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COMMODITY PRICE STABILIZATION IN A PEASANT ECONOMY

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Introduction

Considerable effort has been devoted by economists to studying the welfare effects associated with various mechanisms of consumption smoothing in less developed countries (LDCs). Essential to this effort is a thorough understanding of the cost and benefits induced by commodity price stabilization. Important insights are provided by the extensive literature on the benefits of price stabilization to consumers and producers. [1]

LDCs are, by definition, agrarian economies in which a large share of national product is produced in the agricultural sector, which employs the majority of the workforce. The agricultural sector is likely to be characterized, in large part, by peasant farming. Previous studies of price stabilization have not considered a unique characteristic of peasant farming—farm households are likely to consume a significant portion of the farm product they produce. [2].

This paper considers the effects of various price stabilization schemes on peasant households, examining a neglected aspect of stabilization in this context. Stabilization of the price of a commodity grown by peasant households has effects on both income (through production) and on consumption. The fact that these two effects happen to the same individuals or households requires a different analysis than those in Waugh, Oi, or Massell and the many studies that have followed. The model below thus combines features from price stabilization studies such as Newbery and Stiglitz or Turnovsky, Shalit, and Schmitz with the marketed-surplus literature. Three stabilization

[1] A partial listing includes Waugh; Oi; Massell; Newbery and Stiglitz; Turnovsky, Shalit, and Schmitz; Helms; Choi and Johnson; Wright and Williams.

[2] For analyses of the marketed surplus producer, see Haessel; Renkow; Toquero, Duff, Anden-Lacsina, and Hayami; Herath, Hardaker, and Anderson; Finkelshtain and Chalfant; Ravallion; and Fafchamps.

mechanisms are contrasted: price stabilization for consumers alone (section 5), producers alone (section 4), or both (section 3). Section 2 presents the model and section 6 concludes.

The Objective Function of a Peasant Agricultural Household

The model of the household is the same as that of Finkelshtain and Chalfant and describes the behavior of a peasant farm household facing uncertainty about its income (due to uncertainty about the price of output) and also price instability in consumption (through on-farm consumption of some quantity of the agricultural output). The household is assumed to derive utility from the consumption of a market-produced good (z), some quantity of the farm-produced good (m), and the consumption of leisure (l). Using the notion of full income, its total income (y) consists of initial wealth, the value of its time endowment Tw, and farm profits. Thus, the household's utility function is $U(z, m, l)$, and it is assumed to maximize $E[U(z, m, l)]$—subject to the full income constraint—by choice of the level of agricultural output (x) and the allocation of time between market work and leisure. As in Finkelshtain and Chalfant, these choices are assumed to be made in a planning period, prior to knowledge of prices, while consumption is decided *ex post*, once prices have been revealed. The household thus possesses flexibility concerning the uncertainty about prices in its consumption decisions, but not in its output decisions, resembling instead the competitive producer from Sandmo. [3]

It is convenient to characterize the household's decisions using the dual problem of maximizing the expected value of its variable indirect utility function $V(y, l, p)$. [4] Following Epstein,

[3]To be more precise about the nature of the enterprise we consider, the household faces the typical problem of the competitive firm under price uncertainty—utility depends on profits which are random—except for the fact that another argument of the utility function is also random. In this case, it is the relative price of output, since the producer's income at harvest is used to support the consumption of a market-produced good with a fixed price and some quantity of the farm-produced good.

[4]Leisure appears as an argument of the indirect utility function if it is chosen *ex ante*. Without adopting a dynamic

Finkelshtain and Chalfant described the process by which the household's *ex post* decisions can be substituted into the utility function, analogous to the usual method for obtaining the consumer's indirect utility function defined on income and prices. With only two commodities, and the price of the market good serving as numeraire, only p, the price of the agricultural output, is included. This, however, makes the household's decision problem one of multivariate risk—in contrast to the more familiar problem of choosing a level of output to maximize $E[V(y)]$—since one random variable p affects more than one argument of the objective function. Finkelshtain and Chalfant introduced a risk premium appropriate for measuring attitudes toward such risks.

Some Necessary Caveats

The classic case of price stabilization considered in the economics literature presumes complete stabilization of some price at its arithmetic mean. An "ideal" fixed level of price to which an unstable price regime should be compared is an equilibrium level of price, which is necessarily specific to conditions that vary with the product and the particular economy in question, and hence one that is not applicable in a theoretical study. Therefore, the approach taken in this paper is to choose the arithmetic mean as a convenient base point for comparisons, allowing identification of the various parameters that are important in assessing the benefits from stabilization at any price level. This is not to say, however, that a feasible stabilization method, such as a buffer stock scheme,

model throughout the cropping period, one has to decide whether leisure is an *ex ante* or an *ex post* good. Neither choice is of much importance for our results. Leisure and any other pre-committed consumption good merely affect the level of precommitted expenditures, prior to the realization of crop prices. If leisure is instead chosen *ex post*, the opportunity cost of leisure will enter the variable indirect utility function but no choices concerning the allocation of time need be made until that opportunity cost is realized. Leisure then operates in this model as does the market-purchased good; if its opportunity cost is non-random there is no effect, while if it is uncertain, then the analysis becomes one of several random prices. Disaggregating the market-produced good into a vector of commodities is trivial when there is no relative price risk. The introduction of relative price risks would affect the measures we suggest below, but they can still be related to the parameters describing the agent's preferences and to the covariances of relative prices and the price being stabilized. See Finkelshtain and Chalfant for a discussion.

would imply stabilization of the random price at its mean. We do not consider whether a particular stabilization scheme is feasible, by practical means such as a buffer stock. The paper instead emphasizes a compensating variation measure of the welfare change for an *individual household* that is due to price stabilization. Whatever price turned out to be feasible in an application, the relevant parameters affecting this measure would be those described below.

Our analysis excludes, for the most part, the random nature of output. In order to concentrate on the various parameters that affect the willingness to pay for price stabilization, and for the sake of comparability of our results to those of previous studies of price stabilization, we assume that output is non-stochastic. While this is obviously an unrealistic assumption, it would not substantially affect the main qualitative result of the paper. When the agent is both a consumer and a producer, the neglected interaction between price risk affecting consumption and income risk remains important, regardless of assumptions about the randomness of output. Also, the interpretations of the welfare measures and the important parameters on which they depend are unaffected. [5]

A final caveat concerns *ex ante* decisions. Most agents engage in *ex ante* decisions that have to be made prior to the realization of prices. In the current context, the labor-leisure choice and the level of output chosen by the agricultural household are two such examples. One of the consequences of price stabilization that should be taken into account in the analysis is the possible adjustment of such decisions, *i.e.*, the supply response that is induced by the price stabilization.

[5] The main problem that we see with adding supply risk is that particular comparative static effects concerning output risk presumably depend on how that risk is modeled. Does the producer have a purely additive risk, a multiplicative one, or a heteroscedastic one such as Just and Pope suggested? Or, is there skewness, as emphasized by Antle? Such considerations are essential, of course, to give an accurate assessment of the realized market effects of any stabilization scheme. However, they are less important for emphasizing the interaction effect between income and consumption price risks and for comparisons between various stabilization schemes and the measures of benefits. In any event, once the appropriate specification for output risk is chosen, it could be incorporated in a straightforward manner.

This issue seems to be ignored in literature and certainly deserves more research, although it is beyond the scope of this paper. However, it should be emphasized that any value that is put on the benefits from stabilization that ignores this effect should be viewed as a lower bound on the total benefits, which include the additional gain from the optimal adjustment of decisions.

Benefits from Complete Price Stabilization

The most commonly used measure of benefits from stabilization, and the one that will be used below, is *ex ante* compensating variation (CV). This measure is exact, in the sense that its sign always agrees with that of the change in expected utility that results from price stabilization. Assessing the benefits associated with complete stabilization of p at $\overline{p}$ in the peasant economy, such a measure is defined by

$$E[V(l,\, y,\, p)] = V(l, y(\overline{p}) - CV, \overline{p}).$$

CV is the maximum that the peasant is willing to pay to avoid randomness in y and p in favor of a stable price $\overline{p}$ and income $y(\overline{p})$. Unlike the traditional Arrow-Pratt risk premium (measuring the benefits of stabilizing income), or the traditional CV measure of the benefits of price stabilization considered in the literature (where income is already assumed to be fixed), this measure involves the stabilization of more than one random argument in the utility function. [6] As a result, its sign could be positive or negative for a risk-averse producer (*e.g.* Finkelshtain and Chalfant). The main question of interest concerns the behavioral parameters affecting the magnitude and sign of CV. Moreover, is it possible to identify a class of preferences for which the sign of CV is independent of the specific distribution of p?

[6] Newbery and Stiglitz defined a similar measure in the presence of both random prices and income. They decomposed the benefits associated with the stabilization schemes captured by CV to efficiency and transfer benefits, but they did not examine the specific case of the marketed surplus producer.

Using Jensen's inequality, $CV \geq 0$ for all risks if and only if the variable indirect utility function is concave in p. By the assumption that V is second-order continuously differentiable, this is equivalent to

$$V_{yy}\, x^2 \;+\; 2V_{yp}\, x \;+\; V_{pp} \;\leq\; 0,$$

where subscripts denote partial derivatives of V. Analysis of price stabilization for producers involves V_{yy} alone, while analysis of stabilization for consumers involves only V_{pp}. Neither analysis would need to consider terms like V_{py} unless risks in income and those affecting prices were explicitly recognized to be correlated. Studies of price stabilization in developed economies, perhaps, could safely ignore that correlation. All three of these effects are necessarily present, however, when the same individual or household is both producer and consumer of the good in question.

It is straightforward to convert the condition for $CV \geq 0$ into one involving more familiar parameters. First, divide both sides of the inequality by $V_y \cdot x$ and multiply by $-p$, to obtain

$$-\frac{y}{y}\frac{V_{yy}}{V_y} \cdot x\,p \;-\; 2\,\frac{V_{yp}}{V_y} \cdot p \;-\; \frac{p\,V_{pp}}{V_y \cdot x} \;\geq\; 0.$$

Let r denote the coefficient of relative risk aversion, β the share of the random income in total wealth (px/y), and ρ the percentage of marketed surplus out of total output (*i.e.* $\rho = (x - m)/x$). Denote by s the budget share of the marketed-surplus good, and by η the income elasticity, and, finally, let ϵ be the Marshallian price elasticity of the household's demand for the marketed surplus good. We now make use of expressions easily derived from Roy's Identity for V_{yp} and V_{pp} (*e.g.*

Turnovsky, Shalit, and Schmitz (p. 143) or Newbery and Stiglitz (p. 117)):

$$V_{yp} = m\frac{V_y}{y} \cdot (r - \eta)$$

and

$$V_{pp} = m\frac{V_y}{p} \cdot [s(\eta - r) - \epsilon].$$

The inequality above can thus be simplified to yield

$$r\beta + 2\frac{pm}{y} \cdot (\eta - r) - \frac{m}{x}[s(\eta - r) - \epsilon] \geq 0$$

or

$$r \cdot \beta + 2\,s(\eta - r) - \frac{m}{x}s(\eta - r) + \frac{m}{x}\epsilon \geq 0.$$

The first term is from V_{yy}, the next one from V_{yp}, and the last two are from V_{pp}. The middle terms may be combined and expressed in terms of ρ. Thus

$$r \cdot \beta + s(1 + \rho)(\eta - r) + (1 - \rho)\epsilon \geq 0$$

is the necessary and sufficient condition for a positive CV (for any price distribution), *i.e.* positive benefits from complete stabilization. It can be shown that the above expression is proportional to the CV expressed as a percentage of expected revenues from agricultural production.

Some Special Cases

Some intuition about the expression above is achieved from some special cases. The first one of importance is when m, the amount of the crop consumed at home, is zero, so that $s = 0$ and $\rho = 1$, which means that the producer does not consume any of the farm product. Then the producer experiences only the pure income effect of the price risk, and the expression for a positive CV

reduces to the first term. Stabilization is preferred by a risk averse peasant not consuming from output, just as is true of any other risk averse producer (with no *ex post* flexibility in production choices).

A second case of interest is when a household does not produce any of the food crop ($\beta = 0$). In this case, the household behaves as a pure consumer and the above expression reduces to the one in Turnovsky, Shalit, and Schmitz. Consumer preference for either stabilization or instability depends on the relative magnitudes of the consumer's measure of relative risk aversion and price and income elasticities.

A third special case shows what is required to consider the above two effects separately. Only in this case will the interaction between income and price not affect the benefits from price stabilization. For this case, we require the notion of Frischian demand—the consumer's compensated demand schedule, when the marginal utility of income, rather than the utility level itself, is held constant. This notion will also be used below to provide additional insights when we turn to the quantitative discussion. Besley defines the income elasticity of the Frischian demand function for m as $\mu = \eta/r$. He showed that the elasticity of expenditures needed to keep the marginal utility of income constant with respect to p is given by

$$\frac{\partial log\, \Phi(p, \kappa)}{\partial log\, p} = s(1 - \mu),$$

where Φ is the consumer's "profit function", measuring the cost of maintaining a particular level of marginal utility of income with a change in the price p, and κ is the reciprocal of the marginal utility of income. Besley termed goods with $\mu > 1$ luxuries and those with $\mu < 1$ necessities. As can be seen from the above expression, then, the larger is μ, the less the change in expenditures required to compensate the consumer in the case of a price rise in order to keep the marginal utility of income constant. When $\mu = 1$, no change in expenditures is required. For $\mu > 1$, the necessary level of expenditures decreases. [7]

Thus, the role of the middle term in the equation for CV (*i.e.* the term involving $(\eta - r)$) is now better understood. It represents the effect of consumption price instability on the agent's marginal utility of income. When $\mu = 1$, this effect disappears (since $\eta = r$) and price instability affects the consumer only through income and the price elasticity (the first and third terms). The more risk averse is the peasant, the more desirable is stability (the first term), while the more elastic is the demand for the commodity, the more desirable is instability (the third term). It is only in this special case that the middle term is identically zero and the interaction effect between income and the consumption price vanishes. Thus, only when $\mu = 1$, so that the good m is neither a necessity nor a luxury in the Frischian sense, can one ignore the interaction effect and analyze separately the attitudes toward stabilization in the separate consumption and production roles of the peasant household.

Signing CV For Typical Parameter Estimates

It is interesting to examine the sign of CV for typical parameter values. Typical estimates are found in Turnovsky, Shalit, and Schmitz and in Ahmed and Bernard: $\epsilon = -0.2, \eta = 0.6, r = 1$, $s = 0.3$. Assuming that β is 1, we find that for values of $\rho \geq -8.5$, a stabilized price is preferred. While ρ may be negative, implying that the farm is a deficit farm, in the vast majority of households ρ is above -4. Moreover, note that $\rho = 1 - (s/\beta)$; with $\beta = 1$ this implies that $\rho = 1 - s$ and

[7] As Besley (p. 846) notes, "...luxuries are goods, an increase in the price of which raises an agent's marginal utility of income, while necessities are those goods for which a price increase lowers an agent's marginal utility of income."

$\rho \geq 0$, thus guaranteeing that the household gains from stabilization. If we keep the assumption that $s = .3$ and allow β to vary, we find that only if more than 68% of household income is from nonfarming sources will price instability be preferred.

Thus we can conclude that, unlike Waugh's proposition or the results of Turnovsky, Shalit, and Schmitz regarding typical consumers, for typical peasant households, complete price stabilization is the preferred alternative. Moreover, recalling that the above CV does not take into account the additional benefits that may be yielded by altering the output and leisure choices, that outcome seems even more likely.

Qualitative Propositions

For derivation of a qualitative proposition concerning the sign of CV, the condition that guarantees $CV \geq 0$ can be rewritten in terms of the Hicksian demand elasticity ϵ^c as

$$r \cdot \beta + s(1 + \rho)(\eta - r) + (1 - \rho)(\epsilon^c - s\eta) \geq 0$$

or

$$r\beta\rho^2 + 2s\rho\eta + (1 - \rho)\epsilon^c \geq 0.$$

The second inequality results from rearranging terms. Proposition 1 then follows, characterizing a necessary condition for the household to gain and a sufficient condition for the household to lose from price stabilization.

Proposition 1: The following (equivalent) conditions are sufficient (necessary) for the peasant to lose (gain) from complete stabilization of p:

$$(i)\ r\beta\rho^2 + 2s\rho\eta \leq (>)\ 0$$

$$(ii)\ \rho[2s\eta + \rho\beta r] \ \leq\ (>)\ 0$$

$$(iii)\ \rho[2\eta(1-\rho) + \rho r] \ \leq\ (>)\ 0$$

Proof: Since $\rho \leq 1$, $(1-\rho)\epsilon^c < 0$ is guaranteed, and the peasant can only gain from price stabilization if the sum of the first two terms is positive. A sufficient condition for a loss from stabilization is then that this sum is negative. These observations yield (i) and (ii) above. (iii) follows upon substituting $s = \beta(1-\rho)$ into (ii), and factoring β from both terms. □

If the marketed surplus is negative, *i.e.* the farm is a deficit one and the household is a net buyer of its output, the above proposition agrees *qualitatively* with Propositions 1 and 2 of Turnovsky, Shalit, and Schmitz. In particular, if $\rho < 0$ and m is a normal good, then an alternative sufficient (necessary) condition is

$$2\eta - r \geq (<)\, 0,$$

which coincides with Propositions 1 and 2 of Turnovsky, Shalit, and Schmitz. [8] However, if the household is a net seller of its output ($\rho > 0$), then the current results differ significantly from their findings. The sufficient condition for a risk averse peasant to lose from stabilization of p can be satisfied only if the good is inferior, while if the good is normal, the necessary condition for $CV \geq 0$ is then trivially satisfied.

A Measure of Aversion to Absolute Price Risk

To gain additional intuition, it is useful to express the CV using a second order Taylor approxima-

[8] A stronger necessary condition is actually obtained; $2\eta - r$ must be less than -2η, but the condition above more closely resembles the expression from Turnovsky et al.

tion, which yields

$$CV = -\frac{1}{2} \cdot \sigma_{pp} \cdot \left[\frac{d^2V \,/\, d^2p}{dV \,/\, dy}\right] = -\sigma_{pp} \cdot \left[\frac{1}{2}\frac{V_{yy}}{V_y}x^2 + \frac{V_{yp}}{V_y}x + \frac{1}{2}\frac{V_{pp}}{V_y}\right],$$

where σ_{pp} denotes the variance of p, or

$$PCV = \frac{1}{2} \cdot {\psi_p}^2 \; [r \cdot \beta + s(1 + \rho)(\eta - r) + (1 - \rho)\epsilon] \,,$$

where ψ_p denotes the coefficient of variation of p, after expressing the willingness to pay for stabilization as a percentage of expected revenues from the risky crop. Turnovsky et al. proposed the measure $\sigma = V_{pp} \,/\, V_p$ as a natural measure of relative risk aversion with respect to price risk. Shalit showed that this measure is suitable when the consumer pays the premium in terms of an increase in the expected price. The usual measures of benefits from stabilization as CV and EV, however, assess the benefits from stabilization in terms of the amount of *income* that the consumer is willing to pay to eliminate the price risk. For such measures, the above approximation reveals that an appropriate measure is instead the quantity λ, given by

$$\lambda = -\frac{d^2V \,/\, d^2p}{dV \,/\, dy}.$$

Intuitively, it is λ, rather than σ, that is appropriate, since the former is proportional to the benefits from stabilization per unit of price variation. [9] Formally, assuming a positive marginal utility of income and that λ is uniformly signed (*i.e.* has the same sign for all levels of l, y, p), Jensen's

[9]Alternatively, one might wish to normalize the second derivative as we did earlier, obtaining a risk premium measure as a percentage of the expected value of the risky income that would be foregone in exchange for price stabilization, in which case one would define as the measure of aversion to income risk

$$\lambda' = r \cdot \beta + s(1 + \rho)r(\mu - 1) + (1 - \rho)\epsilon.$$

inequality then implies that the sign of CV is identical to the sign of λ, even for large risks. Turnovsky et al. were correct with their comment regarding σ, that "[i]t must nevertheless be interpreted with some caution". This is because the sign of dV/dp is ambiguous in models where income is affected by the price, as in the current model. The new measure λ, however, is immune to this weakness.

Moreover, from Diamond and Stiglitz (Theorem 3) it follows that any parameter that increases λ will also increase the risk premium its owner will pay for price stabilization. This intuitive proposition is completely analogous to regular relationships between the Pratt risk premium for income stabilization and the Arrow-Pratt measure of absolute risk aversion. Instead of measuring the concavity of the utility function with respect to income, as in the Arrow-Pratt case, here the concavity is measured with respect to p. Either the above argument or the approximate expression derived for CV facilitate the following proposition.

Proposition 2: The benefits from price stabilization are increasing in the measure of relative risk aversion and increasing in the share of risky income in total wealth (holding ρ constant). The benefits from stabilization decrease with increases in the absolute value of the price elasticity. If the household has a positive (negative) marketed surplus, then the benefits from stabilization are increasing (decreasing) in the income elasticity. Similarly, for a given value of r, an increase in μ is the same as an increase in η, so the benefits from stabilization are increasing in μ if $\rho > 0$ and decreasing in μ if $\rho < 0$. Finally, the change in CV from an increase in the marketed surplus ρ can be shown to be of the same sign as the second derivative V_{pp} (which is likely to be positive).

The results are intuitively appealing. A larger price elasticity means that the peasant, playing the consumer role, enjoys more benefits from instability, since substitution possibilities are greater. The opposite is true if a larger portion of the peasant's income is exposed to risk or if he is more risk averse; therefore, the benefits from stabilization are increasing in both the measure of relative risk aversion r and the share of the farm revenue in total wealth.

The rest of the above results are best understood by invoking once more the notion of the Frischian demand. The derivative of CV with respect to ρ turns out to be

$$s(\eta - r) - \epsilon = sr(\mu - 1) - \epsilon$$

which has the same sign as V_{pp}. If ϵ is negative, the derivative is positive unless the first term is negative by enough that it offsets $-\epsilon$. If $\eta > r$, this derivative is unambiguously positive—an increase in the marketed surplus thus leads to an increase in the willingness to pay for price stabilization. The only way to obtain a negative relationship between CV and ρ, as long as $\epsilon < 0$, is to have $\mu < 1$ (*i.e.* $\eta < r$) by enough to offset the effect of ϵ.[10] Rearranging terms, this requires that

$$(\mu - 1) < \epsilon - sr$$

or

$$\mu < 1 + \epsilon - sr.$$

[10]As did Turnovsky, Shalit, and Schmitz, the above condition can be stated in terms of the compensated elasticity ϵ^c to account for the possibility of a Giffen good. Then CV increases with increases in ρ if

$$s(\eta - r) - (\epsilon^c - s\eta) < 0,$$

which is equivalent to

$$2\eta - r < \frac{\epsilon^c}{s}.$$

To see why μ affects the willingness to pay for stabilization, recall that, in the pure production case, the reason for a positive risk premium is that when p increases, the marginal utility of income falls for a concave utility function defined on income, and when p decreases, the marginal utility of income rises. Stabilizing price, then, by Jensen's inequality, increases average or expected utility.

As can be seen from the expression from Besley for $\frac{\partial log\Phi}{\partial log p}$ given earlier, the quantity $1-\mu$ indicates how sensitive is the individual's marginal utility of income to price changes. These changes are due to the consumption effects of the price change, *i.e.* holding money income constant. Thus, when $\mu > 1$, an increase in p leads to an *increase* in the marginal utility of income, working to offset the direct effect of the price change on the marginal utility of income. Similarly, a decrease in p causes the marginal utility of income to fall.

These effects tend to reduce the amount the peasant is willing to pay to stabilize p, because there is a compensating effect on the consumption side to offset changes in the marginal utility of income that occur because of changes in income. The size of these effects depends, of course, on the importance of consumption of the good. If m, and therefore ρ, decrease, the consumption effect is less important and the peasant behaves more as a pure producer, thus tending to be willing to pay more to stabilize price.

When $\mu = 1$, as noted earlier, there is no effect of price changes on the marginal utility of income (*i.e.* $V_{py} = 0$). When $\mu < 1$, the direction of changes is reversed, and the consumption effect of changes in p tend to reinforce the income effect. When p increases, for instance, not only does the marginal utility of income decrease due to the income effect, there is the added decrease from the consumption side, resulting from the good in question being a necessity in the Frischian sense. In this case, the willingness to pay to stabilize income risk would be increased; as a result, a reduction in m leading to an increase in ρ reduces this effect. If μ is sufficiently less than 1 to offset the effect of ρ through ϵ, the net effect could be an increase in CV, thus explaining why $\mu < 1$ is necessary for an inverse relationship between CV and ρ.

A Comparison with Traditional Measures

The value of the CV measure for complete stabilization depends on the particular price risk and on familiar parameters describing preferences. Traditionally, stabilization studies have examined the value of stabilization of income to producers, or of prices to consumers (*e.g.* Shalit), ignoring the possibility that the same agents experience both effects. The term V_{yp} in our expression for the CV captures the effect of this interaction. There is no such effect only when the income elasticity of demand η equals the coefficient of relative risk aversion r, corresponding to μ equal one. Thus, it seems worthwhile to compare the traditional measures to the current one.

The plots in Figure 1 show the effects of various parameters on the benefits to a peasant household from price stabilization and also illustrate the outcomes of ignoring the interaction effect that stabilization eliminates. As described earlier, we express the CV as a percentage of expected revenues from production px. For each case, we show the value of the approximated PCV measure we defined (the unbroken line) and the sum of the pure income term (from V_{yy}) and the pure price term (from V_{pp}), which is the broken line. The latter sum represents the benefits from price stabilization assessed with the traditional method separating consumers and producers. The figures show, for particular values of r, s, β, and the coefficient of variation of price, how the two PCV measures vary with the income elasticity η. Thus, the two lines cross in every case where r

and η are equal (*i.e.* $\mu = 1$ and the two measures are identical).

The first plot shows that the CV measure we defined is smaller, the smaller is the income elasticity. If η exceeds one, however, our measure of benefits is larger than the sum of pure price and pure income benefits of stabilization; in short, the interaction effect has a sign that depends on μ. The second plot shows how this situation can be reversed by a large enough negative value for ρ, which decreases from around .87 in the first plot (*i.e.* a significant marketed surplus) to -3 in the second (corresponding to a deficit producer).

In the third plot, ρ equals -1 (since s is twice as large as β) and the income elasticity thus has no effect on our measure, while the sum of the pure price and income effects does involve η. That parameter does enter V_{pp} as well as V_{py}, so failure to account for both effects leads to this result. The final two plots show the effects of increasing either the coefficient of variation of price or the coefficient of relative risk risk aversion. In each case, the willingness to pay for price stabilization is increased relative to the first diagram.

Benefits from Price Stabilization in the Production Sector

While complete price stabilization can perhaps be achieved by storage in a buffer stock, or by smoothing commodity price shocks using international markets, other stabilization schemes stabilize commodity prices for only a subset of sectors in the economy. Suppose the government is considering the establishment of a support price (stabilization) policy scheme, where there is to be a pre-announced price at which the output of all participating farmers would be purchased, while it will sell to consumers at the prevailing stochastic market price. Alternatively, suppose that producers are offered the opportunity to forward contract all of their output at an unbiased futures price and then decide consumption choices based on the realization of p. What are the consequences of such stabilization schemes and under what conditions are such schemes desirable?

The above stabilization schemes imply that the price of the output x is being stabilized independently of the price of the consumption good m. To put it in other words, the stabilization applies to the production sector only, while in the consumption sector the price remains random. If profits are random *only* due to demand risk (as assumed—incorporating yield risk (e.g. Roe and Graham-Tomasi) would be more realistic, but would not change the main point above, that one must consider the correlation of income and a consumption price in analyzing price stabilization in the marketed surplus case), such schemes provide complete income insurance, while the price from the point of view of consumption remains unstable. The appropriate measure of the willingness to pay for such stabilization was defined by Finkelshtain and Chalfant and termed the "income risk-premium".

Recalling the household objective function, the benefits from such a stabilization scheme are given by CV^y defined through

$$E[V(l, y, p)] \;=\; E[V(l, y(\overline{p}) - CV^y, p)].$$

Note that the third argument p remains random after stabilization. The "income risk" premium CV^y thus measures the willingness to pay to stabilize the income risk when there remains risk in the third argument (p) of V. A Taylor approximation of *ex ante* CV, evaluating in money terms the benefits from such stabilization, yields

$$CV^y \;=\; -\,\sigma_{pp}\, x\;\left[\frac{1}{2}\frac{V_{yy}}{V_y}\,x \;+\; \frac{V_{yp}}{V_y}\right]$$

which can be expressed as

$$PCV^y = \frac{1}{2}\psi_p^2 \cdot \beta\{r[1-2(1-\rho)] + 2(1-\rho)\eta\}.$$

This expression could also be obtained from the expression for the CV for complete stabilization, setting the derivative V_{pp} equal to zero. The first term in the square brackets is simply the risk-premium per unit of variance of profits (resulting from the variance in the output price). This term is essentially identical to the usual Pratt (1964) risk premium. The second term captures the value (or cost) associated with the stochastic interaction between the consumption price and profits. Whether this term is positive or negative depends on whether the good is a necessity or a luxury good in the Frischian sense.

The above expression suggests that it might be possible to characterize the utility functions of households who prefer such a price stabilization scheme, regardless of the probability distribution of p. This is accomplished in Proposition 3, which illustrates the relationships between the willingness to pay for stabilization and various parameters of the peasant's preferences.

Proposition 3: A peasant household prefers stabilization in the production sector (to an unstable price) if and only if

$$\eta > r\left[1 - \frac{1}{2(1-\rho)}\right].$$

Proof: For small risks, preference for stabilization requires that PCV^y is positive, which in turn requires that $\{r[1-2(1-\rho)] + 2(1-\rho)\eta\}$ is positive. Rearranging terms implies the above inequality. A large risk result can be provided following the arguments of Theorem 1 of Finkelshtain and Kella. □

Thus, if the parameter ρ is greater than one-half, a sufficient condition for a risk averse peasant to prefer partial price stabilization in the production sector is that the farm produced good is a normal one. Further insight into how the various parameters affect the benefits from price stabilization in the production sector can be gained by recalling the expression for PCV^y derived above. First, note that—in contrast to Turnovsky et al.'s result that the benefits from stabilization are decreasing in the income elasticity of demand—in this case they are unambiguously increasing in η. Moreover, unlike the conventional wisdom, if the percentage of marketed surplus is negative, or positive but smaller than one-half, the benefits from such stabilization are *decreasing in the degree of risk aversion.* Only for households that sell more than 50% of their output will the benefits from partial stabilization increase with the degree of risk aversion.

Benefits from Price Stabilization in the Consumption Sector

Another possible subsidy scheme in developing countries is that the government buys the total crop of a certain commodity at the prevailing international market price and sells it to consumers at a pre-announced fixed price. Such a program implies that the price of the consumption good m is being stabilized, while the price of x remains random. This is therefore an example of price stabilization in the *consumption* sector only. Again, from the point of view of households, such a scheme represents partial stabilization.

An appropriate measure of the willingness to pay for such stabilization is denoted by CV^p and is defined by

$$E[V(l, y, p)] = E[V(l, y(p) - CV^p, \overline{p})].$$

This time, the argument p is stabilized at $\overline{p}$ after the scheme is introduced, but income remains random. We adopt once more the technique of a Taylor approximation to find an approximate expression for CV^p:

$$CV^p = -\sigma_{pp}\left[\frac{1}{2}\frac{V_{pp}}{V_y} + \frac{V_{yp}}{V_y}\cdot x\right] \Rightarrow PCV^p = \frac{1}{2}\psi_p{}^2\cdot\{s(1+\rho)(\eta - r) + (1-\rho)\epsilon\}\,.$$

This time V_{yy} is deleted from the expression for complete stabilization. The second term in the square brackets captures, as in the previous section, the value (or cost) associated with the stochastic interaction between the consumption price and profits. However, the first term now measures the benefit or cost per unit of variance of the consumption good—it involves V_{pp} rather than V_{yy}. It is only this term that Turnovsky et al. took into account when conducting their analysis of the stabilization of a single price.

Once more, it is possible to characterize the class of utility function which yields $CV^p \geq 0$. This is accomplished in Proposition 4.

Proposition 4: A peasant household prefers partial stabilization in the consumption sector (over an unstable price) if and only if

$$\eta \geq \frac{(\rho - 1)\epsilon^c + rs(1+\rho)}{2s\rho}.$$

The proof follows an argument that is similar to the one used to prove Proposition 3.

Using the above relationships, several qualitative propositions can be derived. First, a sufficient (necessary) condition for a producer with a positive marketed surplus to lose (gain) from partial stabilization in the consumption sector is that the good produced is inferior (normal). Second, a sufficient (necessary) condition for a deficit farm which produces at least one-half of its consumption to lose (gain) from partial stabilization in the consumption sector is that the good produced is a normal (inferior) good. Third, the benefits from partial stabilization are decreasing with the absolute value of the price elasticity. For households that produce at least one-half of their consumption, the benefits from such stabilization are *decreasing* in the measure of relative risk aversion. Finally, for deficit (surplus) farms, the benefits from stabilization are decreasing (increasing) in the income elasticity. Intuition supporting the above propositions is similar to that which was discussed in previous sections.

Partial Versus Complete Stabilization—a Comparison

From the analysis in the last three sections it appears that the benefits associated with each of the above three stabilization schemes are not mutually exclusive. This is not a coincidence—if the risks are small enough so that wealth effects are negligible, then the benefits associated with complete stabilization of the price equals the sum of the benefits from stabilization in the production sector and then stabilization of the price to consumers, given a fixed price to producers. Formally, it is useful to define three additional measures of benefits from stabilization.

The benefits associated with price stabilization in the production sector after the price for consumers is already stabilized is given by the usual Pratt (1964) risk premium, $CV^{y|p}$. It is defined by

$$E[V(l,\, y(p), \overline{p})] = V(l,\, y(\overline{p}) - CV^{y|p}, \overline{p})$$

and measures the willingness to pay to stabilize income when all other arguments of the utility function are already fixed. In a similar manner, we denote by $CV^{p|y}$ the maximum amount an individual would pay to stabilize the consumption price with income certain:

$$E[V(l,\, y(\overline{p}),\, p)] \;=\; V(l,\, y(\overline{p}) - CV^{p|y}, \overline{p}).$$

The above definitions allow the statement of the following proposition which establishes the relationships between the various measures.

Proposition 5: Assuming small risks and using the above definitions,

$$(i)\ CV = CV^{y|p} + CV^{p}$$

$$(ii)\ CV = CV^{p|y} + CV^{y}.$$

Proof: Follows from the approximations for the various measures by simple manipulation. An analogous proposition for large risks can be derived if the appropriate wealth effects of partial stabilization are taken into account.□

The benefits from complete stabilization thus equal the sum of the benefits of either stabilization of the consumption price and stabilization of income after the consumption price is already fixed, or income stabilization and then stabilization of the consumption price with a given fixed income.

The immediate question is whether it can be asserted that one of these three schemes dominates the others. Interestingly, for typical values of the model parameters, the answer is yes, and using the above proposition, the above stabilization schemes may be ranked. By (i), $CV^{p} = CV - CV^{y|p}$. It is well known that for risk averse peasants (in the Arrow-Pratt sense), $CV^{y|p} \geq 0$. Hence, for such peasants, complete stabilization unambiguously dominates partial stabilization in the consumption sector.

By (ii), $CV^{y} = CV - CV^{p|y}$. If the peasant as a "pure consumer" prefers price instability, as was asserted by Waugh, $CV^{p|y} \leq 0$. Moreover, for typical values of elasticities and shares, Turnovsky et al. showed that this is indeed the case. Hence, we can conclude that in the typical case, complete stabilization is dominated by partial stabilization in the production sector.

A formal sufficient condition for the above two assertions to hold can be derived. Note that $CV^{y|p} \geq 0$ if V is concave in income for every p and that $CV^{p|y} \leq 0$ if V is convex in p for every y. The former is equivalent to $r \geq 0$, while a sufficient condition for the latter is that $r \leq 2\eta$. Proposition 6 is then an immediate result.

Proposition 6: Assuming small risks, if $0 \leq r \leq 2\eta$, then

$$CV^p \leq CV \leq CV^y.$$

Thus, if the above condition holds, then from the point of view of the welfare of the peasant household, partial price stabilization—stabilization of the commodity price to producers, without corresponding stabilization on the consumption side—seems to be superior to either complete stabilization or price stabilization on the consumption side alone.

Summary

Increasing attention has been devoted to the simultaneous modeling of the production and consumption sides of an agricultural household's activities. Developing country households are often characterized by significant "on-farm" consumption of an agricultural commodity. This reverses, in many cases, the common result that consumers prefer price instability.

Whether price stabilization is feasible in particular cases—let alone a potential Pareto improvement—depends on many other factors, including the presence of yield risk and the nature of the market for the good in question. Whatever the effect of these other factors, the interaction between the production and consumption decisions in the agricultural household alters the *ex ante* benefits from stabilization, in ways related to readily observed parameters governing household decisions. For plausible values of parameters, it seems likely that marketed surplus households will prefer price stabilization. Furthermore, if separation of production and consumption prices is feasible, then stabilization in the production sector alone is likely to dominate complete stabilization.

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Figure 1. Plots of CV Measures Against Income Elasticities