DEVELOPMENT ECONOMICS RESEARCH CENTRE
UNIVERSITY OF WARWICK

Department of Economics
University of Warwick
Coventry CV4 7AL
England

HOW TO ANALYSE COMMODITY PRICE STABILIZATION?

A REVIEW ARTICLE

S. M. Ravi Kanbur*

Discussion Paper 35

August 1983

* Clare College, Cambridge and Department of Economics, University of Essex

Work on this review article was completed while I was visiting the Development Economics Research Centre at Warwick. I would like to thank Gordon Hughes, Marcus Miller, Ajit Singh, Nick Stern, David Vines and Martin Weale for their help and advice.

Contents

1. Introduction

"One of the greatest evils in international trade before the war was the wide and rapid fluctuations in the world prices of primary products ... It must be the primary purpose of control to prevent these wide fluctuations .."

Keynes (1942)

"The major result of our analysis is to question seriously the desirability of price stabilization schemes, both from the point of view of the producer and of the consumer".

Newbery and Stiglitz (1981)

How can such widely differing conclusions arise, albeit separated by forty years? The answer to this question, as we shall see, leads to other questions: How are we to analyse commodity price stabilization schemes? Which framework of analysis is most appropriate, and what are the critical assumptions? The contrast between the two conclusions above is all the more marked when one realises that Keynes's analysis was conducted in a war time Treasury memorandum, while the Newbery-Stiglitz conclusion forms part of their 450 page book which uses the (mathematical) techniques of the modern public finance literature to analyse the welfare economics of commodity price stabilization.[1]

Keynes, of course, lost his political battle to introduce an International Commodity Control alongside an International Currency Union. It appears, however, that the findings of the Newbery-Stiglitz book are being used to suggest that he has lost the intellectual battle as well. Thus Williamson (1983), in his contribution to the Keynes Centenary Conference, concludes:

"Doubts about the benefits of rejecting commodity price stabilization would be more widespread, though the best professional evidence does not confirm the view that the world, or even the developing countries, have lost much for that reason (Newbery and Stiglitz, 1981)"

---

[1] David M.G. Newbery and Joseph E. Stiglitz: The Theory of Commodity Price Stabilization - A Study in the Economics of Risk, Oxford University Press, 1981

Williamson's view appears to be gaining currency, and recent attempts to revive the Keynesian ideal, in UNCTAD's Integrated Program for Commodities, have met with notable failure. It is in this light that the findings of the Newbery-Stiglitz book have to be assessed.

The Newbery-Stiglitz book is largely an analysis of the microeconomic aspects of commodity price stabilization. In particular, their quantitative estimates of the benefits of stabilization are wholly estimates of the microeconomic benefits. It is on the basis of the microeconomic benefits that they draw the conclusion quoted at the start of this Introduction. This review article will focus, therefore, mainly on their microeconomic analysis, and particularly on their estimates of the benefits of stabilization schemes. Section 2 of the paper starts the discussion by considering producer benefits and transfer effects between producers and consumers, while Section 3 considers consumer benefits. The analysis in sections 2 and 3 assumes a relatively limited set of market responses to the introduction of the stabilization scheme. Section 4 considers the Newbery-Stiglitz analysis of a wider set of responses on the supply side. The analysis contained in the book on this topic is masterly, as is their general analysis of the microeconomic aspects of stabilization. They clarify many issues by means of simple models and lay the foundation for future work. By contrast, the treatment of macroeconomic aspects of stabilization receives an extremely brief treatment (only 30 out of the 450 pages of the book are devoted to macroeconomic analysis) and, more importantly, macroeconomic issues play no role in the empirical findings on the benefits of stabilization. This is commented on in Section 5 of the paper, where it is argued that the neglect of macroeconomic issues is important since some of the Keynesian case for stabilization rests precisely on macroeconomic grounds. Section 6

concludes this review article, while an Appendix provides a brief readers' guide to the chapters of the book.

2. Producer Benefits

The focus of this review article will be Newbery and Stiglitz's estimates of the benefits of commodity price stabilization, "the best professional evidence" on the matter, as Williamson (1983) calls it. This is the evidence that the policy maker will be interested in. As the authors note in their Introduction: "The centre-piece of analysis from the policy viewpoint is Chapter 20, which estimates the benefits of price stabilization," and they conclude in this chapter that "Our theoretical and empirical work suggests that the benefits of price stabilization are comparatively small compared with the likely cost of operating the buffer stock and that they are not necessarily distributed in favour of the producers." How is this conclusion reached? In particular, what is the theoretical and conceptual framework that underlies it?

Let us start with producers first, who are dealt with in Chapter 6 of the book. The representative producer has a von-Neumann Morgenstern utility function of income U(Y). Let

$$R(Y) = \frac{-YU''(Y)}{Y} \qquad (1)$$

be the Arrow-Pratt measure of relative risk aversion for this utility function, and let the effect of the price stabilization scheme be to transform income from the random variable $\tilde{Y}_o$ to the random variable $\tilde{Y}_1$. The money value to the producer of this change is given by B in the following equation:

$$EU(\tilde{Y}_o) = EU(\tilde{Y}_1 - B) \qquad (2)$$

where E is the expectation operator with respect to the appropriate random variable. Using a Taylor series approximation for (2) we get

Table 20.4 *Instabilities by country and commodity 1951–75*

Crop/country	CV (percentages)					
	Q (1)	pQ (2)	p (3)	Q_w (4)	Corr (p, Q) (5)	Corr (Q, Q_w) (6)
Cocoa from						
Ghana	21	22	31	36	–0.7	0.3
Nigeria	21	19	31	22	–0.7	0.6
Ivory Coast[a]	12	40	31	21		0.2
Brazil	24	46	31	23	0.3	–0.3
Coffee from						
Colombia	8	17	15	10	–0.1	–0.1
Ivory Coast	20	27	15	9	–0	–0.1
Mexico	14	23	15	9	0.3	–0.5
Brazil	13	15	15	11	–0.4	0.1
Cotton from						
Egypt	14	20	26	22	–0.6	0.6
Mexico	30	25	26	21	–0.6	0.5
Sudan	33	40	26	21	–0.3	0.5
Brazil	49	56	26	21	–0.1	0.3
Jute from						
Bangladesh	8	22	21	14	–0.0	–0.1
Thailand[a]	42	54	20	14	0.4	–0.2
Rubber from						
Malaysia[a]	7	22	16	16	0.8	0.3
Nigeria	29	37	20	9	0.2	–0.5
Thailand	8	26	20	8	0.7	0.2
Sri Lanka	11	24	20	8	0.1	0.1
Sugar[b] from						
Mauritius	12	63	58	38	0.2	–0.2
Philippines	12	63	58	41	0.1	–0.2
Brazil	72	78	58	42	–0.3	0.1

Sources: IMF (1977); World Bank (1977b); FAO *Trade Yearbook* (various years).
Notes: [a] Estimated for period 1958–75; [b] same 'world' sugar prices series used for all countries.
Key: Q, detrended export volume; p, detrended deflated price, Q_w, detrended export volume of rest of world; corr(p, Q), corr(Q, Q_w) are correlation coefficients of p and Q, Q and Q_w.

Table 20.6 *Net efficiency benefits of total price stabilization*

	Price elasticity ϵ (1)	$100\,\sigma_p^2$ (2)	$100\,\sigma_p^2$ (MA) (3)	B/X % (4)	B/X (MA) % (5)
Cocoa	0.4	9.6	4.8	1.9	1.0
Coffee	0.6	6.8	2.0	2.0	0.6
Cotton	0.4	9.0	0.8	1.8	0.2
Jute	0.5	4.0	2.3	1.0	0.6
Rubber	0.8	16.0	3.6	6.4	1.4
Sugar	0.7	33.6	11.6	14.3	4.1
Average				4.6	1.3

Notes: (1) Estimates from Newbery and Stiglitz (1977; (2) From col. (1) of Table 20.1 – CV of detrended prices; (3) From col. (4) of Table 20.1 – variation from moving average; (4) $\frac{1}{2}$col. (1) X co.. (2); (5) $\frac{1}{2}$col. (1) X col. (3).

Table 20.7 *Storage costs and returns*
Percentages

	Storage costs c (% of price) (1)	σ_p MA (2)	$\frac{\sigma_p}{r+c}$ (3)	Benefit-cost ratio $n = 4$ years (4)
Cocoa	2.5	22	2.9	88
Coffee	1.4	14	2.2	66
Cotton	1.2	9	1.5	44
Jute	4.9	15	1.5	45
Rubber	2.4	19	2.6	77
Sugar	4.7	34	3.5	105

Notes: (1) from UNCTAD TD/B/C 1/198; (2) = col. 4 of Table 20.1; (3) $r = 5\%$; (4) calculated from Eqn. (20.5), $z = 0.5$, $k\sqrt{n} = 2.5$, as a percentage.

Table 20.8 *Producer benefits of complete price stabilization*
Percentages

Crop/Country	Share of world exports, %	Risk benefit $\frac{1}{2}\Delta\sigma_y^2$	Transfer benefit	Net producer benefit
(1)	(1)	(2)	(3)	(4)
Cocoa from				
Ghana	32	0		
Nigeria	22	−0.5		
Ivory Coast	13	7		
Brazil	9	7		
weighted average	76	2.1	−2.9	−0.8
Coffee from				
Colombia	15	1		
Ivory Coast	5	2		
Mexico	3	1.5		
Brazil	31	0.5		
weighted average	54	0.7	−1.4	−0.7
Cotton from				
Egypt	14	1		
Mexico	7	−1.5		
Sudan	6	2.5		
Brazil	5	3.5		
weighted average	32	1.2	−2.7	−1.5
Jute from				
Bangladesh	69	2		
Thailand	19	6,		
weighted average	88	2.9	−1.0	1.9
Rubber from				
Malaysia	53	2		
Nigeria	4	3.5		
Thailand	10	3		
Sri Lanka	6	2		
weighted average	73	2.3	−1.6	0.7
Sugar from				
Mauritius	3	19		
Philippines	8	19		
Brazil	11	4.5		
weighted average	22	11.8	−6.1	5.7

Key: Benefits measured as percentage of average revenue from crop assuming risk aversion $R = 1$ (col. (4) = col. (3) + col. (2)).
Source: Tables 20.4, 20.6.

Table 20.9 *Consumers' residual stabilization benefit*
Percentages

	Expenditure as % of income	Consumer price CV s_p	Corr(p, I) ρ	Residual benefit $-\rho\sigma_p\sigma_i$
	(1)	(2)	(3)	(4)
Cocoa	0.1	4.3	−14	0.1
Coffee	0.3	5.7	40	−0.2
Cotton	0.2	n.a.	37	−0.3
Jute	0.0	n.a.	11	−0.1
Rubber	0.1	n.a.	35	−0.2
Sugar	0.4	6.0	−35	0.6

Notes: (1) ratio of commodity export value to OECD consumer expenditure (1975); (2) CV of UK retail prices 1960–74, detrended; (3) correlation coefficient between world price and OECD GDP deviations; (4) is the consumers' residual benefit, assuming $R^c = 1$.

$$\frac{B}{\bar{Y}_o} = \frac{\Delta\bar{Y}}{\bar{Y}_o} - \frac{1}{2}R(\bar{Y}_o)\left\{\sigma^2_{\tilde{Y}_1}\left(\frac{\bar{Y}_1}{\bar{Y}_o}\right)^2 - \sigma^2_{\tilde{Y}_o}\right\} \qquad (3)$$

where

$\bar{Y}_i$ = mean of $\tilde{Y}_i$; i=0, 1

$\sigma^2_{\tilde{Y}_i}$ = squared coefficient of variation of $\tilde{Y}_i$, i = 0, 1

$\Delta\bar{Y} = \bar{Y}_1 - \bar{Y}_o$

In deriving (3) from (2), terms of order higher than $\sigma^2_{\tilde{Y}_i}$ are neglected. Thus $\frac{B}{\bar{Y}}$ represents an approximation to the cash value of the scheme to producers, as a fraction of their initial average income. The first term on the right hand side is referred to as the "transfer benefit". Notice that the expression in Newbery and Stiglitz equation (6.54), is

$$\frac{B}{\bar{Y}_o} = \frac{\Delta\bar{Y}}{\bar{Y}_o} - \frac{1}{2}R\Delta\sigma^2_{\tilde{Y}} \qquad (NS6.54)$$

where

$$\Delta\sigma^2_{\tilde{Y}} = \sigma^2_{\tilde{Y}_1} - \sigma^2_{\tilde{Y}_o}$$

which is incorrect unless $\sigma^2_{\tilde{Y}_1}=0$ ie complete stabilization of income, or $\bar{Y}_o=\bar{Y}_1$ ie zero transfer effect. The second term in (3) or (NS6.54) is called the "risk benefit" to producers, and these are the benefits in column 2 of Table 20.8, assuming R=1.

Since Newbery and Stiglitz are dealing with neither the $\sigma^2_{\tilde{Y}_1} = 0$ case, nor the $\bar{Y}_o = \bar{Y}_1$ case, the estimates in column 2 are strictly speaking inaccurate. However, given the values of $\bar{Y}_1/\bar{Y}_o$ implied by the transfer benefit estimates in column 3, this inaccuracy is minimal. Given this, let us consider the estimates they present for the risk benefit in Table 20.8. Newbery and Stiglitz take producers' income as being revenue,

and Table 20.4 presents estimates of instabilites of revenue and output for six different crops. Taking perfect price stabilization as the object of the scheme, the revenue instability after stabilization, as measured by the coefficient of variation, is simply output instability assuming no change in supply conditions. Thus, for example, in the case of cocoa from Ghana, perfect price stabilization leads to

$$\Delta\sigma^2_{\underset{\sim}{Y}} = (0.22)^2 - (0.21)^2$$

which is negligible, as shown in the first row of Table 20.8 in column 2. For sugar from Mauritius, however,

$$\Delta\sigma^2_{\underset{\sim}{Y}} = (0.63)^2 - (0.12)^2$$

so that (assuming R = 1)

$$\frac{1}{2}R\Delta^2_{\underset{\sim}{Y}} = \frac{1}{2}\Delta\sigma^2_{\underset{\sim}{Y}} = 0.19$$

as shown in Table 20.8.

The risk benefit, as defined by Newbery and Stiglitz, is determined by two factors - the degree of risk aversion and the extent of reduction in income variability as a consequence of price stabilization. The latter raises some thorny empirical questions on the measurement of instability, and the brief treatment of the issues by the author provides a good introduction to a large literature. However, what of the assumption that the degree of risk aversion is unity? The reasonableness or otherwise of this assumption depends entirely on what the objective function U(Y) is meant to represent. From their discussion it is clear that Newbery and Stiglitz interpret U(Y) as representing preferences between risky outcomes for a single individual, and in fact they appeal to experimental evidence to put a ceiling of about 1.2 on R.[2] Two observations can be made on such

---

[2] Chapter 7, entitled "Empirical Measurements of Producers' Attitudes to Risk", is based on a survey of the work of Binswanger (1978) and others. Newbery and Stiglitz draw the argument together as follows:

"To conclude, most individuals are risk averse, but not very risk averse, and react to fluctuations in income rather than consolidating such changes into lifetime wealth. The coefficient of (partial) risk aversion typically increases from about 0.5 for small fluctuations in income (SD of about one month's wage) to about 1.2 for large fluctuations (SD about 50 per cent of annual income)."

an interpretation. Firstly, it does not take account of the distribution of producers' income, and of inequality aversion with regard to this distribution. Further work is certainly required here. Secondly, and perhaps more importantly, the analysis leaves out completely the issues raised in the literature on "two-gap" models of development, where the focus is on the foreign exchange constraint and the rôle of export revenues in relieving this constraint. This macroeconomic aspect of the problem is taken up in Section 5 of this paper.

Coming now to the transfer effect of the stabilization scheme, Newbery and Stiglitz find it to be largely negative - stabilizing prices around a level that will take up existing supply will reduce consumer expenditure and hence producers' revenue on average, given the demand elasticities involved. Let

$$Q = \bar{Q}\theta$$

be supply, where θ is random, and let

$$Q^d = p^{-\varepsilon}\phi$$

be demand, where p is price and ϕ is random. Newbery and Stiglitz show in Chapter 7 (pp 94-95) that if θ and ϕ are jointly log-normally distributed, then for complete price stabilization the transfer benefit is approximated by

$$B_T = \frac{1}{2}(\varepsilon-1)\ \sigma_p^2 \qquad \text{(NS20.7)}$$

where σ_p^2 is the squared coefficient of variation of price and ε is the elasticity of demand. This is the formula used in calculating the transfer benefits given in Column 3 of Table 20.8. Notice, however, that while the risk benefit is calculated by country for each commodity, the transfer benefit is calculated for the world as a whole, using the estimates for ε and σ_p^2 given in columns 1 and 2 of Table 20.6. Thus for cocoa Table 20.6 gives ε as 0.4 and σ_p^2 as 9.6%. Putting these in the above formula gives B_T as -2.9%, which is the figure reported in Column 3 of Table 20.8.

The transfer benefits for the six commodities considered are all negative although, except for sugar, they are fairly small and lie between -1% and -5%.[3] The transfer benefits and risk benefits are then aggregated together to produce, in column 4 of Table 20.8, the net producer benefit. The figures are strikingly low (except perhaps for sugar) and negative for three of the commodities. Hence the Newbery-Stiglitz conclusion that commodity price stabilization schemes will not lead to a large benefit to producers.

The demonstration that stabilization schemes which take up existing supplies will lead to a transfer from producers to consumers is a striking conclusion, although Johnson (1976) makes the same point. What the argument highlights is the level around which prices are to be stabilized. UNCTAD's discussion of "just and remunerative" prices does not give a precise answer. Newbery and Stiglitz choose that price level which, assuming no supply response, will clear the market since otherwise buffer stocks will either be run down or accumulated indefinitely. This, given that the demand elasticity for the commodities concerned is less than unity, leads to transfer on average from producers to consumers. What if we choose the price level to be that which makes the transfer effect zero? Given the elasticities, a corollary of the earlier argument is that this will only be feasible if output is restricted. "Restriction of output" raises the spectre of cartelisation and may not be acceptable to the consuming nations in international negotiations - although it should

---

[3] There appears to be an arithmetical error in the derivation of the transfer benefit for sugar. Using the figures in Table 20.4 in (NS20.7) gives the transfer benefit for sugar as -5.0%, not -6.1% as reported in Table 20.8.

be made clear that the restriction is merely to make the transfer effect zero, and not to induce a net transfer from consumers to producers. If this is done, then the argument focuses once again solely on the risk benefits to producers.

Chapter 18 of the book is devoted entirely to a discussion of the distributional impact of price stabilization, and the authors argue convincingly that this impact is extremely sensitive to the precise parametrisations and assumptions made about demand and supply. This is one of the major conclusions of their theoretical analysis, and in fact the discussion of the transfer effect in the book as a whole constitutes one of the significant contributions of the book. The sensitivity of conclusions to assumptions is also highlighted by the work of Behrman (1979), who reaches conclusions directly opposite to those of Newbery and Stiglitz on the transfer effect. No doubt the debate on this effect will continue, but Newbery and Stiglitz have set up a framework in which alternative views can be assessed.

3. Consumer Benefits and the Cost-Benefit Analysis of Stabilization Schemes

The consumer is seen by Newbery and Stiglitz as the representative individual in the consuming country, choosing demands to maximise utility given prices. If $U(q_1, q_2, \ldots, q_n)$ is the consumer's utility from consuming quantities $q_1, q_2, \ldots, q_n$ of the n goods, then with known prices $p_1, p_2, \ldots, p_n$ and known income I his problem is

$$\underset{x_1, x_2, \ldots, x_n}{\text{Max}} \; U(q_1, q_2, \ldots, q_n) \text{ subject to } \sum_{i=1}^{n} p_i q_i \leq I \qquad (3.1)$$

Assuming standard concavity and non-satiation properties problem (3.1) leads to demands

$$q_i = q_i(p_1, p_2, \ldots, p_n, I) \; ; \; i = 1,2, \ldots, n$$

and the maximised or indirect utility function

$$V(p_1, p_2, \ldots, p_n, I) \qquad (3.2)$$

The properties of (3.2) are developed by Newbery and Stiglitz in Chapter 8 of the book, and this Chapter, together with Section 5.2 of Chapter 5, provide a lucid account of duality theory for the consumer and the producer, respectively. The property of interest for us is Roy's identity

$$q_i = \frac{-\delta V}{\delta p_i} \Big/ \frac{\delta V}{\delta I} \qquad (NS8.10)$$

and this is used to good effect throughout Chapter 9, which is devoted to a theoretical analysis of the consumer benefits of price stabilization.

The direct utility function $U(q_1, q_2, \ldots, q_n)$ is to be thought of as a von Neumann-Morgenstern utility function over consumption bundles. The indirect utility function $V(p_1, p_2, \ldots, p_n, I)$ is thus a von Neummann-Morgenstern utility function over price-income bundles, and the consumer is concerned with the expected value of this function. Is the individual averse to price risk or not? The answer depends on whether V is concave or convex in the relevant p_i. Dropping the subscript i, and using (3.2) and (NS8.10),

$$V_{pp} = -V_I \frac{dV}{dp} - qV_{Ip}$$

Since

$$V_{Ip} = -V_I \frac{dq}{dI} - qV_{II}$$

we get that

$$V_{pp} = \frac{qV_I}{p} \{\varepsilon - \beta(R^c - \eta)\} \qquad \text{(NS8.15)}$$

where

$\eta = \frac{I}{q}\frac{dq}{dI}$; the income elasticity of demand

$\varepsilon = \frac{-p}{q}\frac{dq}{dp}$; the price elasticity of demand

$R^c = \frac{-IV_{II}}{V_I}$; consumer's relative risk aversion to income variability at given prices

$\beta = \frac{pq}{I}$; expenditure share of the commodity

Thus if ε is greater than $\beta(R^c-\eta)$, which may happen if β is small and the good is relatively income inelastic, then the consumer <u>prefers</u> price instability! We will comment on this feature of the consumer, as modelled by Newbery and Stiglitz, more fully at the end of this section.

Consider now the cash value to the consumer of stabilising the price of a single commodity, say commodity 1, all other prices being assumed fixed before and after the stabilization. Income is allowed to be random, so that the benefit B is given as the solution to

$$EV(\tilde{p}_1, p_2, \ldots, p_n, \tilde{I}) = EV(\hat{p}_1, p_2, \ldots, p_n, \tilde{I}-B) \qquad (3.3)$$

where $\hat{p}_1$ is the level at which the price of commodity 1 is stabilised. Expanding both sides of (3.3) in a Taylor series approximation around $(\bar{p}_1, p_2, \ldots, p_n, \bar{I})$, where $\bar{p}_1$ and $\bar{I}$ are the means of $\tilde{p}_1$ and $\tilde{I}$, we get

$$V(\bar{p}_1, p_2, \ldots, p_n, \bar{I}) + E\{(\tilde{p}_1-\bar{p}_1)\frac{\delta V}{\delta p_1} + (\tilde{I}-\bar{I})\frac{\delta V}{\delta I}\}$$

$$+E\{\tfrac{1}{2}(\tilde{p}_1-\bar{p}_1)^2\frac{\delta^2 V}{\delta p_1^2} + (\tilde{p}_1-\bar{p}_1)(\tilde{I}-\bar{I})\frac{\delta^2 V}{\delta p \delta I} + \frac{1}{2}(\tilde{I}-\bar{I})^2\frac{\delta^2 V}{\delta I^2}\}$$

$$\tilde{\sim} V(\bar{p}_1, p_2, \ldots, p_n, \bar{I}) + E\{(\hat{p}_1-\bar{p}_1)\frac{\delta V}{\delta p_1} + (\tilde{I}-B-\bar{I})\frac{\delta V}{\delta I}\}$$

$$+ E\{\tfrac{1}{2}(\hat{p}_1-\bar{p}_1)^2\frac{\delta^2 V}{\delta p_1^2} + (\hat{p}_1-\bar{p}_1)(\tilde{I}-B-\bar{I})\frac{\delta^2 V}{\delta p \delta I} + \tfrac{1}{2}(\tilde{I}-B-\bar{I})^2\frac{\delta^2 V}{\delta I^2}\}$$

Applying the expectations operator, and ignoring terms in B^2, $B(\hat{p}_1-\bar{p}_1)$ and $(\hat{p}_1-\bar{p}_1)^2$ as being small relative to the approximation being considered, the above reduces to

$$B\frac{\delta V}{\delta I} = -\frac{1}{2}\frac{\delta^2 V}{\delta p_1^2}\,\mathrm{Var}(p_1) + \frac{\delta^2 V}{\delta I \delta p}\,\mathrm{Cov}(I, p_1) + (\hat{p}_1-\bar{p}_1)\frac{\delta V}{\delta p_1}$$

We now use Roy's identity and the following expression for V_{Ip}

$$V_{Ip} = \frac{qV}{I}(R^c-\eta) \qquad \text{(NS8.13)}$$

to give

$$B = -q_1(\bar{p})(\hat{p}_1-\bar{p}_1) - \frac{1}{2}\bar{p}_1 q_1(\bar{p})\{\varepsilon_1\sigma_{p_1}^2 + 2(R^c-\eta_1)\rho(p_1, I)\sigma_{p_1}\sigma_I\} \qquad (3.3)$$

where

σ_{p_1} = coefficient of variation of p_1

σ_I = coefficient of variation of I

$\rho(p_1, I)$ = correlation coefficient of p_1 and I

Expression (3.3) corresponds to expression (9.2) in Newbery and Stiglitz, except that the latter includes terms in covariances between p_1 and other prices, which are taken to be zero here. Since these terms are in fact ignored in their empirical calculations, expression (3.3) above represents the basis on which the estimates of consumer benefits in Chapter 20 are calculated. Notice that the first term of (3.3) is <u>not</u> the transfer benefit, unless supply is riskless. In general the transfer

benefit is

$$B_T = E(pq) - \hat{\bar{p}}\bar{q}$$

The argument now proceeds by making specific assumptions about demand and supply, and using approximations. Assuming the demand function to be

$$q^D = p^{-1/\varepsilon} I^{\eta}$$

and assuming supply and income risk to be independently and lognormally distributed, consumer benefit is shown (on pp 126-127) to be approximated by

$$\frac{B}{X} = \tfrac{1}{2}(1-\varepsilon)\sigma_p^2 + \{\tfrac{1}{2}\varepsilon\sigma_p^2 - R^c\rho(p,I)\sigma_I\sigma_p\} \qquad (3.4)$$

where X is consumer expenditure at the average price $\bar{p}$. The first term is simply the transfer benefit to consumers and is of opposite sign to the transfer benefit to producers[4]. The terms in curly brackets constitute the "efficiency benefit" to consumers, and it is to these that we now turn.

The first term in curly brackets is referred to as the "arbitrage benefit", which would accrue even if consumers were income risk neutral ($R^c=0$). An alternative derivation of the arbitrage term is provided in Chapter 17, and estimates of this benefit are provided in Table 20.6 of Chapter 20. As can be seen from Column 4 of Table 20.6 these arbitrage benefits are small for actual values of elasticities and instabilities. In fact, we have to further take into account the costs of operating the buffer stock. Table 20.7 provides estimates of these costs using a specific

---

[4] It is not quite equal in magnitude to (NS20.7) since that expression gives producers transfer benefit as a fraction of average revenue in the absence of stabilization.

buffer stock model. The benefit to cost ratio is seen to be less than 1 for five out of the six commodities considered.

This leaves the second term in curly brackets in (3.4), which Newbery and Stiglitz christen the "income risk" term. Assuming R^c to be unity, estimates for this term are provided in Table 20.9. They are negative for four of the six commodities and positive for the other two, but all estimates are small in magnitude. It is on the basis of these estimates for the arbitrage benefit and the income risk benefit that Newbery and Stiglitz conclude: "Our theoretical and empirical work suggests that the benefits of price stabilization are comparatively small compared with the likely costs of operating the buffer stock ...."

We end this section by questioning whether the Newbery-Stiglitz conceptualisation of consumer benefit is appropriate. Firstly, much of the argument in favour of stabilization centres around the inflationary cost to consuming countries of commodity price instability. Behrman (1979), for example, stresses the importance of this effect, as does Kaldor (1976). By its very construction, the Newbery-Stiglitz analysis cannot deal with these issues. Secondly, even if we accept the discussion of consumer benefit in terms of a microeconomic framework of the representative consumer, it goes against (at least my) intuition that consumers prefer price instability - as is likely in the model discussed in this section. Given the decision making framework assumed this is not surprising - quantity decisions are made after prices are known. However, this neglects pre-committed consumption, habit formation, etc., which make the consumer averse to price instability. More work is needed here in order to formulate and analyse decision making in a way that will produce results that do not appear contrary to the simple intuition that consumers dislike price instability. When this is done, the consumer benefits of price stabilization may turn out to be higher than estimated by Newbery and Stiglitz.

4. Market Responses to Stabilization

One of the lasting contributions of this book will be the focus on market responses to stabilization schemes. Taking account of agents' responses to policy measures is of course a hall mark of the modern public finance literature, and this book is firmly in that tradition. Although the analysis of market response does not enter into their estimates of the benefits of stabilization, throughout the book the authors use a number of models to illustrate the consequences of taking these into account, and the pitfalls in neglecting them. Part V of the book is devoted entirely to an analysis of supply responses to stabilization, while other chapters of the book highlight other market responses - in future markets and in private storage, for example.

A basic benchmark of analysis used by Newbery and Stiglitz is the rational expectations equilibrium. This serves to anchor the analysis free of complications regarding learning or collecting of information. To fix ideas, let the stochastic supply be given by

$$q = q\ (x,\theta)$$

where x is farming input while θ is the random state of nature. If U (y,x) is the farmer's von Neumann-Morgenstern utility function for income and farming input ("effort"), then his problem is to

$$\underset{x}{\text{Max}}\ EU\ (p^e\ (\theta)\ q\ (x,\theta),\ x)$$

where $p^e\ (\theta)$ is the price expected when the state of nature is θ. The above defines, under the usual conditions,

$$x = x\ \{p^e\ (\theta)\}$$

i.e. the input choice depends on the entire function $p^e\ (\theta)$.

If p (q) is the demand function then the market clearing price when the state of nature is θ is given by

$$p\ (q\ (x\ \{p^e\ (\theta)\},\ \theta))$$

A rational expectations equilibrium is defined as occurring when

$$p^e(\theta) \equiv p(q(x\{p^e(\theta)\}, \theta))$$

i.e. when the price expectation function which generates the market clearing price function via input choice is identical to this market clearing price function. What we are looking for, in other words, is a fixed point in function space, and although Newbery and Stiglitz do not go into it in any great detail sufficient conditions can be found to guarantee the existence of such a function.[5]

What Newbery and Stiglitz are interested in is in the efficiency of this equilibrium, which is discussed in Chapter 15, and in how it changes when a stabilization scheme is introduced. We will focus on the latter issue. A stabilization scheme can be defined as one which produces a particular outcome of price for each θ, given total average supply $\bar{Q}$:

$$\tilde{p} = p(\tilde{\theta}, \bar{Q}, z)$$

where z parametrizes a family of stabilization schemes.

As before, equilibrium is given by

$$\tilde{p}(\bar{Q}, \theta, z) = p(q(x\{\tilde{p}(\bar{Q}, \theta, z)\}, \theta))$$

and is thus parametrised by z. Average output under stabilization scheme z is given by

$$\bar{Q} = E(q(x\{\tilde{p}(\tilde{\theta}, \bar{Q}, z)\}, \theta))$$

and the supply response is thus defined by

$$\frac{d\bar{Q}}{dz} = E\left[\frac{\delta q}{\delta x}\frac{\delta x}{\delta p}\frac{d\bar{Q}}{dz} + \frac{\delta q}{\delta x}\frac{\delta x}{\delta z}\right]$$

With this conceptual apparatus, Newbery and Stiglitz define equilibrium price stabilization schemes as "those which take into account their own effect on the level of output, and the effect on the change in output on the price which will prevail in each state of nature." The argument is

---

5 For a discussion in existence problems see, for example, Hart (1975).

that these are the schemes which are viable in the long run, it is these that should be analysed in terms of benefit to producers and consumers. The analysis now proceeds, in Chapter 22, by simplifying the functional forms in order to derive specific results - a masterful demonstration of a type of theorising which is important in the modern public finance literature, and which is used throughout the book. One of the results which emerges under the special assumptions is that "changes in output can be viewed as pure transfer effects", so that - at least under these assumptions - the analysis of Part IV which assumes no supply response is still valid if distributional considerations are ignored.

Chapter 13 of the book, entitled "Futures Markets and Risk Reduction", is another illustration of the authors' forte in conceptualising and then analysing market response. The problem here is to firstly model future markets and then to model how these affect supply response, and to compare the situation with stabilization schemes in operation. The major conclusion, although no empirical estimates are presented, is that future markets, "where present, may significantly alter the impact of price stabilization."

Similarly, Chapter 14 of the book introduces the possibility of private storage, and analyses the impact of storage response on the effects of a price stabilization scheme. The extent of storage by private agents will depend, in general, on the price difference between dates of buying and selling, Δp. Let the storage be given by $z(\Delta p)$. Let the buffer stock authority attempt to change Δp by storing δQ. This will alter the attractiveness of storage and thus affect the initial calculations. Focussing on the two dates, 1 as the buying date and 2 as the selling date, if $p(.)$ is the demand function then Δp is given as the solution to

$$\Delta p = p\ (Q_1 + \delta Q + z\ (\Delta p)) - p\ (Q_2 - \delta Q - z\ (\Delta p)) \qquad \text{(NS 14.12)}$$

where Q_1 and Q_2 are the available supplies in the two periods. Differentiating with respect to δQ, we get

$$\frac{d\ (\Delta p)}{d\ (\delta Q)} = \frac{\frac{dp_1}{dQ} + \frac{dp_2}{dQ}}{1 - \frac{dz}{d(\Delta p)}\left[\frac{dp_1}{dQ} + \frac{dp_2}{dQ}\right]} \qquad \text{(NS 14.13)}$$

The above equation shows clearly that the price stabilization achieved by public storage depends on the response of private storage to the stabilization scheme. Further analysis can be conducted for specific cases. If the demand curve is linear

$$p = a - bQ$$

and storage is proportional to the excess of the buying price over the selling price,[6]

$$z = \alpha \Delta p$$

then

$$\frac{d\ (\Delta p)}{d\ (\delta Q)} = \frac{-2b}{1 + 2\alpha b} \qquad \text{(NS 14.14)}$$

so that when there is private storage the buffer stock authority must increase storage by a factor of $1 + 2\alpha b$ to get the same effect on Δp. Clearly, then, market response matters! It is a major achievement of this book to focus attention on such market responses.

---

[6] Newbery and Stiglitz do in fact demonstrate a case where the optimal storage rule for farmers is of this type.

5. Macroeconomic Aspects

Macroeconomic aspects of commodity price stabilisation schemes are treated in Part VI of the book. The four chapters in this part, covering 30 pages, constitute the entire discussion of macroeconomic aspects in the 450 page book. Nevertheless, Newbery and Stiglitz have made some attempt at formalising the macro issues involved. Chapter 26, for example, focuses on the foreign exchange constraint, and models national income variability resulting from export revenue variability. They do not, however, provide estimates of the benefits of stabilisation in this case.

The model used in Chapter 26 is of the standard Keynesian variety, but with government revenue and hence government investment being tied to export revenue. Let

$$Y = C + \bar{I} + I_g + \bar{G} \qquad \text{(NS 26.1)}$$

where C is consumption, I_g is government investment, $\bar{G}$ is government expenditure (a constant) and $\bar{I}$ is private investment (assumed constant for this argument). Let tax receipts be

$$T = \tilde{p}X - \hat{p}X \qquad \text{(NS 26.2)}$$

where $\tilde{p}X$ is export receipts and $\hat{p}X$ is stabilised producer revenue, the government being assumed to finance this stabilisation. If s is the short-run marginal propensity to save, then

$$C = C_o + (1 - s)(Y - T) \qquad \text{(NS 26.3)}$$

Denote the marginal (and average) propensity to import for consumption, investment and government expenditure by m_c, m_i and m_g, respectively. Newbery and Stiglitz assume that public investment is constrained to maintain a balance trade account, so that

$$I_g = \frac{\tilde{p}X - m_c(1 - s)(Y - T) - M_o}{m_i} \qquad \text{(NS 26.5)}$$

where $M_o = m_c C_o + m_i \bar{I} + m_g \bar{G}$.

Thus we get that national income is given by

$$Y = Y_o + \alpha\tilde{pX} - \gamma\hat{pX} \qquad \text{(NS 26.6)}$$

where

$$Y_o = \left(C_o + \bar{I} + \bar{G} - \frac{M_o}{m_i}\right) \Big/ 1 - (1 - s)\left(1 - \frac{m_c}{m_i}\right)$$

$$\alpha = 1 + \frac{1 - m_i}{m_c + s(m_i - m_c)}$$

$$\gamma = 1 - \frac{m_i}{m_c + s(m_i - m_c)}$$

To illustrate, Newbery and Stiglitz take the case where $m_c = 0.2$, $m_i = 0.6$, $s = 0.5$ and where X is constant so that the sole source of instability arises from price fluctuations. Since in this case $\alpha = 2$, "The variance of income is four times that of export earnings". They conclude that "Evidently the benefits of stabilising export revenue would be very large in such an economy". The substance of this conclusion is unclear. If the costs of national income variability are being modelled as discussed in Section 2 above, then it is the coefficient of variation of Y that matters, not just its variance. Although the variance of Y is four times that of $\tilde{pX}$ in their illustration, the coefficient of variation of Y is

$$\sigma_Y^2 = \frac{\alpha^2 \mathrm{Var}(\tilde{pX})}{\{(Y_o - \gamma\hat{pX}) + \alpha E(\tilde{pX})\}^2}$$

$$< \sigma^2_{\tilde{pX}} \qquad \text{if } Y_o - \gamma\hat{pX} \geq 0$$

Also,

$$\Delta\sigma_Y^2 = \frac{\alpha^2}{\{(Y_o - \gamma\hat{pX}) + \alpha\}} \Delta\sigma^2_{\tilde{pX}}$$

so that in general reduction of export revenue variability would not be magnified greatly in terms of national income variability, in the framework adopted by Newbery and Stiglitz.

The role of the foreign exchange constraint in making a case for commodity price (or rather export revenue) stabilisation is perhaps better seen in the following highly simplified model, which incorporates both a capacity constraint and lack of Keynesian effective demand in a macro analysis. Let national income be

$$Y = C + I + G + E - M$$

where C is consumption, I is investment, G is government expenditure, E is export revenue and M is imports. Let

$$C = cY$$

$$I = dY$$

$$M = m_c C + m_i I$$

be the consumption, investment and import functions, so that

$$M = [m_c C + m_i d]Y$$

$$= mY$$

is the relationship between import requirements and national income. We assume no reserves and no credit facilities, so that government expenditure always adjusts to balance the trade account. Hence

$$mY = E$$

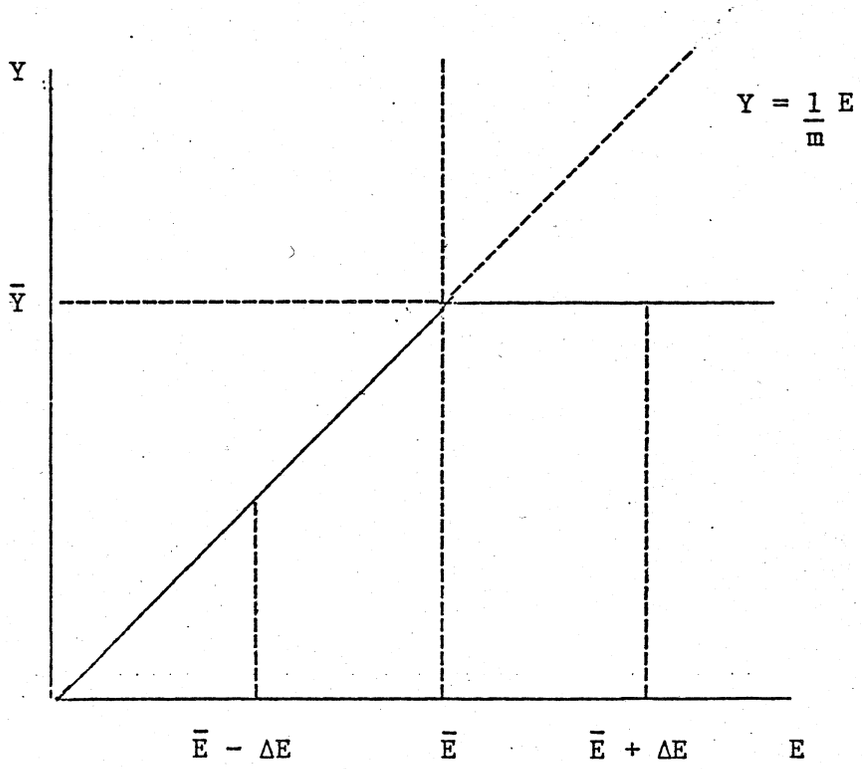
$$\text{or} \quad Y = \frac{1}{m} E \qquad (5.1)$$

Thus, as export revenue fluctuates, Y fluctuates as well. This is the simple version of the Newbery-Stiglitz model discussed earlier. If $m = \frac{1}{2}$, then the variance of Y is four times the variance of E but the coefficient of variation of Y and E are the same.

We now introduce a capacity constraint, $\bar{Y}$. When export demand is low, so that export revenue is low, national income is low because of lack of effective demand. However, when export demand is very high, this does not necessarily lead to a higher national income because of the capacity constraint.

$$\begin{cases} \frac{1}{m} E & ; \quad E \leqslant m\bar{Y} \\ \bar{Y} & ; \quad E \geqslant m\bar{Y} \end{cases}$$

Hence with $E \geqslant m\bar{Y} = \bar{E}$, export demand cannot be satisfied and there is a Keynesian inflationary gap. Let us now analyse the situation where, starting from $\bar{E}$, export demand is $\bar{E} - \Delta E$ half of the time and is $\bar{E} + \Delta E$ the other half of the time.



As the diagram illustrates, Y falls to $\frac{\bar{E} - \Delta E}{m}$, but cannot rise to $\frac{\bar{E} + \Delta E}{m}$ since the capacity constraint ensures $Y \leqslant \bar{Y}$.

What would be the benefits of stabilising E around $\bar{E}$? If we let U(Y) be the utility function of national income, then the benefit B is defined by

$$U(\bar{Y} - B) = \tfrac{1}{2} U\left(\frac{\bar{E} - \Delta E}{m}\right) + \tfrac{1}{2} U(\bar{Y}) \qquad (5.3)$$

Using Taylor series approximations in the same way as in Section 2 :

$$U(\bar{Y}) - BU'(\bar{Y}) + B^2U''(\bar{Y}) \simeq U(\bar{Y}) - \frac{1}{2}\frac{\Delta E}{m} U'(\bar{Y}) + \frac{1}{4}\left(\frac{\Delta E}{m}\right)^2 U''(\bar{Y})$$

Ignoring the term in B^2, we get

$$\frac{B}{\bar{Y}} = \frac{1}{2}\frac{\Delta E}{\bar{E}} + \frac{1}{4} R\left(\frac{\Delta E}{\bar{E}}\right) \qquad (5.4)$$

where R is the measure of relative risk aversion for U(Y). Notice that $\frac{\Delta E}{\bar{E}}$ is the coefficient of variation of export demand variability. If we take this to be around 20% (see Table 20.9), and R = 1, the second term in (5.4) is 1%. This is the "risk benefit", in this model, of stabilising revenue at $\bar{E}$. However, the first term gives the value to the producers of being able to run the economy at full capacity, and this comes out at 10%.

The total benefit to producers, in this simple illustration, is thus of the order of 10% of national income. Now, clearly a lot more work has to be done in order to flesh out this simple model. For example, one would wish to have a more detailed model of production, with a primary commodities sector and a manufacturing sector. The model developed by Newbery and Stiglitz in Chapter 25 may provide a useful start. But the fact remains that until much more work is done on the macro aspects of stabilisation schemes their value cannot be so easily dismissed. In any case, the sorts of factors identified by Brandt (1981) and by Singh (1983) need to be modelled carefully in order to provide a more complete analysis of the benefits of stabilisation schemes.

A similar argument can be made on the consumer side of commodity price stabilisation schemes. Newbery and Stiglitz have provided us with estimates of the micro benefits of stabilisation. However, Kaldor (1976) has put forward a set of macro arguments for stabilisation schemes. Newbery and Stiglitz attempt to model these in Chapter 28 and conclude (without the explicit cost-benfit analysis they used in their micro analysis) that these arguments are not persuasive. However, it is argued in Kanbur and Vines (1983) that the Newbery-Stiglitz model does not capture the spirit of Kaldor's arguments appropriately, and that a model which does bring in explicitly

the sectoral structure and assumptions of Kaldor can indeed serve to illustrate the large benefits that are possible from stabilisation schemes. Behrman (1979) has also pointed to the role of stabilization schemes in easing inflation in consuming countries. These macro arguments need to be treated more fully before a final conclusion can be reached on the efficacy of stabilization schemes. Perhaps Newbery and Stiglitz should themselves have the last word: "Our claim that the benefits of price stabilization have been overestimated by other writers is thus a claim that the quantified, i.e. microeconomic, benefits have been overestimated, not that total benefits have been."

6. Conclusion

In the Introduction to their book, Newbery and Stiglitz state that they have three different audiences in mind - "economic theorists, agricultural economists, and policy-makers." The conclusion of this review article is that the book is an absolute must for economic theorists and agricultural economists interested in the economics of risk. It represents a virtuoso performance in a particular type of theorising - the building of simple, elegant models to provide insight and to aid intuition. Of particular importance is the book's focus on market responses to price stabilization. However, as the authors themselves recognise, the book is primarily devoted to a microeconomic anaylsis of price stabilization - the macroeconomic issues are not treated at any great length. In particular, their estimates of the benefits of stabilization are exclusively microeconomic benefits and have little to say on the macroeconomic benefits. The policy maker should be warned, therefore, that this book is only one type of contribution to the debate on commodity price stabilization. It is not the last word on the subject, and since its empirical findings leave out of court many of the issues held by Keynes and his followers to be crucial to the argument, they cannot be used so easily to dismiss Keynes's call for International Commodity Control.

7. Appendix: A Reader's Guide to the Book

The thirty-one chapters of this book are divided into seven parts. Part I is the Introduction and Summary, and provides an extremely useful quick reference to the main findings of the book (Chapter 3) and to the analytical issues raised in the book (Chapter 2). The summary of findings chapter starts with the sentence quoted at the beginning of this paper. This bold conclusion is modified in later sections of the chapter, where the authors accept that the macro benefits from stabilization "could be significant."

Part II, "Fundamentals: Supply and Demand Risk" is an excellent exposition of various techniques used in the modern analysis of decision making under uncertainty, and could well form part of a teaching course on that topic. Chapter 6 on Supply with Risk Averse Farmers and Chapter 9, on Consumer Benefits of Price Stabilization, develop formulae which are used throughout the book, and will repay a careful working through for the economic theorist or the agricultural economist. Chapters 5 and 8 contain a brief introduction to duality techniques that are in common use in the modern public finance literature. Chapters 10 and 11 focus attention on rational expectations equilibrium, and provide the necessary background for subsequent use of this concept as a benchmark in comparative static analysis.

Chapters 12-16, which form Part III of the book, are replete with models of various aspects of market equilibrium: risk sharing (Chapter 12), future markets (Chapter 13), storage (Chapter 14) and information (Chapter 16). Chapter 15 focusses on the efficiency of market equilibrium under uncertainty, and represents a masterful exposition of concepts of efficiency as well as a detailed analysis of conditions under which efficiency does or does not obtain. Although the authors frequently draw out the implications of their analysis for policy makers, these chapters are primarily for the economic theorist.

The major interest of this book for the policy maker lies in Part IV "Price Stabilization with No Supply Response", in particular in Chapter 20, which presents explicit empirical estimates of the benefits of stabilization; these are considered in detail in the text of this review article, but the other chapters in this part also contain useful material. Chapter 19, in particular, considers the effects of existing distortions in trade on the arguments for stabilization. In contrast to most of the book, in this chapter the authors find "some support for the view that international price stabilization might reduce the degree of price distortion and hence generate additional welfare benefits". Chapters 17 and 18 contain an investigation designed to examine the robustness of the authors' formulae for the benefits of stabilization. The conclusion is that the specification of demand is important in determining the distributional impacts of stabilization, but not as important for the efficiency benefits of stabilization.

Part IV restricts itself to the case of no supply response. Part V advances the analysis by investigating the consequences of supply response. The arguments in Chapter 21, "The Simple Theory of Supply Response to Price Stabilization" have been reviewed in section 4 of this review article. Chapter 22 conducts a geometrical analysis but relaxes some of the restrictive assumptions adopted in Chapter 21. Chapters 23 and 24 are devoted to a discussion of trade aspects.

The 30 pages of Part VI constitute the sole discussion of macroeconomic aspects in this book. However, the four chapters of this part attempt, albeit briefly, to model formally some macro concerns expressed by supporters of buffer stock schemes. In doing so they develop frameworks which will prove useful for future work in this area. As argued in the text of this review article, such work is an absolute must before any final conclusions can be reached on the efficacy of commodity price stabilization

schemes.

Part VII of the book contains an extremely useful introduction to the discussion of optimal rules for the buffer stock authority. The discussion in Chapter 29 in fact provides the basis for the estimates of the costs of operating a buffer stock in Chapter 20 of the book. The Appendix to Chapter 30 contains a good exposition of how to approximate the optimal stock rule, and can be used for teaching purposes. Chapter 31, the Epilogue, concludes the book.

References

Behrman, J.R. (1979) "International Commodity Agreements: An Evaluation of the UNCTAD Integrated Commodity Programme." in W.R. Cline (ed.) Policy Alternatives for a New International Economic Order, Praeger.

Binswanger, H.P. (1978) "Attitudes towards Risk: Experimental Measurement Evidence in Rural India, "American Journal of Agricultural Economics.

Brandt, W. (1980) North-South: A Programme For Survival, Pan.

Hart, O.D. (1975) "On the Optimality of Equilibrium when the Market Structure is Incomplete," Journal of Economic Theory.

Johnson, H.G. (1976) "Commodities: Less Developed Countries' Demands and Developed Countries' Response" Mimeograph.

Kaldor, N. (1976) "Inflation and Recession in the World Economy," Economic Journal.

Kanbur, S.M.R. and Vines, D. (1983) "A Model of North-South Interaction," Mimeograph.

Keynes, J.M. (1942) "The International Regulation of Primary Products," Reprinted in J.M. Keynes Collected Works, Volume XXVII, Macmillan

Newbery, D.M.G. and Stiglitz, J.E. (1981) The Theory of Commodity Price Stabilization: A Study in the Economics of Risk, Oxford University Press.

Singh, A. (1983) "The Present Crisis of the Tanzanian Economy," Mimeograph.

Williamson, J. (1983) "Keynes and the International Economic Order," Paper presented to the Keynes Centenary Conference, King's College, Cambridge.