DOES THE CONSUMER BENEFIT FROM PRICE INSTABILITY?

SUMMARY

A new theorem: consumers harmed by price stability, 602. — I. Related propositions: consumer's surplus and price stability, 602. — II. The general case, 605. — III. Indifference curve analysis, 606. — IV. The theorem in its most general form, 608. — V. The meaning of the above results: "common sense," 609; offsetting price changes, 609; semi-luxuries, 610; extreme cases, 610; producers or sellers, 610; character of the demand function, 611; quantities sold, 611; adjustment of expenditures, 613; advance knowledge of prices, 613.

In preparing material for a course in Welfare Economics, in coöperation with Mr. R. O. Been, I have developed a theorem which is new, so far as I know. This theorem appears to show that, in a certain sense at least, consumers are harmed by price stability, and that they benefit from instability of prices. Such a conclusion, if correct, obviously has important policy implications, since it runs counter to the accepted doctrines upon which many national and international programs are based. I have discussed the theorem with several competent economists in the Government service. None of them has found any basic errors in the analysis, although several made suggestions which will be used in the following presentation.[1] I am submitting it for publication in the hope that other economists will examine it critically — not only to point out errors, if they exist, but to call my attention to any qualifications which should be kept in mind in applying the theorem to practical matters of policy. One important qualification is noted in the next to last paragraph of this paper. The theorem holds exactly only if the consumer has a given sum of money to spend in a series of periods and is indifferent as to how this sum is distributed among the several periods.

I

Before developing the main theorem in its most general form I shall try to establish several related propositions. The first of

1. Among those who have made important suggestions are Richard O. Been, Herman M. Southworth, Albert L. Meyers, L. D. Howell, K. J. McCallister, and A. C. Hoffman, all of the United States Department of Agriculture, and Geoffrey Shepherd of Iowa State College.

these relates to consumer's surplus for a single commodity or service. It can be stated as follows:

Let the price of any commodity or service be p_1 *in one period of time and* p_2 *in another equal period. If these prices are unequal, every individual consumer of the commodity or service will enjoy a greater average consumer's surplus in the two periods than if the price were stabilized at the arithmetic mean,* $p_o = \frac{1}{2}(p_1+p_2)$.

This is true for any demand curve which slopes downward to the right. Draw any such curve, as in Figure 1. Now consider any two prices, p_1 and p_2, which might be set in two successive weeks, years, or other equal periods; and also consider the average price $p_o = \frac{1}{2}(p_1+p_2)$. We wish to compare two situations: first, one in which the price would be exactly stable, being held at p_o in each period; second, one in which the price would be p_1 in the first period and p_2 in the second period. In the period when the price

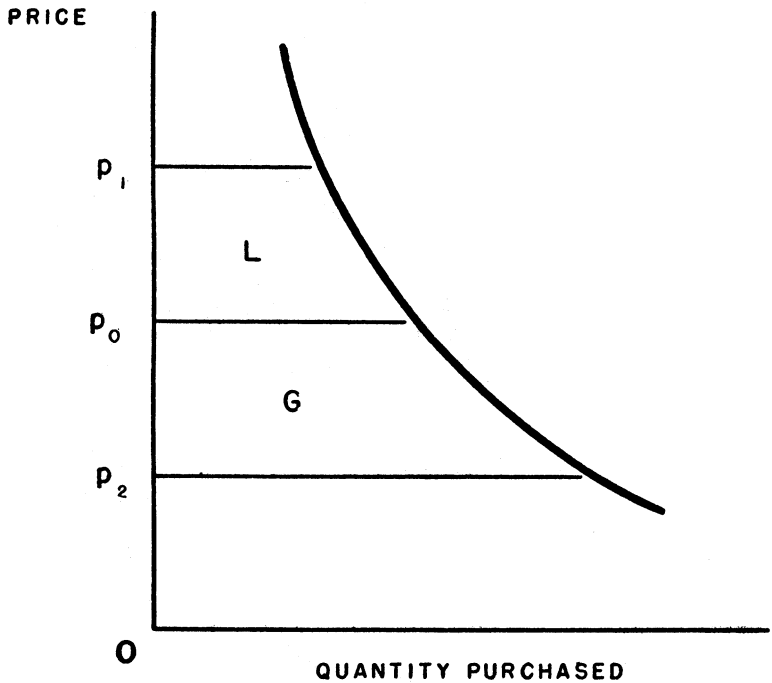

FIGURE 1

is above p_0, the loss in consumer's surplus (as compared with the situation p_0) is represented by the area marked L in Figure 1. When the price is below p_0, the gain is represented by the area marked G. Since the distances p_1-p_0 and p_0-p_2 are equal, it is easy to see that G is always greater than L, if the demand curve slopes downward to the right.

Thus, the proposition, as stated, seems clearly true. We shall not attempt here a detailed interpretation of its meaning. There have been many controversies about the meaning of consumer's surplus, and many objections have been raised to using it as a measure of welfare. I should like to point out, however, that the most common objection to consumer's surplus — that we cannot compare the surpluses of different individuals — does not apply to this case, because *each individual consumer* gains when prices are unstable. If each individual consumer gains, it is perfectly legitimate to say that the whole consuming public gains.

Another very common objection to consumer's surplus is that it does not measure basic utility. We do not need, however, to follow Marshall's[2] interpretation of consumer's surplus. We can use it in the original, and more restricted, sense of Dupuit.[3] This interpretation has been well restated by Hicks[4] in the following words:

> the best way of looking at consumer's surplus is to regard it as a means of expressing, in terms of money income, the gain which accrues to the consumer as a result of a fall in price. Or better, it is the compensating variation in income, whose loss would just offset the fall in price, and leave the consumer no better off than before.

Using the Dupuit-Hicks interpretation, then, we might say that if the consumer paid a tax of G dollars (referring again to Figure 1), when the price was low, and if he received a bounty of L dollars, when the price was high, he would be just as well off as if prices remained always at p_0. But G is greater than L, hence each consumer could afford to pay a net amount of $G-L$ dollars

2. Alfred Marshall, Principles of Economics, London, 1930, Book III, Chap. 7. (The only part of this chapter we need for our purposes is par. 2, pp. 125–127.)

3. Jules Dupuit, De l'Utilité et de sa Mesure, reprinted in 1933 by La Riforma Soziale, Torino, Italy. (Originally published in 1844 and 1849.)

4. J. R. Hicks, "Value and Capital," London, 1939. Note to Chap. II, pp. 38–41.

for the privilege of enjoying an unstable price for the commodity or service.

Some economists with whom I have discussed this problem also have questioned whether the net gain can be measured without considering how the demands for *other* goods and services are affected by variations in the price of the particular commodity or service we are considering. I believe this objection is incorrect and is fully answered in the works of Dupuit and Marshall. Consumer's surplus does take full account of changes in the demands for other things.

II

The first proposition was stated in terms of consumer's surplus for a commodity or service when there were only two possible prices, p_1 and p_2. It can easily be extended to the general case. It can be stated thus: *let the price of any commodity or service in n equal periods of time be* $p_1, p_2, \cdots, p_n$. *If price varies (that is, if not all the p's are equal), the total consumer's surplus in the n periods will be greater than if the price were stabilized at the arithmetic average price:* $p_o = \frac{1}{n}(p_1 + p_2 + \cdots + p_n)$. *In fact, the gain in consumer's surplus will be approximately in proportion to the square of the price variation.*

This fact can be seen rather easily in Figure 2. When the price is above p_o — as it is at p_k in Figure 2 — the *loss* in consumer's surplus is equal to the area of the rectangle $q_o\,(p_k - p_o)$ *minus* approximately $\frac{1}{2}\delta_k\Delta_k$, where δ_k is the change in price and Δ_k is the change in consumption. When the price is below p_o — as it is at p_j in Figure 2 — the *gain* in consumer's surplus is equal to the area of the rectangle $q_o(p_o - p_j)$ *plus* approximately $\frac{1}{2}\delta_j\Delta_j$.

If p_o is the arithmetic average of the prices $p_1, p_2, \cdots, p_n$, the sum of all the rectangles is zero, and the net gain in consumer's surplus is approximately $\frac{1}{2}\,\Sigma_k\delta_k\Delta_k$. If there is no variation in prices, this gain is zero. The greater the variation in prices, the greater the net gain in consumer's surplus. But this is not all.

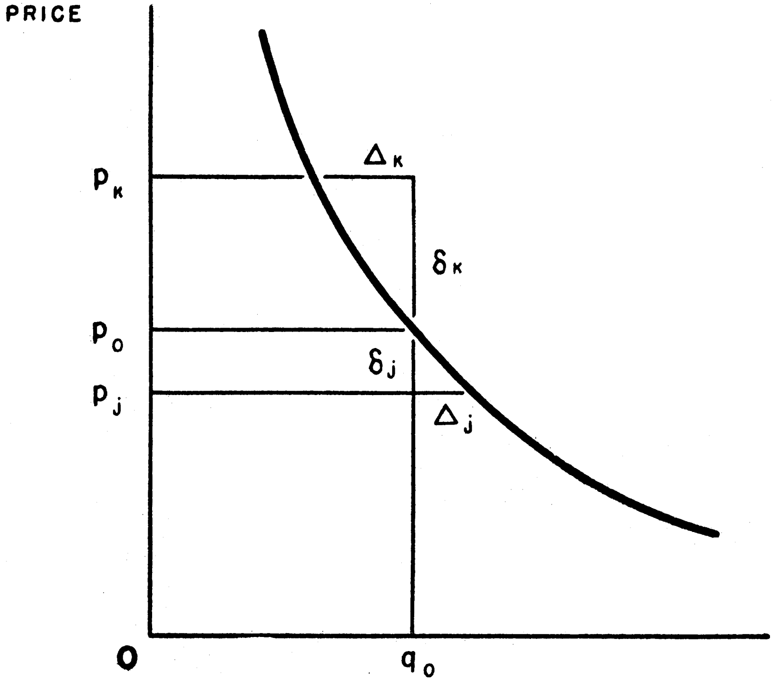

FIGURE 2

When δ_k is doubled, Δ_k tends to be approximately doubled also; hence doubling the price variation tends approximately to quadruple the net gain in consumer's surplus.

III

So far we have been concerned only with consumer's surplus. Many economists may feel that even the limited interpretation of consumer's surplus we have used here is open to question. We shall proceed, therefore, to the less controversial subject of indifference curves. With the help of this analysis I propose, first, to demonstrate that *if any consumer can spend a given amount of money for all goods and services in n equal periods of time, and if the price of any particular good or service varies, the same total expenditure of money could always be so distributed among the n*

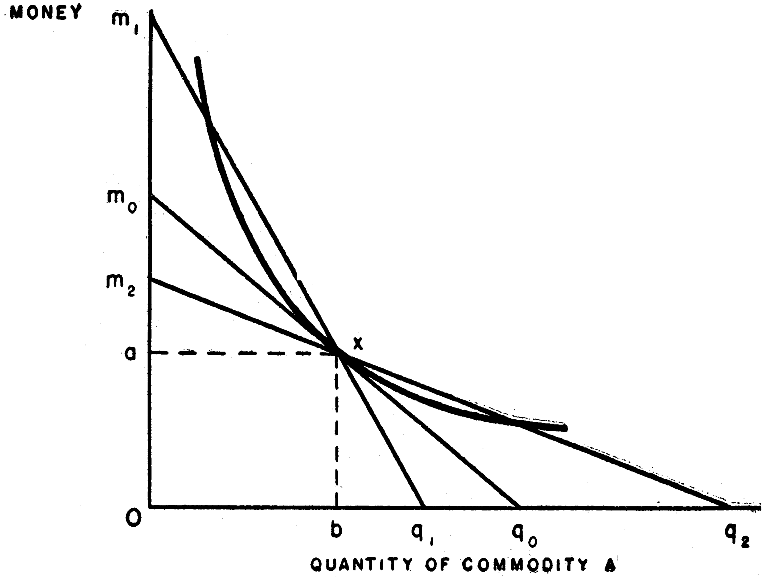

FIGURE 3

periods as to leave the consumer better off than he could be if the price were stable at $p_o = \frac{1}{n}(p_1 + p_2 + \cdots + p_n)$.

For this purpose we shall use Figure 3. Let m_o be the average amount of money the consumer spends on all goods and services in the n periods; that is, let $m_o = \frac{1}{n}(m_1 + m_2 + \cdots + m_n)$. If the price is stable at p_o, and if he spends m_o in each period, he can choose any position along the line m_oq_o. He will choose some point, x on this line, giving up am_o dollars to purchase Ob units of the commodity or service. If he is rational, this means that he prefers that point to any other point on the line. It is well known that this means that there must be an indifference curve which is tangent to m_oq_o at the point, x, and that the indifference curve must slope downward to the right, falling at a decreasing rate as q increases.[5]

Now, imagine that the price in period 1 were higher than the

5. J. R. Hicks, op. cit., Chap. I, par. 7, pp. 20–22.

average price, p_o, but that the consumer could increase his total expenditure of money enough in period 1 to enable him to continue to buy Ob and to continue to have Oa dollars to spend for other things. This position would obviously leave him *at least* as well off. But actually he would be *better* off. His new line of choice would be along m_1xq_1, which would enable him to reach a point on a higher indifference curve.

In a similar manner, if the price in period 2 is reduced, and if the consumer reduces his total money expenditures to the amount which would just enable him to continue to buy Ob and to spend Oa dollars on other things, his new line of choice is m_2xq_2, which allows him to reach a higher indifference curve than the one which is tangent to m_oxq_o.

Now, the point of this is that if the consumer can distribute his total expenditures in the way we have outlined, his total expenditures for the series of n periods will equal nm_o — just as if he spent m_o in each period. Referring to Figure 3, the length of the line am_1 is p_1 times the length of the line ax; the length of the line am_2 is p_2 times the length of the line ax; and so on. The average length of such lines is p_o times the length of the line ax, or am_o. Therefore, if the consumer has nm_o dollars to spend in the n periods, and if he can distribute this expenditure as he pleases in the n periods of time, his worst situation will be that of stable prices at p_o. If prices vary around the arithmetic average, the same total expenditures can be arranged in such a way that any consumer will be better off than with a stable price at p_o.

IV

We are now ready to state the theorem in its most general form: *if a consumer has a given sum of money to spend for all goods and services, and if he can distribute this expenditure as he pleases among n equal periods of time, he will be better off if all prices vary than he would be if all prices were stabilized at their respective arithmetic means.*

Assume that a consumer spends in a given "base period"

$$M = p_1q_1 + p_2q_2 + \cdots + p_nq_n$$

dollars, where the p's represent the prices and the q's represent the quantities of all commodities and services bought.

Now, assume that the prices change to $p_1' = p_1 + \delta_1$,

$p_2' = p_2 + \delta_2$, and so on, and let total expenditures be increased by $\Delta M = \delta_1 q_1 + \delta_2 q_2 + \cdots \delta_n q_n$. As indicated by our analysis of the simpler case, this would leave the consumer *at least* as well off as in the base period, because he *could* still purchase exactly the same quantities as before. Actually, he would be *better* off, because his new budget plane would cut the indifference surface upon which he was located in the base period — thus allowing him to shift his purchases in such a way as to raise his level of living.

If the prices, $p_1, p_2, \cdots, p_n$ in the base period are arithmetic averages, we can add together all the equations

$$\Delta M = \delta_1 q_1 + \delta_2 q_2 + \cdots + \delta_n q_n$$

for each period and find that

$$\Sigma(\Delta M) = (\Sigma\delta_1)q_1 + (\Sigma\delta_2)q_2 + \cdots (\Sigma\delta_n)q_n = 0.$$

In other words, this distribution of expenditures among the n periods would result in the same total expenditures as if the consumer had spent M dollars in each period. Therefore, if he can distribute a given total expenditure as he pleases in the n periods, we have shown that our theorem can be generalized to state that each consumer benefits when prices of *all* commodities and services vary about their respective arithmetic averages.

V

In conclusion I should like to make several comments concerning the meaning of the above results.

1. In discussing the analysis with economists I find that many of them are rather skeptical, although they have not pointed out any important errors. The most common objection is that the theorem runs counter to "common sense"; that "everybody knows" that stability of prices is desirable. We certainly admit that it runs counter to an assumption which appears to be almost universal, and which is playing a very important part in directing public policies. Witness, for example, the "ever-normal granary" program in the United States, and the proposed "buffer stocks" of staple foods to stabilize international food prices after the war. But some common assumptions may be wrong. I should like first to mention two situations in which the consumer obviously gains from instability of prices.

2. One situation in which consumers obviously gain from price instability is that in which increases in some prices are just

offset by decreases in other prices, in such a way that the consumer could, if he chose, continue to get the same quantities of all goods and services, for the same expenditure, as he would get if prices were all stabilized at the arithmetic means. In such a case the consumer could obviously gain by purchasing more of the lower-priced things and less of the higher-priced things.

3. Another example of an obvious gain is the case of the demand for semi-luxuries by low-income people. If prices were stable, they might never be able to afford any semi-luxuries. Instability of prices gives them an opportunity to buy semi-luxuries when the prices are low.

4. Returning to criticisms of the theorem, several persons have imagined extreme cases which, they believed, show that the conclusions are absurd. Imagine, for example, that the commodity is water and that the periods are months. If water were free one month and we had no water at all another month, we might die of thirst. But this does not disprove our theorem. The theorem says nothing about having no water in any period. The extreme case would be for the price to alternate between zero and $2p_o$. I think the theorem holds for all extreme cases — so long as the demand curve slopes downward to the right. It should not be applied to extreme examples in which the demand curve slopes upward to the right.

5. The theorem is limited to the effects of price instability upon consumers. A policy of stable prices may, or may not, be profitable to the producers or sellers of the commodity. This depends essentially on the shape of the demand curve (disregarding differences in cost). If we know the demand curve, $q=f(p)$, it is a simple matter to compute the returns curve, showing the total income of the seller as a function of price. This curve is $r=pq=pf(p)$. If this curve is concave downward, (i.e. if $\frac{d^2r}{dp^2}<0$), stable prices are profitable to the seller. If the curve is concave upward, (i.e. if $\frac{d^2r}{dp^2}>0$), stable prices minimize the incomes of sellers, and they can increase their incomes by a policy of unstable prices.[6] It is not

6. The principles involved in profit from stable or unstable *quantities sold* are developed in some detail in F. V. Waugh, E. L. Burtis, and A. F. Wolf, "The Controlled Distribution of a Crop Among Independent Markets," this

at all impossible that both the sellers and the consumers of a commodity might lose from a policy of stable prices, and might gain from a deliberate policy of instability.[7]

6. Unless the demand function is linear, the total quantity purchased in the n periods will be affected by the degree of stability of price. As we have drawn the demand curves (and as they usually are drawn), they fall at a decreasing rate as the quantity increases. If this is correct, the total consumption of the commodity will be increased by variations in price around the mean.

This need cause us no particular concern, however, unless the total quantity $Q \equiv (q_1 + q_2 + \cdots + q_n)$ is fixed. If we were setting the toll for using a bridge, for example, it would be perfectly possible to establish a toll of seventy-five cents one month and twenty-five cents the next month, if the bridge would carry all the traffic during the month of low prices. But if the total output, Q, is fixed, any policy of unstable prices which will just move this amount into consumption will generally result in an average price different from p_o.

In connection with practical applications of the principles set forth here, we might well note that one of the purposes of many price stabilization schemes is to increase consumption. Yet, if the demand curve falls at a decreasing rate, as we usually assume, and if our arithmetic average price is p_o, a stable price apparently *minimizes* consumption, and any variation around the arithmetic average apparently *increases* consumption. This assumes, of course, that the level of demand depends only upon current prices; that it is not affected by previous prices.

7. As suggested by the preceding point, the stabilization of *prices* may be quite different from the stabilization of *quantities sold*, unless the demand function is linear. If q_o is the arithmetic mean of quantities sold in n periods (i.e if $q \equiv \dfrac{1}{n}(q_1 + q_2 + \cdots + q_n)$, it can be shown that it is impossible for *both* the consumer and the producer to gain from instability around the average of the quantities sold.

JOURNAL, November, 1936. Exactly the same principles can be applied to the analysis of the effects of stable and unstable prices upon returns to sellers.

7. However, the most extreme case of price instability, in which prices are zero half the time and are set at $2p_o$ the other half, can never be more profitable than stable prices at p_o, unless the demand curve slopes upward.

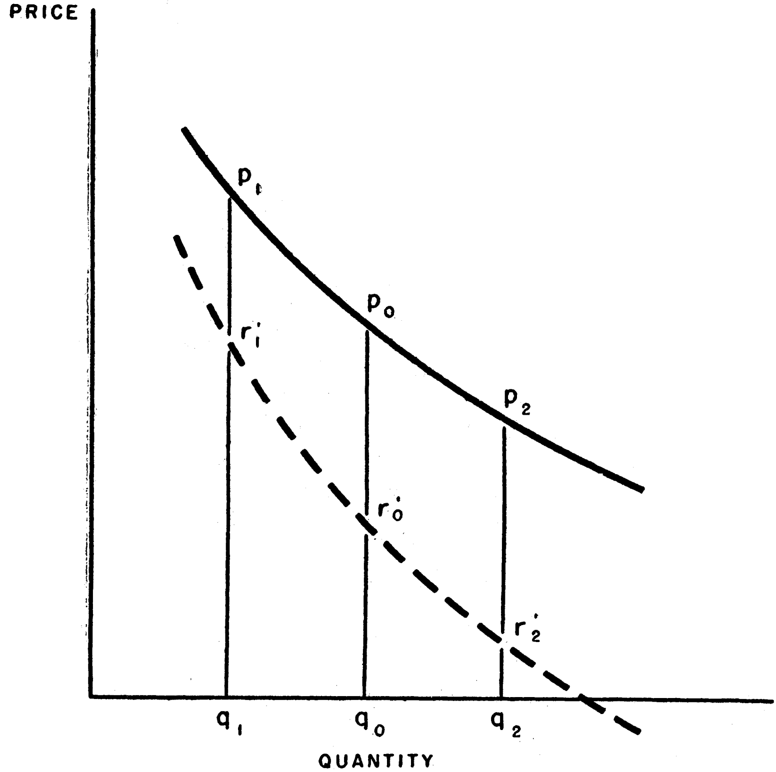

FIGURE 4

For this purpose we draw any demand curve and its derived marginal returns curve as in Figure 4.[8] The solid curve in Figure 4 is the demand curve; price as a function of quantity. The dotted line is the marginal returns curve; marginal returns as a function of quantity. Mr. R. O. Been suggested to me that consumer's surplus can be measured by the area between the demand curve and the marginal returns curve. The area below the marginal returns curve to any point, q_k, represents total returns to the seller (or total expenditures of the consumer) for the amount q_k. Subtracting this area from the area under the demand curve is identical to

8. Joan Robinson, The Economics of Imperfect Competition (London, 1933), Chap. 2, pp. 26–43, describes in some detail the meaning of the marginal returns curve and the methods of computing it mathematically or graphically, when the demand curve is given.

subtracting the area pq, as is usually done in measuring consumer surplus. Now, if the quantity sold is reduced from q_o to q_1, the loss in consumer surplus is the area $p_or_or_1p_1$. When the quantity is increased from q_o to q_2 the gain in consumer's surplus is $p_or_or_2p_2$. If the marginal returns curve is falling more rapidly than the demand curve, and if $p_o-p_1=p_2-p_o$, the second of these areas is greater than the first, and there is a net gain to the consumer. On the other hand, in this case there is a net loss to the seller. In the first period his loss in income is $q_or_o'r_1'p_1$, and in the second period his gain is $q_or_o'r_2'p_2$. It is obvious that if the consumer gains the seller loses. If the marginal returns curve is rising, the seller gains from variations around the arithmetic mean of quantities sold, but in this case the consumer obviously loses. If marginal returns are falling more slowly than prices, both the consumer and the seller will lose from variations around the arithmetic mean of quantity sold.

8. The theorem is true only if the consumer can adjust his expenditures among the n periods in the way we have indicated. He may not be able to do so; and even if he can do so, he may prefer to stabilize his total expenditures. Such a preference doubtless exists and is important, especially to consumers with small savings. This, I think, is the most important limitation of the theorem, and limits its practical application.

9. I am greatly indebted to Dr. Hans Staehle for calling my attention to another practical difficulty: that the consumer could make the necessary adjustments only if he knew in advance what the average prices were to be. Important as this qualification is, I believe it does not necessarily present any insurmountable difficulties. In the case of administered prices (like toll rates, railroad fares, and public utility charges generally), it would be a simple matter to announce a definite schedule of prices which varied from month to month, or from year to year, in a prescribed manner. In the case of a commodity like wheat, instead of attempting to *stabilize* the price, the Government might *forecast* prices for as long a period as possible in the future. Assuming that such forecasts were fairly accurate, the reasoning in this paper would indicate that consumers might make real gains by taking advantage of the price fluctuations, which were *foreseen* instead of *prevented*. Moreover, even if the consumer had no advance information about prospective price changes or about the average price

during a given period, I believe the analysis in terms of consumer's surplus would tend to indicate that he would react in such a way as to get a net benefit; that is, his gain in the low-price periods would be greater than his loss in the high-price periods.

10. Because of the limitations already suggested, as well as limitations of a technical nature (such as the degree of perishability of a commodity), I am not prepared to propose any concrete program to promote price instability. Nevertheless, I do believe the theorem is substantially correct, and that its implications should be considered seriously in dealing with many problems of national and international importance.

FREDERICK V. WAUGH.

WAR FOOD ADMINISTRATION