

THE EFFECTS OF PARTIAL INTERNATIONAL PRICE STABILIZATION ON THE STABILITY OF NATIONAL EXPORT EARNINGS

ROLAND HERRMANN

I. INTRODUCTION

INTERNATIONAL price stabilization agreements represent a major part of the discussion on the "new international economic order." They are often believed to contribute to export earnings stabilization and to avoid the negative macroeconomic effects of instability in export earnings.¹ However, different authors have shown that prices fixed at a precise level (total price stabilization) will stabilize export earnings only under special market conditions. Total stabilization of export earnings via price stabilization will be achieved if import demand shifts are the only cause of price instability [7, pp. 246–47] [10, pp. 151–52]. In the case of export supply shifts, total price stabilization may induce a stabilizing effect on export earnings if the price elasticity of export supply is smaller than 1 [7, p. 239] and the price elasticity of import demand exceeds -0.5 [8, p. 266] [3, pp. 59–61] [7, p. 239] [10, p. 152]. These conditions exist in few world markets of agricultural products [14, p. 34]. As recent studies have pointed out, the probability of a stabilizing effect on export earnings increases if partial rather than total price stabilization is adopted [12, pp. 10–11] [11, pp. 343–49]. Partial price stabilization means that fluctuations around a target price are reduced to a certain extent. Nguyen concludes from his results that "both objectives of price stability and earning stability can be achieved for almost all commodities" [11, p. 351].

The studies on partial price stabilization mentioned above are appropriate for showing the effects either of international price stabilization on the stability of world export earnings or of national price stabilization on national earnings stability. The studies are not appropriate to clarify the effects of international price stabilization on the stability of national export earnings. But, this relation is more relevant than market stabilization for evaluating international commodity

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¹ See, for example, Article 1 of the International Cocoa Agreement (1980).

agreements with price stabilization elements from the national point of view of LDCs.² The purpose of this paper is to investigate this issue.

Within the theoretical framework of a partial equilibrium model, the conditions that must hold for stabilizing national export earnings via international partial price stabilization are elaborated. How the determinants of a "successful" stabilization differ from the national and the supranational points of view, and to what extent a positive evaluation of partial price stabilization agreements applies from the national point of view, is examined. Then, in an empirical case study concerning the world cocoa market in the period 1968–80, it is shown whether a functioning partial price stabilization scheme would have induced stabilizing or destabilizing effects on world and national export earnings. Conclusions are drawn with respect to international commodity policy.

II. THEORETICAL ANALYSIS

A. *Basic Assumptions of the Model and Model Structure*

The approach is based on an export market model with linear functions of export supply and import demand. Shifts in the export supply and import demand schedules are assumed to be random and additive to the planned export supply and import demand.³ Lag-induced export supply shifts are omitted, in line with the studies on partial price stabilization made by Sundrum and Nguyen. The objective function of price stabilization is assumed to be one-dimensional and oriented toward export earnings stabilization.⁴ The stabilizing effects of partial international price stabilization on national export earnings apply to the national export income that may accrue to the government as well as to private exporters. Only under special conditions do they hold for the export earnings of the producers in the sector. A stabilizing effect in the following analysis means that the (relative) change of a variable around its reference level is smaller in the situation with price stabilization than without. This implies the use of the mean percentage deviation from a reference value as the measure of instability, assuming one random test. The mean percentage deviation as a measure

² This holds for the objective of macroeconomic stabilization as well as for the objective of reducing the risks of producers. For the objectives of price stabilization see Newbery and Stiglitz [9, Sec. 1.3.2].

³ As we do not deal with a welfare analysis in terms of producer's and consumer's rent it can be assumed that nonlinear functions and multiplicative disturbances would not change our main results. Therefore, the assumption of a linear-additive model seems justified, for convenience. For a survey on the welfare effects of price stabilization under various assumptions see Turnovsky [13, pp. 123–42]; on empirical problems of their determination see Just [6, pp. 912–16]; on international price stabilization see Hueft and Schmitz [5, pp. 351–65].

⁴ The results on optimal price stabilization rules should be modified if effects on the level of national export earnings and national welfare effects are taken into account. For example, from the national as well as from the supranational point of view a trade-off can exist between the level and the stability of export earnings. See Herrmann [4, Secs. 5.1.2 and 5.1.3].

of relative instability is widely used and seems superior to the variance in a cross-sectional analysis of national instabilities. Too, it seems superior to the coefficient of variation as no squared deviations are used and the signs of the relative fluctuations in price and quantity emerge for the individual years. It will be shown that the correlation of these signs are of special importance for the earnings stabilizing effect of price stabilization.⁵ The reference system for partial price stabilization is a nonstabilized situation. For the purpose of policy evaluation, partial price stabilization is compared with total price stabilization and also with national export earnings stabilization.

For apportioning the national and the supranational point of view, export supply on the world market (q^{ES}) is divided into that of country A (q_A^{ES}) and that of all other countries except country A (q_r^{ES}). Then it holds that

$$q^{ES} = q_A^{ES} + q_r^{ES}. \quad (1)$$

The export supply function of country A is

$$q_A^{ES} = a_A + b_A p_w + v_A \quad (2)$$

and that of the other export suppliers is

$$q_r^{ES} = a_r + b_r p_w + v_r. \quad (3)$$

p_w is the world market price, a_A and a_r are constants, and b_A and b_r characterize the slope of the export supply function. v_A and v_r are parameters of the functions, varying with exogenous shifts in export supply. It holds that $b_A > 0$ and $b_r > 0$ and, for equilibrium without a shift in export supply, $v_A = 0$ and $v_r = 0$. The import demand function is

$$q^{ID} = c + d p_w + u. \quad (4)$$

c symbolizes a constant, d the slope of the import demand function, and u a parameter changing with exogenous shifts in import demand. The signs are as follows: $c > 0$, $d < 0$, and, for equilibrium without import demand shifts, $u = 0$. In the initial situation import demand and export supply are in equilibrium:

$$q^{ES} = q^{ID}. \quad (5)$$

For analyzing the national and the supranational point of view, national export earnings (R_A) and world export earnings (R) have to be distinguished. It holds that

$$R_A = p_w \cdot q_A^{ES} \quad (6)$$

and

$$R = p_w \cdot q^{ES}. \quad (7)$$

Thus, the model is closed with seven equations and seven variables (q^{ES} , q_A^{ES} , q_r^{ES} , p_w , q^{ID} , R , R_A).

B. *Export Earnings Instability in the Case of Nonstabilization*

What are the effects of given shifts in export supply and import demand on

⁵ Nevertheless, the mean percentage deviation may be transformed into the coefficient of variation. See Newbery and Stiglitz [9, p. 286].

the export earnings of country A and world export earnings if no price stabilization policy is adopted? To answer this question, equations (1) to (7) are transformed into rates of change. Inserting the derivations of equatoin (1) to (4) in (5), we get the relative change of the world market price ($\Delta p_w/p_w$). Applying this term to the derivations of the equations (6) and (7), it follows that

$$\Delta R_A/R_A = (\Delta u/q^{ID} - h_A \cdot \Delta v_A/q_A^{ES} - h_r \cdot \Delta v_r/q_r^{ES}) \cdot (1 + \varepsilon_A) / (\varepsilon_A h_A + \varepsilon_r h_r - \mu) + \Delta v_A/q_A^{ES} \quad (8)$$

and

$$\Delta R/R = (\Delta u/q^{ID} - h_A \cdot \Delta v_A/q_A^{ES} - h_r \cdot \Delta v_r/q_r^{ES}) \cdot (1 + \varepsilon_A h_A + \varepsilon_r h_r) / (\varepsilon_A h_A + \varepsilon_r h_r - \mu) + (h_A \cdot \Delta v_A/q_A^{ES} + h_r \cdot \Delta v_r/q_r^{ES}) \quad (9)$$

for relative changes in national and world export earnings.⁶ Here, ε_A and ε_r are price elasticities of export supply in country A and in the rest of the world, h_A and h_r are the trade shares of the two country-aggregates, and μ is the price elasticity of import demand on the world market. Equations (8) and (9) apply in the general case with exogenous shifts in export supply ($\Delta v_A \neq 0$, $\Delta v_r \neq 0$) and in import demand ($\Delta u \neq 0$). They show the determinants of the magnitude of relative changes in export earnings. As we assume one random test, (8) and (9) simultaneously show the determinants of export instability measured by mean percentage deviation.

These determinants are the price elasticities of export supply and import demand, the trade shares, and the magnitude and correlation of shifts in the export supply and import demand schedules. The comparison of equations (8) and (9) shows that different export earnings instabilities may indicate national price elasticities of export supply and export supply shifts that vary from those on the world level.

C. Export Earnings Instability in the Case of Partial International Price Stabilization

1. The general case

Partial price stabilization means that fluctuations around a reference price are reduced to a certain extent. Hence, the relative fluctuations of export earnings for a country and the world change in the case of partial international price stabilization (indicated by an asterisk) to

$$(\Delta R_A/R_A)^* = \beta \cdot (\Delta u/q^{ID} - h_A \cdot \Delta v_A/q_A^{ES} - h_r \cdot \Delta v_r/q_r^{ES})(1 + \varepsilon_A) / (\varepsilon_A h_A + \varepsilon_r h_r - \mu) + \Delta v_A/q_A^{ES} \quad (10)$$

and

$$(\Delta R/R)^* = \beta \cdot (\Delta u/q^{ID} - h_A \cdot \Delta v_A/q_A^{ES} - h_r \cdot \Delta v_r/q_r^{ES})(1 + \varepsilon_A h_A + \varepsilon_r h_r) / (\varepsilon_A h_A + \varepsilon_r h_r - \mu) + (h_A \cdot \Delta v_A/q_A^{ES} + h_r \cdot \Delta v_r/q_r^{ES}), \quad (11)$$

where β is a policy or stabilization parameter. The policy parameter β shows one part of the relative price change in the free market situation that still takes

⁶ For convenience, we ignore the joint effect ($\Delta p \cdot \Delta q$).

place with a price stabilization policy. By assumption, an international buffer stock agency buys or sells exactly that quantity which leads to a reduction in relative price changes by $(1 - \beta)$ compared with the nonstabilized free market case. The range where the stabilization policy affects price formation on the market is $0 \leq \beta < 1$. If $\beta = 0$, we have the special case of total price stabilization. Then, the permissible deviation of the stabilized price from the reference price is 0 per cent. If $0 < \beta < 1$, we have partial price stabilization. The permissible deviation from the reference price is more than 0 per cent but less than the hypothetical deviation in the nonstabilized market. If $\beta > 1$, a price band exists, but the permissible relative price fluctuations are greater than the actual ones. There is, in effect, price destabilization.

The stabilizing effect of partial international price stabilization on national export earnings (s_A) and on world export earnings (s) is measured as follows:

$$s_A = 1 - |(\Delta R_A/R_A)^*|/|(\Delta R_A/R_A)| \quad (12)$$

and

$$s = 1 - |(\Delta R/R)^*|/|(\Delta R/R)|. \quad (13)$$

This contribution to earnings stabilization in each case shows the relative earnings fluctuation from the nonstabilized situation that is suppressed by partial price stabilization. The higher s_A (s), the higher is the stabilizing contribution to national export earnings (world export earnings). A positive stabilizing contribution to national export earnings exists if $0 < s_A \leq 1$. The stabilizing contribution is maximized in the case where $s_A = 1$ and decreases with the value of s_A . If $s_A = 0$, the export earnings instability is equal in the stabilized and nonstabilized cases. In the range where $s_A < 0$, international price stabilization destabilizes national export earnings.

Since the effects of partial price stabilization on earnings stability depend on whether the shift is in import demand or export supply, each case is discussed separately.

2. Import demand shifts

If there are shifts only in the import demand schedule ($\Delta u \neq 0$, $\Delta v_A = 0$, $\Delta v_r = 0$), equations (8) and (9) in the reference situation (without stabilization) simplify to

$$\Delta R_A/R_A = (\Delta u/q^{ID}) \cdot (1 + \varepsilon_A)/(\varepsilon_A h_A + \varepsilon_r h_r - \mu) \quad (14)$$

and

$$\Delta R/R = (\Delta u/q^{ID}) \cdot (1 + \varepsilon_A h_A + \varepsilon_r h_r)/(\varepsilon_A h_A + \varepsilon_r h_r - \mu). \quad (15)$$

With partial price stabilization equations (10) and (11) analogously simplify to

$$(\Delta R_A/R_A)^* = \beta \cdot (\Delta u/q^{ID}) \cdot (1 + \varepsilon_A)/(\varepsilon_A h_A + \varepsilon_r h_r - \mu) \quad (16)$$

and

$$(\Delta R/R)^* = \beta \cdot (\Delta u/q^{ID}) \cdot (1 + \varepsilon_A h_A + \varepsilon_r h_r)/(\varepsilon_A h_A + \varepsilon_r h_r - \mu). \quad (17)$$

Comparing equations (14) and (15) with equations (16) and (17) shows that

partial price stabilization would have a stabilizing effect on export earnings if world market fluctuations are solely due to import demand shifts. This holds for both the national and supranational points of view: inserting (16) and (14) in (12), and (17) and (15) in (13) leads to a stabilizing contribution on export earnings:

$$s_A = s = 1 - \beta. \quad (18)$$

Obviously, the strength of the stabilizing effect is equal domestically and internationally and depends only on the magnitude of the stabilization parameter β . The contribution to earnings stabilization rises as β decreases and, therefore, the price band narrows. Hence, in the import demand shift case, total price stabilization ($\beta=0$) is equivalent to total earnings stabilization and superior to partial price stabilization ($0 < \beta < 1$) from the national point of view. Case 1 in Figure 1 shows this connection between different intensities of price stabilization and their contributions to national earnings stabilization.

Comparing equations (14) and (15) shows that the direction of national export earnings fluctuation is in line with that of world export earnings. However, the magnitude of the relative fluctuations is not necessarily the same. If the national price elasticity of export supply is greater (smaller) than that of world exporters, the relative fluctuation of export earnings in the nonstabilized case is greater (smaller) in country A than for exporting countries as a whole. Partial international price stabilization is not able to meet these different stabilization needs. The relative fluctuations of export earnings which remain after stabilization will still be greater or smaller than for the world as a whole.

3. Export supply shifts

If there are only shifts in the export supply schedules ($\Delta u = 0$, $\Delta v_A \neq 0$, $\Delta v_r \neq 0$), equations (8) and (9) simplify to

$$\begin{aligned} \Delta R_A/R_A = & (-h_A \cdot \Delta v_A/q_A^{ES} - h_r \cdot \Delta v_r/q_r^{ES})(1 + \varepsilon_A) \\ & /(\varepsilon_A h_A + \varepsilon_r h_r - \mu) + \Delta v_A/q_A^{ES} \end{aligned} \quad (19)$$

and

$$\begin{aligned} \Delta R/R = & (-h_A \cdot \Delta v_A/q_A^{ES} - h_r \cdot \Delta v_r/q_r^{ES})(1 + \varepsilon_A h_A + \varepsilon_r h_r) \\ & /(\varepsilon_A h_A + \varepsilon_r h_r - \mu) + (h_A \cdot \Delta v_A/q_A^{ES} + h_r \cdot \Delta v_r/q_r^{ES}). \end{aligned} \quad (20)$$

With partial international price stabilization, equations (10) and (11) analogously simplify to

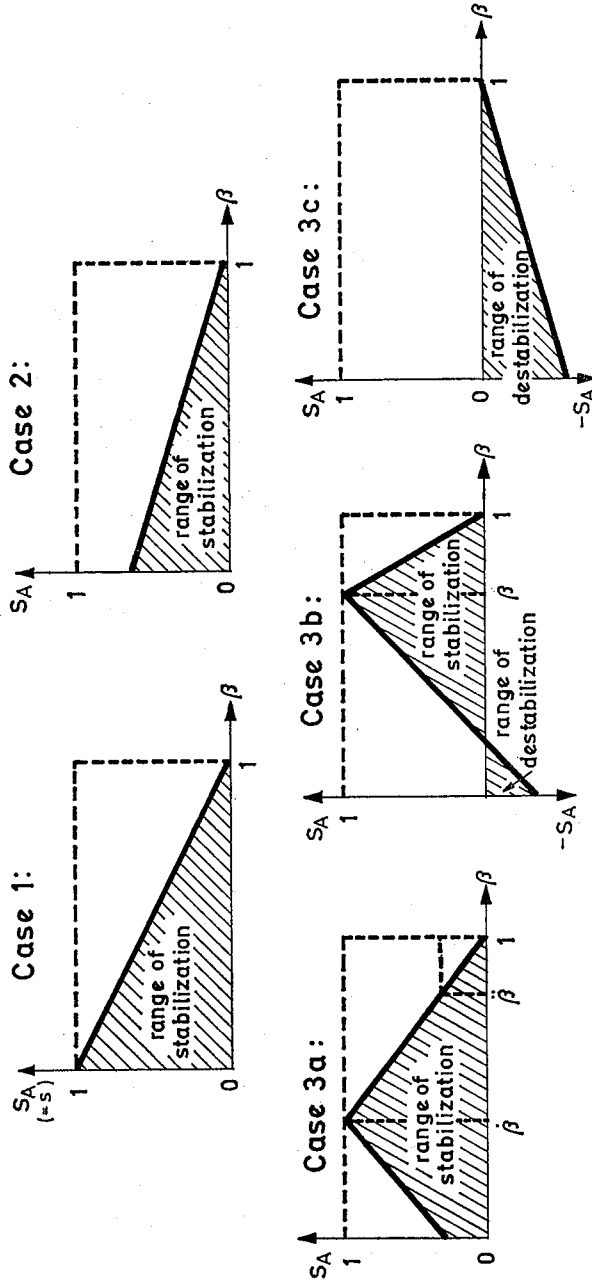
$$\begin{aligned} (\Delta R_A/R_A)^* = & \beta \cdot (-h_A \cdot \Delta v_A/q_A^{ES} - h_r \cdot \Delta v_r/q_r^{ES})(1 + \varepsilon_A) \\ & /(\varepsilon_A h_A + \varepsilon_r h_r - \mu) + \Delta v_A/q_A^{ES} \end{aligned} \quad (21)$$

and

$$\begin{aligned} (\Delta R/R)^* = & \beta \cdot (-h_A \cdot \Delta v_A/q_A^{ES} - h_r \cdot \Delta v_r/q_r^{ES})(1 + \varepsilon_A h_A + \varepsilon_r h_r) \\ & /(\varepsilon_A h_A + \varepsilon_r h_r - \mu) + (h_A \cdot \Delta v_A/q_A^{ES} + h_r \cdot \Delta v_r/q_r^{ES}). \end{aligned} \quad (22)$$

From equation (20), it follows that random shifts in export supply cause opposite fluctuations of prices at the world level. Hence, there exist negatively

Fig. 1. Contributions of Alternative Price Stabilization Rules to the Stabilization of National Export Earnings under Different Market Conditions (National Stabilization Contribution Curves)



Case 1: Import demand shifts.
 Case 2: Export supply shifts with negative correlation between the (small) country and the rest of the world.
 Case 3: Export supply shifts with positive correlation between the (small) country and the rest of the world;
 (a) total and partial price stabilization contribute to national export earnings;
 (b) total price stabilization stabilizes, partial price stabilization destabilizes national export earnings in cases of a "broad" price bandwidth;
 (c) total and partial price stabilization destabilize national export earnings.
 s_A is the stabilization contribution, β the stabilization parameter (see text).

correlated price and quantity fluctuations. From the national point of view, too, inverse price and quantity fluctuations may exist. Then, the sign of the term $\Delta v_A/q_A^{ES}$ is different from that of the whole first term of equation (19). Hence, a partial international price stabilization suppressing a part of the price fluctuation may, in principle, either stabilize or destabilize export earnings. To identify which effect surfaces on the national level, it is essential to ascertain whether the export supply shifts in the country are correlated positively or negatively with those of the rest of the world and whether the individual country or the rest of the world dominate the export supply shifts in the world.

3a. Negative Correlation of Export Supply Shifts in a Particular Country and the Rest of the World

In the case of negatively correlated export supply shifts in a particular country and the rest of the world, partial price stabilization will simultaneously stabilize national export earnings if the rest of the world dominates the export supply shifts ($|h_r \cdot \Delta v_r/q_r^{ES}| > |h_A \cdot \Delta v_A/q_A^{ES}|$). Then, price and quantity effects in equation (19) move in the same direction and reinforce each other. The aggregate effect on national export earnings is weakened by partial price stabilization in accordance with equation (21). However, if guided by the target of national export earnings stabilization, partial price stabilization is inferior not only to a system of total earnings stabilization but to the system of total price stabilization as well. This is all the more the case, the greater the stabilization parameter β and the broader the price band. In contrast to the case of import demand shifts, and given the target of national earnings stabilization, total price stabilization is inferior to total earnings stabilization since exogenous quantity fluctuations in the country remain unaffected. Figure 1 shows this as case 2.

3b. Positive Correlation of Export Supply Shifts in a Particular Country and the Rest of the World

Since in the case of positively correlated export supply shifts opposite price and quantity effects exist, partial as well as total price stabilization may stabilize or destabilize national export earnings.⁷ However, there are fundamental differences between partial and total stabilization. The latter ($\beta=0$) will change the sign of export earnings fluctuations. A total stabilization of national export earnings is impossible as the term $(\Delta v_A/q_A^{ES})$ will not be equal to zero. In contrast, with partial price stabilization the sign of export earnings fluctuations may remain unaffected or may change. In a special case, it may lead to total stabilization of national export earnings. Generally, from equation (19), partial price stabilization may only contribute to national export earnings stabilization if the price-induced element of the relative fluctuation of national export earnings exceeds the part representing the exogenous quantity fluctuation. Therefore, as a necessary condition it must hold that:

⁷ In principle, this also holds for a single country which dominates the export supply shifts on the world market, irrespective of the correlation of its export supply shifts with those of the rest of the world.

$$\begin{aligned} & |(-h_A \cdot \Delta v_A / q_A^{ES} - h_r \cdot \Delta v_r / q_r^{ES}) \cdot (1 + \varepsilon_A) / (\varepsilon_A h_A + \varepsilon_r h_r - \mu)| \\ & > |(\Delta v_A / q_A^{ES})|. \end{aligned} \quad (23)$$

If (23) obtains, $0 < s_A < 1$ is possible. However, total price stabilization will only contribute to national export earnings stabilization if it is the case that:

$$\begin{aligned} & |(-h_A \cdot \Delta v_A / q_A^{ES} - h_r \cdot \Delta v_r / q_r^{ES}) \cdot (1 + \varepsilon_A) / (\varepsilon_A h_A + \varepsilon_r h_r - \mu)| \\ & > |2(\Delta v_A / q_A^{ES})|. \end{aligned} \quad (24)$$

Comparing (23) with (24), it is obviously easier to stabilize national export earnings with partial rather than total price stabilization. The stabilization contribution of partial price stabilization now depends on the width of the price band and, hence, on the magnitude of the stabilization parameter β . The shape of the stabilization contribution curve

$$s_A = s_A(\beta)$$

may be found by determining two strategic points. First, a total stabilization of national export earnings ($s_A = 1$) is possible via partial international price stabilization. In this case, equation (21) becomes zero. The stabilization parameter leading to this total earnings stabilization may be defined as an "optimal stabilization parameter" ($\hat{\beta}$). It holds that:

$$\hat{\beta} = (\varepsilon_A h_A + \varepsilon_r h_r - \mu) \left\{ (1 + \varepsilon_A) \cdot \left(h_A + \frac{h_r \cdot \Delta v_r / q_r^{ES}}{\Delta v_A / q_A^{ES}} \right) \right\}. \quad (25)$$

Moreover, a "critical stabilization parameter" ($\check{\beta}$) may be derived where the stabilization contribution of partial price stabilization is equal to that of total price stabilization. For this critical value it can be shown from equations (19) and (21), and employing (25) that:

$$\check{\beta} = 2\hat{\beta}. \quad (26)$$

From this, three ranges of stabilization may be derived for the national stabilization contribution curve, provided that the conditions of equations (23) and (24) are fulfilled (see case 3a in Figure 1). In the range $1 > \beta > \hat{\beta}$ (range of stabilization I), partial price stabilization as well as total price stabilization would reduce the relative fluctuations of export earnings compared with the case of nonstabilization. However, the price band of partial price stabilization is too broad and the difference from the nonstabilization case too small making the net stabilization contribution smaller than with total price stabilization. If $\beta = \hat{\beta}$, the stabilization contribution of partial price stabilization is equal to that of total price stabilization. However, if the price band becomes narrower and $\check{\beta} > \beta > 0$, the stabilization contribution of partial price stabilization is greater than that of total price stabilization. Yet, with the exception of case $\beta = \hat{\beta}$, partial price stabilization is inferior to total stabilization of national export earnings. Within the range $\check{\beta} > \beta > 0$, two subranges of stabilization have to be distinguished: (a) $\check{\beta} > \beta > \hat{\beta}$ (range of stabilization II) and (b) $\hat{\beta} > \beta > 0$ (range of stabilization III). In range of stabilization II, a narrowing of the price band (decreasing the stabilization parameter β) leads to an increase in the stabilization

contribution with respect to national export earnings. In range of stabilization III, narrowing of the price band decreases this stabilization contribution. In the extreme case of $\beta=0$, partial price stabilization changes into total price stabilization and is no longer superior with respect to national export earnings stabilization. The turning point and maximum of the stabilization contribution curve, $\beta = \beta$, represents the value from which a narrowing of the price band reverses the sign of the relative earnings fluctuation compared with the case of non-stabilization. Moreover, it shows the relative price change on the world market that would totally stabilize national export earnings.

If export supply shifts in the country and the rest of the world are positively correlated, it is always possible that a stabilizing effect on national export earnings does not exist for all values of β . This is especially so with relatively high exogenous export supply shifts in the individual country. Cases 3b and 3c in Figure 1 represent examples of this. Whereas total price stabilization may destabilize national export earnings, partial price stabilization with "broad" price bands may still stabilize, and even an optimal β with total earnings stabilization is possible (case 3b). In these cases, condition (24) is not fulfilled, but condition (23) is satisfied and "high" values of β induce earnings stabilizing effects. However, if the export supply shifts in the country are so large that condition (23) will not be fulfilled even with "broad" price bands, each form of international price stabilization will destabilize national export earnings (case 3c). Partial price stabilization is then inferior not only to total earnings stabilization, but to nonstabilization as well.

3c. Comparison of the National and Supranational Points of View

The effects of partial price stabilization on the stability of national export earnings can be characterized more distinctly by comparison with those at world level. Equations (20) and (22) show the relative changes of world export earnings in the case of nonstabilization and with price stabilization. The relative change in world export earnings can only be smaller with partial price stabilization than with no stabilization if the first term on the right side of equation (20) is absolutely greater than the opposite second term. In this case, a necessary condition for the stabilizing effect of partial price stabilization on world export earnings is:

$$|\mu| < 1. \quad (27)$$

With total price stabilization ($\beta=0$), equation (22) simplifies to:

$$(\Delta R/R)^* = h_A \cdot \Delta v_A / q_A^{ES} + h_r \cdot \Delta v_r / q_r^{ES}.$$

This relative change of export earnings can only be smaller than in the non-stabilization case if

$$|\mu| < 0.5 \quad (28)$$

and the price elasticity of export supply ($\varepsilon_A h_A + \varepsilon_r h_r$) < 1. These necessary conditions for an earnings stabilizing effect of price stabilization show that partial and total price stabilization destabilize world export earnings if import demand

is elastic. Here, partial price stabilization would suppress the compensatory price fluctuations and increase the amplitude of earnings fluctuations. If $|\mu| > 1$, partial price stabilization as well as total price stabilization is inferior not only to total earnings stabilization but also to the free market case when the target is stabilizing world export earnings. On the other hand, in the inelastic portion of the import demand curve ($|\mu| < 1$), partial price stabilization may stabilize world export earnings, even in the range where total price stabilization destabilizes them ($0.5 < |\mu| < 1$). Analogous to the national stabilization contribution curve, the form of the supranational stabilization contribution curve

$$s = s(\beta)$$

may be found. First, there exists an optimal stabilization parameter (β^*) leading to a total stabilization of world export earnings ($s = 1$):

$$\beta^* = (\varepsilon_A h_A + \varepsilon_r h_r - \mu) / (1 + \varepsilon_A h_A + \varepsilon_r h_r). \quad (29)$$

In contrast to partial price stabilization, total price stabilization cannot lead to a total stabilization of world export earnings even if they do have a stabilizing effect. However, the stabilization contribution of partial price stabilization is not higher for any price band than that of total price stabilization. There is a critical value of the stabilization parameter (β^{**}), where the stabilization contribution with respect to world export earnings is equal for both policies:

$$\beta^{**} = 2\beta^*. \quad (30)$$

As with the national stabilization contribution curve, partial price stabilization is inferior to total price stabilization if $\beta^{**} < \beta < 1$. If $0 < \beta < \beta^{**}$, partial price stabilization is superior to total price stabilization. Thus, narrowing the price band in the range $\beta^* < \beta < \beta^{**}$ increases the stabilization contribution with respect to world export earnings. However, it decreases the stabilization contribution within the range $0 < \beta < \beta^*$.

Comparing the stabilization effects of a partial price stabilization policy with respect to national export earnings and world export earnings, it can be seen that they will be equal only in particular cases. Contrasting the optimal β -value from national with that from supranational points of view, it may be derived from equations (25) and (29) that the optimal national stabilization parameter may differ from the optimal supranational parameter from the point of view of all exporters for two reasons:

- (a) the price elasticity of export supply in country A may not equal the price elasticity of export supply of the other exporters ($\varepsilon_A \neq \varepsilon_A h_A + \varepsilon_r h_r$);
- (b) the magnitude of export supply shifts in the particular country may differ from that of the other exporters ($h_A \cdot \Delta v_A / q_A^{ES} \neq h_r \cdot \Delta v_r / q_r^{ES}$).

The optimal width of the price band from the national point of view ($\hat{\beta}$) is smaller than the optimal bandwidth from the supranational point of view (β^*), if the country's price elasticity of export supply is higher and the relative magnitude of export supply shifts is absolutely lower than that of the rest of the world. Conversely, lower national price elasticities of export supply and higher relative export supply shifts than in the rest of the world work toward a higher

optimal bandwidth from the national than the supranational standpoint. The first constellation, *ceteris paribus*, is more likely to apply in countries with significant storage policies; the second is more likely in countries with relatively insignificant storage arrangements. If export supply shifts in the country and the dominating rest of the world are positively correlated, and if partial price stabilization stabilizes earnings at the supranational level, countries with "strong" reactions to changes in world market prices will tend to aim at narrow bandwidths. Conversely, countries with "weak" reactions to changes in world market prices will tend to seek broad bandwidths. Countries with "weak" exogenous export supply shifts will favor narrow bandwidths; countries with "strong" exogenous export supply shifts will prefer broad bandwidths. Provided there are diverging price elasticities of export supply and diverging export supply shifts, one uniform stabilization parameter β at world level will cause very different national stabilization effects, which mostly will differ from those at the world level ($s \neq s_A$). A uniform price stabilization policy with the target of stabilizing the export earnings on the market will then be insufficient to reach the target of national stabilization. It is possible that partial price stabilization on the supranational level will cause strongly earnings stabilizing effects in one country and destabilizing effects in another. Stabilizing effects on the national level apply in the case of negative correlation of export supply shifts in the particular country and in the (dominating) rest of the world. Provided there is a positive correlation of the export supply shifts, stabilizing effects are to be expected in cases of above-average price elasticities of export supply and subaverage magnitudes of export supply shifts in the particular country. On the other hand, destabilizing effects at national level may appear in the case of positively correlated export supply shifts, if the price elasticity of export supply is subaverage, the magnitude of export supply shifts is above average, and the bandwidth is relatively narrow.

Summing up, a uniform partial price stabilization may lead to stabilization effects on national export earnings which are very different and even the opposite of those on the world level. Whether these effects occur in a specific market will depend on the following factors: (a) the price elasticity of import demand on the world market, (b) the price elasticity of export supply in the particular country and in the rest of the world, (c) the relative magnitude of export supply shifts in the country in comparison with shifts in the rest of the world, (d) the covariance between export supply shifts in the country and in the rest of the world; and (e) the main cause of the instability (export supply or import demand).

III. AN EMPIRICAL EXAMPLE: THE INTERNATIONAL COCOA MARKET

Cocoa is one of the "core commodities" for which international price stabilization policies are planned in the Integrated Commodity Programme of UNCTAD. In 1981 the Third International Cocoa Agreement came into effect which con-

tains a buffer stock policy for world market price stabilization. In the following, export instability is analyzed for the main cocoa product, cocoa beans, in the period 1968–80 for exporting countries as a whole and for individual exporting countries. Export instability means instability of export earnings, export prices, and export quantities. Subsequently, for single years of the period 1968–80, it is shown whether partial price stabilization would have stabilized or destabilized world export earnings and national export earnings, and whether a strong or weak stabilization intensity would have been preferable. In line with the above theoretical approach, the relative fluctuations of export earnings are divided into relative fluctuations of prices, quantities, and their product.

Table I presents (in columns 1 to 4) indicators of export instability on the world level and for ten selected cocoa exporting countries. Export instability (I) is defined as the mean percentage deviation from trend:

$$I = (100/n) \cdot \sum_{t=1968}^{1980} |(X_t - \hat{X}_t)| / \hat{X}_t, \quad (31)$$

where X_t is export earnings, export prices, or export quantities in period t , \hat{X}_t the respective trend values, t is time, and n is the number of observations. It can be shown that the R^2 values of a semi-logarithmic trend function are significant at the 1 per cent level for export prices in each case and for export earnings with two exceptions (Ecuador, Mexico). The significant values ranged between 0.74 (Papua New Guinea) and 0.81 (Ghana) for export prices and between 0.65 (Togo) and 0.96 (Malaysia) for export earnings. Therefore, the values of the semi-logarithmic trend function were used in formula (31) in the case of export prices and earnings.⁸ Because of the less significant quantity trend, those export quantities were used as “trend values” that would have led to the trend value of export earnings for a given price trend ($\hat{q} = \hat{R}/\hat{p}$).⁹

Table I for the period 1968–80 shows a higher price instability (21.4 per cent) than earnings instability (16.8 per cent) at the world level. The quantity instability (at 7 per cent) was substantially lower than the price and earnings instability, but the quantity fluctuations were predominantly opposite to the price fluctuations and had a dampening effect on earnings fluctuations. In five cocoa exporting countries (Ivory Coast, Nigeria, Cameroon, Togo, and Malaysia), price instability also exceeded earnings instability, which exceeded quantity instability. Here, quantity fluctuations reduced the effect of price fluctuations on earnings fluctuations. In the main exporting country, Ghana, opposing price and quantity fluctuations were so strong that price and quantity instability exceeded earnings instability. Obviously, Ghana’s high share of the market

⁸ This implies an exponential trend function $\hat{X}_t = a \cdot e^{bt}$ that can be rewritten as: $\ln \hat{X}_t = \ln a + bt$.

⁹ This identity makes it possible to divide the relative fluctuations of export earnings around the trend in the single years as follows:

$$(\hat{R}_t - \hat{R}_t) / (\hat{R}_t) = (p_t - \hat{p}_t) / (\hat{p}_t) + (q_t - \hat{q}_t) / (\hat{q}_t) + (p_t - \hat{p}_t)(q_t - \hat{q}_t) / (\hat{p}_t \hat{q}_t).$$

In principle, this is identical with equations (8) and (9) in the theoretical model, here using trend values as approximations of equilibrium values and including the joint effect.

TABLE I
EXPORT INSTABILITIES ON THE WORLD COCOA MARKET IN THE PERIOD 1968-80 AND EARNINGS STABILIZATION
EFFECTS OF AN INTERNATIONAL PARTIAL PRICE STABILIZATION IN SINGLE YEARS

Indicator	Export Instability (%)		Price Instability /Volume Instability (4) = (2)/(3)	Years with Stabilizing (S) or Destabilizing (D) Effects of Partial Price Stabilization on Export Earnings ^a			D/S (8)	
	Earnings (1)	Prices (2)		Quantities (3)	D (5)	S1 (6)		S2 (7)
World	16.76	21.43	7.00	3.06	79	74, 78	68, 69, 70, 71, 72, 73, 76, 77, 80	75
Ghana	13.92	20.75	13.95	1.49	(75), 79	70, 71, 74	77	68, 69, 72, 73, 76, 78, (80)
Ivory Coast	18.52	19.44	10.08	1.93	79	73, 74, 75, 78	68, 69, 71, 72, 76	(70), 77, 80
Nigeria	16.43	21.10	14.30	1.47	71, (74), 76, 79	78, 80	68, 70, 72, 73, 77	69, 75
Brazil	30.77	28.70	18.34	1.57	68, 75	69, 72, 73, 74, 78	71, 77, 80	(70), 76, (79)
Cameroon	14.25	20.89	11.62	1.80	(75), 79	74	69, 71, 72, 76, 78	68, 70, 73, 77, 80
Papua New Guinea	28.03	26.81	7.93	3.38	(75)	69, 73, 74, 79, 80	68, 70, 71, 72, 76, 77, 78	—
Ecuador	36.83	28.40	23.38	1.21	69, (70), 75	68, 73, 74, 76, 79	71, 72, 77, 78, 80	—
Togo	27.32	30.42	26.24	0.78	68, 71, 74, 79	70, 73, 75, 76, 77, 78	69	72, (80)
Malaysia	22.92	23.05	13.71	1.68	70, 75, 76	68, 71, 72, 74	73, 77, 78, 80	69, (79)
Mexico	45.83	25.67	48.16	0.53	70, 72, 73, (74), 76, 79	71, 75, 77, 78, 80	—	68, 69

Sources: Author's calculations. The data base stems from FAO, *Trade Yearbook, 1980* [1, pp. 130 et seq.] for the period 1978-80 and from computer offprints of the Commodity Division of the FAO (October 1980) for the period 1968-77. Details on the fitted regressions and on the identification of the stabilization and destabilization effects are available from the author on request.

Note: For the definition of export instability, for the various stabilization and destabilization effects (D, S1, S2, D/S) see the text. All computations refer to cocoa beans.

a Years in parentheses signify special cases, where the fluctuation in world export price is negatively correlated with the fluctuation of the national export price.

induced automatic stabilization because of the opposing price and quantity fluctuations. In the period 1968–80, this overall stabilizing effect did not exist for Brazil, Papua New Guinea, or Ecuador,¹⁰ where earnings instability was higher than price and quantity instabilities. Price and quantity fluctuations predominantly reinforced each other. A special case was Mexico, with the highest export quantity instability (48.2 per cent) of the selected countries exceeding its earnings instability (45.8 per cent). Price instability at 25.7 per cent was lower and obviously suppressed the dominating quantity instability in its earnings effect.

National differences may be seen, too, in the magnitudes of export instability, especially in earnings and quantity instability. Export earnings instabilities of individual countries exceeded those of the world as a whole, with the exception of some “great exporters” (Ghana, Nigeria, Cameroon). The highest values are found in Mexico, at 45.8 per cent, Ecuador, 36.8 per cent, and Papua New Guinea, 28.0 per cent. Export quantity instability of each exporting country was higher than on the world level (7 per cent). The highest values are found in Mexico (48.2 per cent), Togo (26.2 per cent), and Ecuador (23.4 per cent). The mean percentage deviation from the trend of export quantities was more than double that on the world level. This indicates compensating export supply shifts on the world level.¹¹

These differences in the magnitude of export quantity fluctuations and in the correlation of price and quantity fluctuations in various countries suggest that partial international price stabilization on the world market is an inaccurate instrument for national export earnings stabilization. Random stabilization or destabilization effects in individual countries and years will probably occur.

Analyzing columns 5 to 8 from Table I confirms this presumption. The results of these columns are based on the analysis of magnitude and sign of relative deviations of the actual values from the reference values for single years. These relative deviations determine the instability of the time series according to equation (31). It may then be stated whether a functioning partial price stabilization in the period 1968–80 would have been stabilizing or not and which bandwidth would have been preferable under the earnings stabilization aspect. Functioning international price stabilization means that a priori the price and earnings trend, calculated here *ex post*, would have been known, and that buffer-stock policies would not have changed the behavior of trading partners.¹² Additive disturbances in the import demand and export supply curves are assumed, as in the theoretical analysis. Four cases have to be distinguished empirically:

¹⁰ In single years, opposing price and quantity fluctuations occurred. See the interpretation of columns 5 to 8 in Table I.

¹¹ This observation holds for other agricultural export markets of LDCs, too. See Herrmann [4, Sec. 4.4] for the world coffee market.

¹² These assumptions will tend to lead to an evaluation overly favorable for partial price stabilization. As experiences with the Third International Cocoa Agreement show, both assumptions probably would not be given.

- (a) In periods where relative quantity fluctuations are absolutely higher than opposing price fluctuations and determine the sign of earnings fluctuations, partial international price stabilization will destabilize national export earnings. Compensating effects of price fluctuations are suppressed. This is exacerbated as partial price stabilization approaches total price stabilization (D in column 5).
- (b) In periods of parallel price and quantity fluctuations, partial international price stabilization will induce stabilizing effects on national export earnings. This tendency increases with the narrowing of the price band ($S1$ in column 6).
- (c) In periods of opposing price and quantity fluctuations where the relative price fluctuation and the parallel relative earnings fluctuation exceed the relative quantity fluctuation in absolute terms, partial price stabilization will stabilize national export earnings. The optimal stabilization parameter ranges between the nonstabilized case and total price stabilization ($S2$ in column 7).
- (d) In periods of opposing price and quantity fluctuations, where the sign of the price fluctuation determines that of earnings fluctuation, and the relative earnings fluctuation is absolutely smaller than the relative quantity fluctuation, partial international price stabilization may stabilize or destabilize national export earnings. "Very broad" bandwidths tend to induce stabilization, while "very narrow" bandwidths destabilize (D/S in column 8).

Empirical results concerning the world cocoa market show that partial price stabilization would have led, predominantly, to stabilizing effects on world export earnings. Exceptions were the year 1979 and, in the case of a "narrow" bandwidth, 1975. However, it may be seen, with the exception of Papua New Guinea, that a uniform partial price stabilization would have led to destabilizing effects for more years on the national level than on the world level.¹⁸ Destabilizing effects would have occurred in Mexico in six years, and in Togo and Nigeria in four years. Assuming total price stabilization or a "very narrow" bandwidth, destabilizing effects on national export earnings would have to be expected in Ghana in nine years, Mexico in eight, Cameroon in seven, and Togo and Nigeria in six. Table I shows, too, that reaching an earnings stabilization effect as high as possible would have required different price stabilization intensities from the various national points of view. In 1968, with the target of earnings stabilization, total price stabilization would have been preferable for Ecuador and Malaysia, but a broader bandwidth would have sufficed for the world as a whole, as well as the Ivory Coast, Nigeria, and Papua New Guinea. For Ghana, Cameroon, and Mexico only a "very broad" bandwidth would have induced stabilizing effects, in contrast to the destabilizing effects of a narrow price band. Togo and Brazil would have suffered from earnings destabilizing effects in any case in 1968. The strongest destabilization would have taken place in the case of total price stabilization, the optimal policy from Ecuador's and Malaysia's point of view.

The inability of partial international price stabilization to achieve precisely

¹⁸ For convenience, we assume that reducing world export price fluctuations will reduce fluctuations of national export prices also without changing the sign.

the target of national export earnings stabilization exists not only within a particular period for different countries, but intertemporally as well for any one country. To attain an earnings stabilization effect as high as possible requires that the optimal price stabilization parameters from the national point of view vary from year to year.¹⁴ A uniform stabilization parameter, e.g., $\beta=0$ in the special case of total price stabilization, would have had destabilizing effects for Nigeria in 1969, 1971, 1974, 1975, 1976, and 1979, and more so than with any partial price stabilization policy. In seven other years, stabilizing effects on the national export earnings would have occurred. Only in 1978 and 1980 would total price stabilization have generated the optimal stabilization intensity from Nigeria's point of view, being superior to each policy of partial price stabilization.

IV. CONCLUSIONS

The foregoing analysis has shown that a positive evaluation of partial price stabilization agreements with respect to earnings stabilization has to be modified if the national instead of the supranational level is being considered. A uniform price stabilization rule can be expected to induce very different stabilization contributions due to the correlation of export supply shifts in the particular country and in the rest of the world, the different magnitudes of export supply shifts, the price elasticities of export supply in the country and in the rest of the world, and the causes of fluctuations from the national and supranational points of view.

In principle, partial international price stabilization may destabilize national export earnings, even if it stabilizes aggregate export earnings. This situation is conceived by subaverage price elasticities of export supply and above-average export supply shifts in the particular country which are positively correlated with those of the (dominating) rest of the world, and by narrowing price bands.

With the target of national export earnings stabilization, a partial price stabilization is not generally superior to total price stabilization. In the cases of import demand shifts or negatively correlated export supply shifts, the reverse is true.

Within a system of partial price stabilization, "optimal bandwidths" with respect to national export earnings stabilization will differ in one year from country to country. Moreover, they can be formulated only for special years, as they will differ in one country from year to year. Such a price stabilization policy differentiated from year to year and from country to country cannot be realized on the world market. Nor is it desirable with respect to a market-oriented international economic order. A uniform stabilization parameter β will induce random earnings stabilization effects on the national level.

Therefore, the ability of partial international price stabilization to achieve precisely the target of national export earnings stability is weak; the effects are

¹⁴ There is here an analogy to the question of optimal storage rules. See Gardner [2, p. 155].

distributed unequally and randomly. If national export earnings are to be stabilized, the instrument of direct export earnings stabilization is preferable. However, it must be noted that existing systems of export earnings stabilization like Stabex may have destabilizing effects, too [4, Sec. 5.2.1].

REFERENCES

1. FAO. *FAO Trade Yearbook, 1980* (Rome, 1981).
2. GARDNER, B. L. *Optimal Stockpiling of Grain* (Lexington, Mass.: D.C. Heath, 1979).
3. HALLWOOD, P. *Stabilization of International Commodity Markets* (Greenwich, Conn.: Jai Press, 1979).
4. HERRMANN, R. *Exportinstabilität auf agrarischen Rohstoffmärkten-Situationsanalyse und Eingriffsmöglichkeiten*, Agrarökonomische Studien 4 (Kiel: Kieler Wissenschaftsverlag Vauk, 1981).
5. HUETH, D., and SCHMITZ, A. "International Trade in Intermediate and Final Goods: Some Welfare Implications of Destabilized Prices," *Quarterly Journal of Economics*, Vol. 86, No. 3 (August 1972).
6. JUST, R. E. "Theoretical and Empirical Possibilities for Determining the Distribution of Welfare Gains from Stabilization," *American Journal of Agricultural Economics*, Vol. 59, No. 5 (December 1977).
7. KOESTER, U. "National and International Aspects of Commodity Stabilisation Schemes," *European Review of Agricultural Economics*, Vol. 6 (1979).
8. MACBEAN, A. I. *Export Instability and Economic Development* (London: George Allen & Unwin, 1966).
9. NEWBERY, D. M. G., and STIGLITZ, J. E. *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk* (Oxford: Clarendon Press, 1981).
10. NGUYEN, D. T. "The Implications of Price Stabilization for the Short-Term Instability and Long-Term Level of LDCs' Export Earnings," *Quarterly Journal of Economics*, Vol. 93, No. 1 (February 1979).
11. ———. "Partial Price Stabilization and Export Earning Instability," *Oxford Economic Papers*, Vol. 32, No. 2 (July 1980).
12. SUNDRUM, R. M. "Primary Commodities, Price Stabilization and Producers' Revenue," *Malayan Economic Review*, Vol. 20, No. 2 (October 1975).
13. TURNOVSKY, S. J. "The Distribution of Welfare Gains from Price Stabilization: A Survey of Some Theoretical Issues," in *Stabilizing World Commodity Markets*, ed. F. G. Adams and S. A. Klein (Lexington, Mass.: D.C. Heath, 1978).
14. UNCTAD. *Survey of Commodity Demand and Supply Elasticities*, Research Memorandum No. 48 of the Research Division (Geneva, 1974).