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Sources of Producer Income Instability in Kenya

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Abstract: The objective of this paper is to examine the sources of producer income instability for marketed commodities in Kenya. Producer income instability can increase foreign exchange administrative costs, create domestic budgetary problems, lead to inefficiencies in resource use, and even to political upheavals. Using a variance decomposition methodology, demand was identified as the major contributor to export earnings instability for coffee, hides and skins, beans and peas, and canned pineapples. Supply was the major contributor of export earnings instability for tea and pyrethrum extract. With respect to domestic producer income instability, supply was the major culprit for most commodities. Supply was the major source of instability for tea, maize, wheat, and fluid milk, while demand was the major source of instability for coffee. Producer income instability of export crops was relatively constant over the study period (1964-83), whereas income instability of domestic crops, and, hence, the instability-minimizing share of exports, rose over the same period. Limitations of the study include the use of aggregate data, selection of methodologies that ignore structure, and using only marketed commodities for analysis.

Introduction

Agriculture is important to Kenya. It is a major source of employment and foreign exchange earnings. Kenyan agriculture can be divided into two components: those products consumed directly by producers and those marketed in either the domestic or foreign markets. This study concentrates on the marketed products. Major export commodities include coffee, tea, and sisal. Major commodities that enter the domestic marketing system are maize, wheat, and fluid milk.

Most current policies associated with food production in Kenya are embedded within the goals of Kenya's national food policy. Broadly, the major policy goals include: (1) self-sufficiency in the basic foodstuffs, with the surplus being exported profitably; (2) a reasonable degree of food security; and (3) increased availability of nutritionally balanced diets for all citizens. Inherent in these goals is the stabilization of domestic food prices. In attempting to achieve these goals, all major farm commodities are marketed through government controlled agencies. A better understanding of the sources of instability will be beneficial to policy makers. The objective of this paper is to examine the sources of producer income instability for marketed commodities in Kenya.

Instability has been defined as a temporary deviation from some underlying trend (Gelb, 1979). Its effects, in a risky, adverse economic environment, cannot be overemphasized. A number of *a priori* propositions regarding its effects have dominated trade and economic development literature for several years (Knudsen and Parnes, 1975). At the national level, unstable government revenues create budgetary problems. Fluctuating foreign exchange earnings increase foreign exchange administrative costs. Budgetary problems may jeopardize domestic economic planning in developing countries. These problems may culminate in political upheavals. At the farm level, unexpected income shortfalls or surpluses induce inefficiencies in resource use. Income instability then represents a cost to an individual producer as well as society at large.

Export Earnings Instability

Producer earnings are a product of price and quantity. Using variance of earnings as a measure of instability, its decomposition can provide useful information. It has been used in a number of studies (Burt and Finley, 1968; Hazell, 1982 and 1984; Murray, 1978; Offutt and Blandford, 1983; and Piggott, 1978). Using a procedure similar to Murray's, which assumes the variables are log-normally distributed, the proportional contribution of each component to the total variability of Kenya's commodity export earnings are presented in Table 1. The table indicates that, for coffee, tea, and hides and skins, price played a dominant role. The variability of quantity dominates in the case of canned pineapples and

of beans and peas. For pyrethrum extract, the covariance term between price and quantity dominates.

The sign of the covariance term is often used as an indicator of the source of instability (Murray, 1978). If supply remains unchanged, movements in demand lead to quantity and price variations

in the same direction. Price and quantity vary in opposite directions if demand does not change when shifts in supply occur. For a small, open economy facing no international trade barriers, demand for its exports is perfectly elastic. Similarly, producers who market exportables through the marketing board, which then takes responsibility for marketing abroad, face an infinitely elastic demand at the board's prices. Consequently, price and quantity vary in the same direction whenever shifts in the demand schedule occur. But, any shift in supply results in changes in the quantity exported only. If supply is perfectly inelastic and demand is relatively inelastic, then quantity and price vary in opposite directions for any shifts in supply. In this case, shifts in demand results in price changes only.

A negative covariance term implies that demand changes have been relatively stable while changes have been unstable. In any particular year, if the value of prices and quantities are below or above the trend line, then a positive covariance term is expected. This would occur if supply were to fluctuate in a steady manner while demand changes were relatively erratic.

From Table 1, tea and pyrethrum extract have negative covariance terms, suggesting that the source of instability has been supply. For the rest of the export commodities, the signs of the covariance terms are positive, indicating that, in general, demand fluctuations have been the main source of instability.

The above analysis has centred on Kenya's exports. Except for beans and peas, all the commodities are storable after some processing. In the absence of suitable storage facilities at the farm level, the commodities are generally perishable, so that producers have to sell to marketing agencies immediately after harvesting. The sources of producer income instability can thus be identified by considering the quantity delivered to the marketing boards and the average price to the producer. The sources of instability of the domestically marketed commodities can then be evaluated and compared with export-oriented commodities.

Table 1-Components of Export Earnings Instability
In Terms of Kenya Shillings, 1964-83

Commodity	Variation			
	Total Var (ln PQ)	Price Var (ln P)	Quantity Var (ln Q)	Covariance 2Cov (ln P, ln Q)
	----- Percent* -----			
Coffee	0.1371	76.59	10.58	12.84
Tea	0.0527	105.69	47.82	-53.51
Hides and skins	0.1124	52.22	31.23	16.55
Pyrethrum extract	0.0454	241.85	197.36	-339.21
Beans and peas	0.4105	8.21	84.24	7.55
Canned pineapples	0.2396	14.27	56.59	29.13

*Percentages indicate the proportional contribution of each component to total variability.
Source: Arap Rop (1986).

Producer Income Instability

Policy changes on commodity prices occurred in 1975 to reflect the surge of inflation that started after 1972. To obtain more insight into producer income instability, the data are divided into two sets. The first set covers 1964-73, while the second set covers 1974-83. In both cases, instability of the five major market-oriented commodities is considered.

With respect to coffee and tea, the sources of export earnings instability are presented in Table 2. During the 1964-73 period, the variability of quantity exported was dominant. Quantity exported had a low positive correlation with the f.o.b. prices earned. Since the covariance terms are positive, one could conclude that volatility on the demand side was the main source of earnings variability. The importance of price variability as a source of

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Table 2-Components of Export Earnings Instability from Coffee and Tea for Selected Periods

Commodity and time period	Variation			
	Total Var(ln PQ)	Price Var(lnP)	Quantity Var(lnQ)	Covariance 2Cov(lnP, lnQ)
	Percent*			
Coffee:				
1964-83	0.1371	76.59	10.58	12.84
1964-73	0.0400	30.50	50.00	19.50
1974-83	0.1940	72.47	4.38	23.19
Tea:				
1964-83	0.0527	105.69	47.82	-53.51
1964-73	0.0199	29.65	69.35	1.01
1974-83	0.0834	52.64	21.94	25.54

*Percentages indicate the proportional contribution of each component to total variability.
Source: Arap Rop (1986).

earnings instability rose significantly in the later period for both commodities. In both cases, the covariance terms contributed more to total fluctuations than quantity terms. Correlation coefficients between the quantities exported and f.o.b. prices improved. Unlike the situation in the former period, earnings and quantities were more highly correlated than earnings and prices.

Of interest to producers is the income insta-

bility for the commodities they sell to the marketing agencies. In most cases, quantities exported do not fully reflect quantities sold by farmers to the marketing agencies during the year because of storage by the marketing agencies. Also, commodity taxation by the government and marketing costs, both at the producer and the agency levels, reduce the price paid to producers. Using average producer prices and gross marketed production during the two periods, the decomposition process yields the results presented in Table 3.

The striking feature for the export crops is that the stability of f.o.b. prices does not necessarily mean that average producer prices are stable. Considering the 1964-83 period, volatility in price was a major source of income fluctuations in coffee, tea, and wheat, while variability in quantity contributed to most of the instability in income from maize and milk. The covariance terms indicate that, except for coffee, supply fluctuations were the major sources of income instability. The negative correlation coefficients between the prices and quantities of tea, maize, wheat, and milk imply that one of the variables was declining while the other was increasing.

The original data indicated that, in the 1960s, prices paid to farmers exhibited a slightly downward trend.

During the 1964-73 period, variability in quantity was dominant (Table 3). The figures for the 1974-83 period suggest that price volatility was important for all commodities except

Table 3-Components of Income Instability from Selected Marketed Production

Commodity and time period	Variation			
	Total Var(ln PQ)	Price Var(lnP)	Quantity Var(lnQ)	Covariance 2Cov(lnP, lnQ)
	Percent*			
Coffee:				
1964-83	0.1347	77.13	9.43	13.44
1964-73	0.0286	52.80	54.90	-7.69
1974-83	0.2015	69.03	4.76	26.20
Tea:				
1964-83	0.0754	105.30	23.74	-29.05
1964-73	0.0086	76.74	132.56	-109.30
1974-83	0.1095	51.69	14.06	34.34
Maize:				
1964-83	0.1501	36.24	96.47	-32.71
1964-73	0.0934	22.27	86.51	-8.78
1974-83	0.2324	7.79	73.54	18.67
Wheat:				
1964-83	0.0736	61.68	46.06	-7.74
1964-73	0.0485	11.55	111.08	-27.63
1974-83	0.0087	59.77	55.17	-16.09
Fluid Milk:				
1964-83	0.0603	34.16	151.41	-85.57
1964-73	0.0531	22.60	74.39	3.01
1974-83	0.0309	21.68	53.40	25.24

*Percentages indicate the proportional contribution of each component to total variability.
Source: Arap Rop (1986).

for maize and milk, which had quantity as the major source of variability. The 1964-73 period had variability in supply as an important instrument in total commodity income instability. Except for wheat, the covariance terms suggest that fluctuations in the demand for commodities were sources of income instability during the 1974-83 period. Unlike the former period, the correlation between prices and quantities was positive except in the case of wheat. The correlation between milk prices and quantities marketed remained positive in both sets of data.

Several factors contribute to the negative correlation between prices and quantities during the 1964-73 period. Generally, price trends were declining while production was expanding. Expansion in production was attributed to increased yield per unit area, especially for maize, due to the rapid adoption of the hybrid seed technology. The introduction and subsequent rapid adoption of the new maize variety in the 1960s opened up an alternative price policy that producer prices would be reduced progressively as returns per unit area increased due to yield increases. This policy was implemented in 1966 to obviate unnecessarily large surpluses that could be exported at a loss. The ultimate producer price would be that at which surpluses could be exported profitably and at the same time production be encouraged to match with the domestic market needs. Lobbying by producers, coupled with several periodic droughts, led to a reassessment of the policy that resulted in maize price increases in 1971.

The area under the traditional plantation crops, coffee and tea, expanded as a result of postindependence government policy that encouraged smallholder participation. The subdivision of large-scale farms and absence of appropriate technology for small-scale production led to a decline in the production of wheat. In some cases, limited production activities hampered the diversion of resources away from those commodities whose relative prices were declining. Kenyan producers often exhibit this less "rational" behaviour.

Notwithstanding the perception of some underdevelopment theorists, agricultural production for export and domestic markets in Kenya is interdependent. Domestic exports are vulnerable to international market fluctuations, while production directed to the domestic market is subject to government control. The linkages between these categories, in addition to government attempts to insulate domestic production from the vagaries of world prices, reinforce the need to stabilize total income through balanced production.

Given that the government's primary goal is to secure domestic food supply, the share of export-oriented production that minimizes total income instability is meaningless. The variability in combined income from coffee and tea, the main exports of Kenya, has been relatively constant over the study period (Table 4). As compared with the combined income variability from maize, wheat, and milk, income instability from exports has been higher than from domestic sales. Assuming no correlation between income from exports and domestic sales, then the instability-minimizing percentage of export value has risen from 12.00 in 1964-73 to 25.00 in the period 1974-83. These results imply that the share of exports that leads to minimum income instability is relatively small.

Table 4—Producer Income Instability from Agricultural Sales
for Selected Periods

Source	1964-83	1964-73	1974-83
	- - - - Percent - - - -		
Variability of income index from domestic sales*	20.56	11.22	17.89
Variability of income index from export sales*	29.71	30.88	30.60
Instability-minimizing share of exports	32.00	12.00	25.00

*The index is a corrected coefficient of variation derived from log-linearly detrended data (Cuddy and della Valle, 1978).

Sources: Bautista (undated) and Arap Rop (1986).

Summary and Conclusions

Considering coffee and tea, the two most important export crops, fluctuations in price contributed most to their export earnings instability over the entire study period. However, during the first 10 years, the contribution of quantity to total variability was dominant. The dominance of price variability prevailed during the later decade, so that not only has variability of earnings increased over the 20-year period, but also the source has changed. In consequence, using this criterion, policy makers facing such situations should be more concerned with external demand than domestic production. This requires stronger multilateral cooperation between producers and consumers, as in the case of coffee, or some other cohesive international commodity cartel.

Comparing producer income instability for 1964-73 and 1974-83, the variability in the income from coffee, tea, and maize has increased; that for wheat and milk has declined. In all cases, the proportional contribution of quantity to total variability has decreased. The sources of instability, as indicated by the signs of the covariance terms, have shifted from supply-dominated to demand-dominated fluctuations in the case of coffee, tea, and maize. Wheat and milk face supply- and demand-dominated fluctuations, respectively. In the case of coffee and tea, income instability measures support the findings obtained in terms of export earnings instability. Maize, the staple food crop in Kenya, followed the pattern of those crops produced mainly for export. For wheat, policy should concentrate on domestic production.

Except in the case of wheat, changes in both export and domestic demand are becoming the major source of income variability for the market-oriented commodities. This suggests that a restructuring of the market is essential for increased income stability, irrespective of destination. Furthermore, the increased price-quantity correlations exhibited by most of the commodities studied would suggest that potential gains in terms of increased stability might be obtained through price manipulation by the Kenyan government. On total income instability, the results indicate that the high level of variability in export earnings was accompanied by an increase in the proportion of exports in total income during 1974-83. Income stabilization measures appeared to favour only domestically marketed commodities.

This study is based on time series data for the 1964-83 period. The results are, therefore, period specific and may not be appropriate for other periods. However, the validity of the results within the time span is not expected to change drastically. The analytical procedure is limited by the fact that the underlying production complexities are excluded. A detailed study is required to isolate the causes of production instabilities. Variation in output may be due to changes in yield per unit of area or to changes in area under cultivation. Also, changes in export earnings may be attributable to fluctuations in the effective exchange rate rather than the volatility in the quantities exported.

Limitations and Scope for Further Research

This study suffers from a number of drawbacks. First, decomposition of statistical identities precludes any direct reference to underlying structural relationships. Second, due to data constraints, aggregate data were used. The results may not necessarily extend to the micro level. Kenya produces a wide variety of agricultural commodities, but only the five most important commodities were studied in detail. The selection criterion was the degree to which they influence Kenya's commercial agriculture.

A wide range of problem areas exist for further research. First, the structural relationship between export commodities and those marketed locally deserves further study. Research that considers not only marketed production but total production would provide much needed information for better decisions. Such a study could include changes in the monetary sector and their impact on income variability. The effects of risky production and product market environments on the overall welfare of producers and consumers should be rigorously investigated. Finally, and perhaps of more immediate importance, is the need to

analyze the long-run implications of price rigidities for quantities produced and supplied to markets.

Note

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DISCUSSION OPENING—Carlos E. Cuevas (Ohio State University)

The paper discusses an important concern of policy makers in developing countries. As the authors correctly point out, producer income instability may create (or be associated with) inefficiencies and adjustment problems at different levels in the economy.

The approach adopted in the paper is to examine the sources of (gross) income instability for selected marketed commodities in Kenya. Using a variance decomposition method, the authors infer the causes of producer income instability by looking at the sign of the covariance term. They are thus able to determine whether the observed variation in the value of total sales is due to demand fluctuations or can be attributed to supply instability.

The authors acknowledge several drawbacks of the study due primarily to the use of a nonanalytical method and of aggregate data. Hence, this comment will focus on some of these limitations and will suggest possible improvements in the presentation of the paper.

Among the limitations pointed out by the authors, perhaps the most important is the applicability of their results to the micro level. However, this limitation does not arise only from the use of aggregate data; the fluctuation of *gross* revenues from individual commodities may not represent a good proxy for the variations in *net* revenues experienced by Kenyan farmers with some degree of product diversification.

On the one hand, the variance of earnings is only one component of the instability of net surplus at the farm level. Variations on the expenditure side should be taken into account. Furthermore, even though individual producers are not able to affect output prices, they are likely to react to fluctuations in input prices by adjusting the amounts of purchased inputs used in production.

On the other hand, product diversification is one of the most common strategies to reduce production risk at the farm level. Hence, instability of net revenue, at the producer level will certainly be affected by fluctuations in gross revenues from individual commodities, but it is likely to include effects of fluctuations on the expenditure side and the compensating influence of product diversification. In this sense, the paper would benefit from a discussion of the patterns of input use in Kenyan agriculture and a description of the typical output mix of different farm types in Kenya.

Data problems forced the authors to use official prices paid by government-controlled agencies. An implicit, and legitimate, concern in the paper is to what extent fluctuations in these prices are fully transmitted to the farm level. A brief description of the marketing chains associated with the commodities dealt with in the paper would help the reader. Indeed, the observed variability of total sales to marketing agencies might be reflecting, in some cases, the instability of total revenues for market intermediaries, rather than that experienced by the primary producers.

The way in which the results are presented (variance of the logarithm of total sales) prevents one from comparing variability across commodities. The use of the coefficient of variation or other standardized indicator would allow comparisons of the relative instability of revenues among different production activities.

Finally, would "price manipulation by the Kenya government" really be income-stabilizing for Kenyan producers as the authors conclude? In fact, the reported increase in instability for several commodities occurred under sustained government intervention in agricultural marketing.

GENERAL DISCUSSION—*Jerome C. Wells, Rapporteur* (University of Pittsburgh)

In the general discussion of this paper, the problem of relating measures of instability in receipts for crops with instability of farmer income was raised, as was the issue of the conditions under which the covariance of price and quantity fluctuations could appropriately be used to assess whether fluctuations were demand or supply determined. The prospects for government (or international) schemes to stabilize producer income were discussed, as was the appropriateness of measures of instability around a trend line.

Participants in the discussion included E. Asante, S. Ehui, T.E. Gina, R. Herrmann, T.N. Jenkins, D. Kirschke, H. Lee, W. Mukhebi, W. Oluoch-Kosura, and N. Traoré.