260 calories per person per day, an 8 percent drop. Latin America, Sub-Saharan Africa, and West Asia and North Africa, however, will experience slight improvements in daily per capita calorie availability in both Asian crisis scenarios due to price-induced increases in food consumption.

The degree of food insecurity measured by the number of malnourished pre-school children (0 to 5 years of age) is directly influenced by the performance of the agricultural sector, the purchasing power parity of the local population, and the import capability from global food markets. In Asia, growth in the agricultural sector due to the introduction and successful adoption of Green-revolution technologies has been instrumental in reducing poverty. In Indonesia, for example, growth rates in the agriculture sector averaged 4.2 percent annually during 1975-85, and then slowed down to 3.4 percent per year in 1986-96. At the same time, the incidence of poverty decreased from over 40 percent in rural areas in 1976 to 14 percent in 1997. However, the Asian economic crisis threatens to reverse this trend (FAO 1998).

Under the pre-crisis baseline projection, over the next three decades, child malnutrition is expected to decline in the group of developing countries by 23 percent. However, the number of malnourished children will increase in Sub-Saharan Africa, from 27 million children in 1993 to about 39 million children in 2020. More progress can be seen for South Asia, home to more than one-half of the world's malnourished children, but some 66 million children will still be malnourished in the region in 2020. These results show the paradox facing global food policy: declining world food prices and buoyant international trade coexisting with sustained or increasing malnutrition in much of the world.

Under the Asian crisis scenarios, food security in Asia will decline substantially compared to the pre-crisis baseline scenario (Figure 14). In the severe crisis scenario, the number of malnourished children in the group of developing countries will increase by 15 million, from 143 million to 158 million children by 2020. In the moderate scenario, the increase would still be 3 million. In the severe crisis scenario, the number of malnourished children will increase from 65.6 million to 76.7 million in South Asia; from 16.4 million to 19.1 million in China; and from 10.1 to 12.2 million in Southeast Asia. At the same time, - and concomitant to daily per capita calorie availability - the number of malnourished children will decline slightly in the other developing regions: in West Asia and North Africa, from 6.4 million to 6.3 million; in Sub-Saharan Africa, from 38.6 million to 37.8 million; and in Latin America, from 6.4 million to 6.2 million. These slight improvements are due to increased food consumption because of the decline in international food prices induced by the Asian crisis.

Conclusion

This paper assessed the possible long-run effects of the Asian economic crisis on long-term global food supply and demand by comparing pre-crisis baseline projections with severe and moderate crisis scenarios. Many important long-term trends are robust across the three scenarios, although the detailed results vary. The long-term prospects for food supply, demand, and trade indicate a strengthening of world cereal and livestock markets. Even under the severe Asian crisis scenario, world prices of these commodities will decline much more slowly than in the past several decades. The stronger price picture is the result of the continued gradual slowing in the rate of growth in both production and demand. Growth in crop area will be slow. Therefore, crop yield growth will account for nearly all of production growth. However, in most countries and regions the gradual slowdown in crop yields, which began in much of the world in the early 1980s, will continue. Livestock production will grow considerably faster than crop production - especially in Asia - but will also slow down relative to the production growth in the past decade.

Countering the continued gradual slowing of production will be a decline in the growth rate in food demand. Population growth rates will be declining throughout the projections period, particularly in developing countries. Rising incomes and rapid urbanization in developing countries will change the composition of demand. Direct per capita food consumption of maize and coarse grains will decline as consumers shift to wheat and rice with increasing incomes. As incomes rise further and lifestyles change with urbanization, there will be a secondary shift from rice to wheat. Growth in incomes in developing countries will also drive strong growth in per capita and total meat consumption, which will in turn induce strong growth in feed consumption of cereals, particularly maize. Per capita meat consumption in developed countries will be nearly constant, with slow declines in beef and pigmeat consumption offset by slow growth in poultry consumption. These trends will lead to an extraordinary increase in the importance of developing countries in global food markets. Under the baseline scenario, a full 84 percent of the increase in global cereal consumption, and nearly 90 percent of the increase in global meat demand between 1993 and 2020 will come from the developing countries. By 2020, developing countries will account for 65 percent of global cereal demand and 63 percent of global meat demand. Under the baseline scenario, Asia emerges as a major player in global cereal and livestock markets in the coming decades. This role is unlikely to be threatened by the current economic crisis in the region.

Developing countries as a group will not be able to fully meet their rapidly growing food demand through growth in their own production. Cereal import demand from developing countries will grow rapidly, more than doubling during the projections period. Partially offsetting the increase in demand from developing countries, Eastern Europe and the former Soviet Union will shift from significant cereal importers to substantial export positions. Traditional developed- country exporters, led by the United States, will significantly expand cereal exports. The growth in cereal trade remains quite strong even under the severe crisis scenario. Although cereal imports drop by 20 percent in Asia, lower world prices cause increased imports in other developing regions, and total developing country cereal imports decline by only 6 percent.

The Asian crisis scenarios will have far larger repercussions on global supply, demand, and markets for livestock. In the pre-crisis baseline, global net trade in livestock products will nearly double, with increased Asian imports accounting for much of this growth, and U.S. and European

exports expanding rapidly. But under the severe crisis scenario, China and several Southeast Asian countries will shift from import to export positions in livestock, virtually eliminating growth in developed-country livestock exports. The sharp reductions in meat exports and smaller cutbacks in other agricultural commodity exports, combined with lower world commodity prices, would result in large reductions in agricultural export earnings of developed countries under the severe crisis scenario. The United States is projected to lose US$12 billion annually, and Western Europe and other developed countries US$10 billion. Losses would also be substantial in the moderate crisis scenario. How the Asian economic crisis plays out will have a decisive impact on the direction and magnitude of global livestock trade and export earnings of developed countries.

The most devastating impact of a severe crisis would be on the food security of Asian countries. For Asia as a whole, an additional 16 million children would be malnourished in 2020 than under the baseline scenario. The improvements in calorie availability in other developing regions will barely impinge on the total increase in the number of malnourished children of 15 million, reaching 158 million malnourished preschool children by 2020.

References

FAO (Food and Agriculture Organization of the United Nations) (1998). FAO/WFP crop and food supply assessment mission to Indonesia. Special report. <http://www.fao.org/giews/english/alertes/1998/srins984.htm>

FAO (1997). FAOSTAT database. <http://apps.fao.org/default.htm>. Accessed March and April, 1997.

Liu, L.-G., M. Noland, S. Robinson, and S. Wang (1998a). Asian competitive devaluations. *Working Paper* 98-2. Washington, D.C.: Institute for International Economics.

Liu, L.-G., M. Noland, S. Robinson, and S. Wang (1998b). The Asian financial crisis and global real adjustment. *Policy Analyses* 56. Washington, D.C.: Institute for International Economics, forthcoming.

Morris, M. and D. Byerlee (1996). Maintaining productivity gains in post-green revolution Asian agriculture. Mimeo.

Radelet, S. and J. Sachs (1998). *The East Asian financial crisis: Diagnosis, remedies, prospects*. Boston: Harvard Institute for International Development.

Rosegrant, M. W., and P. L. Pingali (1994). Policy and technology for rice productivity growth in Asia. *Journal of International Development*, 6: 665-688.

Rosegrant, M. W., M. Agcaoili-Sombilla, and N.D. Perez (1995). *Global food projections to 2020: Implications for investment*. 2020 Vision for Food, Agriculture, and the Environment Discussion Paper No. 5, Washington, D.C.: IFPRI.

Rosegrant, M. W., M.A. Sombilla, R.V. Gerpacio, and C. Ringler (1997). Global food markets and US exports in the twenty-first century. Revised Paper Presented at the Illinois World Food and Sustainable Agriculture Program Conference "Meeting the Demand for Food in the 21st Century: Challenges and Opportunities for Illinois Agriculture," May 28, 1997, Urbana-Champaign.

San, N. N., M. W. Rosegrant, and N.D. Perez (1998). Indonesian agriculture in transition: Projections of alternative futures. *Journal of Asian Economics*, Fall issue, forthcoming.

UN (United Nations) (1996). *World population prospects: The 1996 revision*. Population Division, Department for Economic and Social Information and Policy Analysis, United Nations, New York.

USDA (United States Department of Agriculture) (1998). *Asian financial crisis and U.S. agricultural exports*. <http://www.fas.usda.gov/info/factsheets/asian.html>.

The New Policy Environment for Food Aid: The Challenge of Sub-Saharan Africa

Cheryl Christensen

Food aid decisions are being made in a new policy environment and implemented under changing institutional arrangements and guidelines. Constrained budgets, changing agricultural and food aid policies in the US and other donor countries, as well as economic and policy reform in developing countries are some of the national levels forces changing food aid decision-making and implementation. Global forces-- trade liberalization and continuing negotiations under the WTO, the outcome of the recent World Food Summit and the upcoming renegotiation of the Food Aid Convention--create both constraints and opportunities for food aid's role in a more complicated and dynamic world. All donors and recipients are likely to be impacted to some degree by this new environment. This paper, however, focuses primarily on the US, as a donor, and sub-Saharan Africa as a recipient, since recent analyses have suggested that this continent will most likely face rising food deficits in the next decade.

Introduction: What's Happening to Food Aid?

Between 1985 and 1996, US government food aid levels fell from 7.5 million tons a year to 2.8 million (Table 1). Global food aid shipments by major donors through the Food Aid Convention (FAC) declined from 12.5 million metric tons to an estimated 6.5 million metric tons. Food aid now plays a much smaller role world grain markets. Food aid in grains amounted to nearly 18% of world grain trade in the mid-1960's, 10% in the early 1970's and only 4-6% in the 1990's.

The decline in food aid provided does not, however, reflect a reduced need for assistance. On the contrary, recent analyses suggest there is a looming mismatch between food aid resources and needs.[1] Food aid needs--both to relieve chronic food insecurity and to meet burgeoning emergency and relief requirements, are estimated to nearly double over the next decade. The increasing use of food aid for emergencies reflects not only natural disasters (such as drought) but also the rising number of conflicts and complex emergencies, such as Somalia and Rwanda. Between 1984/6 and 1994/6, the volume of food aid used for relief purposes has remained relatively constant, while food aid for economic and market development fell.

Over its forty-year history, U.S. food aid has changed significantly (Figure 1). When U.S. Public Law 480 (PL480) was passed in 1954, the food aid program was tied intimately to national agricultural policy. Government surpluses, the result of commodity support programs, provided the grain for food aid, as well as the basis of support among farmers and agricultural organizations. US farm welfare was directly linked to food aid. In the mid-1950's, food aid accounted for as much as

[1] Economic Research Service, USDA, *Food Security Assessment* (Washington D.C., November, 1997).

Table 1. Food Aid Shipments (Cereals) by Donor, 1971-1997 and Obligations Under The Food Aid Convention (FAC), 1986-1997

(Figures given in million metric tons)

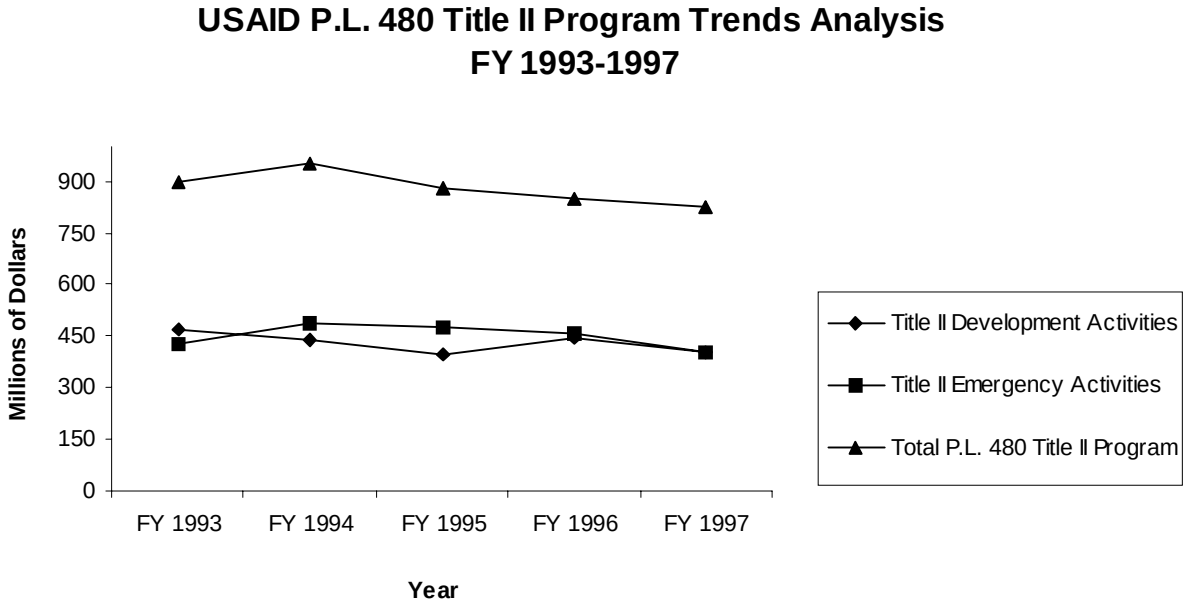
Year	Donors	USA	EU	Canada	Japan	Australia	Other Donors
1972	12.5	9.2	1.0	1.1	0.7	0.2	0.3
1973	10.0	6.9	1.0	0.8	0.5	0.3	0.4
1974	5.8	3.2	1.2	0.7	0.4	0.2	0.2
1975	8.4	4.7	1.5	0.6	0.2	0.3	1.1
1976	6.8	4.3	0.9	1.0	0.0	0.3	0.3
1977	9.0	6.1	1.1	1.2	0.1	0.2	0.4
1978	9.2	6.0	1.4	0.9	0.1	0.3	0.6
1979	9.5	6.2	1.2	0.7	0.4	0.3	0.7
1980	8.9	5.3	1.2	0.7	0.7	0.3	0.6
1981	8.9	5.2	1.3	0.6	0.9	0.4	0.6
1982	9.1	5.3	1.6	0.6	0.5	0.5	0.6
1983	9.2	5.4	1.6	0.8	0.5	0.3	0.5
1984	9.8	5.7	1.9	0.8	0.4	0.5	0.5
1985	12.5	7.5	2.5	0.9	0.3	0.5	0.8
1986	10.9	6.7	1.6	1.2	0.5	0.3	0.7
1987	12.6	7.9	1.9	1.2	0.5	0.4	0.7
1988	13.5	7.9	2.6	1.1	0.6	0.4	1.0
1989	10.2	5.3	2.2	1.2	0.4	0.4	0.8
1990	11.3	6.0	3.3	1.0	0.4	0.3	0.3
1991	12.4	7.3	2.6	1.1	0.5	0.3	0.5
1992	13.1	7.1	3.7	1.0	0.4	0.3	0.6
1993	15.2	8.5	4.1	0.7	0.4	0.2	1.2
1994	12.6	8.3	2.7	0.7	0.4	0.2	0.5
1995	8.4	4.2	2.7	0.5	0.4	0.2	0.3
1996	6.5	2.8	2.4	0.4	0.5	0.3	0.1
Minimum Annual Contributions:							
FAC 1986	7.5	4.5	1.8	0.6	0.3	0.3	0.1
FAC 1995	5.4	2.5	1.8	0.4	0.3	0.3	0.1
FAC 1997*	5.4	2.1	1.8	0.5	0.3	0.3	0.1

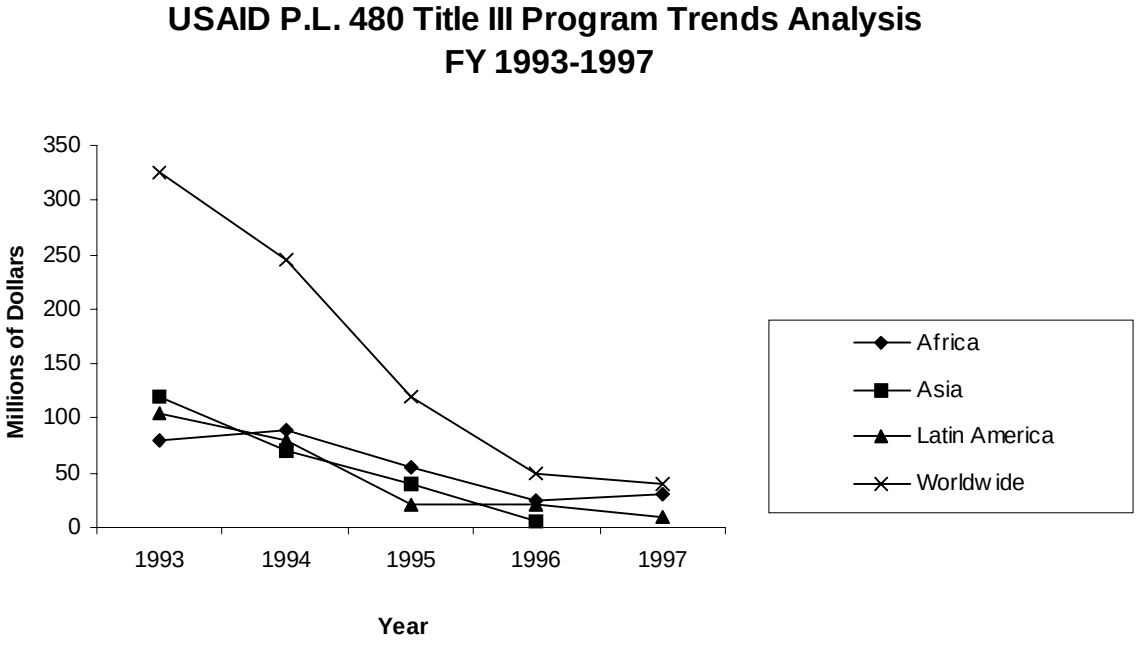
*Provisional Estimate

(Sources: FAO Agrostat and FAO Food Outlook, Aug/Sept 1995; Food Aid Convention 1995 & Food Aid Committee)

U.S. International Food Assistance Report, 1997.

Figure 1.





U.S. International Food Assistance Report, 1997.

much as one third of the total value of U.S. agricultural exports. Food aid also provided a significant foreign policy and development assistance resource in a world where the US was expanding its relations with newly independent nations in the context of a global Cold War. The multiple objectives of PL480 reflected the program's broad constituency in the agricultural community (develop export markets, expand trade), foreign policy makers (promote broad-based development, foster private enterprise and democratic participation) and humanitarian organizations (combat world hunger and malnutrition).

Food aid played an important role in increasing US agricultural trade, as countries which were once food aid recipients went on to become commercial customers. It also played an important role in mitigating famine--as, for example, when massive shipments of grain were made to India in the early 1960's to stave off disaster. Food aid was incorporated into development assistance strategies, as efforts were made to find effective ways both directly (as food) and indirectly (through the use of local currency and sales proceeds) to support economic and agricultural development.

Over time, however, food aid has become much less important to the economic well being of the US agricultural sector. Between the mid-1950's and the mid-1960's, roughly a quarter of U.S. agricultural exports occurred under food aid programs. In the 1970's, however, US agricultural exports grew significantly, while food aid stabilized or declined. By the end of the decade, only 3% of the value of US agricultural exports moved as food aid. While US food aid levels have fluctuated over the 1980's and 1990's, they have remained a relatively small share of US exports. Even in 1993, when US food aid shipments were at record levels, they accounted for only 6% of total exports.[2] Food aid is also a relatively small portion of world food consumption, and while the decrease in Title I and Title III is large, it did not significantly affect global consumption.

Food aid's place in US agricultural policy also changed over time. By the 1980's programs for export promotion were becoming more significant than food aid (Table 2). While food aid retained its export promoting objectives, it was supplemented with other programs which focused more directly on increasing exports. Exports under credit guarantee programs were consistently larger than food aid levels from 1978 on, and total export program levels were well above food aid from 1987 on. [3] US agricultural policy from 1985 on became steadily more market oriented, culminating the 1996 Farm Act, which fundamentally restructured US commodity support programs. Farm programs initially changed, then steadily reduced, the government's role in holding stocks. The large physical supply of grain, which had provided the initial underpinning for food aid, declined. Food aid became more budget driven and less surplus driven. As government accounting reforms increasingly required food transfers to be "scored," food aid moved from being an additional resource for development assistance to being a part of the overall assistance budget.

The actors involved in delivering food aid have changed (Figure 2). Initially food aid was provided primarily through government-to-government negotiations. Since the early 1980's,

---

[2] Karen Ackerman, Mark Smith and Nydia Suarez, *Agricultural Export Programs: Background for 1995 Farm Legislation* (Washington D.C.: June, 1995), p.27.

[3] Export enhancement programs here include EEP, DEIP, COAP and SOAP.

Table 2. Export Program Shipments of Agricultural Products[1]

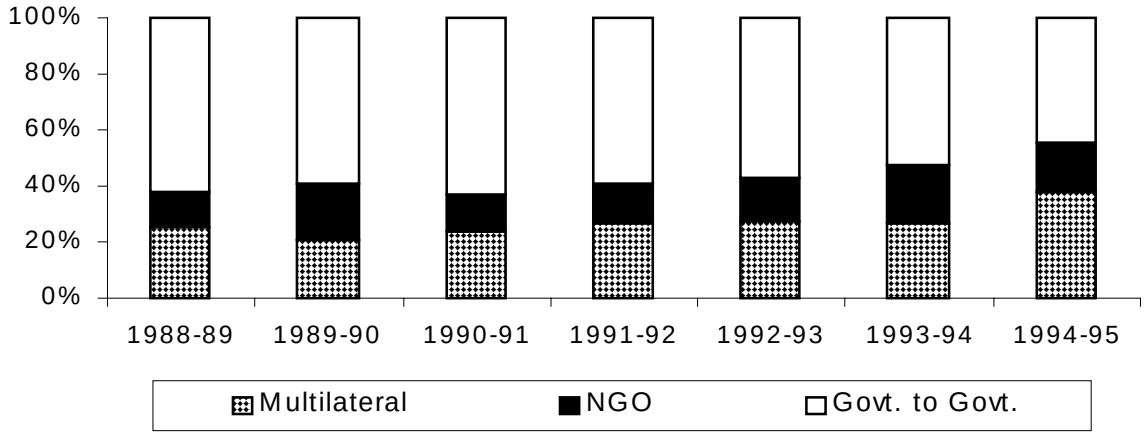
Year	P.L.480 and Section 416	Credit and Guarantee Programs	Export Enhancement Program[2]	Barter[3]	CCC Direct Sales[4]	Agricultural Export Value	Program Share of Exports
		----------Million dollars----------					Percent
1955	384.4	69.0				3,144.0	14.4
1956	984.9	61.9				3,496.0	29.9
1957	1,525.1	73.1				4,728.0	33.8
1958	981.0	203.3				4,003.0	29.6
1959	1,017.3	92.8				3,719.0	29.8
1960	1,115.9	1.0				4,519.0	24.7
1961	1,316.4	18.0				4,946.0	27.0
1962	1,495.5	33.0				5,143.0	29.7
1963	1,456.3	77.0				5,078.0	30.2
1964	1,418.0	118.0				6,068.0	25.3
1965	1,570.5	95.0				6,097.0	27.3
1966	1,345.9	210.0				6,747.0	23.1
1967	1,270.8	339.0				6,831.0	23.6
1968	1,279.5	141.0				6,331.0	22.4
1969	1,038.6	116.0				5,751.0	20.1
1970	1,055.8	211.0				6,958.0	18.2
1971	1,023.0	391.0				7,955.0	17.8
1972	1,057.0	372.0				8,242.0	17.3
1973	946.4	1,029.0				14,984.0	13.2
1974	865.9	297.9				21,559.0	5.4
1975	1,099.1	248.6				21,817.0	6.2
1976	904.1	956.9				22,742.0	8.2
1977	1,103.6	755.3				23,974.0	7.8
1978	1,072.8	1,582.5			16.9	27,289.0	9.8
1979	1,187.2	1,590.6			17.8	31,979.0	8.7
1980	1,341.6	1,417.0			41.4	40,481.0	6.9
1981	1,333.0	1,874.0			172.6	43,780.0	7.7
1982	1,107.6	1,393.0		13.0	24.3	39,097.0	6.5
1983	1,194.7	4,069.0			95.0	34,769.0	15.4
1984	1,505.9	3,646.0		34.0	15.5	38,027.0	13.7
1985	1,905.8	2,761.0	86.5		95.6	31,201.0	15.5
1986	1,334.2	2,416.5	715.7		111.7	26,312.0	15.9
1987	1,077.2	2,984.0	1,684.4		157.0	27,876.0	19.1
1988	1,435.7	3,879.9	3,313.5		108.6	35,316.0	22.0
1989	1,298.4	5,057.0	2,826.7		137.0	39,590.0	23.5
1990	1,315.0	4,299.6	2,384.2		7.1	40,220.0	18.0
1991	1,109.2	4,111.3	2,009.3		39.9	37,609.0	17.9
1992	1,074.3	5,529.0	3,296.8		133.3	42,430.0	19.6
1993	2,365.6	3,759.0	3,733.5		15.9	42,590.0	20.9

[1]Program shares of exports account for overlaps between sales under credit guarantee program and EEP, COAP, and SOAP from 1986 through 1993. The following amounts have been subtracted from total Government-assisted sales to account for the overlap: 1986, $387 million; 1987, $578 million; 1988, $951 million; 1989, $964 million; 1990, $778 million; 1991, $520 million; 1992, $1.7 billion; 1993, $965 million.
[2]Includes EEP, DEIP, COAP, and SOAP sale values.
[3]Barter sales outside of the P.L. 480 program were reported for 1982 and 1984.
[4]The market value of commodities sold by the CCC was not available prior to 1978.

Sources: U.S. Dept. Agr., For. Agr. Serv., Agricultural Assistance Update, "Notices to Exporters," and communications with officials in the Export Credits Division: U.S. Dept. Agr., Econ. Res. Serv. database of P.L. 480 shipments; U.S. Dept. Agr., Econ. Res. Serv. database of P.L. 480 and Section 416(b) shipments and Foreign Agricultural Trade of the United States.

however, more food aid globally has moved through NGO's. In 1997 75% of US food aid was channeled through NGO's and international organizations, up from 41% in 1990. This trend reflects both the rise in emergency/relief operations and the movement on the part of USAID to work more closely with NGOs as participants in their overall development program.[4]

Figure 2. Food Aid Channels



Source: WFP

Finally, the institutional environment within which food aid is embedded is changing. The main thrust of the institutional changes is to create a more market oriented environment for agriculture, both domestically (in the United States and many developing countries) as well as internationally (through the WTO). These changes, coupled with budgetary constraints, are creating a different environment within which food aid will be funded and organized. These institutional factors, over laid on the factors which already impact the need for food assistance--weak development, political strife, weather variability, environmental degradation, have created new challenges for the availability and use of food aid. More market oriented policies put a premium on identifying new food aid options--including options for emergency assistance--which incorporate a more sophisticated concept of risk management. Budget constraints also highlight the need to reexamine the relationship between food aid and the wider process of economic development in the most vulnerable low income, food deficit countries.

What this has meant is that, within the United States, we have moved from a situation in which there was a "hard" link between agricultural programs and food aid to one in which the link was "softer," both because of changing market realities and because of changing farm policies. The transition includes, of course, a shift from a surplus based to a budget-based food aid program. As

[4] Marie-Cecile Thirion, "Synthesis 1: Food Aid, a Multifaceted Tool" in Markets and Institutions for Food Security, proceedings of an international seminar organized by the European Commission, December 10-12, 1997, pp. 1-2.

we discuss in more detail below, it also has meant a shift in strength and role of the agricultural community in the food aid coalition. Finally, the relative mix of policy options and mechanisms which are "optimal" for dealing with food aid remains quite sensitive to market conditions, as well as to the WTO agreements which now apply to international agricultural trade. Finding the right balance between market realities, food security objectives, domestic programs and WTO commitments, both politically and technically, is the major challenge facing the food aid community today.

Domestic US Policy Changes and Their Impact on Food Aid

Changes in the US 1996 Farm Act

Two dimensions of the 1996 Act's impact will be examined in this section. The first deals very briefly with the major features of the 1996 Act, and their potential impact on the global environment in which food aid occurs. The second addresses the impact of the 1996 on Act food aid programs themselves, through explicit amendments to food aid programs contained in the legislation and implicit effects of terminating commodity price support programs, and hence, the accumulation of surplus CCC stocks.

The direct treatment of food aid in the 1996 Act did not constrain its ability to operate effectively. In fact, most of the changes made allowed greater flexibility, without removing previous possibilities. Indirect changes--stemming primarily from the elimination of government stocks--have had a greater impact. The decline in government stocks pushed the transition from a surplus based to a budget-based food aid program. In this context, the severe budget constraints faced by the US government during the last three years have had a significant impact on food aid, through reduced quantities of food aid provided and constraints on the overall development assistance program.

Features of the 1996 Farm Bill

In 1996, Congress passed the Federal Agriculture Improvement and Reform Act of 1996 (FAIR or Freedom to Farm). The 1996 Act is the culmination of a decade of changes increasing the market orientation of US farm policy. [5] While the 1985 and 1990 farm bill made incremental changes, the 1996 Act comprehensively redesigned U.S. farm programs. It fundamentally changed commodity programs by eliminating supply management provisions and changing income support mechanisms for producers of wheat, corn, grain sorghum, barley, oats, rice and upland cotton. It increased planting flexibility and significantly reduced the likelihood of government stockholding[6]

[5] The discussion draws heavily on C. Edwin Young and Paul C. Westcott, *The 1996 Farm Act Increases Market Orientation* (Washington D.C.: USDA/ERS), August, 1996, pp. 5-8.

[6] For a summary of the major features of the 1996 legislation, see C. Edwin Young and Paul C. Westcott, *The 1996 U.S. Farm Act Increases Market Orientation* (Washington D.C.: ERS, USDA), August, 1996. The discussion of program changes relies heavily on this publication.

Supply Management

The 1996 Act replaced the target price/deficiency payment program which had been in place since the early 1970's. Under the old program, price levels (target prices) were established for program commodities (wheat, corn, grain sorghum, barley, oats, rice and upland cotton). Farmers participating in commodity programs received deficiency payments based on the difference between the target price and the higher of the national market price during the specified time period or the loan rate. Farmers' payments, therefore, depended on their level of commodity production. Under the 1996 Act, participating farmers receive direct payments based on their past enrollment in commodity programs, not their present or future production decisions. Payments of a preestablished size are made over seven years, with the size of the annual payment declining steadily over time. Payments are independent of commodity prices or market conditions. Hence, while they do provide farm income support, they do not reduce risk associated with changing market conditions.

Planting Flexibility

Features of previous programs which limited farmers' choices in order to manage supply--such as the need to plant at least 85% of base acreage to a specific crop or idle land--were eliminated. Under previous programs, characterized by attempts to manage supply, farmers were required to plant a certain amount of their land to program commodities in order to qualify for payments. Under the 1996 Act, farmers have almost complete latitude in deciding which crops to plant, with the exception of some restrictions on vegetables and fruits.

This means that farmers can use market signals rather than previous base acreage to determine which crops they plant. Recent analysis suggests that farmers are using this greater flexibility to respond in novel ways to changing market prices.

Reduced Government Stockholding

The 1996 Act built on policies that began in 1985 to reduce government control and ownership of grain stocks.[7] The 1985 Farm Act significantly reduced government accumulation of grain stocks, and over the following decade, government stocks were virtually eliminated, except for the food security reserve (Figure 3).

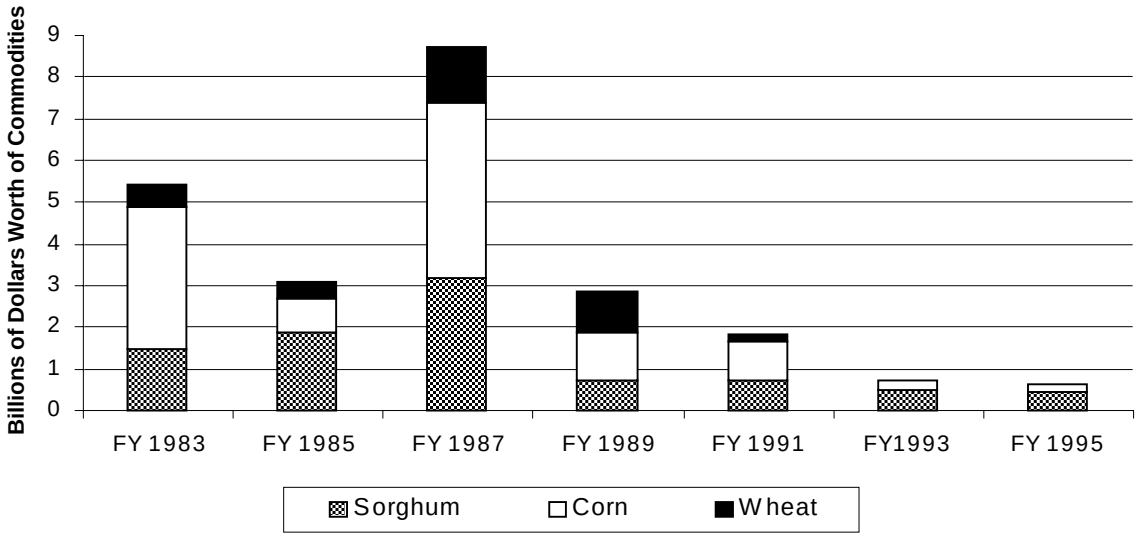
The 1985 Farm Act lowered crop loan rates, generally keeping rates below market prices. Marketing loan provisions, implemented for rice and cotton in 1985 and for wheat feed grains and soybeans in the 1990's, effectively ended accumulation of government-owned stocks. Marketing loans allowed farmers to repay crop loans (and redeem their crops) at lower rates when world prices fell below loan rates.

The 1996 Act further decreases the likelihood of stock accumulation. The Act suspends authority for the Farmer Owned Reserve (FOR). It preserves the 9-month price support loan program primarily to provide a source of short-term liquidity. Marketing loan provisions, combined

[7] Young and Westcott, op.cit.

with loan rates capped at levels below market prices minimize the likelihood of government stock accumulation through loan forfeitures.

Figure 3. Decline in U.S. Government-Held (Surplus) Commodities



Source: OMB International Affairs Division - Emergency Capacity Part 1, April 21, 1997.

The decline in government held stocks has been dramatic. In 1986 approximately 110 million tons of wheat and corn were either owned by the CCC or in the farmer owned reserve (FOR). Currently there are 2.5 million tons of wheat in the CCC-owned Food Security Reserve and no corn stocks. The Food Security Commodity Reserve can contain up to four million metric tons of grain (wheat, rice, corn, grain sorghum) to meet humanitarian food aid needs. However, the 1996 Act made this reserve more difficult because an advance appropriation is required to buy grain for it. The reserve can also be replenished from CCC inventories.

Under the 1996 Act, farmers and the private sector--not the government--have the primary responsibility for managing risk. Farmers will assume significantly more responsibility for managing price risk. While decoupled payments provide some income protection, because they are not tied to market conditions farmers will also assume greater responsibility of managing income variability. As a result, private stockholding and stocks held by other countries will assume a greater role in responding to market price variability. How these stocks are managed can have a significant impact on the volatility of world markets, and hence, on the environment within which food aid operates.

However, while the 1996 Act reduced the **likelihood** of accumulating, the **mechanism** for accumulating stocks does remain in place. If prices become too low in relation to both loan rates and

marketing loan rates, farmers still have the option of forfeiting crops to the government. With wheat prices now at their lowest level in years, the CCC has, in fact, acquired 2.5 million bushels of wheat forfeited by farmers during the 1997 crop year.[8] There is the possibility for additional stock accumulations, as contracts expire and farmers must decide whether to repay their loans or to forfeit the grain. [9] In all, there is about 180 million bushels of wheat under loan this year, and wheat industry officials have expressed concern that more could be forfeited. Industry officials are urging an expansion of food donations to needy countries--rather than storage or sale on the open market--as their preferred option.[10]

Changes to Food Aid Under the 1996 Act

The basic elements of US food aid, as established in 1954, have remained in tact. The major authorities for grant and concessional credit food aid are the Agricultural Trade and Development and Assistance Act of 1954 (PL480), the Food for Progress Act of 1985, and Section 416 (b) of the Agricultural Act of 1949.

Food aid still has the same basic, multiple objectives: combating hunger and malnutrition; expanding international trade; developing and expanding US agricultural export markets; and fostering the development of private enterprise and democratic participation in developing countries. The objectives remain concentrated in different food aid programs (titles under PL480) and authority for food aid programs is still divided between USDA and USAID.

The 1996 Act made both direct and indirect changes to food aid programs. Direct changes were made by amending the basic authorities as part of the new farm legislation, and are described below. The largest indirect changes flow from the elimination of commodity programs, and hence the elimination of government stocks. The 1996 Act therefore accelerates the shift, which has been ongoing for years, from directly supplying commodities to providing funding which allow commodities to be purchased.

The direct changes are as follows.[11]

PL480 Title I, administered by USDA, focuses primarily on the objectives of expanding international trade and developing and expanding US agricultural export markets. Basic legislation authorized government to government sales of agricultural commodities to developing countries

---

[8] Data on stocks are regularly reported on the FSA homepage--http://www.fsa.usda.gov. The data cited are from circular 1506.9, June 9, 1998.

[9] The discussion of the forfeiture possibility comes from Knight-Ridder, story #14847, May 29, 1998.

[10] Jim Miller, vice president for governmental affairs, National Association of Wheat Growers in Knight-Ridder, story #14847, May 29, 1998.

[11] The changes made by the 1996 Act are taken from Karen Ackerman, "Title II: Agricultural Trade" in Frederick Nelson and Lyle Schertz (eds), *Provisions of the Federal Agricultural Improvement and Reform Act of 1996* (Washington D.C.: USDA/ERS), September, 1996, pp. 33-36.

under long-term credit arrangements. Repayment could be made in either local currency or US dollars. Loans could be repaid over a period as long as 30 years, including up to a 7-year grace period. Local currencies received could be, and in the past were, used to carry out a range of activities specified under section 104 of the 1954 legislation. Permitted activities included: developing new markets for US agricultural products on a mutually beneficial basis, paying US obligations, and supporting agricultural development or research. Currently the local currency provisions contained in section 104 are not being implemented for budgetary reasons.

Title I program modifications reflect the increased market orientation of the 1996 Act as a whole. The repayment terms of Title I sales were modified. The minimum repayment period of 10 years was eliminated, and the maximum grace period was reduced to five years from the previous seven years. The Act also shifted the priority among criteria for allocating assistance to countries. The priority for determining assistance had been the country's need for food, whether the country was taking needed steps to improve food security and promote economic development, and whether the country demonstrated the potential to become a commercial market for US agricultural products. The 1996 Act reorders the priorities to raise the importance of market development potential in allocating Title I funds.

The 1996 Act authorized Title I agreements with private entities, as well as with developing country governments. In the case of private agreements, it also permits US trade organizations to carry out a project or program in the country using funds derived from Title I sales if the organization has a market development plan approved by the Secretary. The process for purchasing commodities for Title I, as well as the CCC's oversight and funding role, is described clearly in a recent FAS release. [12]

PL480 Title II, administered by USAID, focuses primarily on the objectives of combating hunger and meeting humanitarian and emergency food needs. Under the basic legislation commodities could be provided to meet emergency needs under government to government agreements, through both public and private agencies. These agencies included international organizations (IOs) such as the World Food Program and other multilateral organizations. Non-emergency assistance can be provided through private voluntary organizations (PVOs) and cooperatives, as well as through international organizations.

Title II program modifications generally provide greater flexibility for the program. It increases the maximum level of funding which can be provided to defray overseas administrative costs from $13.5 million to $28.0 million, and allows IGOs such as the World Food Program, as well as PVOs and cooperatives, to receive such funding. It also raises the percentage of non-emergency commodities which can be sold on local markets to generate foreign currencies (monetized) from 10% to 15%. Foreign currencies can be used to pay for the transportation, storage or distribution of commodities, as well as for community development and health programs. The 1996 Act also allows PVOs and cooperatives to use the local currencies for development activities in other countries in the region in which the Title II commodities are sold.

---

[12]12. FAS, "Public Law 480 Sales Program: A Brief Explanation of Title I," January, 1998 available on the FAS homepage at fas.used.gov/export credits/PL480 brief/html.

Finally, the Act allows Title II programming in countries where USAID does not have missions since so many AID missions have closed in the past few years, especially in sub-Saharan African countries. The 1996 Act prohibits USAID from disapproving a proposed grant solely because it does not have a mission in that country or because the grant is not part of a USAID-administered development plan. The Act extended--but did not raise--the total minimum assistance levels under Title II. The levels are 2.025 million metric tons of agricultural commodities and 1.55 million tons of assistance.

Before the 1996 Act, commodities requested could be provided either from the Commodity Credit Corporation's (CCC) inventory acquired under price support programs or through purchase from private stocks. All commodities must now be purchased, since the CCC no longer has available stocks. The CCC also finances ocean transportation, and finances land transportation to ports of entry and to storage and distribution sites inland.

PL. 480 Title III, administered by USAID, focused primarily on the objective of promoting broad-based, equitable development. The US government provides commodities to recipient countries, and pays associated handling and transportation costs. Recipient countries can sell commodities on the local market and use the revenue generated to support development programs.

The 1996 Act expanded the range of local organizations which could administer Title III development projects to include all private organizations operating in the country, not only local or indigenous private organizations.

Section 416 (b), administered by USDA, provided for the overseas donations of surplus commodities owned by the CCC to carry out assistance programs in developing countries and friendly countries. Surplus commodities acquired by the CCC as a result of price support operations became available for foreign donation if they are not needed for domestic food assistance program and cannot be sold at competitive world prices.

Under the 1996 Act, Section 416 (b) was changed to provide more flexibility in the use of local currencies derived from the sale of commodities. It allowed local currencies to be used to cover overseas administrative costs for overseas donation programs and lengthens the time period over which the local currencies can be spent under development projects.

Since the 1996 Act, CCC acquisition of commodities has been limited to dairy products, and very recently, a small quantity of wheat. As a result (Figure 4), section 416 (b) has been essentially inactive except for a very small quantity of nonfat dried milk.

Food for Progress (FFP), administered by USDA, authorizes the CCC to finance the sale and export of agricultural commodities on either a credit or a grant basis to support developing countries and countries that are emerging democracies which have made commitments to introduce or expand free enterprise elements into their economies. Legislation in 1992 included the independent states of the former Soviet Union under this program. Commodities may also be provided under the authority of Title I or Section 416 (b). CCC has the authority to purchase commodities for use in FFP programs if they are not held in CCC stocks. CCC also pays transportation costs to the ports of entry or point of entry into landlocked countries.

Under the 1996 Act, Food for Progress, like other programs, was also made more flexible. The program began in 1985 as a government to government program, and was amended in the 1990 farm bill to permit FFP agreements with private voluntary organizations, nonprofit agricultural organizations and cooperatives. The 1996 Act extended this authority to include intergovernmental organizations as well. The Act maintains a cap of $30 million annually on transportation costs under the program. Up to $10 million per year are provided to cover a portion of the NGO's management and operational costs in recipient countries.

Other legislative changes reflect the changes in overall US agricultural policy, and a move toward greater flexibility. The 1996 Act eliminates the requirement that the Secretary of Agriculture determine prior to the beginning of the fiscal year the list of commodities and the quantity of those commodities available for PL480 programming. Now the Secretary must determine if a commodity is in short supply and not available for PL 480 programming.

The Act also increases flexibility in the allocation of the PL 480 annual appropriation across titles, allowing up to 15% of the funds allocated for any title to be used to carry out any other title. In addition, up to 50% of Title III may be used to Title II. Finally, while USDA and USAID must continue to assure that PL480 food assistance does not have a disruptive effect on local farmers or the local economy, it no longer has to consult with IGOs and other donor organizations in making this determination.

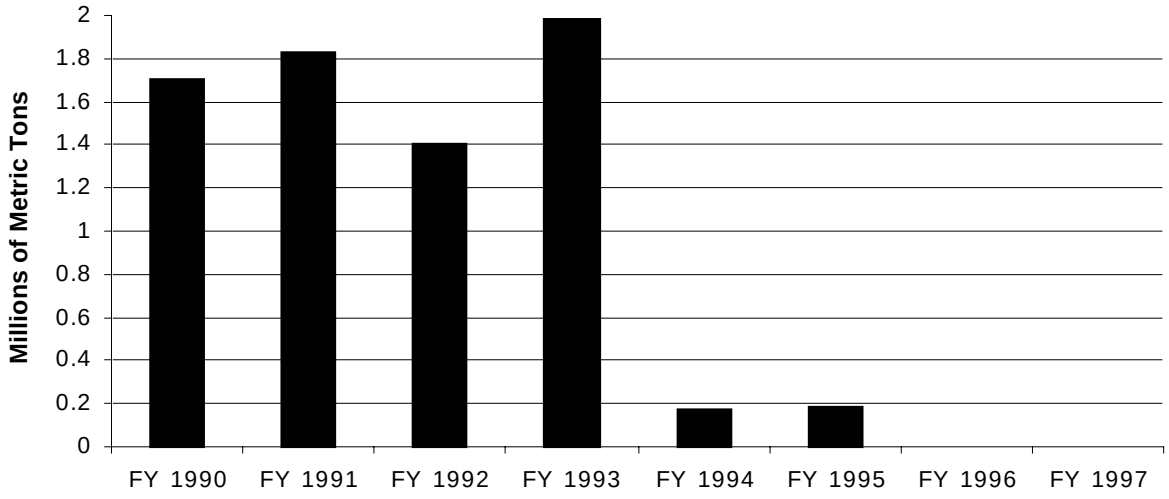
The Food Security Commodity Reserve, which was originally authorized in the 1980 farm bill, was established as a reserve of up to four million tons of wheat which would be available to meet extraordinary needs for food aid. The Secretary of Agriculture has the authority to release commodities from the reserve if domestic supplies are not sufficient to meet the availability criteria of P.L. 480 or if there is an unanticipated need for food aid which cannot be met through normal programming channels. The 1996 Act expanded the commodities to be included in the reserve, adding grain sorghum, corn and rice. The size of the reserve remains at four million tons. The Secretary of Agriculture has the authority to replenish the reserve, either by designating CCC stocks for it or through additional purchases. However, funds for replenishment must have been approved in advance through an appropriation act. The 1996 Act removed the requirement that the reserve be replenished within 18 months of releases, and did not specify a new time by which the reserve would need to be replenished.

The Act also raised the amount of commodities which could be released for Title II donation programs without regard to domestic supply conditions from 300,000 to 500,000 tons, and allowed for the release of up to 500,000 additional tons of eligible commodities which could have been released in earlier years but were not. The Secretary can also continue to release stocks from the reserve when supplies are so limited that commodities cannot otherwise be made available for PL 480 programming.

The most immediate impact on the quantity of food aid provided now comes from the budgetary appropriation for food aid. PL480 programs require, and have always required, an annual budgetary appropriation. Other food aid mechanisms--Section 416 (b) and Food for Progress-- do not depend exclusively on annual appropriations. Section 416 (b) commodity and transportation costs are funded by CCC. Food for Progress could operate either from CCC funds or through the

funding authority of Title I. Most of the cost of these programs is paid by CCC, with losses recovered by future year appropriations.

Figure 4. Decline in Sec. 416 Food Aid



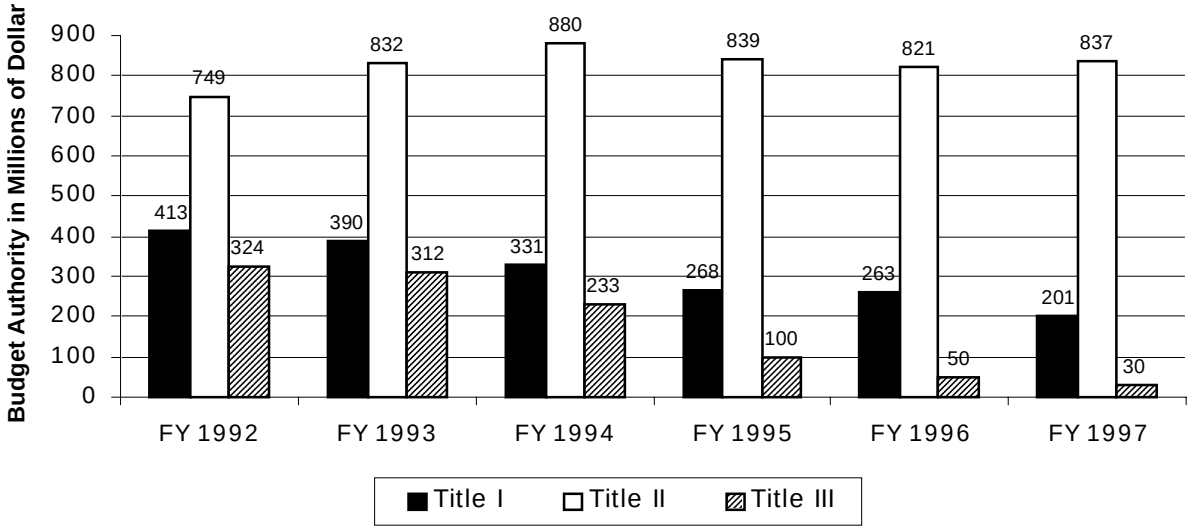
FY 1996 program is zero. No firm estimates available for FY 1997 but program is unlikely to exceed FY 1995 level.
Source: OMB International Affairs Division - Emergency Capacity Part 1, April 21, 1997.

Changes in Budgetary and Development Assistance Programs

By far the greatest impact on the availability of food aid came from the Administration's budget reduction program. Significant spending cuts occurred across virtually all government departments. Over the past few years, budgetary allocations for food aid decreased significantly. Overall funding for foreign affairs (the 150 account) fell significantly, and USAID was forced to close a number of missions and undertake a reduction in force (RIF) to live within its lower allocation. In response to budget pressures, the US unilaterally cut in half its commitment to provide food aid under the Food Aid Convention. Actions in other developed countries, reflecting their tightened budget constraints, reinforced rather than countered US reductions, leading to a significant overall fall in food aid resources.

The recent budget mark up for FY99 increased the program level for Title I by $10.9 million, and the subsidy level by $9.5 million (see Figure 5). Budget pressure, in general, remains strong, however, as the implementation of the long-term balanced budget agreement proceeds. The foreign affairs (150 account) appropriation for FY99 is $2 billion lower than the President's request and

Figure 5. P.L. 480 Funding Levels by Program, FY 1992-FY 1997



Source: OMB International Affairs Division - Emergency Capacity Part 1, April 21, 1997.

$200,000 million below the FY98 level. Secretary Albright indicated that "these cuts would require shutting down current programs which address poverty and hunger."[13]

Since the budgetary reforms of the early 1990's, food aid and local currency resources have been treated more directly as budgetary outlays which were under the discipline of budget agreements. The Credit Reform Act of 1992 required Congress to appropriate the cost of the subsidy associated with PL480 Title I and Title III programs. This means that an explicit request for budget authority must be included in the budget which goes to OMB, where it can be approved or denied. In an environment of budgetary discipline, this process forced a more explicit assessment of the value of programs which a significant subsidy component. Credit Reform also brought the use of accumulated local currencies under more budgetary discipline, and forced agencies intending to use them to obtain appropriations to do so. The net effect was to reduce the use of local currencies for associated development purposes.

The actual quantity of food aid provided depends not only on the appropriated outlay, but also on the price of commodities. When prices rise, as they did in 1993/4, a given food aid budget will translate into a smaller quantity of delivered commodities. When market prices are lower, as they currently are, the appropriation will buy more commodities. Hence, developing countries sometimes find that food aid is most available when it is least required, and least available in periods when it is most needed.

[13] Washington Post, June 17, 1998, p.A6.

Food Aid and Development Assistance

Development assistance budgets have also been smaller, reflecting both general budget austerity and skepticism about the impact and effectiveness of development assistance. The cumulative impact of these budget-driven changes has been to reduce US food aid levels, create a sharper tradeoff between emergency assistance and development activities, and force a reexamination of the size and nature of the role food aid could pay in promoting economic development.

In addition to the budgetary impact discussed above, the management of food aid resources within USAID has been radically transformed in recent years.[14] The concept of food security is providing a framework for more effectively targeting food aid and increasing its impact. There is also heavy emphasis on being able to measure and report upon results, as required by the Government Performance Reform Act. (GRPA) All Title II projects designed after 1996 must obtain baseline information against which they can gauge success during midterm and final impact evaluations. USAID and cooperating sponsors are beginning to systematically conduct joint assessments of the food security and nutrition situation of target populations before implementing new programs.

Some PVO's have expressed concerns that the additional reporting requirements, and the emphasis on being able to demonstrate impact over a relatively short period of time can endanger some traditional uses of food aid--such as school feeding programs.[15] In a bill currently before Congress--Africa: Seeds of Hope (H.R. 3636) PVOs are asking for greater flexibility in the use of both food aid and development assistance to meet local needs in developing countries.

It is worth noting, however, that USAID is not alone in promoting the baseline and impact assessment approach. The World Food Program, UNICEF and UNHCR follow similar assessment procedures when they program jointly.[16]

On the other hand, USAID's re-engineering process has provided both and recipient countries a more direct voice in the design of both specific food aid and overall program objectives. Discussions among key "stakeholders" are important in developing the strategic objectives (SOs) around which development assistance is organized within each country.

One of the most striking trends in food aid allocation has been the sharp growth in the requirements for emergency/humanitarian assistance between 1993-1995 and the continuing tradeoff between emergency assistance and other food aid objectives share of the overall food aid allocation going to cope with such emergencies. There are two central components of these requirements: responses to natural disasters, such as floods and droughts, and recently, the effects of El Nino; and

---

[14] USAID, *U.S. International Food Assistance Report: 1997* (Washington D.C., January, 1998), p.16.

[15] David Beckman, president of Bread for the World, seminar on "Africa: Seeds of Hope Initiative," International Food Policy Research Institute, June, 1998.

[16] USAID, *International Food Assistance Report: 1997* (Washington CD: January, 1998), p. 16.

allocations to what are now called complex emergencies--those involving political and military conflict. Complex emergencies have accounted for much of the recent growth in the need for disaster assistance. While conflicts fluctuate in their intensity, their resolution can be very difficult, and relief assistance for civilian populations can be required for long periods. More than 50% of the assistance to complex emergencies goes to African countries.[17] Large populations in Angola, Bosnia, Liberia, Somalia, Rwanda, Burundi and Sudan continue to require assistance to survive.

The presence of such complex emergencies, overlaid with other humanitarian needs, has had a dramatic impact on the use of food aid in Sub-Saharan Africa. In its 1999 Congressional Presentation on Africa, USAID had a total of $127.3 million in food aid, $107.9 million (almost 85%) was for Title II. All food aid, including the small Title III programs, was being programmed under the Humanitarian Assistance Strategic objective (SO). This SO was about 14% of total development assistance for Africa.

Complex emergencies and emergency assistance focus attention on the catastrophic side of Sub-Saharan Africa. These are countries which, almost by definition, fail to meet the criteria set by USAID for a sustainable development country. Yet, it is also imperative from a humanitarian perspective to respond to such dramatic conditions, even while recognizing that in an era of tight budgets, they may pull resources away from more development-oriented investments, which will have larger long-run payoffs for food security. Such emergencies also make clear the linkages between events in a single countries and wider regional patterns, which can exacerbate or dampen instability.

USAID has attempted to respond to this dilemma by developing a strategy for explicitly linking relief and development.[18] The key principles and operating guidelines of the strategy are:

- countries have primary responsibility for their transition from relief to development.
- international partners are responsible for assuring positive impact of their program through effective strategic coordination and adherence to established principles.
- relief programs should reinforce development objectives.
- programs should be designed to help prevent or mitigate disasters.

USAID concretized some of these principles in its Greater Horn of Africa Initiative (GHAI). The GHAI was founded on the assumption that while drought and other natural disasters may be beyond control, whether or not they lead to famine is something we can influence. The initiative

[17] USAID, "International Disaster Assistance" on http://www.info.usaid.gov/hum_response/ida.htm.

[18] USAID, *U.S. International Food Assistance Report: 1997* (Washington D.C.: January, 1998), p. 17.

includes 15 countries, many of which have experienced civil war or domestic upheaval. It builds on an explicit recognition of the role regional organizations and markets can play in responding to complex emergencies, as well as in creating conditions which will support future economic growth. In addition to dealing with food security, it recognizes the key importance of conflict prevention, management and resolution. It also focuses on infrastructure development. Working with the Intergovernmental Authority on Development (IGAD), which includes Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, and Uganda, GHAI has been able to address key regional issues such as the positioning of food stocks to minimize social disruptions caused by famine, particularly refugee movements, as well as developing regional approaches to crisis management.

On the other hand, however, it is clear that some African countries have made significant progress in their own policy reform processes, and that some of these are positioned to make major improvements in their development. In some countries, leaders with pragmatic, market-oriented views and an aversion to corruption are in place.[19] The President's recent trip highlighted some of these cases, and these are also other countries poised to benefit from the African Food Security Initiative, as well as the proposed African Growth and Opportunity Act. In a number of African countries, policy liberalization and improved ability for coordination is making regional food security initiatives viable. One instance of this is the operation of SADAC, and the role it played both in coordinating food assistance in the 1993 food emergency, as well as its proactive role in preparing for a potential El Nino impact. AID has fostered the development of more effective agricultural and trade links among Southern African countries through its Initiative for Southern Africa (ISA), and these countries are strong candidates for partnership in discussing improved regional food aid practices.

Countries which have made progress on domestic policy reform, both agricultural and general, are better positioned to address both development and security issues. As McCelland found in his review, improvements in the policy environment are often a precondition for the effective use of investments in agricultural research, technology transfer and infrastructure development.[20] Investments in agricultural development and agricultural research have a high payoff in this environment.[21] Accelerated investments of this type hold great potential for alleviating chronic food insecurity, which still accounts for the largest share of food insecurity in Sub-Saharan Africa and

---

[19] Dan Connell and Frank Smyth, "Africa's New Bloc," Foreign Affairs, vol. 77, no.2 (March/April, 1998), pp. 80-95.

[20] Donald G.McCelland, *Investments in Agriculture: A Synthesis of the Evaluation Literature*, USAID Program and Operations Assessment Report No. 15, July, 1996.

[21] For a good discussion of the role of agricultural transformation in catalyzing economic growth, see John Staatz, "The Strategic Role of Food and Agricultural Systems in Fighting Hunger Through Fostering Sustainable Economic Growth," Michigan State University, prepared for the USAID Workshop on "The Silent Challenge of Hunger," June 28-29, 1994. For a food synthesis of many studies of return to agricultural research in sub-Saharan Africa, see James Oehmke, P. Anandajayasekeram and William Masters, *Agricultural Technology Development and Transfer in Africa*, Technical Paper No. 77, November, 1997.

other low income food deficit countries.[22] The development policy issue, then, is how to deal with the real danger that the immediate imperative to respond to emergencies puts at risk the investments in increasing productivity and agricultural transformation which over the longer term are the keys to improved food security. The African Food Security Initiative, now in its first year, is one step in this direction, but falls short of the resources needed to take advantage of the changing policy and economic climate to address chronic food insecurity through increased productivity and development.

Global Policy Impacts on Food Aid

There are several main global impacts on food aid. The first is the inclusion of agriculture in the WTO, and the interaction between the WTO reform and the process of policy reform in both developed and developing countries. This leads to a discussion of the role for, and instruments of, food aid in managing risk in this new global environment. The second is the emerging perspective of food security, reflected in the outcome of the recent World Food Summit, and its follow-on actions. This leads to the discussion of the interface between food aid and other instruments to promote improved food security. The third is the potential for changes in food aid implementation and guidelines, including the outcome of the new food aid convention. The fourth is improved donor collaboration on food security assistance.

The WTO agreement on agriculture and world markets

The Uruguay Round of multilateral trade negotiations, which concluded on April 15, 1994, brought agriculture into the global trade liberalization process which had previously occurred under the GATT (General Agreement on Tariffs and Trade). Some of the major provisions of the agreement are briefly summarized below.[23]

- converting nontariff barriers to tariffs (tariffication), binding all tariffs and reducing them over six years by an average of 36%.

- reducing domestic support (as measured by the total Aggregate Measure of Support) by 29% in equal installments over six years.

- reducing budget expenditures for export subsidies by 36% and volume by 21% over six years.

- developing countries are subject to only 2/3 cut in tariffs, domestic support and exports over a 10 year period.

---

[22] ERS, *Food Security Assessment: Situation and Outlook Assessment* (Washington D.C., November, 1997).

[23] The discussion follows Praveen Dixit, "Agriculture and the WTO: The Road Ahead," *Agricultural Outlook*, December, 1996, pp. 18-23.

- exempting least developed countries from all reductions but are requiring them to bind tariffs and domestic support.

The status of food aid was a major concern of developing countries during the Uruguay Round. Negotiators agreed to guarantee that the implementation of the round would not adversely affect food aid commitments to meet authentic food needs of developing countries.[24] At the same time, the agriculture agreement contains specific measures to prevent the evasion of commitments to reduce export subsidies (Article 10).[25] It stipulates that food aid cannot in any way substitute for commercial exports, and that as much as possible, should consist of donations. Adherence to these measures would be monitored by the Consultative Surplus Disposal Committee (CSD), which has in the past required notification of food aid operations and assurance that the transaction did not displace commercial sales. The process for monitoring adherence to this provision is essentially that already in place under the CSD. [26] The food aid provided under long-term credit arrangements, such as Title I, avoids restrictions on export subsidies, even though the stated objective of the program is to expand commercial markets. Negotiations are still on going, however, to define clear distinctions between food aid and trade.[27]

Developing countries expressed strong concern that reforming agricultural policies in exporting countries would damage their own food security. The Marrakesh agreements stipulate that donor countries must set the commitment levels for food aid high enough to meet the reasonable needs of developing countries during the reform process. The commitments must be made under the Food Aid Convention.

Throughout the trade liberalization process, there have been concerns that freer trade and reduced domestic levels of support to agriculture would result in lower stock levels, increased price variability and a reduced incentive on the part of exporters to provide food aid.[28] Recently several scholars have argued that world cereal markets are entering a new era as a result of the WTO

---

[24] Ackerman, op.cit, p.33.

[25] Marie-Cecile Thirion, "Synthesis 1: Food Aid, a Multifaceted Tool" in *Markets and Institutions for Food Security*, proceedings of an international seminar organized by the European Commission, December 10-12, 1997, p. 3.

[26] The requirements to assure that commercial exports are not displaced include a prohibition on the export of the product (or similar products) received by the recipient country, the calculation of a usual marketing requirement (UMR) indicating the quantity of commercial purchases the recipient country must make, and the possibility for review and challenge of notifications by other exporting countries.

[27] Marie Cecile Thirion, "Synthesis 1," p.3.

[28] See Nicole Ballenger and Carl Mabbs-Zeno, "Treating food security and food aid issues at the GATT," *Food Policy*, August, 1992, pp. 264-276.

agreement.[29] The thrust toward more open markets, and the restrictions on the magnitude and type of interventions allowed, they suggest, will fundamentally change the nature of the global agricultural regime. While some scholars argue that more open regimes will be inherently stabilizing, allowing for improved price transmission and supply response across countries, other believe that lower levels of stockholding can increase price variability, especially if price signals are effectively transmitted to farmers who are able to respond to them.

Empirical analysis suggests that world markets respond quickly to price shocks, and tend to adjust rather quickly to them.[30] It also found no increase in inter-year or intra-year cereal price variability in recent years.[31] The recent experience with higher prices in 1995-96 and the vigorous response to them is consistent with these analyses. Nevertheless, low income food deficit countries are particularly vulnerable to more variable markets, since they face more serious income constraints and must deal with the reality that food aid becomes less available in periods of high prices. Regardless of whether or not markets become more volatile, it seems clear that the responsibility for managing production variability and stocks will shift substantially to private actors (farmers and private companies) as well as to a wider range countries. The implications this has for food aid and food security is discussed below.

However, production variability is only one factor affecting global agricultural markets. Analysis of the 1970-84 period found that macroeconomic shocks and other exogenous shocks accounted for 50% of price shocks, agricultural policy shocks about 25% and the rest due to unexplained factors such as weather.[32] This is certainly the case for current global markets, where economic downturns and political upheaval in Asia have played an important role in dampening global demand and reducing world market prices for grain. Demand shocks have traditionally been absorbed primarily through government programs, although analysis is being done on managing income risk for U.S. farmers. The reaccumulation of some levels of surplus stocks in the US appears a possibility. Some implications of this situation for food aid and food security are also discussed below.

.

Many developing countries have been concerned that the WTO process would hurt, rather than benefit them. This has been a particular concern in sub-Saharan Africa, where studies suggest

---

[29] Alexander Sarris, "World Cereal Market Instability and Developing Country Response" in *Markets and Institutions for Food Security*, Proceedings of a conference held by the European Commission, December 10-12, 1997, Brussels, p.1.

[30] Alexander Sarris, 'The Evolving Nature of International Prices in Cereal Markets," paper prepared for FAO, March, 1997; J. Leon and R.Soto, "Structural Breaks and Long Run Trends in Commodity Prices," World Bank Policy Research Working Paper No. 1406, January, 1995.

[31] Sarris, op.cit.

[32] D.O. Mitchell, "Prices Affecting Grain Prices 1970-84," World Bank International Commodities Working Paper No. 1987-10, November, 1987.

that the continent appears to suffer small losses under trade liberalization.[33] The Hertel et al. analysis, however, finds that the losses directly related to Uruguay Round trade changes are smaller than the efficiency losses countries incur by not reforming their economies. It also found that the estimated losses would be far outweighed by the potential gains from catching up with other developing countries in agricultural productivity and transportation costs.

The World Food Summit

The World Food Summit, held in Rome in November 13-17, 1996, focused world attention on the problems of chronic food insecurity, which plagues some 860 million people. The Summit Declaration set the goal of reducing by half the number of hungry people in the world by 2015.[34] It also identified seven broad actions which would be instrumental in achieving this objective:

- ensuring an enabling political, social and economic environment designed to create the best conditions for eradicating poverty.
- implementing policies aimed at eradicating poverty and inequality and improving economic and physical access to food.
- pursuing participatory and sustainable policies and practices which are essential to adequate and reliable food supplies.
- striving to ensure that food, agricultural and overall trade policies are conducive to fostering food security through a fair and market oriented world trade system.
- promoting the optimal allocation and use of public and private investment to foster human resources, sustainable food, agricultural, fisheries and forestry systems, and rural development.
- implementing and monitoring the Plan of Action.[35]

The Summit was a vehicle for refocusing global attention on chronic food insecurity, which the Summit clearly recognized as rooted in poverty and inequitable access to physical and monetary resources. While not ignoring emergency needs, the Summit set them in the context of the need to work more effectively to lessen the chance of such emergencies by promoting economic and political development. It also stressed the need to more effectively integrate emergency assistance into the longer process of economic development. While the Summit affirmed the principle that food security

---

[33] Thomas Hertel, William Masters and Aziz Albehri, "The Uruguay Round and Africa: A Global, General Equilibrium Analysis" forthcoming in *Journal of African Economies*, vol.7, no.2 (1998).

[34] "Rome Declaration on World Food Security and World Food Summit Plan of Action," WFS 96/3, November, 1996.

[35] "Rome Declaration on World Food Security and World Food Summit Plan of Action," WFS, 96/3, November, 1996.

is primarily secured at the national level, it recognized the importance of globally coordinated action to achieve the Summit goal of halving the number of food insecure people by 2015.

The World Food Summit encouraged donors to focus their food aid on the most chronically food insecure countries and regions, to provide an appropriate volume of food aid on the basis of need, to establish incentives to encourage the best use of food aid, and to strive to ensure that food aid reaches women, who often have the most responsibility for household food security. (Note--this came from the draft US plan of action.)

Within the US government, preparing for and following up on the Summit has created a process both for coordinating across US government agencies and involving wider civil society. A high level Interagency Working Group, composed of representatives from a broad range of government institutions, including USDA, USAID, OMB, Commerce, USTR, CIA, Treasury, State Department, Health and Human Services, dealt in an integrated way with both the US position for the Summit and the development of the follow on US Plan of Action. Both the US position paper and the process of drafting the Plan of Action involved open meetings in which representatives of civil society participated. [36] The result of this process has been a broad-based dialogue on food security, both domestic and international, with a wider constituency than has previously been formally involved.

How significant this process will prove to be in shaping food aid remains unclear. Several things are worth noting, however. First, the Working Group is continuing to be active in preparing the U.S. Plan of Action as the follow on to the WFS. In this context, it is reviewing actions which the US might undertake in the areas of economic security and the policy environment, trade and investment, research and education, sustainable agriculture and the environment, food security safety net, information and mapping, food and water safety and human rights. Second, there appears to be a firm consensus that the US should work to integrate food aid programs more effectively into the food security strategy. Third, while the Plan of Action has not been finalized, there are some concrete steps being taken to make food aid more "food security friendly." The US Government will give priority in its PL 480 programs to the most food insecure countries, as well as those that promote market economy and desirable food security policies. Legislation (HR3636) has been introduced to modify sources of funding for the Food Security Commodity Reserve. The US Government will also procure and pre-position small quantities of US commodities to improve response to sudden overseas emergencies. The Administration will seek authority to use uncommitted PL 480 funds to purchase commodities, as appropriate, to replenish the reserve. In addition, it will seek authority to expand

[36] The development of the US position paper included a forum on food security, held in several locations within the country, to obtain comments and views from civil society. The forum's discussions were summarized and published in USDA, *U.S. Forum for the World Food Summit Summary Report*, June, 1996. A similar forum was conducted during the development of the regional (US-Canada) paper. The discussions were summarized and published in USDA, *U.S. Canadian Forum for the World Food Summit Summary Report*, August, 1998. The final US position was published in USDA, *The U.S. Contribution to World Food Security: The U.S. Position Paper Prepared for the World Food Summit*. July, 1996.

the grant food aid provisions to cover inland transportation for countries in transition from crisis to development, as well as for the least developed net food importing countries.

The dialog with civil society has surfaced some differences, and in at least one instance, has catalyzed an independent movement toward increased funding for food security.[37] An expanded commission of the BIFAD (get proper citation) was established to more effectively add representatives of civil society into the process.

The Food Aid Convention

The international Food Aid Convention (also called the London Convention) lays down the minimum volume of food aid commitments by donors.[38] When it was signed in 1967, the agreement covered cereals, although since 1997, pluses (up to 10% of total volume) have been included. At present the Food Aid Convention is the only international legal agreement covering food aid, and there is no provision under the WTO to create a new, or alternate, body. The Food Aid Convention itself was scheduled for renegotiation in 1997, but this process was deferred until 1998. While the convention can serve as a means of limiting drastic cuts in aid, the commitments themselves can change as circumstances change.

While it would be premature to judge the outcome on the renegotiation of the Food Aid Convention, it seems likely that discussions will entail efforts to expand both the number of countries willing to be food aid donors, as well as the list of products which can be donated as food aid. Other issues could include approaches to assuring reliable supplies for net food importers, the possibility of improved donor coordination in recipient countries; and the possibility for changes in the levels and nature of food aid commitments.

New Bilateral Coordination Efforts

The two largest food aid donors--the US and the EU--developed a Food Security Coordination Program in 1995.[39] They affirmed the importance of using food aid to address the root causes of food security, and committed to mutually reinforce food security policy. They agreed to promote increased coordination among agencies involved in implementing food aid programs in both entities. Finally, they developed a joint plan for coordination including:

- promoting the formulation of national food security strategies and action plans in Angola, Bolivia, Eritrea, Ethiopia, Malawi, Haiti and Bangladesh.

- periodically convene food aid donor forums involving major food aid donors.

---

[37] Beckman, op.cit., Bread for the World, Seeds of Hope.

[38] The discussion of the Food Aid Convention follows Marie-Cecile Thirion, "Synthesis 1," p.3.

[39] USAID, *U.S. International Food Assistance Report 1997* (Washington D.C.: January, 1998), p.18.

- better information exchange.

- developing a strategy to increase involvement by the US and EU in national crop assessments.

- joint periodic review of the World Food Program's development project portfolio with the aim of strengthening food security objectives.

Greater coordination under the Transatlantic Agenda is likely in the area of food security. In addition to engaging in program coordination, the US, EU and other donors have participated in two broadly-based seminars on issues related to food security. The first, in April 1996, dealt with the issue of long-term food security prospects. The second, held December 10-12 in Brussels, focused on the issue of markets and institutions for food security. Ongoing exchange of research and issue discussions will be important to expanding future coordination on food security issues.

Coalitions

The policy environment is generally shaped not only by programs, which have been discussed primarily to this point, but also by the actors who participate in shaping the environment in which programs are developed and implemented. There have been significant shifts in actors which are likely to shape the development of future policies. The grand coalition which undergirded the original food aid program-- farm interests, the foreign policy establishment, the development assistance establishment and humanitarian interests-- has been replaced with a narrower, and far more conditional, collection of interests.

US agriculture now has a major financial stake in the global trading environment. Not only does more of its product move through commercial channels, but a higher portion of production is exported. This has made the farm lobby more intensely interested in issues of both trade and development. Some measure of the importance of this new shift can be found in the results of a recent commission, composed of representatives of the agricultural industry as well as universities and PVOs, which came out in support of both enhanced trade, more investment in international agricultural research and increased development assistance.[40] Changes in international markets--such as the financial crises in Asia--have a direct and immediate impact on the pocketbook of US farmers. So, however, does the enhanced growth of developing countries which use their increased purchasing power to buy American products.

The US agricultural community's level of interest in food aid depends strongly on market conditions. If markets remain soft, and even more so if CCC begins to accumulate stocks, support for additional food assistance is likely to grow within the US farm constituency. Soft markets, in the context of WTO disciplines on export programs, could also have the effect of catalyzing support for additional food assistance. In this case, however, the uses of food aid would need to conform to

[40] National Center for Food and Agricultural Policy (NCPAP), *US Interests in Economic Growth, Trade and Stability in the Developing World* (Washington D.C.: February, 1997).

WTO guidelines. This suggests, in practice, an emphasis on donations--rather than sales--and a more careful targeting to low income countries and low income people. Movement in this direction, however, is very consonant with the objectives of the World Food Summit, and could serve as an effective means to reduce global food insecurity.

US commercial farm organizations may be ready to join a wider coalition to support increased foreign assistance, over and above food aid, IF they continue to see it as effective in promoting their commercial interests. The research underpinnings for such a possibility were clearly laid out in an IFPRI study demonstrating the "win/win" nature of foreign assistance, showing that $1 in development assistance for agricultural research led to a $0.29 increase in total imports and a $0.07 increase in agricultural imports.[41] The possibility of a real coalition became evident in the outcome of the Commission on Trade and Research in which representatives of farmers and commercial agriculture came out with statements, press releases and subsequently follow on activities to promote increased foreign assistance and enhanced investments in international agricultural research.[42] How far such support could go would depend critically on the ability of such assistance to demonstrate a real impact on growth, which could translate relatively quickly into an increased ability to participate in global markets.

Humanitarian organizations--especially PVOs–have become permanent advocates of both foreign assistance and food aid. With the increasing importance of as delivers and implementers of US food aid programs, they have become the strongest, most durable supporters of food assistance. The same is increasingly true of development assistance, where PVOs are a prominent "stakeholder" and important participants in the design, as well as the implementation, of development assistance activities. Budget constraints, as well as the decline in the availability of food aid resources, has made stronger advocates of some of these groups. On the other hand, US land grant universities, historically implementers and advocates for agricultural development, has become more disaffected from the AID process as funding in these areas has fallen.

One expression of the enduring humanitarian interest in both food aid and agricultural development is the Africa: Seeds of Hope legislation (H.R. 3636) currently before Congress. Orchestrated by Bread for the World, it has the support of some 170 other organizations. It supports resources for agricultural and rural development; increased agricultural research and extension; more flexibility in the use of food aid and development assistance; and a new Bill Emerson Humanitarian Trust that amends the Food Security Commodity Reserve Act of 1996 to allow replenishment of the reserve when commodity prices are low.[43]

With the end of the Cold War, foreign policy making has become more diffuse. Efforts to focus on economic issues have come primarily through the promotion of a more liberal trade regime,

---

[41] Per Pinstrup-Andersen, Mattias Lundberg and James Garrett, *Foreign Assistance to Agriculture: A Win-Win Proposition, IFPRI* (Washington D.C., July, 1995).

[42] NCFAP. op.cit.

[43] Bread for the World, "Africa: Seeds of Hope H.R. 3636 Summary Sheet" (mimeo), May, 1998.

reduced impediments to investment and trade, and not through an increased focus on development assistance.[44]

Recently, however, there has been somewhat more diplomatic attention to the issue of complex emergencies, and a recognition that there is a strategic interest in preventing, as well as containing, such crises. The State Department has established an inter-agency working group on complex emergencies, and USAID is focused on using food aid and development assistance to cope with such crises. This has not, to date, translated into a policy vision which includes a significantly different role for food aid, however. The State Department has orchestrated the international follow up to the World Food Summit, but the US Plan of Action is still being developed.

Former defense secretary William Perry has argued that preventive defense--working to prevent threats from emerging--should be a key element in America's post cold-war strategy.[45] In many parts of Africa, resource scarcity, poverty and hunger are powerful forces exacerbating or even causing conflict. To the extent that the United States hopes to move from responding to complex emergencies to a more proactive, preventive defense against them, food security could play a more significant role in future diplomacy.

It is also clear that there is now a changing perspective on sub-Saharan Africa within the foreign policy community. A more differentiated view of the continent has emerged--a view in which it is possible to see genuine opportunities for market-based growth, trade expansion and even investment opportunities. This perspective is reflected legislatively and programmatically in the African Food Security Initiative and the Africa Growth and Opportunity Act. Both programs are intended for countries which have made it "over the hump" in the economic reform process, and are willing and able to continue. The perspective is reflected politically in the President's recent trip to Africa--the first ever by a sitting President--and his stated intention to promote a new relationship with the continent. His announced Partnership for Economic Growth and Opportunity in Africa was an initial step in this direction. Finally, the perspective is reflected publicly in a Time magazine article which stated "This story is not about the Africa you think you know" and talked of an emerging, though fragile, African Renaissance.[46]

It appears that there is a nascent coalition of interest supporting food aid. It also, however, is probably not about the "food aid you think you know." This coalition will be narrower and more tentative than the original food aid coalition. Market conditions will be important in shaping the strength and direction of participation of agricultural interests. This will be reflected in differing levels of support for expanding food aid programs (higher support in weaker markets).

---

[44] For a discussion of some of the tensions currently characterizing this approach, see Jeffrey E. Garten, "Business and Foreign Policy," Foreign Affairs, vol.76, no.3 (May/June, 1997), pp. 67-79.

[45] William Perry, "Defense in an Age of Hope," Foreign Affairs, vol.75, no.6 (November/December, 1996), pp. 64-79.

[46] Johanna McGeary and Marguerite Michaels, "Africa," Time, March 30, 1998, pp. 37-46.

Issues

The changes just discussed--in policies, institutional arrangements and constituencies--give rise to two issues which will be discussed briefly in this section. The first is the inadequacy of resources to deal with food security if movement toward a reduction of the number of food insecure people is, in fact, a priority for the US. The second is the need, created by the movement to more market-oriented policies, to develop better mechanisms for handling production risk and potential market instability.

Moving Toward Food Security: What Role for Food Aid?

The looming mismatch between food aid and food security needs will remain--despite the very positive steps being taken to in our development assistance program and our follow on to the world food summit. This will be true for both chronic food needs and emergency requirements. The most recent ERS Food Security Report estimates the quantity of food needed to maintain consumption will increase from 8.5 million in 1997 to 18 million tons by 2007, with quantity needed to meet nutritional needs increasing from 15 million to 24 million tons. The greatest increase is in sub-Saharan Africa, where the gap for current consumption would increase from 3.7 million to five million tons, and the nutrition gap would rise from nine million to almost 16 million tons.[47]

This knowledge puts a high premium on acting now to equip ourselves to cope with the present food security problem, while making every effort to alter the underlying trends which give rise to the dire future just described. Changes in the level and use of food aid can play an important role in doing this.

The confluence, however short lived, of the emphasis on food security flowing from the World Food Summit and relatively soft world market conditions, provides a window of opportunity for actions to reverse the recent declines in the quantity of US food aid. These actions could follow a different path, depending primarily on market conditions. If grain prices continue to fall, and the US accumulates significant stocks, these stocks could be used directly to replenish the food security reserve or to increase food assistance through section 416 (b) and Food For Progress.

By June 7, CCC had acquired 2.5 million bushels of wheat in forfeitures. This quantity is small in relation to the 54 million bushels (1.5 metric tons) which would be required to replenish the food security reserve. CCC inventories may continue to grow. USDA's latest estimate is that less than 10 million bushels of wheat will be forfeited, however. This quantity of grain could easily flow into the food security reserve. Some trade sources, however, believe that the number could be considerably higher.

Stocks in excess of 54 million bushels could not be absorbed into the food security reserve. Anything above this level would have to be sold on the market or put into a donation program--such as section 416(b). Under the 1996 Act there is no provision for holding stocks in excess of those in

[47] USDA, ERS, *Food Security Assessment* (Washington D.C., November, 1997), pp. 3,15.

the food security reserve, so presumedly forfeited grain would have to be moved relatively quickly through donation programs.

Given the structure of the 1996 Act, it seems unlikely that the US would acquire large stocks or maintain them for a prolonged period. Farmers both in the US and abroad have significant planting flexibility, and would likely reduce acreage in crops where conditions were unfavorable enough to make forfeiture a real option. However, if world markets were to experience a downward shift in demand, linked for example to a prolonged economic crisis in Asia, market conditions would put considerable stress on US farmers, and adjustment options could narrow significantly.

If markets remained soft, but prices were strong enough to avoid forfeiture, additional funding could be sought to replenish the Food Security Reserve. This would require an advance appropriation, and would therefore come as part of a budget initiative. An alternative mechanism for accumulating stocks through purchase--the trust concept contained in the Africa: Seeds of Hope bill, would allow for purchases on a market price trigger, which would be a more flexible option for responding to soft market targets of opportunity than the appropriations route.

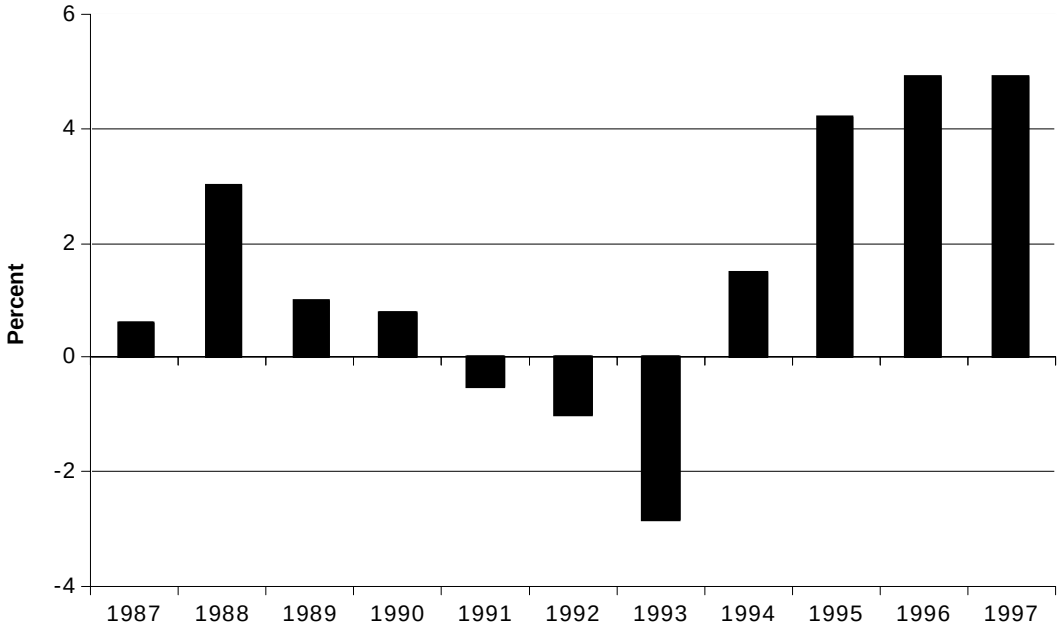
In either of these cases, support would be likely to come from a coalition similar to that which underlay the original food aid program: farmers, PVOs, and development interests.

This range of options for food aid has some serious constraints, however. It runs the risk of institutionally reinforcing the past trend toward more food being used for emergency purposes. There is little opportunity under either of these mechanisms to use food aid to address the projected growth in chronic food insecurity, which is the driving force behind the projected increase in food insecurity in sub-Saharan Africa. Additional appropriations for food aid would be needed to allow it to provide additional leverage on chronic hunger.

However, a much wider range of actions--depending more heavily on economic development, investment, trade and poverty reduction--are required to change the dynamics underlying these negative projections. The mix of actions will undoubtedly vary from country to country, and region to region. However, Sub-Saharan Africa, as a region, must focus on increasing aggregate growth and aggregate agricultural productivity in order to have a chance at coping with food security. If trends established over the past 15 years in agricultural production and export performance continue over the next decade, two thirds of sub-Saharan Africa's population will be undernourished in 2007. This is such a large proportion of the population that ONLY a significant increase in aggregate growth will work. Because much of the food insecure population is still engaged in agriculture, increasing agricultural productivity is the most efficient and equitable strategy for jump-starting growth in most countries.

Despite the very real perils sub-Saharan Africa faces in a "trend based" future, there are promising indications that some of these trends can be, and are being, altered (Figure 6). After years of low or negative growth, GDP increased significantly in 1995-97, providing three years of

Figure 6. Annual Growth Rate of Real Gross Domestic Product in Sub-Saharan Africa, 1987-97



Source: United Nations, World Economic and Social Survey 1997 (New York, 1997).
Note: 1996 = preliminary, 1997 = forecast. Data do not include Nigeria or South Africa.

consecutive increases in per capita GDP for the first time in many years.[48] The economic recovery is widely shared, with 20 countries achieving a GDP growth rate of 5% or better in 1996.

Agricultural growth was a major contributor. While some of the growth in agriculture reflects good weather and favorable export prices, other factors such as an improved macroeconomic policy environment and agricultural policy reform played an important part.[49] So did improvements

[48] The discussion follows Per Pinstrup-Andersen, Rajul Pandya-Lorch and Mark Rosegrant, *The World Food Situation: Recent Developments, Emerging Issues, and Long-term Prospects*, IFPRI, December, 1977

[49] For a summary of major policy changes in East and Southern Africa, see Nehemiah Ngeno, *Comparative Analysis of Economic Reform and Structural Adjustment Programs in Eastern Africa*, USAID/SD/Africa Bureau, Technical Paper No. 19 (Washington D.C.: June, 1996) and George Abalu et al., *Comparative Analysis of Structural Adjustment Programs in Southern Africa*, USAID/SD/Africa Bureau, Technical Paper No. 23 (Washington D.C.: June, 1996).

in agricultural productivity as a result agricultural research and the dissemination and adoption of improved technologies.[50]

There are powerful synergies between markets, technology adoption, and wider economic growth.[51] In countries where policy reform has created a more enabling economic and political environment, significant gains in food security can be made through a concerted effort to raise agricultural productivity. Five such countries are currently targeted under the African Food Security Initiative, but the number could easily expand if additional funding were available. Such countries are also poised to be better candidates for investment, and would likely be beneficiaries of the Africa Trade and Investment Policy if it is enacted into law. Nurturing the forces capable of shifting the historical trends is critical. Per capita incomes in sub-Saharan Africa have fallen so far that even at 5% annual GDP growth, it would still take at least a decade to recover to the level of 1980.[52]

Food aid could be a constructive part of a growth-promoting, agriculturally oriented strategy for reducing food insecurity in Africa. It can provide support for countries undertaking policy reforms. It can also be an effective tool for reaching poor, nutritionally vulnerable groups--including poor mothers and children--who may not benefit quickly or evenly from growth. Food aid can be an important part of the transition from relief to development, as it was in Mozambique.[53] Finally, it can provide a vehicle for working in countries where food insecurity prevails, where the US lacks a development presence, either through US PVO's or the wider international organizational community (e.g. WFP).

But food aid can also weaken a growth-oriented strategy if it delivers commodities at the wrong time, disrupts operations in reforming markets, undercuts the operations of new private actors or serves as a disincentive for local production. One of the dangers in the new food aid environment is that the incentive to deliver more food aid is strongest when world markets are weakest. As more developing countries are themselves tied into world markets, it becomes more difficult to insulate them from these negative effects unless food aid resources are carefully targeted and monitored.

A major challenge for those designing food aid programs for sub-Saharan Africa over the next decade will be to develop the ability to work at both ends of two continuums: the soft/tight world

---

[50] There is now an impressive body of evidence on returns from agricultural research and technology transfer in Africa. For a summary of much of this work, see James F. Oehmke, P. Anandajayasekeram and William Masters, *Agricultural Technology Development and Transfer in Africa: Impacts Achieved and Lessons Learned*, USAID, SD Technical Paper No.77, November, 1997.

[51] For evidence on the importance of markets to technology adoption, see Cheryl Christensen, *Agricultural Research in Africa: A Review of USAID Strategies and Experience*, USAID, SD Technical Paper No. 3.

[52] Anderson, Pandya-Lorch and Rosegrant, op.cit., p.22.

[53] For a description of the food aid experience in Mozambique, see USAID, *U.S. International Food Assistance Report 1997*, pp.55-58.

market continuum and the crisis/progress continue among sub-Saharan African countries. Intellectually, this means considering new ways to operate food aid programs in ways which can absorb commodity resources in weak markets, and use them over a longer time frame to effectively to reduce hunger without overhanging future, stronger markets. It also means finding ways to integrate food aid into more market-based risk management strategies, which must play a more important role in global markets in the absence of large government stocks. It means actively looking for new, creative ways to support the relief to development transition, as well as devising new linkages with growth in promising countries who will still have large numbers of food insecure people.

Managing Risk in the New Environment

More market-oriented policies--domestic and international--put a premium on developing more market-based instruments to deal with some of the risks which in the past were mitigated by large government stocks and larger food aid supplies. Even if actions are taken to restore, or increase, food aid levels the changed policy environment suggests the need to develop complementary market-based mechanisms for handling production and price risk. This is particularly important for poor food deficit importing countries of sub-Saharan Africa.

Countries in sub-Saharan Africa face two major sources of risk. One comes from the variability of production in countries dominated by rainfed agriculture.[54] In principle, production variability could be handled by imports. In practice, sub-Saharan remains the only region of the world where production variability still translates into famine. It does so in part because countries lack purchasing power to import, in part because infrastructure constrains the transportation of food to vulnerable populations, and in part because conflicts and domestic instability complicate both commercial transactions and relief. When countries do import, they face another source of risk--price volatility and particularly, sudden increases in grain prices. Not only do rising prices increase the country's own cost of importing food, but they also reduce the quantity of food which donors can purchase and deliver within a fixed food aid budget.

A number of mechanisms have recently been suggested for managing risk, including compensatory financing funds, national risk management programs such as crop or income insurance, buffer funds, buffer stocks, and the use of futures markets.[55] Sarris has proposed creating a futures-market based international fund to help low income developing countries manage import price risk. The international fund which would essentially act as an international food import insurance agency whose premiums would be subsidized by the international community. Under his proposal, the fund would examine world markets before the beginning of the country's crop year and decide the premiums at which it would make purchase contracts available to the country and the period over

[54] For historical data and national coefficients of variation, see USDA, ERS, *Food Aid Needs Assessments* (Washington D.C.: November, 1996), 84-85.

[55] Alexander Sarris, "World Cereal Market Instability and Developing Country Response" in Markets and Institutions for Food Security, proceedings of a seminar organized by the EU Commission, December 10-12, 1997 pp. 6-8.

which the contract would extend. The country could contract with the fund for this "call option like" contract. If it purchased the contract, and later needed to buy grain from the world market, and the market price was higher than the contract's strike price, the country could purchase at the lower (strike) price. If world market prices were lower than the contract price, the country would simply buy on the market at the lower price and forfeit the premium.[56] Such a program would achieve economies of scale in its operation, provide developing countries flexibility in accessing markets, and take advantage of well-established market instruments. The cost, or organizational complexity, associated with such a program has not been studies, however.

ERS recently explored two possible options for managing risk in Southern Africa: a strategic regional grain reserve, a regional food import insurance option, and identified a third--freer regional trade.[57] The regional strategic reserve would deal primarily with production risk. Analysis found that a regional reserve with quantity-based rules for acquiring and releasing stocks could potentially smooth aggregate consumption significantly. Using the rule that stocks are acquired when supply is greater than 120% over trend supply (including trend imports) and released when they are less than 80% of trend supply, a counter-factual study of the 1962-95 period found that consumption was smoothed considerably. Additional analysis, incorporating a more complex relationship between where stocks and trade, and looking at cost and cost sharing, is underway. The food import insurance option, on the other hand, dealt primarily with import price risk, and is basically a financial program. Using the rule that individual countries receive reimbursement for imports over one standard deviation above trend and pay into the fund when imports were more than one standard deviation below trend, the counter factual historical analysis found that every country would have saved on its imports, although some more than others. Exporting countries like South Africa and Zimbabwe gained the most, although Mozambique, Tanzania and Zambia were also big beneficiaries. The region as a whole would have saved $665.8 million over the 1962-95 period.

Conclusions

The policy environment for food aid has changed. The "hard" link to US farm programs--built on surpluses and an important role for food aid in bolstering farmers' income--has been replaced with a "soft" link, mediated by markets, budgetary constraints and changing institutional roles. This has, however, been a gradual process, beginning with the significant expansion of commercial export markets in the early 1980's, continuing with the more market-oriented farm bills of 1985 and 1990, and culminating in the 1996 Act and more budget-driven food aid programs.

The reality now is that food aid is not a "free good." It has to compete with other priorities in a tight budgetary environment. This means both increased program competition, as well as project

---

[56] Alexander Sarris, "World Cereal Market Instability and Developing Country Response" in Markets and Institutions for Food Security, proceedings of a seminar organized by the EU Commission, December 10-12, 1997, p.7.

[57] Mike Trueblood, "Can Regional Policy Initiatives Help Achieve Food Security in Souther Africa?" in USDA/ERS, *Food Security Assessment* (Washington D.C., November, 1997), pp. 30-35.

competition within the food aid budget. The weaker linkage of food aid to domestic programs also means that non-agricultural interest groups have become more powerful in shaping, and supporting, food aid programs. Smaller resources, in the face of growing needs and multiple objectives, will make it more difficult to show a positive, global impact, and increase the need for food aid managers to choose among competing needs.

Food aid programs have themselves changed. Government to government arrangements have been overshadowed by PVO and NGO implementation, and a rising role for multilateral food aid programs going through international organizations. The 1996 Act extended the scope for non-governmental actors even further by permitting private companies to handle Title I food aid.

Non-governmental organizations handling food aid face a different implementation environment. GPRA concerns with impact and effectiveness have led to new requirements for collecting baseline data and monitoring and quantifying impact which some find burdensome and inflexible. On the other hand, the reengineering of USAID has given "stakeholders" in both the PVO community and recipient governments a much greater opportunity for involvement in the formulation of programs, and a greater ability to relate them to local needs. The 1996 Act went further than any other farm bill in recognizing, and funding, the costs non-governmental organizations incur in carrying out food aid programs overseas.

Markets matter more--both nationally and internationally. International markets are now very critical to the well-being of American farmers and the agricultural sector. Commercial exports are much more important than government export programs, which are in turn more important than food aid. With the successful conclusion of the Uruguay Round, agriculture is for the first time part of the trade liberalization process which has transformed global commerce over the past thirty years. Disciplines on national policies which are trade distorting, as well as some commitments on the availability and appropriate uses of food aid, will continue to affect future programs. How and how much they affect them will, once again, depend a great deal on international market conditions, as well as on whether the reform and liberalization process begun under the Uruguay Round continue. Whether markets become more volatile, with lower stock levels, or more stable, with better price transmission and increased supply response, remains to be seen.

Food aid, most clearly that handled through USAID, is increasingly oriented toward improving food security. The conclusion of the World Food Summit, and the global commitment to reduce by half the number of food insecure people by 2015, could affect both food aid levels and their use if making food on the WFS pledge becomes an important US policy objective.

Sub-Saharan Africa has a serious food security problem, which will grow to catastrophic proportions if the trends of the past 15 years continue. It has been home to some of the worst complex emergencies. It is also, however, a continent which is showing new signs of promise and growth, particularly among countries which made critical policy reforms and have performance oriented leaders. Investments in increasing agricultural productivity, fostering trade and attracting investments will be especially important to accelerating growth in these countries.

Food aid has an important role to play in sub-Saharan Africa. How well it performs depends in part on the ability to design programs which deal effectively with both soft and tight international

markets, and can be smoothly interfaced with other strategies for managing risk in a market environment. It also depends on the ability to develop new approaches for supporting the transition from relief to development, as well as for operating effectively in growing countries which will still have a high proportion of food insecure people.

Poverty and Undernutrition in South Asia

T.N. Srinivasan

Introduction

In 1993 nearly half a billion people, accounting for 43% of the population of South Asia were poor who consumed less than $2 a day (UNDP, 1997; Table 2.1). Although South Asia's share in the population of the world was about 22%, it accounted for nearly 40% of the world's poor. Indicators of health, nutrition and poverty are given in Tables 1A and 1B. Except for Sri Lanka, which historically has had a record of extraordinary achievement for a country of its level of income, these indicators for other countries are pretty dismal.

It is natural to expect that poverty, undernutrition and poor health status are closely related. In South Asia as elsewhere national poverty lines in terms of real minimum consumption expenditure per head are based on estimates of the level of expenditure at which the consumption basket is adequate to meet the minimum nutritional requirements (basically energy content of food in kilocalories per day). 'International' poverty lines, such as one or two dollars a day are meant to facilitate international comparisons as well as regional and global aggregations of consumption or income based poverty. There are a number of serious conceptual and measurement problems in interpreting poverty measures derived from such national poverty lines as measures of undernutrition. I will discuss them in the next section.

Common measures of health status of the population as a whole, and of children in particular, are various indicators of morbidity and mortality (or survival) such as life expectancy at birth, infant and child mortality, adult mortality and maternal mortality. Measures of nutritional status include the extent of stunting and wastage among children and incidence of low birth weight babies. Once again there are serious measurement problems with these indicators as well and I will draw attention to them in the next section.

Table 1B clearly shows that the incidence of poverty in rural areas is substantially higher than in urban areas of South Asia. Since an overwhelming majority of the people, ranging from 65% in Pakistan to 86% in Nepal live in rural areas, it is evident that South Asian poverty is primarily rural, although the absolute numbers of urban poor are staggering. Most of the rural poor are either landless wage labourers and artisans, or own and operate small land holdings. Thus, they own few other assets besides their own potential labour power. Dasgupta (1997) argues that this potential labour power is "not necessarily an asset ... the reason is that if over an extended period of time, a person is to convert potential labour into actual labour power in any specified, physiologically admissible amount, he requires, among other things, nutrition of a corresponding quality and magnitude over that period. But, an assetless person with no support would be capable of meeting this requirement only if he were able to obtain appropriate employment" (Dasgupta, 1997, p. 6). Dasgupta views his model as providing a link between nutritional status and capacity for work and an analytical foundation for the concept of efficiency wage. He claims that it explains how involuntary unemployment of unskilled workers could arise in poor countries and above all, provides not only an unfortunate mechanism in which some poor households get entrapped in poverty but also

Table 1. Poverty and Malnutrition: South Asia

A. Health and Nutrition

	Life Expectancy at birth 1996		Infant Mortality Rate(%) 1996	Prevalence of Child Malnutrition (% of children under 5) 1990-96	Low Birth Weight Babies (%) 1989-1995
	Male	Female			
Bangladesh	57	59	77	68	34
Bhutan	53*		107	38	
India	62	63	65	66	33
Maldives	64*	64	49	39	
Nepal	57	57	85	49	26
Pakistan	62	65	88	40	
Sri Lanka	71	75	15	38	25

B. Poverty

	GNP per caput (Atlas) $ 1996	GNP per caput (PPP) $ 1996	Proportion of Population Below			
			National Poverty Line			International Poverty Line $1 a day %
			Rural %	Urban %	National %	
Bangladesh	260	1,010	39.8 (95-96)	14.3 (95-96)	35.6 (95-96)	
Bhutan	390					
India	380	1,580	36.7 (94)	30.5 (94)	35.0 (94)	52.5 (92)
Maldives	1,080	3,140				
Nepal	210	1,090	44.0 (95-96)	23.0 (95-96)	42.0 (95-96)	50.3 (95)
Pakistan	480	1,600	36.9 (91)	28.0 (95-96)	34.0 (95-96)	11.6 (91)
Sri Lanka	740	2,290	45.5 5-86)	26.8 (85-86)	40.6 (85-86)	4.0 (90)

Notes: *refers to entire population.
Although Afghanistan is part of South Asia, no data are available for that country.

Sources: World Bank, 1998 World Development Indicators, Washington, D.C.: IBRD/World Bank, 1998; Tables 1.1, 1.2, 2.7, 2.16.
World Bank, 1998 World Bank Atlas, Washington, D.C.: IBRD/World Bank, 1998.

a causal link from poverty to inequality in addition to the conventional one running from inequality to poverty. I will return to these issues in the next section.

A focus on consumption-based, or more precisely food-consumption-based poverty measures naturally lead to an analysis of the food sector in general, and issues of food security in particular. The role of public interventions (market and non-market) in the production, consumption, distribution and foreign trade (including foreign aid) of food is one of the more important policy issues. The third section is devoted to the food sector.

The fourth section addresses the interaction among economic development, growth and poverty as well as specific policies for poverty alleviation. After a brief review of the correlates of poverty and undernutrition in South Asia, it goes on to discuss overall development strategies. The final section offers a few concluding remarks.

Poverty and Undernutrition: Concepts, Measures and Data

Poverty

Poverty: Concepts

The definition of poverty calls for a method to distinguish a poor individual from a non-poor one. The widely used method is one of classifying an individual as poor if he or she does not meet a norm or set of norms. However, it is not simple, either conceptually or empirically, to define a set of norms. Even if one were to agree that the minimum amount of food, clothing and shelter needed to sustain life should constitute a universal set of norms, these minima are neither unambiguously defined nor easily quantified. Even the minimum energy from food needed to sustain the basic bodily functions of an individual of a given age, sex, height, weight and engaged in a well defined activity is not a constant. In any case, from Adam Smith on, many economists have argued that there are no universal poverty norms but only ones that are space, time and society specific. Regardless of the norms chosen, there is the further issue whether an individual who has the resources to meet the set norms but fails to do so either by choice or because of ignorance or inefficiency in the allocation of resources should be deemed poor. A rights approach to poverty would focus only on the right to the resources to meet the norms and not on whether the resources are in fact utilized to meet them. Also it is arguable whether a vector of norms should be specified or one should adopt a welfarist perspective and use the welfare attained by an individual (as judged by the individual) as the basis for judging whether she is poor.

Besides somehow determining the poverty status of an individual, one needs to address the issue of aggregation, that is, the procedure followed to derive a poverty measure that aggregates the member-specific poverty status over all members of a given population. In addressing it one has to recognize that an individual is often a member of several socio-economic groups ranging from his or her immediate family at one end to more and more inclusive groups at the other. Whether or not an individual is deemed poor may depend on the extent to which she can draw upon, and in turn is obliged to supplement, the resources of others in each of the groups of which she is a member. To the extent one's own resources vary over time with the stage in one's life cycle or are subject to

random shocks, being a member of a family and other networks enables one to smooth consumption over time and insure it.

The fact that there may be a life cycle and a random component to the resources available to an individual or a household at a point in time makes it important to distinguish between transient and chronic poverty. As the causes of two types of poverty differ, so are the policies to alleviate them. Clearly an individual who is poor because his harvest has failed due to adverse weather (but whose normal harvest would have placed him comfortably out of poverty) is temporarily poor. He may or may not need any private or public assistance, depending on whether he had access to insurance against such risks. But one whose land holding is too small to provide an adequate harvest even in ideal weather is chronically or permanently poor. He certainly would need such assistance to escape poverty. The former, if he needs any assistance at all, would need temporary income support while the latter would need permanent income support or equivalent asset transfers.

Poverty: Aggregate Measures

Once a poverty norm or indicator at the level of some unit (e.g. household) has been defined and the corresponding population (e.g. all households living in Bangladesh in 1990) identified, one aggregates poverty status of individual units into that for the population as a whole. This aggregation problem is analogous to that involved in aggregating individual welfare indicators into a social welfare indicator. It is natural that the axiomatic approach used in the analysis of the latter problem has been extended in the literature to poverty measures. Among the more important axioms or properties desired of procedures of aggregation are: (i) monotonicity, i.e. reduction in the poverty indicator (e.g. food consumption or income) of an individual classified as poor leads to an increase in aggregate poverty, (ii) (transfer) a change that reduces the indicator for a poor unit while at the same time increasing the indicator for a less poor or non-poor unit by the same amount leads to an increase in aggregate poverty, (iii) (transfer sensitivity) for an aggregator satisfying the transfer axiom and for a transfer from a poor to another less poor unit, the increase in aggregate poverty is smaller the larger the value of the poverty indicator for the person from whom the transfer is being made.

There are four widely used poverty aggregates. Denoting by y_i the chosen scalar poverty indicator for a unit, z the poverty threshold, N the number of units in the population, and for convenience ordering the units i according to increasing value y_i, the four indices are defined as follows:

(1) Head-Count Ratio, $H \equiv N_p/N$, where N_p is the number of poor in the population, i.e. those i with y_i less than the poverty threshold z. This is the most commonly used index and equals the proportion of the poor in the population.

(2) Poverty-Gap Index,

$$G \equiv \frac{1}{N_p z} \sum_{i=1}^{N_p} (z - y_i) = 1 - \frac{1}{N_p} \sum_{i=1}^{N_p} \left(\frac{y_i}{z} \right).$$

This measures the average gap between the threshold and the indicator values of the poor, expressed as a proportion of the threshold. An alternative definition is to take the average gap over the entire population of N units treating the gap for the non-poor zero. Under this definition, poverty gap is GH.

(3) Sen Index $S \equiv H[G + (1-G)g]$ where g is the Gini coefficient of the distribution of y_i among the poor.

(4) Foster-Greer-Thorbecke Index,

$$F(\alpha) = \frac{1}{N} \sum_{i=1}^{N_p} (z - y_i/z)^{\alpha} \quad for \ \alpha \geq 0.$$

The four indices are related: F(0) = H and F(1) = GH, the value that the Sen index takes if g = 0, i.e. if all the poor have the same y. Except H, the others (with $\alpha > 0$ in the case of $F(\alpha)$) are distributionally sensitive in that they <u>increase</u> if some unit with a y below the threshold is made poorer. H does not satisfy any of the three axioms, while G satisfies the monotonicity axiom but not the transfer sensitivity axiom. It satisfies the transfer axiom if the unit receiving the transfer is not poor, i.e. has a y exceeding the threshold. $F(\alpha)$ satisfies the monotonicity axiom for all $\alpha > 2$, the transfer axiom for all $\alpha > 1$ and the transfer sensitivity axiom for all $\alpha > z$. Another desirable property of $F(\alpha)$ is its <u>decomposability</u>: thus if a population of N units is divided into M mutually exclusive and collectively exhaustive subgroups with the number of units in jth subgroup being N_j then the $F(\alpha)$ of the subgroups, i.e.

$$F(\alpha) = \sum_{j=1}^{M} (N_j/N) \ F_j(\alpha).$$

This property is particularly useful when the sub-groups have well-defined socio-economic characteristics (e.g. place of residence such as rural, urban, state, region, sex and so on).

<u>Poverty Estimates: Data Problems</u>

Once decisions are made regarding the choice of a poverty measure, whether or not to take into account differences in age and sex through the use of some form of equivalence scales, the choice of a poverty line, and a way of adjusting the chosen poverty line to reflect differences in prices, overtime and across space, estimates of the extent poverty can be made.

The estimates of poverty reported in Table 1 are derived from surveys of household expenditure using a national or international poverty line. It is often the case that the survey-based estimate of aggregate household consumption expenditures differs substantially from the estimate derived from national income accounts. The difference often remains substantial even after adjustments are made for the fact that unincorporated enterprises are part of the household sector in national accounts though not in surveys. Adjusting for this difference by scaling-up the survey-based estimate of per capita aggregate consumption expenditure to equal that from national accounts which is higher, and

using the household distribution data from the survey leads to lower estimates of the incidence of poverty as compared to using the survey data without scaling.[1] Also the particular price index used to inflate (or deflate as appropriate) the poverty line in base year prices to arrive at the same poverty line at current year's prices can also significantly affect the estimates of poverty. Besides, it is not necessarily the case that the choice of price deflator or scaling of survey-based aggregation consumption expenditure only affect the levels and not the time trends in estimated poverty incidence. Both can be affected.

The size and composition (in terms of age and sex) of the household clearly matter in assessing the poverty status of a household. For example, two households with the same aggregate consumption expenditure and the same size are obviously not the same from the perspective of their poverty status, if the composition of the two in terms of the number of adults and children is not the same. Equivalence scales (i.e. coefficients to scale individuals of different age and sex to a common reference individual of a specified age and sex) if available, could be used to convert households of different sizes and age-sex compositions into households with corresponding number of reference individuals. Then given a poverty line for the consumption of the reference individual, a household can be classified as poor only if its consumption expenditure per reference individual is below the chosen poverty line. But, since estimating equivalence scales is in itself an exercise of some complexity (as well as a degree of arbitrariness) such scales are not often used. Instead age-sex differences are usually ignored and actual, rather than equivalence-adjusted, household size is used to arrive at household consumption expenditure per capita for comparison with a poverty line.

Non-response is often a serious problem in household surveys of developing countries and such non-response is unlikely to be randomly distributed across different expenditure classes. Other problems include varying reference periods (day, week, month, year) used in canvassing consumption expenditure. Recall biases could also depend on the reference period. Adjustment for seasonal effects, if different households are canvassed in different seasons, is not often done. Since surveys from different countries often differ in their designs as well as in the extent of the biases and errors of measurement, international comparisons and aggregations of incidence of poverty are hazardous.

Lastly, poverty measures (particularly the headcount) are often highly sensitive to the choice of poverty line. To cite just one example, if an international poverty line of US$2 is used instead of US$1, the headcount measure of poverty rise from 52.5% to 88.8% in India and from 11.6% to 57.0% in Pakistan (World Bank, 1998, Table 2-7).

[1] Bardhan (1974) found that scaling-up survey based mean consumption expenditure by 12% to account for its difference with national accounts based estimate reduced the estimated incidence of rural poverty in India in 1968-69 from 54% to 43% of the rural population.

Undernutrition

Concepts

A widely used concept to reflect the nutritional status of an individual is the adequacy of energy and protein intakes. An individual is said to be undernourished if his energy or protein intake is below what is required for good health. The finding that those who had adequate energy from their food intakes also met their protein requirements led to the abandonment of protein deficiency as a separate concept in favour of a single energy deficiency. Two other concepts, used to reflect the nutritional status of children, are stunting and wastage.

A better understanding of the concept of energy requirement can be had by taking a process approach to energy balance. Such an approach views energy intakes, expenditures and energy balance for an individual as a vector stochastic process. First, analytical and policy interest lies in the health and well-being of each individual over a life time and not just at an arbitrary point in time. Second, it is unrealistic to assume that intakes or expenditures are deterministic: after all, even if we ignore everything else, avoidance of monotonicity in diets may induce an individual to vary in an unpredictable way the composition, and hence the energy content, of his diet from day to day. Since many of the components of this stochastic process are subject to the choice of the individual, the evolution of the stochastic process will depend on such choices as well as any other exogenous shocks to the system and not only on the metabolic processes involved. To take a mundane example of an exogenous shock, usually cold or hot weather may affect one's intake of food. As such, it is conceivable that, depending on the exogenous shocks and choices actually made, the system may or may not be stable and, if the stochastic process converges the (joint) distribution to which it converges need not be unique.

Once again, it is natural to ask whether the metabolic processes have a tendency to maintain the system along a stable path towards convergence if the processes relating to choice and exogenous variables satisfy such a property. A system with such a tendency is said to be homeostatic. Suppose the system exhibits homeostasis and is in stochastic equilibrium but the processes relating to a subset of exogenous variables is altered at some point from one stable convergent set to another. Then if the processes relating to the choice variables can be suitably altered and the metabolic processes also adjust if necessary to steer the system towards another stochastic equilibrium, then the system is said to exhibit adaptation. Thus homeostasis relates only to the metabolic processes, while adaptation involves in addition choice variables in an essential way.

Homeostasis and adaptation can be illustrated by applying laws of thermodynamics which dictate that the sum of inflows of energy into the process from all sources must equal exactly the sum of all outflows, the flows being defined as rates of energy per unit of time, e.g. kilocalories per day, megajoules per day etc. In applying this identity to energy balance in human beings, inflows are essentially two, energy content of food intake and the energy withdrawn from stores within the body. Energy outflows or expenditures consist of (i) energy expended by metabolic processes, including energy needs for system (blood circulation, respiration, etc.) maintenance and growth (if relevant), (ii) energy expended on activities relating to one's occupation or profession, exercises or other physical activities aimed at maintaining good health, recreation etc, (iii) energy added to bodily stores and (iv) energy content of bodily wastes, including dissipated heat not included in other flows.

Clearly, for flow accounting what matters is the rate of net addition (positive or negative) to bodily stores per unit of time so that we can transfer from the inflow side of the identity the energy withdrawal from stores to the outflow side and treat the net addition (positive or negative) formally as an outflow.

Consider the hypothetical case of an individual whose energy expenditure on activities remains constant. The energy needs for metabolic processes are a function of age, sex and body weight and the intake itself. If we ignore the variation due to aging and neglect energy content of wastes, then for an individual who is in energy balance while maintaining body weight, his constant energy intake equals the sum of energy needed for activities and metabolic processes. As long as the body mass and the levels of activities which are being maintained are satisfactory, the process has a satisfactory outcome. Then his intake could be defined as the (hypothetical) energy requirement of the individual under discussion. Of course the issue of stability does not arise since neither the inflow nor outflow vary over time.

In order to pose the stability problem in a simple, yet meaningful way let us proceed by stages of increasing realism and complexity. First, assume that the intake process and activity process are exogenous and stationary and that the other processes are endogenous so that they adjust to maintain energy balance. Clearly adjustments that indefinitely increase or decrease body mass, are not meaningful. As such, one would like to ensure that the process of net additions to body mass is stationary with mean zero. Thus, the stability of the system in enabling the individual to maintain good health and perform exogenously specified activities with exogenously given intakes depends on whether the endogenous metabolic processes can adjust to maintain net additions to body mass stationary at mean zero. Clearly, the variance of the exogenous processes together with the adjustment `capability' of the endogenous processes will determine whether the system is stable in the above sense. This suggests that one can define the system to be homeostatic and the variances of the exogenous processes to be within its homeostatic range, if the system is stable, i.e. the endogenous processes adjust to keep the individual in energy balance (in a stationary stochastic equilibrium) with no drift in his body mass while enabling him to perform the exogenously specified activities given the exogenously specified intake.

Adaptation, as contrasted with homeostasis, can be defined for the above model as follows: suppose a system which has been in stationary stochastic equilibrium is shocked at some point. Then adaptation is the process of achieving a new stationary stochastic equilibrium.

It is evident that analogous to the limits on process variances within which homeostasis applies, there are likely to be limits, this time on the changes in means of the relevant process, applicable to adaptation. Put another way, stationary stochastic equilibrium may be infeasible, for instance, if mean body mass to be maintained at such an equilibrium is too high or too low. That is to say, even if one reduces all energy expenditures other than for the functions of metabolic processes to zero, one may not be able to maintain too high a body mass. Equally too low a body mass may be inconsistent with survival.

From the point of view of the health and well-being of an individual throughout her life, the entire time path of the relevant indicators of health and nutrition would be relevant. However, in conformity with common practice and for the sake of analytical simplicity, the long-term nutritional

status, or in the above context the steady state distribution of the relevant processes, will be used to assess the nutritional status of an individual. Thus unsatisfactory nutritional status will arise if the steady joint distribution of the relevant processes is deemed unsatisfactory in some well-defined sense. Clearly with nutritional status identified with long-term consequences, if the system does not exhibit homeostasis, the question of evaluating the nutritional status does not arise. If nutritional stress, as exhibited by disruption of homeostasis, is not reversed, the nutritional status of the individual is ill-defined. Thus the presence of nutritional stress at a point in time raises the presumption of impairment of nutritional status. On the other hand, the absence of nutritional stress does not preclude the possibility that the individual is moving towards an unsatisfactory nutritional status. That is, even though the individual is presumably moving towards a stable equilibrium, the equilibrium itself may be unsatisfactory.

Dasgupta's model is based on two critical assumptions: "(a) maintenance requirement is a large fraction of total energy expenditure, and (b) at levels of energy intake somewhat in excess of maintenance requirement [i.e. energy needed for metabolic processes] there are diminishing gains in productivity from further increases in consumption" (Dasgupta 1997, p. 27). These two assumptions lead to a rate of intake, say x, at which productivity per unit of intake is maximized. In a private ownership agricultural economy which is in the aggregate very poor and has a highly unequal distribution of land, the landless worker is assumed to either work in agriculture or live off the commons but he cannot do both. But the food energy available from commons is assumed to be below x. If the aggregate land endowment and its distribution are such that the landless cannot all be employed at a wage, which if entirely spent on food intake would yield an intake above x, then some of the landless would be unemployed. Thus, "There is no wage rate for landless folk at which the demand for labour power can equal its supply. So the labour market in the model imposes rations, and a fraction of the landless find employment in the agricultural sector, while the remaining fraction live off the commons" (Dasgupta 1997, p. 29).

In this model any attempt by the unemployed at undercutting the employed by offering to work at a wage lower than that of the employed would fail. Dasgupta himself admits, " A crucial assumption of the model -- is that nutrition intake is all-important to the typical landless worker ... otherwise the unemployed landless person could undercut those who are unemployed -- in short, it is taken that there is no slack in the household budget; the worker does not indulge in non-essential consumption." Although Dasgupta claims that the reason that this crucial assumption finds ambiguous empirical support is in part because empirical studies have not been faithful to economic theory, I do not find this assertion persuasive. I have elsewhere (Srinivasan 1994) discussed the Dasgupta Model and its empirics in some detail. I do not find it satisfactory as a theoretical model that captures the essentials of undernutrition - poverty syndrome in poor countries. I will not repeat my criticism here.

Conventional definition of a stunted (resp. wasting) child is one having a height (resp. weight) below two standard deviations of the median value for a reference population of children of the same age (resp. height). The reference population is usually the population of children of the United States whose heights and weights have been tabulated by the U.S. National Center for Health Statistics (NCHS), rather than of children of the country whose nutritional status is being evaluated. Clearly, stunting or wastage in relation to an advanced country reference population is not necessarily the relevant concept for a poor country. Besides, moderate stunting need not have deleterious functional

consequences - in other words, being relatively short need not necessarily be a disadvantage for leading a healthy and productive life. Wastage is a more appropriate measure of malnutrition. The proportion of children that are wasting is usually much less than those that are stunted. For example, in 1994-1995, almost 63% of rural Indian children were classified as stunted using U.S. NCHS standards, whereas only 17% were classified as wasting. (Sadhana et al 1997, p. 12). In fact an extremely small proportion of Indian children had heights that exceeded the median height of U.S. children of comparable age.

Undernutrition Measures

In contrast with the process approach described above, most of the literature on measurement of the extent and severity of undernutrition ignores homeostasis (and hence, intra-individual variation in intakes) altogether by implicitly assuming in essence that energy inflows and outflows are kept unchanged at their long-term mean. For instance, a joint FAO/WHO/UNU expert committee defined the energy requirement of an individual as "the level of energy intake from food that will balance energy expenditure when the individual has a body size and composition, and level of physical activity, consistent with long-term good health; and that will allow for the maintenance of economically necessary and socially desirable physical activity" and states that "all requirement estimates refer to needs persisting over moderate periods of time. The corresponding intakes may be referred to as "habitual" or "usual" to distinguish them from intakes on a particular day" (FAO/WHO/UNU (1985), p. 12). Since most procedures of estimation of energy-related undernutrition compare an estimated intake of an individual for a day, week or month with a requirement estimate derived from WHO (1985) or its antecedents, which, as quoted above, refer to a much longer period, such procedures have to assume that the estimated intake is a good estimate of the long-term average, even if it is based on a single day's data! Even if one were to assume that averaging over a week or a month is adequate to provide a good estimate of the long-term average and this equals the long-term requirement needed for maintenance of good health etc., there is still the question of whether the variance in daily intakes is within a homeostatic range. To put the point dramatically, an alternating feasting and fasting regime together may yield an average intake equaling requirements as defined by FAO/WHO/UNU (1985), but clearly there is no presumption that it is healthy!

Once intra-individual variation in intakes associated with homeostasis is recognized, it is clear that observed intakes for whatever period (sufficiently short) can differ from long-term requirements without either creating stress or invoking the process of long-term adaptation, as long as the intake process is stationary with its mean equal to the long-term requirement and has a variance that is within the homeostatic range. Only when the observed intake is outside the range of homeostasis, there will be presumption of nutritional stress. And unless it can be inferred from the short period data that the long-term mean of the intake process differs from requirement, there is no presumption that adaptation is taking place either.

Undernutrition: Data Base and Measurement Errors

The data base most often used for estimating the extent of undernutrition consists of a distribution of energy intakes for some specified period, such as a day, week, month or even a whole year. The intake may refer to individuals, but more often it is likely to be the average intake per

person in a household or per consumption unit where each person in a household is weighted differently according to age and sex in arriving at the total number of consumption units. The weights may have little to do with the metabolic processes involved and in any case aggregation may not make sense in this context. The distribution may be based on household survey data on actual intake of cooked food at one extreme or to expenditure on various food items on the other. Alternatively as in FAO's world food survey (FAO (1985)) it may be a synthetic distribution whose parameters are either exogenously specified or indirectly estimated from aggregate data. Given the distribution function F(x) of intakes x and a cut-off point R dividing adequate from inadequate intakes, the proportion of the relevant population (individuals or households) with inadequate intake is then estimated as F(R). In some studies R is set as the average energy requirement of the population, the average being computed from WHO norms using the usually available information on the distribution of population according to age and sex and (largely untested) assumptions about activity. Usually no account is taken of variation in actual body mass of individuals within each age-sex-activity cell in computing this average.

There are serious problems associated with aggregating or averaging intake requirements of members of a household. This is because that in addition to the processes of homeostasis and adaptation at the individual level, at the household level some adjustment in activity and food allocation to changes in aggregate food availability is likely to take place to reduce any adverse impact of such changes.

A few remarks are in order on the errors of measurement in data sets used for estimating the extent of undernutrition. The sensitivity of the estimates to the errors, depending on the method used with respect to averaging the energy intake of a population, can be substantial. For instance, consider the crudest method of classifying persons as undernourished if their energy intakes are below the average requirement for the population. If intakes are distributed normally with a mean of 2700 kcals per day and standard deviation of 200, the proportion deemed undernourished will be 50% if the average requirement is also 2700. If, because of measurement error, the true mean intake is 2650 (an error of about 2%) with no error in the standard deviation, the true proportion deemed undernourished will be 60% instead of 50%, an error of 20%. Since very often intake data are put together from food balance sheets and estimates of population, both being subject to significant measurement error, the resulting estimates of proportion of undernourishment are subject to substantial error, even if we accept the methodology of estimation of undernourishment.[2]

Consider, for example, the data in Table 2 on energy intakes derived from a sample survey of households in rural India in 1971-72. The average energy intake per consumer unit varied from 1493 kilo calories (k cals) per day in the poorest class to 6193 k cals per day in the richest. If we

[2] In a very interesting study Bhattacharya et al. (1991) found that almost all the 62 households of their sample had less energy intake than their conventionally calculated energy requirement, the deficit varying from 3% to over 70%. They rightly argue, "These figures raise considerable doubts in our mind about the significance of calorie norms. The members of the households investigated did not give the impression of lacking the physical capacity to work. If one can carry out arduous physical labour with calorie deficiency of 30% or even 50% one wonders what significance to attach to the recommended norms" (Bhattacharya et al., 1991, p. 374).

take 1500 k cals as the bare minimum for survival, nearly 6% of the sample households had average intakes below this level and 75% of these households belonged to the two poorest classes and 83% to the poorest three classes. At the other extreme, nearly 19% of sample households had intake exceeding 4000 k cals of which 51% came from the richest three classes. If there is anything to the theory of energy requirement and if these data are taken at face value, 6% of rural households in India are at the verge of death and nearly 20% were pushing towards serious problems of obesity! There is no independent evidence whatsoever to corroborate this. Indeed crude death rate in 1984 for India as a whole was only 12 per thousand of population.

Table 2. India: National Sample Survey, 26th Round (1971-72): Rural Households

Monthly expenditure per capita (Rs)	Average energy intake per day per consumer unit (k cals)	Number of Households		
		Total	With intakes below 1500 k cals per day per consumer unit	With intake above 4000 k cals per day per consumer unit
0-15	1493	444	267	5
15-21	1957	1207	218	16
21-24	2287	813	55	19
24-28	2431	1174	45	37
28-34	2734	1748	33	112
34-43	3127	2028	16	281
43-55	3513	1655	5	433
55-75	4016	1318	5	578
95-100	4574	598	5	341
100+	6181	482	2	337
All Classes	2724	11468	651	2159

Source: National Sample Survey (1976), Tables 0.0R - 0.10R.

A part of the explanation for this puzzle lies in measurement errors. Although the enumerators were instructed to record the value of food consumed by each household rather than the value of food produced by the household, there are reasons to believe that this instruction was not observed. For example, meals provided by employers as part of wages and consumed by agricultural workers were sometimes recorded as consumption of the employer households and not as that of the employee households, thereby overstating their consumption and understating the consumption of the worker households. Another example is the food served on ceremonial occasions, such as marriages, funerals, religious functions, etc.[3] These are recorded in the consumption of the 'host' household, although many invites also partake of the meals. Here again it is likely that this overstates the consumption of richer households as they are more likely to spend lavishly on feasts. But poor

[3] Bhattacharya et al. (1991) found that even in poor households there is considerable entertaining so that there is a considerable amount of eating in the household by non-household members and eating elsewhere by members of the household.

also spend on ritual feasts. Interestingly, five households in the poorest class had intakes exceeding 4000 kcals and two in the richest intakes below 1500 kcals which is consistent with the former hosting a feast and latter partaking of a feast hosted by some other household! If agricultural workers (who are fed by employers while at work) belong to the poorest classes and the land-owning employer households (who feed their employees at work) belong to the richest classes, the figures reported in Table 2 are plausible.

The error in recorded consumption as compared to true consumption will obviously bias the estimated extent of undernutrition. There are other possibilities of measurement error arising from differential wastage of food across income classes (it is likely that poor waste less than the rich), errors in conversion to energy intake using Atwater conversion factors etc. It is not possible to determine how widespread measurement errors are and whether they are quantitatively significant without undertaking a specially designed study.

It is not the case that consumption survey data from developing countries are the only ones subject to serious measurement error. Bhalla (1980) analyzed data from Health and Nutrition Evaluation Survey of over 20,000 individuals in the United States during the period 1971-74. The intake data related to one day and were obtained through recall. The data showed that 67% of US males and 80% of US females had intakes below recommended daily requirements! In a society where obesity rather than undernutrition is the more serious problem, these figures do not make sense. This demonstrates the weakness of the methodology and the data base. Clearly, either intake data have a downward bias, or requirements are overstated, or both.

Most births in South Asia do not take place in hospitals or attended by midwives who weigh babies at birth. As such the data on incidence of low birth weight babies are unlikely to be representative of the population. Data on childhood malnutrition i.e. stunting and wasting, are often based on small samples which may not be representative of the population of children.

Poverty and the Food Sector

Government Interventions in the Food Sector

Although the concept of poverty goes beyond not having enough food to eat, clearly having to survive with inadequate food consumption is undoubtedly a strong evidence of poverty. It is not surprising that the functioning of the food sector, that is the system consisting of markets and private and public non-market institutions, that are involved in the production, trade and distribution of food affects the extent and depth of poverty.

Taking food production first, South Asian countries have succeeded in raising their output significantly so as to be largely self sufficient in the aggregate, although at relatively low levels of consumption per capita. Food output has grown, cereal yields have increased and the share of food imports in total merchandise imports have remained stable or fallen (World Bank, 1998 Tables 3.3, 4.4 and 4.5). However, given the inequality in the distribution of consumption expenditure, aggregate self-sufficiency marks a substantial extent of food insecurity.

Governments all over the world intervene in markets for agricultural outputs and inputs and South Asia is no exception. South Asian governments have subsidized inputs (e.g. irrigation water, fertilizers, electricity and other fuel, credit) controlled prices and restricted internal as well as external trade in agricultural commodities. For example, India is as yet to integrate its agricultural sector with world markets even though economic liberalization since 1991 have largely integrated (except for consumer goods) the manufacturing sector with world markets. It will take me too far (and many pages!) to discuss these myriad government interventions and their impact (or lack thereof!). Instead I will focus on those interventions that are ostensibly for alleviating poverty and increasing food security of the poor. These include subsidized public distribution of food grains and other essential commodities, various food-for-work and other employment oriented programmes, food-for-education, food-for-health programmes and food-aid from external donors. Although food aid per se is not strictly a recipient government instituted programme, it is often a significant source of supply of food as well as a major driving force behind some of the other programmes instituted by recipient governments.

The Public Distribution System and Food-For-Work Projects

A number of aspects of the public distribution systems (PDS) in South Asia have been extensively studied. First of all, not all PDS's are targeted programmes in the sense of being directed at a particular subset of the population (i.e. the poor). Second, whether or not they are targeted, questions arise of their effectiveness in reaching the poor and cost-benefit ratios, i.e. how many dollars it costs to transfer one dollar to the intended beneficiary. Third, when other programmes besides PDS's are also in place, all of them meant to transfer resources to the poor at least in part, how do various programmes compare in terms of effectiveness of reach and cost-benefit ratios?

India's PDS originated in the early 50's. Its primary objective then was to protect urban consumers against inflation in the prices of staple food. Its coverage initially was confined to urban areas and a few food deficit states. To acquire the food grains for the PDS, government purchased from producers (or processors such as rice mills) at a price (procurement price) below the prevailing market price. In early years, food aid under US PL 480 was a major source of food for the PDS. Urban ration card holders were provided a specified amount of grain at the so called 'issue price' which was set above procurement price to cover transportation and storage costs. The coverage of PDS has since been extended to rural areas in some states. The PDS is currently being perceived to be the main safety net to protect the poor from food-price inflation.

The PDS was untargeted until 1997 when the government introduced targeting by distinguishing two separate distribution channels. The first distributes wheat and rice to poor households (those whose overall consumption expenditure is deemed to be below the official poverty line) at about half the issue price. The other channel is for distribution to (at issue price) households above the priority line. It is too soon to evaluate the effect of this change.

The PDS has been a costly programme and the subsidies involved (Table 3) have been substantial. The central government alone spent over 0.5% of GDP on food subsidies. Radhakrishna and Subbarao (1997) conclude:

"The access of the poor to PDS is still very limited. The access is particularly weak - almost nil - in the states with the highest incidence and severity of poverty.

The per capita income gain to the poor from all (food and non-food) consumer subsidies was no more than ... 2.7% of their per capita expenditure in rural areas ... [and] in urban areas it was slightly higher at 3.2%.

The impact of PDS on poverty and nutritional status was minimal. For the country as a whole, without PDS poverty would have increased by 2 percentage points, the adverse impact would have been extremely small at 0.3% points in rural areas of the states with the highest incidence of poverty.

In comparison with other antipoverty programs, PDS turns out to be the costliest. PDS delivered ... nutrients at three times the cost incurred under the direct nutrition programme of Integrated Child Development Services. In term of cost per rupee of income transferred ... the national PDS -- [is] much less cost efficient than employment and nutrition programme" (Redhakrishna and Subbarao, 1997, pp x, xi).

Table 3. Subsidies in Public Distribution of Cereals

Year	Cost (Rs. per 100 kgs.)		Sales Realization Subsidy (Rs. per 100 kgs.)		(Percent of Cost)	
	Wheat	Rice	Wheat	Rice	Wheat	Rice
1991-92	391	497	252	366	36	26
1992-93	504	585	279	442	45	24
1993-94	532	665	356	500	33	25
1994-95	551	695	408	601	26	14
1995-96	564	747	416	610	26	18
1996-99*	616	811	423	623	31	30
1997-98*	719	921	374	592	48	36

Source: Government of India (1998), Table 5.10, p. 74.

The same study (p. 55) estimated the cost in rupees per rupee of income transfer of five anti-poverty programmes to have been as follows during 1988-90: PDS, 5.37; rice subsidy scheme of the state of Andhra Pradesh, 6.35; a national employment programme for the poor, 4.34; the employment guarantee scheme of the state of Maharashtra 3.1; and, Integrated Child Development Services, 1.8.

The picture is not very different in other countries of the region. Again Radhakrishna and Subbarao (1997) provide some estimates of leakage to non-poor and cost of transfer of some anti-poverty programmes. These are reproduced in Table 4.

Table 4.

Country	Program	Targeting	Date	Leakage to: Nonpoor as Percent of Total Transfer to the Poor	Cost to: transfer 1000-calories per day (1997 US$)
Pakistan	Feeding	Self-Selection	1982	low	0.69
Bangladesh	Ration	Geographic	1991	74.0	2.11
Bangladesh	Food-for-Education	Individual Assessment	1991	31.0	
Bangladesh	Food-for-Work	Self Selection	1994	7.	

Source: Radhakrishna and Subbarao (1997), Tables 5.3 and 5.4, pp. 66-67.

A comparison of several programs in operation in Bangladesh during 1993-94 led to the following estimates (Radhakrishna and Subbarao, 1997, Table 5.4).

Programme	Leakage	Cost/$ of income transfer
Rural Rationing	70%	6.55
Vulnerable Group Development	14%	1.68
Rural Maintenance Program	0%	1.32
Food-for-Work (CARE)	26%	2.81
Food-for-Work (WFP)	28%	2.06
Food-for Education	7%	1.59

It should be clear that whatever their other effects on the economy (positive or negative) strictly as poverty alleviation instruments, public distribution systems for food have neither been very efficient in reaching the poor nor have they been cost effective. Self-targeting schemes such as food-for-work and employment programs have for various reasons been more successful in avoiding leakages of benefits to the non-poor. However, they have not been cheap - they cost anywhere from $1.32 to $6.55 for transferring $1 to the poor.

Food Aid

Food aid can play a useful role in furthering development and poverty amelioration in situations in which the recipient country is generally following an appropriate development strategy and the aid is used either in support of distributive policies that are effectively targeted at the poor or in financing efficiently executed and effectively targeted investment projects. But the use of any aid, in the form of food or foreign exchange, in support of policy reform and adjustment has to be

carefully thought through so that it does not end up encouraging the very thing it wants to eliminate, namely, inappropriate policies. Of course, the effectiveness of the use of food aid can be enhanced substantially through proper design, the choice of commodities, and the flexibility with which recipients can exchange with each other commodities supplied by aid and their own output (Mellor and Ezekiel 1987; Hopkins 1987).

During the 1950s and the 1960s the United States and Canada were the major food aid donors, and most of the aid was received by the South Asian states of India, Pakistan, and Sri Lanka, and to a lesser extent other Asian states (the Republic of Korea and the Philippines). With the dramatic increase in food output in all of them and the accumulation of large food stocks in some in the 1990s (more than 31 million tons in India as of January 1998 as compared to a minimum buffer stock of 25 million tons according to Government of India, 1998, Table 5.8), it is tempting to conclude that purposely used food aid is a major factor in this turnabout. Such a conclusion is too facile, however. Certainly, food aid at concessional terms, particularly in years of unprecedented droughts, helped India avert what could have been major disasters. But regardless of the persuasion that aid donors may have applied, it is the availability since the mid-1960s of dwarf varieties of wheat and rice with high-yield responses to heavy doses of chemical fertilizers that largely explains the change. Some of the domestic policy distortions, such as zonal restrictions in the movement of food, have been removed even earlier. The new technology brought in its wake new distortions: fertilizer subsidies, irrigation subsidies, and price supports at levels that led to the accumulation of stock. The extent of their distortionary effects is hard to judge since the distortions in favor of agriculture were in part corrections for distortions in other sectors that penalized agriculture. Still, the availability of technology and the desire to exploit it induced these, albeit distortionary, producer incentives.

With Sub-Saharan Africa (SSA) replacing South Asia as the major recipient of food aid, it may be thought that in SSA also, food aid leverage can be used to turn the situation around. Extreme caution is warranted before any such conclusion is drawn. First of all, the domestic policy distortions with respect to agriculture in SSA appear, according to some studies, to be far more serious and pervasive than they were in South Asia. South Asia has never experienced a decline in the trend of growth of food or agricultural output, let alone a negative trend. Although severe droughts in the Sahel and other regions are partly responsible, the declining trend in SSA output is a reflection largely of policy failures. Most important, in South Asia, a research infrastructure existed that could rapidly breed rice and wheat varieties to suit local conditions once the dwarf genes became available, and an extension service for spreading the knowledge about new varieties could be assembled. None of these conditions exist in SSA to the same extent, not to mention the differences in soil, climate, and factor endowments between SSA and South Asia. One should not be unduly optimistic about the quick success of food aid conditional on policy reform. It remains to be seen whether policy-reform conditioned food aid will prove to be a cure.

Within South Asia, food aid continues to be a significant factor in the food economy of Bangladesh. A comprehensive quantitative analysis of food security issues in Bangladesh by Ninno and Dorosh (1998) concludes "that barring unforeseen changes in technology or very large increase in the price of wheat relative to rice, Bangladesh will likely remain a net importer of wheat in the medium run. Thus, moderate levels of food aid can substitute for commercial imports without adversely affecting producer price incentives" (Ninno and Dorosh, 1998, p. 20). While pointing out that aid-in-kind such as food aid is inferior to lump sum income transfers through cash aid, they

recognize the reality that "food aid has more political support in donor countries (farm lobbies and public approval for donations of food) than does other aid. The implication is that cuts in food aid would likely mean cuts in total public resource flows to Bangladesh, to the detriment of the country's poor" (ibid, p. 20).

Economic Growth and Poverty

Correlates of Poverty in South Asia

The correlates of poverty are of some interest as they may suggest ways for alleviating poverty. However, in interpreting correlates, one must not confuse correlation with causation. The following is a brief summary of the correlates of rural poverty, as documented in Quibria and Srinivasan (1994).

Bangladesh: In Bangladesh in 1987-1988, the extremely poor (i.e. those, according to their own admission, who cannot meet their minimum consumption needs throughout the year) owned less than half as much land on average as did the non-poor (1.02 versus 2.15 acres). Only a quarter of the land of the poor was irrigated in contrast to more than a third for the non-poor. The poor devoted 31 percent of their land to modern rice varieties (versus 45 percent by the non-poor). Extremely poor households were slightly smaller in size (5.4 versus 5.8 household members) but with a larger share of children under the age of 10 (35 percent versus 24 percent), fewer males above sixteen (24 percent versus 31 percent) and a larger child-women ratio (79 percent versus 57 percent) as compared with the non-poor. There were more illiterates (80 percent versus 47 percent) and fewer with higher education (10 percent versus 25 percent) among literates in extremely poor households compared to the non-poor. The poor depended on agriculture for roughly two thirds of their income in contrast with 58 percent for the non-poor, and 30 percent of their agriculture income was from wage labour in contrast to 13 percent for the non-poor. Over 72 percent of the functionally landless (i.e., those owning less than half an acre of land) and two-thirds of non-cultivator and pure tenant households were poor. In contrast, only 32 percent of those who owned more than 7.5 acres of land and about half of owners or owner-cum-tenants were poor.

Extreme and moderately poor (i.e. those who cannot meet their consumption need in some (not all) months of the year) have a lower male labour force participation rate of 41%-49% versus 57% for non-poor households. Urban poor have a higher participation rate than rural poor because of higher female participation. Only 5% to 9% of females are workers in moderate and extremely poor rural households, while the corresponding figure is 32% in urban areas. In both rural and urban areas, there are more female headed households among the extremely poor as compared to the non-poor. Rural migrants among the urban poor are more likely to be recent migrants, engaged as day labourers in construction and are more likely to have experienced a deterioration in living standards in the recent past, and less likely to have children between ages 6-11 in school as compared to earlier migrants and non-poor. Majority of the urban poor have regular connections with the villages from which they emigrated and a large proportion (45%) of slum dwellers obtained their jobs through kinship and social networks after migration.

India: More than half of poor rural households in India were wage-labour households and a little over 30 percent were self-employed in agricultural occupations. The socially disadvantaged and discriminated groups, consisting of the so-called scheduled castes and tribes, accounted for more than a third of the rural poor in 1983 even though they accounted for less than 12 percent of the rural population. Over 70 percent of heads of poor households were illiterate and less than 3 percent of them had education above the secondary school level. Those households self-employed in agricultural occupations and in agricultural labour not only were an overwhelming majority (78 percent) among poor households, but also accounted for three-fourths of person-days of unemployment in 1982. Households cultivating no land or less than one hundredth of an acre of land had an incidence of poverty of over 40 percent, while those cultivating more than 10 acres had an incidence of under 15 percent.

Surveys conducted by the National Institute of Urban Affairs in the slum and squatter settlements show that the poor households on average are larger in size, i.e. 5.9 versus the non-poor at 5.2. Approximately 60% of the poor households have between 5 and 7 members, with very large (above 7) or very small (under 3) households being uncommon. Poor households also have a larger proportion of adult females and children. The labour force participation rate among the poor is about 4% higher than among the non-poor. However, this is due to greater participation by females and children than by males. Majority of the poor are self-employed or engaged in casual labour in a variety of occupations, work long hours (over 70% of the workers put in more than 12 hours a day). Unemployment among poor households is low, but it is higher for the more educated than for illiterates.

Sri Lanka: In Sri Lanka, about 28 percent of all households surveyed in 1987 had insufficient food expenditures to meet 90 percent of the recommended energy requirement, the proportion being highest (33 percent) in rural areas, least (12 percent) in urban areas and about 14 percent in the estate sector. Roughly half of the poor households had more than 5 members. For 19 percent of all poor households, the main income earners were farmers. Sixty-four percent of the poor (rural and urban) had education up to grade 5 or less, 14 percent being totally illiterate with no schooling. The corresponding figures for the entire sample of households were 47 percent and 2 percent respectively. The incidence of poverty at 38 percent was somewhat higher among the rural unemployed as compared to the 33 percent incidence among the employed. The rate of unemployment among the poor was only slightly larger among the poor as compared to the entire sample (6.9 percent versus 5.8 percent). The incidence of poverty was substantially higher in households with main earners having non-professional occupations other than clerical and service work (including sales). Of the main income earners in poor households, 54 percent were in the agricultural sector, of which 20 percent were cultivators and 26 percent were agricultural workers. A large majority of poor farmers were those with holdings less than one acre, although in areas with adequate rainfall and opportunities to grow and market high value crops, such as vegetables and fruits, even a holding of 0.25 acre can generate enough income for a household to be out of poverty. Thus, apart from land scarcity, the productivity of land under its present pattern of use was a major contributory factor to the poverty of farm households. The lack of adequate housing and civic amenities, such as water and sanitation, were more general features of rural poverty.

Ratnayake (1993) finds that the urban poor comprise, among others, the recent migrants, those who failed to successfully enter into the urban markets, employees in poorly paid industries,

casual and seasonal workers and unemployed educated youths. In urban areas, given the non-existence of an extended family network, single parent households, street children and the old are increasingly among the poor. Most of the urban poor are recent migrants from rural areas and are in the process of adapting to the labour production markets. Incidence of poverty is over 30% among households of over 6 in size (the highest incidence being 46% among households with six members), and less than 20% in households of size 3 or less (the least incidence being 11% in single member households). More than 50% of the urban poor live in households of size 6 or more. More than half of the main income earners among the poor are likely to have no schooling or schooling only up to grade 4.

In summary, though there are some inter-country differences, the incidence of poverty is greater in rural areas, though generally declining over time. The rural poor, in comparison with the rural non-poor, tend to be characterized by greater dependence on agriculture, either as small cultivators, tenants or agricultural workers. Rural poor households are more likely to be larger in size, have more children and a higher dependency ratio and to be headed by individuals who are either illiterate or have little formal education than rural non-poor households. The farmers among the poor are more likely to cultivate a smaller area of land and devote a smaller proportion of it to high yielding modern crop varieties. Rural areas in general and their poor residents in particular are likely to have less access to safe drinking water, toilets and sanitary facilities, health care, and education.

There are substantial rural-urban differences in the incidence of poverty in all countries, with the incidence being lower in urban areas. Urban poor include a significant proportion of recent migrants from rural areas. They have less access to education, health and sanitation facilities as compared to the urban non-poor, though somewhat better served than the rural poor. They are likely to be disproportionally engaged in informal production and the service sector.

Access to Cultivable Land, Technology and Inputs

A large majority of the rural poor in South Asia are those who farm small-holdings, sharecroppers and tenants, and landless agricultural labourers. It is also the case that the number of landless agricultural labourers in South Asia has been increasing in recent decades. Poverty alleviation policies such as land and tenancy reform have attempted redistribution of land ownership, reduction of rents and crop shares paid to the landlords by tenants as well as increasing the security of tenure, and legislating minimum wages to be paid to and the improvement of the condition of employment of the agricultural workers. The effectiveness of implementation of these policies and their success in alleviation of poverty where implemented have varied.

While land and tenancy reforms attempted to ensure a more equitable distribution of land, given the low ratio of arable land to rural population in South Asia, a completely equal distribution of land among rural households would have resulted in extremely small and unviable holdings. As it happened, except perhaps in Pakistan, a large proportion of cultivators operated holdings which were small or marginal in total size besides being fragmented into several, even smaller fragments. It is conceivable that such fragmentation has a positive aspect in that it achieves risk reduction through geographical diversification. However, it is likely that by inhibiting lumpy investment in irrigation, increasing unproductive expenditure of the cultivator's time in traveling from fragment to fragment and wasteful use of land in fragment boundaries, the negative aspects of fragmentation far

outweigh the positive. Attempts to consolidate fragmented holdings through legislation have had limited success.

Turning now to factors that influence the productivity and returns from cultivation, the most important is the introduction of fertilizer responsive high-yielding varieties (HYV) of (mostly cereal) crops in the late sixties. Although HYV technology was scale neutral in that it could be profitably adopted by large, small and marginal farmers as well as tenants were they to have access to irrigation, fertilizers, pesticides, credit etc, and able to sell their output, on similar terms, the fact that medium and large farmers had far better access and more favourable terms certainly blunted its poverty alleviating potential. However, the fears expressed in the early days of the introduction of the HYV technology that it will further enrich the richer segment and impoverish the rural population fortunately proved to be unfounded. I. J. Singh's (1990) careful analysis of the South Asian experience leads him to conclude that although small farmers initially lagged behind large farmers in the adoption of HYV's, they quickly caught up and matched their gains in productivity.

The major inputs (other than land and labour) in agriculture and livestock operations are animal feed, draught power, water, fertilizers and pesticides. Access to short-term credit for working capital needed for the purchase of inputs and long-term credit for investment in livestock, agricultural equipment, including pumpsets, tubewells, livestock, including draught animals, could be important, particularly in the cultivation of irrigation-fertilizer-pesticide incentive HYV's. Public investment in and the efficiency of functioning of large-scale irrigation systems, agricultural research and extension, transport and communication, rural electrification and roads significantly influence agricultural productivity.

Since small and marginal farmers form a significant proportion of the rural poor in South Asia, their access to marketed and publicly provided agricultural inputs would be important for their getting the maximum returns from their agriculture and livestock activities. In India, fertilizers (until recently), irrigation water, electricity and agricultural credit are heavily subsidized. Leaving aside the question whether some of these subsidies accrue to the farmers (for example, the fertilizer subsidy in India is in fact an offset to the high cost of domestically produced fertilizer relative to imports and hence should be viewed as a subsidy to domestic fertilizer industry rather than a subsidy to farmers), it is widely believed that small and marginal farmers do not get their proportionate share in these subsidies. Also, the fact that the operating losses of irrigation and electricity systems are financed out of the general budget means that the resources available to the public sector for other social consumption and for investment (including investment in irrigation, power etc.) are reduced. This in turn means that the share of the poor in social consumption and the additional supply of goods and services arising out of public investment are reduced as well.

India vastly expanded institutional credit to rural areas through cooperatives and branches of the nationalized commercial banks. Bell (1990) finds, after looking at three major surveys of the rural credit market, that even in the eighties, the moneylender was still a major source of credit. According to the World Bank, only 27% of India's farmers used cooperative credit and two-thirds of term credit went to large farmers. Besides, as the government admits, "Despite a substantial increase in overall agricultural credit, the problem of mounting overdues has slowed credit expansion. Overdues have been around 40-42 percent during the last 3-4 years" (Government of India, Economic Survey 1991-92). The situation in Pakistan seems similar. Quereshi and Shah (1992) find that in 1985 institutional

loans constituted only 7.45 percent of all loans for farmers cultivating less than 5 acres, while it was 61.3% for those cultivating more than 50 acres. The average loan per household in the former category consisting of 38% of all farms was Rs. 6983 and accounted for 5% of institutional loans. The latter category consisting of 2.4% of all farms on an average got Rs. 41202 per household and accounted for 14% of all institutional loans. The financial and administrative cost of every Rs. 100 disbursed by the Agricultural Development Bank of Pakistan was Rs. 33 and only 59% of the cumulative dues had been recovered in 1990-91.

An innovative approach to extending credit to the poor is that of the well-known Grameen Bank of Bangladesh.

In summary, it would appear that among those who cultivate land, poverty arises more from an unequal distribution of operational holdings rather than from lack of access to new technology, irrigation, fertilizers, etc. on the part of small farmers and tenants. Tenants and sharecroppers do not appear to lag behind owner-cultivators in the adoption of new technology or the intensity of input use, although lack of access to credit is a problem in this regard. Sharecropping seems to have survived attempts to abolish it through legislation. Its incidence varies across countries and across corps.

Poverty and Human Resources

The only asset most of the poor in South Asia have is their labour. Trends in returns to labour and growth in demand for labour influence trends in poverty. On the one hand, trends in population growth and changes in the age structure determine the growth of the population of working age. Their decisions to participate in the labour force, acquire education and skills, the extent to which the participants are employed and the income those employed earn from their labour are all affected by the process of development and by public policies.

Self-employment appears to be the dominant mode of employment in rural areas in all countries. Urban poor are engaged in informal activities largely in the service sectors. In all countries except Sri Lanka, open unemployment was not significant except perhaps for the relatively well educated and in agriculturally slack seasons. However, underemployment was a major problem. All countries have one or more rural employment programs, some of which have poverty alleviation as one of their objectives. Among the latter are the food-for-work programs. A common feature of many of the employment programs that they tend to be poorly designed and poorly implemented, do not involve the intended beneficiaries in their planning and suffer from significant leakages of their benefits to the non-poor, although the severity of these problems varies across countries. However, the potential for poverty alleviation of programs that are suitably designed with the participation of poor beneficiaries and well implemented is substantial. Nevertheless, such programs could only be safety-nets and the long-term solution for rural unemployment and underemployment lies in the adoption of a development strategy and economy-wide policies that do not penalize labour-use and generate rapidly growing and more productive employment opportunities outside of agriculture. Except in Pakistan where there is evidence of significant increases in real wages, in other countries growth of real wages, if any, has not been substantial. However, because of the dominance of self employment, trends in wage rates may not capture trends in real incomes even for the poor.

The quality of human resources reflects investments in health, nutrition and education. It has long been recognized that improvements in health, education and nutrition of the poor were important not only in their own right but also to promote growth in incomes, including incomes of the poor. Recent developments in the theory and empirics of aggregate growth also reinforce the importance earlier given to human capital in the growth process.

While the health and nutritional status of the rural households including poor households has been improving in all, there are substantial differences across countries. At one end of the spectrum is Sri Lanka where there is no significant bias against rural areas and females in the access to and the quality of health and nutritional services, although the poor do suffer from nutritional gaps relative to the non-poor and the post-1977 reform of the food subsidy program may have worsened this situation. In Bangladesh, India and Pakistan there are substantial rural-urban and male-female differences: the rural poor receive far less than their proportionate share of public expenditures on health and nutrition and there are far fewer health care facilities in rural areas and their quality is far worse than those in urban areas. With respect to education, particularly higher education, the rural poor (and in particular poor females) are at a disadvantage in all countries, except Sri Lanka.

Economy-Wide Policies and Poverty

Economy-wide and sectoral policies are likely to have a significant impact on the level and trends in poverty, in many cases even to a greater extent and possibly in opposite directions than the policies directly addressed to the alleviation of poverty. These include: the broad development strategy, macro-economic policies (fiscal and monetary), foreign trade and exchange rate policies, policies toward production sectors (e.g., agriculture) from which the poor derive their income and in which they are employed and finally income transfer policies. It should be emphasized once again that these as well as direct poverty alleviation policies interact with the market and non-market exchanges that the poor have with the non-poor and the state. These interactions are often complex and not likely to be necessarily stable over time or space. Above all, firm knowledge based on solid empirical evidence about these interactions does not exist for most countries. Under the circumstances, policy analyses and conclusions have to be based more on intuition, judgment and familiarity with the culture, history and socio-economic and political institutions of the countries than on narrow economic analysis.

Until recently the development strategies of all the countries emphasized import substitution and industrialization. However, the intensity and extent to which it was pursued varied across countries with India being at an extreme with its goal of self-sufficiency across the board and at all costs. Sri Lanka combined its import substitution in industry and agriculture with a thorough going social welfare program. The chosen development strategy was implemented in each country with its own combination of a number of economy-wide policy instruments including overvalued exchange rates, fiscal deficits that were monetized, operation of plantations, industrial and financial enterprises in the public sector etc. and sectoral policies that included widely varying tariffs, import quotas, selective credit allocations and loan. At the same time, a variety of subsidies were employed to mitigate the distortionary effects of the policy regime on particular socio-economic groups and on activities such as exporting as well as reward and encourage such groups or activities. Although the range of the instruments used and the severity of the distortions created varied between countries over time (for example, the strategy of import substitution and the use of distortionary instruments

were both adopted to a moderate degree in Thailand prior to the eighties and to an extreme degree in India), there is no doubt the cost of import substitution and distortions was high overall. The poor paid an undue share of the cost by being denied the opportunities that a faster growth based on outward orientation would have generated.

Poverty and Growth

It should be evident from the discussion of correlates of poverty that, barring politically unacceptable radical redistribution of non-labour assets, particularly land, to the poor, for poverty to be eliminated permanently, policy attention has to be focused on augmenting the demand for labour and on improving the productivity of labour through investment in human capital, broadly conceived to include education, skill formation, health and nutrition. This is not to say that until poverty is eliminated, hopefully in less than a generation, safety-net policies to insulate the poor against temporary adverse shocks are not needed - only that such policies have to be designed so as to avoid leakage to the non-poor and their cost of transferring incomes to the poor (directly or in kind) is kept to the minimum. Any leakage or excess cost of a safety-net policy would only insulate the poor against temporary adverse shocks at the possible cost of postponing, if not aborting, the process of investments needed for permanent elimination of poverty.

Turning to increasing the demand for labour, the only asset that poor have, it goes without saying that policies that have the effect of encouraging the use of relatively scarce non-labour resources such as capital in production have to be phased out. Also, abandoning costly and inefficient import substitution and encouraging the efficient production for the world market of labour-intensive products is essential.

The most effective strategy for rapidly eliminating poverty is one that accelerates economic growth while ensuring that the fruits of growth are widely shared. The available evidence from East Asia as well as South Asia supports this finding. The East Asian evidence is well known. Let me turn to evidence from India.

Data from India's National Sample Survey provides poverty estimates, annually except for the years 1979-82 and 1984-85. Economic growth (annual average rate of growth of GNP) averaged at about the infamous Hindu rate of growth 3.5% per year during the period 1950-51 to 1973-74. Subsequently GNP growth averaged slightly over 5% per year until a macroeconomic crisis in 1991 forced the government to institute radical economic reforms. After a year of recovery, GNP growth has averaged at over 6.5% per year since the reform.

World Bank (1997) concluded that "First, the period from the early 1950s to the mid 1970s was characterized by fluctuations in poverty with no clear trend in either direction. The average head-count index was 53% in 1951-55, about the same as the average over 1970-74 ... Second from, 1971 to 1986-87 poverty entered a phase of steady decline ... Finally after 1986-87 poverty appears to have entered a new phase of fluctuation, although around a level considerably lower than that which prevailed in the 1970's " (World Bank 1977, pp 2-3). The same report decomposes the change in poverty measures into contributions due to growth and redistribution. It finds that overall growth accounted for the lion's share of poverty reduction, 80% of the decline in the head cost index over a 40 year period [since mid fifties] and almost 100% since 1970" (World Bank 1997, p. 17). A

comparison of trends in GNP growth and poverty suggests that the period of substantial reduction in poverty coincided with the period of sustained and rapid growth.

Demery and Walton (1998) estimate the rate of growth required to reduce existing poverty levels by a half in the twenty-five year period 1990-2015 for various countries and regions. Two international poverty lines $1 and $2 per day are used in estimating the incidence of poverty. They also project real per capita GDP (and consumption) growth for the period 1997-2000 using the cross-country regression of Sachs and Warner (1995). They find that for halving the proportion of 43.1% of the South Asian population living below the $1 poverty line in 1993 in twenty-five years, the required growth in South Asian per capita consumption has to be 1.4% per year. By comparison the actual growth was 1.9% per year during 1991-95 and the projected growth for 1997-20 was 3.5% per year. Thus the targeted poverty reduction is feasible. However, if a poverty line of $2 per day is used, the required growth rate jumps to 5% per year which is not feasible to achieves given current policy.

Conclusions

I can be brief. Although there are serious conceptual and measurement problems as well as inadequacies of data in quantifying the extent of poverty and undernutrition, they are unlikely to overturn the finding that most of the world's poor and undernourished live in South Asia and within South Asia, a large majority of the poor live in rural areas. The rural poor are mostly landless labourers, marginal farmers or artisans.

South Asian governments have intervened in agricultural markets, particularly food markets. They have also instituted several anti-poverty programmes such as subsidized public distribution of food and employment generation projects linked to food. The available empirical evidence suggests that the efficiency of these programmes in reaching the poor is low and many are costly in that they spend far more resources in transferring than the resources transferred to the poor.

The only approach to the eradication of poverty within a reasonable time is to adopt development strategies that accelerate growth, keeping in mind that the character of growth, not merely the rate of growth, determines whether or not the poor benefit from growth. Thus, what is needed is a growth strategy that focuses on human capital accumulation, that is investment in education and health, while ensuring the efficiency of investment in human and physical capital is maximized by promoting competition within the economy and above all, with the rest of the world through liberal foreign trade and investment regimes.

References

Bardhan, P. K., (1974). "Incidence of Rural Poverty in India," in T.N. Srinivasan and P.K. Bardhan (Eds.) Poverty and Income Distribution in Turkey, Calcutta, Statistical Publishing Society.

Bell, Clive (1990). "Interactions Between Institutional and Informal Credit Agencies In Rural India," The World Bank Economic Review, Vol. 4, No. 3, pp. 297-327

Bhalla, S. (1980). "Measurement of Poverty: Issues and Methods," Washington, D.C., World Bank (processed).

Bhattacharya, N., P. Chakraborty, M. Chattopadhyay, and A. Rudra (1991). "How Do the Poor Survive?", Economic and Political Weekly, February 16, 1991, 373-381.

Dasgupta, P. (1997). "Nutritional Status, the Capacity for Work, and Poverty Traps," Journal of Econometrics, 77, 5-37.

Demery, L. and M. Walton (1998). "Are Poverty and Social Goals for the 21st Century Attainable?" Washington, D.C., World Bank. Poverty Reduction and Economic Management Net Work (processed).

FAO/WHO/UNU (1985). Energy and Protein Requirements, WHO, Technical Report Series, No. 724, Geneva, World Health Organization.

FAO (1985). The Fifth World Food Survey, Rome, Food and Agriculture Organization.

Government of India (1998). Economic Survey 1997-98, New Delhi, Government of India Press.

_____ (1992). Economic Survey 1991-92, New Delhi, Government of India Press.

Hopkins, R. (1987). "Is Food Aid a Solution to World Hunger?" Department of Political Science, Swarthmore College, Swarthmore, PA.

Mathur, O.P. (1993). "The State of India's Urban Poverty," Finalization Meeting, Critical Issues and Policy Measures to Address Urban Poverty. Manila, Asian Development Bank (processed).

Mellor, J. and H. Ezekiel (1987). "Food Aid in Sub-Saharan Africa," Research Report 16, MADIA, Country Economics Department, Washington, D.C., World Bank.

National Sample Survey (1976). "Calorie and Protein Values of Food Items Consumed Per Diem Per Consumer Unit in Rural Areas," New Delhi, National Sample Survey Organization.

Ninno, C. and P. Doresh (1998). "Government Policy, Markets and Food Security," Washington, D.C., International Food Policy Research Institute (processed).

Quereshi, S. and A. Shah (1992). "A Critical Review of Rural Credit Policy in Pakistan," The Pakistan Development Review, Vol. 31, No. 4, pp. 781-798.

Quibria, M.G. and T. N. Srinivasan (1994). "Introduction" in M.G. Quibria (Ed.) Rural Poverty in Developing Asia, Volume 1, Manila, The Philippines, Asian Development Bank, 2-74.

Radhakrishna, R. and K. Subbarao (1997). "India's Public Distribution System," Discussion Paper, 380, Washington, D.C., World Bank.

Ratnayake, R. M. K. (1993). "Characteristics of Urban Poverty," Finalization Meeting, Critical Issues and Policy Measures to Address Urban Poverty, Manila, Asian Development Bank (processed).

Sachs, J. and A. Warner (1995). "Economic Reforms and the Process of Global Integration," Brookings Paper on Economic Activity, 1-118.

Sadhana, G., K. A. B. L., Murthy, M. S., Reddy and G. N.V. Ramana (1997). National Strategy to Reduce Childhood Malnutrition, Hyderabad, India, Administrative Staff College.

Singh, I. J. (1990). The Great Assent: The Rural Poor in South Asia, Baltimore: The Johns Hopkins University Press.

Srinivasan, T. N. (1994). "Destitution: A Discourse," Journal of Economic Literature, Vol. XXXII, December 1994, pp. 1842-1855.

_____ (1992). "Undernutrition: Concepts, Measurements and Policy Implications," Chapter 4 in S. R. Osmani (Ed.), Nutrition and Poverty, Oxford, Clarendon Press, 97-120.

_____ (1989). "Food Aid: A Cause of Development Failure or an Instrument for Success," World Bank Economic Review, 3(1), 39-65.

UNDP (1997). Human Development Report 1997, New York, Oxford University Press.

World Bank (1998). World Development Indicators, Washington, D.C., World Bank.

World Bank (1997). "India: Achievements and Challenges in Reducing Poverty," Report No. 16483-IN, Washington, D.C., World Bank.

The Macro Dimensions of Food Security: Economic Growth, Equitable Distribution, and Food Price Stability

C. Peter Timmer

Famine and food security are at opposite ends of a spectrum. It is only in modern times that entire societies, as opposed to privileged members of those societies, have been able to escape from chronic hunger and the constant threat of famine (Fogel, 1989, 1991). Many countries in the developing world, especially in Africa and South Asia, have not managed this escape. In these countries, understanding the factors that cause widespread hunger and vulnerability to famines, and the mechanisms available to alleviate their impact, remain important intellectual challenges (Ravallion, 1987, 1998; Sen, 1981; Dreze and Sen, 1989).

There is a different way to pose the question, however. Rather than asking how to cope with hunger and famine, the question might be how to escape from their threat altogether. As Fogel has emphasized, this is a modern question that is only partly answered by the institutional and technological innovations that are at the heart of modern economic growth (Kuznets, 1966). Without these innovations, to be sure, the modern escape from hunger to food security would not have been possible. But the record of economic growth for the Third World since the 1950s shows that even in countries with relatively low levels of per capita income, government interventions to enhance food security can lift the threat of hunger and famine. The countries most successful at this task are in East and Southeast Asia, although the experience in South Asia has been instructive as well.

Food Security and the Escape from Hunger

That rich countries have little to fear from hunger is a simple consequence of Engel's Law; consumers have a substantial buffer of nonfood expenditures to rely on, even if food prices rise sharply. In a market economy, the rich do not starve. Wars, riots, hurricanes, and floods, for example, can disrupt the smooth functioning of markets, and all in their wake can perish. But rich *societies* usually have the means to prevent or alleviate such catastrophes, social or natural. Food security in such societies is simply part of a broader net of social securities.

Without the buffer of Engel's Law, consumers in poor countries are exposed to routine hunger and vulnerability to shocks that set off famines (Anderson and Roumasset, 1996). And yet, several poor countries have used public action to improve their food security.[1] The typical approach reduces the numbers of the population facing daily hunger by raising the incomes of the poor, while

[1] Defining food security is an exercise in itself, especially when both macro and micro dimensions are included in the definition. In a recent review, Simon Maxwell (1996) listed 32 (!) different definitions of the term used by various authors between 1975 and 1991. Each definition is sensible in some context. The goal of this essay is to understand the economic context in which food security is no longer a personal or a policy concern. Almost any definition that is intuitively plausible will do for that purpose.

simultaneously managing the food economy in ways that minimize the shocks that might trigger a famine. These countries, some of them quite poor, have managed the same "escape from hunger" that Fogel documents for Europe.

The main premise of this essay is that an early escape from hunger is not primarily the result of private decisions in response to free-market forces. Improved food security stems directly from a set of government policies that integrates the food economy into a development strategy that seeks rapid economic growth with improved income distribution (Timmer, et al., 1983). With such policies, countries in East and Southeast Asia offer evidence that poor countries can escape from hunger in two decades or less--that is, in the space of a single generation. Although two decades may seem an eternity to the hungry and those vulnerable to famine, it is roughly the same as the time between the first World Food Summit Conference in 1974 and the second one in 1996. Despite much well-meaning rhetoric at the earlier summit, including Henry Kissinger's pledge that no child would go to bed hungry by 1985, the failure to place food security in a framework of rural-oriented economic growth, in combination with policies to stabilize domestic food economies, meant that two decades have been wasted in many countries.

Food Security and Economic Analysis

The focus here is on food security as an objective of national policy. The emphasis is on food security at the "macro" level. At that level, policyrnakers have an opportunity to create the aggregate conditions in which households at the "micro" level can gain access to food on a reliable basis through self-motivated interactions with local markets and home resources. The perspective taken is, thus, primarily an economic one.

Surprisingly, however, recent literature on food systems and economic development makes such an *economic* assessment of food security a difficult task. Three bodies of literature are potentially relevant to an analysis of how countries can escape from hunger and provide food security for their citizens, and yet none addresses the topic directly.

First, there is a substantial literature on the achievement of rapid economic growth (World Bank, 1993; Lucas, 1988; Barro and Sala-i-Martin, 1994; Taylor, 1996). Export orientation and openness to trade tend to be the dominant policy issues in this literature. In none of this literature is food security even mentioned, and agriculture receives only passing notice. Both omissions are surprising in view of the historical links between agriculture and economic growth and the fact that no country has sustained rapid economic growth without first achieving food security at the macro level (Timmer, 1996b);

Second, agriculture is treated in the literature on rapid poverty alleviation through rural-oriented economic growth (Timmer, 1991, 1995, 1996a; Birdsall, Ross, and Sabot, 1995; Ravallion and Datt, 1996; Lipton, 1977; Mellor, 1976). But even though the agricultural sector and the rural economy are the focus of this literature, no connections are made to price stability or other dimensions of food security, and trade issues are largely ignored.

Third, there is a growing literature on stabilization of domestic food economies and the contribution of stability to economic growth (Bigman, 1985; Chisholm, 1982; Sarris, 1982; Newbery

and Stiglitz, 1981; Morduch, 1995; Timmer, 1989, 1996c; Dawe, 1996; Ramey and Ramey, 1995). But the stabilization literature is badly bifurcated into micro-based analyses of decision-maker response to risk (both consumers and producers) and macro-based assessments of the impact of instability, usually measured by rates of inflation, on economic growth. Virtually no analysis has been done to connect these two topics, which is surprising in view of the macroeconomic significance of the food sector in most developing countries. A further connection links food security to political stability, which is increasingly important as a factor influencing investment, including foreign direct investments and portfolio investments in these countries.

The Asian Approach to Food Security

Not surprisingly, food security strategies in Asia have been little influenced by this economic literature. The lack of influence stems from at least two factors. First, the dominance of rice in the diets of most Asians, coupled to the extreme price instability in the world market for rice, forced *all* Asian countries to buffer their domestic rice price from the world price. This clear violation of the border price paradigm and the accompanying restrictions on openness to trade seem to have escaped many advocates of the East Asian miracle, who saw the region's rapid growth as evidence in support of free trade (World Bank, 1993).

Second, most Asian governments have paid little attention to formal efforts to define food security as a prelude to government interventions that would be seen as their approach to "food security." Instead, the food security strategies of most countries in East and Southeast Asia have had two basic components, *neither* of which is specifically linked to any of the standard definitions of food security used by international agencies. The United States position paper for the 1996 World Food Conference, for example, uses one version of these standard definitions:

> Food security exists when all people at all times have physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life. Food security has three dimensions:
>
> AVAILABILITY of sufficient quantities of food of appropriate quality, supplied through domestic production or imports;
>
> ACCESS by households and individuals to adequate resources to acquire appropriate foods for a nutritious diet; and
>
> UTILIZATION of food through adequate diet, water, sanitation, and health care. (United States Department of Agriculture (USDA), 1996, p. 2)

This definition is obviously an ideal that no country could hope to reach in fact. By contrast, the Asian countries that have been most successful at providing food security to their citizens have based their strategies on two elements of their domestic food system over which they have some degree of policy control: the sectoral composition of income growth and food prices.

The rate and distribution of economic growth are primarily matters of macroeconomic and trade policy (once asset distributions are given as an initial condition). Although there is now widespread controversy over what role Asian governments played in stimulating growth and

channeling its distribution, there is no disagreement that high rates of savings and investment, coupled with high and sustained levels of capital productivity, in combination with massive investments in human capital, explain most of the rapid growth that occurred up to 1997 (World Bank, 1993). Growth that reached the poor was one component of the food security strategy.

In the second element of the strategy, Asian governments sought to stabilize food prices, in general, and rice prices, in particular. Engel's Law ensures that success in generating rapid economic growth that includes the poor is the *long-run* solution to food security. In the language of Dreze and Sen (1989), such economic growth provides "growth-mediated security." In the meantime, stabilization of food prices in Asia ensured that short-run fluctuations and shocks did not make the poor even more vulnerable to inadequate food intake than their low incomes required.

Economists are highly dubious that such stability is economically feasible or desirable. It is not a key element of the "support-led security" measures outlined by Dreze and Sen (1989). In a recent review of food security and the stochastic aspects of poverty, Anderson and Roumasset (1996) essentially dismiss efforts to stabilize food prices using government interventions:

> Given the high costs of national price stabilization schemes (Newbery and Stiglitz, 1979, 1981; Behrman, 1984; Williams and Wright, 1991) and their effectiveness in stabilizing prices in rural areas, alternative policies decreasing local price instability need to be considered. The most cost-effective method for increasing price stability probably is to remove destabilizing government distortions. Government efforts to nationalize grain markets and to regulate prices across both space and time have the effect of eliminating the private marketing and storage sector. Rather than replacing private marketing, government efforts should be aimed at enhancing private markets through improving transportation, enforcing standards and measures in grain transactions, and implementing small-scale storage technology (Anderson and Roumasset, 1996, p. 62).

Although this condemnation of national price stabilization schemes might well be appropriate for much of the developing world, it badly misinterprets both the design and implementation of interventions to stabilize rice prices in East and Southeast Asia (Timmer, 1993, 1996c).

For food security in this region, the stabilization of domestic rice prices was in fact feasible in the context of an expanding role for an efficient private marketing sector. The resulting stability was not an impediment, but was probably conducive to economic growth. In addition, the stabilization scheme and economic growth had to work in tandem to achieve food security as quickly as possible.

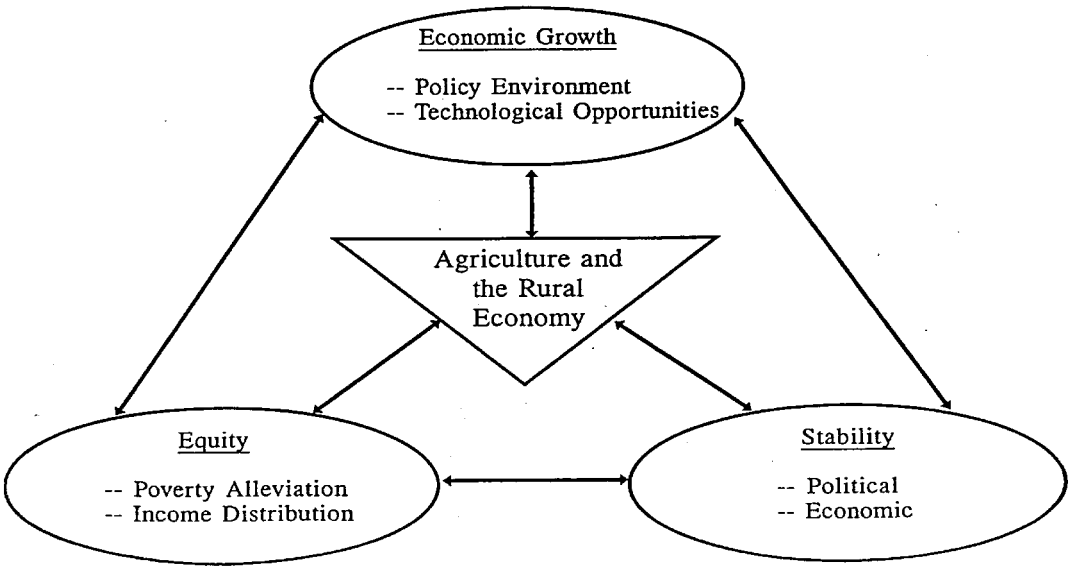
Both elements of the Asian strategic approach to food security--rapid economic growth and food price stability--address the "macro" dimensions of food security, not the "micro" dimensions found at and within the household. Governments can do *many* things to improve food security at the household and individual level, and most countries in East and Southeast Asia have programs to do so. Rural education accessible to females and the poor, family planning and child-care clinics in rural areas, nutrition education, and extension specialists helping to improve home gardens are just a few of the possibilities. Most of the literature on food security deals with approaches at this level, but problems of definition, measurement, project design, and management vastly complicate strategies that rely on household interventions (D. Maxwell, 1996).

The complications, in turn, sharply limit the number of households that can be reached with a micro approach. Without dismissing the potential effectiveness of these approaches to enhance food security in particular circumstances, it is still important to realize the scale of the problem. *Hundreds of millions* of people still do not have food security in Asia, and programs directed at households will not bring it. Only food security at the macro level can provide the appropriate facilitative environment for households to ensure their own food security.

Conceptualizing the Strategic Approach

Achieving food security through a "macro" strategic approach involves active development of the agricultural and rural economy to link and stimulate rapid economic growth, poverty alleviation, and stability (see Figure 1). In turn, each of these three elements is a primary input into food security at *both* the macro and micro levels.

Figure 1. The "Development Trilogy" and the Rural Economy



The mechanisms behind this strategic approach to food security are not well understood analytically or quantified empirically. The basic arguments, however, are straightforward. Improvements in agricultural productivity that are stimulated by government investment in rural infrastructure, agricultural research and extension, irrigation, and appropriate price incentives contribute *directly* to economic growth, poverty alleviation, and stability (Timmer, 1992, 1995).

For the large countries of Asia, investments to raise the productivity of domestic rice producers brought greater stability to the rice economy at the macro level, mostly because reliance on the world market was destabilizing in relation to domestic production. Expanded rice production

and greater purchasing power in rural areas, stimulated by the profitable rice economy, improved the stability of food intake of rural households.

The dynamic rural economy helped to reduce poverty quickly by inducing higher real wages. The combination of government investment, stable prices at incentive levels, and higher wages helped reduce the substantial degree of urban bias found in most development strategies (Lipton, 1977, 1993). Equity is nearly always enhanced when urban and rural areas compete equally for policy attention and resources.

Once the process of rapid growth is under way, political tensions are inevitably induced by a structural transformation that takes place too rapidly for resources to move smoothly from the rural to the urban sector (Anderson and Hayami, 1986; Timmer, 1993). The agricultural sector is less prone to these tensions if the gap between rural and urban incomes does not widen too much. All successfully growing countries have had to find ways to keep this gap from widening so much that it destabilizes the political economy and jeopardizes continued investment.

A third set of mechanisms connects growth in agricultural productivity with more rapid economic growth in the rest of the economy. An entire body of literature exists that analyzes the role of agriculture in economic growth (Johnston and Mellor, 1961; Eicher and Staatz, 1990; Timmer, 1992, 1995). Specific linkages that have been identified in this literature work through the capital and labor markets, as analyzed by Lewis (1955); through product markets, as specified by Johnston and Mellor (1961); and through a variety of non-market connections that involve market failures and endogenous growth models (Timmer, 1995).

In turn, economic growth, poverty alleviation, and stability are linked to each other through the "virtuous circles" reviewed by Birdsall, Ross and Sabot (1995). Greater stability of the food economy contributes to faster economic growth by reducing signal extraction problems, lengthening the investment horizon, and reducing political instability (Ramey and Ramey, 1995; Dawe, 1996). In the other direction, stability contributes to equity and poverty alleviation by reducing the vulnerability of the poor to sudden shocks in food prices or availability. Greater equity also stimulates investment in human capital, especially in rural areas (Williamson, 1993; Birdsall, et al., 1995), thus speeding up economic growth.

One important outcome of the strategic approach illustrated in Figure 1 is the achievement of food security. This occurs when economic growth has raised the poor above a meaningful poverty line and when stabilization of the food economy prevents exogenous shocks from threatening their food intake. In this approach, food security is sustained by the productivity of the poor themselves, but this security continues to depend on public action to maintain a stable macro environment, including the food economy, as the precursor to that productivity.

Modeling the Strategic Approach

This strategic approach to food security can be understood more clearly if it is developed into a simple model of economic development. A framework borrowed from Reutlinger and Selowsky (1976) is used here to organize the discussion (see Figure 2). A calorie-income relationship,

illustrated in Panel A, is used to identify a "poverty line" and a "famine line " (World Bank, 1986, Annex A). The standard Engel relationship in panel A portrays a representative consumer or household whose income (Y) determines calorie intake (C) according to a semi-logarithmic function, conditional on food prices (P). When food prices are held at their "average" level (P^A), the relationship shows that individual i will be below the poverty line C* when Y_i is below Y*. A further reduction in income to Y^F would make the individual vulnerable to severe hunger. Famine would be widespread if individual i is representative of a broad class of individuals.[2]

Panel A illustrates what happens to individual i when there are exogenous shocks to the food system, shown as equally likely "good" shocks, when food prices are low (P^L), and "bad" shocks, when food prices are high (P^H). When prices are high, more income is required to stay above the poverty line or the famine line. Obviously, factors other than food prices might affect similar vulnerabilities in particular households: illness, death of a wage earner, an additional child, and so on. The framework here abstracts from such idiosyncratic shocks to focus on individual income (or household income, where unitary decision making makes that a sensible approach) or economy-wide shocks.

From Individual Behavior to National Aggregates

The translation from individual behavior to national indicators of poverty or vulnerability to famine is shown in Panel B of Figure 2, which displays the distribution of income for the society. The starting point for the discussion is $Y_o|D_o$, where average per capita income Y^A is distributed in a log linear fashion, with each income quintile having double the per capita income of the quintile below (see Table 1 for illustrative data). Such a distribution means the top quintile has a per capita income that is 16 times higher than the bottom quintile, a "poor" but not "bad" distribution of income. For comparison, Indonesia started its modern growth process in the late 1960s with a top 20/bottom 20 ratio of 7.5:1, whereas, in the 1970s, it was 15:1 in the Philippines and more than 30:1 in Brazil.

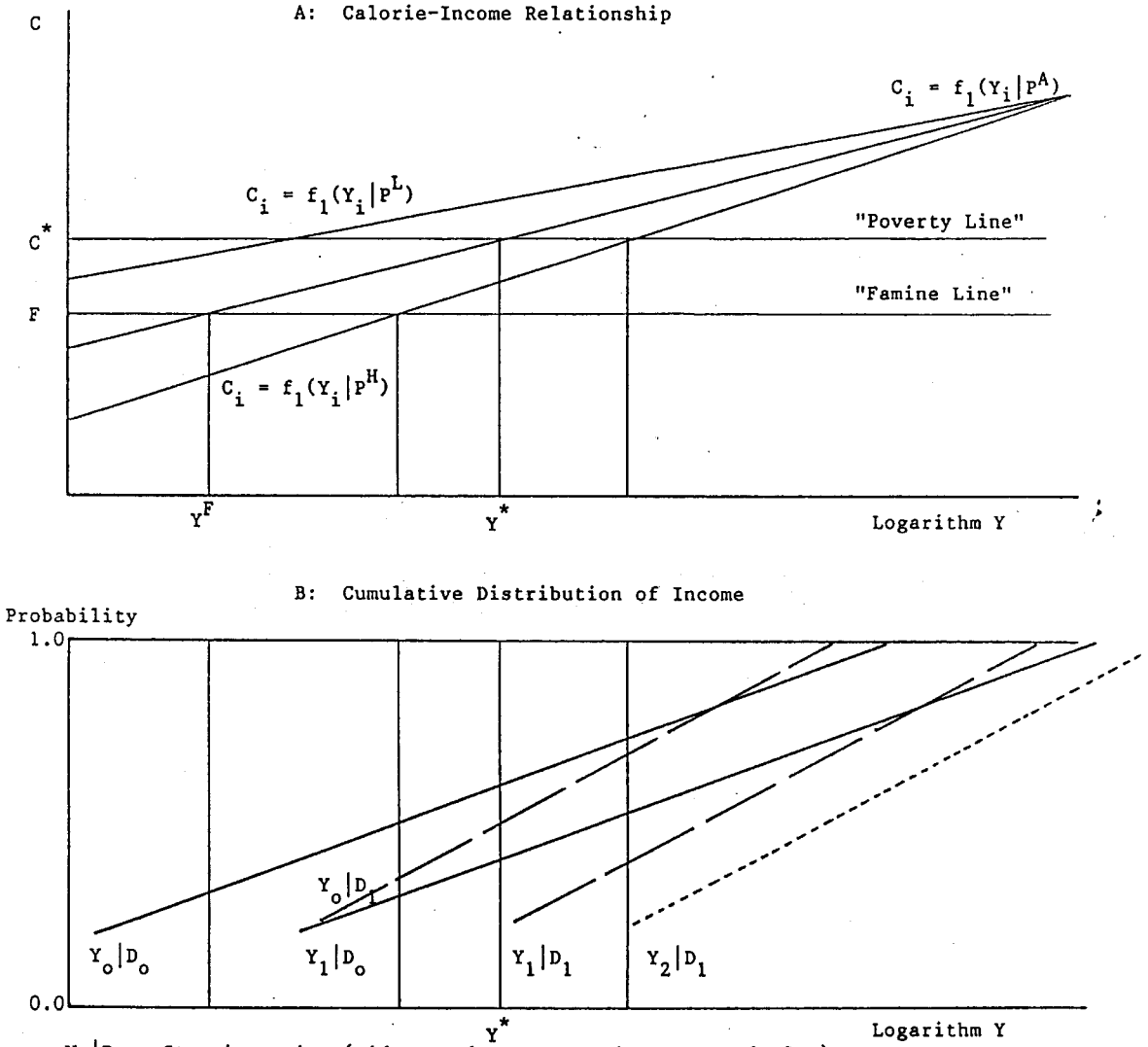
Table 1 offers a concrete idea of income levels that might be appropriate for this discussion. To start, the society has an average income per capita of $310 per year (about the level of India in the mid-1990s), distributed in such a way that the lowest quintile has an income per capita of $50 and the top quintile $800. The poverty line is drawn such that Y* = $200 and C* would be on the order of 2,100 kilocalories per capita per day.[3] Panels A and B can be read in combination to

[2] There is an entire body of literature devoted to estimating the calorie-income relationship illustrated in Panel A of Figure 2 and to examining the significance of any relationship between calorie intake and severe health consequences, such as infant mortality or shortened life expectancy (Srinivasan, 1981, Poleman, 1981, Behrman and Deolalikar, 1988). The perspective here draws on Reutlinger and Selowsky (1976), Alderman (1986), and Alderman and Paxson (1992).

[3] For convenience, all individuals in each income quintile are assumed to have the average income of that quintile. However, income distribution in Panel B is drawn continuously after the first quintile to reflect the smooth distribution likely after incomes rise above a subsistence floor.

indicate the national degree of poverty and vulnerability to famine. To start, 60 percent of the population has incomes at or below the poverty line, and 30 percent is vulnerable to famine. This is a very poor, famine-prone society. The question is, how does such a society achieve food security?

Figure 2. Poverty, Famine, and Food Security



$Y_o|D_o$ = Starting point (widespread poverty and prone to famine)
$Y_o|D_1$ = "Revolution" (static redistribution of income)
$Y_1|D_o$ = "Trickle-down Growth" (no redistribution of income)
$Y_1|D_1$ = "Redistribution with Growth"
$Y_2|D_1$ = "Redistribution with Rapid Growth"

Source: See Table 1

Table 1. Illustrative Data Showing Relationships Among Poverty, Famine, Income Levels, Income Distribution, and Food Prices

Income Quintile	Per Capita Income, US $				
	$Y_o\|D_o$	$Y_o\|D_1$	$Y_1\|D_o$	$Y_1\|D_1$	$Y_2\|D_1$
Lowest	$50	$100	$100	$200	$320
Second	100	160	200	319	494
Third	200	254	400	508	787
Fourth	400	398	800	797	1235
Highest	800	638	1600	1276	1978
Average	$310	$310	$620	$620	$961
Ratio: Top 20% to Bottom 20%	16:1	6.4:1	16:1	6.4:1	6.4:1
Proportion of Population Below the Poverty Line, C* (POV) or Prone to Famine, C<F (FAM), at Various Food Prices					
$P=P^A$	Average price level, or stabilized prices				
POV	0.6	0.5	0.4	0.2	0
FAM	0.3	0	0	0	0
$P=P^H$	High "price shock"				
POV	0.72	0.68	0.52	0.38	0
FAM	0.5	0.35	0.3	0	0
$P=P^L$	Low "price shock"				
POV	0.37	0	0	0	0
FAM	0	0	0	0	0

Define food security as an environment in which the lowest income quintile has a near-zero probability of being vulnerable to famine. The "escape from hunger" has a more challenging definition; it requires a similar near-zero probability of falling below the poverty line (defined strictly in calorie terms). Within the framework presented here, the escape from hunger and famine can be accomplished through one or a combination of three approaches. First, incomes can grow with no change in income distribution. Second, income distribution can improve with no change in average incomes per capita. Third, the domestic food economy can be stabilized to eliminate shocks that result in P^H as the prevailing price environment. The argument here, following Figure 1, is that the East and Southeast Asian approach of "growth with redistribution," relying heavily on stimulation of the rural economy, in combination with a policy to stabilize domestic food prices, is the fastest approach to managing this escape (Chenery, et al., 1974; Timmer, et al., 1983; Dasgupta, 1993; Timmer, 1995; Birdsall, et al., 1995).

What is Feasible?

Both theory and the empirical record of economic growth during the second half of the twentieth century argue that only certain combinations of growth, redistribution, and price policy are feasible as long-run strategies. In particular, two appealing strategies for overcoming hunger in the short run must be ruled out. The first, a strategy of keeping food prices low (P^L) through direct subsidies and macroeconomic distortions, such as overvalued domestic currencies, eliminates all probability of famine in our illustrative society (see the bottom line in Table 1), and it ends poverty with either doubled incomes per capita (Y_1) or a sharp redistribution of income (D_1). The problem with this strategy, unfortunately, is one of incentive compatibility. The strategy is not sustainable because it fails to provide incentives to the rural sector and, consequently, it is unable to maintain levels of agricultural productivity (Timmer, et al., 1983; Nerlove, 1994; Taylor, 1996). Without this productivity, the entire growth process is threatened.

The second strategy that fails is an immediate redistribution of income, from D_o to D_1. In Figure 2 and Table 1, this redistribution is shown as a change in the top 20/ bottom 20 ratio from 16:1 to 6.4:1. These particular numbers result from doubling the income per capita of the bottom quintile, holding average income per capita at the initial level, and then maintaining a log linear distribution for the remaining income quintiles. This doubling accomplishes immediately what economic growth takes years to accomplish--the elimination of vulnerability to famines in an environment of price stability. Unfortunately, such revolutionary redistributions of income have carried powerful, negative consequences for economic growth because they disrupt property rights and incentives for investment. Without such investment, economic output cannot be maintained (Barrett, 1995; Levine and Renelt, 1992; Barro and Sala-i-Martin, 1994; Taylor, 1996).[4]

[4] The extensive land reforms carried out in East Asia after World War II can be considered as a strategy of immediate income distribution. They were carried out in revolutionary circumstances or at the instigation of foreign powers, and the reforms established a distribution of assets from which equitable growth was possible. The conditions for similar reforms in other countries do not seem widely applicable in the 1990s (Tomich, et al., 1995).

"Trickle-Down Growth"

Two other strategies offer more hope. The first is economic growth with unchanging income distribution ($Y_1|D_o$). On the face of it, this strategy would seem to require a very long time to eliminate vulnerability to famine and hunger (World Bank, 1986). In the event of an adverse price shock, for example, even a doubling of income per capita in the lowest quintile leaves 30 percent of the population vulnerable to famine and more than half the population below the poverty line. In addition, with such an adverse income distribution and price instability, doubling of incomes per capita is likely to be slow, requiring 20 to 30 years (growth rates of income per capita of 2.4 to 3.6 percent per year) (Williamson, 1993; Birdsall, et al., 1995). It is not surprising that such "trickle-down growth" strategies have a poor reputation among most development specialists.

However, if the probability of P^H is reduced to near zero through public action to stabilize the food economy, even such a modest growth performance benefits the poor quite quickly by eliminating their vulnerability to famine. Many remain below the poverty line, 40 percent in the illustration, but they are protected from falling to the famine line because adverse price shocks are eliminated by the stabilization policy. This approach, in conjunction with urban food distributions to holders of ration cards, is a rough characterization of the Indian experience with food security.

The Indian experience is particularly interesting because the country started with a relatively egalitarian distribution of income. Because the country was so poor, however, absolute poverty was widespread, thus presenting a difficult dilemma. If substantial resources were used to subsidize food intake of the poor, sufficient funds would be diverted from productive investments to slow the rate of economic growth. Thus the strategic choice in much of South Asia--to opt for food security through distribution mechanisms that were built during British colonial rule to alleviate famines--may have sacrificed some of the potential for economic growth in order to provide "support-led" poverty alleviation (Dreze and Sen, 1989).

Growth With Redistribution

An alternative strategy of bringing the poor more directly into the process of economic growth offers considerably greater hope than trickle-down policies, even with effective stabilization of food prices. The alternative is, however, much more complicated to implement. Here, redistribution with growth is attempted, in order to shift from $Y_o|D_o$ to $Y_1|D_1$ in a relatively short period of time. In this strategy, incomes per capita double on average, as before, but redistribution of the increased output doubles the incomes of the poorest quintile yet again. Such a strategy, if it is possible, eliminates all vulnerability to famine, even in the face of a price shock, and nearly eliminates poverty when the growth strategy is implemented in conjunction with a policy of price stabilization. This was the Indonesian approach.

What are the barriers to such a strategy? It is clearly difficult to find a way to structure the growth process so that the poor gain in relation to the rich. Historically, the only way to do that has been a rural-oriented development strategy that raises productivity and incomes of the broad population of small farmers and other rural workers (Mellor, 1976; Tomich, et al., 1995; Timmer, et al., 1983).

Such a strategy, however, requires significant price incentives to create the rural purchasing power that, in turn, stimulates the rural growth needed to make the strategy consistent with overall macroeconomic performance. This consistency is crucial to maintaining internal economic balance (World Bank, 1993; Timmer, 1995, 1996b). Thus a growth strategy that aims at $Y_1|D_1$ is probably not feasible without a price policy that approaches P^H as an average rather than as an extreme shock. This "food price dilemma," in which poor consumers have their food intake threatened in the short run in order to fuel a long run growth process that removes them from poverty, has been emphasized before (Ravallion, 1989; Timmer, et al., 1983; Sah and Stiglitz, 1992). But experience in East and Southeast Asia since the 1970s shows that such a strategy, when implemented in the context of large-scale investments in rural infrastructure, human capital, and agricultural research, can lead to economic growth and an increase in average incomes per capita of 5 percent per year or more, with the rate of growth in the bottom two quintiles faster than that in the top (World Bank, 1993; Huppi and Ravallion, 1991; Timmer, 1995).

With doubling times of 10 to 15 years for incomes per capita and redistribution in favor of the poor, the "rural-oriented, price-led" strategy has the potential to reach outcome $Y_2|D_1$, illustrated in Figure 2 and Table 1, and shown for the 1970-1995 experience of Indonesia in Figure 3. With this strategy, the escape from hunger and famine is as complete as in the United States, Western Europe, and Japan. At the rates of growth experienced by Malaysia, Thailand, and Indonesia since the mid-1960s, the escape has been managed in less than three decades.[5]

Lessons from Asia

To achieve and sustain food security through rapid economic growth, the Asian experience suggests that the agricultural sector must be linked through three elements to food security: poverty alleviation, stability of the food economy, and growth itself. The effectiveness of these links depends critically on the initial conditions at the start of the process of rapid growth. In particular, agriculture can contribute little to equity if it is based on a "bi-modal" distribution of production or to stability if it is concentrated on a single export crop subject to substantial price fluctuations. Even in these circumstances, however, agriculture can be a significant contributor to economic growth.

Because of the dominance of rice in Asian diets, the prevalence of smallholder cultivators, the large size of many Asian countries, and the instability of the world rice market, the most successful countries in achieving food security developed effective programs and policies to raise the productivity of their own rice farmers. Many of these programs were explicitly motivated by the objective of self-sufficiency in rice, especially after the world food crisis in 1974, when the "world rice market" in Bangkok disappeared for nearly half a year. When long run costs of production are less

[5] It should be noted that the income gap between "rich" and "poor" continued to widen in Indonesia between 1970 and 1995, despite the faster growth rate of the incomes of the poor during that period. In the bottom quintile, for example, per capita incomes increased by $336 (in 1995 U.S. $) in the 25-year period, whereas incomes of the top quintile increased by $1,374. Even highly successful poverty alleviation does not necessarily solve the problems of income distribution, especially in the political arena.

than the costs of importing, such programs make economic sense, and the "self-sufficiency" slogan can be used effectively to mobilize political and bureaucratic support.

But self-sufficiency campaigns can do much mischief. Many countries have a deep aversion to international trade, an aversion seen since well before the Corn Laws debate in England in the early nineteenth century. Lindert (1991) has documented an "anti-trade bias" in agricultural pricing and trade policy that has deep historical roots. In the face of this clear political preference for self-sufficiency, Asian countries have had a difficult time distinguishing legitimate concerns for food security from a simple desire not to import anything that could be produced domestically, whatever the costs.

Even in Indonesia, which has an admirable record on stabilization of rice prices, higher productivity of rice farmers, and food security for nearly the entire population, self-sufficiency for a broad array of staple foods has become a policy objective (Timmer, 1994). An assessment of the steps needed to reach this objective concluded as follows:

> If economic considerations should play a significant (but not complete) role in determining appropriate policy for rice and its contribution to Indonesia's food security, the economic arguments are even stronger for all non-rice commodities. There is simply no nutritional, political, or logistical rationale to override the long run signals from the world market on which foods Indonesia should produce domestically and which it will be more economic to import, because these economic signals are the surest indicators of where to allocate resources for increased productivity and incomes (Timmer, 1994, p. 39).

Such openness to short run price signals from world markets for all but the most important staple food, and for all commodities in the long run, will require more open and stable markets in the future than have existed in the past. One major attraction to developing countries of the Uruguay Round of the GATT negotiations was the promise that liberalized agricultural trade would result in more stable prices on world grain markets. However, this promise may have been premature (Greenfield, el al., 1996; Islam, 1996). The shortages that caused high grain prices in world markets in 1995 and 1996 renewed anxieties about future food supplies, and policy-induced reductions in grain stocks seem destined to cause greater, not less, instability in grain prices. Asia, with nearly half the world's population to feed, is understandably concerned about how much to respond with new investments in domestic production and how much to rely on privately-held stocks available in international markets for supplies of basic grains.

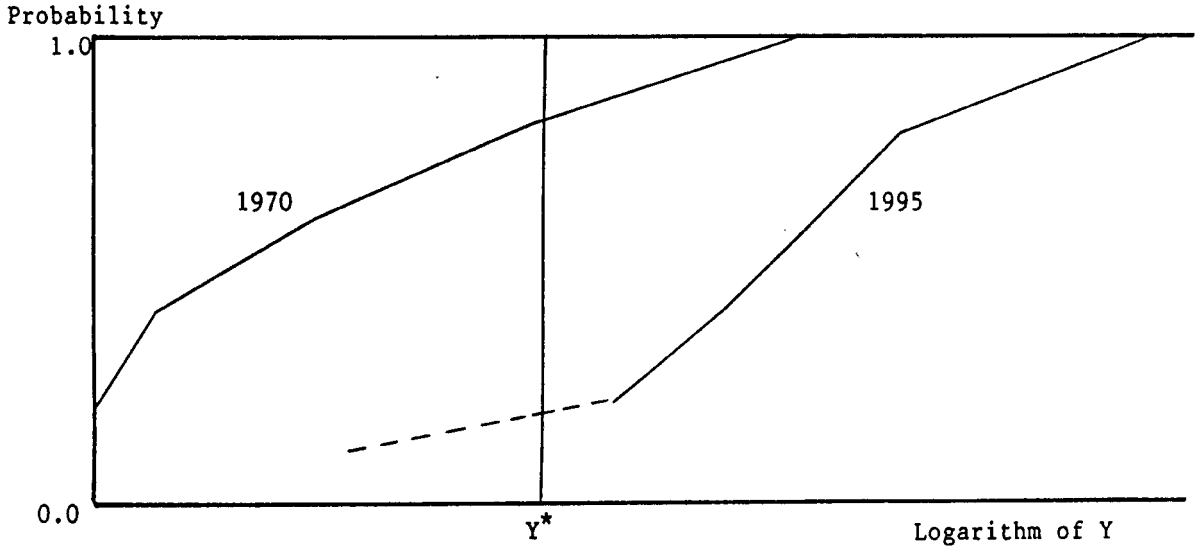
However the balance is struck on domestic versus imported supplies, the striking improvement in food security in Asia since the mid-1960s, especially in East and Southeast Asia, is not likely to be threatened. That is the advantage of "growth-mediated" food security. From this perspective, the lesson from East and Southeast Asia for achieving and maintaining food security can be summed up in this way: a growth process stimulated by a dynamic rural economy leads to rapid poverty alleviation, which, in the context of public action to stabilize food prices, ensures food security.

Figure 3. Poverty Alleviation, Income Distribution, and Income Growth in Indonesia, 1970-1995

Income Quintile	Income Shares 1970	Income Shares 1995	Per Capita Incomes 1970	Per Capita Incomes 1995	Annual Growth Rate, 1970-95
Lowest	6.6	8.7	$ 99	$ 435	6.1 %
Second	7.8	12.1	117	605	6.8
Third	12.6	15.9	189	795	5.9
Fourth	23.6	21.1	354	1055	4.5
Highest	49.4	42.3	741	2115	4.3
Ratio of Top 20% to Bottom 20%	7.5:1	4.9:1			
Average Per Capita Income			$ 300	$1000	4.9 %

Note: Income shares are based on SUSENAS data for total expenditures, and are drawn from surveys drawn in the mid-1970s and early 1990s, respectively. The per capita incomes are in 1995 U.S. dollars, and the 1995 figure is based on projections using the newly revised national income accounts.

Cumulative Distribution of Income



How General are the Lessons?

This approach might not work in other settings--for example, where the staple foodgrain is traded in more stable world markets, or where land holdings are highly skewed, or where technologies are not available to raise agricultural productivity. At least part of Africa's failure to achieve widespread food security for its population can be attributed to these factors, but part must also be attributed to differential treatment of agriculture by prevailing development strategies in Africa.

Two dimensions are important. First, because government policy makers maintained a macroeconomic environment that supported exports, Southeast Asia invested heavily in building a comparative advantage in a wide range of agricultural exports. The contrast with Africa is striking.

> Much can be learned from Asia's experience of changing its long-term comparative advantage in export commodities through investments in research, training and market development over the past three decades. For example, Thailand, Pakistan and Vietnam are routinely selling rice throughout Africa by outcompeting African farmers even after international and internal transport charges are taken into account. Moreover, Nigeria, Kenya and many other countries are importing palm oil from Malaysia to meet their growing demand for cooking oil. This is especially humbling to Nigeria because at independence in 1960, it was the world's leading producer and exporter of palm oil. Today, Malaysia's production of palm oil is about ten times larger than that of Nigeria. [Eicher (1992), p. 80.]

Second, governments in Southeast Asia actively sought to provide food security to domestic consumers, both urban and rural. Their ability to do so had both economic and political roots. Because populations were large in relation to agricultural resources, and because domestic rice consumption was large in relation to supplies available in world markets, countries in Southeast Asia were forced to develop successful rice intensification programs to ensure domestic food security.

As noted earlier, this food security was implemented in the short run through policies that stabilized rice prices. But these policies would have been impossible to sustain without rising productivity in the domestic rice economy. The broader theme of this paper--that food price stabilization is a crucial determinant of investment rates and subsequent economic growth--is also, in the context of Southeast Asia, an argument for substantial investment to raise productivity in the cultivation of food staples.

However, the multi-staple food economies of Africa differ markedly from the irrigated rice economies of Southeast Asia. Thus it is important to identify the crucial linkages between stabilization of rice prices and consequent stimulus to economic growth and determine whether similar linkages can be established in the agricultural environment of Africa. If the rice economy of Asia is sufficiently different from food systems of Africa, which are based on maize, millet, sorghum, cassava, and yams, substantial doubt will be cast on the relevance to Africa of the models of food security and economic growth that propelled Southeast Asia. Unless new growth models can be discovered specifically for the African context--and, in thirty years of trying, they have not been--such doubts are very troubling. We may be in the awkward position of knowing that agricultural development and stabilization of the domestic food economy are necessary for rapid economic growth but not knowing how to do it in Africa.

In the African context there are two important questions. Does the analytical support for policies that stabilize food prices hold only for rice economies? Is the implementation of such policies inherently more difficult and expensive in multi-staple food economies? If the benefits are smaller and the costs are larger in African food systems, stabilizing food prices might not be necessary or desirable. But if food prices are not stabilized, how can the investment climate be stabilized for farmers and urban industrialists? How can consumers be assured of food security? What would stimulate the dynamic linkages between agriculture and industry that were the basis of rapid economic growth in East and Southeast Asia?

Rice Is Different

A massive literature exists on Asian rice societies and the extent to which they are culturally, ecologically, and politically unique, but there has been surprisingly little effort devoted to understanding how these unique noneconomic dimensions translate into advantages and disadvantages for economic development. Cultural and sociological aspects are treated in Geertz (1963) and Castillo (1975), ecological dimensions in Grigg (1974) and Hanks (1972) as well as Geertz, and political effects of large-scale irrigation systems in Wittfogel (1957). The Asian rice *economy* has been studied as a commodity system in the classic volume by Wickizer and Bennett (1941), an approach updated by Barker and Herdt (1985). Country or village studies that use economic methodologies to analyze rice systems are more numerous; representative examples are Mears (1981) for Indonesia, Hayami and associates (1978) for a village in the Philippines, and Croll (1982) for a household perspective in China. But apart from Bray's (1986) extensive historical treatment, and Oshima's (1987) incorporation of labor demands in wet-rice cultivation into a general explanation of Asian poverty relative to European development, the unique characteristics of rice cultivation in the Asian environment have not been examined for their direct and indirect contributions to the overall process of economic growth.

This paper can merely highlight the key linkages that are likely to mediate these contributions. The Asian rice economy can be characterized in sufficient detail to outline the story and to indicate the nature of the rice, economy, especially in economically important ways, without becoming lost in the complexity of any given specific setting. Grigg (1974) provides an excellent description of wet-rice cultivation in Asia before the advent of high-yielding varieties developed at the International Rice Research Institute (IRRI). Barker and Herdt (1985) provide the details on the post-Green Revolution rice economy.[6]

Rice in Asia is produced primarily in irrigated or rainfed paddy fields that are managed intensively in a highly labor-intensive manner. Typical management units are households that own or rent these paddy fields, and few households actively manage more than one or two hectares of irrigated paddy. The median size of management unit for rice cultivation in Southeast Asia is probably less than one hectare, with double cropping the norm if water supplies are adequate.

[6] A less detailed set of stylized facts for Asian agriculture is developed by Haggblade and Liedholm (1991) as part of their simulation model that traces the evolution of the rural nonfarm economy under the stimulus of linkages between labor demand in agriculture and in the nonfarm rural economy.

Most households retain some rice for home consumption, but nearly all households that cultivate rice in Southeast Asia market at least small quantities after the harvest. Farmers with larger surpluses will often store rice for sale well after harvest when seasonal prices are higher. Purchased inputs are used almost universally, and nitrogen fertilizer--usually urea--is normally the single most important input bought from the market. Hired labor has become an important cash purchase as well, although exchange labor during planting and harvesting has been a feature of Asian rice cultivation for ages.

Large cash purchases of fertilizer and labor, small size of rice plantings managed by individual households, and active marketing of a significant share of output combine to make intensification of rice cultivation and the achievement of high yields an important objective of farmers and governments alike. Successful intensification has been important to farmers in order to keep their incomes on a par with opportunities elsewhere in the rural and urban economies. Likewise, intensification has been important to governments who are concerned about the availability of marketed supplies of rice that are needed to feed growing urban populations.

The very nature of irrigated rice cultivation means that farmers are not able to raise their rice yields successfully unless the government provides key ingredients in the intensification process. At the same time, governments cannot intensify rice cultivation directly--farmers are needed to make all the key managerial decisions that translate productive potential into high yields. An important symbiosis exists in the relationship between farmers and governments, even if the political system does not support a democratic voice for the rural population. Each party is dependent on the other to provide a crucial element of success.

Asian rice cultivation uses a small-farmer technology that offers high rewards to farmer knowledge and skilled management. These rewards depend on availability of high-yielding varieties, productive inputs, and incentives for their use, all of which can be delivered efficiently only through a system of competitive rural markets. Governments have had to build rural marketing systems that were able to connect farmers with local buying agents, thus transmitting market information and permitting exchange to take place, which generated gains in efficiency from trade. The marketing system serves to transform agricultural commodities at the farm gate into foods at the time, place, and form desired by consumers. An efficient marketing system has to solve the problem of price discovery, at least at the local level and seasonally, even if government price policy sets a band in which such price discovery must take place.[7]

Asian governments have also had to make large-scale investments in rural infrastructure. Managing these investments generated important opportunities for "learning by doing" on the part of government bureaucrats and policy makers. Part of this rural infrastructure supported the marketing system--roads, communications systems, market centers, and so on. But large investments were also needed in irrigation systems so that rice cultivation could be intensified successfully. Such systems have been the responsibility of governments nearly everywhere. The coordination and planning skills required to design, build, and maintain large-scale irrigation systems imposed serious

[7] See Chapter 4 of Timmer, et al. (1983) for further analysis of the importance of an efficient marketing system and the role of price policy in developing one.

obligations on those governments that undertook the tasks successfully. On the other hand, governments that acquired these skills by learning how to manage an irrigation-based agriculture also acquired a confidence in governance that was quickly applied to other dimensions of managing economic growth.

The key steps in the argument are now in place. Food security became the principal task of Asian governments with large populations in relation to their arable land resources. Policies to stabilize rice prices were the key interventions used to provide food security at the national level. Heavy reliance on rice imports was not feasible unless the country was small--for example, Singapore, Hong Kong, and to some extent Malyasia. But the larger countries of Southeast Asia had to grow nearly all of their own rice. Inducing farmers to produce this rice, for their own needs as well as surpluses for urban consumers, required governments to pursue an agricultural development strategy that focused on small farmers, reached them via markets, and raised the productivity potential of rice cultivation through large investments in rural infrastructure, irrigation, and research on high-yielding rice varieties.

Food Security and the Government

Both tasks undertaken by Asian governments--reaching small farmers via markets and raising agricultural productivity--created positive externalities for the overall process of economic growth in addition to the direct contribution from higher output of the staple food grain and the consequent lowering of the real wage bill.[8] First, making rural markets work is a direct lesson in the efficacy of a market-oriented economy. Building an efficient rural marketing system requires careful intervention and support from the government, but not too much if the private sector is to grow, learn how to take risks, and compete effectively. Governments must learn how to play their role in a market economy just as traders, banks, shipping companies, and supporting institutions must learn theirs. Solving the problem of food security in Asia forced governments to learn the importance of a market-oriented economy and the means to make it work.

Simultaneously, however, the need to invest in public infrastructure, irrigation, research and extension systems and to ensure the price stability that enabled the market economy to grow quickly and efficiently also forced Asian governments to develop a high degree of governmental competence in economic management. Without both components--a market economy and a competent government investing in agriculture--Asian countries could not have developed the high degree of food security that they have achieved at the national level. Not all countries have been equally successful in translating this aggregate degree of food security into equitable access to food on the part of all households. That success would require a government devoted to alleviating poverty as well as stimulating growth while maintaining political stability. Among countries of Southeast Asia, Malaysia and Indonesia have good records of achieving all three objectives of growth, stability, and improved welfare.

[8] For a review of the importance of externalities in the development process, see Stewart and Ghani (1991).

If this argument for a market economy and competent management on the part of government is correct, the rapid economic growth in Southeast Asia since the 1960s can be traced to a considerable extent to the development of a new rice technology that greatly increased yield potential when the surrounding environment--economic, ecological, and political--was conducive to rapid adoption by farmers. The elements of this environment are well known for irrigated rice systems, but they have never been assembled successfully for the staple foods of Sub-Saharan Africa.

Africa is Different

The staple food economies of Sub-Saharan Africa are not easily described with the simplicity possible for rice cultivation in Asia. Two standard references on African food systems, Johnston (1958) and Grigg (1974), stress the heterogeneity and complexity of production systems even within small localities. The point can be made in a vivid fashion by comparing the area around Krawang in West Java, Indonesia, one of the country's major rice bowls, and the Machakos region of Kenya, home to many of the country's most progressive small farmers. A drive across Krawang reveals that irrigated rice is grown as far as the eye can see. Small home gardens surround the many villages, but farming is almost completely a matter of managing a homogeneous ecological environment to grow one crop. The relative simplicity of developing a high-yielding technology for this environment and of learning to optimize its management accounts for the nearly universal adoption of IRRI varieties and the high and stable yields produced from them.[9]

The contrast with Kenya and the rest of Sub-Saharan Africa is striking. Wherever it is possible to drive through regions of intensive food production--and the poor state of the road networks often makes driving very difficult for tourists and for trucks--an unbroken stretch of a single foodcrop is uncommon. Small patches of land with multiple and inter-cropping are the norm, and the pattern shifts radically as one crosses areas with changed altitude, soil type, or rainfall. Maize, sorghum, millet, cassava, yams, groundnuts, cowpeas, and many others are intercropped in complex combinations, which reflect the farmer's knowledge of local growing conditions, available technologies, market prices, and the family need for food.

Tasks to Modernize African Agriculture.

Raising the productivity of such complicated, multi-staple food systems requires more of agricultural scientists than improving the average yield of a single crop when grown under ideal conditions in a pure stand. As with upland regions in Asia, the farming systems research has not been extensive enough to identify the constraints facing farmers in these heterogeneous environments.[10] The economic as well as the ecological interactions among various crops need to be analyzed and incorporated into the research strategy. When successful results have been achieved at the research center, they must then be transmitted back to farmers through messages that contain the same range

[9] A drive from Jakarta to Krawang in the early 1990s also revealed a number of factories being built on former rice paddies.

[10] A good review of this approach has been produced by the CIMMYT Economics Staff (1984).

of complexity that stimulated the development of new crop varieties and farming systems in the first place.

The point here is not that rice intensification is easy--that would misrepresent the hard-won achievements in Asia since the mid-1960s and the continuing challenge facing Asian researchers,, farmers, and policy makers--but it will be harder to achieve similar results in Africa. The farming systems that produce the great bulk of Africa's food staples are much more complicated, less understood by researchers, and operate under environmental stresses that vary more widely, especially moisture stress, than in the ricebased systems of Asia. A major difference between Africa and Southeast Asia is the role of women in household decision making and management of food crop production, which complicates the design of institutions that provide modern inputs, new technology, and credit to farmers. None of these difficulties is unsurmountable with appropriate investments in research, infrastructure, and incentives. It remains to be seen how much more expensive these investments will be in Africa than they were in Asia.[11] A serious test has yet to be made.

A multi-staple food system is more complicated to modernize not only at the farm level but also at the level of marketing inputs and output. Marketing a wide variety of different commodities with varying degrees of substitutability requires greater knowledge on the part of traders, higher storage and transactions costs because of smaller average lots handled, and far more sophisticated policy designs if governments attempt to stabilize prices for the three or four important food staples. But is this degree of intervention in pricing necessary? In the specific context of Ghana, Alderman (1992) has asked whether cross-commodity substitution in consumption, production, and storage is adequate to link prices of maize with prices of sorghum and millet. The answer is a qualified yes, with price integration requiring three months on average. Such integration offers the potential for government policy to stabilize the price of maize only, if that is desirable, while allowing market forces to transmit these stable prices to other staple foods that are close substitutes.[12]

Reliance on Imported Food.

The food economy of Africa has one other feature that distinguishes it from the rice economy of Southeast Asia: the heavy reliance on imported wheat to provision urban areas. Although wheat is an increasingly popular food in urban Asia, in none of the Southeast Asian countries does it account for as much as 10 percent of caloric intake. By contrast, in the cities of Sub-Saharan Africa, where roughly 30 percent of the population lives, an average of 50 kilograms per capita of imported grain,

---

[11] For a particularly eloquent statement of the lack of investment in African agriculture, see Eicher (1992). Block (1995) demonstrates how serious the productivity problems are in agriculture.

[12] The rather long period required for price integration to occur may be a significant impediment to such a single commodity stabilization policy. Three months of highly unstable prices for substitutes may impose very heavy burdens on consumers who depend on these commodities for most of their caloric intake. Similarly, prices can collapse at harvest for these commodities for as long as three months even if maize prices are stabilized, thus providing to producers few of the benefits of stable prices. The difficulties of stabilizing prices in the African context, and the costs of doing to, are modeled in Pinckney (1988).

most of it wheat, provides nearly 500 calories per day, or nearly 25 percent of daily energy intake. To a substantial extent, Sub-Saharan Africa is dependent on world grain markets to provision its urban (and vocal) population.

But the world market for wheat (and yellow maize) is not nearly so unstable as the world rice market. Total volumes traded are much higher--on the order of 100 million tons per year each for wheat and maize, compared with only 20 million tons for rice. The shares of production are similarly larger. Rice trade is just 5 percent of world production, whereas wheat and maize are 20 and 15 percent, respectively. The thinness of the world rice market has made it notoriously unstable, thus forcing policy makers in rice-consuming countries to insulate their domestic rice economies from the world market. Such insulation is not nearly so important for economies whose staple food is wheat or yellow maize. Many African cities depend heavily on imported wheat for their staple food supply.[13]

Compared with a rice-based, domestically supplied economy, a wheat-based, import supplied food economy does not have the same imperative to develop its domestic food production. When the domestic staples produced are root crops or specialized coarse grains not available in world markets, governments are even less inclined to invest in domestic food production. If a political economy with a powerful urban bias is superimposed on this bifurcated food economy, the neglect of African food producers is easily understandable.[14] Nor is it easy to see how to end this neglect, either politically or economically. In particular, if price stabilization of staple foods is important to both consumers and producers, the nontradable status of root crops rules out the trade-oriented approach used in Southeast Asia. Price fluctuations in world markets for white maize and local varieties of sorghum and millet are similar to those for rice, and high transportation costs mean extraordinarily wide margins between c.i.f. import and f.o.b. export prices.[15]

Price Stability, Agricultural Productivity, and Economic Growth

Switching the role of food imports from the mainstay of food security to a vehicle for stabilizing the domestic food economy at levels that provide ample incentives to farmers to increase productivity is an enormous challenge for African governments. Cereal imports are increasing steadily, and more than one-third of them are provided as food aid. Most urban food systems are not well linked to domestic supplies but rely heavily on imports. Redressing this bias requires more than simply improving price incentives to farmers, although this step is necessary. A marketing system that is "pointing in the wrong direction" requires substantial changes in ways of doing business, infrastructure, institutions, and credit facilities before food supplies grown domestically can be the foundation of a stable and secure food system.

---

[13] Imported rice is increasingly important in several West African countries.

[14] The political economy dimensions of the argument are explained in Bates (1981).

[15] Several countries in East Africa fluctuate around self-sufficiency for white maize, their staple grain. In good years exports are possible and in bad years imports are needed. For landlocked Malawi, the swing between the c.i.f. and f.o.b. prices can be very wide indeed--from negative prices for exports to more than $300 per ton for imports!

Without these changes, it is difficult to see how stability in food prices and genuine food security can be achieved in Africa. Reliance on food aid and subsidized grain exports from North America and Western Europe undermines the political will needed to invest in domestic agriculture through a form of "Dutch Disease" that undervalues local food production. Such reliance is not sustainable in the long run. Even worse, it may not be stable in the short run. Africa relies heavily on exports of primary commodities to earn the foreign exchange needed to finance a food-import strategy. The prices of these commodities in world markets are highly unstable. The result is that earnings of foreign exchange are also highly unstable, thus destabilizing the entire macro economy. Research by Dawe (1996) has demonstrated that this destabilization takes a significant toll in terms of economic growth. Because it is harder to stabilize export earnings than to stabilize food prices, a switch in priority away from export crops toward domestic production of food crops is likely to improve food security as well as stimulate economic growth.

Nothing said so far suggests that such a switch will be easy. New priority will have to be placed on rural infrastructure and research on raising productivity of farming systems. Governments will have to intervene to restructure incentives in favor of food production, and these incentives will involve both stability and price levels for inputs and output. Such priorities were not so difficult to establish in the Asian context, where populations are large relative to land resources and where the density of economic activity justifies an extensive network of roads and traders who use them. Population pressures and favorable ecological settings also justified massive investment in irrigation systems that have stabilized Asian agricultural output while raising crop yields. It is easy to see how the emphasis on increasing domestic rice production evolved in the Asian context as a mechanism for stabilizing rice prices, and that this focus on production was the key to food security at the national level. It is difficult to see how a similar orientation can evolve in Africa.

The failure of African countries to look to domestic agriculture as the basic mechanism for providing food security comes at high cost in a final arena--learning how to manage the ingredients of rapid economic growth. By solving their food problems through agricultural development, Asian governments arguably learned both the appropriate role of the government in this process and the careful management of the economic environment required to bring it about.

> Asian governments realized, in the words of Lee Kuan Yew, that they "must create an agricultural surplus to get their industrial sector going." Rich and industrious rice-farmers have been the foundation of Asia's industrialization. *[The Economist*, "Survey of Asia's Emerging Economies," November 16, 1991, p. 18.]

There is an obvious economic rationale to the strategy articulated by Lee Kuan Yew, even if, as Prime Minister of Singapore, he did not have to follow it for his own country. This paper explains the high level of governmental competence in Asia in managing the process of economic growth by appealing to the learning that took place from the necessity and complexity of solving their domestic food problems. The low level of competence at similar tasks demonstrated in the 1960s and 1970s in Africa can be traced to development strategies that met growing urban food needs from imports. That is, much of the explanation for the differential competence can be traced directly to how governments treated, and learned from, their agricultural sectors. The underlying political economy of the different approaches has already been explained, but the full consequences of the difference are just now being recognized.

The fundamental lesson from Asia's economic success is that there is no substitute for agricultural development in societies that have a substantial rural sector. Providing food security is an important rationale for investing in agriculture, and widespread confidence in food security--made manifest by stable food prices--can be translated through extensive externalities and linkages into rapid economic growth. There might be alternative strategies that would also generate rapid economic growth, but Southeast Asia is not the place to look for them.

References

Alderman, Harold (1986). *The Effect of Food Price and Income Changes on the Acquisition of Food by Low-Income Households.* Washington, D.C.: International Food Policy Research Institute.

_____ (1992). "Intercommodity Price Transmittal: Analysis of Food Markets in Ghana." Working Paper Series No. 884. Washington, D.C.: The World Bank, April.

_____ and Christina H. Paxson (1992). "Do the Poor Insure? A Synthesis of the Literature on Risk and Consumption in Developing Countries." Research Program in Development Studies Discussion Paper no. 164. Princeton, NJ: Princeton University.

Anderson, Jock R., and James A. Roumasset (1996). "Food Insecurity and Stochastic Aspects of Poverty." *Asian Journal of Agricultural Economics*, Vol. 2, No. I (August), pp. 53-66.

Anderson, Kym, and Yujiro Hayami (1986). *The Political Economy of Agricultural Protection.* Sydney: Allen and Unwin.

Barker, Randolph, Robert W. Herdt, with Beth Rose (1985). *The Rice Economy of Asia.* Washington, D.C.: Resources for the Future (distributed by Johns Hopkins University Press).

Barrett, Christopher B. (1995). "Idea Gaps, Object Gaps, and Trust Gaps in Economic Development." Economic Research Institute Study Paper No. 95-16. Logan, UT: Department of Economics, Utah State University; August.

Barro, Robert J., and Xavier Sala-i-Martin (1994). *Economic Growth.* New York: McGrawHill.

Bates, Robert H. (1981). *Markets and States in Tropical Africa: The Political Basis of Agricultural Policies.* Berkeley: The University of California Press.

Behrman, Jere R. (1984). "The Analytics of International Commodity Agreements." In Carl K. Eicher and John M. Staatz, eds. *Agricultural Development in the Third World* (Baltimore, MD: Johns Hopkins University Press).

_____ and Anil B. Deolalikar (1988). "Health and Nutrition." In Hollis Chenery and T. N. Srinivasan, eds., *Handbook of Development Economics,* Vol. 1, Amsterdam: North-Holland, pp. 631-711.

Bigman, David (1985). *Food Policies and Food Security Under Instability: Modeling and Analysis.* Lexington, MA: Lexington Books.

Birdsall, Nancy, David Ross, and Richard Sabot (1995). "Inequality and Growth Reconsidered: Lessons from East Asia." *World Bank Economic Review,* Vol. 9, No. 3, pp. 477-508.

Block, Steven A. (1995). "The Recovery of Agricultural Productivity in sub-Saharan Africa." *Food Policy,* Vol. 20, No. 5 (October), pp. 385-406.

Bray, Francesca (1986). *The Rice Economies: Technology and Development in Asian Societies.* Oxford: Basil Blackwell.

Castillo, Gelia T. (1975). *All in a Grain of Rice.* Los Barios, Philippines: Southeast Asian Regional Center for Graduate Study and Research in Agriculture.

Chenery, Hollis, et al. (1974). *Redistribution with Growth.* Oxford: Oxford University Press for the World Bank.

Chisholm, Anthony H. (1982). "Commodity-Price Stabilization: Microeconomic Theory and Policy Issues." In Anthony H. Chisholm and Rodney Tyers, eds., *Food Security: Theory, Policy, and Perspectives from Asia and the Pacific Rim.* Lexington, MA: Lexington Books and D.C. Heath.

CIMMYT Economics Staff (1984). "The Farming Systems Perspective and Farmer Participation in the Development of Appropriate Technology." In Carl K. Eicher and John M. Staatz, eds., *Agricultural Development in the Third World.* Baltimore: Johns Hopkins University Press, pp. 362-77.

Croll, Elisabeth (1982). *The Family Rice Bowl: Food and the Domestic Economy in China.* Geneva: United Nations Research Institute for Social Development (UNRISD).

Dasgupta, Partha (1993). *An Inquiry into Well-Being and Destitution.* Oxford: Clarendon Press.

Dawe, David (1996). "A New Look at the Effects of Export Instability on Investment and Growth." *World Development,* December.

Dreze, Jean, and Amartya Sen (1989). *Hunger and Public Action.* Oxford: Clarendon Press.

The Economist (1991). "A Survey of Asia's Emerging Economies." November 16, pp. Sl-S18.

Eicher, Carl K. (1992). "African Agricultural Development Strategies." In Frances Stewart, Sanjaya Lall, and Samuel Wangwe, eds., *Alternative Development Strategies in SubSaharan Africa.* London: MacMillan, pp. 79-102.

_____ and John M. Staatz, eds. (1990). *Agricultural Development in the Third World.* Second edition. Baltimore, MD: Johns Hopkins University Press.

Fogel, Robert W. (1989). "Second Thoughts on the European Escape from Hunger: Famines, Price Elasticities, Entitlements, Chronic Malnutrition, and Mortality Rates." NBER Working Paper Series on Historical Factors in Long Run Growth, No. 1. Cambridge, MA: National Bureau of Economic Research.

_____ (1991). "The Conquest of High Mortality and Hunger in Europe and America: Timing and Mechanisms." In Patrice Higonnet, David S. Landes, and Henry Rosovsky, eds., *Favorites of Fortune: Technology, Growth, and Economic Development since the Industrial Revolution* (Cambridge, MA: Harvard University Press), pp. 35-71.

Geertz, Clifford (1963). *Agricultural Involution: The Processes of Ecological Change in Indonesia.* Berkeley: University of California Press.

Greenfield, Jim, Maurizio de Nigris, and Panos Konandreas (1996). "The Uruguay Round Agreement on Agriculture: Food Security Implications for Developing Countries." *Food Policy,* Vol. 21, Nos. 4/5 (September/November), pp. 365-76.

Grigg, David B. (1974). *The Agricultural Systems of the World: An Evolutionary Approach.* Cambridge: Cambridge University Press.

Haggblade, Steven, and Carl Liedholm (1991). "Agriculture, Rural Labor Markets, and the Evolution of the Rural Nonfarm Economy." GEMINI Working Paper No. 19. East Lansing, MI: Michigan State University.

Hanks, Lucien M. (1972). *Rice and Man: Agricultural Ecology in Southeast Asia.* Arlington Heights, IL: AHM Publishing Corp.

Hayami, Yujiro, and Associates (1978). *Anatomy of Peasant Economy: A Rice Village in the Philippines.* Los Banos, the Philippines: International Rice Research Institute.

Huppi, Monica, and Martin Ravallion (1991). "The Sectoral Structure of Poverty in Indonesia During an Adjustment Period: Evidence for Indonesia in the Mid-1980's." *World Development,* Vol. 19, No. 12, pp. 1653-78.

Islam, Nurul (1996). "Implementing the Uruguay Round: Increased Food Price Stability by 2020?" 2020 Brief 34. Washington, D.C.: International Food Policy Research Institute; June.

Johnston, Bruce F. (1958). *The Staple Food Economies of Western Tropical Africa.* Stanford, CA: Stanford University Press.

_____ and John W. Mellor (1961). "The Role of Agriculture in Economic Development." *American Economic Review,* Vol. 51, No. 4, pp. 566-93.

Kuznets, Simon (1966). *Modern Economic Growth.* New Haven, CT: Yale University Press.

Levine, R., and D. Renelt (1992). "A Sensitivity Analysis of Cross-Country Growth Regressions." *American Economic Review,* Vol. 82, No. 4 (September), pp. 942-63.

Lewis, W. Arthur (1955). *The Theory of Economic Growth.* London: Allen and Unwin.

Lindert, Peter H. (1991). "Historical Patterns of Agricultural Policy." In C. Peter Timmer, ed., *Agriculture and the State: Growth, Employment, and Poverty in Developing Countries* (Ithaca, NY: Cornell University Press), pp. 29-83.

Lipton, Michael (1977). Why *Poor People Stay Poor: Urban Bias in World Development.* Cambridge, MA.: Harvard University Press.

_____ (1993). "Urban Bias: Of Consequences, Classes and Causality." In Ashutosh Varshney, ed., *Beyond Urban Bias.* London: Frank Cass, pp. 229-58.

Lucas, Robert E. (1988). "On the Mechanics of Economic Development." *Journal of Monetary Economics,* Vol. 22, No. 1, pp. 3-42.

Maxwell, Daniel G. (1996). "Measuring Food Insecurity: The Frequency and Severity of 'Coping Strategies'." *Food Policy,* Vol. 21, No. 3 (July), pp. 291-304.

Maxwell, Simon (1996). "Food Security: A Post-Modern Perspective." *Food Policy,* Vol. 21, No. 2 (May), pp. 155-170.

Mears, Leon A. (1981). *The New Rice Economy of Indonesia.* Yogyakarta, Indonesia: Gadjah Mada University Press.

Mellor, John W. (1976). *The New Economics of Growth: A Strategy for India and the Developing World.* Ithaca, NY: Cornell University Press.

Morduch, Jonathan (1995). "Income Smoothing and Consumption Smoothing." *Journal of Economic Perspectives,* Vol. 9, No. 3 (Summer), pp. 103-14.

Nerlove, Marc (1994). "Reflections on Agricultural Development, Population Growth and the Environment." Prepared for the Third Conference on Development Economics, 23-25 November, 1994, in Manila. Manila: Asian Development Bank; typescript.

Newbery, David M. G., and Joseph E. Stiglitz (1979). "The Theory of Commodity Price Stabilization Rules: Welfare Impacts and Supply Responses." *Economic Journal,* Vol. 89, pp. 799-817.

_____ (1981). *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk.* New York: Oxford University Press.

Oshima, Harry T. (1987). *Economic Growth in Monsoon Asia: A Comparative Study.* Tokyo: University of Tokyo Press.

Pinckney, Thomas C. (1988). *Storage, Trade, and Price Policy Under Production Instability: Maize in Kenya.* IFPRI Research Report No. 71. Washington, D.C.: International Food Policy Research Institute.

Poleman, Thomas (1981). "Quantifying the Nutrition Situation in Developing Countries." *Food Research Institute Studies,* Vol. 28, No. 1, pp. 1-58.

Ramey, Garey, and Valerie A. Ramey (1995). "Cross-Country Evidence on the Link Between Volatility and Growth." *American Economic Review,* Vol. 85, No. 5 (December), pp. 1138-51.

Ravallion, Martin (1987). *Markets and Famines.* Oxford: Clarendon Press.

_____ (1989). "Do Price Increases for Staple Foods Help or Hurt the Rural Poor?" *Oxford Economic Papers.*

_____ (1998). "Economics and Famines." *Journal of Economic Literature.*

_____ and Gaurav Datt (1996). "How Important to India's Poor is the Sectoral Composition of Economic Growth?" *World Bank Economic Review,* Vol. 10, No. I (January), pp. 1-25.

Reutlinger, Shlomo, and Marcelo Selowsky (1976). *Malnutrition and Poverty: Magnitude and Policy Options.* World Bank Occasional Paper No. 23. Baltimore, MD: Johns Hopkins University Press for the World Bank.

Sah, Raj K., and Joseph E. Stiglitz (1992). *Peasants Versus City-Dwellers: Taxation and the Burden of Economic Development.* Oxford: Clarendon Press.

Sarris, Alexander H. (1982). "Commodity-Price Theory and Public Stabilization Stocks." In Anthony H. Chisholm and Rodney Tyers, eds., *Food Security: Theory, Policy, and Perspectives from Asia and the Pacific Rim* (Lexington, MA: Lexington Books, and D.C. Heath).

Sen, Amartya (1981). *Poverty and Famines.* Oxford: Oxford University Press.

Srinivasan, T. N. (1981). "Malnutrition: Some Measurement and Policy Issues." *Journal of Development Economics,* Vol. 8, pp. 3-19.

Stewart, Frances, and Ejaz Ghani (1991). "How Significant are Externalities for Development?" *World Development.* Vol. 19, No. 6, pp. 569-94.

Taylor, Alan M. (1996). "On the Costs of Inward-Looking Development: Historical Perspectives on Price Distortions, Growth and Divergence in Latin America from the 1930s to the 1980s." Evanston, IL: Department of Economics, Northwestern University; typescript.

Timmer, C. Peter (1989). "Food Price Policy: The Rationale for Government Intervention." *Food Policy,* Vol. 14, No. I (February), pp. 17-42.

_____ (1991). "Agricultural Employment and Poverty Alleviation in Asia." In C. P. Timmer, ed., *Agriculture and the State: Growth, Employment, and Poverty in Developing Countries.* Ithaca, NY: Cornell University Press, pp. 123-55.

_____ (1992). "Agriculture and Economic Development Revisited." In Paul S. Teng and Fritz W. T. Penning de Vries, special editors, *Agricultural Systems,* Vol. 38, No. 5 (Amsterdam: Elsevier), pp. 1-35.

_____ (1993). "Rural Bias in the East and Southeast Asian Rice Economy: Indonesia in Comparative Perspective," *Journal of Development Studies,* Vol. 29, No. 4 (July), pp. 149-76.

_____ (1994). "The Meaning of Food Self -Sufficiency," *Indonesian Food Journal,* Vol. 5, No. 10, pp. 33-43.

_____ (1995). "Getting Agriculture Moving: Do Markets Provide the Right Signals?" *Food Policy,* Vol. 20, No. 5 (October), pp. 455-72.

_____ (1996a). "Agriculture and Poverty Alleviation in Indonesia." In Ray A. Goldberg, ed., *Research in Domestic and International Agribusiness Management,* Vol. 12 (Greenwich, CT: JAI Press), pp. 205-34.

_____ (1996b). "Food Supplies and Economic Growth in Great Britain, Japan and Indonesia." Cambridge, MA: Harvard Institute for International Development, typescript.

_____ (1996c). "Does BULOG Stabilize Rice Prices in Indonesia? Should It Try?" *Bulletin of Indonesian Economic Studies,* Vol. 32, No. 2, (August), pp. 45-74.

_____ Walter P. Falcon, and Scott R. Pearson (1983). *Food Policy Analysis.* Baltimore, MD: Johns Hopkins University Press for the World Bank.

Tomich, Thomas P., Peter Kilby, and Bruce F. Johnston (1995). *Transforming Agrarian Economies: Opportunities Seized; Opportunities Missed.* Ithaca, NY: Cornell University Press.

United States Department of Agriculture (1996). "The U.S. Contribution to World Food Security." The U.S. Position Paper Prepared for the World Food Summit. Washington, D.C.: United States Department of Agriculture; July 3.

Wickizer, Vernon D., and Merrill K. Bennett (1941). *The Rice Economy of Monsoon Asia.* Stanford, CA: Food Research Institute in cooperation with the Institute of Pacific Relations.

Williams, Jeffrey C., and Brian D. Wright (1991). *Storage and Commodity Markets.* Cambridge: Cambridge University Press.

Williamson, Jeffrey G. (1993). "Human Capital Deepening, Inequality, and Demographic Events along the Asia-Pacific Rim." In Naohiro Ogawa, Gavin W. Jones, and Jeffrey G. Williamson, eds., *Human Resources in Development along the Asia-Pacific Rim* (Singapore: Oxford University Press), pp. 129-58.

Wittfogel, Karl (1957). *Oriental Despotism.* New Haven: Yale University Press.

World Bank (1986). *Poverty and Hunger: Issues and Options for Food Security in Developing Countries.* Washington, D.C.

_____ (1993). *The East Asian Miracle: Economic Growth and Public Policy*. London: Oxford University Press for the World Bank.

The Weak Link Between World Food Markets and World Food Security

Robert Paarlberg

World food security is an easily agreed upon political goal, yet hard to define and operationalize as a policy objective. Here we shall define food insecurity as any transitory interlude of below-trend food consumption that threatens human health. Food insecurity is thus distinct from chronic malnutrition (which may be non-transitory) and from outright famine (which threatens not just health, but life itself). Food insecurity, when defined in these terms, could be measured either for individuals, households, communities, nations, or for the whole world.

Analysts often must rely on indirect indicators of food security, and one conventionally popular indicator of "world" food security has been the changing condition of international grain markets. It is conventional to assume the world's food system (whatever that is) will be more secure when grain export prices are low and when carry-over stocks in exporting countries are high. World grain prices and stocks are among the principal indicators of food security routinely tracked and reported by FAO, the World Bank, IFPRI, and USDA. Here we shall argue against continued use of such indicators. Evidence will be presented showing that people in poor countries vulnerable to hunger tend to be no better fed when world prices are low and stocks abundant, than when world prices are high and carry over stocks low.

World grain markets are a poor indicator of food insecurity because most food insecure countries still depend only lightly on imports of grain from the world market. Dependence on international grain markets is low for most poor countries even when food aid shipments are considered together with commercial imports. Food insecure citizens in poor countries are not disconnected from all world markets, of course; their income and employment prospects are often heavily dependent on world markets for *non-food* products, including raw materials markets and markets for various non-food agricultural commodities, plus world markets for financial capital, currency exchange, and direct investment. It is only world food markets, paradoxically, that seldom loom large.

The Habit of Tracking World Grain Markets

World grain market conditions have been used as indicators of changing food security conditions among the poor for at least three decades, ever since the so-called world food crisis of the 1970s. Grain export prices roughly doubled in 1973-74, largely as a consequence of global macroeconomic imbalances that were not specific to the food sector; the international price of almost all commodities and raw materials increased sharply during this period, including petroleum, bauxite, copper, and tin, not just food and farm commodities. Still, analysts within the food sector assumed higher world grain export prices presented a threat to consumption options for the poor. FAO convened a World Food Conference in Rome in November 1974, were the Director General of FAO described the situation as "grave." Yet actual evidence of below-trend consumption among poor countries was scant at the time. FAO's 1974 report on the State of Food and Agriculture provided current estimates of agricultural production, trade, stocks, prices, and food aid, but no estimates of

current consumption.[1] Consumption was simply assumed to be under threat, because world prices were high and stocks low.

The research community followed the policy community and quickly picked up this habit of judging world food security circumstances by tracking grain export price levels and world carryover stocks. One prominent academic account of the early 1970s by Hopkins and Puchala was typical: "The gravity of the situation as it developed between 1972 and 1975 is captured rather dramatically in two sets of indices--(1) grain export prices, and (2) reserve stocks of grain." (Hopkins and Puchala, 1978, p. 6). These same two indicators were later singled out in an account of the period offered by Valdes and Siamwalla: "[Agricultural prices had risen to record highs, carry-over stocks of grain were at precariously low levels, and concern was focused on the undernourished millions in the Third World suffering from the scarcity and high price of food." (Valdes and Siamwalla, 1981, p. 1).

This use of export price and world stock levels as indicators of global food security has proved durable through the 1980s and even into the 1990s. When grain export prices fell sharply and stocks began to accumulate within exporting countries in the mid 1980s, it was commonplace to conclude that the world food crisis was over. In one widely cited account of this period in the influential periodical *Foreign Affairs*, Barbara Insel announced the world was now "awash with grain" (Insel 1985). Then in 1995-96, when grain stocks fell and export prices rose sharply again, food insecurity concerns were revived. The World Bank, in a report it prepared for yet another FAO World Food Summit conference in Rome in November 1996, used high world prices and low stock conditions as a basis for noting similarities to the earlier 1970s interlude of presumed insecurity.[2] Even the International Food Policy Research Institute (IFPRI), which in its own research has generally employed more reliable country level and household level indicators of food insecurity (von Braun et al. 1992), reinforced the conventional view that world grain market conditions deserved priority attention. IFPRI observed in 1997 that, "Sharp increases in international wheat and maize prices, along with significant reductions in global cereal stocks, have received wide publicity and greatly excited concerns about food security during the past two to three years." (IFPRI 1997, p. 14).

This conventional association between high grain export prices and food insecurity needs to be discarded. Most poor country citizens are little affected one way or the other by high grain export prices in the world market, and often they are doing better rather than worse when world grain prices

---

[1] The most recent consumption data in this 1975 report were from 1970. See FAO, State of Food and Agriculture 1974, Rome, 1975, p. 120.

[2] As the Bank explained, "The first World Food Conference, held in 1974, was the culmination of worldwide concern about the global food situation. Many of the same concerns have emerged again. Food reserves are low, as they were in 1974. The ratio of world end-of-year grain stocks to consumption, a common measure of food reserves, had fallen to 15 percent in 1974 -- the lowest level recorded until that time. The current ratio is even lower, at 13 percent. Food prices have been rising as they were from 1972 to 1974 ... "(World Bank 1996, p. 3).

are high, because world grain prices so often rise under conditions of rapid macroeconomic growth, when employment and income levels in poor countries will move above trend. Also, world grain markets often move in parallel with other raw material and commodity export markets, which to many poor countries are still important sources of income growth and foreign exchange earnings.

Here we shall illustrate the impropriety of using world grain market conditions as indicators of food security conditions in poor countries, first by examining recent per capita cereal consumption trends during times of both high and low world market prices. We shall explain the failure of per capita consumption to react to world prices by showing the small (and shrinking) extent to which genuinely poor countries depend on world grain markets. We shall then go on to observe that neither the instability nor the unreliability of world grain markets has discouraged food insecure poor countries from depending on them more heavily. We then close by examining some more important non-market sources of transitory food insecurity in poor countries, including political malfunctions such as violent civil conflict, policy errors made by non-accountable governments, and natural disasters such as drought.

International Grain Market Conditions: Erroneous Indicators of Food Security

The impact of tightened world grain market conditions on food consumption trends among the world's poor is subject to empirical test. When world grain market conditions tighten, is below trend consumption the result in poor countries?

First consider the experience of poor countries during the "world food crisis" of 1973-74. Between 1971 and 1974 the real export price of U.S. wheat increased by 103 percent and the real export price of U.S. maize by 58 percent. (Johnson, 1991). World food reserves simultaneously declined from 71 days worth of annual grain consumption to just 33 days of annual grain consumption (Hopkins and Puchala 1978, page 7). Many analysts assumed under these tightened world market conditions only the rich would be able to sustain their accustomed consumption levels.[3] Did per capita consumption of grains in poor countries decline?

FAO estimates of 1971-74 per capita grain consumption levels country by country and region by region do not confirm any overall pattern of decline. Table 1 compares per capita food consumption of all cereals (wheat, maize, rice, and other coarse grains) for various developing countries and regions in 1971 versus 1974.[4] In some nations or regions per capita consumption

[3] As Mellor observed in 1981, "In high income countries, much of the adjustment to fluctuating supplies is made by changes in livestock numbers. Contrastingly, in low-income countries it is the low-income people who must adjust to fluctuating supplies." (John W. Mellor, Foreword to Valdes, ed., 1981, p. xv).

[4] This "cereals only" measure of food consumption actually provides an exaggerated measure of food intake decline in poor countries during periods of shortage, since non-cereal supplementary food sources will remain available in those countries in most cases.

Table 1. Per Capita Food Demand for All Cereals (wheat, maize, rice, other course grains), in kg./capita, by IMPACT Regions, 1971 and 1974

		1971	1974
Latin America			
	Mexico	167	168
	Brazil	96	102
	Argentina	131	127
	Colombia	76	81
	Other Latin America	108	107
Africa			
	Nigeria	64	61
	Central and West Sub Sahara Africa	66	65
	Southern Sub Sahara Africa	115	117
	Eastern Sub Sahara Africa	70	78
	Egypt	165	174
Asia			
	Other West Asia North Africa	155	167
	India	130	126
	Pakistan	115	125
	Other South Asia	96	99
	Indonesia	125	135
	Malaysia	157	160
	Philippines	114	119
	Myanmar	176	175
	Other South East Asia	161	168

Source: FAO data, complied into IMPACT regions by IFPRI.

declined slightly, but in most developing countries and regions per capita cereals consumption either remained steady or actually rose while the so-called “food crisis” was at its worst.

In Latin America, per capita cereals consumption did decline in Argentina from a high initial level, yet it increased a bit in Mexico, Brazil, and Colombia, and remained essentially unchanged elsewhere in the region. In Africa per capita cereals consumption declined a bit in Nigeria, but remained essentially unchanged in the rest of Central and West Africa, and also in Southern Africa, and increased markedly in East Africa, Egypt, and North Africa (here, from already high levels). In Southeast Asia, including Indonesia, Malaysia, and the Philippines, per capita consumption also increased during the so-called world food crisis. In South Asia, per capita cereals consumption did decline in India between 1971 and 1974, but at the same time it was increasing sharply in Pakistan, and it increased in the rest of the region as well. We thus find no generalized deterioration of grain

consumption circumstances in the developing world as world grain prices increased sharply between 1971 and 1974.[5]

A later increase in world cereals export prices in 1995-96 also failed to produce any noticeable decline in per capita consumption in developing countries. Between 1994/95 and 1995/96 U.S. wheat export prices increased from $157 per ton to $216 per ton, and world cereal stocks as a percent of world consumption fell from 17.8 percent to just 14.1 percent, generating talk of another world food crisis. Yet the imports of most developing countries were sustained and average per capita food use of cereals in developing countries overall continued to increase. Average annual per capita cereals food use in the developing world as a whole increased from 170 kg in 1994/95, to 171 kg in 1995/96, and then to 172 kg in 1996/97, despite much higher world grain prices.[6]

Food consumption circumstances in many poor countries were actually better in the mid 1970s (and mid 1990s) when grain export prices were high, than in the mid-1980s when grain export prices were low. Comparing the 1970s to the 1980s is revealing. Grain markets were generally tight during the decade of the 1970s, but food consumption circumstances in most poor countries were nonetheless improving in most cases. In Latin America between 1970 and 1980, the share of the population that was chronically malnourished dropped from 19 percent to 13 percent; in the Near East, the share of the population chronically undernourished fell from 22 percent to 12 percent; and in Sub-Saharan Africa, the share of the population that was malnourished remained relatively steady (at roughly one third), despite exceptionally rapid population growth in that region (USDA 1995, p. 46).

In contrast during the decade of the 1980s, when world grain markets were generally slack (export prices low and stocks abundant), food consumption circumstances in many poor countries worsened. In Africa overall the rate of dietary improvement fell by two thirds during the decade of the 1980s compared to the 1970s, and in Latin America by more than half.[7] This deterioration took place in Latin America despite slowing population growth in that region. FAO estimates that the number of chronically undernourished people in Latin America and the Caribbean grew from 46 million around 1980 to over 60 million by the early 1990s, reaching roughly 14 percent of the population (Alexandratos 1995).

---

[5] Adjustments were small in poor countries in part because they were so large in rich countries. In 1973-74, when grain prices rose, the feeding of grain to livestock declined in the United States by 37 million tons, or approximately 25 percent. Feed use of grains declined so much in exporting states in 1973-75 (Canada and Australia also cut feed use in response to high prices) that it was possible for the rest of the world to continue increasing the feeding of grain not only to people but also to animals, at the depths of this so-called world food crisis period. See Johnson, 1991. Reduced feed use of grains in wealthy exporting countries such as the United States did not result in food insecurity; it led to higher meat prices and reduced consumption of red meat, on balance a nutritional benefit.

[6] FAO, "Food Outlook," No. 2, Rome, April 1998.

[7] FAO 1991, p. 31.

The decade of the 1980s was marked by low grain prices on the world market, yet it was one of severe of food crisis within both Africa and Latin America. This was due to the onset of a world recession and high interest rates after 1980, which brought reduced income and export earnings, and unserviceable external debts. Macroeconomic performance plummeted. For Latin America and the Caribbean in the 1980s compared to the 1970s, real GDP growth rates fell from an annual average of 5.7 percent to just 1.2 percent. For Sub-Saharan Africa real GDP growth fell from a 1970s annual average of 3.4 percent to a 1980s annual average of just 1.8 percent (Grindle 1996, p. 20). Governments in Latin America and Africa responded to this macroeconomic crisis by cutting per capita expenditures for social services, including health care, adding a further burden to those suffering from malnutrition due to unemployment and slower income growth. Wage compression in the public sector plus lower government spending on electricity, water, and transportation also deepened the crisis for the poor.

Per capita grain consumption trends confirm that the decade of the 1980s was generally worse for the developing countries than the decade of the 1970s. Table 2 provides a comparison of growth rates in per capita cereal consumption in the 1970s versus the 1980s across a number of developing country regions. This table reveals that throughout Latin America (except in Argentina) per capita growth in cereals consumption was higher during the decade of the 1970s than during the 1980s. Table 2 reveals that the rate of growth of per capita cereals consumption slowed almost everywhere in Latin America in the 1980s, and turned negative in Brazil plus collectively in the numerous smaller Latin countries presented here as "other Latin America." Likewise in much of Africa, the rate of growth in per capita cereals consumption was slower during the decade of the 1980s than during the 1970s. In South Sub-Saharan Africa and in East Sub-Saharan Africa, consumption growth went from strongly positive during the 1970s (despite tight world markets and an alleged "food crisis" at the time) to strongly negative during the 1980s (despite glutted world grain markets). In Central and West Sub-Saharan Africa, the rate of growth in per capita cereal consumption was comparably low (from a low starting point) both in the 1970s and the 1980s, despite dramatically different world market conditions. Only in Nigeria do we find consumption growth significantly higher in the 1980s than in the 1970s. In Egypt, and also in West Asia and North Africa, per capita cereals consumption growth remained high -- from high starting levels -- during both decades, and was actually higher during the "food crisis" decade of the 1970s than during the "food glut" decade of the 1980s.

In South Asia, at last, we find a region where per capita cereal consumption growth was generally lower (in fact, negative) during the decade of the 1970s, compared to the 1980s. Yet even in this region, exceptions are noted. While India and Bangladesh both struggled during the decade of the 1970s then recovering during the decade of the 1980s, neighboring Pakistan was doing the reverse. The 1970s were also better then the 1980s for all of Southeast Asia (except for Myanmar), despite higher world market prices and lower stock levels.

This general worsening of food security circumstances in the 1980s was missed by those in the international policy community that were inferring food security from world grain market conditions. Slack market conditions tricked many into thinking that the "world food crisis" had

Table 2. Per Capita Food Demand for All Cereals (kg./capita), by IMPACT Regions, Average Annual Rate of Growth (%), 1971-1980 and 1981-1990

		1971-80	1981-90
Latin America			
	Mexico	.48	.37
	Brazil	1.45	-.35
	Argentina	-.91	.75
	Colombia	1.15	.56
	Other Latin America	.63	-.40
Africa			
	Nigeria	-.30	2.97
	Central and West Sub Sahara Africa	.31	.37
	Southern Sub Sahara Africa	1.06	-1.12
	Eastern Sub Sahara Africa	1.79	-1.02
	Egypt	4.10	2.90
Asia			
	Other West Asia North Africa	3.23	1.76
	India	-1.15	1.71
	Pakistan	7.84	-1.49
	Other South Asia	-.30	2.64
	Indonesia	3.05	2.58
	Malaysia	-1.06	-2.37
	Philippines	2.39	.86
	Myanmar	-1.79	.81
	Other South East Asia	2.85	2.18

Source: FAO data, complied into IMPACT regions by IFPRI.

ended, and partly as a consequence international assistance to agriculture in developing countries went into a damaging decline. Between 1980 and 1988, the real value of World Bank lending for agricultural and rural development declined by 20 percent (Lipton and Paarlberg 1990). Real public spending on farming in the developing world itself was also declining (at an annual average rate of *negative 15 percent* early in the 1980s), partly because of the severity of the crisis.[8] In Sub-Saharan Africa, publicly financed spending on agricultural research had been increasing in real dollar terms by 2.5 percent annually between 1971-81, but then grew at only an 0.8 percent annual rate in the 1980s. Agricultural research spending fell even more sharply in Latin America, from a positive 7.2 percent growth rate in the 1970s to a negative 1.1 percent rate in the 1980s (FASF 1997). These cut backs in investment and research in the 1980s, partly inspired by the false indicator of world grain market conditions, led indirectly to slower agricultural productivity growth in many developing countries in the 1990s.

[8] FAO 1984.

What explains the counter-intuitive disconnect between world grain market conditions and actual food security circumstances in poor countries? World market conditions are a bad indicator of food circumstances in poor countries first of all because the poor countries are not heavy users of world grain markets. The share of world grain imports taken by poor countries (those for whom food security is an issue) has always been small, and within genuinely poor countries the share of food consumption satisfied by imports is smaller still.

When world grain markets expanded in size dramatically in the 1970s, it became commonplace to attribute a significant part of this increased trade to the growing "food deficits" of potentially food-insecure poor countries. In fact, the share of world grain imports (including food aid) taken by genuinely poor developing countries has always been small and has scarcely changed over the past three decades. As shown in Table 3, poor developing countries took 21.6 percent of world grain imports in 1973, 22.9 percent of total imports in 1983, and 24 percent of total imports in 1993.

The "poor country" share of world grain imports shown in Table 3 could be made larger or smaller by adjusting the definition of what constitutes a poor country. Here we define the poor as all countries in Asia, Africa, or Latin America with a gross national income per capita of $1000 or less in constant 1987 U.S. dollars. This is a generous definition of poverty - and potential vulnerability to food insecurity - since it is well above the $750 threshold (GNP per capita) used in recent years by the World Bank to classify economies as "low income." Table 3 shows that in 1993 a total of 64 countries around the world could be classified as poor when using the $1000 per capita national income threshold, with a combined population that constituted 61.7 percent of the total world population. Under this definition of poverty, most of the world's largest developing countries (including China, India, Indonesia, Bangladesh, Nigeria, and Pakistan) are all still considered poor and are included in Table 3.

Table 3 also reveals that this has been a relatively stable category of countries over the years, containing a stable share of the world's population. Between 1973 and 1993, only nine countries "graduated" from this list into the ranks of the non-poor (Cameroon, Congo, Mauritius, Republic of Korea, Columbia, Ecuador, Paraguay, Syria, Tunisia, and Thailand), four were added to the list of the poor due to per capita income decline (Papua New Guinea, El Salvador, Peru, and Nicaragua), and two that had graduated between 1973 and 1983 (Cameroon and Congo) had by 1993 fallen back again. Overall, between 1973 and 1993 the total countries on this list fell only slightly, from 68 to 64, and the share of the world's population contained within these poor countries rose only slightly, from 58.7 percent to 61.7 percent.

The important conclusion to draw from Table 3 is that this large group of poor and still hungry countries may contain 60 percent of the world's population, but they take less than 25 percent of total world grain imports. The poor countries of Africa (38 in 1993) took only 4.6 percent of world grain imports (including food aid) in 1993. The poor countries of South Asia in 1993, containing 21 percent of the world's total population and still the largest total number of food insecure people, took only 2 percent of world's total grain imports.

Table 3. Poor Country[1] Population, Grain Imports[2], and World Shares By Region, 1973, 1983, 1993

Region	Year	Total Number Poor Countries	Population Millions	Share of World Population (%)	Grain Imports (1000 MT)	Share of World Grain Imports (%)
Sub-Sahara Africa	'93	38	582	9.3	10,392	4.6
	'83	36			7,064	3.2
	'73	39	265	6.9	3,652	2.3
South Asia	'93	6	1188	21.3	5,510	2.4
	'83	6			6,697	3.1
	'73	6	754	19.6	8,929	5.7
East Asia and Pacific	'93	7	1516	27.2	19,599	8.6
	'83	8			23,556	10.8
	'73	8	1097	28.6	16,141	10.2
Latin America and Caribbean	'93	9	71	1.3	4,593	2.0
	'83	7			1,415	1.0
	'73	9	58	1.5	1,290	1.0
Middle East and North Africa	'93	4	82	1.5	14,474	6.4
	'83	4			11,253	5.1
	'73	6	77	2.0	3,959	2.5
Poor Country Total	'93	64	3439	61.7	54,568	24.0
	'83	61			49,986	22.9
	'73	68	2251	58.7	33,977	21.6

[1] Poor countries defined as those with gross national income per capita of $1000 or less (constant 1987 U.S. dollars), as recorded in World Bank World Tables 1995, Johns Hopkins University Press.
[2] Imports of cereals (041-046).
Sources: FAO Trade Yearbooks 1995, 1985, 1975; FAO Production Yearbooks 1993, 1973.

Not only are the grain imports of poor countries relatively unimportant to the world market; imports from the world market also remain relatively unimportant to total grain availability within most poor countries. Table 4 shows that in 1993 all genuinely poor countries together (again, we consider poor countries to be those with gross national income per capita of $1000 or less) imported 54.6 million tons of grain from abroad, while at the same time producing 993.7 million tons of grain at home. If we take as a measure of import dependence tonnage of imports divided by the sum of domestic production plus imports, these poor countries together in 1993 depended on the world market for only 5.2 percent of their grain. This is actually down slightly from the grain import dependence of all poor countries two decades earlier in 1973, when the percentage of dependence recorded was 6.4 percent.

This scant dependence of most poor countries on world grain markets today is a surprise, given some of the expectations generated by food security researchers several decades ago. In 1977 IFPRI projected that by 1990 the poor developing countries would see their dependence on food imports grow dramatically as a share of total consumption. IFPRI projected a food import

dependence rate of 10-12 percent for India by 1990, 30-35 percent for Bangladesh, 14-17 percent for Indonesia, and 44-46 percent for the Sahel Group of countries in Africa (IFPRI 1977). Table 4 shows that for most poor countries today, grain import dependence remains well below 10 percent.

Table 4 also provides a breakout of grain import dependence among poor countries region by region for 1993 and for 1973. Notice that in 1993 poor countries in South Asia (and *all* the countries in this region were counted as poor in 1993 by the per capita gross national income standard being applied here) depended on world markets for only 2.0 percent of their total available grain. Poor countries in East Asia and the Pacific (this includes China and Indonesia) depended on the world market for only 3.8 percent of their total grain. For this important set of poor and still hungry Asian countries, containing roughly half of all the world's citizens, national dependence on grain imports is close to trivial.

In other regions, poor countries have come to depend a bit more on imports. Table 4 shows that the import dependence of poor countries in Sub Saharan Africa for grains - including food aid as well as commercial imports - was 13.6 percent in 1993, up slightly from 10.0 percent 20 years earlier. This does reflect some significant and growing dependence on world grain markets, but adjustments must be made in Africa to reflect the smaller share of the total diet provided there by basic grains (compared to root crops, for example). Higher levels of grain import dependence in Africa need not reflect higher levels of overall food import dependence; the World Bank has estimated that while more than 10 percent of Africa's total grain consumption may have been imported in 1988-92, only 6.5 percent of total calorie consumption in Africa came from these imported grains (Ingco, Mitchell, and McCalla 1996). So once again, import dependence is small.

Table 4, because it includes only countries that are genuinely poor, provides some useful corrective to conventional views regarding grain import dependence. When the World Bank calculates overall cereal import dependence for the "developing" countries of North Africa and the Middle East (see Ingco, Mitchell, and McCalla 1996, p. 16) it concludes that dependence is high and rising, yet the Bank has apparently included among the developing countries of this region a number of "middle income" countries like Syria, Tunisia, Algeria, Iran, Iraq, Libya, and Oman, and even Saudi Arabia, all of which today have gross national incomes per capita well above $1000 1987 U.S. dollars. The greater wealth of these nations should take them off the list of those vulnerable to food insecurity. Table 4 reveals that for the nations of the region that have remained genuinely poor, cereal import dependence has in fact declined since 1973, from 22.5 percent down to 8.3 percent (this, even though the genuinely poor nations from this region still include two large grain importers - Egypt and Morocco).

Another important discovery from Table 4 is that today's poor countries in Latin America and the Caribbean are significantly dependent (and increasingly so) on grain imports. In 1993 the poor countries in this region (Bolivia, Dominican Republic, El Salvador, Guatemala, Guyana, Haiti, Honduras, Nicaragua, and Peru) imported 4.6 million tons of grain, while producing only 8.0 million tons at home, giving them a collective import dependence ratio of 36.5 percent, up from 17.6 percent for poor countries in this region in 1973. Peru, Haiti, and the Dominican Republic had exceptionally high individual import dependence ratios in 1993 of 49 percent, 51 percent, and 64 percent, respectively. Those seeking ways to cushion poor countries from international grain market fluctuations should perhaps be paying more attention to the poor countries of this region. The poor

countries in this region are small (together they contain only 1.3 percent of the world's citizens), and easily overlooked by grain trade analysts because together they take only 2 percent of world grain imports. Yet they are unique among poor countries in their high dependence on imports, and would seem to deserve special food security consideration. The fact that these poor countries are all proximate to the United States and traditionally dependent upon close and sometimes nearly exclusive trade relations with the United States suggests that U.S. scholars and officials should take the lead in providing such consideration.

Table 4. Poor Country[1] Grain Import[2] Dependence[3] By Region, 1973, 1993

Region	Total Production Cereal (1000 MT)		Total Cereal Imports (1000 MT)		Import Dependence	
	1973	1993	1973	1993	1973	1993
Sub-Sahara Africa	32,957	66,151	3,652	10,392	10.0%	13.6%
South Asia	154,583	267,493	8,929	5,510	5.5%	2.0%
East Asia and Pacific	288,063	493,374	16,141	19,599	5.3%	3.8%
Latin America and Caribbean	6,082	7,986	1,296	4,593	17.6%	36.5%
Middle East and North Africa	13,916	158,709	3,959	14,474	22.5%	8.3%
All Poor Country	495,601	993,713	33,977	54,566	6.4%	5.2%

[1] Poor countries defined as those with gross national income per capita of $1000 or less (constant 1987 U.S. dollars).
[2] Imports of cereals (041-046).
[3] Dependence measured as cereals imports divided by domestic production plus imports..
Sources: FAO Trade Yearbooks 1995, 1985, 1975; FAO Production Yearbooks 1993, 1973.

For the vast majority of poor countries, however, international grain market conditions are not the logical starting point for understanding local cycles of food security or insecurity. Poor countries vulnerable to cycles of food insecurity depend so little on world grain markets that it is erroneous to use conditions in those markets as indicators of the circumstances of the poor. Yet an objection might be raised at this point. Perhaps the disconnection we have noted between world grain markets and food insecure citizens in most genuinely poor countries (albeit not those of Central America and the Caribbean) is attributable not to independent causes, but to the instability or unreliability of the world grain market itself. If so, conditions in the world grain market could re-emerge as a legitimate analytic starting point for scholars and practitioners looking at poor country food security problems. Are poor countries deciding not to depend on world grain markets because those markets are undependable?

Explaining Disconnections between World Grain Markets and the Food Insecure

Perhaps some poor countries containing food insecure people have chosen not to depend on grain imports because they fear price instabilities in the world market, or the unstable foreign exchange burdens of trying to sustain imports when currencies are devalued or world market prices rise. Perhaps others have chosen not to depend on grain imports because of their fear access to those markets could suddenly be denied by powerful exporting countries (such as the United States) for a

variety of domestic political or diplomatic reasons. If today's minimal dependence on grain imports by so many poor countries does grow out of such fears, if there is something problematic about the world grain market that has discouraged greater use of that market by the poor, then world grain market characteristics might re-emerge as a legitimate analytic starting point for food security scholars. We now turn to consider these possibilities, looking first at the issue of world market instability and second at the issue of unreliability.

Scholars have long noticed a "bias against trade" in the agricultural policies of both rich and poor countries (Lindert 1991). For most rich countries, the principal source of this bias is not an anxiety about unstable and insecure world markets, or any other food security linked concern; it is political organization and successful rent-seeking behavior by domestic producer groups (Anderson and Hayami 1986). By embracing policies to protect such groups, rich countries (especially the countries of the EU, and Japan) have distorted and at times destabilized world grain markets. Do these distortions and instabilities produce, in turn, a reactive "bias against trade" on the part of the poor? Since the net impact of rich country policies has been to lower the average real price of grain on world markets, we might just as well expect the grain policies of the rich countries to have produced a bias *toward* trade among the poor, and specifically a bias toward larger imports of grain. Yet even in the face of this inducement the policies of many poor countries have remained biased against grain imports. Policies designed explicitly to promote "self sufficiency" in grains are not uncommon.

Perhaps price stability rather than price level is the concern. The policies of some rich countries, while lowering the average price of internationally traded grains, tend at the same time to destabilize that price. This is especially true for the EU, which worsens downward price movements in the world market by increasing its own export subsidies when world prices fall, and worsens upward price movements by imposing taxes on its own exports when world prices rise (a price destabilizing effect noted both during the world food crisis of the mid 1970s, and then again when world prices rose in 1995-96). Perhaps such policies present poor food insecure countries that would dare to rely more heavily on grain imports with unacceptable short term foreign exchange costs or risks.

The foreign exchange costs associated with importing grain are not a convincing explanation for the persistent import aversion of so many developing countries, since these costs are generally quite small and in many cases are getting smaller. Between 1970 and 1991 the cost of food imports as a share of total import costs fell from 16 percent down to 6 percent in South and Southeast Asia; from 11 percent down to 10 percent in Latin America, and from 14 percent down to 12 percent in Western Asia. Only in Africa did the food import share of costs increase slightly, from 14 percent up to 15 percent (FAO 1996, Technical Document 12, page 9). Given such small and generally declining cost burdens associated with importing food, and given the significant unmet food needs in so many of the poor countries in question, we might expect them to be making greater use of world grain markets than they are.

A reason more often given for avoiding greater dependence on grain imports from the world market is not total foreign exchange cost, but rather the instability and unpredictability of those costs, given the reputed instability of world grain prices. Yet this as well emerges as a dubious rationale for import aversion. Consider the developing countries of Asia, where most of the world's

malnourished people still live, yet where total costs of cereal imports in 1988-92 were equal to just 3.5 percent of the region's total export revenues (Ingco, Mitchell, and McCalla 1996, p. 16). Such a tiny share of export earnings spent on imported grain means that import cost burdens would still be tiny even if world grain prices temporarily doubled. The import cost share would increase from 3.5 percent to 7 percent, if export earnings remained unchanged. Moreover, evidence suggests that export earnings would probably not remain unchanged; they would rise as well. This is because such a large share of the export earnings of poor countries are still derived today from raw material and commodity production, and export prices in these markets tend to move in parallel with world cereals markets. Historically, this positive covariance has been an important source of food import security for poor countries.

Goreaux has shown that for 46 developing countries (from all regions) over the years 1963-75 the value of export earnings and costs of cereal imports tended to be positively correlated. During this observation period the costs of cereal imports for these countries "were more often than not offset by excesses in export earnings..." (Goreaux 1981, p. 311). D. Gale Johnson found this same covariance during the 1973-75 food crisis years. For 31 developing countries (countries with populations in excess of 7 million), the annual average value of the excess of agricultural exports over agricultural imports *increased* between 1969-71 and 1973-75 by $4.3 billion, generating an agricultural trade surplus for these countries of $11.6 billion during the so-called "crisis" period (Johnson 1991, p. 176).

To the extent that some of today's poor countries are no longer such large net exporters of agricultural commodities (the nations of Sub Saharan Africa stand out in this regard) this historical buffering mechanism may recently have been weakened, yet world markets are hardly to blame for this weakening. Africa has seen its agricultural exports dwindle not because of import protection by rich countries, but because of taxes it has imposed on its own export producers. Between 1962-64 and 1991-93, Sub-Saharan Africa's share of various agricultural commodity exports (such as vegetable oils, palm oil, palm nuts and kernels, and groundnuts) dropped 47-80 percentage points below earlier levels, and Sub-Saharan Africa's share of global exports of all products fell from 3.1 percent in 1955 to just 1.2 percent by 1990, implying annual trade losses of roughly $65 billion. Yet the World Bank has determined that this disappointing export performance by Africa is not explainable through reference to OECD country policies, since African exporters tend to face average tariffs below those of other exporters; since nontariff protection against African exports is generally less restrictive than that facing other developing countries; and since the overall external environment for exports facing Africa today (tariff and nontariff) is more favorable than that which the East Asian economies previously faced, and overcame (Yeats 1997). Africa's damaging marginalization in world trade has accurately been described by Jeffrey Sachs as a "self-imposed economic exile" (Sachs 1996). As policies in other nations and regions continue to move toward greater trade liberalization, particularly with the implementation of the Uruguay Round, the continent of Africa, which undertook much less liberalization in the Round, will of its own volition see its shares of world exports and imports shrink even more (Hertel, Masters, and Elbehri 1997).

In any case, most of the variability in food import costs for poor countries has not, historically, come from fluctuations in world market prices. Valdes and Konandreas demonstrated that for a sample of developing countries over the period 1961-76, three quarters of all food import cost variability came from fluctuations in import volume, not price (Valdes and Konandreas, in

Valdes, ed., p. 36). Fluctuations in import volume, in turn, are most often an indicator of fluctuations in domestic production. It isn't the world market that has most destabilized the food import costs for poor countries, but instead unstable domestic grain production within those countries. For most such countries, a policy of relying more on grain imports and less on domestic production would have been, at the margin, a stabilizer rather than a destabilizer both of internal grain consumption and foreign exchange outlays for grain.

To illustrate consider the case of India, mentioned above as one country in which per capita consumption of cereals did decline during the 1973-74 period of much higher world grain prices. The principal cause of this damaging internal consumption decline was not India's exposure to world price instabilities, since India was at that time pursuing a policy of depending as little as possible on world grain markets. India had terminated all grain imports (commercial as well as food aid) late in 1971, even though world market prices were still low, and in 1972 India actually emerged as a small net exporter of one half million tons of wheat (Chopra 1981, p. 292). This self-sufficiency policy malfunctioned when an autumn drought in 1972 reduced that year's grain harvest 7 million tons below the 1971 level. The Government of India did not wish to abandon self-sufficiency, so it did not arrange any imports until after it had dumped almost all of its own domestic foodgrain stocks, by which time a rapid rise in domestic prices was underway. When the government did finally decide to import late in 1972, it then did so with far too much caution, placing orders for only 1.5 million tons of wheat, despite a foreign exchange position described at the time as "satisfactory...to finance such imports as may be considered necessary".[9] Internal prices rose and per capita consumption fell.

India later increased its volume of wheat imports substantially, to 3.6 million tons in 1973 and 4.7 million tons in 1974, despite the rise in world market prices by then underway. India thus increased rather than cut back its imports as world market conditions tightened, belatedly but successfully using the international market - even at the depths of a so-called world food crisis - to make up for some of its domestic shortfall. If it had been willing to turn to the world market sooner it could have made up the domestic shortfall in a more timely fashion, at a lower foreign exchange cost. What blocked this policy opportunity was not any malfunction of world grain markets, but instead India's own independent policy of not wishing to use of those markets.

The supposed foreign exchange risks associated with importing grain have in any case been reduced in recent years by improved trade information reporting systems that minimize surprises (for example, surprises such as the large and secretive Russian grain purchases in 1972 which panicked the world market), better developed futures markets which facilitate hedging against risk, and now liberal policy reforms in major exporting countries which can further stabilize world prices - including tariffication of import barriers under the Uruguay Round Agreement on Agriculture, and termination of annual acreage reduction programs (ARPs) by the United States under the 1996 farm bill. It is indicative of the small and diminishing risks now associated with cereals imports that the Compensatory and Contingency Financing Facility (CCFF) of the IMF, which makes available medium-term credit for cereal imports (credits which are additional to resources available under other

[9] *Economist Intelligence Unit*, Quarterly Economic Review, India (fourth quarter) 1972, p. 4.

IMF arrangements) has been little used since the inception of its cereal element in the early 1980s. This may partly reflect the relatively short repayment period for borrowed funds (at a market related interest rate), but it also reflects a diminished frequency and magnitude of international cereal price shocks. (FAO 1996, Document 12, p. 36).

If world price instability is not a convincing explanation for the low reliance of so many food insecure poor countries on the world grain market, we might next consider risks associated with unreliable export suppliers. Two possible kinds of trade suspensions by exporters might discourage some poor countries from depending more heavily on world grain markets: grain trade suspensions triggered by short supplies in exporting countries, and those designed specifically as political sanctions, to coerce or punish importers.

An example of a short-supply export suspension (though a non-grain example) would be the 1973 U.S. "soybean embargo." This was a suspension of all U.S. soybean exports for approximately one month beginning in late July 1973, at a time of food price inflation both in the U.S. and on the world market, due largely to macroeconomic policy mismanagement. U.S. soybean prices went from $3.32 a bushel in June 1972 to a peak of $12.90 a bushel in June 1973. In response to anxieties among domestic consumers, the U.S. government responded with a brief suspension of soybean exports, one which shocked the Japanese (then dependent on imports for 97 percent of soybean consumption, and 92 percent dependent on soybean imports specifically from the United States). This 1973 soybean embargo episode later came to be invoked by agricultural protectionists in Japan as a reason to reduce dependence on food imports (George and Saxon 1986).

The 1973 soybean embargo, though it continues to be cited by some Japanese as a reason to mistrust world food markets, was never a factor in Japan's food security, or in the food security of any other country. It lasted for only a little more than one month (from July 27 to August 1), and upon lifting the embargo the U.S. Commerce Department immediately said it would license exports of up to 100 percent of the embargoed soybeans earlier contracted for sale, so back orders were promptly filled. U.S. soybean exports from the 1973 crop in the end exceeded exports from the 1972 crop. The one policy lesson Japan rightly learned from the soybean embargo was to avoid such heavy dependence upon any one supplier, and imports were subsequently diversified to Brazil and Argentina. But Japan's overall dependence on food imports (which was and remains greater than that of any other large industrial country) was not significantly altered by the soybean embargo experience. In the decades since the embargo, Japan has moved steadily away from its traditional posture of imposing quantitative restrictions on a wide range of farm products, and has even abandoned its formal ban on imports of rice. Japan learned the value of permitting rice imports when, due to bad weather, its own domestic production declined by 26 percent in 1993/94 (down from 13.2 million tons in 1992/93 to just 9.8 million tons in 1993/94). In response Japan arranged 2.4 million tons of rice imports in 1994. These rice imports both preceded and exceeded the rice import liberalization requirements Japan undertook under the final 1994 Uruguay Agreement on Agriculture.

Short supply export embargoes are still legal in the United States, but they are much less likely today than they were in 1973, not only because that was an era of food price inflation now for the moment passed, but also because of the angry political reaction to the embargo by agricultural interests inside the U.S. To protect U.S. farmers in the future against short supply embargoes, farm state representatives in Congress in 1977 inserted a Section 1002 into that year's U.S. farm bill, which

obliged the Department of Agriculture to compensate U.S. producers at a prohibitive level (90 percent of parity) in the event of any future embargo based on short domestic supplies. The purpose of this "embargo insurance" provision was to make future short supply embargoes unaffordable for the U.S. government, and hence unthinkable. Similar provisions have been retained in U.S. farm law ever since, at the insistence of vigilant U.S. domestic producer and exporter interests. In 1996, when rising grain prices and falling grain stocks in the U.S. gave rise momentarily to new talk of a U.S. short supply embargo, the President of the U.S. National Association of Wheat Growers (NAWG) said that he was willing to believe official assurances that an embargo was not to be feared, because the presence of this embargo insurance clause in U.S. farm law would make any embargo much too costly in budgetary terms.

Grain export suspensions designed to sanction importers for international political reasons are a slightly different matter. The leading historical example is the 1980-81 partial embargo on U.S. sales to the Soviet Union, to punish the Soviet Union for its invasion of Afghanistan. When President Carter imposed this embargo he invoked reasons of foreign policy and national security under the 1979 Export Administration Act, thus neatly avoiding Congressional embargo insurance provisions which at that time only covered export suspensions linked to short domestic supplies. Over a period of 16 months the U.S. government allowed only 8 million tons of wheat and corn a year to be sold to the Soviet Union (this was the quantity of grain the U.S. had promised earlier it would make available in a 1975 bilateral agreement). In the aftermath of this 1980-81 grain embargo, Indira Gandhi, the former Prime Minister of India, warned in a speech to FAO that grain exports had now become a U.S. diplomatic weapon, and she urged other developing countries to follow India's lead and "do their utmost to attain self-sufficiency within the shortest possible time."[10]

Fear of grain export suspensions linked to international politics (rather than to grain market conditions) might seem a more legitimate reason for some food insecure countries to shun a dependence on imports. The foreign policies of the United States, in recent years, have if anything become more rather than less dependent on use of economic sanctions. The Clinton Administration alone, over the brief period 1993-1998, imposed sanctions 61 times. By one count 73 countries, which are home to two thirds of the world's population, have recently been subject to some kind of economic sanction from the U.S., either to discourage weapons proliferation, bolster human rights, deter terrorism, thwart drug trafficking, discourage armed aggression, promote market access, or protect the environment (Haas 1998).

In the immediate aftermath of the 1980-81 U.S. grain embargo, some developing countries did strengthen their grain self-sufficiency policies at least in part as foreign policy protection against U.S. "food power." The leaders in this movement at the time were a number of states newly rich with oil export revenues, including Mexico, Saudi Arabia, Nigeria, and to some extent Indonesia. Diplomatic concerns had earlier helped motivate the Government of India to embrace its own more determined foodgrain self-sufficiency policies, following a 1965-67 manipulation by the U.S. of PL 480 food aid wheat exports to that country, when President Lyndon Johnson briefly conditioned those

[10] Prime Minister Indira Gandhi, speech presented to Food and Agriculture Organization of the United Nations, Rome, 9 November 1981, pp. 7-8.

food aid exports on changes in India's domestic agricultural policies, its exchange rate policies, and even its policies toward the U.S. war in Vietnam (Bjorkman 1975). Likewise in China, foodgrain self-sufficiency policies have always had a national security dimension.[11]

Such developing country fears of losing access to grain imports for diplomatic reasons are largely unjustified. The results of the 1980-81 grain embargo itself demonstrate how hard it is for exporters to deny grain supply access to cash-paying importers. Because the U.S. tried but failed to prevent other suppliers from selling to the Soviet Union during this embargo, the Soviets were actually able to import more grain in the first calendar year of the embargo (28.7 million tons in 1980) than they had imported in calendar year before the embargo (25 million tons in 1979). The U.S. sought cooperation from other grain exporting nations in 1980, and received some for a time from close and dependent foreign policy allies such as Canada and Australia, but Argentina never agreed to cooperate, and by shifting the direction of its normal trade away from traditional customers it was able to increase its rate of grain exports to the Soviet Union tenfold during the embargo. It did so to capture the premiums Soviet purchasing agents had begun offering for non-U.S. grain.

The Soviet Union was importing grain in 1980 primarily as animal feed to boost meat production, rather than for direct human consumption, so basic food security was never at issue. Yet the Soviets were even able to import enough grain during the embargo to avoid serious damage to domestic livestock herds. In November 1980, nearly a year into the embargo, Soviet inventories of cattle, hogs, and poultry all stood above the pre-embargo level. These expanded inventories were then maintained throughout 1981, despite four more months of the embargo and, more remarkably, despite a third bad domestic grain harvest (Paarlberg 1985, p. 202).

Much like the earlier short supply soybean embargo, the foreign policy motivated grain embargo generated a powerful backlash from domestic U.S. farm interests. President Jimmy Carter was the first to feel this backlash, as he was punished with a loss of farm state support in the 1980 presidential election and replaced by Ronald Reagan, who had courted farmers in that election with a pledge to lift the embargo. U.S. Presidents have avoided selective grain embargoes against foreign countries ever since, and President Reagan carried out his promise in 1981 to lift the embargo against the Soviet Union, despite his own hard line views toward the "evil empire," and despite foreign policy objections from his Secretary of State, his Secretary of Defense, his National Security Advisor, his Ambassador to the United Nations, and even his U.S. Trade Representative. When a new round of sanctions was imposed on the Soviet Union in 1982-83 after an imposition of martial law in Poland, commercial U.S. grain sales were excluded from the sanctions package from the start, and they have been excluded from every U.S. sanctions episode since.

---

[11] Reflecting the national security significance attributed to grain issues in China, the total size of the State Grain Reserve remains a military secret. Yet one recent private estimate puts the size of this state reserve at just 15 million tons, far less than the estimated 400 million tons plus of cereals stocks recently held on the farm by Chinese peasant households, for personal food security and as a hedge against inflation. See"China Agriculture Newsletter," published by Clear Thinking (HK) Ltd., vol. 2, issue 6, June 1997, p. 5.

Congressional actions have reinforced this exclusion of commercial farm sales from new U.S. sanctions policies. Following the 1980-81 embargo, Congress inserted Section 1204 into the Agriculture and Food Act of 1981, extending the embargo insurance concept to foreign policy and national security cases by requiring that U.S. producers be compensated at an unacceptably high rate (at 100 percent of parity) in the event of any future export suspension which singled out farm products. This provision has been retained in U.S. farm law ever since 1981, and was renewed for 1996-2002 in the FAIR Act of 1996.

In some exceptional cases the U.S. still does impose commercial food export suspensions, as an accompaniment to more comprehensive diplomatic sanctions. Cuba, Iran, Libya, North Korea, and Sudan have recently been targeted by the U.S. in this manner.[12] Seldom, however, do these more comprehensive U.S. sanctions policies block other exporters from supplying the target states in question. In the case of comprehensive U.S. sanctions against Iraq during and after the 1990-91 Persian Gulf War, strict U.S. bilateral sanctions were initiated by executive order which prohibited the export of any U.S. goods (including farm goods) to Iraq, but when the U.S. sponsored a multilateral version of this export embargo within the United Nations, it agreed to exempt both food and medicine and it even permitted Iraqi oil sales of $1 billion every 90 days to pay for the cost of such humanitarian imports (Melby 1998).

Even in some of its bilateral sanctions practices, the U.S. frequently exempts food and farm products. The 1998 sanctions to punish India and Pakistan for conducting nuclear tests are a case in point. Commercial grain sales were not touched by these Congressionally mandated sanctions, nor were PL 480 food aid shipments. Legal experts in the U.S. Department of Justice did conclude that taxpayer funded General Sales Manager (GSM) export credit guarantee programs would have to be terminated under the law (the Glenn provision of the Arms Export Control Act), but farm state interests objected and persuaded the Clinton Administration's National Security Council to support an exemption for GSM programs as well, under the guise that a "humanitarian" issue was at stake. Secretary of Agriculture Dan Glickman conspicuously pledged that the Administration would "resist any action that would lead to a de facto grain embargo."[13] An amendment exempting USDA export credit guarantees from the Arms Export Control Act (AECA) was hastily passed and signed by President Clinton in July 1998, just in time for U.S. exporters to bid on a 365,000 metric ton wheat tender from that country.[14]

---

[12] U.S. wheat producers object to these sanctions policies, arguing that they cost $1 billion a year in lost export sales, but the ITC has recently found that these sanctions policies cost little in the way of lost sales, because the countries targeted were mostly small economies not heavily engaged in imports of farm products. *Inside U.S. Trade*, September 11, 1998, p. 17.

[13] "White House Endorses Bills to Exempt Farm Credits from Sanctions," *Inside U.S. Trade,* Vol 16, no. 24, June 19, 1998, p. 3.

[14] *Inside U.S. Trade,* July 17, 1998, p. 9.

A powerful domestic constituency had generated this policy outcome: U.S. growers of soft white wheat from the Pacific Northwest. Pakistan had recently emerged as the largest foreign buyer of U.S. white wheat (taking as much as one third of the entire Pacific Northwest crop), and U.S. commercial sales to that country would have slipped if Pakistan lost its access to GSM-102 credit guarantees. The leaders in the Congressional effort to exempt GSM programs from the sanctions included House Agriculture Committee Chair Bob Smith (R-Ore.), a special friend of export-oriented Pacific Northwest U.S. wheat interests, and Senate Agriculture Committee Chair Richard Lugar (R-Ind.), long a critic of any sanctions policy that might harm U.S. agricultural interests.

China is another case in point. Following China's violence against pro-democracy demonstrators in June 1989, the U.S. government imposed broad economic sanctions on China, but again exempted commercial exports of U.S. farm products. Not only did the U.S. continue farm exports on commercial terms, it also continued to subsidize farm exports to China under the Export Enhancement Program (EEP). Early in 1994 the USDA offered China a record-high $65 per ton EEP export subsidy as an inducement to purchase U.S. wheat, despite a diplomatic conflict at the time over China's decision to arrest of pro-democracy dissidents on the eve of a visit to Beijing by U.S. Secretary of State Warren Christopher.

If international grain markets favor anyone in diplomatic terms, they tend to favor importers rather than exporters. This is not only because long term price trends in grain markets continue to be downward[15]; it is also because of the strong political organization of grain interests in most exporting countries, which generate a political imperative to sustain and enlarge commercial grain exports. Recent grain trade relations between the U.S. and China again illustrate the point. China has gained rather than lost political leverage over the U.S. by virtue of its periodic emergence as a large market for U.S. grain exports. China's importance as a potential market for U.S. farm products is consistently mentioned as a reason to extend MFN status to China. Grain export interests in the U.S. Congress tend to support cooperative commercial relations with China whether grain markets are slack or not, and whether China's imports have been dependable or not. In 1983-84, China was not punished when it failed to make the annual minimum purchases of U.S. grains that it had earlier agreed to make under the terms of a formal U.S.-PRC bilateral grain trade agreement; instead it was rewarded, by pressures from U.S. wheat producer interests on the U.S. Commerce Department to relax restrictions on imports of Chinese textile and apparel products.

This same pattern re-emerged in 1995-96, at a time when grain markets were tight rather than slack. Despite a sharp increase in grain export prices and despite a simultaneous increase in China's grain import needs, the reliability of the U.S. as a supplier of grains to China was never in question. China, by contrast, gained bilateral leverage by posing as an unreliable customer. An important test came May 1996, at the time of a sharp U.S.-Chinese dispute over intellectual property rights. The U.S. never threatened during this dispute to interrupt exports of grain, but China did threaten to interrupt imports, warning that it would retaliate against any U.S. economic sanctions with 100

[15] The short term trend is downward as well. With the 1995-96 price spike behind us, USDA now expects grain prices for 1998/99 to return to the much lower levels of the early 1990s. See USDA, *Agricultural Outlook*, June-July 1998, p. 2.

percent tariffs on selected imports from the U.S. led by "agricultural and animal husbandry products." Earlier in the year China had ignored a personal plea from Agriculture Secretary Dan Glickman to lift its ban on imports of U.S. wheat suspected of being contaminated with TCK fungus, and later in the year it felt free to cancel some U.S. wheat purchases outright, as it became clear that China's own summer grain harvest was about to set a record.

So even in a tight world market, food importers can exercise bilateral bargaining leverage over exporters, rather than the other way around. Food insecure nations should have little reason to limit grain imports due to worries about the structure, condition, stability, or reliability of international grain markets. Other explanations for their grain import aversion must be sought, on a region by region or country by country basis.

The existing literature suggests that a number of other explanations can be found. In Africa, governments have not been notably hostile to grain imports as such, but they have embraced economic policies that have generated such little dynamic income growth as to stunt effective demand for imports, while cutting their own foreign exchange earnings by overtaxing producers of exportable cash crops and raw materials. Their marginal position in international grain markets is consequently just a reflection of their marginal position in most other international markets. It is part of what Sachs has called their "self imposed exile" from open international trade. For India, Srinivasan (1994, p. 156) found that import-averse agricultural trade policies were also much more than a sector-specific phenomenon. They were part of India's larger post-independence desire to gain separation from all private world markets, which Congress Party leaders viewed at the time as a "whirlpool of economic imperialism." Ironically, India's subsequent industrial development planning efforts so neglected agriculture as to lead, by the mid 1960s, to an interlude of deep dependence on U.S. food aid. This dependence had to be corrected through larger public agricultural investments and improved incentives policies for farmers, plus green revolution seed varieties. India's food self-sufficiency policies today reflect in part a continuation of the original aversion to all kinds of private international trade, plus now as well an organized effort by rent-seeking commercial grain interests to hold onto the subsidies and incentives policies earlier extended to them by the state, in the name of "self sufficiency."

China's grain policies grow out of a larger state aversion to markets, more than out of any misgivings specific to the world food market. China since 1949 has mistrusted private grain markets at home almost as much as abroad. China regulates domestic grain trade tightly with a variety of goals in mind: provisioning the army, accumulating capital and foreign exchange for the development of urban industry, and procuring cheap food to lower and stabilize retail prices for workers in politically volatile urban areas. This tight state regulation of the grain sector malfunctioned badly during the 1959-60 Great Leap Forward, producing a massive state-created internal famine. China's current rhetorical stress on "grain self-sufficiency" is as much a reaction to this past history of self-inflicted famine during the Maoist period as it is a comment on the reliability of international markets.

Today it is not the world grain market that threatens to destabilize grain markets in China; it is instead China's erratic and unpredictable state-managed grain trade policies that threaten to destabilize the world market. Despite official rhetoric embracing "self sufficiency" in grains, China has a long history of denying adequate price incentives to grain farmers, while simultaneously

importing and exporting grains.[16] China can switch suddenly from a substantial net exporting posture to large net imports. In China's pursuit of self-sufficiency the ratio of average net imports to total domestic production has gone down since the 1980s (Chen and Pan 1997), yet China's swings in net trade have remained quite large. Between 1993 and 1995 China briefly unnerved world markets by switching from being a net exporter of 7.5 million tons of grain to being a net importer of 15.5 million tons, a total turnaround of 23 million tons, or about 10 percent of global grain trade (Crook and Colby 1996). Part of this large turnaround in net trade can be explained by an 11 million ton domestic production shortfall in 1994, but swings in China's net trade are often much larger than swings in its domestic production, in part because trade decisions are made by slow-moving market-insulated state bureaucracies. In 1994 China's state grain trade companies continued to export corn (nearly 9 million tons total) even though, due to a poor domestic crop, the average domestic price for corn was already above the world market price. Then in 1995, in a panic over domestic food price inflation (brought on largely by undisciplined monetary policies) China's trading companies turned around and imported too much grain (Ke 1997). These excessive imports in 1995 then led, by 1996, to a disruptive pattern of sudden import cancellations.

If some poor countries are averse to using world grain markets more efficiently, then, it is not necessarily because of bad experiences they have had with those markets. It is usually, instead, because of a larger policy aversion the governments in these countries have toward all markets, both grain and non-grain, both domestic and foreign. The transitory food insecurity of these countries does not usually reflect any malfunction of international food markets, or even a malfunction of domestic food and farm markets within these countries. When poor countries experience transitory food insecurity today, it is usually a severe malfunction of internal political institutions that is to blame.

Non-Market Sources of Food Insecurity

The most important sources of transitory food insecurity in the developing world today are natural disasters (such as prolonged droughts), non-accountable political systems hostile to the operation of markets (such as the regime in North Korea), and violent internal civil conflict. Conventional work on food security persists in underemphasizing these factors, partly because of the influence of Amartya Sen's early work on famine, which directly challenged the importance of drought-induced food availability declines in particular. Sen stigmatized this as a simple-minded "FAD" (food availability decline) approach to a problem he said stemmed from poverty plus adverse relative price shifts within a market system.[17] Sen influential 1981 book on poverty and famine did

[16] Particularly during the period 1966-76 China exported rice and imported wheat, to take advantage of rice prices in the world market nearly twice as high as wheat prices. This strategy allowed China to balance its international grain trade in terms of value, while maximizing domestic calorie availability through an annual average 2.2 million tons of net grain imports.

[17] As Sen noted, "A sharp change in the relative prices of sandals, or haircuts, or labor power (i.e., wages) vis-a-vis food can make the food entitlements of the respective group fall below the starvation level" See Sen 1981, p. 155.

not address at all the issue of non-accountable government or the threat of violent internal conflict.[18] Instead he implicitly assumed internal peace, then hoped benign governments would ensure food security by providing the poor with minimum wage employment guarantees and comprehensive social security systems (Sen 1981, p.7).

Agricultural economists also tend to ignore the non-market sources of food insecurity. They sometimes put forward a variant of Sen's argument, agreeing with him on the importance of poverty but then proposing improved agricultural development policies rather than wage or income insurance policies as the most likely escape from poverty-induced food insecurity. Only at the end of the analysis do some acknowledge the importance of non-economic factors such as violent conflict (Tweeten, et al. 1992). In some cases the importance of such non-economic factors is acknowledged at the beginning, but then avoided at the end (Von Braun, et. al. 1992).

Improved agricultural development policies are indeed essential in most cases to the elimination of poverty, but transitory food insecurity is not caused by poverty alone. It is a transitory phenomenon with transitory causes most often rooted in the malfunction of political institutions, natural disasters, or both. In an absence of drought or violent conflict, even a poor nation's citizens can be food secure, and experience shows that food security can even be provided under conditions of drought or natural disaster, if accountable government is present and violent conflict is absent.

Consider the country-by-country patterns of transitory food insecurity tracked recently by the Office of Foreign Disaster Assistance (OFDA) at USAID, the agency which coordinates humanitarian responses to manmade and natural disasters outside the United States. In 1996, OFDA was monitoring what it calls "complex humanitarian emergencies" underway in 23 different countries, affecting a total of 34 million people. In 19 of these 23 country cases (all but Armenia, Cambodia, Sri Lanka, and Tajikistan) "food insecurity" was a conspicuous part of the emergency. In 17 of these 19 food insecurity cases (all but North Korea and Eritrea) a "civil conflict" was underway.[19]

The United Nations Food and Agriculture Organization also tracks countries facing exceptional food emergencies. In 1996 FAO listed 14 countries in Sub-Saharan Africa alone (involving 22 million people) as falling into this category. In 10 of these 14 countries the reasons given for the emergency included either civil strife or population displacements linked to civil strife, and in 2 of the remaining 4 countries (Eritrea and Ethiopia) citizens had been made vulnerable to the

---

[18] The cases of famine used by Sen to draw this conclusion appear, from today's perspective, to be highly selective. Sen's cases were the Bengal in 1943, Ethiopia in 1972-74, the African Sahel in 1972-74, and Bangladesh in 1974. Even at the time these cases were far from typical; they were among the very few which did not feature either a violent internal conflict or a Marxist/Leninist regime.

[19] These seventeen cases in 1996 were Afghanistan, Angola, Azerbaijan, Boznia-Herzegovina, Burundi, Chechnya, Ethiopia, Georgia, Haiti, Iraq, Liberia, Mozambique, Rwanda, Sierra Leone, Somalia, Sudan, and Zaire (Natsios 1997, Table 1, p. 8).

1996 food emergency due to earlier episodes of violence. For the 2 cases in which violence and population displacement were not mentioned, “drought-reduced harvest” was given as the cause of the emergency. In none of these cases did the FAO find that poverty alone, or bad development policies alone, or the malfunction of food markets (internal or international), had caused the transitory emergency (FAO 1996).

Private evaluations done by NGOs tend to reinforce the conclusion that violent conflict is in fact the world's greatest food security threat today. In 1994 the World Hunger Program at Brown University assembled a count of armed conflict cases which also involved the destruction or diversion of food supplies, or destruction of the potential to produce food. Forty-two countries affected by such "food wars" were identified overall, and in 32 of those 42 countries a food threatening conflict was still currently underway. Fourteen of these 32 active cases were in Africa in 1995, but 8 were in Eastern Europe or the former USSR - including most prominently Bosnia and Chechnya (Messer and Uvin 1995; De Rose, Messer, and Millman 1998).

Food insecurity in Sub-Saharan Africa today is distinctively related to political unrest and violent internal conflict. Africa since decolonization has been the scene of more than 60 successful political coups, plus more than a dozen long-running civil wars among post-colonial contenders for political power. Per capita war fatality rates in Sub-Saharan Africa are three times higher than the Middle East. Seven million Africans have died fighting over the past 30 years. By one count eleven civil wars were still underway on the continent in the early 1990s (Deng and Minear 1992). The most destructive of these included a 17 year old civil war still underway in Angola, a three-sided military conflict in Liberia, a 16 year old civil war finally winding down in Mozambique, a revived civil war between Hutus and Tutsis in Rwanda, fighting in Togo that had created 230,000 refugees, the continuation of a civil war in the south of Sudan, plus widespread sub-clan violence amid virtual anarchy in Somalia.

The links between violent civil conflict and food insecurity are multiple and powerful. Civil conflicts are often rooted in traditional ethnic, tribal, or religious animosities, and groups that organize around these identities typically form militias either to defend themselves or attack their weaker neighbors. In primarily agricultural societies, the recruitment of young men into these militias will both reduce family income and take labor away from food production, be it farming or herding. Food availability and access to food will also be diminished directly, due to the predatory activities of both militias and regular armies in the field, which tend to subsist in poor societies by eating whatever they can take from the unarmed population. These militias and armies will also be motivated to destroy any food they cannot use immediately in contested areas, so as to deny it to their adversaries. Anticipating this theft and destruction, farmers that remain on the land in violence-torn societies will lose their incentive to plant crops in the first place (Natsios 1997). Countries experiencing conflict in Africa on average have produced 12.4 percent less food per capita in war years than in peacetime. Comparison or wartime and a “peace adjusted trend” shows that since 1980 in Africa, peace would have added 2 to 5 percent to the continent’s total food production per year (Messer, Cohen, and D’Costa 1998).

Violent internal conflict will also typically bring a termination of important government health, education, and infrastructure maintenance services in contested zones, physical insecurity for traders on all trunk roads moving through rural areas, a hyperinflation of the economy, a destruction of the

currency, and a more general interruption of private employment and economic exchange. These are calamities from which rural economies may recover only slowly. In Uganda, a succession of internal wars and military coups between 1971 and 1986 reduced real income per person by 40 percent. Between 1975 and 1986 food production per capita fell by 39 percent, as national extension services and agricultural research stations stopped functioning and as farming technology went backwards. Use of animals for land clearing became impossible as the animals were either killed or stolen, so less productive hand tool techniques had to be revived. Today, more than a dozen years after this period of devastation, per capita food production in Uganda has yet to recover to the 1971 level (Nygaard, et al. 1998).

Amid violent internal conflicts, it is not uncommon for farmers in contested areas to give up food production entirely, leave their land, and become what the United Nations refers to as "internally displaced persons." Since the early 1990s, total numbers of internally displaced persons world wide have fluctuated between 20 million and 25 million, in 35 to 40 different countries (Cohen and Deng 1998). At one point early in the 1990s more than 6 million people in Africa were refugees and 16 million more were internally displaced. The internally displaced are often more vulnerable to hunger than cross-border refugees, since they can find themselves beyond the diplomatic reach of international relief agencies. Once mass population movements begin, a second order of public health as well as feeding difficulties than will emerge, sometimes producing widespread deaths from diseases linked to poor sanitation as well as malnutrition. States torn by internal conflict will usually lack the authority, financial resources, and institutional capacity needed to respond to such emergencies without external assistance, and this assistance must at times be accompanied by external military intervention.

Some scholars have attempted to reassert the primacy of economic variables in such cases of violent conflict, by depicting the violence itself as a consequence of poverty and resource scarcity. Thomas F. Homer-Dixon has sought to link the outbreak of violent conflict in poor countries to factors such as land shortages that accompany high rates of population growth, land degradation, and increased youth entering the labor force (Homer-Dixon 1991; Homer-Dixon 1994). Michael Renner has sought to attribute conflict in poor countries not so much to tribal, ethnic, or religious differences but instead to "explosive population growth, severe land shortages, land degradation, lack of nonagricultural employment, falling export earnings, and the pain of structural economic adjustment." (Renner 1996) Yet actual frequency counts of violent minority conflict in Africa tend to belie such assertions. These counts show that rates of violent conflict in Africa have not been rising over time, as would be expected if population density or land scarcity were the cause. Instead, rates of violent minority conflict in Africa surged to a high level in the mid 1960s, immediately following European decolonization, and have remained steady at that high level ever since (Gurr 1993).

One ambitious effort at statistical correlation, a still-classified 1995 CIA study of "state failure," has concluded (judging from press reports[20]) that the state failures producing internal civil conflict in so many developing countries were correlated with high infant mortality rates. This

[20] For example, "Why do countries fall apart? Al Gore wanted to know," *U.S. News and World Report,* February 12, 1996, p. 44.

prompted some to infer, once again, that some form of Malthusian emiseration might be at the root of Africa's political distress. Yet this seems a highly unlikely inference especially for Africa, since infant mortality rates there have recently been falling sharply rather than rising. Between 1960 and 1990 the mortality rate (per 1000 live births) for children under five years fell sharply in a number of "failed" states in particular: in Somalia from 294 to 215, in Rwanda from 248 to 198, in Liberia from 310 to 205, and in Sudan from 292 to 172 (UNDP 1992, Table 4, p. 135). Africans on average are living dramatically longer today, thanks to improved public health, inoculations against childhood disease, and also thanks to gradually improving nutrition. Their transitory food insecurity grows out of political malfunction and civil conflict plus periodic drought, rather than out of an overall population driven eco-malthusian decline.

Consider Rwanda, where population growth has been dramatic, but where both famine and civil conflict have taken place independent of changing population density. In Rwanda between 1900-1950 there were seventeen years of famine, despite the fact that the nation at that time contained only 20 percent of its current population (Uvin 1996). The full scale civil war that resumed in Rwanda in 1990, and which led to a terrible genocide in that country in 1994, is most parsimoniously understood as the continuation of an unresolved post-colonial political conflict between Hutu and Tutsi peoples, rather than as the result of eco-malthusian emiseration.

A far more convincing explanation for violent conflict in Sub-Saharan Africa starts with the serious geographical mismatch, long noticed on the continent, between post-colonial national boundaries and ethnic boundaries. The boundaries of today's African states south of the Sahara were drawn by European colonial powers at a conference in Berlin in 1885, and the purpose on that occasion was to keep peace among Europeans, not among Africans. When the European colonizers finally departed in the 1960s, the diverse ethnic groups contained within these poorly drawn national boundaries naturally began to struggle with each other for control of the various state assets (armed forces, civil service payrolls, state-owned enterprises, marketing boards and other instruments of trade regulation and taxation, diplomatic services, etc.) that the colonizers had left behind.

The great diversity of ethnic groups in Africa would have made the problem of peaceful nation state formation difficult even if Africans had been in control from the start. According to one conservative count, black Africa has 74 different ethnic minorities, versus only 43 in Asia, where the population is much larger (Gurr 1993, p. 254). In Sub-Saharan Africa minorities comprise 42 percent of the region's population, versus a global average of 17 percent. Fourteen out of the fifteen most ethnically diverse societies in the world are in Africa. Ethnopolitical groups in Africa also tend to have a stronger sense of group identity than in other regions. Fifty-seven percent of black African minorities on which data are available are strong identity groups, versus the global mean of 37 percent. Africa's greater ethnic diversity is a force which seems to have constrained the region's economic performance independent of any tendency to generate violent conflict. One World Bank correlation study found that Africa's much greater than average ethnic diversity accounted for approximately 35 percent of its growth differential with the rest of the world, in contrast to the more ethnically homogeneous nations of East Asia (Easterly and Levine 1994, p. 12).

Violent conflict has now become an even more important source of transitory food insecurity than natural disasters such as drought, thanks to the dramatic improvements that have recently been made in international systems of drought warning and famine relief. Improved famine early warning

systems, well developed intergovernmental and NGO relief delivery systems, plus modern communication and transport infrastructures have sharply curtailed the forces of nature alone as a source of famine. Consider Africa in 1984, when drought related production losses (plus a world recession, low commodity export prices, and a debt crisis) put the continent's food security at risk. Harvests failed for three consecutive years in a number of countries, more than 35 million people were affected, and some 10 million left their homes in search of food and water. Yet in those African countries were peaceful conditions prevailed, food relief measures were undertaken with remarkable success (Deng and Minear 1992). As Jean Dreze observed, "Though drought threatened a large number of African countries at that time, only some of them - notably war-torn ones - actually experienced large-scale famine." (Dreze 1995).

No less dramatic was the timely international response to a severe 1991-92 region-wide drought in southern Africa. Grain yields in the ten states of the Southern African Development Community (SADC) were only 56 percent of normal, and regional stockpiles were inadequate to cover the shortage. Cereal production fell by 60 percent in Malawi and Swaziland, and by more than 70 percent in Namibia and Zimbabwe. The drought placed 17-20 million people at risk of starvation, yet there were no famine related deaths reported, except in Mozambique where a civil war was still underway (DeRose, Messer, and Millman 1998). Starvation was avoided because per capita food aid to the region increased dramatically, from an average of less than 10 kg. per person in the 1980s to a peak of more than 25 kg. per person in 1992 (Pinstrup-Anderson, Pandya-Lorch, and Babu 1997). It once again helped that most of the nations worst affected by this drought were not being torn by internal military conflict.

The greater food security threat posed by civil conflict versus drought is also illustrated in the case of Sudan. When northern Sudan faced a drought during the middle years of the 1980s, it managed to avoid widespread starvations thanks in part to the successful delivery of $1 billion in external assistance. Yet when violent civil conflict later escalated in southern Sudan, relief could not be delivered to the affected areas and hundreds of thousands starved, even though the drought by then had ended. During the years 1986-88, an estimated 400,000 persons lost their lives in Sudan. By 1988 roughly half of the population in the south had been displaced by the fighting, and famine deaths in that year alone reached about 250,000. A new international relief effort was mounted in response to this conflict-linked emergency in the south (Operation Lifeline Sudan), but it was far less successful than the earlier international drought relief effort, due to armed attacks on food shipments by the warring parties (Deng and Minnear 1992).

Somalia is another illustrative case. The same drought that devastated southern Somalia beginning late in 1991 also devastated southern Ethiopia and northern Kenya, yet in these latter two countries there were few deaths because international relief efforts succeeded in getting food to the vulnerable without incident. In Somalia food relief shipments were blocked by armed sub-clan militia groups engaged in a struggle for political control, and so a major famine took place. Not until a U.S. military intervention late in 1992 was a minimum of food security restored (Natsios 1996). Where civil conflict is absent, food relief can work well in response to drought. Where conflict is present, food relief not only can fail; it can become counterproductive. Without military intervention to neutralize or disarm the warring factions, food relief is likely to be taken at gunpoint by those warring factions and either destroyed or otherwise used for war making purposes.

Violent internal conflict has not always been the premier indicator of food insecurity in poor countries that it is today. During the middle years of the 20th Century transitory food insecurity was at times a result of violent *international* conflict (particularly during and after the Second World War). It was also a frequent result of the food and farm policy initiatives undertaken by Stalinist or Maoist political regimes. Stalin's coercive collectivization and food procurement policies in the Ukraine brought death by famine to an estimated 7 million peasants in 1932-33 (Conquest 1986). Mao's Great Leap Forward brought death by famine to over 15 million peasants in China in 1959-62 (Riskin 1995). A number of other self-styled Marxist-Leninist political systems also brought food emergencies onto their own people, including Kampuchea under the Khmer Rouge after 1975, Ethiopia under Mengistu in 1984-85, Angola and Mozambique following independence from Portugal, and currently the Democratic People's Republic of (North) Korea. Fortunately, fewer such systems remain in place around the world today, and China has largely corrected Mao's most damaging land collectivization policies. The world's only unreformed Stalinist political system today is the North Korea, and that regime is now itself under threat due to an internal famine of its own creation.

The recent demise of so many market-hostile, non-accountable Marxist-Leninist regimes is part of a wider late 20th Century global trend toward more democratic governance (Huntington 1991). This has been a fortunate trend for food security purposes, since governments which guarantee press freedom and feature accountability through democratic competition are more likely to provide timely public sector responses to food needs and food emergencies (Dreze and Sen 1995).

Summary and Qualification

We have argued here that transitory food insecurity in poor countries is not directly or significantly linked to changing conditions in world grain markets. We have shown that per capita grain consumption in the developing countries did not generally worsen when grain export prices increased in 1973-74, or when they increased again briefly in 1995-96. We have also shown that per capita grain consumption in these developing countries generally grew more rapidly during the decade of the 1970s than during the decade of the 1980s, even as world grain market conditions were giving the opposite impression. We have explained this disconnection between consumption trends and world market conditions by showing that the reliance of genuinely poor developing countries on grain imports is usually low, and generally lower today than it was several decades ago, even when food aid is taken into account.

We have next argued that this low dependence by food insecure poor countries on grain imports cannot be explained as a response to the instability of the world grain market. Most poor countries spend only a small and shrinking share of their foreign exchange earnings on food imports; for most, export earnings tend to rise and fall in parallel with food import prices; and for most, the instability of domestic grain production is a more frequent source of internal market destabilization than world grain market prices. Of all the world market fluctuations that can destabilize food security circumstances within poor countries (including fluctuations in non-grain farm commodity markets; raw materials and energy markets; foreign exchange markets; international financial markets; and markets for international direct investment), fluctuations in international grain markets are perhaps the least important to the poor.

Low dependence on grain imports also cannot be justified as a response to unreliable supplier concerns, since even when markets are tight many of the larger exporters into the world grain market - led by the United States - will continue to export to all cash paying customers. They do so because strong domestic grain producer lobbies argue so forcefully against any restraint on export sales. These producer interests in rich countries consistently trump disorganized domestic consumer interests, and easily override foreign policy interests. As a consequence in today's world grain markets, exporters tend to be far more reliable than the importers, and importers tend to exercise more bilateral bargaining leverage than exporters.

The tendency of so many poor countries to depend so little on world grain markets is not generally a reflection on the operation of those markets. Instead it usually reflects a mistrust toward all private markets, both grain and non-grain markets, both foreign and domestic markets.

Having concluded that transitory food insecurity is seldom a result of market malfunction, we ended by reviewing the most conspicuous non-market sources of food insecurity, including most of all violent internal conflict, plus non-accountable governments and natural disasters such as drought. We concluded that violent internal conflict is increasingly the most important of these three, now that the means to provide drought relief have improved, and since non-accountable (especially Stalinist and Maoist) political regimes are now fewer in number. Where violent conflict is absent, international food relief in the face of drought is possible and often successful. Where violent conflicts continue, food relief can become impossible and unsuccessful even in the absence of drought.

One important qualification must be added at the end of this argument. International food aid played a large role in the successful humanitarian response to the drought related food insecurities of central Africa in 1984, and southern Africa in 1992. Any sanguine view of future humanitarian response capabilities therefore must assume a continued availability of large scale international food assistance when required in an emergency. In the future, timely food aid could become more difficult to arrange if commercial stocks are low and export prices high, or if government-owned stocks (for example, CCC inventories in the U.S.) have either been depleted through export subsidy use or terminated as a result of liberal domestic farm policy reforms (for example, the 1996 FAIR Act). In other words, international grain market conditions could start to make a difference.

Recent trends in food aid availability are worrisome in this regard. Total cereals food aid availabilities for 1997/98 have been forecast by FAO at 5.5 million tons, 12 percent up from the reduced volume of 1996/97, yet less than half the level of the early 1990s, when large supplies were needed to meet transitory demands in the Balkans, the former Soviet Union, and in southern Africa.[21] If large humanitarian food aid relief requirements were to arise some time in the near future, perhaps due to a return of drought conditions in Sub Saharan Africa, this availability level would have to increase quickly, something that could be more difficult to arrange if world export prices were momentarily high or government stock levels low. It was fortunate in this regard that the brief 1995-96 interlude of higher world grain export prices and diminished stocks coincided with a period of

[21] FAO, *Food Outlook*, No. 2, April 1998, p. 22.

above trend food production in Sub Saharan Africa, rather than with a period of suddenly higher food aid needs in that region.

In this indirect sense then, world food market conditions do link up to the food security prospects of some poor countries, particularly those threatened by periodic drought. Yet the most obvious policy solutions begin in the realm of government and international food aid budgets and international food aid agreements (such as the Food Aid Convention), rather than in the realm of commercial trade or market management policies. Declining food aid availability should be understood as a foreign assistance budget problem, and not be redefined as an international grain market stability problem. International commercial grain markets are important for many things, but we have shown here that they are not the appropriate analytic starting point for estimating, diagnosing, or addressing the transitory food security problems of the poor.

References

Alexandratos, Nikos, ed. (1995). *World Agriculture: Towards 2010,* Rome: FAO.

Alexandratos, Nikos (1997). "The World Food Outlook: A Review Essay." *Population and Development Review* 23(4), December 1997, pp.877-888.

Bjorkman, James W. (1975). "Public Law 480 and the Policies of Self-Help and Short Tether: Indo-American Relations, 1965-68," in Appendices (Case Studies, Economic Policy), *Commission on the Organization of the Government for the Conduct of Foreign Policy*, Washington, D.C., June.

Chen, Xikang, and Xiaoming Pan (1997). "China's Grain: Challenges and Productivity Potentials in the 21st Century," Chinese Resource Papers, Millenium Institute, Washington, D.C.

Chopra, R. N. (1981). *The Evolution of Food Policy in India.* New Delhi: Macmillan India, Ltd.

Cohen, Roberta, and Francis M. Deng (1998). "Exodus Within Borders," *Foreign Affairs* 77(4), July/August, pp. 12-16.

Conquest, Robert (1986). *The Harvest of Sorrow: Soviet Collectivization and the Terror-Famine.* New York: Oxford University Press

Crook, Fredrick W., and W. Hunter Colby (1996). "The Future of China's Grain Market," Washington, D.C.,USDA, ERS Information Bulletin Number 730, October.

Deng, Francis M., and Larry Minear (1992). *The Challenges of Famine Relief*. Washington, D.C.: The Brookings Institution.

Dreze, Jean (1995). "Famine Prevention in Africa: Some Experiences and Lessons," in Jean Dreze, Amartya Sen, and Athar Hussain, *The Political Economy of Hunger,* Oxford: Clarendon Press, pp. 554-603.

Dreze, Jean, and Amartya Sen (1995). "Introduction," in Dreze, Sen, and Athar Hussain, *The Political Economy of Hunger:* Oxford, Clarendon Press, pp. 13-45.

Easterly, William, and Ross Levine (1994). *Africa's Growth Tragedy*. Unpublished manuscript. Washington, D.C.: World Bank.

FAO (Food and Agriculture Organization of the United Nations) (1984). *Public Expenditure on Agriculture in Developing Countries, 1978-1982.* Rome: FAO. November 1984. Policy Analysis Statistics Division.

FAO (Food and Agriculture Organization of the United Nations) (1991). *The State of Food and Agriculture 1991*. Rome: FAO.

FAO (Food And Agriculture Organization of the United Nations) (1996a). World Food Summit, Technical Background Documents, Volume 3. Rome: FAO.

FAO (Food and Agriculture Organization of the United Nations) (1996b). *Food Supply Situation and Crop Prospects in Sub-Saharan Africa*. Rome: FAO, May.

FASF (Federation of American Scientists Fund) (1997). *Perspectives on the Long-Term Global Food Situation,* Volume II, Issue No. 2. Washington, D.C.:FASF.

George, A., and E. Saxon (1986). "The Politics of Agricultural Protection in Japan," in Kym Anderson and Yujiro Hayami, *The Political Economy of Agricultural Protection: East Asia in International Perspective*, Sydney: Allen and Unwin, pp. 91-110.

Gurr, Ted R. (1993). *Minorities at Risk: A Global View of Ethnopolitical Conflict.* Washington, D.C.: U.S. Institute of Peace.

Haas, Richard N. (1998). *Economic Sanctions and American Diplomacy*. New York: Council on Foreign Relations.

Hertel, Thomas W., William Masters, and Aziz Elbehri (1998). "The Uruguay Round and Africa: A Global, General Equilibrium Analysis," *Journal of African Economies* 7(2).

Hopkins, Raymond F., and Donald J. Puchala (1978). "Perspectives on the International Relations of Food," *International Organization*, 32:3, summer 1978, pp. 3-40.

Homer-Dixon, Thomas (1991). "On the Threshold: Environmental Changes as Causes of Acute Conflict," *International Security,* 16(Fall), pp. 76-116.

Homer-Dixon, Thomas (1994). "Environmental Scarcities and Violent Conflict: Evidence from Cases," *International Security*, 9(1):5-40.

Huntington, Samuel P. (1991). *The Third Wave: Democratization in the Late Twentieth Century.* Norman: University of Oklahoma Press.

IFPRI (1977). *Food Needs of Developing Countries: Projections of Production and Consumption to 1990.* Research Report No. 3, Washington, D.C.: IFPRI.

Johnson, D. Gale (1978). "World Food Institutions: A ÔLiberal' View," *International Organization,* 32:3, summer 1978, pp.265-282.

Ke, Bingsheng (1998). "Food and Agricultural Policy in China: Reviews and Future Perspectives," Millenium Institute, Chinese Resource Papers.

Lindert, Peter H. (1991). "Historical Patterns of Agricultural Policy," pp. 29-83 in C. Peter Timmer, ed., *Agriculture and the State,* Ithaca: Cornell University Press.

Lipton, Michael, and Robert Paarlberg (1990). *The Role of the World Bank in Agricultural Development in the 1990s.* Washington, D.C.: IFPRI.

Melby, Eric D. K. (1998). "Iraq," pp. 107-128, in Richard N. Haass, ed., *Economic Sanctions and American Diplomacy*, New York: Council on Foreign Relations.

Messer, Ellen, and Peter Uvin (1996). *The Hunger Report: 1995.* Alan Shawn Feinstein World Hunger Program, Brown University.

Messer, Ellen, Marc J. Cohen, and Jashinta D'Costa (1998). *Food From Peace: Breaking the Links Between Conflict and Hunger.* 2020 Brief 50. International Food Policy Research Institute. Washington, D.C.: IFPRI.

Natsios, Andrew W. (1996). "Humanitarian Relief Interventions in Somalia: The Economics of Chaos," *International Peacekeeping* 3(1):68-91.

Natsios, Andrew S. (1997). *U.S. Foreign Policy and the Four Horsemen of the Apocalypse: Humanitarian Relief in Complex Emergencies.* Washington, D.C.: Praeger.

Nygaard, David, Robert Paarlberg, Jane Sanyu-Mpagi, Ruth Matovu, and Suresh Babu (1998). (forthcoming). "The Modernization of Agriculture in Uganda: The Political Challenge of Moving from Adjustment to Investment." Washington, D.C.: IFPRI

Pinstrup-Andersen, Per, Rajul Pandya-Lorch, and Suresh Babu (1997). "A 2020 Vision for Food, Agriculture, and the Environment in Southern Africa," in Lawrence Haddad, ed., *Achieving Food Security in Southern Africa*, Washington, D.C.: IFPRI.

Renner, Michael (1996). *Fighting for Survival: Environmental Decline, Social Conflict, and the New Age of Insecurity.* New York: W.W. Norton & Co.

Riskin, Carl (1995). "Feeding China: The Experience Since 1949," in Jean Dreze, Amartya Sen, and Athar Hussain, eds., *The Political economy of Hunger.* Oxford: Clarendon Press, pp. 401-444.

Sachs, Jeffrey (1996). "Growth in Africa: It can be Done." *The Economist*, June 29 1996, pp. 19-21.

Sen, Amartya (1981). *Poverty and Famines: An Essay on Entitlement and Deprivation.* Oxford: Clarendon Press.

Tweeten, Luther, with John Mellor, Shlomo Reutlinger, and James Pines (1992). *Food Security Discussion Paper* (PN-ABK-883), prepared for U.S. Agency for International Development under supervision of the International Science and Technology Institute, released in May, 1992.

USDA. (1995). "Food Aid Needs and Availabilities: Projections for 2005," ERS Report GFA-6, October 1995.

USDA (1996). "The U.S. Contribution to World Food Security: The U.S. Position Paper Prepared for the World Food Summit." Washington, D.C.: U.S. Department of Agriculture.

Valdes, Alberto, and Panos Konandreas (1981). "Assessing Food Insecurity Based on National Aggregates in Developing Countries," pp. 25-52, in Valdes, ed., *Food Security for Developing Countries*, Boulder, Colorado: Westview Press.

Valdes, Alberto, ed. (1981). *Food Security for Developing Countries.* Boulder, Colorado: Westview Press.

World Bank (1996). "Global Food Supply Prospects: A Background Paper Prepared for the World Food Summit, Rome, November 1996," prepared by Merlinda D. Ingco, Donald O. Mitchell, and Alex F. McCalla. World Bank Technical Paper No.353, Washington, D.C.: World Bank.

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

Alexander H. Sarris

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

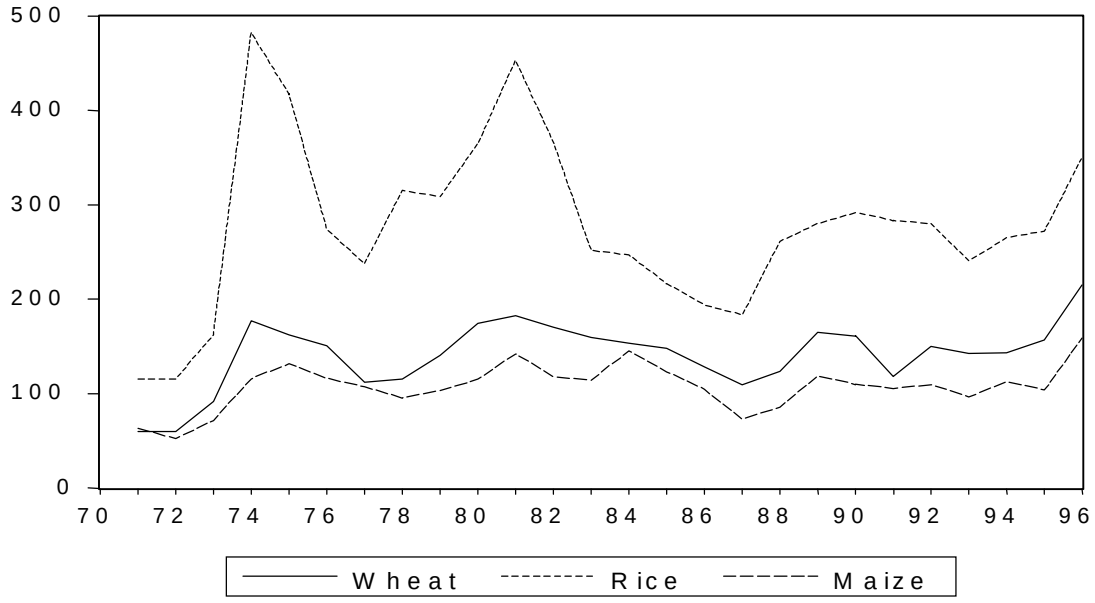
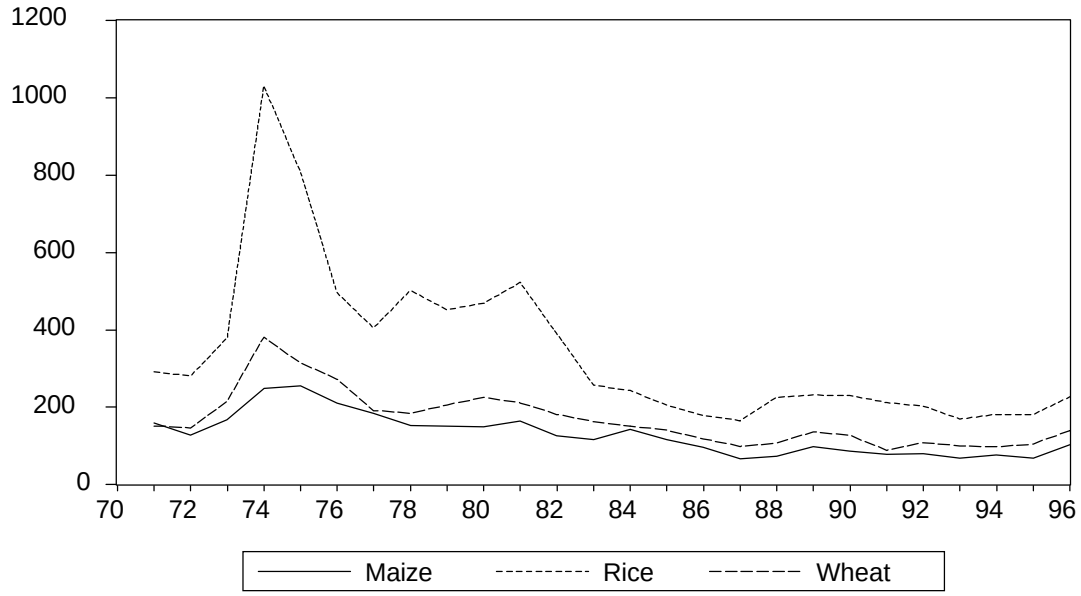


Figure 2. Annual Series for Real World Prices of Cereals



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 (tr)	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.

---

[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

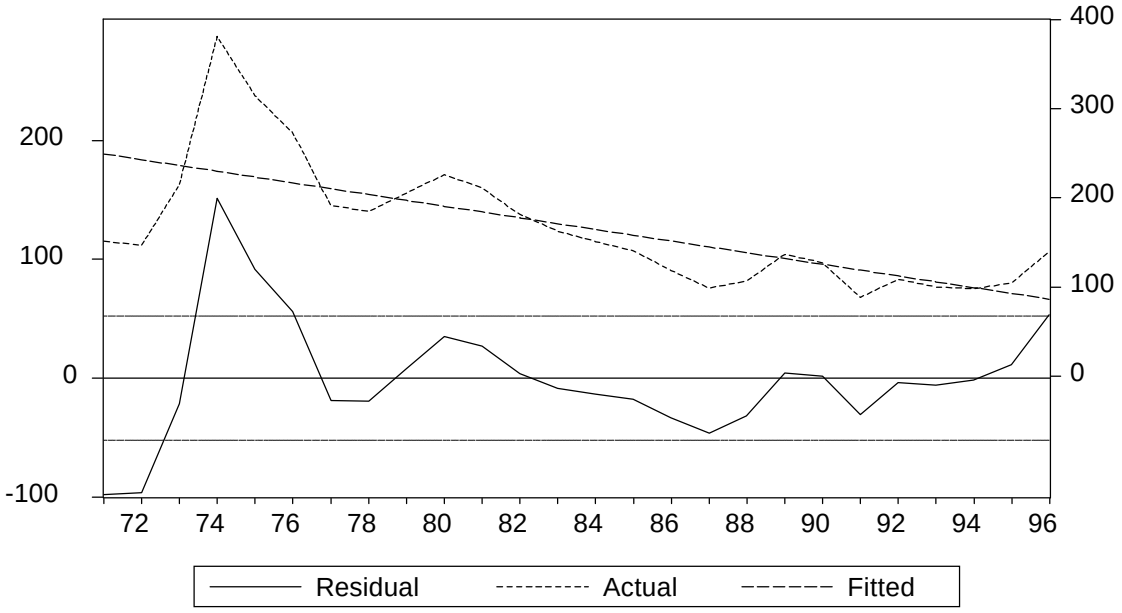


Figure 4. Plot of Actual, Fitted (Linear Trend), and Residuals of Real World Maize Prices

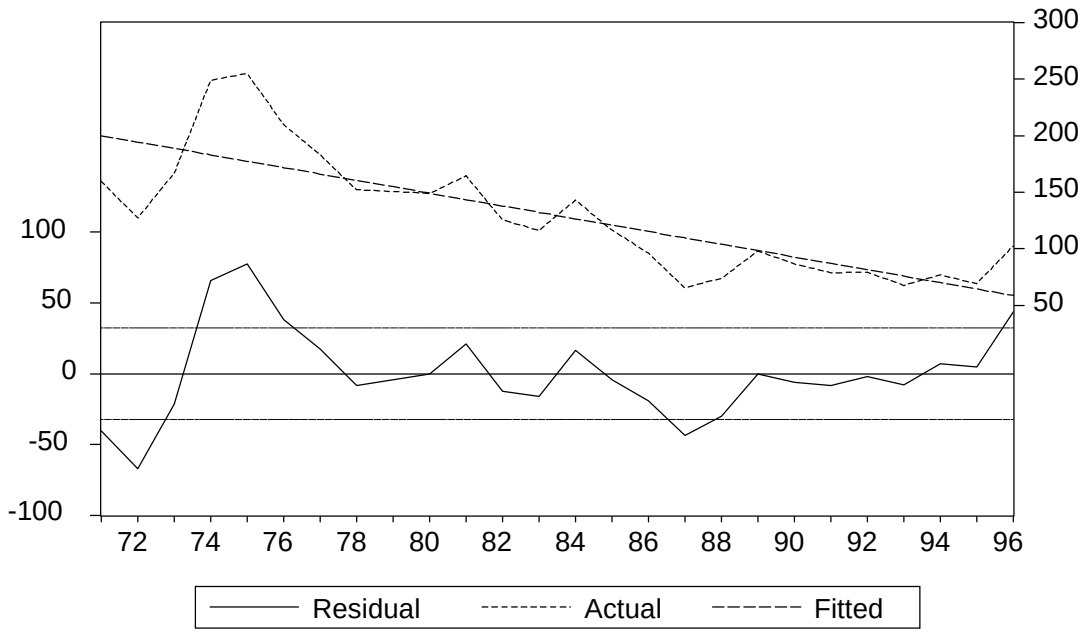


Figure 5. Plot of Actual, Fitted (Linear Trend), and Residuals of Real World Rice Prices

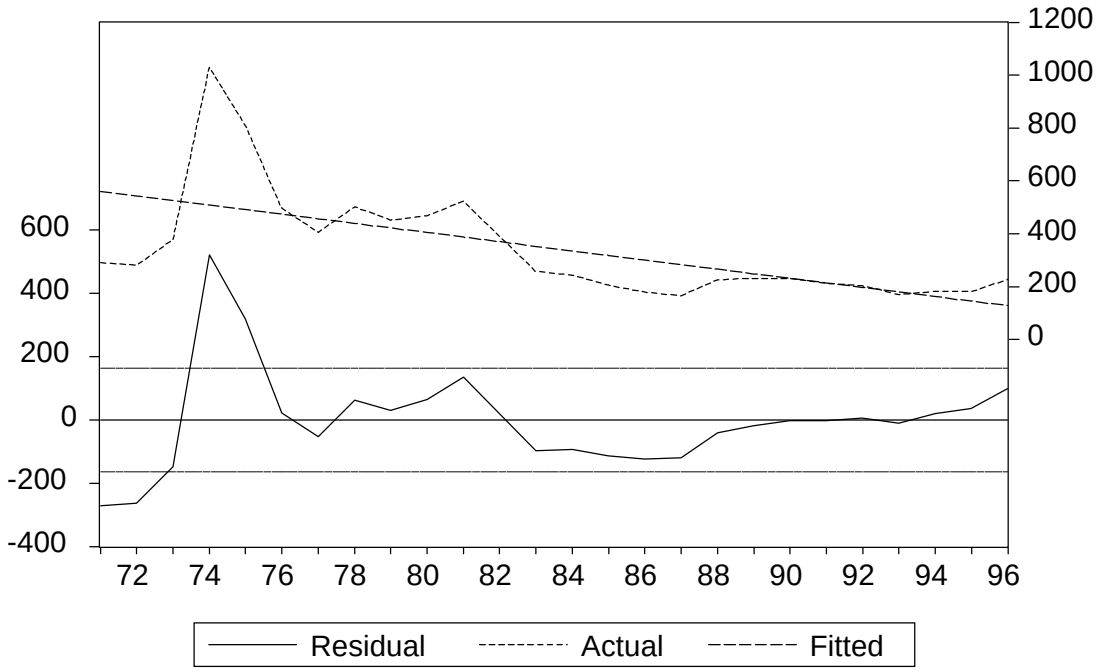


Table 2. Results of Linear Trend Regressions on The Annual Real Crop-Year Prices of Cereals

(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

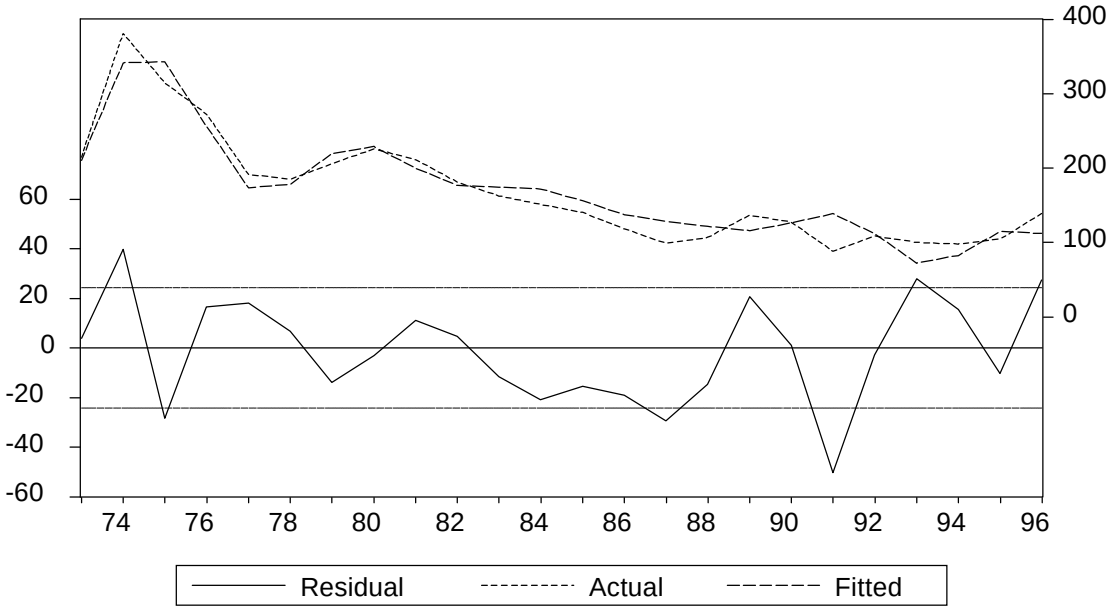


Figure 7. Plot of ARMA(2,0) Model of Real World Annual Maize Prices

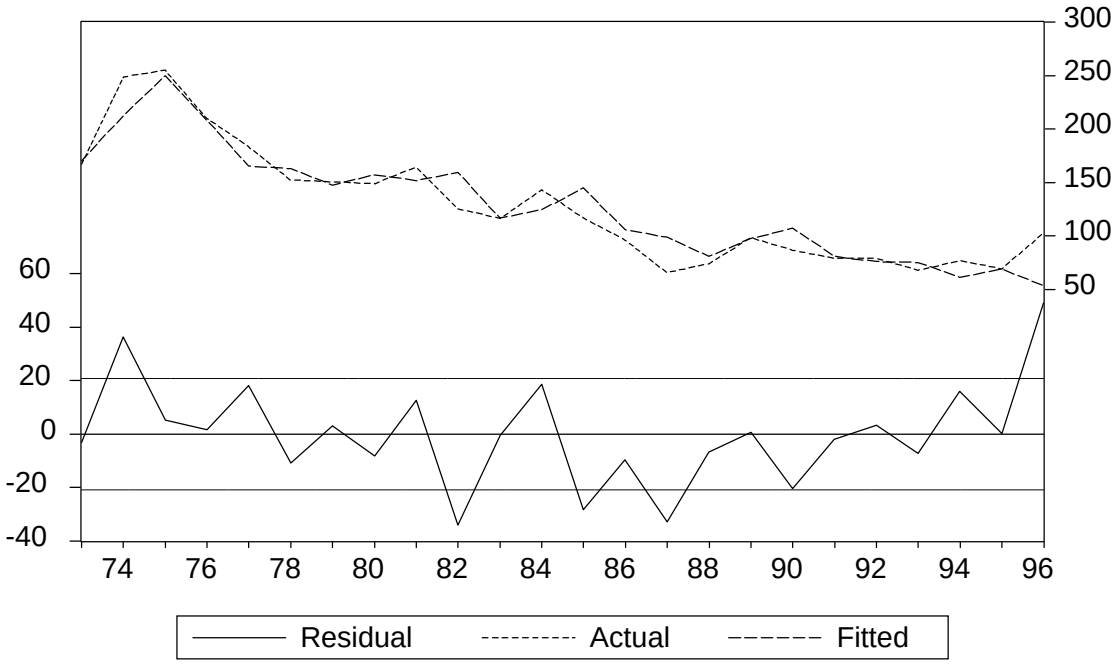
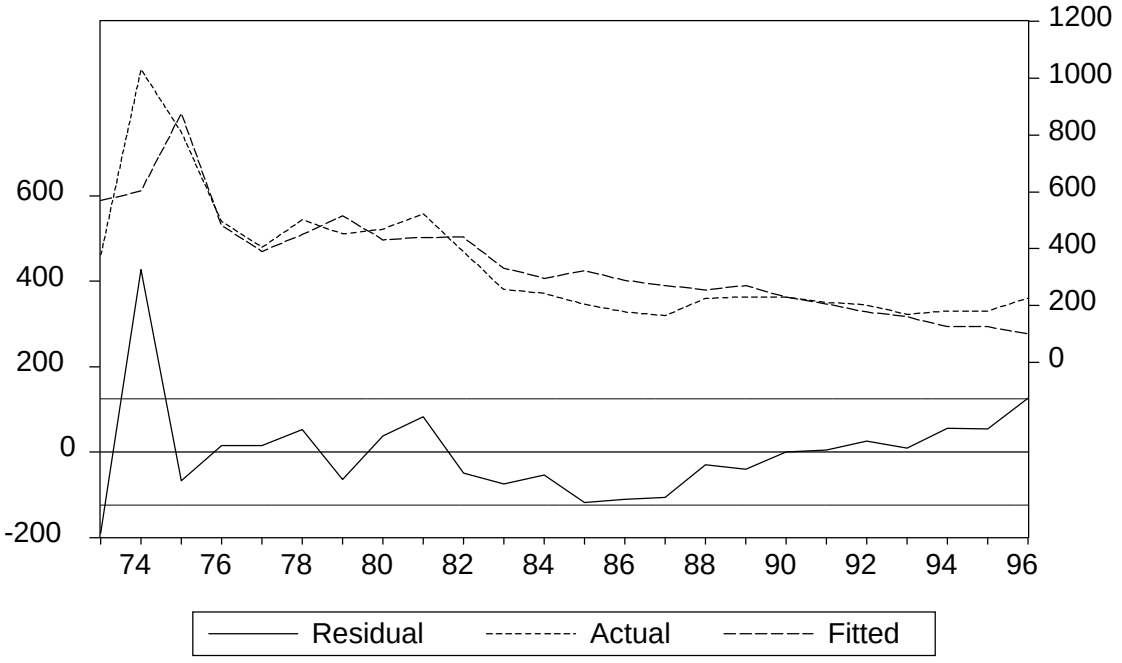


Figure 8. Plot of ARMA(2,0) Model of Real World Annual Rice Prices



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

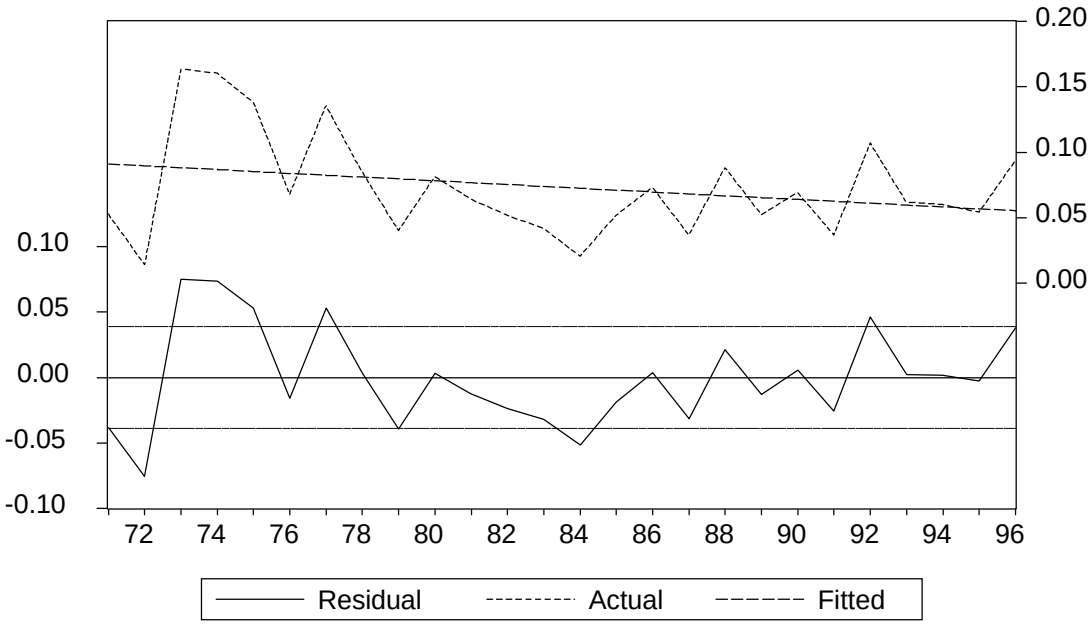


Figure 10. Plot of Intra-Year Coefficient of Variation of Real World Maize Prices

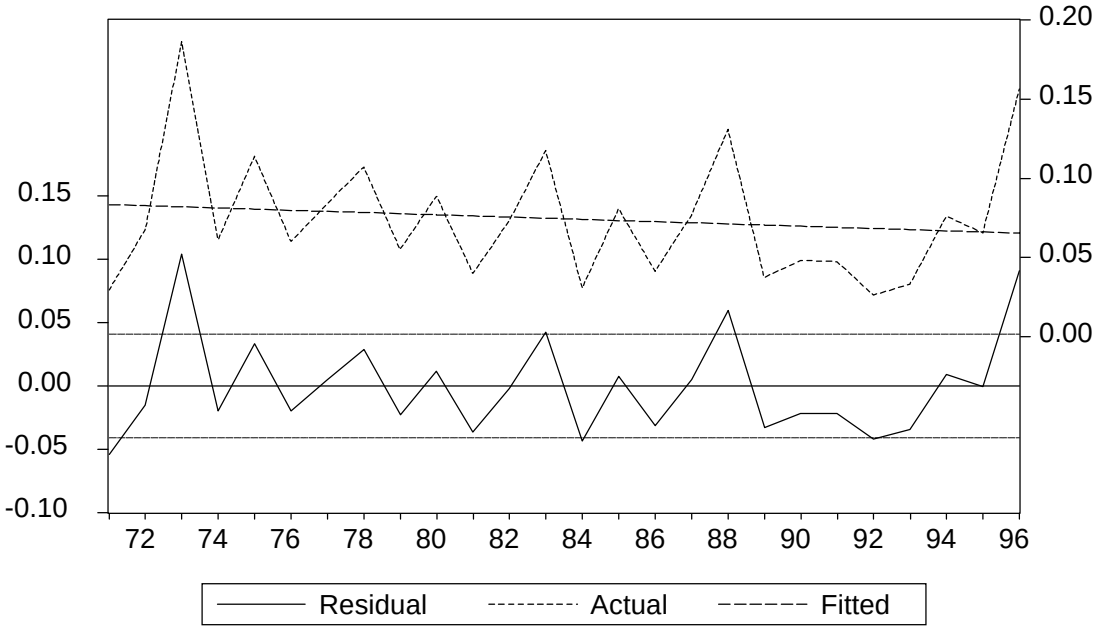
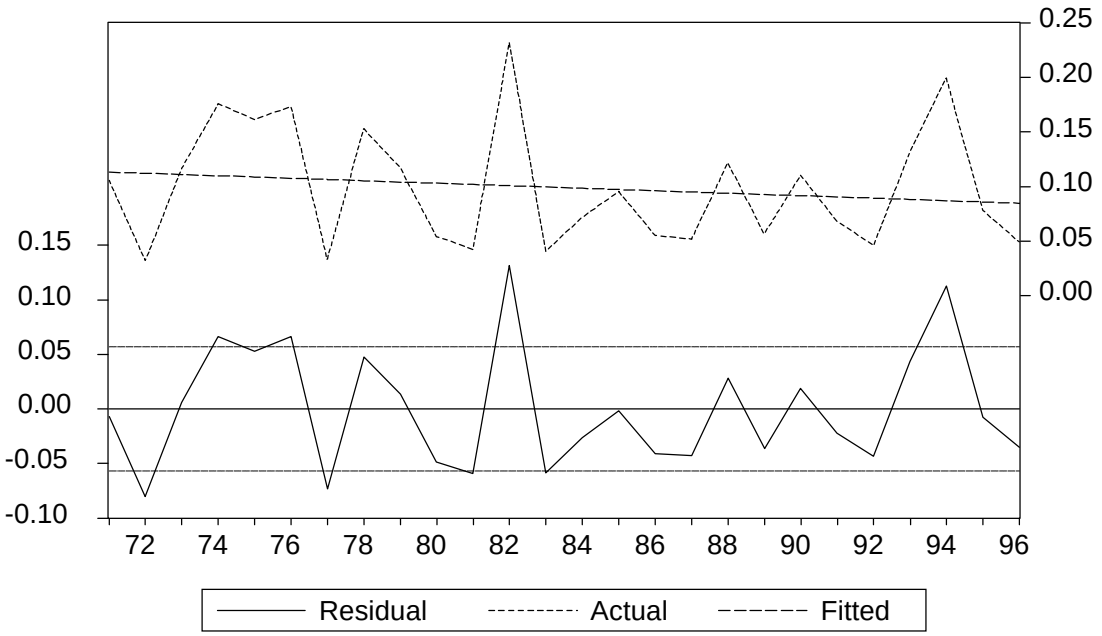


Figure 11. Plot of Intra-Year Coefficient of Variation of Real World Maize Prices



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.

References

Bencivenga, V. R. and B. D. Smith, (1991). "Financial Intermediation and Endogenous Growth," *Review of Economic Studies*, vol. 58, pp. 195-209.

Blandford, D. (1983). "Instability in World Grain Markets," *Journal of Agricultural Economics*, vol. 43(3), September, pp. 379-395.

Enders, W. (1995). Applied Econometric Time Series. New York, John Wiley.

Engle, R. F. (1982). "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation," *Econometrica*, vol. 50, July, pp. 987-1007.

Granger, D. W. J. (1997). "On Modelling the Long Run in Applied Econometrics," *Economic Journal*, vol. 107, No. 440, January, pp. 169-177.

Hamilton, J. D. (1994). Time Series Analysis. Princeton, Princeton University Press.

Harvey, A. (1997). "Trends, Cycles and Autoregressions," *Economic Journal*, vol. 107, No. 440, January, pp. 192-201.

Hendry, D., and A. Neale (1991). "A Montecarlo Study of the Effects of Structural Breaks on Tests for Unit Roots," in P. Hackl and A. Westlund (eds), Economic Structural Change: Analysis and Forecast, Berlin, Springer-Verlag.

Leon, J, and R. Soto (1995). "Structural Breaks and Long-Run Trends in Commodity Prices," World Bank, Policy Research Department, Policy Research Working Paper No. 1406, January.

Mitchell, D. O. (1987). "Factors Affecting Grain Prices, 1970-84," World Bank, International Economics Department, International Commodities Markets Division, Division Working Paper No. 1987-10, November.

Mundlak, Y, and D. Larson (1992). "On the Transmission of World Agricultural Prices," *The World Bank Economic Review*, vol. 6, No. 3, September, pp. 399-422.

Pesaran, M. H. (1997). "The Role of Economic Theory in Modelling the Long Run," *Economic Journal*, vol. 107, No. 440, January, pp. 178-191.

Platteau, J. P., (1991). "Traditional Systems of Social Security and Hunger Insurance :Pat Achievements and Modern Challenges," in E. Ahmad, J. Dreze, J. Hills, and A. Sen (editors), Social Security in Developing Countries, Clarendon Press, Oxford.

Rudebusch, G. (1993). "The Uncertain Unit Root in GNP," *American Economic Review*, vol. 83, pp. 264-272.

Sarris, A. H., (1985). "Food Security and Agricultural Production Strategies under Risk in Egypt," *Journal of Development Economics*, Vol. 19, No.½, September-October.

Sarris, A. H. (1990). "The Impact of Agricultural Trade Liberalization on World Cereal Instability and Stocks," mimeographed, FAO Commodities Division, ESCB:90/Misc.1, September.

Sarris, A. H. (1997a). "The Evolving Nature of International Price Instability in Cereals Markets," mimeographed report prepared for FAO Commodities Division, March.

Sarris, A. H., (1997b). "Risk Management in Cereal and Oilseed Markets," paper prepared for the Agricultural Directorate of the Organisation for Economic Cooperation and Development, August.

Varangis, P., and D. Larson (1996). "Dealing with Commodity Price Uncertainty," World Bank, Policy Research Working Paper 1667, Washington, October.

On Reform, Food Prices and Poverty in India

Martin Ravallion

There are understandable concerns about the effects on India's poor of higher food prices stemming from recent or proposed policy reforms. Over 24 rounds of the National Sample Survey, spanning 1959-94, one finds a strong positive correlation between the relative price of food and India's poverty rate. This article questions how reform critics have interpreted this correlation. It is not an income-distribution effect. Rather it appears to be due to covariate fluctuations between average consumption and food prices due to other variables, including food supply; bad agricultural years simultaneously lower rural living standards and increase food prices. The correlation is uninformative about the welfare effect of a sustained increase in the relative price of food.

Advocates of liberalizing economic reforms often argue that there will be net gains to the poor from the higher relative prices of agricultural goods, including food, consequent to devaluation, the removal of restrictions on external trade, and cuts to subsidies on agricultural inputs. It is argued that higher relative prices of agricultural goods will benefit the rural sector, where poverty tends to be concentrated in most developing countries, including India.[1] The extent of the gains will depend on a number of contingencies, including the distribution of land, and access to credit and infrastructure. But gains are normally expected.

However look at Figure 1, which plots survey-based estimates of India's national poverty rate (percent below the poverty line, on the vertical axis) against an index of the relative price of food over the period 1958-94. (I describe the data later). The correlation coefficient is 0.76, and it is highly significant.[2] Advocates of reforms which would entail higher relative prices of food in India must surely be disturbed by Figure 1. There has been strong resistance to liberalizing Indian agriculture, and there has been little progress relative to other countries in the region (Ahmed 1996). A fear of adverse effects on living standards has been one factor in resistance to reform in agriculture, and critics of reform have pointed to evidence similar to Figure 1 to support their case. For example, Abhijit Sen (1996) includes the relative price of cereals in a regression equation of the proportion of the rural population living below the poverty line, and finds a highly significant (positive) coefficient. From this he argues the supposedly pro-poor shifts in the terms of trade in favor of agriculture following reform will hurt the poor by increasing the relative price of food:

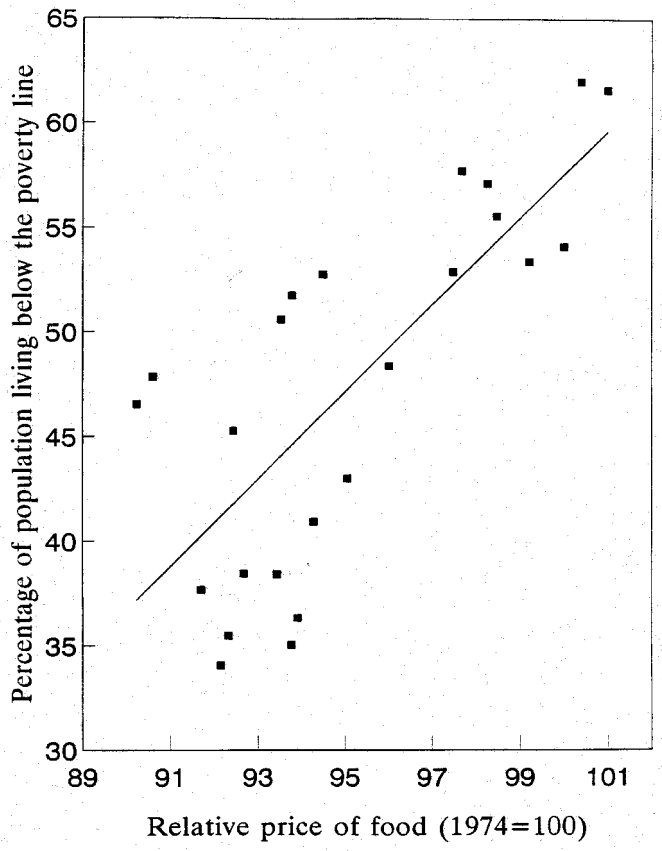
> "..the very mechanism through which agricultural output is expected to increase under structural adjustment involves increasing the price of agricultural goods, notably, food, relative to all other prices in the economy...this essential relative price implication of structural adjustment is permanent by design and so also is its likely

[1] For overviews of the issues on food pricing policy in developing countries see Timmer et al., (1983) and Streeten (1987). For a survey of evidence on poverty, and the links of policy in this context, see Lipton and Ravallion (1995).

[2] The standard t-test of the null hypothesis that the correlation is zero gives a test statistic of 5.6.

adverse impact on poverty...Under these circumstances...it must be recognized that a 'reform' strategy which aims [amongst other things] to liberalize agricultural trade and thus enrich the rich at the direct cost to the poor...is at its root a fundamentally iniquitous adventure" (Sen, 1996, p. 2470 and 2476).

Figure 1. Poverty and the Price of Food in India, 1958-94



Does the evidence justify such claims? This article probes into the reasons why India's poverty rate and the price of food are positively correlated. There are a number of possible explanations. Maybe the correlation is driven by the adverse welfare effects of food price changes in urban areas. The Indian food economy was largely closed to external trade over the period. The rural sector as a whole must then produce more food than it consumes, the urban sector being a net consumer. It follows under seemingly weak assumptions that an increase in the relative price of food must benefit the rural sector as a whole.

Figure 1 is based on the national poverty rate (the population-weighted aggregate of urban and rural poverty rates), so effects on urban living standards may well account for some of the correlation. However, there may also be adverse distributional effects within rural areas, as has been

found elsewhere.[3] There has been a long-standing concern in India about adverse impacts on the rural poor of higher food prices.[4] In rural areas of India, it is plausible that the poorest households tend to be net consumers of food, since in most regions they are unlikely to have sufficient land for their own consumption needs. They may benefit as agricultural workers, depending on the dynamics of wage adjustment and income shares from this source (Ravallion, 1991). But it remains that some of the poorest households in rural areas could lose initially from higher food prices, with the initial gains being concentrated amongst the rural non-poor.

It is also possible that the correlation is spurious. The correlation in Figure 1 may well be driven by rather different processes, with little or nothing to do with the arguments that the critics of reform have made on the basis of evidence such as in Figure 1. Covariate fluctuations over time arising from a common third variable, such as domestic food supply or the rate of inflation, could also produce such a correlation.

The rest of this article will try to determine why we observe the correlation in Figure 1. In doing so I will return to some longstanding concerns in the literature on poverty in India. The main points to be made here only require relatively simple statistical methods, though reference will be made to other papers which go into more depth on some points, often requiring more sophisticated methods.[5] While this article focuses on the relationship between food prices and welfare, richer causal models of poverty in India can be found in the recent research that Gaurav Datt and I have done, which I will refer to when relevant.

Methods and Data

In principle, there are two approaches one might take to assessing the welfare impacts of a price change. The first, and most common, method relies on analytic results from economic theory. The farm-household is assumed to be able to buy or sell anything it wants (subject to its endowments) at prevailing prices and wages. It can then be readily shown that the welfare gain to a farm household (who both produces and consumes food) from a small increase in the price of food holding all other prices and wages constant is given by the value of the household's excess supply of food (production minus consumption) times the change in price. A cross-sectional survey collecting both consumption and production data can be used to estimate such first-order welfare effects, and locate them within the distribution of some measure of levels of living. This approach infers the change in welfare, rather

---

[3] See, for example, Ravallion (1991), for Bangladesh, Ravallion and van de Walle (1991), for Indonesia, and Barrett and Dorosh (1996), for Madagascar.

[4] An important compilation of papers on the topic can be found in Mellor and Desai (1985), building on the work of Dharm Narain. This literature focused on the relationship between rural poverty measures and the nominal level of the consumer price index rather than the relative price of food. For further discussion of the distinction, and also the link with the effects of inflation on poverty see Datt and Ravallion (1997a), where we argue that the relevant variables are the relative price of food and the inflation rate, not the level of the price index as such.

[5] A non-technical summary of results from that research can be found in Ravallion and Datt (1996a). Copies of the papers are available from me, as is the data set.

than measuring it directly, which clearly requires far more data. Needless to say, the inference may be wrong if the assumptions do not hold.

The second approach is more direct, but has been far less popular, probably due to its data requirements. This method looks ex post at how a measure of welfare varies over time or space, and compares this to differences in food prices. If data are ideal (notably a fully comparable and exact welfare metric) then this second method will be preferable, as it requires far fewer assumptions. But data are rarely ideal and assumptions will be needed (which are likely to be of a different nature to those made by the first method). Even then, this second method may at least offer a cross-check on the first.

This investigation relies on the second method, though not losing sight of some insights from the first. I will use the same data set as Datt and Ravallion (1997a) to explore the relationship between India's poverty rate and the relative price of food. This is one of the questions that Datt and Ravallion look into, though in the context of a more fully developed econometric model of the joint determination of various consumption-poverty measures (including measures which are more sensitive to distribution below the poverty line), and focusing more on the relationship with average farm productivity.

The key features of the data are as follows. The measures of poverty and distribution I will use were all estimated on the distribution of total consumption of goods and services from India's National Sample Surveys. This entails 24 observations spanning 1958-94.[6] This is one of the longest time series of reasonably comparable household surveys available (in developed or developing countries). However, it is still only 24 observations, which limits our confidence in assessments of (for example) trends over time, or other time series properties of the data. To add to the difficulty, the observations are unevenly spaced, depending on survey dates; the time between surveys ranges from just under one year to five years.

Consumption is deflated by the Consumer Price Index for Agricultural Laborers (CPIAL).[7] This is a standard fixed-weight price index. (I will return to the problems with such an index.) The poverty line recommended by the Planning Commissions' (1993) Expert Group is used, namely a per capita monthly expenditure of Rs. 49 at 1973-74 all-India rural prices.

The index of the relative price of food was obtained by dividing the food component of the CPIAL by the value of the general index (the same deflator as used for consumption). The relative price index for food was quite stable; using the annual data over the period 1958-94, the coefficient of variation was 2.9%; the largest year-to-year fall was 3.8% while the largest rise was 2.9%. (Non-food prices were more variable; the CV of the implicit relative price index for non-food goods was

[6] The data are described more fully in Datt (1997) and Özler, Datt and Ravallion (1996), and are available on disc. The series of poverty measures are also given in World Bank (1997).

[7] The index has been corrected from the problem that the standard CPIAL ignored increases in firewood prices after 1960-61. See Datt and Ravallion (1977a, Appendix) for details.

8.3%). This stability in the relative price of food probably reflects governmental efforts at food price stabilization, through foodgrain procurement and storage.

These data yield Figure 1. What explains it?

Is the Correlation Found Solely in Urban Areas?

One possible explanation can be readily dismissed. Naturally almost all urban households are net consumers of food, since very little food is produced there. However, the relationship in Figure 1 is not being driven by adverse effects of higher food prices on living standards in the urban sector. Indeed, the correlation is even stronger if one focuses solely on rural consumption. The figure for rural areas looks very similar to Figure 1. The correlation coefficient with the rural poverty rate is 0.79.

The rest of this article will focus on this positive correlation between the rural poverty rate and the relative price of food. That, as we shall see, is the real mystery underlying Figure 1.

Is the Correlation a Distributional Effect Within Rural Areas?

One might follow Sen (1996) and others and surmise that the correlation is due to adverse distributional effects of higher food prices. However, one must immediately confront the fact that the proportion of people living below the poverty line, the popular "headcount index," will be unaffected by distributional changes below the line; a loss to the poorest, for example, with have no effect on the index. Alas, given the data publicly available, we do not know whether people living at India's poverty line are on average net consumers or net producers of food.[8] Even if one agrees that there may well be adverse distributional effects within rural areas from higher food prices, it is far from obvious that the headcount index of poverty will reflect them.

One can instead calculate "higher-order" measures of poverty which will reflect changes in distribution below the poverty line. I also tested the correlation of food price with the squared poverty gap index.[9] The correlation was 0.67, somewhat lower than for the headcount index, but still highly significant.

However, this still does not directly test for distributional effects; indeed, the squared poverty gap is still (heavily) dependent on the level of mean consumption. (The elasticity of the squared

[8] Standard tabulations from the NSS data give budget shares of total expenditure, but not production data, which is not usually covered in the survey.

[9] This is given by the sample mean of the squared values of the distance below the poverty line expressed as a proportion of the line, where the distance below the line is set to zero for those who are not poor. The measure is due to Foster et al., (1984).

poverty gap to the mean in India is even higher than that of the headcount index; see Ravallion and Datt, 1996b).

To test for distributional effects, a better approach might be to use a measure of inequality. So I tested the correlation of food price with the most widely used measure of overall inequality, namely the well known Gini index.[10] Over the 24 NSS rounds, the Gini index of consumption for rural areas is uncorrelated with the price of food; the correlation coefficient is -0.12 and is not significantly different from zero. Clearly this is not consistent with the view that there is an adverse distributional effect of higher food prices.

Another test is to look at the underlying distributional components of the poverty measures (Datt and Ravallion, 1992). This can be done by setting the poverty line at a constant proportion of the survey mean for each data.[11] Thus the poverty measure is entirely purged of the effect of mean consumption, leaving only the effect of distribution (as embodied in the Lorenz curve).[12] The result can be thought of as a measure of "relative poverty."

One finds a negative correlation between the distributional component of the headcount index and the relative price of food, and it is not significant at the 5% level (nor the 10% level, but it is almost so; the correlation coefficient is -0.34). A better test for pro-poor distributional effects is the correlation with the distribution component of the squared poverty gap; this correlation is virtually zero (a coefficient of 0.09).

So the positive correlation with food price vanishes in measures of relative poverty,[13] consistent with what we have seen happens when one uses the Gini index of overall inequality. These tests cannot be deemed conclusive since the underlying welfare indicator does not embody the substitution effects and differences in budget shares which could be important to a full reckoning of the welfare-distributional effects. The tests (for both inequality and relative poverty) should

---

[10] The Gini index takes the value zero when there is perfect equality, and the value one when the richest person consumes everything; my estimate from the NSS data of the Gini index of consumption in rural India in 1993/94 is 0.29.

[11] This is of course equivalent to keeping the real value of the poverty line fixed, but also fixing the means for all dates at a common real value. Datt and Ravallion fix the mean at the average value over all survey rounds, which is equivalent to setting the poverty line at 84% of the current survey mean. For further details on construction of this measure see Datt and Ravallion (1997a).

[12] The measure is essentially the same as that used in Ravallion and Datt (1996a) to decompose changes over time in India's poverty rate into components due to growth in mean consumption versus changes in distribution.

[13] Datt and Ravallion (1997a) test this further, in the context of a structural model of the determination of the poverty measures which also controlled for the effects of changes in the real agricultural wage rate and average farm productivity. They also find that the relative price effect vanishes.

nonetheless pick up any adverse distributional effects amongst the rural poor via incomes, or over the whole rural distribution. There is no sign of such effects.

So it appears that the positive effect of higher food prices on the incidence of absolute poverty is transmitted through average consumption, not via worsening distribution of consumption. The correlation coefficient between mean rural consumption (food plus non-food) and the relative price of food is -0.81. Regressing log mean rural consumption on the log of the food price gives an elasticity of -2.81 with a standard error of 0.42. However, this is a potentially spurious regression (in the sense of Granger and Newbold, 1974) since there is significant serial dependence in the residuals; the Durbin-Watson test is 0.40. If one adds a linear trend then the residuals are much better behaved (the Durbin-Watson test is 1.45), and the least squares elasticity is -2.41, with a standard error of 0.21.

Let us now focus on the correlation between food price and average consumption in rural areas.

Is the Correlation Due to the Method of Deflation?

One reason to be suspicious of the correlation between food price and mean consumption lies in the methods of deflation used in these data (though they are perfectly standard methods). The CPIAL has an above average weight on food; its weight of 78% is above the average rural food share in all years for which the data are available. This means that even if there are no real effects of the relative price of food, it will be negatively correlated with mean consumption (deflated by the CPIAL).

However, this does not explain the negative correlation between mean rural consumption and the price of food. If the consumer price index is re-weighted using the average food share for the 1980s in rural India (65%), then the correlation coefficient between mean consumption and the relative price of food drops only slightly, to 0.76, while the least squares elasticity of mean consumption to the price of food drops to -1.45 with a standard error of 0.27.[14] The elasticity of real consumption to the relative price of food is no lower in absolute value, as one would expect. But it is still negative, and highly significant.

So we now seem to have a real puzzle: how it is possible that higher prices for the main agricultural output in India lead to lower average rural living standards?

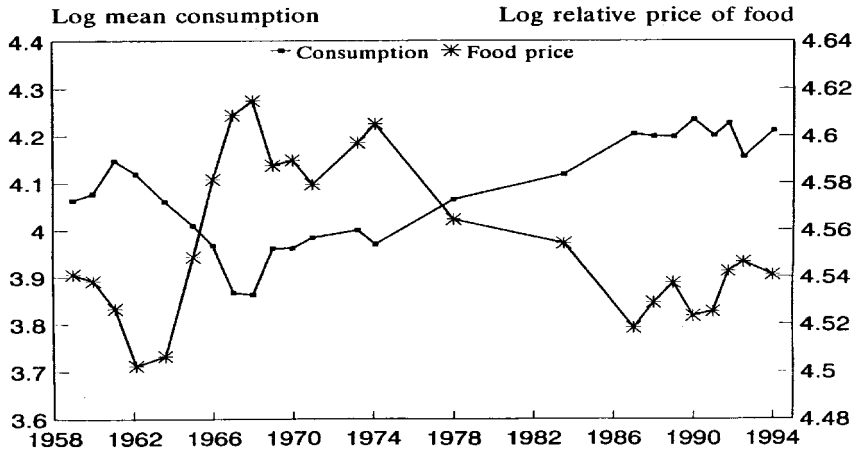
Is the Correlation Due to a Common Trend?

Maybe a clue can be found in the time series properties of these two variables. Figure 2 plots both variables over time. There was no trend increase or decrease in the relative price of food in

[14] Again the residuals are autocorrelated; allowing for the trend in consumption, the elasticity drops to -1.19, with a standard error of 0.13, and the signs of serial correlation in the residuals vanish.

India over this period. The regression coefficient of the log of the relative price of food on time is -0.06 percent per year, with a standard error of 0.06. However, there was a trend increase in mean consumption; the corresponding coefficient for consumption per capita was 0.64 percent per year, with a standard error of 0.15. (The corresponding trend for the rural poverty rate is -1.21, with a standard error of 0.21; the trend is almost identical for the national poverty rate as used in Figure 1.) Figure 2 suggests strongly that the correlation in Figure 1 is driven by covariate fluctuations over time rather than a common trend.

Figure 2. Rural Consumption and the Price of Food by Year



Since one variable has a trend and the other does not, there cannot be a stable long run relationship between the two variables; real consumption will inevitably drift from the relative price of food. So the policy interpretations of these data which assume such a relationship are dubious to say the least. The only long run relationship evident in Figure 2 is that between the fluctuation. In the terminology of modern time series analysis, these two variables are only cointegrated if one allows for a time trend in the cointegrating regression; otherwise there is no long run relationship.[15] So these data cannot be used to support the view that a sustained increase in the relative price of food will hurt the rural poor.

[15] Although the test is not strictly valid with unevenly spaced data, this conclusion is confirmed by the Likelihood Ratio test of Johansen (1991) which firmly rejects cointegration; the test statistic is 10.11 with a 5% critical value of 15.41. (Augmented Dickey-Fuller tests indicate that both variables are integrated of order one.) However, this changes if one allows an independent deterministic trend in the cointegrating equation. Then the Johansen test (narrowly) accepts that the series are cointegrated; the test statistic is 26.21 for which the 5% critical value is 25.32. The test statistics are very similar when the price index is re-weighted. On "cointegration" see, for example, Granger (1986) or Hendry (1995).

Is the Correlation Due to a Third Variable?

To summarize the findings so far, a closer inspection of the data offers no support for the interpretations which critics of reform have given to evidence such as Figure 1. Though the use of a fixed weight price index will no doubt hide some of the welfare-distributional effects, the data that have been used in recent debates on this issue do not suggest that higher food prices lead to a worsening of relative inequalities in incomes, either over the whole distribution, or from the point of view of the poor. The correlation in Figure 1 is largely driven by a negative correlation with mean consumption, which leaves the puzzle as to how the rural sector as a whole could lose from higher food prices in a closed economy. The tests in the last section suggest that over the period 1959-94, the correlation between the poverty rate and food prices is driven mainly by covariate fluctuations between mean rural consumption and the relative price of food. Indeed, the only long run relationship which can be detected in the data is that between the fluctuations over time in these two variables.

Could there be one or more other variables which might account for these covariate fluctuations? There is one obvious candidate: aggregate farm output.

Let us assume that rural households cannot fully buffer their consumption in the face of income shocks stemming from farm output fluctuations due to the vagaries of the weather. This will affect both farmers and workers (the latter through demand for labor.) In good agricultural years, rural living standards will tend to rise, and they will fall in bad years. At the same time the price of food will tend to be higher in bad agricultural years, and fall in good years.[16] A negative correlation between consumption and the price of food will emerge; but it is spurious, being attributable to a common third variable, namely farm output.

Are the data consistent with the interpretation? There are two links in the argument. The first says that rural consumption depends on agricultural output, allowing for an independent time trend. To test this link, I regressed the log of mean rural consumption on the (price-weighted) real value of agricultural output per capita; the fit improved if I used the two period moving average (suggesting that consumption is more vulnerable to two bad years in a row than one).[17] The least squares elasticity was 0.451, with a standard error of 0.062. However, strong serial correlation in the error term was evident. I allowed the error term to be serially correlated, using non-linear least squares

[16] In a competitive market this holds as long as food has a downward sloping aggregate demand function. The government of India attempts to buffer food prices from such shocks to output, through its procurement and storage decisions. The correlation between food price and farm output will still arise as long as a government cannot fully fix the food price, which seems a plausible assumption.

[17] This is crude as a causal model, but adequate for the present purpose; for a fuller discussion of the determinants of rural poverty see Datt and Ravallion (1997a); for an analysis at the state level see Datt and Ravallion (1997b).

to deal with the uneven spacing, and I added a time trend in mean consumption.[18] The estimate of the elasticity of rural consumption to agricultural output was then 0.512, with a standard error of 0.203.[19] The first link in the argument seems firm.

To test the second link (between the relative price of food and agricultural output), I regressed the price of food on current agricultural output and its two lags.[20] Since this does not require the survey data, the regression can be run on annual data, with 34 observations spanning 1960-93. This regression also called for a correction for serial correlation in the error term,[21] and the coefficients on current and lagged output were strongly indicative of a three year moving average with double weight on the first year's lagged value.[22] With this specification, the regression coefficient of log relative price of food on the moving average of log agricultural output was -0.254 with a standard error of 0.053.[23]

So both links are strong. An elasticity of rural consumption to agricultural output of 0.512 and an elasticity of food price to agricultural output of -0.254 together imply a food price elasticity for rural consumption of -2.02, not too far off the value obtained in the last section. So this alternative interpretation can account reasonably well for the correlation between mean rural consumption and the price of food. It seems Figure 1 is explained.

However, there appears to be other common influences on both variables. I compared the residuals of the above regressions on agricultural output. Figure 3 plots the residuals from both regressions. Comparing the residuals is complicated by the fact that the food price regression has

---

[18] The autoregression coefficient is raised to the power of the time period between observations. The use of a ARE correction to the error term can be interpreted as a parsimonious method of estimating a more general dynamic model (with a lagged dependent variable and both current and lagged explanatory variables) under Sagan's (1980) common factor restriction (Henry, 1995). The latter restriction allows one to consistently estimate a dynamic model with unevenly spaced data. However, the restriction is not testable with unevenly spaced data.

[19] The estimate of the autoregression coefficient was 0.806, with a standard error of 0.105, while the estimate of the time trend was 0.0067, with a standard error of 0.0047; the R^2 was 0.894.

[20] Again, I do not claim this to be a good causal model, although one could interpret it as the inverse demand function for food, allowing for smoothing of the impacts of production shifts on food prices. For a full analysis of the link between the relative price of food and farm yields in India see Datt and Ravallion (1997a).

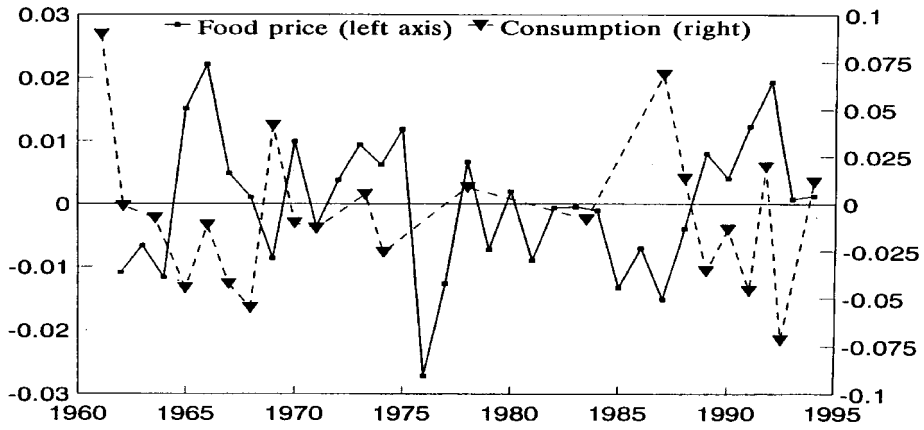
[21] This specification was tested against a first-order distributed lag model; Sargan's (1980) common factor restriction was easily accepted. (A Wald test gave F=0.56.)

[22] The coefficient on current agricultural output per capita was -0.075 (with a standard error of 0.026), the coefficient on the first lag was -0.127 (0.028), and the second lag -0.049 (0.026).

[23] The coefficient on the lagged error term was 0.835, with a standard error of 0.088. The R^2 was 0.863.

evenly spaced data, while the consumption regression does not. So the residuals do not always line up in time. Nonetheless, there is a sign of negative co-movement in the residuals, suggesting that there is another common determinant of both variables. For most of the cases in Figure 3 in which there is a reasonably close visual matching of observations in time the residuals have opposite signs. Putting the same point somewhat differently, there is an indication of a partial correlation between mean rural consumption and the price of food controlling for agricultural output, and further statistical analysis confirms this conclusion.[24]

Figure 3. Residuals from Regressing Consumption and Food Price on Farm Output Per Capita



Possibly a better measurement of domestic food availability would be able to account fully for the correlation between average rural consumption and the relative price of food. Average agricultural output is a rather crude measure for this purpose.

There may also be other common factors which account in part for the covariate fluctuations. For example, another variable which can help explain the negative correlation between mean rural consumption and relative price of food is the inflation rate. Inflationary periods in India have led to lower real consumption in rural areas; this could be a wealth effect, or it may involve savings behavior. The regression coefficient of the proportionate change (difference in logs) in mean real consumption between NSS rounds and the rate of inflation between the rounds, controlling for the length of time between surveys, is -0.409, with a standard error of 0.091.[25] At the same time, higher rates of inflation in India have been associated with higher relative prices of food; the initial

[24] Datt and Ravallion (1997a) estimate a structural model of rural poverty in India in which the relative price of food is significant, controlling for a moving average of agricultural output per acre and the real agricultural wage rate.

[25] The residuals appear to be well behaved; the Durbin-Watson test gives 2.01. The coefficient of the length of time between surveys is 0.38, with a standard error of 0.007. The R^2 is 0.56.

inflationary shock has often come from the food markets. Using the annual data, the regression coefficient of the log difference of the relative price of food on the rate of inflation is 0.147, with the standard error of 0.015.[26] Together, the joint effect of inflation implies as elasticity of mean consumption with respect of food prices of -2.8, again quite close to what we observe.

So it is not difficult to account for the correlation in Figure 1 in terms of variables which have little or nothing to do with the way that critics of reform have interpreted that correlation.

An Aside on Wages and Prices

To this point, I have relied entirely on household survey data for the welfare indicators. An alternative indicator often used in discussions of rural poverty in India is the real agricultural wage rate. It is of interest to see what relationship this has with the relative price of food over this period. Although the real agricultural wage is a far less comprehensive welfare indicator than real total consumption, it has the advantage that one can switch to annual observations; I will use the 35 annual observations available for 1958-93.[27]

One also finds a negative correlation between the real agricultural wage rate and the relative price of food; the coefficient is -0.59, which is significantly different from zero (a t-test gives 4.29). The least squares elasticity is also high, at -4.61, with a standard error of 1.03. However, this correlation is very likely to be spurious; indeed, the Durbin-Watson test on the regression of log real wage on log food price is a remarkable low 0.08, indicating considerable autocorrelation in the residuals. The main reason is probably that the real wage rate in Indian agriculture, like that in other sectors and countries, does not adjust instantaneously to changes in its determinants; there is strong serial dependence in wages, interpretable as wage "stickiness." There is also a strong positive trend in real wages. (The least squares growth rate over 1958-93 is 1.8% per year, with a standard error of 0.16%.) Furthermore, as Datt and Ravallion (1997a) argue, the rate of inflation also matters, since nominal wages do not adjust instantaneously to an increase in all prices.[28]

---

[26] This time an ARI correction to the error term was needed. The coefficient on the lagged residual was 0.440, with a standard error of 0.161. The R^2 was 0.79.

[27] Again deflated by the CPIAL. On the sources and how the series was constructed see Datt and Ravallion (1997a).

[28] This is not the same as saying that the level of prices matters, as has been debated in the literature on rural poverty in India (see, for example, Saith, 1981, and Mellor and Desai, 1985). By one view in this debate, real variables (such as a poverty measure) cannot depend on monetary variables, such as a consumer price index. But there is still a correlation between the poverty rate and the level of the price index; how can it be explained? Datt and Ravallion (1997a) argue that the correlation is spurious, and that the missing variable is the lagged price index. With both current and lagged (log) price levels, they find that one cannot reject the null that the coefficients on these two variables are of equal size with opposite sign. So it is rate of inflation, not the price level per se, which matters to the living standards of India's poor. Furthermore, Datt and Ravallion argue that the effect of inflation on rural poverty measures is transmitted largely through the real agricultural wage rate.

As soon as the lagged real wage rate, the rate of inflation (change in the log of the CPIAL[29]) and a time trend are added to the regression of the real wage rate on the relative food price, the latter becomes insignificant; its coefficient changes from -4.61 in the bivariate regression to -0.39, with a standard error of 0.31 (and the residuals become well behaved by standard tests). The supposedly adverse effect of a higher relative price of food on real wages in agriculture also appears to be spurious.

Conclusions

The strong positive correlation between the poverty rate in India and the relative price of food over a 35 year period appears to be due mainly to negatively covariate fluctuations between average rural consumption and food prices from year to year, rather than a common trend in poverty and food price, or income-distributional effects. The covariate fluctuations are consistent with the effect of shocks to food supply associated with the vagaries of the weather; a good harvest affect both farm incomes (positively) and food prices (negatively). A moving average of farm output can account well for the correlation between mean consumption and food prices. However, there is evidence that another factor is at work, possibly involving savings behavior in inflationary periods, which tend also to be periods of high food prices. The strong negative correlation between the real agricultural wage rate and the relative price of food also appears to be spurious; it vanishes when one allows for the stickiness of real wages and the adverse short term effects of inflation.

These results would appear to cast considerable doubt on some of the policy implications that have been drawn in the past from the correlation between the price of food in India and the country's poverty rate and the level of real agricultural wages. It is clearly specious to conclude from these data that policy reforms which entail a sustained increase in food prices are a threat to India's poor in the longer-term. Yes, there could well be adverse short-term welfare impacts of higher food prices for many of India's poor, in both urban and rural areas; this must be taken seriously, and can have important implications for both the timing of reforms and public spending priorities. But that is a very different proposition to the claims that some critics of liberalizing economic reform in India have made on the basis of such data.

[29] The fact that it is the rate of inflation rather than the level of prices that matters is easily tested by including instead both the current and lagged log of the price index and testing if their coefficients add up to zero; the test passed easily (the F-test on the restriction was 1.53).

References

Ahmed, Raisuddin (1996). "Agricultural Market Reforms in South Asia," *American Journal of Agricultural Economics,* Vol. 78, pp. 815-819.

Barrett, Chistopher B. and Paul A. Dorosh (1996). "Farmers' Welfare and Changing Food Prices: Nonparametic Evidence from Rice in Madagascar," *American Journal of Agricultural Economics,* Vol. 78, pp. 656-669.

Datt, Gaurav (1997). "Poverty in India, 1951-1994: Trends and decompositions," mimeo, International Food Policy Research Institute, Washington D.C.

Datt, Gaurav and Martin Ravallion (1997a). "Farm Productivity and Rural Poverty in India," *Journal of Development Studies,* forthcoming.

Datt, Gaurav and Martin Ravallion (1997b). "Why Have Some Indian States Done Better Than Others at Reducing Rural Poverty?" *Economica,* Vol. 64.

Foster, James, J. Greer and Erik Thorbecke (1984). "A Class of Decomposable Poverty Measures," *Econometrica,* Vol. 52, pp. 761-765.

Granger, C.W. J. (1986). "Developments in the Study of Cointegrated Economic Variables," *Oxford Bulletin of Economics and Statistics,* Vol. 48, pp. 213-228.

Granger, C.W. J. and P. Newbold (1974). "Spurious Regressions in Econometrics," *Journal of Econometrics,* Vol 2, pp. 111-120.

Henry, David (1995). *Dynamic Econometrics,* Oxford: Oxford University Press.

Johnasen S. (1991). "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregression Models," *Econometrica,* Vol. 59, pp. 1551-1580.

Lipton, Michael and Martin Ravallion (1995). "Poverty and Policy," In Jere Behrman and T.N. Srinivasan (eds.) *Handbook of Development Economics Volume 3,* Amsterdam: North-Holland.

Mellor, John and Gunvant M. Desai (eds.) (1985). *Agricultural Changes and Rural Poverty,* Baltimore, Johns Hopkins University Press.

Özler, Berk, Gaurav Datt and Martin Ravallion (1996). "A Database on Poverty and Growth in India," Development Research Group, World Bank.

Planning Commission (1993). *Report of the expert group on estimation of proportion and number of poor,* Government of India, New Delhi.

Ravallion, Martin (1991). "Rural Welfare Effects of Food Price Changes Under Induced Wage Responses," *Oxford Economic Papers,* Vol. 42, pp. 574-585.

Ravallion, Martin and Gaurav Datt (1996a). "India's Checkered History in the Fight Against Poverty: Are Their Lessons for the Future?," *Economic and Political Weekly*, Vol. 31 (September, Special Number), pp. 2479-2486.

Ravallion, Martin and Gaurav Datt (1996b). "How Important to India's Poor is the Sectoral Composition of Growth?," *World Bank Economic Review*, Vol. 10, pp. 1-26.

Ravallion, Martin and Dominique van de Walle (1991). "The Impact on Poverty of Food Pricing Reforms: A Welfare Analysis for Indonesia," *Journal of Policy Modeling*, Vol. 13, pp. 281-299.

Saith, Ashwani (1981). "Production, Prices and Poverty in Rural India," *Journal of Development Studies*, Vol. 19, pp. 196-214.

Sargan, J.D. (1980). "Some Tests of Dynamic Specification for a Single Equation," *Econometrica*, Vol. 48, pp. 879-97.

Sen, Abhijit (1996). "Economic Reforms, Employment and Poverty: Trends and Options," *Economic and Political Weekly*, Vol. 31, pp. 2459-2478.

Streeten, Paul (1987). *What Price Food? Agricultural Price Policies in Developing Countries*. London: Macmillian Press.

Timmer, C. Peter, Walter P. Falcon and Scott R. Pearson (1983). *Food Policy Analysis*. Washington, D.C.: Johns Hopkins University Press for the World Bank.

Does Food Aid Stabilize Food Availability?

Christopher B. Barrett

The stubborn persistence of food insecurity, hunger, and malnutrition in spite of steady growth in per capita global food production underlines the centrality of distribution systems to the alleviation of food insecurity. Although global per capita food production has increased roughly 15 percent in the past twenty years, a substantial subpopulation continues to suffer from malnutrition. The most commonly cited figure suggests that 800 million or so people experience protein energy (or macronutrient) malnutrition. And that statistic ignores a much larger cohort suffering micronutrient (especially iodine, iron, or vitamin A) deficiency, or facing significant, but as-yet-unrealized threat of macronutrient or micronutrient deprivation (Barrett forthcoming). Recent large-scale natural and manmade disasters, particularly in Sub-Saharan Africa, have brought extraordinary episodes of deprivation and threatened full-blown famine. Combating food insecurity in this world of plenty demands, among other things, improved distribution systems to ensure that food flows to those areas where it is most scarce.

Human physiology makes optimal food consumption volumes per capita relatively stable. Food supply, however, is notoriously volatile, especially in low-income economies relatively dependent on rainfed, rather than irrigated, agriculture. Fluctuations in domestic per capita production lead to highly variable import volume requirements in food importing nations. Trade is the principal means for international food distribution at the macro level. But poorer countries often lack the foreign exchange necessary to purchase commercially all the food needed to meet their population's nutritional requirements. Food aid is therefore often suggested as a way to cope with variable food import requirements and restricted commercial import capacity in low-income economies.

The basic logic of food aid for food security is simple. In so far as food aid is meant to address food availability shortfalls that might cause undernutrition, food aid should flow disproportionately to countries exhibiting low per capita nonconcessional food availability (NA), a sharp negative deviation from trend NA, or both. But does food aid in fact stabilize food availability in recipient economies? That is the question tackled in this paper, as I explore the empirical relationship between food aid flows per capita from the United States' PL480 programs and nonconcessional food availability per capita in PL480 recipient economies. If food aid indeed stabilizes food availability, then per capita food aid flows should be inversely related to recipients' per capita nonconcessional food availability, in terms of levels, deviations from trend, or both. This is an empirically testable hypothesis that, to the best of my knowledge, has not yet been studied.

Nonconcessional Food Availability Trends in PL480 Recipient Economies

Let me begin with some definition of terms and data description. Because individual physiology drives nutritional needs, and in order to be able to compare countries with vastly different human populations, all figures reported are in per capita terms. In order to work with readily comparable series without introducing serious aggregation bias problems, I use cereals volumes to

proxy total food production, nonconcessional availability (production plus commercial imports), and aid flows per capita. Annual production, commercial import, and population data, 1961-95, were provided by the Food and Agriculture Organization of the United Nations, while disaggregated (by year, commodity, Title, and recipient country) PL480 food aid flows data were made available by the U.S. Department of Agriculture's Economic Research Service. The data cover 124 different recipient economies, representing all PL 480 recipients during the period other than Japan and developed European economies.[1] For those countries that achieved independence after 1961, only independence-era data are used, yielding an uneven panel of data.

The food available to feed a country's residents comes from one of four sources: domestic production, domestic inventories, commercial imports from abroad, or food aid inflows from abroad. This paper looks at how the latter source, food aid, covaries with the first three in order to establish whether food aid helps stabilize aggregate food availability. A data problem emerges immediately. Reliable cereals inventories data are unavailable for most countries, particularly poorer food aid recipients. But since interannual cereals stocks per capita are generally quite small in developing countries, the unrealistic limiting assumption that per capita inventories equal zero probably has little effect on the forthcoming analysis. I should also point out that I do not include total food aid flows from all donors; the analysis considers only PL480 shipments from the United States. A planned extension of this analysis will include multilateral flows from the World Food Programme and aggregate food aid flows. But since PL 480 comprised about two-thirds of global food aid, 1961-95, the data used here should capture the basic patterns prevailing more broadly.

Own production and commercial trade account for the vast majority of cereals availability in PL480 recipient nations. Pooling across years and recipients, domestic production's mean (median) proportion of aggregate national cereals availability, defined as production plus commercial imports plus PL480 receipts, was 69.3 (80.2) percent.[2] Mean (median) commercial imports accounted for another 28.6 (17.6) percent of recipient country food availability, leaving only a tiny fraction covered by PL480 shipments most years in most recipient countries, as can be seen in Table 1 and graphically in Figure 1. Given that PL 480 flows rarely comprise more than a negligible proportion of total food availability in recipient countries, this suggests that food aid can play, at best, a very limited stabilizing role.

The 1961-95 Green Revolution era of rapid biochemical improvements to cropping systems, brought unprecedentedly rapid annual average growth of 0.5 percent in global cereals production per capita (Barrett forthcoming). PL 480 recipients, however, lagged significantly behind. Annual average growth rates in production and NA for each PL480 recipient, 1961-95, were estimated by equations (1) and (2), respectively.

$$\ln(\text{PRODUCTION}_t)=\alpha_{0P}+\alpha_{1P}\,\text{YEAR}+\varepsilon_{Pt} \qquad (1)$$

[1] The 1961-95 PL 480 recipients omitted from the data set are Austria, Finland, France, Germany, Hungary, Iceland, Italy, Japan, Malta, and Spain.

[2] Note that this "aggregate" cereals availability figures omits both food aid receipts other than PL 480 shipments and domestic cereals inventories, although these are both relatively small volumes.

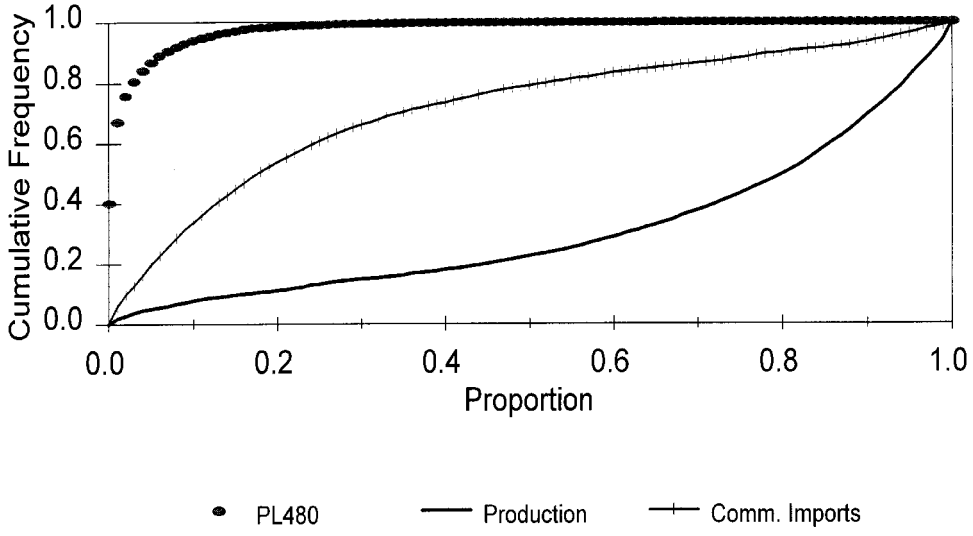
$$\ln(NA_t)=\alpha_{0N}+\alpha_{1N}\,YEAR+\varepsilon_{Nt} \quad (2)$$

Across the 124 PL 480 recipients, the median annual growth rate in per capita cereals production was -0.2 percent, i.e., more than half (53%) the countries suffered negative average annual growth. The voluminous literature on food aid emphasizes its potential disincentive effects on recipient country production, and perhaps the sluggish growth in recipient production reflects this (Maxwell and Singer 1979; Ruttan 1993; Barrett forthcoming). Rapid growth in PL 480 recipients' commercial cereals imports has made up for sluggish cereals production growth. The median annual growth rate in per capita nonconcessional cereals availability was 0.5 percent, the same as the global growth rate in per capita cereals production (and therefore global NA). Still, more than one-third (37%) of the countries exhibit negative average annual growth even in NA.

Table 1. Shares of Aggregate Cereals Availability; PL 480 Recipients, 1961-95

	Own Production	Commercial Imports	PL 480
Mean	0.693	0.286	0.021
Median	0.803	0.176	0.002
Std. Deviation	0.294	0.286	0.047
Maximum	1.000	1.000	0.644
Minimum	0	0	0

Figure 1. Aggregate Cereals Availability Shares; PL 480 Recipients, 1961-95



While the trends are informative, the variability around trend NA is of at least as much interest, in that this reflects short-run instability in food supplies to which food aid is supposed to at least partly respond if it is to serve food security objectives. The standard errors of the residuals of equations (1) and (2), ε_{Pt} and ε_{Nt}, capture this interannual variability around trend production and nonconcessional availability, respectively. In the next section, I study the empirical relationship between PL 480 flows and ε_{Nt} in order to test whether PL 480 flows stabilize food availability (i.e., covary negatively with shocks to trend nonconcessional food availability). But first, let's quickly look more carefully at the regression results from equations (1) and (2).

Among PL480 recipients there exists a negative univariate relationship between the average annual growth rate and the standard deviation around trend of cereals production per capita. Let v_P be the standard deviation of the ε_{Pt} series and v_N be the standard deviation of the ε_{Nt} series. Regressing v_P on α_{1P} and an intercept term yields a partial correlation coefficient estimate of -0.914 (with a standard error of the estimate of 0.465).[3] This simple result supports the intuitive hypothesis that faster growth in cereals productivity tends to bring with it greater stability in per capita production. Put differently, agricultural development appears important not only to increasing developing countries' food availability but also to stabilizing food availability. Since own production comprises by far the greatest share of developing countries' food availability, this relationship deserves serious attention.

Moreover, because production makes up the bulk of countries' food availability (Figure 1), domestic food production drives nonconcessional food availability. The simple ordinary least squares regression of the annual average growth rates in PL 480 recipients' nonconcessional cereals availability, α_{1N}, on production per capita, α_{1P}, shows that the two are positively and statistically significantly related, as one would expect.[4] The statistically significant, sub-unit (0.644) estimated partial correlation coefficient also reflects the effective role that commercial international trade plays in stabilizing food availability in developing countries. NA responds at less than a one-for-one rate to changes in domestic production. Commercial trade's stabilizing effect is also reflected by the fact that $v_N<v_P$ in more than 80 percent of the sample recipients. The mean reduction in the standard deviation of per capita cereals volumes is greater than eight percent per annum, from $\bar{v}_P = 0.237$ to $\bar{v}_N = 0.156$. Contrary to some populist claims, commercial food trade contributes significantly to the stabilization of food availability in developing countries.

While commercial cereals trade plays a crucial role in stabilizing food availability in low- and middle-income countries, binding foreign exchange constraints nonetheless commonly limit the capacity of poorer countries to dampen food supply volatility through commercial markets. At 15.6 percent, the standard deviation of NA per capita in PL 480 recipients remains more than three times the world standard deviation around trend of 4.7 percent. Indeed, 122 of 124 PL480 recipients evince more variable NA than the global rate (all except Georgia and Russia). Given the residual

---

[3] Unlike, cereals production, NA variability and growth rates are unrelated in the set of PL 480 recipient economies.

[4] The OLS regression result is: $\alpha_{1N} = -0.006 + \underset{(0.102)}{0.644}\ \alpha_{1P}$

need for food consumption smoothing in developing countries, the core question remains: have PL 480 food aid shipments helped to stabilize food availability in the face of extraordinary variability in recipients' nonconcessional food availability? Put differently, how effectively has PL480 targeted food insecurity at the national level?

PL 480 Responsiveness To Need: An Empirical Analysis

PL480 flows have dominated global food aid since the program's inception in 1954. There are two basic types of PL480 food aid: program (Titles I and III) and emergency (Title II). A primary reason to examine PL480 flows disaggregated between program and emergency assistance is the popular belief that Title II flows are more responsive to need, particularly to short-term instability in recipient country NA. Yet program food aid has long dominated PL480 flows. Between 1954 and 1995, Titles I and III of PL480 accounted for better than 80 percent of the more than 300 million metric tons of U.S. food aid and more than half of total worldwide food aid flows. That said, program (emergency) food aid has steadily diminished (grown) in importance over the past twenty years. Program flows averaged 86% of PL480 deliveries and were at least 80% each year prior to 1973, but averaged only 72%, 1973-95, and were above 80% only 3 of those 23 years. Title II shipments surpassed Title I flows for the first time only in 1993.

There are at least four interrelated reasons to be skeptical about the effectiveness of PL480 food aid in dampening variability in recipient country food availability. First, previous studies have shown US food aid has been driven largely by geopolitical considerations, with relatively little targeting toward countries with pronounced food deficits (Ruttan 1993, 1995; Ball and Johnson 1996). Political objectives tend to trump food security concerns in Washington. Second, and related to the first, PL480 flows have shown far greater persistence over the years than is consistent with the claim that they respond to transitory nonconcessional food availability shortfalls in recipient countries (Barrett 1998). Third, PL480 flows — indeed bilateral flows more generally — have proved procyclical in aggregate, not countercyclical, because they are budgeted in monetary rather than volume terms (Barrett forthcoming). Fourth, until quite recently few good early warning systems existed to anticipate emergencies accurately, so food aid deliveries are largely reactive and therefore often ill-timed. Of these four concerns, only the latter situation may be improving significantly in the case of PL480, although early warning systems continue to have a spotty performance record (Barrett forthcoming).

The simplest way to establish whether food aid dampens the variability of recipient country food availability is to estimate the empirical relationship between food aid flows per capita, FA, and both the levels, NA, and the deviations from trend NA , ε_N, from equation (2). If food aid flows to those most in absolute need, as reflected by a negative correlation between PL 480 and NA levels, then food aid can be described as progressive. If food aid responds negatively to deviations from national trend NA, then FA has a stabilizing, countercyclical effect. The magnitude of the latter relationship is of particular interest as it indicates the compensation proportion, i.e., the proportion of a shortfall that is made up for by PL 480 flows.

Since FA is a nonnegative variable often taking zero value, this relationship is estimated by the Tobit model:

$$FA_{it} = \beta_0 + \beta_1 \varepsilon_{Nit} + \beta_2 NA_{it} + \omega_{it} \qquad \text{if } FA_{it} > 0 \qquad (3a)$$

$$FA_{it} = 0 \qquad \text{if } FA_{it} = 0 \qquad (3b)$$

where i indexes recipient countries and t indexes years. β_1 captures the stabilization effect of food aid, while β_2 reflects the distributional effect. Since the data are pooled cross-sectional and time series, it is necessary to test first for fixed effects in cross-section, intertemporally, or both. The specification test statistics suggest it is necessary only to control for unobserved region-specific effects.[5] A bit later, I consider the results of country- and year-specific estimation of (3) to see whether imposing a universal relationship masks different relations in a nontrivial subsample of countries (it doesn't).

Four interesting results appear in Table 2. The β_1 and β_2 estimates are of uniformly low magnitude, most of the β_1 (β_2) estimates are positive (negative), and most of the estimates are not statistically significantly different from zero. The low magnitudes and statistical significance reflect the negligible contribution of food aid to aggregate food availability in food recipient economies, as suggested earlier by Figure 1. The negative and statistically significant β_2 estimate suggests that PL 480 has flowed somewhat more to food scarce than food abundant economies. Although the point estimates are of uniformly low magnitude, there appears to be some global progressivity to PL480 distribution. But the counterintuitively positive signs of the β_1 estimates suggest that food aid flows have been, if anything, procyclical, not countercyclical on average. The data support the claim that PL480 has been (modestly) distributionally progressive, but not that it has stabilized food availability.

These results hold not only in the full pool of 124 developing country PL 480 recipients, but also in three subsamples of particular interest. In the 1960s and into the 1970s food aid — especially program (Title I) PL 480 — was disproportionately concentrated on South Asia. For South Asia, home to the largest number of the world's food insecure, PL 480 flows have been statistically significantly procyclical while the estimated progressivity effect is not statistically significantly different from zero. Since the world food crisis of the mid-1970s, PL 480 — especially humanitarian (Title II) flows — have been disproportionately focused on Sub-Saharan Africa (SSA), the only world region in which the proportion of the population suffering food insecurity has not fallen significantly for a generation. PL 480 flows to SSA are of particularly low magnitude and statistical significance, and of the wrong (positive) sign to support either the claim that PL 480 has stabilized African food availability or the claim that food aid has flowed most generously to those countries most in need. Finally, I also ran the regression for an international group of countries whose PL 480 programs (or termination of those programs) are widely recognized as geopolitically motivated. One might suspect that the estimation results from the full sample are contaminated by the inclusion of

[5] Using the general model form $FA_{it}=\beta_0 +\beta_1 \varepsilon_{it} +\beta_2 NA_{it} +\sum_j \delta_j REGION_{jit} +\sum_t \gamma_t YR_{it} + \omega_{it}$ if $FA_{it} > 0$, likelihood ratio tests of the joint restrictions $\delta_j =0 \ \forall$ j, $\gamma_t =0 \ \forall$ t, or both yield test statistics that uniformly support rejecting the null hypothesis of $\delta_j =0 \ \forall$ j at any level of statistical significance for program, emergency, or all PL 480 aid, and uniformly fail to support rejecting the null hypothesis of $\gamma_t =0 \ \forall$ t at even the ten percent significance level for program, emergency, or all PL 480 flows. Test details are available from the author by request.

Table 2. Tobit Regression Results, All PL 480 (Titles I, II, and III)*

	All 124 Countries	South Asia[a]	Sub-Saharan Africa[b]	Geopolitically Motivated[c]
β_1 (stabilization effect)	0.001 (0.004)	0.038 (0.012)	0.001 (0.002)	-0.008 (0.010)
β_2 (distributional effect)	-0.029 (0.010)	-0.029 (0.037)	0.014 (0.012)	-0.008 (0.029)
ln(L)	-553.0	-231.6	-319.6	-188.0
n	3838	210	1453	880

Standard errors in parentheses.

*Tobit regressions including regional dummy variables to control for fixed effects. Regions included are Central Africa, Central America, East Africa, East Asia, Europe, Middle East, North Africa, North America, South America, South Asia, Southeast Asia, Southern Africa, former USSR, West Africa, West Asia, and former Yugoslavia. South America is the base for the global model, West Africa is the base for the Sub-Saharan Africa model, and Europe is the base for the geopolitically motivated model. No fixed effects were found in the South Asia model.

[a]*South Asia*: Afghanistan, Bangladesh, India, Nepal, Pakistan, Sri Lanka.
[b]*Sub-Saharan Africa*: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Canary Islands, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Sao Tome Principe, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe.
[c]*Geopolitically Motivated*: Afghanistan, Belarus, Bosnia, Cyprus, Dominican Republic, Egypt, El Salvador, Ethiopia, Gaza Strip, Haiti, Honduras, Iran, Iraq, Israel, Jordan, Korea, Laos, Lebanon, Nicaragua, Philippines, Poland, Russia, Somalia, Sudan, Syria, Taiwan, Ukraine, Vietnam, Zaire.

countries whose PL 480 programs have been plainly driven by non-economic and non-humanitarian considerations. The curious result is that while the magnitudes and statistical significance of the parameter estimates are also low, only in this subsample do we get negative point estimates for both β_1 and β_2. So the subset of geopolitically motivated PL 480 country programs do not seem to distort the estimation results in the full sample.[6] The results are also qualitatively unchanged when we reestimate off emergency (Title II) food aid alone or program (Titles I and III) food aid alone, as shown in Tables 3 and 4, respectively. PL 480 food aid, of any sort, has not stabilized food availability on average in recipient economies, even though its distribution has been modestly progressive on a global -- if not always regional -- scale.

Given the idiosyncracies of PL 480 programs in individual recipient countries, and the evolving rhetoric and operational codes of PL480 over 35 years, one might be skeptical of the results from regressions using data pooled across countries and years. The same qualitative results obtain,

[6] The qualitative results in the rightmost column of Table 2 are robust to each of the several combinations of countries tried in the "geopolitically motivated" set.

Table 3. Tobit Regression Results, Emergency (Title II) PL 480

	All 124 Countries	South Asia	Sub-Saharan Africa	Geopolitically Motivated
β_1 (stabilization effect)	0.001 (0.001)	0.002 (0.002)	0.001 (0.001)	-0.00003 (0.001)
β_2 (distributional effect)	-0.006 (0.001)	-0.008 (0.007)	0.005 (0.004)	-0.009 (0.004)
ln(L)	-2299.2	-385.4	-619.4	-823.7
n	3838	210	1453	880

Standard errors in parentheses. Same notes apply as on Table 2.

Table 4. Tobit Regression Results, Program (Titles I and III) PL 480

	All 124 Countries	South Asia	Sub-Saharan Africa	Geopolitically Motivated
β_1 (stabilization effect)	0.0004 (0.004)	0.037 (0.011)	0.001 (0.002)	-0.008 (0.009)
β_2 (distributional effect)	-0.025 (0.009)	-0.023 (0.035)	0.009 (0.009)	-0.003 (0.027)
ln(L)	-623.8	-240.9	-374.7	-206.3
n	3838	210	1453	880

Standard errors in parentheses. Same notes apply as on Table 2.

however, when one examines the distribution of country- or year-specific estimation results.[7] For example, the distribution of country-specific estimates of model (3) shows that most parameter estimates are statistically insignificantly different from zero, extraordinarily few β_1 estimates are less than -0.1 (which would imply ten percent average stabilization effect from PL 480 flows) or even statistically significantly negative, and PL 480 most commonly flows procyclically around recipients' food availability trend, not countercyclically (Table 5). The consistency between the patterns found in the distribution of parameter estimates derived from the country-specific time series and the estimated from the pooled sample reported in Tables 2-4 suggests that country-specific differences due to variation in local PL480 operations or recipient country policy do not explain the failure of food aid to stabilize food availability. Although not reported here, the same basic results are obtained

[7] In estimating the country-specific time series, the regression residuals were subjected to diagnostic portmanteau statistics for autocorrelation. In those (relatively few) instances where autocorrelation was evident, appropriate correction was made using Box-Jenkins techniques.

in cross-sectional, in the distribution of year-specific estimates.[8] Moreover, the common claim that improvements have been made to PL 480 operations based on past lessons learned finds no support in these estimates. There were only five years, 1961-95, in which both the β_1 and β_2 point estimates were positive in cross-section. Three of the five came in the 1990s, in emergency, program, and pooled PL 480 samples alike. So the claim that PL480 distribution meets distributional and stabilization goals more effectively today than in the (Cold War) past finds no support in these data.

Table 5. Descriptive Statistics of Country-Specific Tobit Regression Results

	All PL 480	Title II only	Titles I and III only
Stabilization effects:			
$\beta_1 > 0$ (%)	67.7	67.6	71.8
Reject H_0: $\beta_1 = 0$ (%)	26.6	28.8	43.5
o/w $\beta_1 < 0$ (%)	6.4	8.9	9.9
10^{th} percentile β_1	-0.084	-0.002	-0.074
Median β_1	0.014	0.004	0.008
90^{th} percentile β_1	0.152	0.055	0.345
Distributional effects:			
$\beta_2 > 0$ (%)	36.3	30.6	56.4
Reject H_0: $\beta_2 = 0$ (%)	17.7	17.1	34.6
o/w $\beta_2 < 0$ (%)	11.3	11.7	24.3
10^{th} percentile β_2	-0.091	-0.034	-0.187
Median β_2	-0.008	-0.003	-0.012
90^{th} percentile β_2	0.074	0.017	0.088
n	124	111	78

The macro data used in this analysis cannot capture prospective changes in the efficacy of intranational food distribution systems in reaching food insecure subpopulations. So although these regression results suggest food aid is ineffective in stabilizing food availability at the macro level, and indeed may be more likely to modestly *destabilize* food availability in recipient countries, it is possible that food aid targeting within recipient economies is nonetheless much more successful in stabilizing food availability for particular food-insecure communities or individuals. There is certainly much anecdotal evidence of emergency food aid distributions proving helpful in averting humanitarian disasters on short notice (Barrett forthcoming; Shaw and Clay 1993). And there has been notable progress in the modalities of emergency food aid delivery, although this seems more true for World Food Programme distributions than PL480 flows (Barrett 1998, forthcoming; Clay et al. 1996).

[8] A table presenting these results is available from the author by request.

Nonetheless, emergency food aid deliveries are often mistimed, misallocated, or both, sometimes doing more harm than good (Jackson with Eade 1992; Stewart 1998). And the only study of which I am aware that studies community- and household-level food aid targeting using micro-level data finds that food aid flows disproportionately to the most food secure regions and households in Ethiopia (Clay et al. 1998).[9] Given the uneven project-level performance of Title II PL480, the evidence presented here puts the burden of proof on those who would claim that PL 480 food aid is effectively targeted to overcome its insignificant macro-level effects in stabilizing recipient food availability.

Conclusions

Improving food security and nutritional outcomes around the world will require dampening the extraordinary variability in per capita food availability in low-income economies. Improved food productivity and commercial international trade appear far more useful than PL 480 food aid in achieving that objective. The small volumes, opaque allocation mechanisms, and bureaucratically cumbersome procurement procedures behind PL 480 have made food aid a relatively ineffective response mechanism to instability or insufficiency in macro-level food availability. While there are surely particular emergencies in which food aid can play an effective role in stabilizing and improving food availability (Shaw and Clay 1993, Ruttan 1995, Stewart 1998), commercial trade and more rapid domestic food productivity growth both appear more effective in stabilizing developing country food availability in the regular course of development. Perhaps if food aid were targeted entirely toward relieving food insecurity it could be a more effective instrument. But food aid has long been intensely political, serving many masters. So long as that remains the case, food aid is unlikely to stabilize per capita food availability effectively.

[9] Note that cross-sectional studies like Clay et al. (1998) test only what I term the "progressivity" of food aid distribution. No one appears to have yet studied the dynamic "stabilization" effects at the micro level.

References

Ball, Richard and Christopher Johnson (1996). "Political, Economic, and Humanitarian Motivations for PL 480 Food Aid: Evidence from Africa," *Economic Development and Cultural Change*, 44, 3: 515-537.

Barrett, Christopher B. (1998). "Food Aid: Is It Development Assistance, Trade Promotion, Both or Neither?" *American Journal of Agricultural Economics*, 80, 3: 566-571.

Barrett, Christopher B. (Forthcoming). "Food Security and Food Assistance Programs," in Bruce L. Gardner and Gordon C. Rausser, editors, *Handbook of Agricultural Economics* (Amsterdam: Elsevier Science).

Clay, Daniel C., Daniel Molla, and Debebe Habtewold (1998). "Food Aid Targeting in Ethiopia: A Study of Household Food Insecurity and Food Aid Distribution," Michigan State University mimeo.

Clay, Edward J., Sanjay Dhiri and Charlotte Benson (1996). *Joint Evaluation of European Union Programme Food Aid: Synthesis Report* (London: Overseas Development Institute).

Jackson, Tony with Deborah Eade (1992). Against The Grain: The Dilemmas of Project Food Aid (Oxford: OXFAM).

Ruttan, Vernon W. (1993). *Why Food Aid?* (Baltimore: Johns Hopkins University Press).

Ruttan, Vernon W. (1995). *United States Development Assistance Policy: The Domestic Politics of Foreign Economic Assistance* (Baltimore: Johns Hopkins University Press).

Shaw, John and Edward Clay, eds. (1993). *World Food Aid: Experiences of Recipients and Donors* (Portsmouth, NH: Heinemann).

Stewart, Frances (1998). "Food Aid During Conflict: Can One Reconcile Its Humanitarian, Economic and Political Economy Effects?" *American Journal of Agricultural Economics*, 80, 3: in press.

A Role for Capital Markets in Natural Disasters: A Piece of the Food Security Puzzle

Jerry R. Skees

Introduction

Agricultural development is the key to food security in many countries around the world. Natural disasters reduce domestic food supplies in the short-run and retard agricultural development in the longer-run. Natural disasters are a major source of risk for production.[1] And while many alternatives are used to cope with this type of risk, careful consideration of the consequences of these alternatives is essential.

This paper evaluates the consequences of alternatives to cope with natural disasters by first developing a conceptual frame for understanding these risks and then reviewing some alternatives. The challenge for introducing market-based solutions is evaluated by focusing on one source of natural disaster risk – drought. Market-based policies that pay when there is a shortfall in rain offer some promise for coping with many of the problems identified. Such 'index-based' policies could be applied to many natural disasters. Risk-sharing using these methods will require an active participation from capital markets. New developments in capital markets give reason for optimism. Still, there may be a role for government in developing the market for risk-sharing for natural disasters.

The Role of Risk-Sharing in Agricultural Development

In a market-based economy risk must be internalized. Farm managers have many means for coping with risk. Diversification in enterprise mix or in use of family labor for both on and off-farm jobs is a common and dominant choice. Diversification does not come without a cost. The benefits of specialization in production are well-documented in economics (Debreu). When farmers diversify they give up the higher expected income that would come with specialization to reduce the variation in income. In effect this can be thought of as an insurance premium. Another means of managing risk involves use of credit reserves. If the firm decides to limit the use of credit below a level that may be optimal, the opportunity to borrow funds will be open in the event of a major disaster. Again, there is an opportunity costs associated with maintaining a credit reserve for major disasters. This competes with desires to maintain credit reserves that would allow the firm to take advantage of unforeseen opportunities.

Possibly more significant, if farmers do not have the means to manage catastrophic risk from natural disasters, bankers will be forced to internalize these risk in some fashion. When bankers

[1] By natural disasters I am referring to risks that cover a wide area at the same time. For example a major drought, excess rain, hurricanes, or volcanoes can inflect wide-spread damage to production agriculture. In small countries, these types of disasters also create short-term food security problems.

recognize that loan defaults are tied to natural disasters they will either 1) ration credit or 2) build in a credit premium to cover these risks (i.e., charge higher interest rates). There are no free lunches. Agricultural risks are an impediment to fully developed financial markets in many developing countries. Access to affordable credit is a key to development. With affordable credit farmers can adopt new technologies and take more risk in developing improved farming systems. There is a catch twenty-two – if farmers had access to credit they could mange agricultural risk better – if bankers did not have to worry about loan defaults from agricultural risks they wold provide more access. In many countries, the financial markets are incomplete. Effective risk-sharing markets for natural disaster risks are largely lacking the world over. If such markets existed, one might expect the following: 1) more access to affordable credit; 2) more rapid adoption of new technologies; 3) more specialization in production; and 4) a more adaptive and flexible agricultural sector.

Most economists agree that using insurance allows decision makers to engage in new productive activities with benefits for the entire economy (Arrow 1964, 1996). However, great care must be taken. Farmers must pay for the risk protection and the market contract must be structured so that it cannot be abused. These two conditions are fundamental to a sustained risk sharing program and to one that results in welfare gains to society. If farmers are given risk protection via various subsidies, significant inefficiencies will follow, and some of these inefficiencies may have negative environmental consequences. If the contract is subject to abuse, the losses must be added to future premiums and soon there will be no private interest in either purchasing or supplying insurance.

With classic insurance, pooling independent loss events yields a mean loss for the pool that has a variance that is less than the mean of the individual variances. This result is derived from the classic statistical property of the “law of large numbers." Thus society benefits from pooling independent risks since the risk faced by the pool is less than the pre-aggregated sum of individual risks (Priest). In short insurance markets *reduce* the risk faced by society and thus the aggregate cost of managing risk.

Attempts to Manage Natural Disaster Risk

A variety of alternatives have been used to protect societies against the adverse effects of natural disasters. Free assistance is likely the most common. While such assistance may be necessary for humanitarian reasons, there are reasons to proceed with caution. Free assistance sends the wrong signals. Consider the response. Decision makers will soon value the free assistance and change their behavior in ways that will ultimately lead to more losses. If the government gives free assistance to farmers who lose their crops on a regular basis, the farmers will plant more crops and collect more disaster payments in the future. Such a decision creates a cycle that may be burdensome to the government budgets, the environment, and to the people taking the undue risks. There is a rich literature discussing the public policy problems created when free disaster assistance is provided (Dacy and Kunreuther; Kaplow; Kunreuther 1973, 1993, 1996).

Governments have also been active in providing government supported insurance. In many cases the government has been the direct retailer and risk-bearer of such insurance programs. For the US crop insurance program, the government uses the private sector to deliver subsidized crop

insurance and share the risk of the crop insurance through a special reinsurance agreement with the government. Whether the government sells insurance directly or uses the private sector, there are problems. Most government insurance is subsidized as a percent of premium. Providing subsidies as a percent of premium still favors more risky areas more than less risky areas, sending similar signals as free disaster aid. Further, the transaction costs of providing individual insurance can offset any welfare gains for society. Finally, allowing the private sector to sell government insurance and share the risk creates rent-seeking behavior that can destroy the efficiency gains for society (Goodwin and Smith; Hazell, Pomareda, and Valdes; Mishra). Hazell does a nice job of developing reasons multiple-peril crop insurance programs have failed in developing countries.

Incomplete Risk-Sharing Markets for Natural Disasters

There are several reasons why private markets have not developed for risk-sharing from natural disasters that damage agriculture. First, it may be that government actions have crowded out such market development. Private insurance does exist for earthquakes and hurricanes in the U.S. Second, the transaction costs of insuring farm level yields are high because of information asymmetries. Third, the risk from natural disasters is widespread and correlated creating huge losses and requiring special forms of risk-sharing. In fact, this is a reason given by many for needing government involvement. Finally, it is possible that there is a cognitive failure problem on the part of many decision makers who undervalue insurance.

Government Crowding Out Markets

Governments may simply crowd out private sector interest. Many governments generally provide assistance to communities ravaged by natural disasters and operate highly subsidized public crop insurance programs. Such government activities have been blamed for competing unfairly with private insurers, stifling development of innovative insurance products. Governments also tend to regulate the insurance sector heavily creating another burden to innovation.

Information Asymmetries

Incomplete agricultural and rural risk markets also stem from information asymmetries. Farmers will always know more about their yield risks than the government or any private company. Thus the classic problems of adverse selection and moral hazard can create serious problems for any multiple peril crop insurance program. There is an extensive literature on these problems (Goodwin and Smith; Ahsan, Ali, and Kurian; Skees and Reed). If individual risks are not properly classified prior to selling insurance, then high risk growers may be the only ones to participate. Such adverse selection will create losses that are greater than the insurance premium rates creating a need to continually raise rates. By the same token, if insureds change their behavior after they purchase insurance in ways that create more losses because they are insured, rates will need to be increased on a regular basis. This is moral hazard. Controlling adverse selection and moral hazard requires investments in information. Investing in information will add to the transaction costs of delivering insurance. This increases premiums and reduces demand for insurance.

Correlated Risk

Independent risk is a classic pre-condition for insurance (Rejda; Vaughan). When risks are not independent, markets may be incomplete. The widespread nature of natural disaster losses undermines the ability of insurance companies to pool risks and offer affordable insurance coverage. Although crop losses are often widespread, they may not be completely correlated. General price movements for a bulk agricultural commodity are generally correlated. Such correlated risks can be managed with futures exchanges. In many ways, crop and natural disaster risks are "in-between risks." They are neither completely correlated nor independent (see figure 1). New ways of thinking are required to introduce markets for such "in-between risks." When insurance is offered for natural disaster risks the rates must be loaded for catastrophes because of the nature of the risk. In effect, the potential seller must overestimate the pure risks.

Figure 1: Independent versus Correlated Risk

0 correlation	In-between risk	100% correlated
AutoAccidents	Natural Disasters	Commodity Prices
Heart Attacks	Rainfall/ crop yields	Interest rates
Insurance Markets	Government/ ? ?	Futures Markets

Cognitive Failure by Decision Makers

Cognitive failure problems may also contribute to the problem of incomplete risk-sharing markets (Kunreuther 1996 Tversky and Kahneman; Kunreuther and Slovic). If decision-makers underestimate the risks they face, they will be less willing to purchase risk-sharing products. Interestingly, decision makers seem to underestimate risks from natural causes and overestimate risks from man-made causes (Camerer and Kunreuther; Kunreuther 1976). If potential purchasers of insurance underestimate the risk and potential sellers overestimate the risk, a market will not evolve.

Insuring Natural Disasters

Insurance is available for natural disaster risk in developed economies. Homeowners can insure against damage from hurricanes and earthquakes. These risks are clearly different than most insurable risk. Unlike automobile insurance where the risks are largely independent, natural disaster risk are correlated with some low probability of very high losses as a widespread area is damaged by a single event. This requires special arrangements to share these risks in the capital markets. Primary insurers pass on certain levels of risk to an international reinsurance market (Miranda and Glauber; Cutler and Zeckhauser).

The simplest form of reinsurance is a stop loss where the primary insurer pays a premium to get protection if their losses exceed certain levels.[2] For example, if an insurance company has a book of business that is concentrated in a hurricane prone area they would likely need such reinsurance. If they have $100 million of property value insured with an average premium rate of 10 percent, they would collect $10 million in premiums. While this company may have another $10 million in assets to cover significant losses, they cannot cover losses beyond the combined $20 million level or beyond a loss ratio of 2 (indemnities / premiums). They may decide to buy a stop loss where the reinsurer pays for all losses above the $20 million level.

The reinsurer has an interesting problem – how does one rate a policy for a low probability high-loss event? While there are very sophisticated models used to address this problem, most wise reinsurers will load the risk beyond levels experienced in the past (Anderson; Hogarth and Kunreuther 1989, 1992). Things can always get worse. Or as anyone in the risk management business will say "just because it has never happened, that doesn't mean it won't." The other problem is intertemporal. Suppose the big hit comes in the first year. This will require capital reserves to pay large losses. Rate makers load to build these reserves quickly for early losses. Finally, keep in mind that all of the issues of asymmetric information apply for the principle-agent relationship between the primary insurer and the reinsurer. Reinsurers must invest in monitoring and information systems to balance the information. This increases transaction costs. In the end, all of these costs must be summed together with the pure risk of the contract to develop a premium rate.

(1) Premium Rate = Pure premium rate + Catastrophic Load + Reserve Load
+ Charge to cover transaction costs + Return on equity

It is little wonder that premium rates can exceed the expectations of decision makers who tend to forget bad events from natural disasters. These arguments are used to justify government involvement. Efficiencies are needed. Large international reinsurers can spread risks around the world -- applying all of the principles of portfolio theory. If the portfolio of reinsurance is large enough, what may be low-probability high catastrophic events for a small company become a largely independent and diversifiable risk for the large reinsurer. There has been significant growth in the international reinsurance markets. Walter reports a compound growth rate of 16% and estimates that, in 1997, all premiums from reinsurance may be greater than $100 billion.

Yet, reinsurance markets are thin with few large international firms and limited capacity. Kunreuther (1996) and Stipp review some of the problems with reinsurance markets. Reinsurers have short memories. After a major catastrophe reinsurance prices increase greatly or the reinsurer simply pulls out of the market. This happened in Florida after Hurricane Andrew and in California after the Northridge earthquake. State reinsurance pools were created in both Florida and California to offset these problems (Noonan; Jaffee and Russell).

Improved efficiencies are needed in reinsurance markets. The transaction costs of putting together large sums of capital can be high. There are new developments that hold promise for reducing the transaction costs (Doherty; Lamm). There is some promise that exchange markets can

[2] Other forms of reinsurance are also common. For example, quota-share arrangements involve simply sharing both premiums and indemnities.

be used as risk-sharing institutions for disasters. The Chicago Board of Trade (CBOT) trades a Catastrophic Insurance Options Contract (CAT). Property Claim Services (PCS) catastrophe loss indices are traded for nine geographic regions in the U.S. As such, the contract allows those at risk from large property and causality losses due to hurricanes or earthquakes to share some of that risk with a larger community of traders in an exchange market. The contract has grown a good deal in recent year but still comprises only about two percent of the total market.

Another important development is the emergence of catastrophic bonds. This is truly using of capital markets to share catastrophic risk. These take on a variety of structures. In essence, they represent contingent capital should the disaster occur. Some have called the CAT bonds the ultimate junk bond – you have a very high probability of getting a high rate of return on your money or you have a very low probability of losing everything. Since catastrophes are not correlated with other market equities, they should be a good diversification strategy for portfolio managers.

The use of the capital markets for sharing "in-between" risk remains in the infant stages, leaving the issue of capacity and efficiency in doubt. This raises questions about the role of government in sharing such risk. For the U.S., Lewis and Murdock recommend government catastrophic options that are auctioned to reinsurers. Part of the thinking is that the government has adequate capital to back stop such options and may be less likely to load these options as much as the reinsurance market.

Using Index Contracts to Insure Natural Disasters

There are serious questions about trying to insure individual crop risks. Potential societal welfare gains can quickly disappear when there are high transaction costs for monitoring the micro level problems of adverse selection and moral hazard or if extra resources are needed by rent-seekers to keep subsidies. Without investments in monitoring, actuarial performance will almost certainly be poor (Hazel). The nature of the systemic risk also presents major challenges in reinsurance. When a significant systemic risk component is present, index contracts may be optimal. In other words, if most potential insureds face losses from the same events, then offering a contract that pays when those events occur can offer significant risk protection. Crop insurance that pays indemnities based on yield shortfalls from normal area yields is a case in point (Miranda; Skees, Black, and Barnett; Mishra).

The problem with index contracts is that an individual can have a loss and not be paid because the major event trigging a payment has not occurred. In futures markets this type of risk is referred to as basis risk. With index contracts it is also possible for an individual to be paid when they suffer no losses. While traditional insurers think this is a problem it is this very aspect that makes index contracts attractive. The insured paid the premium based on the underlying risk of the index so that is not an issue. Most importantly the insured's management decisions after planting a crop will not be influenced by the index contract. There is no moral hazard. The insured farmer (in this case) still has the same economic incentives to make a crop as the uninsured farmer.

The most serious aspect of basis risk for an index contract is that a farmer can have a loss and not get paid. If the basis risk is not too high, this issue is also not as serious as many make it to be.

First, consider that an index product should be more affordable than individual insurance. Second, if it protects against most of the risk, it can be better than having no other alternatives. Third, keep in mind that offering an index contract that takes most of the risks out and leaves only independent risks opens the possibility that an insurance company can offer an insurance contract for the independent risk. Such a wrap-around contract would still be subject to the same problems of high transaction costs due to monitoring and information needs by the insurer. If buyers are not willing to pay for the transaction costs then maybe a market should not evolve.

In short, index contracts tradeoff basis risks for transaction costs. Transaction costs of index products are generally much less than for individual insurance. Everyone should have access to the same information. Asymmetric information is not a problem. Again, with lower premiums because there is lower transaction costs a market might evolve. Still one must be concerned about the level of loading that may be necessary for an index contract. When one is writing index contracts on natural disasters, the degree of systemic risks can be significant. More will be said about this issue as alternatives ways to offer reinsurance for index contracts is discussed below.

Besides being largely free of adverse selection and moral hazard problems, index contracts can be made widely available. Traditional farm-level crop insurance is made available to farmers only. In reality many individuals are at risk when there is a natural disaster that does severe damage to crops. For example, the lender is clearly at risks if a large number of their borrowers suffer serious financial losses from the same event. Further, agribusinesses selling inputs to farmers or purchasing the final product are at risks. In particular an agribusiness that earns revenues based only on throughput of a basic commodity might find an area-based index contract attractive. Finally, individual consumers of basic food stuffs could purchase the index contract that would indemnify them when there is a food shortage in their area. There is no reason to limit who can purchase an index contract that pays when a natural disaster damages a crop. Farmers are not the only ones at risk.

Rainfall Index Contracts

One index contract that merits consideration for many developing countries is a rainfall index. While an area-yield contract may be preferred to a rainfall contract in many cases, there are a number of reasons why a rainfall contract may be better. First, many more countries likely have a better history of measuring rainfall with a government meteorological agency than the countries with quality statistics on crop yields. Second, it is less costly to set up a system to collect rainfall for specific locations than to develop a reliable yield estimation procedure for small geographical areas. Third, in some cases rainfall shortfalls or excess rain will influence income and not crop yields. Finally, either shortages or excess rainfall are the major source of risk for crop losses in many regions. Drought causes low yields and excess rainfall can cause either low yields or serious losses of yield and quality during the harvest. For irrigated farms, a drought can also cause increased costs as the cost of

irrigation may be tied to the level of water needed. Hazell mentions the possibility of developing rainfall insurance in his review of crop insurance for developing countries.[3]

For purposes of discussion some terms need to be defined:

Liability – the face value of the contract or the most you could ever be paid.
Pure premium rate – the expected losses in percent of liability terms
or frequency of loss x severity of loss
Strike – the level of rainfall where payments begin (usually as percent of average)

An area-based rainfall contract can be quite simple or complex. In order of complexity, there are three basic alternatives that merit consideration: 1) a zero-one contract that pays all liability when cumulative rain is at or below the strike; 2) a layered contract that pays an additional fixed amount of the liability as each layer is penetrated; 3) a percentage contract that pays based on percentage below the strike. While the simple contracts may be more attractive as they are easier to understand, the more complex contracts are more likely to offer the best risks protection.

The Zero-one Contract

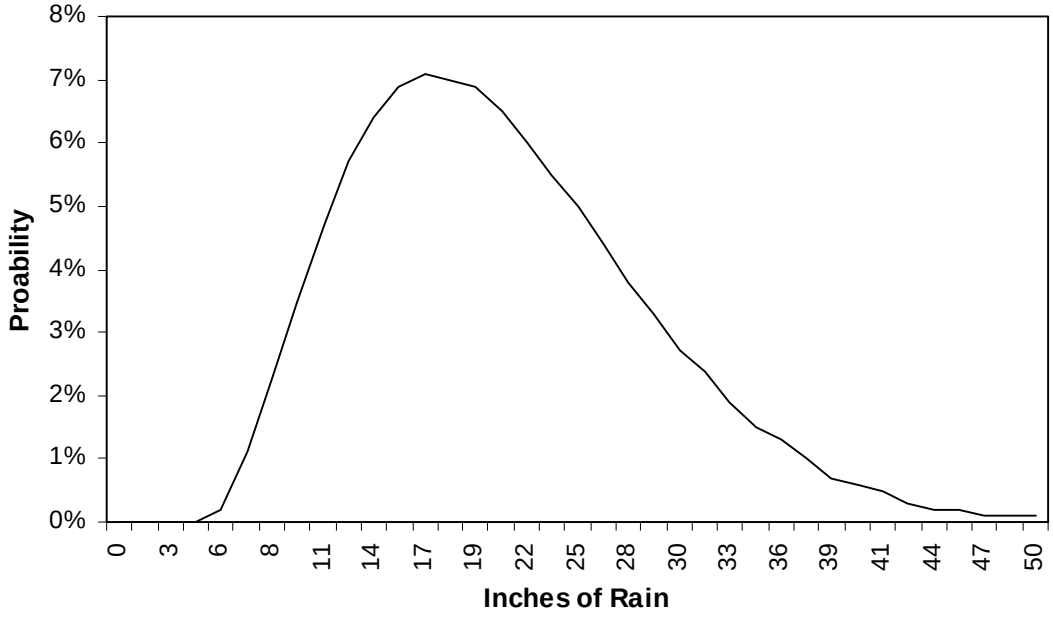
In it's most simple form, a rainfall contract would simply pay the full face value anytime there were a rainfall shortfall in a specific location. For example, let's say that the most critical period for rainfall is the first two months after planting. One could design a policy that would pay when rainfall is below a specific percentage of the average rainfall during that period. The payment schedule would simply be the face value (liability) of the contract.

Consider the probability distribution (pdf) represented in figure 2. In this pdf, the rainfall is positively skewed and has an average of 20 inches of rain with a standard deviation of 8 inches. If an individual purchases a $100 contract that pays if rainfall drops below 50% of the 20 inch average rainfall for the two month period, the strike is 10 inches. All $100 of liability would be paid for rainfall at or below 10 inches. For this pdf, such an event will occur 8.3 percent of the time. Since all liability is paid for rainfall at or below the strike, the pure premium rate would also equal 8.3 percent.

While the simplicity of the zero-one design is attractive, there are some shortcomings. First, the loss function is rarely bimodal. The relationship between rainfall and income is more likely a linear or curvilinear since the degree of damage is likely a function of how much below average the rainfall actually is. Second, making things so precise gives undue pressure for individuals to try to manipulate the system in some fashion. As the rainfall gets close to the strike, a fraction of an inch of rain either way can make the difference between paying all or nothing. Third, either premium rates would have to be very high or some very low levels of rainfall would need to be insured. Again, consider the pure premium rate of 8.3% for the distribution in figure 2. To complete the rating all

[3] Peter Hazel and I proposed such a program in Nicaragua as part of a World Bank credit project (Hazel and Skees). Mario Miranda and I are now working on this project (Skees and Miranda). Much of what is written here comes from these experiences.

Figure 2. Distribution of Spring Rain



factors introduced in equation (1) would need to be added to the pure premium rate. This may double that rate. Rates in excess of 10% are generally not attractive to potential purchasers of these type of contracts. Therefore, a zero-one contract may have to be written for very low and infrequent events – say one in twenty years or a 5% chance. If purchasers are not indemnified any more frequently than this, they are not likely to stay with the contract. Receiving some level of payment frequently is important because of some of the cognitive failure problems discussed above.

A Layered Contract

To address some the shortcomings of the zero-one contract consider a layered contract with multiple strikes paying a fixed additional amount when each layer is penetrated. Again consider the distribution in figure 2. We can design a policy that would pay one third of the face value (liability) for three levels of rainfall. For a $100 policy, consider the following payment schedule that starts paying for rain below 60 percent of the average:

If rain > 8 inches but <= 12 inches pay $33.33 odds of rain below 12 inches=15.8%
If rain > 4 inches but <= 8 inches pay $66.66 odds of rain below 8 inches = 3.0%
If rain <= 4 inches pay $100 odds of rain below 4 inches = 0%

To rate this policy, sum frequency x payouts (severity) for each layer:

.158 x $33.33 = $5.3 /$100 of liability
.030 x $33.33 = $1.0 /$100 of liability
.000 x $33.33 = $ 0 /$100 of liability

Total pure premium = $ 6.3/$100 of liability or a pure premium rate of 6.3 %[4]

A Percentage Contract

The third way to structure these contracts is to develop payouts as a function of rain below a strike level. Using percentages below the strike and multiplying those percentages by the liability selected is the most straight-forward functional relationship. Using the same strike rainfall of 12 inches, one would pay as follows:

(2) Payment = [(12 – actual rain) / 12] x liability

The rate is simply the average of the percentage shortfalls below the strike. For the distribution in figure 2 at the strike of 12 inches, the pure premium rate is 3.2%. Now it is possible to offer protection at higher levels. For example, offering coverage at 70 percent of the average or a strike of 14 inches has a pure premium rate of 5.6%.

Obtaining Risk Protection from A Rainfall Index

Extensions of portfolio theory are needed to evaluate the utility of a rainfall index. For the farm manager, the rainfall index simply becomes another enterprise in the portfolio of choices. In some cases, the rainfall index enterprise may offer a better portfolio than adding another crop, especially if better terms of credit are available when the rainfall index is purchased. While the full evaluation of these choices is involved and requires good data, there are some important considerations that will give some indication about the utility of using a rainfall index. Formal models have evolved from the original portfolio work by Markowitz. Capital asset pricing models, hedging models and contingent claims models all use the same basic constructs and principles: expected values of the alternatives; variance of the alternatives; and the covariance of the alternatives.[5]

For a rainfall index, the degree of correlation between net receipts from the index and farm income will play a large role in the effectiveness of the risk protection offered. With higher correlation there will be less basis risk. Understanding income-rainfall correlation requires crop yield modeling. Further, it is possible that a set of rainfall indexes may fit best for different farming systems. Farm income risks for certain crops may be most sensitive to rainfall shortfalls at different times during the season (e.g. planting and blooming). Income may also be at risk during harvest if there is excess rain (the designs described above can be applied to excess rainfall contracts as well).

[4] If the same procedures are used with a starting coverage level at 60% of average and 5 layers, the pure premium rate drops to 5%.

[5] In the final version of this paper, the equations will be developed to demonstrate these properties.

CAPM type models can be used to determine the optimal level of these contracts once the income-rainfall relationships are understood (Miranda does this for an area yield contract). One advantage of CAPM type models is they also help sort out the independent risk and the systemic risk. This is critical as systemic risks are the "in-between" risk that concern the insurer and reinsurer. Therefore, index products are a bit different than traditional insurance in that the very presence of high levels of systemic risks improves their attractiveness. To the extent that there is high spatial correlation between rainfall stations in a region, the exposure for an insurance company would be even higher. The reinsurance issues must be resolved. Before moving to that issue, it is useful to summarize the advantages and potential difficulties of the rainfall contract.

The advantages of a rainfall contract include:

1) Low moral hazard and adverse selection.
2) Low administrative cost since no on-farm inspections are needed and no individual loss adjustments are required.
3) There is no need to track yields or financial losses (one need only measure rainfall). The insurance can be sold to anyone who has income that is correlated to the rainfall event, including bankers, agricultural traders and processors, farm input suppliers, shopkeepers, consumers of basic commodities, and agricultural worker.
4) The contracts could be sold as a simple certificate at low denominations.
5) To the extent that these contracts cover a large systemic risk component, they can facilitate development of other kinds of insurance to handle independent risk.
6) Since the insurance would be sole as certificates, a secondary market could emerge enabling people to cash in the tradable value of a standard unit contract at any time.

The potential difficulties include:

1) The need to have reliable and secure rainfall measures for a large geographical area
2) The need to model intertemporal weather events such as El Nino.
3) Mistakes could be made in selection of the critical rainfall periods and in other contract design features.
4) The difficulty of potential purchasers in understanding how to use the contracts.
5) The high degree of correlated risk making it necessary to have reinsurance.

Using Government to Address the Potential Difficulties

To the extent that the government helps in development of rainfall contracts it will lower the transaction and start up costs. Some government assistance would be needed in most developing countries. There is a public good in developing research needed to understand the critical periods for rainfall (i.e., those periods that are most highly correlated with income). Public research to model El Nino events is needed. Investing in the infrastructure for secure and reliable rainfall stations also has some public good dimensions. Governments may also engage in the educational efforts needed to help potential users know how to evaluate purchase decisions. These public investments help assure transparency in information, an important condition for efficient markets.

Secure and reliable rainfall measures are critical for all parties. New technologies hold significant promise. One company in the US offers a rain gauge operated by a battery with a five year life. Tiny buckets trip the measuring device so that rainfall at .01 of an inch can be recorded. No rain is collected. By using a data jack with windows based software, a worker simply plugs into the rainfall measuring device and downloads the data. This can go as long as one month between intervals. A complete system of 50 such gauges, software and data jack cost about $240 each. This is affordable and offers the opportunity to densely populate a region with rain gauges. Finally, geographically smoothing can be used with a heavily populated set of rain gauges to provide point estimates for rainfall. This has great promise for reducing opportunities for any individual to tamper with a single gauge and to reduce the basis risk of offering a contract on a rain gauge that is several miles form the crop. Security can be enhanced by placing the rain gauges on telephone poles with shields around them from below.

To give companies the comfort needed to insure rainfall in a developing country, the government may consider writing low probability insurance contract on individual rainfall stations. Primary insurers and reinsures would determine how many and what mix of such contracts to purchase from the government. These contracts could be simply rated at the historical break-even rate, or they could be auctioned to the highest bidder. The World Bank or others in capital markets could back up these contracts with a contingency loan so that the government would have sufficient capital to pay all losses if the bad year came early in the pilot test. In effect, the capital markets would be offering a stop-loss type contract to the government.

To make this clear, consider a hypothetical scenario. A primary insurance company in decides to offer several drought contracts to farmers, bankers, and others for limited test market. To make this simple, let's say that only one contract is available at each station. That contract pays when cumulative rainfall in the months of May through July is less than 75 percent of the average rainfall at each station. Between 75 and 50 percent, the contract pays 1/3 the face value. Between 50 and 25 percent of the average, the contract pays 2/3's the face value and for rainfall that is 25 percent of the average the contract pays the full face value. Again, assume that the primary insurer sells $1 million of these with a face value of $10 million. In the worst case, if each rainfall station had rainfall of less than 25 percent of average, the insurer would pay $10 million. For these three stations such an event has never occurred. However, that does not mean it is not possible. Such a possibility would be priced by a reinsurer and this would likely make the reinsurance more expensive for the primary insurer.

The host-country government could sell individual rainfall contracts to reinsurers to prevent this. For example, the government may sell a rainfall contract for each station that pays in two stages: 1) 50 percent of the face value for rainfall below 40 percent of the average; and 2) 100 percent of the face value for rainfall below 20 percent of the average. There are many possible contracts. The government would sell very low level coverage for each station. The reinsurer would have to purchase the mixture of these that would best protect their risk. As the government sells these, they must have the capital to pay if the bad year comes early. For small countries this could be a problem The World Bank, an international reinsurer, or a financial entity that is ready to write CAT Bonds could offer simple 'stop-loss' coverage via a contingency loan. For example, if the government sold premium of $500,000 for these contracts, at premium rates of 5 percent, the maximum possible loss would be 20 times the total premium or $10 million. While the expectations are that the government

would break-even over the long run, they could have the bad event early. The World Bank or the international capital markets would cover such an event with a loan. As things are phased in, the government may want to offer these contracts in a limited number via an auction to move the market to an insurance market. Or the government may be able to build a reserve fund and offer the contracts without outside capital after some time. A system needs to be established to consider the alternatives as things develop. The primary objective should be to move to a market-based system with little or no involvement in reinsurance from the government.

Conclusion

Food security has many dimensions. Natural disasters challenge food security in the short-run with food shortages and in the long-run with underdevelopment of the agricultural economy if there are incomplete risk-sharing markets. Attempts to introduce multiple peril crop insurance programs in developing economies have largely failed. This paper reviews some of the reasons for that failure. Based on this review and an introduction on international reinsurance markets for natural disasters and new capital markets, an alternative is presented.

The case for using a rainfall index in developing countries rather than traditional crop insurance is strong. Among the more important advantages is the absence of moral hazard and adverse selection and that an index can be sold to anyone at risk. Three major challenges must be addressed before effective rainfall contracts are introduced: 1) the critical periods rainfall and how correlated they are to income for those at risks; 2) the need for a secure and reliable infrastructure to measure rainfall; and 3) the role of government versus international reinsurers in protecting against the systemic risks embedded in a portfolio of rainfall contracts. If effective rainfall contracts are offered, they can take much of the systemic risk out of the equation and open the possibility for private efforts at insuring independent risk.

References

Ahsan, S. M., A. A. G. Ali and N. J. Kurian (1982). "Towards a Theory of Agricultural Insurance." *American Journal of Agricultural Economics* 64(3): 520-529.

Anderson, D. R. (1976). "All Risks Rating Within a Catastrophe Insurance System." *Journal of Risk and Insurance* 43: 629-651.

Arrow, Kenneth J. (1964). "The Role of Securities in the Optimal Allocation of Risk Bearing." *Review of Economic Studies* 31: 91-96.

Arrow, Kenneth J. (1996). "The Theory of Risk-Bearing: Small and Great Risks." *Journal of Risk and Uncertainty* 12: 103-111.

Cutler, David M. and Richard J. Zeckhauser (1997). "Reinsurance for Catastrophes and Cataclysms." *NBER Working Paper Series,* Working Paper 5913. Cambridge: National Bureau of Economic Research.

Camerer, Colin F. and Howard Kunreuther (1989). "Decision Processes for Low Probability Events: Policy Implications." *Journal of Policy Analysis and Management* 8: 565-592.

Dacy, D. C. and Howard Kunreuther (1969). *The Economics of Natural Disasters: Implications for Federal Policy*. New York: The Free Press.

Debreu, Gerard (1959). *Theory of Value: An Axiomatic Analysis of Economic Equilibrium*. New York: Wiley.

Doherty, Neil A. (1997). "Financial Innovation in the Management of Catastrophe Risk." Fifth Alexander Howden Conference on Disaster Insurance, August, Gold Coast, Australia.

Goodwin, Barry K. and Vincent H. Smith (1995). *The Economics of Crop Insurance and Disaster Aid*. Washington: The AEI Press.

Hazell, Peter, Carlos Pomareda, and Alberto Valdes (1986). *Crop Insurance for Agricultural Development: Issues and Experience*. Baltimore: The John Hopkins University Press.

Hazell, Peter B. R. (1992). "The Appropriate Role of Agricultural Insurance in Developing Countries." *Journal of International Development* 4: 567-581.

Hogarth, Robin M. and Howard Kunreuther (1989). "Risk, Ambiguity, and Insurance." *Journal of Risk and Uncertainty* 2: 5-35.

Hogarth, Robin M. and Howard Kunreuther (1992). "Pricing Insurance and Warranties: Ambiguity and Correlated Risks." *The Geneva Papers on Risk and Insurance Theory* 17: 35-60.

Jaffee, Dwight, M. and Thomas Russell (1997). "Catastrophe Insurance, Capital Markets, and Uninsurable Risks." *The Journal of Risk and Insurance* 64: 205-230.

Kaplow, L. (1991). "Incentives and Government Relief for Risk." *Journal of Risk and Uncertainty* 4: 167-175.

Kunreuther, Howard (1973). *Recovery From Natural Disasters: Insurance or Federal Aid?* Washington: American Enterprise Institute for Public Policy Research.

Kunreuther, Howard (1993). "Combining Insurance with Hazard Mitigation to Reduce Disaster Losses." *Natural Hazards Observer* 17: 1-3.

Kunreuther, Howard (1996). "Mitigating Disaster Losses through Insurance." *Journal of Risk and Uncertainty* 12: 171-187.

Kunreuther, Howard and Paul Slovic (1978). "Economics, Psychology, and Protective Behavior." *American Economic Review* 68: 64-69.

Lamm, R. McFall Jr. (1997). "The Catastrophe Reinsurance Market: Gyrations and Innovations Amid Major Structural Transformation." *Bankers Trust Research.* New York: Bankers Trust Company, 1-13.

Lewis, Christopher M. and Kevin C. Murdock (1996). "The Role of Government Contracts in Discretionary Reinsurance Markets for Natural Disasters." *Journal of Risk and Insurance* 63: 567-597.

Markowitz, Harry M. (1952). "Portfolio Selection." *Journal of Finance* VII: 77-91.

Miranda, Mario J. and Joseph W. Glauber (1997). "Systemic Risk, Reinsurance, and the Failure of Crop Insurance Markets." *American Journal of Agricultural Economics* 79: 206-215.

Miranda, Mario J. and Joseph W. Glauber (1997). "A Stochastic Simulation Model of the Standard Reinsurance Agreement." Computer program. The Ohio State University.

Mishra, Pramod K. (1996). *Agricultural Risk, Insurance and Income: A Study of the Impact and Design of India's Comprehensive Crop Insurance Scheme.* Brookfield: Avebury Press.

Noonan, Brendan (1994). "A Catastrophe Waiting to Happen?" *Best's Review* (February): 30-33.

Priest, George L. (1996). "The Government, the Market, and the Problem of Catastrophic Loss." *Journal of Risk and Uncertainty* 12: 219-237.

Rejda, George E. (1995). *Principles of Risk Management and Insurance.* New York: Harder Collins College Publishers.

Skees, Jerry R., J. Roy Black, and Barry J. Barnett (1997). "Designing and Rating an Area Yield Crop Insurance Contract." *America Journal Agricultural Economics.* 79(May): 430-438.

Skees, Jerry R. and Michael Reed (1986). "Rate-making for Farm-level Crop Insurance: Implications for Adverse Selection." *American Journal of Agricultural Economics* 68: 653-659.

Stipp, David (1997). "A New Way to Bet on Disasters." *Fortune* Sept.

Tversky, Amos and Daniel Kahneman (1973). "Availability: A Heuristic for Judging Frequency and Probability" *Cognitive Psychology* 5: 207-232.

Vaughan, E. (1989). *Fundamentals of Risk and Insurance.* New York: John Wiley & Sons.

Walter, Alan S. (1997). "Risk Management in Agriculture." Testimony. U.S. Senate Committee on Agriculture, Nutrition, and Forestry. Washington 17 April.