PRICE STABILIZATION AND WELFARE *

BENTON F. MASSELL

I. INTRODUCTION

Some time ago Frederick Waugh demonstrated that, with a negatively sloped demand curve, assuming consumers to be price-takers, and starting from a given price, consumers gain more from a price decline than they lose from an equal price rise.[1] They thereby gain from price fluctuations, and accordingly lose from price stabilization. More recently, Walter Oi demonstrated that, with a positively sloped supply curve, and assuming producers to be price-takers, producers also gain from price fluctuations and hence lose from price stabilization.[2] Oi was apparently unaware of Waugh's much earlier work. But, having seen Oi's paper, Waugh restated his argument.[3] Unfortunately, in doing so, he stopped short of integrating the consumer and producer sides of the picture.

It is the purpose of the present paper to integrate the Waugh and Oi results and to consider the welfare effects of price stabilization in a model containing both producers and consumers. Following Waugh and Oi, we shall use as a measure of gain: (a) for producers, the expected value of producer surplus; and (b) for consumers, the expected value of consumer surplus. We thus ignore the effect of price stabilization on the variances of the variables involved. One interpretation of our model is that it assumes individuals to be indifferent to risk. A more palatable interpretation is that we assume the commodity under discussion to form a sufficiently small part of

* I am indebted to Professor R. M. Parish (University of New England, Armidale, Australia) for contributing actively to the formulation of some of the ideas contained in this paper and for stimulating comments on three earlier drafts. I also wish to thank the referee for helpful suggestions concerning the organization of the paper.

1. Frederick V. Waugh, "Does the Consumer Benefit from Price Instability?", this *Journal*, LVIII (Aug. 1944), 602–14.

2. Walter Oi, "The Desirability of Price Instability Under Perfect Competition," *Econometrica,* Vol. 29 (Jan. 1961), pp. 58–64.

3. Frederick V. Waugh, "Consumer Aspects of Price Instability," *Econometrica,* Vol. 34 (April 1966), pp. 504–8.

total producer sales and consumer purchases that a change in its price leaves the marginal utility of money unchanged.

We begin, in the following section, with a review of the results obtained by Waugh and Oi. Then, in Section III, we consider a market consisting of producers and consumers, and examine the gains from price stabilization to each group individually and to society as a whole. It is assumed that the price fluctuations are due to parallel shifts in the demand or supply curves. Following Waugh and Oi, the analysis is presented geometrically, permitting the price to assume only a limited number of values. The assumption of costless storage, made in Section III, is relaxed in Section IV, and the results modified accordingly. In Section V we formulate the model algebraically, with price as a continuously distributed random variable, and consider the gains from price stabilization to producers and consumers jointly. Section VI continues with a discussion of the distribution of the gains between producers and consumers. Then, in Section VII, we extend the analysis to the case of an individual producer or consumer. Section VIII notes the relationship between price stabilization and quantity destabilization.

In Sections II–VIII, stabilization is referred to the arithmetic mean of the price; in Section IX, we indicate how the results can be modified to permit stabilization about a trend. Section X presents some concluding remarks.

II. The Waugh-Oi Results

Waugh's result can be seen in Figure I, where it is assumed that consumers are faced with either of two competitively determined prices: p_1 or p_2.[4] Each price occurs with .5 probability. Using a cardinal measure of utility, consumer surplus, C, can be written

$$C = \begin{cases} a+b+c+d+f, & p=p_1 \\ f, & p=p_2 \end{cases} . \tag{1}$$

Then the expected value of consumer surplus, $E(C)$, is given by

$$E(C) = f + \frac{1}{2}(a+b+c+d) . \tag{2}$$

Now consider that consumers are given as an alternative a single price, $\mu = \frac{1}{2}(p_1+p_2)$, which obtains with certainty. At this price, the expected value of consumer surplus equals

4. Waugh, this *Journal, op. cit.*

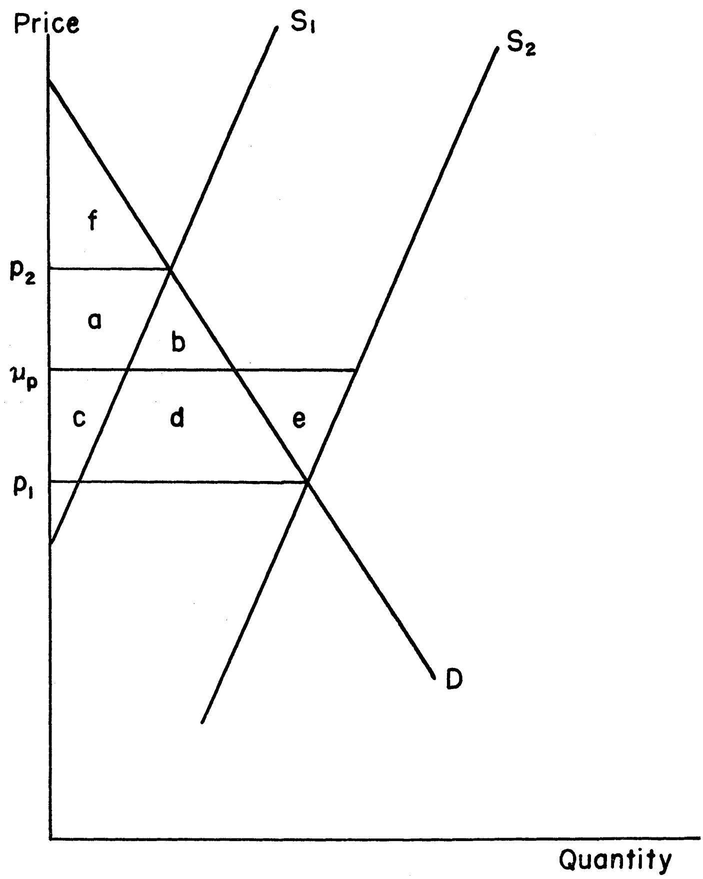

FIGURE I

$$(3) \qquad E(C) = a + b + f.$$

Compared with the prestabilization regime, the consumers stand to lose an amount equal to areas $c+d$ when the market price is p_1 and to gain $a+b$ when the price is p_2. Provided the demand curve is negatively sloped, and subject to the assumption that the marginal utility of money is constant with respect to a change in the price of the item, $c+d > a+b$, so that stabilization provides a net loss, measured in terms of consumer surplus; i.e., $E(C)$ is less in equation (3) than in equation (2).

Oi's argument is formally equivalent to the above.[5] In Figure II, producers are confronted with two prices, each with .5 probabil-

5. Oi, *op. cit.*

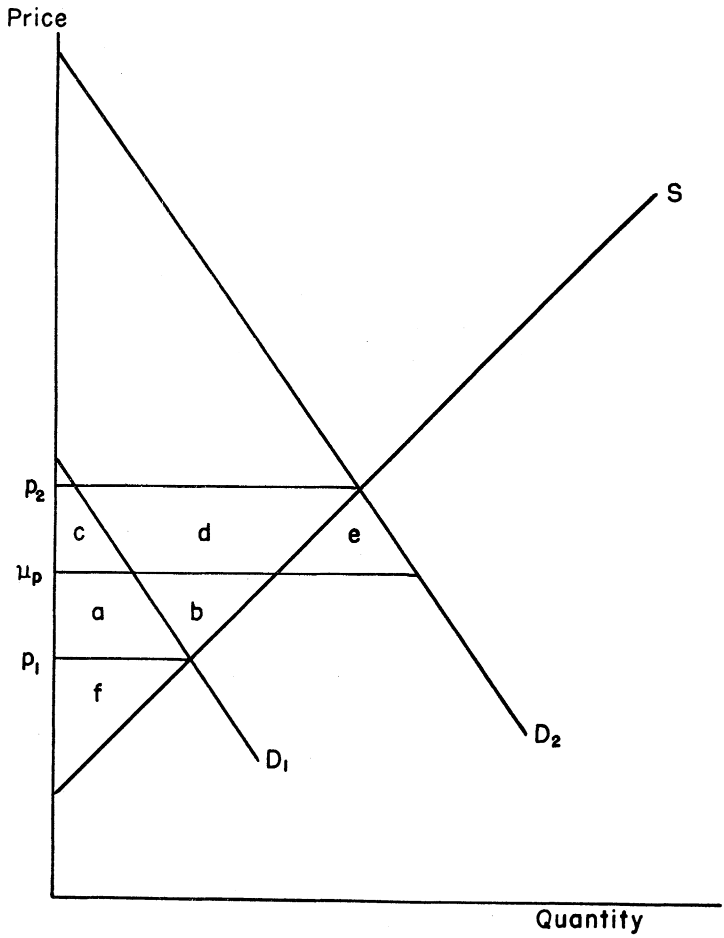

FIGURE II

ity. Producer surplus, F, is given by equation (1), and the expected value, $E(F)$ is given by (2). It can be seen that stabilization reduces the expected value of producer surplus by an amount equal to $\frac{1}{2}(c+d-a-b)$, as was the case above with consumer surplus. It is necessary to assume, as above, that the supply curve is positively sloped and that the marginal utility of money remains constant as producers move along this curve.[6]

6. For a further discussion of this point see: Clem Tisdell, "Uncertainty, Instability, Expected Profit," *Econometrica*, Vol. 31 (Jan.-Apr. 1963), pp. 243–47. Walter Oi, "Rejoinder," *Econometrica*, Vol. 31 (Jan.-Apr. 1963), p. 248.

In Waugh's analysis, consumers gain from a fluctuating price because they can adjust quantity purchased to the price. Thus they are able to buy more at a low than at a high price. If the price is stabilized not at μ_p but at a price p^*, defined

$$p^* = \frac{q_1 p_1 + q_2 p_2}{q_1 + q_2} \tag{4}$$

where q_1 and q_2 are the quantities demanded at p_1 and p_2 respectively, then consumer welfare is not reduced through stabilization. A corresponding argument holds for producers.[7]

Oi's results depend on the assumption, not made explicit in his analysis, that there is a zero covariance between shifts in the supply curve and changes in the price. His analysis is based on a stationary supply curve, in which case the covariance is trivially zero. Thus, price changes are due solely to shifts in demand.

A similar condition holds for Waugh's results. His analysis implicitly assumes that the demand curve is stationary, so that price changes arise solely from shifts in supply. In this sense, the two sets of results cannot both hold simultaneously.

III. A Model with Producers and Consumers

Consider a market consisting of atomistic consumers and producers. In this market, price fluctuations can arise from shifts in either supply or demand or both. The case of a supply shift is depicted in Figure I and a demand shift in Figure II; in both cases, the curves are assumed to be linear and the shifts to be parallel.

In Figure I we have assumed that the price fluctuations are due to shifts in supply, with S_1 and S_2 each obtaining with .5 probability. The price μ_p is an alternative that can be achieved through a costless storage activity.[8] A buffer stock is set up, with a buying and

Albert Zucker, "On the Desirability of Price Instability: An Extension of the Discussion," *Econometrica*, Vol. 33 (April 1965), pp. 437–41. Oi's result was obtained independently, at about the same time, by Richard R. Nelson, "Uncertainty, Prediction, and Competitive Equilibrium," this *Journal*, LXXV (Feb. 1961), 41–62, in a slightly different context. Nelson's paper draws on this result to build an interesting model of the value of information to the firm. Oi's result was also obtained by H. G. Grubel. "Foreign Exchange Earnings and Price Stabilization Schemes," *American Economic Review*, LIV (June 1964), 378–85. A somewhat less sophisticated presentation of this point appeared earlier in Ragnar Nurkse, "Trade Fluctuations and Buffer Policies of Low-Income Countries," *Kyklos*, XI (Fasc. 2, 1958).

7. Zucker, *op. cit.*

8. In the discussion by Waugh and Oi it is unnecessary to specify how price stabilization is achieved. Here, however, it is necessary. We shall assume that stabilization is brought about by a buffer stock.

selling price equal to μ_p, thereby establishing the market price at this level.

Raising the price from p_1 to μ_p involves a gain to producers of $c+d+e$, and a loss to consumers of $c+d$. If we subtract the consumers loss from the producers gain, there is a net gain equal to area e. Reducing the price from p_2 to μ_p benefits consumers by $a+b$ and costs producers only a; thus again there is a net gain of b. On balance, stabilizing the price at μ_p provides a net gain to producers of $c+d+e-a$, and a net loss to consumers of $c+d-(a+b)$, and therefore a net gain of $b+e$ to consumers and producers jointly. Although this analysis involves the addition of producer and consumer surplus,[9] and thus raises sticky welfare questions, one can argue that producers are able to compensate consumers so as to leave both groups better off. Given costless storage, the stabilization authority breaks even by buying and selling equal amounts at the same price, μ_p.[1]

In Figure II, price fluctuations are caused by shifts in the demand schedule, with D_1 and D_2 each obtaining with .5 probability. By an argument analogous to that above, it can be shown that there is a net gain to consumers of $c+d+e-a$, a net loss to producers of $c+d-(a+b)$, and a net gain to the two groups jointly of $b+e$.

The case considered by Waugh is that shown in Figure I, whereas Oi's results relate to the situation in Figure II. Waugh (Oi) is correct that price stabilization makes consumers (producers) worse off if the source of the instability is shifts in the supply (demand) schedule. However, this is only half of the story. If the instability is due to shifts in demand (supply), then consumers (producers) as a whole gain from a buffer stock scheme that stabilizes the price at μ_p. And the gain to consumers (producers) is sufficiently large to permit compensation, leaving both parties better off.[2]

9. This assumption is made by J. E. Meade "Degrees of Competitive Speculation," *Review of Economic Studies,* XVII (3), 1949–50, No. 44, 159–67, in his analysis of the welfare effects of speculation. Meade's gains from speculation are (not surprisingly) similar to our gains from stabilization.

1. An alternative would be to stabilize the price at $p^* = \dfrac{p_1q_1+p_2q_2}{q_1+q_2}$. In this case areas a and b would be larger and $c+d$ smaller, so that $a+b=c+d$. Consumers would then be indifferent to stabilization while producers would gain. However, the price p^* would not be an equilibrium price, as there would be on balance an excess demand providing pressure for the stabilization authority to raise the price.

2. Viewed differently, whereas the Waugh (Oi) results implicitly assume zero correlation between demand (supply) shifts and price changes, the analysis of the present section assumes perfect correlation.

IV. A Positive Storage Cost

A positive storage cost can easily be accommodated in the model. Figure III corresponds to Figure I, except that here the stabilization authority has set a buying price of $p_1' > p_1$ and a selling price of $p_2' < p_2$. As in Figure I producers and consumers jointly gain $e+b$ from stabilization, although these areas are smaller here than in Figure I. The stabilization authority makes a gross return of $p_2' - p_1'$ on each unit of the product handled. The pegged prices can be set so that $p_2' - p_1' = J$, the unit cost of storage. Stabilization will always afford a gain if $J < p_2 - p_1$.

V. The Gains from Price Stabilization: A More General Analysis

This section presents a more general analysis of the gains from price stabilization. Here the supply and demand curves each have a shift factor that is a continuously distributed random variable. Consider a competitively priced commodity with supply and demand curves of the form

$$S = \alpha p + x \qquad (\alpha \geqslant 0) \tag{5}$$

$$D = -\beta p + y \qquad (\beta \geqslant 0) \tag{6}$$

where S = quantity supplied, D = quantity demanded, p = price, α and β are constants, and x and y are jointly distributed random variables with means μ_x and μ_y, variances σ_{xx}, and σ_{yy} covariance $\sigma_{xy} = 0$.

By assuming that $\sigma_{xy} = 0$, we are in effect postulating a market in which shifts in demand and shifts in supply are influenced by different sets of forces. Shifts in demand may be related to changes in income and tastes, and in the prices of substitutes and complements; whereas shifts in supply may be related to changes in factor costs and technology. In the case of agricultural commodities, there are typically large shifts in supply because of factors related to the weather,[3] which are unrelated to the factors influencing demand.[4]

The equilibrium price and quantity traded are given by

$$p = \frac{y - x}{\alpha + \beta} \tag{7}$$

3. We are using "supply" here in an *ex post* sense, and not in the conventional *ex ante* sense. Thus the weather does not affect planting decisions (*ex ante* supply), but does affect the harvest (*ex post* supply).

4. If $\sigma_{xy} > 0$, the gains from stabilization are reduced but not eliminated.

$$(8)\qquad q=\frac{\alpha y+\beta x}{\alpha+\beta}$$

where $\alpha+\beta>0$, $p\geqslant 0$, and $q\geqslant 0$.

Consider that the mean price, μ_p, is known, and that a decision is made to eliminate price fluctuations by establishing a buffer stock authority that stands ready to buy or sell at μ_p. Stocks held by the authority are stored at zero cost. In any one year, producers gain

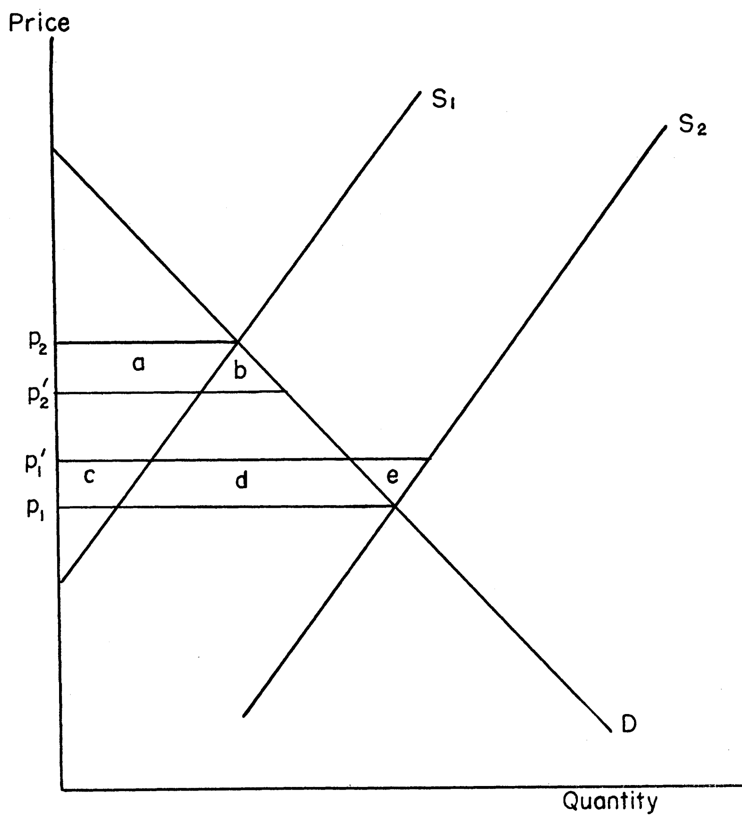

FIGURE III

an amount corresponding to $c+d+e$ in Figure I or $a+b$ in Figure II.[5] Algebraically, letting G_p= the gain to producers (i.e., the increase in producer surplus), we can write [6]

5. This amount may be negative.

6. Geometrically, this gain is the sum of the areas of a rectangle and a triangle. The area of the rectangle is given by the product $(\mu_p-p)[S(p)]$,

$$(9)\qquad G_p=\frac{1}{2}(\mu_p-p)\,[S(p)+S(\mu_p)]$$

where

$$(10)\qquad \mu_p=\frac{\mu_y-\mu_x}{a+\beta}\,.$$

Substituting (5), (7), and (10) into (9), and simplifying,

$$(11)\qquad G_p=\frac{1}{2}\left[\frac{\mu_y-\mu_x-(y-x)}{a+\beta}\right]\left[\,2x+\frac{a(\mu_y-\mu_x+y-x)}{a+\beta}\right].$$

Integrating over x and y, the expected value of the gain can be written[7]

$$(12)\qquad E(G_p)=\frac{(a+2\beta)\,\sigma_{xx}-a\sigma_{yy}}{2(a+\beta)^2}\,.$$

Next, consider the effect of price stabilization on consumer welfare, measured as the expected value of the change in consumer surplus. Denoting the gain from price stabilization by G_c, we can write[8]

$$(13)\qquad E(G_c)=\frac{(2a+\beta)\,\sigma_{yy}-\beta\sigma_{xx}}{2(a+\beta)^2}\,.$$

To derive the total gain, G, we add the gains to consumers and to producers:

$$(14)\qquad G=G_p+G_c\,.$$

Substituting (12) and (13) into (14), and simplifying,

$$(15)\qquad E(G)=\frac{\sigma_{yy}+\sigma_{xx}}{2(a+\beta)}$$

which is necessarily nonnegative and is positive if either σ_{yy} or σ_{xx} is. Thus those gaining from stabilization can compensate those losing, leaving everyone better off. This is then a generalization of the conclusions presented in Section III.

It can be seen that the price variance is given by

$$(16)\qquad \sigma_{pp}=\frac{\sigma_{yy}+\sigma_{xx}}{(a+\beta)^2}$$

thus

and the area of the triangle can be written $\frac{1}{2}(\mu_p-p)\,[S(\mu_p)-S(p)]$. Equation (9) is the sum of these two expressions.

7. Remember it is assumed that $\sigma_{xy}=0$.

8. G_c is given by the areas $a+b$ in Figure I, $c+d+e$ in Figure II. The derivation of the algebraic expression for G_c is analogous to that for G_p, above.

$$(17) \qquad E(G) = \left[\frac{a+\beta}{2}\right]\sigma_{pp} .$$

It follows that the gains from price stabilization will tend to be greater the greater the degree of price instability. From (15) we see that $E(G)$ is greater the larger are the demand and supply variances and the steeper the two curves.

VI. The Distribution of Gains Among Producers and Consumers

In deriving expression (15) for the total gains, we obtained expressions for the gains to producers and consumers individually. Although there is necessarily a total net gain, it is possible for one group to gain at the expense of the other. It is correspondingly of interest to consider the conditions under which each group gains from stabilization.

From equation (12) we see that

$$(18) \qquad E(G_p) > 0 \text{ if } \frac{\sigma_{yy}}{\sigma_{xx}} < \frac{2\beta}{a} + 1 .$$

Producers are more likely to gain the larger the supply variance relative to the demand variance. Further, the likelihood of gain is greater the steeper the supply curve relative to the demand curve. In the limiting case of either a vertical supply curve or a zero demand variance, producers cannot lose from price stabilization.

The factors that influence the likelihood of a gain are nearly (but not exactly) the same as the factors that influence the magnitude of the gain. By differentiating (12) with respect to σ_{xx}, σ_{yy}, a, and β, we find that the magnitude of the gain to producers is a decreasing function of the demand variance and an increasing function of the supply variance and of the steepness of the supply curve. The relationship between $E(G_p)$ and the demand slope is more complex. It can be shown that

$$(19) \qquad \frac{\partial E(G_p)}{\partial \beta} > 0 \text{ if } \frac{\beta}{a} < \frac{\sigma_{yy}}{\sigma_{xx}} .$$

Thus, beyond some point, further increases in the demand slope reduce the gain to producers. This results from the fact that the denominator of (12) increases faster than the numerator. In the limiting case of a horizontal demand curve, the price is stable even without a buffer stock, so the problem is irrelevant.[9]

9. In an important sense, this result is built into the model, by specifying

The gain to consumers was given by (13). A condition for this expression to be positive is

$$(22) \qquad E(G_c) > 0 \text{ if } \frac{\sigma_{xx}}{\sigma_{yy}} < \frac{2a}{\beta} + 1 \, .$$

This expression is analogous to that for producers. Consumers are more likely to gain, the larger the demand variance relative to the supply variance, and the steeper the demand curve relative to the supply curve. In the limiting case of a vertical demand curve, consumers cannot lose from price stabilization. Similarly, consumers cannot lose from stabilization if the supply variance is zero. The results of the present section can be viewed as an extension of the results obtained in Section III.

VII. Gains to Individual Producers and Consumers

Although producers as a whole may benefit from price stabilization, some producers may gain at the expense of others. It is of interest to consider the conditions under which the gains are positive to an individual producer — or a subset of producers. The notion of a subset of producers has particular real-world relevance if one wishes to consider whether an individual producing-country gains from an international buffer stock. For expository convenience we shall refer only to a single producer, but the analysis of this section can equally well apply to a subset of producers. We shall also discuss the gains to an individual consumer.

Consider an individual producer with supply curve

$$(23) \qquad s = \gamma p + z \qquad (\gamma \geqslant 0)$$

where $s =$ the firm's output and z is a random variable with mean and variance, μ_z and σ_{zz}. It is assumed that the producer is sufficiently small to be a price-taker. By the same method used in Section V, we may obtain the gain to the producer, g_p. Write

the demand shift as linear in the quantity (rather than price) variable. Strictly speaking, the demand curve shifts perpendicularly to the horizontal axis. The effect of a demand shift on the price diminishes as the demand curve becomes flatter, and becomes zero when the demand curve is horizontal. This assumption is acceptable if it is understood that one is discussing only demand curves that are fairly steep.

An alternative formulation would be to write

$$(20) \qquad D = -\beta p + y[\lambda + \beta(1-\lambda)] \qquad (0 \leqslant \lambda \leqslant 1).$$

Here, the demand curve shifts relative to both axes. The analysis can be generalized by substituting (20) for (6). It can be shown that, with this formulation,

$$(21) \qquad \lim_{\beta \to \infty} \sigma_{pp} = \sigma_{yy}(1-\lambda)^2,$$

which is positive if $\sigma_{yy} > 0$ and $\lambda < 1$.

(24) $$g_p=\frac{1}{2}(\mu_p-p)\,[s(p)+s(\mu_p)]\,.$$

Substituting; integrating over x, y, and z; and simplifying, the expected value of the gain can be written

(25) $$E(g_p)=\frac{1}{a+\beta}\left[\sigma_{xz}-\frac{\gamma}{2(a+\beta)}(\sigma_{yy}+\sigma_{xx})\right]$$

where it is assumed that $\sigma_{yz}=0$. It can be seen that

(26) $$E(g_p)>0 \text{ if } \frac{2\sigma_{xz}}{\sigma_{yy}+\sigma_{xx}}>\frac{\gamma}{a+\beta}\,.$$

If the individual producer's supply curve is influenced by some of the same forces that affect the industry's supply curve, then $\sigma_{xz}>0$. Whether the producer gains from stabilization will then depend on the values of the parameters in inequality (26). He will be more likely to gain — and the gain will be greater — the larger is the covariance between his and the industry's supply curve, relative to the industry supply and demand variances. An intuitive interpretation of this result is that the industry will tend to be in a Section III rather than a Section II situation. He is also more likely to gain the steeper is his supply curve relative to the industry supply and demand curves. In the limiting case, where his supply curve is vertical (assuming $\sigma_{xz}\geqslant 0$), he cannot lose from stabilization.

Consider next the effect of price stabilization on consumer welfare, measured as the expected value of the change in consumer surplus. Let the individual consumer's demand curve be written

(27) $$d=-\delta p+v \qquad (\delta\geqslant 0)\,.$$

Denoting by g_c the gain from price stabilization we can write

(28) $$E(g_c)=\frac{1}{a+\beta}\left[\sigma_{yv}-\frac{\delta}{2(a+\beta)}(\sigma_{yy}+\sigma_{xx})\right]$$

assuming $\sigma_{xv}=0$. Thus

(29) $$E(g_c)>0 \text{ if } \frac{2\sigma_{yv}}{\sigma_{yy}+\sigma_{xx}}>\frac{\delta}{a+\beta}\,.$$

The reader will note the similarity between (29) and (26). A consumer is most likely to gain if the covariance between his and the industry's demand curve is large relative to the industry demand and supply variances, and if his demand curve is steep relative to the industry demand and supply curves.[1]

1. An interpretation of the Oi-Waugh results is that they relate not to producers (consumers) as a whole but to an individual producer (consumer). In the case considered by Oi, it is then implicitly assumed that $\sigma_{xz}=0$, and $\gamma>0$, so that (26) does not hold, and the producer loses from stabilization.

VIII. Quantity Destabilization

If producers benefit from price stabilization, a likely result is the destabilization of the quantity sold. Denote by σ^*_{SS} and σ_{SS} the variance in producers' sales with and without price stabilization. Then let $\Delta\sigma_{SS}=\sigma^*_{SS}-\sigma_{SS}$. Now

$$(30)\qquad \sigma_{SS}=E[a(p-\mu_p)+(x-\mu_x)]^2 = \frac{a[a\sigma_{yy}-(a+2\beta)\sigma_{xx}]}{(a+\beta)^2}+\sigma_{xx}$$

$$(31)\qquad \sigma_{SS}^*=\sigma_{xx}\,.$$

Thus, subtracting (30) from (31), and substituting (12),

$$(32)\qquad \Delta\sigma_{SS}=2aE(G_p).$$

Therefore, if $a>0$, then $\Delta\sigma_{SS}>0$ if and only if $E(G_p)>0$, establishing the link between producer gain and quantity destabilization.[2]

It is easy to show for consumers, as we did for producers, that if price stabilization increases consumer surplus, it must destabilize the quantity purchased, assuming the demand curve to be negatively sloped.

Assuming that neither the supply nor the demand curve is vertical, then either the quantity purchased by consumers or the quantity sold by producers must be destabilized. If consumer purchases are destabilized, then consumers gain; and if producer sales are destabilized, then producers gain. This suggests some scope for empirical research on particular stabilization schemes. In the absence of stabilization, $\sigma_{DD}=\sigma_{SS}$. Thus if $\sigma^*_{DD}>\sigma^*_{SS}$, it follows that $\Delta\sigma_{DD}>0$. Similarly, if $\sigma^*_{SS}>\sigma^*_{DD}$, then $\Delta\sigma_{SS}>0$. Therefore, if under stabilization, the variance in consumer purchase exceeds the variance in producer sales, then consumers have necessarily gained. Alternatively, if the variance in producer sales exceeds the

Similarly, with Waugh's implicit assumption that $\sigma_{yv}=0$ and $\delta>0$, (29) does not hold and the consumer also loses from stabilization. Although the Waugh and Oi results cannot both hold for consumers and producers as a whole, it is certainly possible for individual consumers and producers to lose from stabilization, if σ_{xz} and σ_{yv} are sufficiently small.

One can no doubt find the isolated producer whose *ex post* supply curve shifts in a way that is independent of shifts in the total supply curve for the product. This would be the case for a good whose supply curve shifts mainly in response to changes in the weather, and with respect to a producer situated in a climatically atypical area. However, it is a very special assumption, even for an individual producer and is less likely to hold for a group of producers. Similarly, the factors influencing shifts in demand are likely to affect large groups of consumers in roughly the same way. This is particularly the case for the derived demand by firms — for example, for materials for further processing.

2. If $a=0$, then $\Delta\sigma_{SS}=0$.

variance in consumer purchases, producers have necessarily gained. This method permits us to determine that one group has gained. It does not permit us to say whether the other group has gained or lost. However, the more nearly equal are the two variances, and the more nearly equal are the slopes of the two curves, the greater the likelihood that both groups have gained.

IX. Time Trend

Our analysis has proceeded thus far on the implicit assumption that there is no time trend in either demand or supply, and therefore in price or quantity traded. Clearly, if there is a trend, then stabilization of price about the mean would make little sense, and would produce some odd results.

Consider that both the demand and supply curves shift linearly to the right over time, not necessarily at the same rate. If the demand curve shifts faster (slower) than the supply curve, there will be an upward (downward) linear trend in price; only if the two curves shift at the same rate, will price contain no time trend. The reader can easily verify that the analysis of Sections V–VII holds if price is stabilized about the trend instead of about the mean. The stabilization authority is then assumed to know the expected value of price as a function of time.[3]

X. Conclusions

The present paper has tried to reconcile the analyses presented by Walter Oi and Frederick Waugh, concerning the gains to producers and consumers resulting from a stable as compared with a fluctuating price. Using the expected value of the change in producer and consumer surplus as a measure of gain, we have shown that price stabilization, brought about by a buffer stock, provides a net gain to producers and consumers taken together.

It is tempting to argue from this that a buffer stock is a desirable policy measure. However, one should bear in mind the simplifications underlying the analysis. First, we assumed storage to be costless. Taking the cost of storage into account would reduce the gains from price stabilization.

3. If storage operations stabilize price about a trend, the storage authority will no longer earn zero profits: instead, profits will be positive or negative depending on whether the price trend is rising or falling.

Second, we ignored the effect of price stabilization on the variance of producers' and consumers' incomes. This is particularly serious with respect to producers, because income from the commodity produced is likely to form a large part of total income. If price stabilization increased the expected value of producers' income but also increased the variance, then producers might on balance suffer a welfare decline. A more complete analysis would consider this aspect of the problem as well.

Third, we have assumed that μ_p was known so that the price could be stabilized at this level. It goes without saying that one of the chief difficulties of a price stabilization scheme is to predict the changes in the equilibrium market price.

Food Research Institute
Stanford University