THE DISTRIBUTIONAL INCIDENCE OF COMMODITY PRICE STABILIZATION IN AN OPEN ECONOMY

Peter Gibbard and Rod Tyers

Department of Economics, The Faculties
Australian National University

ABSTRACT

The effects of commodity price stabilization are generally examined in the closed economy context with emphasis given to the role of stocks. In the open economy, unless considerable international market power is present, the degree to which domestic prices are stabilized is determined by trade policy. This paper employs a model which incorporates international market power, responsiveness of planned production to price risk and the separation of producer and consumer price policy instruments to examine the welfare incidence of market-insulating trade policies. The model is then illustrated using an application to Indonesian rice policy. When domestic agents are risk averse, some combinations of insulating policy instruments are net welfare improving, albeit to a small extent, and no agents appear to be significant net losers, suggesting that insulating policies are politically easy for governments to implement.

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The insulation of key domestic commodity markets from fluctuating prices abroad is common in both industrial and developing countries. The policies used to achieve this insulation are always distortionary, if to degrees which vary as border prices change. Superficially, at least, some inefficiency is therefore suggested. Our interest is in examining the welfare incidence of such insulation and thereby shedding light on the reasons why it is so readily implemented by governments.

Before proceeding further, it is important to distinguish between the respective roles of trade policy and stocks. Much of the literature on price stabilization has focussed on stocks, most often taking the closed economy as its point of reference (Newbery and Stiglitz 1981, Wright and Williams 1982 and 1984, Hinchy and Fisher 1988). Instead, if free trade is taken as the reference point, the active ingredient in open economies is trade policy. Then, where infrastructural costs are small, only in large countries are stocks useful in stabilizing domestic prices, and only via their effect on world price stability. Even in that case trade policy, by acting directly on domestic prices, is the more powerful instrument. The role of stocks in open economies is primarily to stabilize the current account (the net foreign exchange cost of trade in the commodity) and not, by itself, to maintain the stability of relative prices in the domestic economy. Our focus in this paper, then, is the open economy and its trade policy.

One way a government can use trade instruments to stablize domestic prices is to impose taxes on trade which are variable through time, such as the variable levies which have formed part of the European Common Agricultural Policy. Such a policy reduces tariffs when world prices are high and raises them when they are low. In staple food markets, however, most countries tend to achieve the same

effect by establishing trade monopolies which stabilize domestic prices by managing domestic supply through imports.[1]

This paper uses a partial equilibrium model to investigate the trade policy component of a stabilization policy. The approach has four main features. First, planned production is dependent on risk, consistent with the growing body of evidence that farmers, at least in developing countries, are averse to risk and that this affects both their attitude to price stabilization and their production decisions (see Binswanger 1982, Fraser 1986). Second, the prevalent "small country" assumption is relaxed. Third, the incomes of affected groups are seen as dependent on prices while their consumption depends on both prices and incomes. Finally, the analysis provides for separate policies affecting producer and consumer prices.[2] In estimating the benefits from stabilization, we have adapted the approach of Newbery and Stiglitz (1981). Their expression for producer benefits is modified to allow for endogenous supply of producers' labour and that for consumer benefits is extended to accommodate non-negligible expenditure shares.[3]

The approach is illustrated with an application to the rice market in Indonesia. Benefits and losses to all groups of agents from price stabilization are shown to be small relative to incomes. Nevertheless, when all groups are risk averse, price stabilization can be net welfare improving. Indeed, the gains from such stabilization accrue to both industrial capital owners (paying wages which are at least partially indexed to the rice price) and rural rice-producing households. Losses by other groups are insignificant compared to their incomes. Price stabilization therefore emerges as an "easy" policy for governments, although one which confers only minor benefits on the economy as a whole.

In Part I the model is introduced. Part II then develops expressions for the welfare of each group of agents. Part III presents the application to Indonesia and, finally, Part IV provides a summary of our main conclusions.

I THE MODEL

In order to focus on the effects of pure stabilization in a key domestic commodity market, we make the standard partial equilibrium assumptions: that the prices of other commodities and the exchange rate are exogenous (for simplicity of presentation, the exchange rate is set at unity throughout). Risk emanates from random disturbances to domestic production, and from disturbances to demand and supply in the rest of the world.

Government policy is specified as having two components: one fixed (a specific tariff or its equivalent), creating a wedge between mean domestic prices and the mean world price; and a variable component, ensuring only a fraction of any given fluctuation in the world price is transmitted to the domestic market. Hence the consumer and producer price transmission equations take the following form:

$$P_p = \bar{P} + f_p + \phi_p(P - \bar{P}) \tag{2}$$

$$P_c = \bar{P} + f_c + \phi_c(P - \bar{P}) \tag{3}$$

where the subscripts p and c signify variables relating to producers and consumers respectively; p denotes the domestic price; f is a specific tariff or subsidy and ϕ the rate of transmission of international price changes to domestic prices. Stabilization policy is therefore defined by the pair (ϕ_p, ϕ_c). If no stabilization is carried out, this vector has the values (1, 1). Total stabilization, on the other hand, is given by (0, 0).

Domestic Supply

Studies using the Newbery and Stiglitz approach to calculate the welfare incidence of price stabilization generally make the simplifying assumption that there is no supply response by producers (see, for example, Hinchy and Fisher 1988). The challenge is to formulate a model of production consistent with the growing body of evidence that, at least in developing countries, farmers are typically risk averse (see Binswanger 1982 and Antle 1987, 1989). Wright and Williams (1984), for example, retain the assumption that producers are risk-neutral. Our approach is to develop a linear expression for aggregate production by risk averse farmers. The approach builds on the work of Newbery and Stiglitz (1981) and Fraser (1986, 1988). The key analytical result from Fraser (1986) is modified for the case of additive risk, aggregated and linearised for incorporation in our simultaneous-equation, market-equilibrium model.

Producers are assumed identical and atomistic, each facing the same additive rick. The only input to production is the producer's own labour, ℓ.

Following Newbery and Stiglitz (1981), it is assumed the farmer's utility function is separable in income and leisure. This is justified by the fact that it is equivalent to assuming labour (or its product) and leisure are on the borderline between being complements and substitutes, and there is no clear empirical evidence either way. The marginal disutility of labour is assumed fixed at w.

Utility is thus given by: $U = U(y) - w\ell$. Input decisions are made at the beginning of the period, based on expectations of outcomes of random variables during the period. Farmers are assumed to have Muthian rational expectations. Grisley and Kellogg (1983) provide empirical evidence to support this assumption in the case of a developing country. By the von Neumann-Morgenstern expected utility hypothesis, farmers choose their labour allocation to solve the following problem:

$$\max_{\ell} \{E_p[U(p_p x)] - w\ell\}. \qquad (11)$$

II. THE DISTRIBUTIONAL IMPACT OF STABILIZATION

For the calculation of benefits from stabilization, we extend the approach developed by Newbery and Stiglitz (1981), principally to allow for risk averse production behaviour. At an elemental level, households whose money incomes are directly or indirectly affected by price stabilization (such as farmers and urban workers earning indexed wages, respectively) derive "producer benefits". These and other households also derive "consumer benefits" through the effects of price stability on the purchasing power of their money incomes.

(see Gibbard and Tyers 1990)

The foregoing analytical results allow us some preliminary conclusions as to which groups gain and lose from price stabilization through trade policy. Producer price stabilization yields positive producer benefits to the farmers of the focus commodity, but it destabilises the purchasing power of the rural sector. Mean government revenue from trade policy is adversely affected by producer price stabilization. As for the stabilization of the consumer price, urban workers whose wages are not indexed, and the rural sector, only gain if they are substantially risk averse. If, on the other hand, the wages of urban workers are fully indexed to the commodity price, then they lose, irrespective of their level of risk aversion, while industrial capital owners gain from greater income stability. Consumer price stabilization reduces the mean revenue of the government only if the country is a particularly large and inelastic consumer of the commodity. Other things equal, in countries where the demand elasticity is low (high), consumer price stabilization tends to cause government revenue to fall (rise), and the welfare of consumers to rise (fall).

It is obvious, however, that the welfare incidence of stabilization through trade policy depends on the size and behaviour of the particular commodity market. For this reason, we illustrate the model with an application to rice policy in Indonesia.

III. AN APPLICATION TO RICE POLICY IN INDONESIA

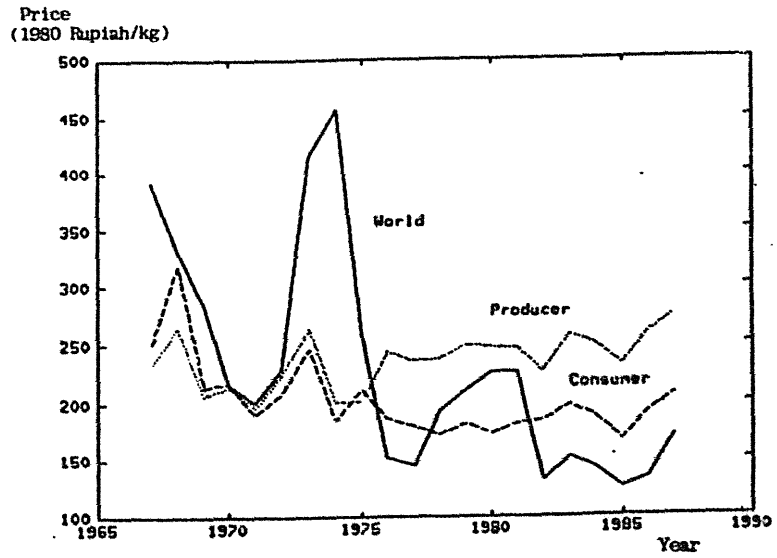
The National Logistics Agency of Indonesia (BULOG) is given exclusive rights to importation of rice for the purpose of maintaining acceptable and stable domestic prices (Amat, 1982). It is also empowered to procure and market rice domestically. That such policies have significantly reduced the fluctuations in domestic consumer and producer rice prices is clear from Figure 1. The coefficients of variation of producer price and the consumer price, as fractions of the coefficient of variation of the world price, are 0.20 and 0.35 respectively.

Traditionally Indonesia has been a major importer of rice. In the 1970's and early 1980's it was the world's largest importer. Despite the extraordinary growth in domestic rice production of the mid 1980's which took Indonesia to rough self-sufficiency, it has been argued that substantial imports are likely to re-emerge (Booth 1988, Chapter 7). The wages of urban workers are compensated, at least partially, for changes in the price of rice. This is mainly through the receipt of payments in kind by many workers, including those in the public service and the military (Amat, 1982). Table 1 displays our estimates of the model parameters for the Indonesian case. The coefficient of risk aversion for the rural sector, 1.2, is the approximate mode value from Binswanger's (1980) study of farmers in India. Values of the coefficient for other groups are assigned by considering their probable magnitude relative to the farmers' coefficient. The guide to assigning these values is the finding by Binswanger (1981, p. 878) that as wealth increases, the coefficient falls.

The distributional effects of a range of alternative price stabilization policies in Indonesia are summarised in Table 2. This includes the policy which maximises net national benefits as well as those which would be considered optimal by individual groups: rice farmers, rural consumers, urban workers, industrial capital owners and the government. In what follows we discuss the implications of stabilisation for each group in turn.

FIGURE 1

Real* Producer, Consumer, and Border Rice Prices in Indonesia



Source: Various issues of Indikator Ekonomi, International Financial Statistics.

TABLE 1

Parameters for the Application : Rice in Indonesia

	Group: Rural	Urban Workers	Industrial Capital Owners	Government
RP[†] Mean Income (1000 billion rupiah[††])	22.3	12.9	2.3	13.6
RP Mean Consumption (million metric ton)	20.4	6.0	-	-
Price Elasticity of Demand	-0.19	-0.11	-	-
Income Elasticity of Demand	0.34	0.14	-	-
Expenditure Share	18%	9%		
Coefficient of Risk Aversion	1.2	2	1	0.5

RP Mean World Price (rupiah per kg)	145	RP Standard Deviation of Producer Price (rupiah per kg)	21.4
RP Mean Producer Price (rupiah per kg)	255	RP Covariance between Producer Price and Domestic Production (billion rupiah)	-3.8
RP Mean Consumer Price (rupiah per kg)	191		
RP Mean Domestic Production (million metric ton)	26.19	Elasticity of Output to Labour Input	0.27
Standard Deviation of Production Disturbances (million metric ton)	1.17	RP Elasticity of Output to Mean Producer Price[†††]	-0.052
RP Mean Imports (million metric ton)	0.18	RP Elasticity of Output to Variance in Producer Price[†††]	$2.2x10^{-4}$
Standard Deviation of World Market Disturbances (rupiah per kg)	52.0	RP Elasticity of Output to Producer Price-Output Covariance[†††]	$-3.5x10^{-5}$
Coefficient of Excess Supply Function (β) (rupiah per kg^2)	20.2		

† RP stands for reference period: 1983 1987.

†† 1980 Rupiah.

††† Calculated using equations (16), (17), (18) and (19).

Source: The time series used to calculate mean values, variances, covariances and disturbance terms are from various issues of International Financial Statistics, Indikator Ekonomi, Bank of Indonesia Annual Report, FAO Trade Year Book, and from Survei Social Ekonomi Nasional (1984). Price and Income Elasticities of demand are from Dixon (1982) and Tabor, Altemeier and Adinegroho (1989). The elasticity of rice production to labour input is from Kalirajan and Flynn (1983). The coefficient of the excess supply function was calculated using the approach reported in Tyers and Anderson (1989). For further explanation, see Gibbard and Tyers (1990).

TABLE 2

Net Distributional Effects of Rice Stabilization in Indonesia[a]

	Group-Specific Optimal Policies				National Welfare Maximizing Policy (.25, .35)		
	Policy (ϕ_p, ϕ_c)	Benefit (1980 billion Rupiah)	Benefit as % of Group Income	Benefit as % of Group Expenditure on Rice	Benefit (1980 billion Rupiah)	Benefit as % of Group Income	Benefit as % of Group Expenditure on Rice
Producer Benefits to Rice Farmers	(.1, 1)	92.8	1.4	-	87.9	1.3	-
Consumer Benefits to Rural Sector	(1, 1)	0	0	0	-32.1	-0.1	-0.8
Rural Sector	(.25, 1)	61.0	0.3	1.6	55.8	0.25	1.4
Urban Workers (full indexation)	(1, 1)	0	0	0	-1.8	-0.01	-0.2
Urban Workers (no indexation)	(1, 0)	5.9	0.05	0.5	-[c]	-[c]	-[c]
Industrial Capital Owners (full indexation)	(1, 0)	13.5	0.6	-	7.8	0.3	-
Government	(1, .65)	7.3	0.05	-	-3.3	-0.02	-
Net Domestic Benefit	(.25, .35)	58.4	0.1[b]	1.2	58.4	0.1[b]	1.2

a These results have been derived using the model presented in the text and parameters from Table 1.
b This figure is taken as a percentage of national income.
c This figure is omitted because the national welfare maximising policy is derived assuming full indexation.

Rice producers benefit from producer price stabilization. Relative to free trade, complete stabilization of the producer price increases mean farm income by 0.3 per cent. Furthermore, any degree of producer price stabilization, relative to free trade, improves farm income stability. The link between natural production fluctuations and opposing fluctuations in the domestic market price, the strength of which depends on Indonesia's international market power, is not sufficiently strong to generate the destabilizing effects discussed in Part II(1). The link is sufficiently strong, however, to ensure that maximum income stability is achieved by a level of producer price stabilization less than total: by a ϕ_p of 0.1. The rice farmers in this application behave cautiously ($R = 1.2 > 1$) so they reduce their labour supply as income risk is reduced. Their benefit from doing so, however, is always dominated by the aforementioned gains in the mean and stability of farm income. Consumer price stabilization, on the other hand, has little impact on producer welfare, again because Indonesia's international market power is insufficient for domestic producer prices to be affected. Overall, producer benefits are maximized by a high degree of producer price stabilization. The benefit to rice producers from this policy is about 1.4 per cent of their base income.

For our purposes, a particularly important conclusion concerns the role of the supply response to price risk. Ignoring this response (as in most prior work) would have led to considerable inaccuracies in estimates of producer benefits. For example, the benefits from the optimal policy for rice farmers are overstated by 60 per cent if mean production is assumed constant.

The effects of price stabilization on rural consumers stem mainly from changes in the covariance between consumer price and rural income and in the variance of the consumer price. Consumers gain from a reduction in the variance of the consumer price only if they are highly risk averse relative to the elasticity of demand. In the Indonesian case, with $R = 1.2$ and low price elasticities of demand, the risk benefits are approximately offset by Waugh-Oi-Massell losses.

Thus, the welfare of rural consumers is roughly independent of the consumer price variance. It is, nevertheless, strongly influenced by the covariance between the consumer price and rural (rice) income. Were it implemented, total consumer price stabilization would, by weakening this covariance, cause a loss to rural consumers equal to 0.9 per cent of their expenditure on rice, or about 0.16 per cent of total rural income. But overall, producer gains dominate the rural interest in price stabilization. The rural sector as a whole receives its maximum benefit (equal to 0.3 per cent of base income) from partial producer price stabilization ($\phi_p = 0.25$, $\phi_c = 1$).

Turning to the urban sector, Indonesian urban workers have lower price and income elasticities of demand than rural dwellers (Dixon, 1982), and are assumed more risk averse. They are sufficiently risk averse relative to their elasticity of demand to ensure that, so long as their incomes are independent of the rice price, they gain from consumer price stabilization. These benefits are maximized if the policy is ($\phi_p = 1$, $\phi_c = 0$). This yields a gain of 0.5 per cent of their total expenditure on rice, or 0.05 per cent of their total incomes.[4] As we saw in Part II, however, if their wages are indexed to the rice price, urban workers tend to lose (the Waugh-Oi-Massell effect operates untrammelled), but to a smaller extent. At its largest, when consumer price stabilization is total, this loss is only 0.2 per cent of their rice expenditure or 0.02 per cent of their total income.

Where wages are indexed to the rice price, industrial capital owners gain from consumer price stabilization since it smooths income from capital. They are fairly indifferent to the level of producer price stabilization, as predicted in Part II. The best outcome for industrial capital owners is total stabilization of the consumer price, yielding a benefit of about 0.6 per cent of their income.

The impact of stabilization on government revenue also follows the analytical results of Part II. The expected net revenue position is adversely affected by producer price stabilization. But the effect of consumer price stabilization on mean government revenue depends upon the market power of the country relative to the elasticity of domestic demand. Indonesia has a fairly high level of market power but a low elasticity of demand. There is therefore a

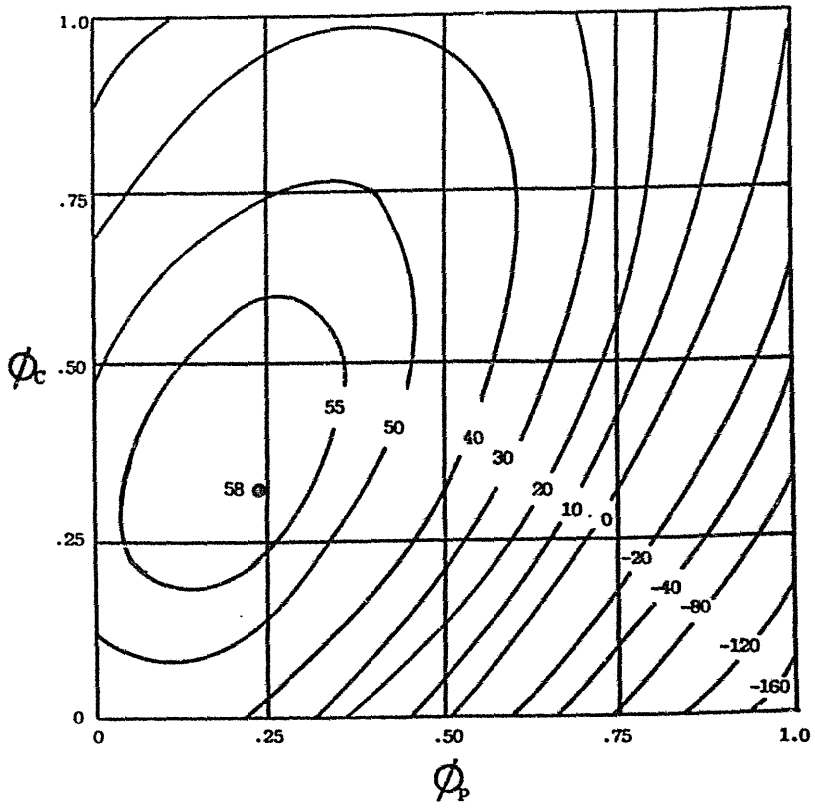
positive correlation between Indonesian imports and world prices. Thus, consumer price stabilization increases the mean revenue from selling the domestically procured rice to consumers, but it reduces the mean revenue from selling imported rice to consumers. The former effect dominates at low levels of stabilization, but the latter effect dominates at higher levels. The policy maximizing mean government revenue is ($\phi_p = 1$, $\phi_c = .4$), which increases mean government revenue by 0.09 per cent.

All price stabilizing policies destabilize Indonesian government revenue. Where producer and consumer policies are similar, the destabilizing effect is small: for all policies such that $|\phi_p - \phi_c| \leq 0.1$, the standard deviation in government revenue is increased by less than half. Widely divergent policies cause massive revenue instability, however. The policy (1, 0) increases the standard deviation in revenue twelvefold. In calculating the overall benefit to the government, the mean revenue effect tends to dominate the stability effect, except where producer and consumer price policies are very divergent. The worst outcome is that which generates maximum instability, (1, 0). The best outcome is similar to the policy which maximises mean revenue, (1, .65), and the benefit is 0.05 per cent of mean government revenue.

The net welfare effect on the economy as a whole is measured, for the case where urban wages are fully indexed to the rice price, as the sum of the benefits accruing to each group of agents. The net effects of various combinations of price stabilization are illustrated by the contour diagram in Figure 2. All stabilization policies result in positive net welfare benefits, except those involving a low degree of producer price stabilization and a high degree of consumer price stabilization. The losses in this region are mainly due to high instability in government revenue associated with such policies. Net welfare is maximized by the policy (.25, .35), which yields a net gain of about 0.1 per cent of national

FIGURE 2

Effect of Price Stabilization on Net National Welfare†



† The diagram depicts contours of constant net national benefit to Indonesia, over the range of feasible price stabilization schemes. Net national benefit is measured in billions of 1980 rupiah.

income. The welfare incidence of this policy is recorded in Table 2. Producer benefits to the rural sector are the largest component of this gain. These are somewhat mitigated by losses to the rural sector as consumers, but overall the rural sector would be the major beneficiary of such a price stabilization scheme. Assuming wages are fully indexed, industrial capital owners receive a small but significant gain from this policy. Urban workers lose, but this loss is trivial relative to the net national benefit and to their incomes. In reality, the loss is smaller than this, as the indexation of wages to the price of rice in Indonesia is less than total.

IV. CONCLUSION

This paper introduces a model for the analysis of commodity price stabilization through trade and domestic pricing policies. The three main features which distinguish the model are found to significantly affect the results obtained. International market power is important not so much because it allows the mean price to vary, but because it captures the effect of domestic schemes on the variance of the world price and the covariance between the world price and domestic production. Incorporating the response of planned production to price risk greatly alters estimated producer benefits from stabilization. And, finally, in assessing price stabilization policies, it is important to distinguish between consumer and producer price stabilization, since any divergence between them has widely different welfare impacts depending on its direction.

Possible analytical improvements in subsequent applications of the model include the relaxation of some of the restrictive assumptions. This might, for example, allow for multiple crops and inputs, a variable disutility from labour, a non-separable utility function, and a variable coefficient of risk aversion. Finally,

some empirical testing of how well the model represents the behaviour of Indonesian agents would be necessary to transform what is presently an illustration into a strict analysis of Indonesian policy.

The illustrative application to Indonesia is nevertheless informative. It suggests that commodity price stabilization schemes which rely on trade and price policy alone may be justified on the grounds of national welfare. Ignoring administrative and infrastructural costs, net welfare gains result from stabilization policies, excepting only those combining a high level of consumer price stabilization and a low level of producer price stabilization. But the net benefits are small, amounting to, at most, about 0.1 per cent of national income. This seeming triviality notwithstanding, none of the groups in Indonesia can be expected to apply pressure on the government to prevent the realization of that benefit: the rural sector and industrial capital owners both gain significantly; and the effect on urban workers (at least those whose wages are partially or fully indexed to the rice price) is insignificant. Hence, while the net domestic benefit to Indonesia is small, the government is able to intervene to stabilize the domestic price of rice because it can truthfully claim net national benefits and because there are no opposing vested interests. The implementation of commodity price stabilization schemes might therefore be seen as reflecting the national interest rather than differential political pressure. Whether this is true in fact depends on a comparison of the net national benefits with the administrative and other costs of the state trading institutions which carry out stabilization policies.

FOOTNOTES

1 For example, the National Logistics Agency of Indonesia, India's Food Corporation, and Malaysia's National Paddy and Rice Authority.

2 Inspection of a sample of estimates of elasticities of transmission of international price changes to domestic prices (Tyers and Anderson 1989), reveals many cases of significant differences between the elasticities of transmission for consumer and producer prices - particularly for coarse grain, rice and livestock products.

3 Zwart and Blandford (1989) use a simpler model (it recognizes neither the feedback effect between income and consumption, nor the producers' aversion to risk) to analyze the effect of domestic price stabilization by trade policy on stability in the world market, and how this feeds back into the domestic economy. However they stop short of determining the distributional impact of such a policy. Tyers and Anderson (forthcoming) use a simple model of a small open economy to obtain expressions for benefits to various groups. That analysis embodies some sensitive assumptions, however. These we relax in this paper.

4 The smallness of these effects can partly be explained by the low elasticities of demand - ensuring a weak Waugh-Oi-Massell effect. On the other hand, the results are consistent with other studies finding weak effects on consumers (see Newbery and Stiglitz, 1981, p. 297).

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