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Ezriel Brook, Enzo Grilli, and Jean Waelbroeck

Commodity Price Stabilization and the Developing Countries

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Commodity Price Stabilization and the Developing Countries*

The problem of instability in primary commodity prices and export earnings is well known. Developing countries have, for more than two decades, emphasized the adverse impact of prices and export revenue fluctuations on their economies. The problem has also been intensely studied by individual economists as well as by international organizations. However, despite the considerable effort that went into the study of the causes and effects of primary commodities' price instability, progress in devising practical solutions and implementing them has been slow.

The debate itself has been marred by considerable confusion: failure to differentiate between the problem of short-term instability of prices and earnings and that of long-term growth of export revenue from primary commodities has clouded the discussion over possible solutions and has often led to confusion as to the objectives of national and international action in this field. Even where the short- and long-term problems were clearly differentiated and attention was focused on short-term price and export earnings instability, there has often been a further element of confusion: the assumption that price stabilization would automatically yield revenue stabilization as well. Furthermore, the critical question of the distribution of gains of price stabilization between producers and consumers, although quite intensely debated at the theoretical level, has received little, if any, empirical attention.

In the recent past, mostly as a result of the UNCTAD Integrated Program for Commodities,[1] there has been a revival of interest in

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[1] UNCTAD, "An Integrated Program for Commodities: The Role of International Buffer Stocks," (Report by the Secretary General of UNCTAD), Docs. TD/B/C.7/166 Suppl. 7 and TD/B/C.7/166/Suppl. 7/Add. 7, December 1974.

international commodity trading arrangements — buffer stocks in particular — designed to reduce short-term fluctuations in the prices of primary commodities exported by the developing countries. Attention has been focused on the short-term problem, but primary commodities — as candidates for international action aimed at stabilizing their market prices — still seem to be chosen on the basis of technical criteria (e.g., ease of storage) and their importance to developing countries as revenue earners. This procedure for choice is clearly unsatisfactory, since it rests on the implicit assumption that producers (most often developing countries) would automatically benefit from price stability and pays no apparent regard to the welfare and income distribution effect of price stabilization.

In dealing with commodity price stabilization from the standpoint of developing countries it is essential to distinguish clearly between the goals that such action is intended to reach whether (a) stabilization of export revenue; (b) maximization of export revenue and welfare of commodity exporting countries; (c) minimization of import expenditure and maximization of welfare of commodity importing countries. The simultaneous achievement of more than one of these desirable goals is in no way assured. The purpose of this article is to look at commodity price stabilization — defined as an operation intended to smooth out price fluctuations around the trend set by market forces — in terms of specific objectives and to define criteria for determining the primary commodities whose price stabilization at the international level would benefit most the developing countries as producers or consumers.

1. Commodity Price Stabilization: The Income Effects

Two-state analysis conducted within the framework of a simple market model that assumes (1) linear demand and supply schedules; (2) instantaneous reaction of supply and demand to changes in market prices; (3) additive stochastic disturbances; and (4) price stabilization at the mean of the prices that would have prevailed in an unstabilized market, shows quite clearly that (a) the source of commodity price instability — together with the value of the price elasticities of demand and supply over the relevant range — is an important factor in determining whether price stabilization will also bring about revenue stabilization; and that (b) the source of commodity price

instability is also the critical factor that determines whether price stabilization via buffer stocks increases or decreases producers' income (or exporters' revenue).

It can be shown that if the market for a commodity is characterized by demand instability, price stabilization will — over two periods of time — also bring about revenue stabilization, provided that demand is price-inelastic over the relevant range. On the contrary, if demand is price-elastic over the relevant range, price stabilization will destabilize revenue. Both of these results hold regardless of the value of the price elasticity of supply. If the market for a product is characterized by supply instability, it can be shown that price stabilization would destabilize revenue if demand is price elastic over the relevant range. This result holds regardless of the value of the price elasticity of supply. If, on the contrary, both demand and supply are price inelastic over the relevant range, price stabilization can bring about revenue stabilization as well.

Under the same assumptions made with respect to the market model, it can be shown that over two periods of time price stabilization would decrease the total earnings of the commodity exporting countries, if demand shifts are the cause of the price change,[2] while it would increase the total earnings of the commodity exporting countries, if supply shifts are the cause of the price change. These general conclusions hold as long as the demand and supply curves are well behaved. While price elasticities determine the size of the difference between stabilized and unstabilized export revenue, the validity of the general conclusions stated above does not depend on specific elasticity values.[3]

2. Commodity Price Stabilization: The Welfare Effects

The desirability of price stabilization from the standpoint of welfare has long been debated in economic literature. Government

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[2] This is Grubel's result; see: H. GRUBEL, "Foreign Exchange and Price Stabilization Schemes," *The American Economic Review*, Vol. LIV, No. 4, June 1964, pp. 378-385.

[3] For a fuller treatment of the income effects of price stabilization, including the proofs of the conclusions mentioned above, see: E. BROOK, E. GRILLI, and J. WAELBROECK, "Commodity Price Stabilization and the Developing Countries: The Problem of Choice," *World Bank Staff Working Paper*, No. 262, Washington, D.C: July 1977, pp. 6-10 and Annexes I and II.

programs designed to stabilize the prices of agricultural commodities stimulated economic analysis of welfare gains and losses of producers and consumers. F. V. Waugh demonstrated that consumers having a downward sloping demand curve gain from price fluctuations that originate from random supply shifts.[4] Similarly, W. Y. Oi showed that producers having an upward sloping supply curve gain from price fluctuations caused by random demand shifts.[5]

B. Massell generalized the analysis of Waugh and Oi within the framework of a linear demand-supply market model.[6] Assuming a demand-supply model identical to the one used in Section 1 to analyze the income effect of price stabilization and using — as Waugh and Oi had done before — the expected value of the change in producer and consumer surplus as a measure of gain,[7] Massell showed that:

(a) (1) Producers gain from price stabilization if price instability originates from random shifts in supply, and (2) lose if price instability originates from random shifts in demand.

(b) (1) Consumers gain from stabilization if the source of price instability is random shifts in demand, and (2) lose if price instability originates from random shifts in supply.

(c) Price stabilization brought about by a buffer stock provides a net gain to producers and consumers taken together. The total gains from stabilization are always positive from a global welfare standpoint: gainers can compensate losers. If this happens, consumers and producers are better off with price stability than with price instability.[8]

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4 FREDERICK V. WAUGH, " Does the Consumer Benefit from Price Instability? " *The Quarterly Journal of Economics*, Vol. LVIII, No. 4 (Aug. 1944), pp. 602-614.

5 WALTER Y. OI, " The Desirability of Price Instability under Perfect Competition," *Econometrica*, Vol. XXXIV, No. 2 (April 1966), pp. 504-508.

6 BENTON F. MASSELL, " Price Stabilization and Welfare," *The Quarterly Journal of Economics*, Vol. LXXXIII, No. 2 (May 1969), pp. 285-297.

7 Massell's results continue to hold — with minor modifications — if demand and supply functions are non-linear, provided that the stochastic disturbances are still additive in nature. If stochastic disturbances are instead multiplicative in nature, some of Massell's results no longer hold, unless alternative definitions of producers' surplus are used. See, for example, P. B. R. HAZELL and P. L. SCANDIZZO, " Market Intervention Policies When Production is Risky," *American Journal of Agricultural Economics*, No 57 (Nov. 1975), pp. 641-649.

8 The underlying assumption here is that the buffer stock authority acts as storage agent and makes no profit. The buffer stock operation is here assumed to be costless (both in terms of storage costs — including general overhead and interest costs on the capital used). Obviously the economic costs of the buffer stock operation need to be considered to arrive at estimates of net benefits.

Finally, D. Hueth and A. Schmitz[9] extended Massell's analysis to international traded goods (both final and intermediate).[10]

3. Integration of Income and Welfare Effects

In terms of criteria for the choice of commodities whose price stabilization could benefit developing countries, the welfare results of Massell-Hueth-Schmitz are parallel to the income (revenue) results reached in Section 1. It would appear that if market price instability originates mostly from supply shifts developing exporters would gain from price stabilization in terms of both income (revenue) and welfare. The opposite would appear to be the case if market price instability is essentially a demand phenomenon. However, a closer scrutiny of the results of Massell and Hueth-Schmitz reveals that their welfare conclusions are really a combination of the pure welfare and income effects of price stabilization.

The decomposition of the Massell and Hueth-Schmitz welfare results into pure welfare and income can be shown graphically.[11] The first step is to define: (1) pure producers' welfare gains as the expected difference between the costs of producing a commodity in a stabilized and non-stabilized market; (2) pure consumers' welfare gains as the expected difference in utility obtained from consumption of a commodity in a stabilized and a non-stabilized market; and (3) the income effect as the difference between the expected value of revenue (of expenditure) in a stabilized and non-stabilized market.

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9 D. HUETH and A. SCHMITZ, " International Trade in Intermediate and Final Goods: Some Welfare Implications of Destabilized Prices," *The Quarterly Journal of Economics*, Vol. LXXXVI, No. 3 (Aug. 1972), pp. 351-365.

10 If it is postulated that the supply decision is based on expected instead of actual prices, then some of Massell's results need to be modified. These modifications depend on the type of price expectations which are assumed. Under the assumption of rational expectations, Massell's results (a) (1), (b) and (c) continue to hold. Result (a) (2) holds if the random demand disturbance is positively or negatively autocorrelated. Under the assumption of adaptive expectations, Massell's results (c), (a) (1), and (b) (2) continue to hold, while (a) (2) and (b) (1) remain quite indeterminate. See STEPHEN J. TURNOVSKY, " Price Expectations and the Welfare Gain from Price Stabilization," *American Journal of Agricultural Economics*, Vol. 56, No. 4 (Nov. 1974), pp. 706-716. It is very difficult, however, on both theoretical and empirical grounds to decide whether one type of price expectation hypothesis is superior to another in portraying what really happens in the various commodity markets.

11 For an algebraic decomposition of the Massell results into " income " and " pure welfare," see E. BROOK, E. GRILLI and J. WAELBROECK, " The Welfare Impact of Price Stabilization: A Rule of Thumb Based on Massell's Results," (February 1977, Mimeo).

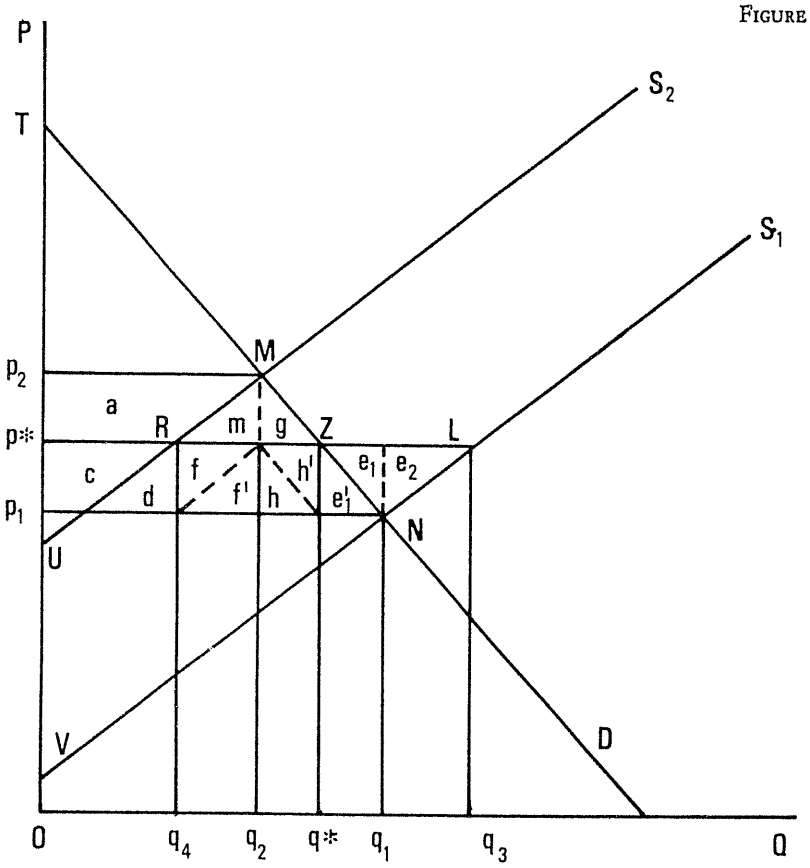
It follows that, if the resource cost of producing a commodity is lower (higher) in a stable than in an unstable market, producers gain (lose) from price stabilization. If the total utility derived by consumers from the consumption of a certain good is higher (lower) in a stable than in an unstable market, consumers gain (lose) from stabilization. If exporters of a certain commodity derive a higher revenue from selling their product in a stable than in an unstable market, they gain from stabilization (and importers lose from it).

In a supply shift market Massell's results are as follows: the expected value of producers' gains from price stabilization expressed in terms of producers' surplus $(G_{pw}) = e_1 + e_2 + e'_1$; the expected value of consumers' gains from price stabilization expressed in terms of consumers' surplus $(G_{cw}) = -e_1$ and, assuming compensation, the expected value of joint net gains $(G_{ww}) = e_1 + e_2$. In such a supply shift market it is apparent that: $G_{cw} = G_{cpw}$ (pure welfare gains to consumers) $- G_{cy}$ (income losses to consumers) and $G_{ww} = G_{ppw} + G_{cpw}$ (see Figure 1).

This decomposition of Massell's results clearly brings out the point that pure welfare gains from market price stabilization are positive to both producers and consumers and, therefore, to the world economy as a whole, but that while producers (exporters) would also gain from price stabilization from the standpoint of revenue in a supply shift market, consumers (importers) would lose from it (their import expenditure would be higher than in an unstable market). The total net gain of producers is the summation of a positive pure welfare gain and a positive income gain. The total net loss of consumers is the summation of a positive pure welfare gain and a negative income gain. Since the latter is larger than the former, Massell's G_{cw} $(= -e_1)$ is the result of a larger income loss G_{cy} $(= -2e_1)$ that swamps the smaller pure welfare gain G_{cpw} $(= e_1)$.

Similarly, in a demand shift market, Massell's results are as follows: the expected value of producers' gains from price stabilization expressed in terms of producers' surplus $(G_{pw}) = e'_1$; the expected value of consumers' gains expressed in terms of consumers' surplus $(G_{cw}) = e'_1 + e_1 + e_2$; and — assuming compensation — the expected value of joint net gains $(G_{ww}) = e_1 + e_2$. It is apparent that in such a market: $G_{pw} = G_{ppw}$ (pure welfare gains to producers) $- G_{py}$ (income loss to producers) and $G_{ww} = G_{ppw} + G_{cpw}$ (see Figure 2). As in the supply shift case, the decomposition of Massell's results shows that in a demand shift market pure welfare gains from price

FIGURE 1



A. Expected value of "welfare" gains from stabilization (Massell's results):

$Gpw = \frac{1}{2}\{(p_1p^*LN) - (p_2p^*MR)\} = \frac{1}{2}(c + d + f + f' + h - h' + e'_1 + e_1 + e_2 - a) = e_1 + e_2 + e'_1$

$Gcw = \frac{1}{2}\{(p^*p_2MZ) - (p_1p^*ZN)\} = \frac{1}{2}(a + m + g - c - d - f - f' - h - h' - e'_1) = -e'_1 = -e_1$

$Gww = Gpw - Gcw = e_1 + e_2$

B. Expected value of income (revenue/expenditure) from stabilization:

$Gpy = \frac{1}{2}\{2(Op^*Zq^*) - (Op_2Mq_2 + Op_1Nq_1)\} = (h + h') = 2e_1$

$Gcy = -2e_1$

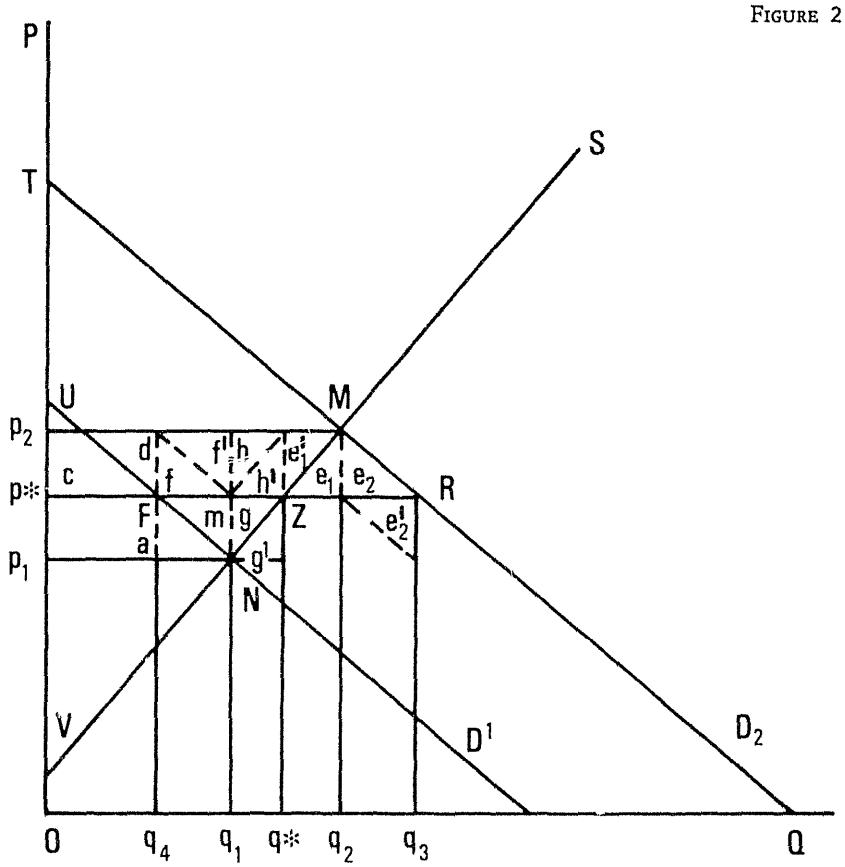
C. Expected value of pure welfare gains from stabilization:

$Gppw = \frac{1}{2}\{(OVNq_1 + OUMq_2) - (OVLq_3 + OURq_4)\} = \frac{1}{2}(RMq_4q_2 - NLq_1q_3) = \frac{1}{2}(f + m) = e_2$

$Gcpw = \frac{1}{2}\{2(OTZq^*) - (OTMq_2 + OTNq_1)\} = \frac{1}{2}(g + h') = e'_1 = e_1$

1. $Gpw = Gpy + Gppw$
2. $Gcw = Gcy + Gcpw$
3. $Gww = Gcppw + Gcpy$

FIGURE 2



A. Expected value of "welfare" gains from stabilization (Massell's results):

$Gcw = ½ \{(p^*p_2MR) - (p_1p^*FN)\} = ½ (c + d + f + f' + h + h' + e'_1 + e_1 + e_2 - a) = e'_1 + e_1 + e_2$

$Gpw = ½ \{(p_1p^*ZN) - (p_2p^*MZ)\} = ½ (a + m + g - c - d - f - f' - h - h' - e'_1) = - e'_1 = - e_1$

$Gww = Gcw - Gpw = e_1 + e_2$

B. Expected value of income (revenue/expenditure) from stabilization:

$Gcy = ½ \{2 (Op^*Zq^*) - (Op_2Mq_2 + Op_1Nq_1)\} = (e'_1 + e_1) = 2e_1$

$Gpy = - 2e_1$

C. Expected value of pure welfare gains from stabilization:

$Gppw = ½ \{2 (OVZq^*) - (OVNq_1 + OVMq_2)\} = ½ (e_1 + g') = e_1$

$Gcpw = ½ \{(OTRq_3 + OUFq_4) - (OTMq_2 + OUNq_1)\} = ½ (Mq_2Rq_3 - Fq_4Nq_1) = ½ (e_2 + e'_2) = e_2$

$Gpw = Gpy + Gppw$

$Gcw = Gcy + Gcpw$

$Gww = Gppw + Gcpw$

stabilization are positive for both consumers and producers, but that the income effect is positive only for the former. For producers, the negative income effect swamps the positive pure welfare effect.

In terms of criteria for choice, if the objective of commodity price stabilization is that of helping developing countries, the integration of the income and welfare aspects of price stabilization shows the importance of the knowledge of the income effect of price stabilization to determine in which commodities these countries would benefit from international action aiming at stabilizing prices. Since the pure welfare effects of price stabilization are always positive for both producers and consumers — at least when demand and supply are linear in price and the stochastic disturbances, whose effect on price one wants to eliminate (or reduce, to be more realistic), are additive in nature — the income effect of price stabilization becomes the critical criterion for determining at first approximation in which commodities developing countries as a group would gain most from price stability. If the income effect is positive for exporters and the developing countries as a group are the dominant exporters of a given commodity, price stabilization can be expected to benefit them. Similarly, price stability would be beneficial to developing countries whenever the income effect is positive for importers and the developing countries as a group as the dominant importers of a given commodity.

4. The Income Effect of Price Stabilization: Empirical Analysis

To ascertain the impact of price stabilization on producers' and consumers' income, a basic choice had to be made: a single commodity vs. a cross commodity approach. The income and pure welfare effects of price stabilization can be determined through detailed case studies of individual commodity markets where demand and supply functions for a particular commodity are fully specified and estimated. The advantage of such an approach is that it permits one to determine not only who is likely to gain or lose from price stabilization, but also to quantify pure welfare as well as income gains or losses. The main disadvantage lies in the formidable difficulties that are involved in trying to specify and estimate full models for a large number of commodities.

Knowledge of model structures, however, is not necessary to ascertain the income effect of price stabilization. The income effect depends on observable variables and it can be ascertained directly from them. The conclusions that can be derived are qualitative in nature, but nonetheless significant in terms of providing preliminary answers to the questions at stake: in which commodities is the income effect of price stabilization likely to be favorable to developing countries as producers (exporters) or consumers (importers)? On grounds of convenience as well as economy it was therefore decided to use a simple cross-commodity approach.

It was assumed that for each commodity:

$$[1] \qquad q = s = \alpha p + x \qquad (\alpha \geqq 0)$$

$$[2] \qquad q = d = -\beta p + y \qquad (\beta \geqq 0)$$

where: s = quantity supplied, d = quantity demanded, q = quantity traded, p = price, α and β are positive constants and x and y are random variables with contemporaneous moment matrix σ_{xx}, σ_{yy}, and σ_{xy}; all the variables are expressed in terms of deviations from their means which are themselves functions of time ($\mu_x = \mu_y = \mu_q = \mu_s = \mu_d = \mu_p = 0$). Now, since equations [1] and [2] imply that:

$$[3] \qquad p = \frac{y-x}{\alpha+\beta} \text{ and}$$

$$[4] \qquad q = \frac{\alpha x + \beta y}{\alpha+\beta}$$

the income effect of market price stabilization, i.e. the difference between the mean value of revenue in a non-stabilized and a stabilized market is:

$$[5] \qquad \sigma_{pq} = \frac{\beta\sigma_{xx} + (\beta-\alpha)\ \sigma_{xy} + \alpha\sigma_{yy}}{(\alpha+\beta)^2} = \theta\sigma_{pp}$$

Since $\sigma_{pp} > 0$, from the sign of θ (the regression coefficient of observed quantity deviations from trend on price deviations from trend) it is possible to determine whether $\sigma_{pq} \gtrless 0$. If $\theta > 0$ the income effect is favorable to consumers (importers) since their expenditure in a stabilized market is smaller than in an unstable market and unfavorable to producers (exporters) since their revenue is lower

with stable prices than with unstable prices. Vice versa if $\theta < 0$, the income effect is favorable to producers (exporters) and unfavorable to consumers (importers).[12]

Seventeen primary commodities were included in the sample on the basis of their technical suitability for buffer stock operation (on this ground meat, bananas and citrus products were excluded because of their poor storability), and importance in developing countries' trade. Commodities that are sold under long-term contracts (e.g. iron ore and fertilizers) were also excluded. For each agricultural commodity the trend in world exports and prices was calculated for the 1954-73 period. Linear and semilog trends were computed for both exports and prices (or unit values of exports).[13] Quantity deviations from trends were then regressed against price (or export unit value) deviations from trends. Four regressions of quantity deviations from trends against price deviations were conducted for each commodity: (a) quantity deviations against price deviations from linear trend; (b) quantity deviations against price deviations from log trend; (c) quantity deviations from log trend against price deviations from linear trend and (d) quantity deviations from linear trend against price deviations from log trend. From the sign of the regression coefficients the income effect of price stabilization on exporters and importers was then ascertained.

The same procedure was used in the case of minerals and metals, but because of data limitations on exports, production data for the 1954-73 period were first used. The results concerning the sign and statistical significance of the coefficients obtained by regressing pro-

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[12] It may be helpful to quantitatively oriented readers to point out that (1) and (2) can be thought of as derived from complete econometric demand and supply equations which are linear in all variables except time. For the derivation see E. Brook, E. Grilli and J. Waelbroeck, " Commodity Price Stabilization and the Developing Countries: The Problem of Choice ", *op, cit.*, Annex III.

[13] Prices and export unit values were expressed in current US$ terms. Because international market price quotations for some commodities may not accurately reflect the unit prices realized by exporters, it was decided to use world export unit values wherever available (generally for agricultural products) as an alternative to market price quotations. Production and export data for the agricultural commodities were taken from FAO Production and Trade Yearbooks, except in the cases of rubber and jute for which International Rubber Study Group (IRSG) and national statistics were used; unit values of exports were also taken from FAO Trade Yearbooks. All production statistics were taken from the Metalgesellschaft Yearbooks. Export statistics for copper were taken from the World Bureau of Metal Statistics publications; for tin from the International Tin Council Yearbooks, for lead and zinc from the Lead and Zinc Study Group Statistical Bulletins and Yearbooks. Market prices were taken from the IBRD Commodity Trade and Price Trend Yearbook.

duction deviations from trends against price deviations from trends were subsequently compared to and checked whenever possible, against those obtained regressing export deviations from trends on price deviations from trends during the same (bauxite and tin) or different time periods (copper and zinc).

The results of the time series regressions of world export deviations from trends against world price deviations from trends for the 12 agricultural commodities included in the sample are given in Table 1. The corresponding results obtained for 11 agricultural commodities using world export unit value deviations from their trends instead of world prices are given in Table 2. The two sets of results are broadly consistent. There are sign reversals in two cases — tea and sisal — but the statistical significance of the regression coefficients is very low for both these commodities.

The regression coefficient has a positive sign and is statistically significant [14] in the case of wheat, maize and rubber. Importers are likely to gain from price stabilization in these commodities in terms of reduced import expenditure (and exporters correspondingly likely to lose). Developing countries as a group are net exporters of all these commodities except for wheat. It follows, therefore, that the income effect of price stabilization would be positive to developing countries only in wheat: as importers developing countries would have a smaller expenditure with stable, rather than unstable prices. The income effect would be negative for developing countries in maize and rubber (their export revenue will be smaller with, rather than without, price stabilization).

The regression coefficient has a negative sign in the case of rice, coffee, cocoa, jute, wool, cotton and sugar. Exporters would stand to gain from price stabilization in these commodities in increased export revenue (and importers would correspondingly lose). The regression coefficients, however, are statistically significant for the first five commodities, but statistically insignificant for the latter two. Developing countries as a group are net exporters of all these commodities except rice. It follows, therefore, that the income effect of price stabilization would be positive for developing countries in all these products except rice. However, because of the statistical insignificance of the regression coefficient in the cases of sugar and

[14] At the 90% level or above.

cotton, only in cocoa, coffee, jute[15] and wool would developing countries' export revenue be likely to be greater with than without price stabilization. The income effect of rice price stabilization would be negative for developing countries as a group.

The results of the time series regressions of world production and export deviations from trends against price deviations from trends for the 5 minerals and metals included in the sample are given in Table 3. The results obtained using world production over the 1954-73 period and world exports over shorter periods appear to be broadly consistent with each other: there are no sign reversals, even though the statistical significance of the regression coefficients varies somewhat from one set of regressions to the other. The regression coefficients of all five commodities have positive signs. Those of copper, bauxite, zinc, and lead are statistically significant.[16] Developing countries as a group are net exporters of all these five commodities. The income effect of price stabilization in the minerals and metals included in the sample, with the possible exception of tin, would seem to be negative to developing countries.

On the whole, the results concerning the income effect of price stabilization reached here seem to conform broadly with *a priori* expectations about the prevalent source of commodity price instability (demand for minerals and metals and supply for most agricultural products) and with those of the only previous empirical study on the source of price instability that has come to our attention.[17]

5. Conclusions and Qualifications

Our empirical analysis on the income effect of price stabilization suggests that in cocoa, coffee, wool and jute developing countries as a group would gain in terms of greater export revenue and in wheat they would gain in terms of lower import expenditure. In these commodities both the income and the pure welfare impact of price stability are positive to developing countries. In two other com-

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15 In the case of jute reliable export series exist only for Bangladesh. This country, however, accounts for over 85 percent of world exports of true jute. Historically the market share of Bangladesh was even higher. Bangladesh exports were used as a proxy for world exports.

16 At the 90% level or above.

17 R. C. PORTER, "Who Destabilizes Primary Product Prices?" *The Indian Economic Journal*, Vol. XVI, No. 4 (April-June 1969), pp. 389-413.

TABLE 1

RELATIONSHIP BETWEEN DEVIATIONS FROM TRENDS OF WORLD EXPORT QUANTITIES AND PRICES FOR 12 AGRICULTURAL COMMODITIES: 1954-73

Commodity/ Trend	LINEAR FORM			LOG-LINEAR FORM			LINEAR-LOG FORM			LOG-LOG FORM		
	Intercept	Regression Coefficient	R^2	Intercept	Regression Coefficient	R^2	Intercept	Regression Coefficient	R^2	Intercept	Regression Coefficient	R^2
Wheat	$-5.2561 \cdot 10^{-8}$	195.2699** (2.536)	0.263	$5.4946 \cdot 10^{-12}$	0.00137 (0.656)	0.023	$-9.4664 \cdot 10^{-7}$	20852.72** (2.753)	0.296	$-1.4119 \cdot 10^{-12}$	0.16033 (0.769)	0.032
Maize	$-7.4176 \cdot 10^{-8}$	190.8229*** (4.865)	0.568	$1.0152 \cdot 10^{-12}$	-0.00363 (-1.225)	0.077	$-1.9303 \cdot 10^{-7}$	13919.88*** (4.063)	0.478	$4.5222 \cdot 10^{-12}$	-0.36560 (-1.591)	0.123
Rice	$3.5367 \cdot 10^{-10}$	-3.7975* (-1.897)	0.166	$3.4982 \cdot 10^{-11}$	-0.00062 (-1.899)	0.167	$1.7556 \cdot 10^{-8}$	-1005.38** (-2.498)	0.258	$3.7711 \cdot 10^{-11}$	0.15958** (-2.388)	0.241
Sugar	$4.6116 \cdot 10^{-10}$	-3.6012 (-0.562)	0.017	$1.7500 \cdot 10^{-11}$	-0.00030 (-0.716)	0.027	$8.4972 \cdot 10^{-9}$	-432.53 (-0.706)	0.027	$1.8118 \cdot 10^{-11}$	-0.03339 (-0.838)	0.037
Coffee	$-3.7252 \cdot 10^{-10}$	-0.2509** (-2.170)	0.207	$1.9645 \cdot 10^{-11}$	-0.00015*** (-3.673)	0.428	$-1.4571 \cdot 10^{-10}$	-311.73** (-2.518)	0.260	$1.9771 \cdot 10^{-11}$	-0.17346*** (-4.091)	0.482
Cocoa	$7.4505 \cdot 10^{-10}$	-0.2638*** (-4.827)	0.564	$3.6379 \cdot 10^{-11}$	-0.00029*** (-4.827)	0.564	$2.4949 \cdot 10^{-9}$	-240.50*** (-6.076)	0.672	$3.8299 \cdot 10^{-11}$	-0.26383*** (-6.623)	0.709
Tea	$-2.0107 \cdot 10^{-11}$	0.0539 (0.604)	0.019	$-3.0024 \cdot 10^{-14}$	0.00008 (0.515)	0.014	$-1.9830 \cdot 10^{-9}$	60.56 (0.586)	0.019	$-3.4382 \cdot 10^{-12}$	0.10501 (0.584)	0.019
Cotton	$-4.4703 \cdot 10^{-9}$	0.0158 (0.043)	0.000	$1.3824 \cdot 10^{-11}$	-0.00006 (-0.5 0)	0.017	$-1.5336 \cdot 10^{-9}$	-87.74 (-0.27)	0.004	$1.6672 \cdot 10^{-11}$	-0.08510 (-0.594)	0.039
Jute[1]	$8.3117 \cdot 10^{-10}$	-1.0708*** (-3.206)	0.363	$3.2894 \cdot 10^{-11}$	-0.00158** (-2.518)	0.260	$4.1669 \cdot 10^{-9}$	-270.34** (-2.747)	0.295	$3.7630 \cdot 10^{-11}$	-0.38593** (-2.116)	0.199
Wool	$2.3517 \cdot 10^{-9}$	-0.1883*** (-8.306)	0.793	$3.2741 \cdot 10^{-11}$	-0.00012*** (-8.156)	0.787	$5.2139 \cdot 10^{-9}$	-511.74*** (-7.099)	0.736	$3.2741 \cdot 10^{-11}$	-0.00012*** (-8.156)	0.787
Sisal	$9.3132 \cdot 10^{-11}$	-0.0059 (-0.047)	0.000	$-2.6921 \cdot 10^{-11}$	-0.00003 (-0.109)	0.000	$-7.8067 \cdot 10^{-11}$	8.714 (0.245)	0.003	$2.6671 \cdot 10^{-11}$	-0.01272 (-0.171)	0.001
Rubber[2]	$-7.5406 \cdot 10^{-10}$	0.6946** (2.979)	0.405	$4.4751 \cdot 10^{-12}$	0.00021* (2.149)	0.262	$-1.6004 \cdot 10^{-8}$	414.86** (2.923)	0.396	$-1.2323 \cdot 10^{-13}$	0.12505 (2.128)	0.258

[1] Bangladesh exports of jute.

[2] 1959-73.

Notes: t ratios in parentheses.
* significant at the 90% level.
** significant at the 95% level.
*** significant at the 99% level.

TABLE 2

RELATIONSHIP BETWEEN DEVIATIONS FROM TRENDS OF WORLD EXPORT QUANTITIES AND UNIT VALUES FOR 11 AGRICULTURAL COMMODITIES: 1954-73

Commodity/ Trend	LINEAR FORM			LOG-LINEAR FORM			LINEAR-LOG FORM			LOG-LOG FORM		
	Intercept	Regression Coefficient	R^2	Intercept	Regression Coefficient	R^2	Intercept	Regression Coefficient	R^2	Intercept	Regression Coefficient	R^2
Wheat	$3.8673 \cdot 10^{-8}$	294.925* (1.908)	0.168	$5.9097 \cdot 10^{-12}$	0.00059 (0.148)	0.001	$5.4982 \cdot 10^{-7}$	23358.72* (1.833)	0.157	$5.2511 \cdot 10^{-12}$	0.02447 (0.075)	0.001
Maize	$-1.9011 \cdot 10^{-8}$	317.829*** (5.247)	0.604	$-3.5007 \cdot 10^{-14}$	0.06010 (−1.259)	0.081	$-1.6566 \cdot 10^{-7}$	19901.76*** (4.525)	0.532	$3.4532 \cdot 10^{-12}$	−0.47460 (−1.515)	0.113
Rice	$3.8949 \cdot 10^{-10}$	−8.36437** (−2.306)	0.228	$3.4993 \cdot 10^{-11}$	−0.00148** (−2.556)	0.266	$2.9763 \cdot 10^{-8}$	−1410.59** (−2.589)	0.271	$4.0189 \cdot 10^{-11}$	−0.24950** (−2.877)	0.315
Sugar	$4.6399 \cdot 10^{-10}$	−5.45231 (−0.345)	0.006	$1.7462 \cdot 10^{-11}$	−0.00065 (−0.639)	0.022	$1.9231 \cdot 10^{-8}$	−777.39 (−0.378)	0.007	$1.9557 \cdot 10^{-11}$	−0.08467 (−0.635)	0.022
Coffee	$-3.7252 \cdot 10^{-10}$	−3.6334** (−2.342)	0.233	$1.9645 \cdot 10^{-11}$	0.00021*** (−3.944)	0.464	$6.7488 \cdot 10^{-9}$	−362.50** (−2.602)	0.273	$2.3582 \cdot 10^{-11}$	−0.20044*** (−4.235)	0.499
Cocoa	$7.4505 \cdot 10^{-10}$	−0.42451*** (−4.922)	0.573	$3.6379 \cdot 10^{-11}$	−0.00048*** (−5.659)	0.640	$8.9421 \cdot 10^{-9}$	−296.47*** (−6.074)	0.672	$4.5468 \cdot 10^{-11}$	−0.32873 (−6.876)	0.724
Tea	$-1.0806 \cdot 10^{-11}$	−0.02901 (−0.239)	0.003	$-6.2965 \cdot 10^{-14}$	−0.00017 (−0.812)	0.035	$-1.3776 \cdot 10^{-10}$	4.854 (0.036)	0.000	$2.8511 \cdot 10^{-12}$	−0.10048 (−0.428)	0.010
Cotton	$-4.4703 \cdot 10^{-9}$	−0.58055 (−0.818)	0.035	$1.3824 \cdot 10^{-11}$	−0.00031 (−1.460)	0.106	$1.1502 \cdot 10^{-8}$	−422.16 (−0.837)	0.037	$2.2254 \cdot 10^{-11}$	−0.22280 (−1.461)	0.106
Wool	$2.2351 \cdot 10^{-9}$	−0.50060*** (−6.879)	0.724	$3.2741 \cdot 10^{-11}$	−0.00033*** (−7.015)	0.732	$9.3273 \cdot 10^{-9}$	−649.83*** (−5.843)	0.654	$3.7405 \cdot 10^{-11}$	−0.42735 (−5.895)	0.659
Sisal	$9.3132 \cdot 10^{-11}$	0.12058 (0.669)	0.024	$2.6921 \cdot 10^{-11}$	0.00022 (0.591)	0.019	$7.9839 \cdot 10^{-11}$	29.71 (0.827)	0.036	$2.6597 \cdot 10^{-11}$	0.05551 (0.740)	0.029
Rubber[1]	$3.3358 \cdot 10^{-10}$	0.87574** (2.807)	0.475	$4.8023 \cdot 10^{-12}$	0.00026* (2.013)	0.237	$-2.1896 \cdot 10^{-8}$	452.60** (2.754)	0.368	$-1.8349 \cdot 10^{-12}$	0.13512* (2.001)	0.236

[1] 1959-73.

Notes: t ratios in parentheses.
* significant at the 90% level.
** significant at the 95% level.
*** significant at the 99% level.

TABLE 3

RELATIONSHIP BETWEEN DEVIATIONS FROM TRENDS OF WORLD PRODUCTION (OR EXPORTS) AND PRICES FOR 5 METALS/MINERALS

Commodity/Trend	LINEAR FORM			LOG-LINEAR FORM			LINEAR-LOG FORM			LOG-LOG FORM		
	Intercept	Regression Coefficient	R^2	Intercept	Regression Coefficient	R^2	Intercept	Regression Coefficient	R^2	Intercept	Regression Coefficient	R^2
Copper - Production : 1954-73	0.006813	0.415806* (1.988)	0.180	0.000009	0.000035 (1.066)	0.059	0.006209	366.817 (1.722)	0.144	0.000090	0.032745 (1.013)	0.033
- Production (ex. CPE) : 1954-73	0.022487	0.510498** (2.441)	0.298	0.000025	0.000094** (2.656)	0.335	0.011900	483.743* (1.805)	0.189	0.000023	0.100578** (2.280)	0.271
- Production : 1960-75	0.024606	0.432245* (1.877)	0.201	0.000033	0.000068** (2.474)	0.304	0.017832	321.453 (1.090)	0.078	0.000031	0.066740* (1.919)	0.208
- Exports : 1960-75	0.012416	0.183944* (2.026)	0.227	0.000025	0.000058 (1.985)	0.220	0.087860	166.857 (1.454)	0.131	0.000024	0.056736 (1.549)	0.146
Zinc - Production : 1954-73	0.05366	0.620464 (1.674)	0.135	0.000012	0.000020 (0.271)	0.004	0.002206	331.186* (1.947)	0.174	0.000012	0.022075 (0.631)	0.022
- Production (ex. CPE) : 1954-73	0.002873	0.412800 (1.112)	0.065	0.000006	0.000054 (0.497)	0.015	0.000305	269.893 (1.601)	0.125	0.000006	0.054133 (1.093)	0.063
- Exports : 1959-75	0.001394	0.243189 (1.674)	0.158	−0.000011	0.000127 (1.076)	0.072	−0.000615	153.225 (1.675)	0.158	−0.000011	0.081448 (1.099)	0.075
Lead - Production : 1954-73	0.002592	1.484596*** (4.019)	0.473	0.000013	0.000336*** (3.459)	0.399	0.000766	398.119*** (4.451)	0.524	0.000012	0.093704*** (4.061)	0.478
Tin - Production : 1954-73	0.00202	0.003700 (0.291)	0.005	−0.000009	0.000031 (0.38)	0.008	0.000209	3.609 (0.09)	0.000	−0.000009	0.59023 (0.217)	0.003
Bauxite - Production : 1954-73	−0.013209	1.789196* (2.060)	0.191	0.000000	0.004193 (1.131)	0.067	0.017933	393.939* (1.977)	0.178	0.000000	0.096200 (1.138)	0.067
- Exports : 1954-73	−0.000373	1.41377** (2.517)	0.260	0.000002	0.013904* (1.786)	0.151	0.021060	317.537** (2.466)	0.253	0.000002	0.318276* (1.794)	0.152

Notes: t ratios in parentheses.
* significant at the 90% level.
** significant at the 95% level.
*** significant at the 99% level.

modities — cotton and sugar — where the income effect would also be positive to developing countries as exporters and the pure welfare effect would be equally positive, the direction of the income effect is statistically inconclusive and falls outside the probabilistic range of acceptance. In maize, rice, rubber, lead, copper, zinc, and bauxite, the income effect would be negative to developing countries, while the pure welfare effect would be positive. Therefore, while no strong answer concerning the desirability of price stabilization for developing countries can be given until the size of the income and pure welfare effect is quantified to determine by how much the income loss is larger than the positive pure welfare gains, it would seem doubtful that stabilization could be worthwhile for developing countries if they were also required to bear the burden of the financial costs of buffer stocking. In all other commodities — tea, tin and sisal — the income effects of price stabilization are statistically uncertain. The results of our analysis are summarized in Table 4.

Some preliminary yet important conclusions can be drawn from the analysis of the likely distribution of income and pure welfare gains of international price stabilization. First, the number of primary commodities for which price stabilization can be assumed to be clearly beneficial to developing countries appears to be quite limited, i.e. cocoa, coffee, jute, wool and wheat. Coffee, cocoa, jute and wool accounted in 1973 for about 12 percent of the total primary commodity export earnings of developing countries (excluding oil), and wheat accounted for about 15 percent of developing countries' total import expenditures on primary commodities (excluding oil). Only coffee — as an export commodity — has general importance to developing countries. Cocoa, wool and jute have only regional importance as an export commodity respectively for West Africa, Asian sub-continent and Latin America. However, cocoa and jute are a very important source of income, employment and foreign exchange for some of the poorest developing countries. Only if sugar and cotton could be included — on stronger empirical grounds than those found in our research — among the group of commodities for which international price stabilization can be assumed to be beneficial to developing countries, would the scope of international action in this field broaden enough to become more worthwhile for developing countries.[18]

[18] In 1973, the total value of developing countries' exports was $108.8 billion, of which oil was $43.3 billion, all primary commodities $41.7 billion, manufactures

TABLE 4

PURE WELFARE AND INCOME EFFECTS OF PRICE STABILIZATION FOR DEVELOPING COUNTRIES: SUMMARY OF RESULTS

Commodity	(1) Developing Countries Trade Position	(2) Sign of Regression Coefficient	Income Effect	Pure Welfare Effect	Total Effect
Wheat	NM	+	Positive	Positive	Positive
Maize	NX	+	Negative	Positive	Uncertain
Rice	NM	—	Negative	Positive	Uncertain
Sugar	NX	— [1]	Uncertain	Positive	Uncertain
Coffee	NX	—	Positive	Positive	Positive
Cocoa	NX	—	Positive	Positive	Positive
Tea	NX	+ *	Uncertain	Positive	Uncertain
Cotton	NX	— [1]	Uncertain	Positive	Uncertain
Jute	NX	—	Positive	Positive	Positive
Wool	NX	—	Positive	Positive	Positive
Sisal	NX	+ *	Uncertain	Positive	Uncertain
Rubber	NX	+	Negative	Positive	Uncertain
Copper	NX	+	Negative	Positive	Uncertain
Lead	NX	+	Negative	Positive	Uncertain
Zinc	NX	+	Negative	Positive	Uncertain
Tin	NX	+ [1]	Uncertain	Positive	Uncertain
Bauxite	NX	+	Negative	Positive	Uncertain

Note: NM = Developing countries as a group are net importers of the commodity; NX = Developing countries as a group are net exporters of the commodity.

[1] Sign of regression coefficient is statistically insignificant.

* Sign of regression coefficient alternates from the first set of regressions using prices to the second set of regressions using export unit values and is statistically insignificant.

Source: Tables 1, 2 and 3.

The second conclusion is that international price stabilization in minerals and metals is not likely to benefit developing countries in terms of income.[19] The empirical findings on the source of price instability for these products are largely in conformity with *a priori* expectations: demand fluctuations — induced by changes in economic

$22.7 billion, and miscellaneous products $1.1 billion. Exports of coffee (raw) and cocoa (beans) amounted to $5 billion. Exports of wool (raw) and jute (raw) amounted to $0.5 billion. Exports of cotton (raw) and sugar amounted to $5.0 billion.

[19] The developing countries' income (revenue) losses from international price stabilization in minerals and metals are likely to be relatively small, since the short-term price elasticities of supply for these products are small.

activity in developed countries — are the main cause of price fluctuations. International price stabilization in these commodities would benefit the developed countries that consume most of the minerals and metals exported by developing countries. To mitigate the adverse macroeconomic impact of fluctuations in the prices of minerals and metals on the economies of developing countries' producers, compensatory financing schemes appear to be the most appropriate policy avenue that should be followed. Developing countries — particularly if freed from stringent BOP constraints — could resort to domestic policy instruments to alleviate some of the most undesirable micro effects of price fluctuations in their mineral-metal industries.

Some specific qualifications apply to these two conclusions drawn from the analysis presented in this paper. This type of analysis of the benefits of price stabilization is based on a partial equilibrium model and focuses on income and pure welfare gains and losses. The use of partial equilibrium analysis for problems of this kind presents the usual drawback that it neglects the possible indirect effects of commodity price stabilization. One potentially serious drawback is that, by considering commodity price stabilization of individual commodities, one could overlook the indirect market price stabilizing effects on related commodities. The available empirical evidence on the nature of intercommodity price movements, however, points to the conclusion that these indirect benefits are likely to be quite small.[20]

A more important drawback on this type of analysis is perhaps the exclusive concentration on income and pure welfare effects. There are other benefits that can accrue to exporter developing countries from international price stabilization. These include possible improvements in the long-term demand prospects for their products, reduction of the incentive to develop man-made substitutes, and greater bargaining strength of commodity sellers in international markets. These benefits could in some commodities be quite important and sufficient to justify price stabilization even when the income effects are likely to be negative for the developing exporting countries.[21] While this

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[20] Intercommodity covariance analysis shows that apart from the oils and fats group (which was excluded from our sample on the basis of the enormous technical difficulties implicit in its price stabilization), other within-group price correlations are low and limited in extent. See WALTER C. LABYS and YVES PERRIN, " Optimal Portfolio Analysis of International Commodity Buffer Stocks," (mimeo), October 1976.

[21] This consideration applies in particular to rubber.

possibility should be clearly acknowledged, whether price stabilization can be justified on these grounds is a question that can only be answered after in-depth analysis of the specific market conditions of the commodities in question. For the products that compete with man-made substitutes, price stability is a necessary condition for improving their long-term demand prospects, but price competitiveness must also be present. How much a buffer stock could improve the bargaining strength of commodity sellers is open to some question. If the objective of international assistance in commodities is that of avoiding distress sales by financially weak sellers in times of low market demand in order to avoid both the seller's loss of potential revenue and the ripple effect of such sales on market price, some form of international foreign exchange reserve assistance would *prima facie* appear to be the most efficient method of coping with this problem.

The question of how general the conclusions reached in this paper are, deserves some final comments. The welfare and income results that constitute the basic criteria for the choice of the commodities whose price stabilization at the international level would benefit the developing countries follows from the market form that was assumed as the basis of the analysis. The assumption of linear demand and supply curves in variables other than time and of additive stochastic disturbances are quite critical. Changing the assumption of linearity of demand and supply would change the welfare and income results. The linearity issue, however, is well understood and the theoretical limitations implied by this assumption are quite clear. On the other hand, the critical importance of the assumption about the nature of the stochastic disturbance has emerged only recently in economic literature.

It can be shown, in fact, that if stochastic disturbances are multiplicative in nature, and thus affect also the slopes of the demand and supply curves, the desirability of price stabilization for either exporters or importers no longer depends on the source of market price instability, but only upon the shapes of the deterministic component of the demand and supply curves.[22] The critical question is, therefore, whether the assumption of multiplicative disturbances is more realistic than that of additive disturbances. While the answer

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[22] See STEPHEN J. TURNOVSKY, " The Distribution of Welfare Gains from Price Stabilization: The Case of Multiplicative Disturbances," *International Economic Review*, Vol. 17, No. 1 (Feb. 1976), pp. 133-148.

is to a large extent dependent on empirical evidence of producers' behavior (which to date is not available to any sufficient extent), some *a priori* consideration can put this issue into perspective. Multiplicative disturbances on the supply side are a justifiable hypothesis for annual crops,[23] but not for perennial crops (cocoa, coffee, tea, rubber, hard fibers, wool, and cane sugar) and minerals-metals (copper, lead, zinc, tin and bauxite). Across the sample of the 17 commodities considered in this study, uncertainty about the distributional impact of price stabilization on exporters' or importers' welfare would remain in the case of rice, wheat, maize, cotton, and jute, if a multiplicative form of stochasticity were to affect the supply of these commodities. The assumption of multiplicative stochastic disturbances could change only two of the strong conclusions reached in this study: that developing countries would stand to gain from price stabilization in wheat as consumers and in jute as producers. The basic inference of this study — that *prima facie* the scope for commodity price stabilization which is clearly beneficial to developing countries in welfare and income terms appears to be quite limited, pending possibly more conclusive evidence from in-depth commodity-specific studies — remains virtually intact.

Washington, D.C.
Bruxelles

E. Brook - E. Grilli - J. Waelbroeck

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[23] In the case of annual crops, while areas planted can be thought to depend on prices, yields are certainly dependent on random factors such as weather. Since production is (area)×(realized yields), the stochastic error term affects the slope of the supply function in addition to its location. A simple example well illustrates this point. Assume that: A (area) $= ap + b$ and Y (yield) $= \bar{y} + u$. Since S (supply) $= AY$, we have: $S = (ap + b)(\bar{y} + u) = a(\bar{y} + u)p + b(\bar{y} + u)$, from which it is apparent that the stochastic disturbance (u) influences the location as well as the slope of the supply curve.