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Instability in Food and Export Crop Incomes: The Philippine Case

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Abstract: Recent discussions of food security issues for developing countries have drawn attention to short-term fluctuations in effective demand, especially of low-income households, as a critical area for policy analysis. Real income instability is presumed to be particularly acute in the rural areas, given fluctuating agricultural production and volatile international markets for primary commodities. This paper provides a systematic examination of income variability in food and export crop production, develops a framework of analysis, and uses it to investigate the instability of total agricultural crop income in the Philippines and how that income has been affected by the marked increase in the share of export crops in the total value of crop production over the post-war period. Some policy implications of the empirical results are briefly considered.

Introduction

A common perception in developing countries is that agricultural exports are vulnerable to the inherent volatility of world commodity markets. Indeed, that perception represents one facet of the so-called “food-export crop” tradeoffs, indicating a conflict between the likely gains in efficiency and income from exploiting comparative advantage in export crop production and the greater instability in agricultural income that may result from an increasing share of export crops. The analytical distinction between food and export crops is appropriate for many developing countries that effectively insulate the agricultural food sector from the world market but are significant exporters of some other agricultural products. Direct government intervention in food trade is widely observed among food-deficit LDCs, the chief reason being that the domestic price of food, in terms of both its level and variability, is regarded as an all-important economic-political variable that needs to be tightly controlled.

The purpose of this paper is to provide a systematic examination of relative income instability in food and export crop production by developing a suitable framework of analysis and using it to investigate the variability of total agricultural crop income in the Philippines and how that income has been affected by the marked increase in the share of export crops in the postwar period. The analytical discussion in the following section describes the conditions under which a rise in export share will increase total income instability. In application to Philippine agriculture, the export value share associated with minimum income instability is calculated and the induced change in total income instability estimated for each of the cases considered. Some policy implications of the empirical results are briefly considered and other concluding remarks are given in the final section of this paper.

Analytical Framework

In the representation of the instability in total crop income arising from the variability of food and export crop incomes, we focus on the gross value of crop production, abstracting from fluctuations in the costs of intermediate and other inputs, which, following Newbery and Stiglitz (1981), may be considered to be of second-order importance. Total crop income in real terms (Y) may then be expressed as the sum of the nominal production values of food and export crops (Y_{nf} and Y_{nx} , respectively) divided by the general price index (P):

$$(1) Y = (Y_{nf} + Y_{nx})/P = (Y_{nf}/P) + (Y_{nx}/P) \equiv Y_f + Y_x,$$

where Y_f and Y_x are the real incomes from food and export crops, respectively. The variance of Y is given by:

$$(2) \text{var}(Y) = \text{var}(Y_f) + \text{var}(Y_x) + 2\text{cov}(Y_f, Y_x).$$

For the present purposes, the coefficient of variation (CV) is preferable to use since, unlike the variance, it is dimensionless and does not require adjustment for scale differences. Equation (2) can be written as follows (Köester, 1982):

$$(3) CV_y^2 = S_f^2 CV_f^2 + S_x^2 CV_x^2 + 2S_f S_x r CV_f CV_x,$$

where S_f and S_x are the shares of food and export crops, respectively, in total value of production; CV_y , CV_f , and CV_x are the coefficients of variation of total crop income, food crop income, and export crop income, respectively; and r is the correlation coefficient between Y_f and Y_x .

Thus, given the coefficients of variation of Y_f and Y_x and their correlation coefficient, the food-export shares in production value determine total crop income instability. To see how the latter would be affected by a change in the production mix, assuming that the CV 's and r remain unchanged, equation (3) can be totally differentiated to give:

$$(4) CV_y dCV_y = CV_f^2 S_f dS_f + CV_x^2 S_x dS_x + r CV_f CV_x (S_f dS_x + S_x dS_f).$$

Setting $S_f = 1 - S_x$ and $dS_f = -dS_x$ yields:

$$(5) CV_y (dCV_y / dS_x) = - (CV_f^2 - r CV_f CV_x) + (CV_f^2 + CV_x^2 - 2r CV_f CV_x) S_x.$$

Therefore, a rise in the income share of export crops will result in greater instability in total crop income if:

$$(6) S_x > (CV_f^2 - r CV_f CV_x) / (CV_f^2 + CV_x^2 - 2r CV_f CV_x) \equiv S_x^*.$$

Provided that the second order condition is met (i.e., $d^2 CV_y / dS_x^2 > 0$), the right-hand side in inequality (6) also represents the export crop share (S_x^*) at which total crop income instability is lowest.

For simplicity of exposition, we proceed to consider the determination of the shares of food and export crops associated with minimum instability in total crop income under the special case of zero correlation coefficient between Y_f and Y_x .² Equation (6) may then be written:

$$(7) S_x > 1 / [1 + (CV_x^2 / CV_f^2)] = S_x^*.$$

Thus, the larger the ratio of the income variability of export crops to that of food crops, the smaller the "optimum" (i.e., income instability minimizing) export crop share. Also, S_x^* will be zero (meaning complete specialization in food crops) only if Y_f is stable and CV_x is nonzero. If $CV_f = CV_x$, then $S_x^* = 0.5$, which means that equal income shares of food and export crops will lead to minimum instability in total crop income. Finally, even if instability is greater in Y_x relative to Y_f , a change in the production mix favouring export crops will increase total crop income instability only if the initial export share is greater than S_x^* ; otherwise, further diversification of production into export crops can reduce instability of total crop income. Therefore, the common sense proposition that an increasing share of export crops will give rise to greater variability of total crop income does not necessarily hold.

The Philippine Case

During the 1950s and 1960s, the export orientation of Philippine crop production increased significantly in value terms, from 37 percent in 1950 to 49 percent in 1960 and 56 percent in 1970. That increase was accompanied by a rapid growth of agricultural exports—by 64 percent in US dollar value terms from 1949-51 to 1969-71—and an increasing dependence on imports of cereal products (which grew by 46 percent in per capita quantity terms from 1953-56 to 1967-70). After the food supply crisis of 1972/73, policy efforts to promote domestic food (especially rice) production were greatly intensified; the national government implemented a massive fertilizer and credit subsidy programme (and continued to promote the adoption of high yielding rice varieties started in the late 1960s).

The early 1970s also witnessed a major policy shift towards the promotion of nontraditional exports (mainly labour-intensive manufactures) and greater domestic processing of primary products for exports (see Bautista, Power, *et al.*, 1979). Export taxes were levied on primary products beginning in 1970 as a stabilization measure in support of the February 1970 devaluation of the Philippine peso (from 3.9 pesos per US dollar to 6.4 pesos by the end of 1970) but which later on

became a permanent part of the country's tax system. Additionally, export premium duties were imposed in 1973, which served to partly siphon off the windfall gains from the world commodity boom at the time.³ Those policy developments help explain the observed leveling of the value share of export crops during the 1970s to 57 percent in 1979/80.

The primary concern here is, of course, not the explanation of food export share changes, but in the evaluation of their effect on instability in total crop income. In particular, to what extent had the marked increase in the share of export crops in the 1950s and 1960s led to greater (or lower) real agricultural crop income instability (and hence, rural food insecurity)? As the discussion in the preceding section has shown, the answer would depend on the relative variability of food and export crop incomes, their correlation, and the initial crop value shares.

In view of the significant policy shifts in the early 1970s as noted above, distinguishing between the two postwar subperiods 1949-69 and 1970-80 in our preliminary analysis of instability in nominal incomes is useful. Table 1 gives a comparison of instability indices for export earnings on agricultural crops, export crop income and food crop income, based on annual data for the two subperiods and the entire 1949-80 period. Following Cuddy and Valle (1978), the instability measure used here is the "corrected" (or detrended) coefficient of variation CV times the square root of $1-R^2$, where R^2 is the coefficient of determination adjusted for degrees of freedom in a trend regression, which has been shown to be equal to the ratio of the standard error of the estimate and the mean of the variable). The index is bounded, with a lower limit at zero (when $R^2 = 1$) and an upper limit at the (uncorrected) CV .

Each of the five income variables in Table 1 has markedly lower instability values for the two subperiods compared to those for the entire 1949-80 period, reflecting the much greater deviations from the estimated 32-year trend lines and indicating the need to incorporate (in the income instability measure based on the entire period) the significant difference in the observed trends for the two subperiods.

The instability of foreign exchange earnings from export crops during 1949-69 is lower than that of producers' export crop income, but the opposite case holds during 1970-80, in part attributable to the more active government intervention policy in the latter period in response to the increased instability in the foreign trade sector as described above and to the adoption of a flexible exchange rate inaugurated by the February 1970 floating of the Philippine peso.

Comparing the variabilities of farm incomes from food and export crops in nominal terms, we find consistently lower values for food crop income, as would be expected from the traditionally tighter government control of the food sector in the Philippines (Bautista, 1978) and the additional instability due to external disturbances to which export crop income is exposed. Despite the greater instability in Philippine foreign trade in the 1970s (Bautista, 1980), both food and export crop incomes appear from Table 1 to have become less unstable relative to the earlier two decades, due to the policy developments in the 1970s, which apparently provided an effective offset to the exogenous shocks emanating from the external sector.

Table 1—Calculated Values of Detrended Coefficients of Variation*

	1949-80	1949-69	1970-80
Crop export earnings (US dollars, f.o.b.)†	44	11	21
Nominal income from export crops, Y_{nx} (pesos, farm gate)	75	29	19
Nominal income from food crops, Y_{nf} (pesos, farm gate)	63	23	12
Real income from export crops, Y_x	22	16	12
Real income from food crops, Y_f	18	13	11

[*Based on deviations from linear trends. †Includes processed products.]

The last two rows of Table 1 report the calculated values of real income instability pertaining to the deviations from trend of nominal food and export crop incomes deflated by the consumer price index for the two subperiods 1949-69 and 1970-80 as well as for the entire 1949-80 period. That the instability values for real incomes are consistently lower than the instability values for nominal incomes reflects the positive correlation between the general price level and nominal incomes (in terms of deviations from trend) for both food and export crops.⁴ Another striking observation is the greater variability of export crop income (in real terms) relative to food crop income; however, the disparity in instability values is surprisingly small—4.2 percentage points for 1949-80, 3.2 for 1949-69, and 1.2 for 1970-80.

Although the respective Y_f and Y_x instability values are closer for the two subperiods compared to those based on nominal incomes (Y_{nf} and Y_{nx}), the variability around the 1949-80 trend line is much higher for both Y_x and Y_f . One way of measuring instability for the entire period that would allow for a shifting trend⁵ between the two subperiods is to introduce intercept and slope dummies in the trend equation as follows:

$$(8) Y = a + bT + cD + dDT + e,$$

where Y and T are the income and trend variables, respectively, e is the error term, and D is a dummy variable equal to zero for the years from 1949 to 1969 ($T = 1, \dots, 21$) and unity for the years 1970 to 1980 ($T = 22, \dots, 32$). On that basis, the calculated instability values are 12 for Y_f and 15 for Y_x , while the correlation coefficient (of their residuals) is computed to be 0.167. Real income from export crops is still seen to be more unstable (but not markedly so) relative to food crops, the difference in their instability values being 2.3 percentage points.

We may now use equation (6) to calculate the export share associated with minimum instability in total crop income. Based on the values of $CV_f = 12$, $CV_x = 15$, and $r = 0.167$, the calculated S_x^* is 40 percent, higher than the initial export share in total crop income (37 percent for 1949 and 1950) but much lower than the export share prevailing in 1979 and 1980 (57 percent).

The change in total crop income instability induced by the observed increase in export share from 1949-50 to 1979-80 may be estimated from equation (3), which gives $CV_y = 10.65 - 10.24 = 0.41$ percentage points, or only 4.0 percent of the initial value. Using the CV 's and r s for the separate subperiods 1949-69 and 1970-80 gives even smaller increases in the variability of total crop income (in real terms)—by only 3.5 percent and 0.12 percent of the (initial) CV values in 1949 and 1970, respectively. The very small increase in income instability from 1970 to 1980 is attributable to the insubstantial rise in the export share (from 0.561 to 0.568), the small difference in CV_f and CV_x values (11 vs. 12, from Table 1), and the insignificant correlation between Y_f and Y_x during the period ($r = -0.078$).

The above estimates represent relatively modest increases in real income instability arising from the observed rise in export crop share over the postwar period. What may be called the *ex post* elasticity of real crop income instability with respect to export crop share for the entire 1949-80 period is calculated to be only 0.074 (4.0/53.9).

Conclusion

The results of the above empirical analysis confirm, for Philippine agriculture in the postwar period, the greater income instability for export crops relative to food crops. What is surprising, however, is the comparatively small differences in the instability values (especially for the 1950s and 1960s, during which the export orientation of crop production in the Philippines increased markedly), considering that the food sector had been effectively shielded by government policy from international price fluctuations.⁶ In the 1970s, the variability of both food and export crop incomes decreased significantly, which contrasted with the increased instability in the country's foreign sector, particularly export earnings from agricultural crops. The greater degree of government intervention in the 1970s, especially in the agricultural export sector, apparently provided a partial offset to the foreign price fluctuations of primary product exports during the decade.

The decline in export crop income instability was not accompanied by a continuation of the increasing export share in total crop income, which actually levelled off in the 1970s. Export crop production presumably became less attractive relative to food crop production as a result of the changed policy environment that actively promoted food crop production at the same time that the

gains to agricultural export producers from exchange rate liberalization and favourable world commodity prices were being siphoned off through various “stabilization” tax measures. Thus, the reduction in export crop income instability in the 1970s was apparently achieved due to the heavier export taxation in times of improved earnings, effectively reducing the average profitability of export crop production. Whether maintaining that policy is desirable if the world economy continues to be “turbulent” is a question that deserves serious study.

The empirical estimate of only a moderate effect on income instability due to the large increase in export crop share in the 1950s and 1960s does not validate the prevalent apprehension among LDC policy makers about the increased instability in agricultural income arising from greater export orientation of agricultural production (which took place before the policy interventions of the 1970s). The possibility exists that agricultural export expansion in developing countries can be effected at a relatively small cost (in terms of rural income instability).

The nature of food-export crop tradeoffs in developing countries needs to be carefully examined rather than presumed. Empirical knowledge of the tradeoffs can provide guidance to LDC governments in selecting policy instruments and development strategies that are consistent with their overall perspectives. While this paper has focussed, rather narrowly, on real income instability, considerations affecting the choice of food-export crop output mix related to some of the other major concerns of development policy (such as employment and income distribution) also warrant systematic analysis.

Notes

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²The application to the Philippine case does not entail this extreme assumption.

³Thus, “...during the 1970s, government policies generally reduced domestic prices of export crops below those which would have prevailed under the previous regime...” of insignificant government intervention in the production and trade of export crops (David, 1982, p. 5) .

⁴Calculated values of the correlation coefficients are as follows:

	1949-80	1949-69	1970-80
Between Y_{it} and P	0.975	0.914	0.338
Between Y_{it}^{ff} and P	0.970	0.845	0.695

⁵In the context of food security, defined as the ability to meet target consumption levels (Valdés and Siamwalla, 1981), the implication of a shifting trend line is that target consumption levels over time are not being set along a strictly linear trend, owing to changes in the economic environment.

⁶The protection is well documented in the case of rice, the dominant food crop in the Philippines. See, for example, Bouis (1982).

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Discussion Opening – *Kamil I. Hassan*

The three papers presented today have a common theme, “food security,” that could be related to food production, food distribution, and the tradeoff between producing food domestically or producing export crops that could be used to purchase food on world markets.

We know that increased production could take place through increasing area under food crop production or through improving yields. The former approach depends on land and water availability, especially in African agriculture, while the latter depends on the availability of modern inputs such as fertilizer and hybrid varieties. The variability in LDC food production as seen in the African case could suggest both the potential and possible shortfalls that could occur. Such variability, linked to natural and economic factors, has implications for the questions of distribution of food within a country (i.e., between rural and urban areas) as well as decisions on producing food or cash crops.

As variability in production affects the availability of food, the question of increasing food production is related to its distribution. But food distribution is also related to the distribution of wealth and income within a country. An urban bias exists in the distribution of food within LDCs, especially related to imported foods (whether on commercial or food aid terms), as can be seen in the case of wheat in Sudan. Hence, measuring impacts of food availability through welfare indicators should look not only at the distribution of income but also at the ownership of income producing assets. A majority of African countries depend on exports of primary agricultural commodities for foreign exchange earnings and must minimize their dependence on imported inputs and at the same time become competitive in international markets. The imported inputs may be necessary to increase yields, but their pricing is beyond the control of LDCs. The choice of crops (i.e., export vs. food) depends on the natural (physical) environment as well as on economic forces. Economic and physical conditions (such as rainfall) are dynamic and variable, making crop decisions difficult. Sudan (until 1983) focussed on producing sorghum and cotton (export crops) in the irrigated subsector. When the drought hit in 1984, up to 10 Mt of sorghum had to be imported, all as food aid. At the same time, foreign exchange could not be earned as sales of cotton declined steeply, despite surpluses.

General Discussion – *Carlisle A. Pemberton*, Rapporteur

The discussion of the paper by Hrabovszky, Parikh, and Zeöld focussed on the appropriateness of the causal influences depicted in the paper and the exclusion of population growth as a basic variable. Can income distribution reasonably be expected to determine the ratio of calorie availability to requirements? Parikh stated that if the income distribution were skewed certain low income individuals could be expected to have fewer calories than if the distribution were even. He argued that the causal influences were generally supported in the results.

On the paper by Shapouri, Dommen, and Rosen, the discussion focussed on the most suitable interpretation of the results. For example, in drought stricken areas a positive response to price may be a misinterpretation of a positive response to starvation and crisis. Also, the level of aggregation in the study may attribute a positive price response to traditional subsector when the subsector may be price neutral but masked by a very positive price response by a large commercial farming sector.

Shapouri argued that the analysis was geared to determining an aggregate price response for the particular countries, since that was the authors' particular concern. She urged, however, that researchers working on African countries take the next step and estimate more disaggregated functions, utilizing techniques that are now available.

The discussion on the paper by Bautista was concerned with the specific empirical procedures and their policy implications. Instead of an examination of income variability, should that variability have been disaggregated into yield and price variability so that more appropriate policy remedies could be formulated? Was the producer price for the commodity (procurement price) or the final export price (determined by international market conditions) used?

Bautista replied that household income is a very relevant concept, especially to national policy makers concerned about the status of rural household incomes relative to urban household incomes. Thus, he argued, an analysis of fluctuations of rural household incomes as carried out in his paper was most appropriate. On the second question, Bautista stated that the export price used was an “amalgamation” of the procurement price and the international market price. He argued, however,

that, provided that the coefficients of variation of the prices were identical, the choice of particular price was immaterial.

Finally, Bautista stressed that the nature of the food-export crop tradeoff needs to be examined to provide guidelines to policy makers and argued that other variables that affect policy in addition to real income variability need to be analyzed.

Other issues raised included the difficult policy choice between high prices for producers and low food prices for consumers, the need for more discussion on farming systems research, and the need to examine the impact on developing countries of forms of aid other than food aid (e.g., personnel aid and the necessity of maintaining the delicate natural balance in the ecosystems of sub-Saharan Africa to forestall serious environmental and ultimately human suffering).

Participants in the discussion included R.C. Agrawal, J. Berthelot, I. Elbudawi, D.M. Etherington, R. Fawcett, M.R. Villa Issa, J. Groenewald, H. Mahran, L. Moore, W. Mwangi, I.G. Simpson, and E. Tollens.