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THE RELATIONSHIP BETWEEN FOOD PRODUCTION AND CONSUMPTION VARIABILITY: POLICY IMPLICATIONS FOR DEVELOPING COUNTRIES

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This paper examines whether there is increased inter-year instability in food consumption at the national level, and to what extent this is attributable to increased instability of food production in the wake of adoption of modern agricultural technology. The data analysed indicates that increased production instability does translate into increased fluctuations in consumption. Nevertheless, year-to-year consumption variability among the sample of 38 countries has declined during the past 25 years. This is attributed to improved stocking operations and trade practices which accompany economic growth. Nevertheless, food insecurity, as measured in terms of fluctuations around trend levels of consumption, does remain a problem, especially among the poor. Therefore, policy options to reduce consumption instability are outlined.

Introduction

There is evidence that year-to-year variability in world foodgrain production has been increasing (Hazell, 1985; Weber and Sievers, 1985). In particular, this is attributable to an increase in inter-regional and inter-crop production covariance during the past two decades. This paper therefore discusses the effects of increased production variability on food consumption and national food security.

It is stressed that, although this paper is concerned specifically with fluctuations in production and consumption, this does not suggest that chronic undernutrition related to persistent levels of deficiency in food consumption is a less heinous problem. Indeed, it is taken as given that increasing food availability, along with increasing demand for labour and wages, are corollaries to any agricultural development strategy.

The fundamental policy issue addressed is whether policymakers concerned with nutrition should display an interest in the transitory component of production in planning for and assessing the performance of the agricultural sector. In answering this question, the point of departure is that malnutrition is closely linked with poverty, and that poverty, to some extent, is episodic in

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nature. Malnutrition and illness are often transient states for individuals. Households that fall within the category of low-end poverty one year may well be above that spectrum the next year (Scott, 1980; Anderson and Scandizzo, 1984; Srinivasan, 1985).* On the other hand, regions and countries displaying a dramatic reduction in hunger and poverty may quickly revert back to deficiencies in basic needs. As stated by Mellor and Desai (1985, p.1), 'the temporal variations in poverty include . . . substantial intermediate-term undulations that can cause the number of people in absolute poverty to vary by 50 per cent or more,' and the instability in per capita food production plays an important role in determining this outcome.

Fluctuations in per capita food consumption in developing countries are largely determined by the changes in food consumption of the poor who characteristically have high price- and income-elasticities of demand for food. Price and income changes affecting the consumption of the poor are, in fact, a function of many complex relationships among exogenous events (e.g., price shocks, deteriorating terms of trade), domestic policy changes (e.g., increases in the relative price of tradeables versus non-tradeables due to currency devaluation), and stochastic weather-induced events (e.g., drought) interacting with the existing technology in a given resource endowment. In certain circumstances, the complex interaction of these factors can lead to dramatic reductions in the ability of the poor to effectively demand adequate food.

In this paper we examine the fluctuations in per capita consumption. The level of aggregation of the data employed, however, does not allow us to determine the distribution of declines in consumption, or to understand clearly the dynamics of the variability. Nevertheless, the analysis which follows does have relevance to the seminal work on causes of food consumption shortfalls and famine by A. K. Sen (1981). He shows that the decline in food production and availability is not necessarily the primary cause of famine. Rather a series of factors may converge to reduce the exchange entitlement of households, precipitating reduced consumption. These factors may include redistribution of available food, inflation, or drops of income due to unemployment or lower farm profits. This implies that governments often pay excessive attention to aggregate food supplies, failing to recognise the other key elements that result in the decline of food consumption of population segments which, at the extreme, results in famine.

While it is beyond the scope of this paper to resolve issues such as the effect of a transitory decline in production and availability of food on the poor, and its relative contribution to hunger and famine (Sen, 1981), we can gain insight into the degree to which consumption instability, mediated by the entitlement function, arises out of production instability.

Empirical Analysis of Market Aggregates at the Country Level

In a given year, the following staple food balance must hold in a country:

$$\text{Food consumption} = \text{Production} + \text{Imports} - \text{Exports} + \text{Stock changes} - \text{Feed} - \text{Waste} - \text{Seed} - \text{Processing}$$

* Srinivasan (1980) points out that, even though the proportion of poor in a population may remain constant, this does not imply that it is the same households which are falling in this category from year to year or month to month. In considering this observation, however, one must be careful to distinguish between real fluctuations in measured poverty rather than statistical problems. For example, Scott (1980) discusses how instability in household membership could affect poverty determinations from one survey period to the next. Similarly, to the extent that consumption expenditures are measured with error from one period to the next, it may falsely appear that poverty arises out of a stochastic process, with some families doing well in one year and badly the next.

Policies that adjust any of the components on the right-hand side of this equation can mitigate the effects of increased production variability (IPV) on food consumption. Thus, increased production variability may, in principle, be balanced by trade policies, stockholding policies, or adjustments in the use of staple food for feed and processing.

Production and Consumption Variability Pre- and Post-Green Revolution

The relationship between production variability and its effect on consumption were analysed for 38 countries using time-series data from FAO Food Balance Sheets, covering the period 1961 to 1983*. In Table 1, the coefficients of variation for linearly detrended cereal production per capita, and of calorie consumption per capita are presented. The most telling feature of these data is that the level of variability in cereal production is generally greater than calorie consumption variability†. In fact, the average of the coefficient of variation (CV) of cereal production in the 38 countries was 18.1 per cent, nearly three times as high as that of total calorie consumption, 6.7 per cent during the period 1961-83. Similarly, in only 2 countries — Korea and Egypt — did consumption variability exceed production variability over the entire time series.

These data have also been disaggregated according to two overlapping time periods to determine how the variability in cereal production and consumption changed over time. The periods are overlapping so as not to be biased by the years of the oil shock and world food shortage in 1972-74. The two time periods are designed to roughly depict production and consumption variability pre-green revolution, or in its early stages (1961-71), versus post-green revolution (1975-83).

These data from the sample of countries indicate a small increase in the average CV of per capita production from one period to the next. Concurrently, the CV of consumption declined from 4.6 to 4.3 per cent. Whether it be through trade policies, domestic stocking behaviour, or other means captured in the identity above, the aggregate increase in the level of variability in production has not translated into aggregate consumption variablity. Similarly, only 15 of the 38 countries registered an increase in CV for total per capita calorie consumption, while 26 out of the 38 countries had a higher CV for per capita cereal production. Of the 26 countries which show increased variability in cereal production from the first to the second period, 11 also experienced higher variability in total food consumption. Fifteen of the countries with increased variability in production managed to achieve decreased variability in consumption. Four anomalous countries — India, Syria, Ivory Coast, and Rwanda — witnessed a decreased cereal production and increased calorie consumption variability, as measured by the CVs. In sum, despite the fact that cereal production variability has increased in more than two-thirds of the sample of countries, only four-tenths of the countries saw consumption variability rise.

In order to understand better the relationship between production and food consumption variability, and to test it statistically, regressions were run to determine whether the deviations from the expected value of per capita cereal

* We are grateful to J. S. Sarma for advice on the selection of countries with the least unacceptable agricultural data base for this analysis. Robin Donaldson and Yisehac Yohannes helped in the statistical analysis. It should be noted that only cautious interpretation of results is made here as the food data base in a number of countries included is unsatisfactory. This is particularly the case in a number of sub-Saharan African countries.

† This finding is in line with the analysis done by Valdes and Konandreas (1981) for staple food consumption and production. The differences with this analysis herein are that the data are in per capita terms, cover a most recent time period, examine a different set of countries, and employ a different source of data.

Table 1. Coefficients of Variation for Cereal Production Per Capita and Daily Calorie Consumption Per Capita.

Country	1961-1983		1961-1974		1972-1983	
	Cereal Production	Daily Calorie Consumption	Cereal Production	Daily Calorie Consumption	Cereal Production	Daily Calorie Consumption
	(per capita)					
Taiwan	18.2	10.5	13.5	6.9	10.7	6.7
Korea	9.7	11.0	5.9	10.2	12.3	1.8
Philippines	12.4	10.1	7.6	5.6	9.6	7.0
Indonesia	17.1	11.7	11.7	6.6	12.4	7.3
Malaysia	12.8	4.5	13.2	3.8	13.6	1.4
Thailand	7.5	5.2	7.0	3.6	8.4	2.9
Bangladesh	8.0	4.7	9.1	4.2	4.2	2.4
Sri Lanka	19.7	4.7	14.2	4.9	18.4	4.7
India	8.3	5.1	7.4	4.7	7.2	5.4
Pakistan	15.4	9.6	14.5	7.8	6.7	4.2
Syria	34.7	11.6	40.0	4.9	32.5	9.8
Turkey	10.6	6.4	10.1	4.2	11.1	2.9
Egypt	6.1	10.5	4.9	3.7	5.4	8.3
Tunisia	22.3	10.3	24.4	7.9	18.7	4.5
Algeria	34.7	17.3	31.5	6.2	32.5	11.7
Morocco	31.7	7.3	28.4	5.6	29.4	2.6
Senegal	25.6	4.7	22.2	2.9	27.7	5.0
Gambia	21.2	2.6	8.5	2.7	22.2	2.3
Ivory Coast	10.1	6.0	11.7	4.5	7.2	5.2
Cameroon	12.3	5.6	10.7	3.9	13.6	5.6
Sudan	18.6	8.8	18.4	6.9	16.5	5.2
Kenya	17.0	5.4	7.8	2.7	19.9	6.3
Rwanda	14.7	8.8	17.9	6.4	9.4	7.2
Tanzania	22.4	10.0	9.5	2.8	20.4	8.3
Malawi	12.3	5.2	12.5	5.5	12.5	1.4
Botswana	71.4	2.7	67.0	2.5	73.2	1.5
Jamaica	38.4	8.8	33.6	9.5	43.8	3.2
Guatemala	5.1	2.5	5.3	2.6	4.4	0.8
Honduras	10.7	4.4	7.5	4.7	9.2	1.5
Costa Rica	16.1	5.9	9.2	4.8	15.3	1.8
Panama	16.7	2.5	15.9	2.7	9.9	2.2
Venezuela	17.6	5.9	14.1	2.4	22.4	5.6
Colombia	12.9	6.5	7.8	2.8	9.2	4.6
Equador	17.9	4.8	10.6	3.8	17.9	2.0
Peru	13.6	3.3	7.6	1.9	13.3	3.5
Brazil	10.8	3.5	7.8	2.9	9.6	1.8
Chile	17.5	3.0	12.0	3.2	15.6	2.9
Argentina	16.5	2.6	13.6	3.0	15.0	2.2
Average	18.1	6.7	15.1	4.6	16.9	4.3

Source: Computed from time-series of FAO-Food Balance Sheets (FAO, 1985).

production, cereal consumption, and calorie consumption are changing over time, thereby indicating increasing instability. Specifically, the absolute value of the difference between the expected value (based on fitted trend lines) and actual value of cereal production, cereal consumption, and calorie consumption — all in per capita terms — were regressed on time.

In only a few cases were there any significant patterns in terms of increased/decreased fluctuations for per capita production or consumption over the entire time period or the two sub-periods (see Table 2). Between 1961 and 1983, 21 of the 38 countries showed increased deviations from the trend in cereal production. But only in seven cases was this also statistically significant, while in five countries there was a significant decline in production instability, as measured by deviations from expected trend values. Thus, while total aggregate production may have become more unstable in many of the sample countries (Hazell, 1985), per capita production has done so only in a small number of them. Similarly, in eight countries, there was a significant increase

Table 2. Regressions of the Deviations of Actual from Expected Value as a Function of Time, where S represents Significant Coefficient, N Represents Non-Significant Coefficient, and (−) Represents a Negative Value of the Coefficient

	1961-1983		
Country	*Cereal Production = f(Time)*	*Cereal Consumption = f(Time)*	*Daily Calorie Consumption = f(Time)*
		(per capita)	
Taiwan	N	−N	N
Korea	S	−S	N
Philippines	N	−N	N
Indonesia	N	N	N
Malaysia	S	N	N
Thailand	N	−N	N
Bangladesh	−S	−N	−S
Sri Lanka	N	N	−N
India	−N	−N	−N
Pakistan	−N	−S	−N
Syria	−N	N	N
Turkey	−N	−S	−N
Egypt	−N	S	S
Tunisia	−S	S	−N
Algeria	−S	N	−N
Morocco	−N	S	S
Senegal	N	N	N
Gambia	S	−N	N
Ivory Coast	−N	−S	−N
Cameroon	−N	S	S
Sudan	N	N	S
Kenya	N	N	S
Rwanda	−S	N	−N
Tanzania	S	N	S
Malawi	−N	−N	N
Botswana	−N	−N	−N
Jamaica	N	N	N
Guatemala	−N	−N	−N
Honduras	S	−S	−S
Costa Rica	S	−S	S
Panama	−S	N	−N
Venezuela	N	−S	S
Colombia	N	N	−S
Ecuador	N	N	N
Peru	N	N	−N
Brazil	S	−N	−N
Chile	−N	N	−S
Argentina	N	S	−N

in deviations from trend values of calorie consumption, while four countries registered a decline in the level of instability, as measured by the time-trend regressions of deviations from expected values. In combination, the data on CVs and the simple time-trend regressions on deviations from trends give no strong indication of a growing problem of consumption variability in the aggregate. If indeed there is a trend toward increased variability of cereal production, a combination of market intervention, stocking and trade policies which accompanies high per capita incomes has mitigated the consumption consequence as measured in terms of aggregate country-level data.

Transmission of Production Variability into Consumption Variability

In an attempt to further explain the patterns of variability in food consumption across the sample countries, multivariate techniques were employed to estimate the following model:

$$CVC_{it} = f(CVQ_{it}, [CVQ_{it}]^2, GNP, D)$$

with CVC_{it} being the coefficient of variation of per capita calorie consumption in country i over the time period t (1961-83), CVQ the CV of production per capita, GNP the gross national product per capita, and D being a dummy variable which equals 1 for Sub-Saharan Africa and 0 otherwise. Regressions for the two overlapping time periods as well as for the entire time-series were analysed (Table 3).

The results clearly indicate that an increase in production variability leads to an increase in consumption variability. Evaluated at the mean, for a one unit increase in the average level of the CV of production the parameter estimates indicate an increase in the CV of consumption by 0.14 units. This represents an elasticity of the CV of consumption with respect to the CV of production of 0.41, according to the model in the first column of Table 3. As indicated by the negative and significant quadratic term of CVQ, food production variability has a decreasing marginal impact on the level of consumption variability. Obviously, the countries with very high levels of production variability cope with this through various policy measures so that production variability does not translate proportionally into consumption variability.

The regression results also indicate that with increasing GNP per capita, variability of consumption tends to be lower which is in line with expected food consumption behaviour of consumers. The elasticity of the CV of consumption with respect to GNP per capita, according to the first model, indicates that a 10 per cent increase in GNP per capita will reduce the CV of consumption by 2.5 per cent. This is the case controlling for the level of food production variability. Middle-income developing countries are obviously more capable of coping with instability in domestic food production through trade and storage policies that reduce its impact on consumption variability. When a dummy variable for Sub-Saharan African countries is added to the regressions, one can see that in the period 1961-1974, consumption variability appears lower than in the remainder of the countries. This appears counter intuitive and may be a result of poor data quality of the food balance sheets for those countries.

Table 3. Regressions of the Coefficient of Variation of Per Capita Daily Calorie Consumption on GNP Per Capita and the Coefficient of Variation of Per Capita Production, and Resulting Elasticities

Independent Variables	Dependent Variable: *Coefficient of Variation of Per Capita Daily Calorie Consumption for:* 1961-1983	1961-1974	1972-1983	1961-1983	1961-1974	1972-1983
Intercept	5.190	3.399	3.429	4.640	2.916	3.533
Mean GNP/capita	−0.00308 (2.54)	−0.00397 (4.758)	−0.0105 (1.431)	−0.002 (1.998)	−0.00316 (3.845)	−0.0012 (1.886)
Coefficient of variation of per capita food production	0.2863 (2.354)	0.2471 (4.791)	0.14167 (1.474)	0.261 (2.118)	0.2449 (4.421)	0.15139 (1.641)
(Coefficient of variation of per capita food production)^2	−0.00387 (2.317)	−0.00361 (4.610)	−0.00224 (1.711)	−0.00377 (2.213)	−0.00370 (4.405)	−0.00231 (1.800)
Dummy for Sub-Saharan African countries	−1.840 (1.60)	−1.1153 (2.436)	0.436 (0.433)	—	—	—
R^2	0.2504	0.5738	0.1515	0.1903	0.4922	0.1465
Elasticity of CV calorie consumption with respect to GNP	−0.253	−0.270	−0.196	−0.164	−0.245	−0.224
Elasticity of CV calorie consumption with respect to CV production	0.41	0.48	0.27	0.35	0.46	0.30

Notes: t-statistics are in parenthesis
[Elasticities are computed at the mean of the respective variables.]

In sum, the conclusions from the regression analysis are that:

- increased variability of cereal production does significantly increase food consumption variability with a sizeable effect, but
- with increasing levels of production variability, the transmission into consumption variability is reduced;
- growth in per capita income of developing countries not only increases food consumption levels but also leads to more stability in food consumption. The reverse side of this favourable outcome is, of course, that the numerous developing countries which are currently facing reductions in per capita income are affected by the unfavourable combination of lower food consumption levels *cum* increased consumption variability.

Policy Options to Reduce the Effects of Production Instability for Consumption

In considering measures to reduce the deleterious effects of IPV, one may either intervene through production-related strategies, or through mechanisms which help buffer the impact of IPV on real incomes and consumption. Concerning the former, there are potential conflicts between yield-variance-reducing and mean-increasing measures. This conflict reinforces the notion that, if output can be raised sufficiently, thereby generating employment, reducing prices, and raising real incomes, production fluctuations become less consequential in terms of nutritional well-being.

In terms of strategies to assure access to food for households, even in the face of IPV, a distinction can be made between price and supply stabilisation and infrastructure development, both of which are non-targeted interventions, and other target-group-oriented projects. These are briefly discussed below.

Price and Supply Stabilisation

Domestic prices can be smoothed by keeping quantities supplied and demanded in proportion so that a targeted price is achieved. Price stability in and of itself, however, does not represent a goal which, if achieved, implies that consumption variability is mitigated. Supply and demand may both fluctuate upward and downward synchronously, keeping prices stable. Similarly, the stabilisation of prices may increase fluctuations in demand for certain segments of the population. Thus, demand stabilisation requires accounting not only for variability in prices and incomes, but also for the correlation between these two factors.

Stabilising the supply of food at the national level can be achieved through a combination of stocking policy and trade. This relationship is captured in the identity at the bottom of p.316. The most important lesson is that, if the government chooses to reduce the present and future gaps between consumption and production, there are two options: the first is to change the stocks either by increasing storage or drawing down existing reserves; the second is to adjust the levels of net imports.

For exploiting trade opportunities, the lament of many developing countries is that the instability in world grain markets has been a major cause of food insecurity. The question arises as to whether the prospect for increased global instability in production and, perforce, prices represents a hazard to developing

countries. In turn, is stabilisation of world prices an important or affordable proposition for food security in developing countries?

First, the cost of stabilising world prices would be extremely high, probably exceeding $10 billion per year (Svedberg, 1984). Second, even if this were feasible, in few countries did cereal import bills represent more than 10 per cent of total import expenditures in the early 1980s (Svedberg, 1984). Therefore, smoothing prices on world foodgrain markets would do little to stabilise foreign exchange requirements given the importance of the prices of other imports.

Third, Valdes and Konandreas (1981) indicated that national-level food security problems do not arise primarily out of price instability on international markets. Rather, real income variability due to domestic production variability, as well as changes in the volume (not price) of imports, are the major constraints to national food security.

It has been extensively argued that trade is a better and cheaper way to address this problem than buffer stocks. This view has also been expressed by Siamwalla (1984, p.5) who stated that 'the central message is thus for the individual country to eschew a policy of holding large volumes of domestic stock to cope with possible harvest shortfalls, because the fiscal costs of doing so can be quite high.' Instead, reliance primarily on the market is commended, although maintaining a well-managed small security stock of around five per cent of grain consumption is suggested as an element of a national food security programme (McIntire, 1981).

Furthermore, if a country follows an open economy approach to stabilising supplies, this does not necessarily result in unstable prices at home due to unstable import prices. Rather, there is the potential for insulating domestic prices from the vagaries of widely fluctuating world prices through import subsidies and import tariffs applied in years of high international prices or low international prices, respectively.

There are exceptions to this logic of using trade rather than storage to stabilise consumption. The first exception is raised by a precipitous rise in grain prices. The obvious response to this problem is that countries can hedge against such possibilities by trading in futures. The second exception comes in the case of landlocked countries with poor transport infrastructure, where trade may be prohibitively expensive. A third exception would be when a certain country's imports represent such a large volume that world price may be affected by its trade activities. This prospect of inelastic supply of imports, however, is limited to a few, although important cases. Fourth, and most significant, is the case of those countries which are nearing self-sufficiency. A good harvest may result in it being a net exporter; a bad harvest means it would be a net importer. Increased variability may cause more frequent shifts in a country's market-clearing price, from the FOB to CIF price or vice versa. Given the evidence that these price differences can be on the order of 100 per cent in some African countries, this strongly commends relying on stockholding between periods and promoting intra-regional trade, rather than international trade, so that a country can avoid switching from an FOB to a CIF price.

In these semi-subsistence countries where relatively larger buffer stock operations are appropriate, the expenses should not be overlooked and thus their size should be kept to a minimum. One reason is that there are diminishing returns to expenditures in stabilisation schemes, making fiscal costs large. It is also difficult to sustain storage operations, especially when two or more bad years are strung together. If two or more good years come in succession, the grain in

storage may be held for several years — indeed, a very costly enterprise. Furthermore, public storage operations supplant private stores (Newbery and Stiglitz, 1981).

The question then arises as to why countries still suffer the consequences of food insecurity as manifested by consumption instability when trade and storage opportunities persist. One answer is found in the difficulty of financing food imports. This can become quite a burden in successive years where foreign exchange earnings and domestic production are low, and international prices are high, resulting in large import bills. In the case of small and poor countries, these difficulties are further compounded by the problems of gaining access to needed capital from the international financial community.

One response to such problems has been the extension of the IMF Compensatory Finance Facility (CFF). This facility is basically designed to provide balance-of-payments support to compensate for precipitous increases in the cost of cereal imports. It enables countries to stabilise demand for cereals, in both urban and rural areas, where it was previously impossible. There may be drawbacks to this scheme and a need for further modification (Huddleston *et al*, 1984).* Nevertheless, it represents an important complement to other food aid measures and acts effectively as an insurance cum foreign exchange reserve system.

Infrastructure Development

Improved marketing infrastructure, both for agricultural inputs and foodcrops, is another fruitful method for reducing consumption instability in the face of IPV. More integrated factor markets will provide an outlet to cope with the potential adverse effects of covariances which accompany IPV, and integrating product markets will mitigate the impact of local production variability on local prices by facilitating the flow of goods and services from one geographical area to another. This in effect reduces the link between the supply situation and price in a given locality, thereby addressing the problem of fluctuations which may occur due to local market conditions (Anderson and Roumasset, 1985). It is also likely that market investments will encourage risk-sharing over a broader population, as well as facilitate the implementation of targeted and non-targeted schemes designed to reduce the effects of fluctuations.

Reducing marketing margins through improved infrastructure will be especially advantageous to the marginal farmer who may be a net consumer or producer of a cereal grain in any given year. To the extent that the difference between farmgate and market prices can be reduced, so would the magnitude of the price change when a marginal producer switches from a position of being a surplus to deficit farmer. Thus, the level of variability would be reduced, at least in terms of cereal prices if not incomes.

Targeted Programmes

If a government stabilises aggregate demand through a combination of buffer stock and trade policies, the nutritional well-being of certain household types

* Included among the more important problems that they identify are that the foreign exchange constraints often stem from fluctuations in the prices of non-cereal exports, that there are constraints to full compensation for the poorest countries (and that, of course, such a scheme has no effect on incomes of households, and supply or price stabilisation may not have the desired distributional consequences in terms of assisting the poor, for whom consumption fluctuations are most serious).

may still be in jeopardy. Just as aggregate consumption is not evenly distributed, transitory shortfalls in consumption will not be either. Green and Kirkpatrick (1982) point out, that under some plausible assumptions, for example, a relatively small 2.5 per cent shortfall in aggregate consumption may result in a dramatic 10 per cent decline for 30 per cent of the population. Consideration should therefore be given to implementing targeted programmes to assure food security for vulnerable households.

Income-generating schemes and transfer programmes, such as employment guarantee schemes, food subsidies, and food-for-work projects, are types of appropriate programmes to address the problems of at-risk households becoming increasingly food-insecure. Nonetheless, the difficulties of employing such measures should not be overlooked. For example, food aid allocations traditionally are not responsive to year-to-year fluctuations in the food situation in recipient countries. In fact, given the surplus disposal element of food aid programmes, the quantity of food aid globally programmed is counter-cyclical to the needs of developing countries. This makes for a situation, such as in the early 1970s, when food aid allotments were reduced despite acute need.

Employment-generation schemes are another mechanism to counteract variability in production (Greenough, 1982). Few countries, however, have either the managerial or financial resources to operate flexible employment programmes. The fact that the years of low production are the years when domestic resources are most scarce, and the need for employment generation most acute, is a pro-cyclical problem which reduces the likelihood of rapid and meaningful government response. Food-for-work projects, which use donated resources, may have the advantages of being viable in a time of severe domestic resource constraints caused by a year of low production. Furthermore, food-for-work provides not only employment opportunities but, as a wage-good, is additionally beneficial in a year of shortages. Such employment and income-oriented programmes come closer to taking account of the fundamental cause of poverty and famine as identified by Sen (1981) than do price stabilisation and subsidy schemes. Yet, the use of targeted food subsidies may also be a policy option. Food price subsidies and food stamp programmes have been shown to be an effective way of transferring income to the poor (Pinstrup-Andersen and Alderman, 1984). Consideration could be given to employing a 'flexible price wedge,' which could be made relatively larger in lean years and smaller in years of high output. Likewise, the experiences from Bangladesh illustrate how vulnerable group feeding programmes can be expanded in years of low food consumption, either due to problems of availability or incomes, to protect the poor (Cutler, 1985).

Another targeted strategy is the various forms of crop insurance programmes. The results of this approach have proved disappointing, fulfilling few of its objectives. In addition, crop insurance runs the potential of promoting greater inequality and doing little to help those in greatest need (Hazell, Pomareda, and Valdes, 1986). Simply, the landless wage labourer or small farmer will benefit least from this form of implicit income-transfer programme. While there are spinoff benefits, such as reducing risk to producers, and thereby encouraging greater investment which in turn will both increase production and possibly promote increased labour absorption, caution must be exhibited in applying this strategy which has high administrative and budgetary costs, and has been characterised by moral hazard problems. Targeting of its benefits remains crucial, although the targeted employment-generation schemes and food subsidies will probably be more successful in achieving welfare goals for a lower cost.

A further type of intervention is to improve access to consumption credit or to enhance the ability to save through stocking behaviour. As fluctuations increase, the ability to adjust inter-temporal consumption becomes more urgent. The goal is to reduce the elasticities of consumption variability with respect to income variability. This requires that financial markets function well and that they do not discriminate against the poor. In this regard, special arrangements for repaying loans and procuring credit may be required for the poor with little collateral. The ability of the poor to smooth consumption is constrained not only by access to institutions and facilities but also because the poor's planning horizon is undoubtedly short. They have to be more concerned with survival and coping in the present than with conjecturing about what the future will portend.

Conclusion

In this paper the effects of increased production variability (IPV) and covariances on consumption have been discussed. National-level data and policy options were explored because of the direct link between the macro-food economy of the country and the micro-food economy of the household. It was found that only in a small proportion of the 38 developing countries examined did cereal production variability increase significantly over the last 25 years. Multivariate analysis shows, however, that increased variability of cereal production does significantly increase food consumption variability but with a decreasing marginal effect. Growth in per capita income not only increases food consumption levels but also leads to more stability in food consumption. Negative consumption consequences of production fluctuations are another manifestation of underdevelopment. Poor countries and poor households are beset with constraints, be they structural or not, which limit the ability to prevent, and thereafter to cope with IPV. These constraints will largely be overcome in the course of agricultural development and economic growth. Technological change which increases output, creates employment, moderates prices, improves market integration and efficiency are the goals of development. They too represent the long-term solutions for protecting the poor from the negative effects of IPV. The need for developing trade, storage, and pricing policies which mitigate the consequences of instability on the consumption of poor households is stressed. In addition a variety of targeted strategies for improved access to food through income transfers, employment generation, price subsidies, and consumption credit to protect the poor from nutritional problems which arise out of variability were presented.

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