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WHO DESTABILIZES PRIMARY PRODUCT PRICES?

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Errata

Page	Paragraph	Line	For	Read
389	2	6	opposite is	opposite -- is
391	1	14	(i.e., Q_t)	(i.e., $\overline{Q}_t$)
391	2	17	component will	component that will
392	2	4	$d_t = (\ln Q_t - \ln\overline{Q}_t)$	$q_t = (\ln Q_t - \ln\overline{Q}_t)$
392	2	5	$p_t = (\ln p_t - \ln\overline{P}_t)$	$p_t = (\ln P_t - \ln\overline{P}_t)$
398	fn18	4	σ_2	σ^2
398	fn18	7	(i.e., R^2_{pq}	(i.e., R_{pq}
398	fn18	7	If R^2_{pq}	If R_{pq}
401	Column 4	Median (All Comm.)	9.00%	9.84%
405	Column 8	Beef and Veal	4.23*	4.33*
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409	2	5	(σ_{pp})	(σ^2_{pp})
412	fn36	5	approaches zero	approaches infinity

WHO DESTABILIZES PRIMARY PRODUCT PRICES?

INSTABILITY in the prices of primary product exports has long been considered a serious problem to the underdeveloped countries, hampering their efforts to plan efficiently for accelerated and self-sustained economic growth.[1] The causes of this greater instability are seen as 1) the relative price inelasticity in the short run of both the supply and demand schedules, and 2) the relative instability of either or both of these supply and demand schedules. Whether the cause of resulting fluctuations of primary products is predominantly the demand fluctuations or the supply fluctuations is a question about which there is much opinion but little conclusion in the literature.

Those who place the blame largely upon the advanced countries (i.e., upon fluctuations of the demand curve) rely upon the experience of the 1930's and upon numerous U.N. studies during the past decade and a half. Unfortunately, the U.N. method—of blaming demand when price and quantity move in the same direction, and blaming supply when in the opposite is not satisfactory as a method,[2] and it is far from indisputable that prices and quantities of primary products have generally moved in the same direction, once trend is removed.[3]

Those who place the blame largely upon the primary-product-exporting countries (i.e., upon fluctuations of the supply curve) rely upon the argument that the business cycle has become (or is becoming) a phenomenon of the past. Even if this optimistic view were true, however, fluctuations in the demand curves of particular primary products may still occur. Absence of recession is not the same thing as absence of variation in the "boominess" of booms; technological change affecting raw material use is generally discontinuous;

[1] For a critical review of this literature, see [3], especially Chaps. 1-4.

[2] See [4].

[3] As will be noted in Table 1 below, a negative correlation between the price and quantity deviations from trend was found for 31 or 33 (depending upon which of two definitions of trend was used) of the 46 commodities studied in this paper over the post-World war II period.

speculation can turn small demand changes into large price variations; commercial policies of advanced countries change sporadically; etc.

The debate is, in the end, in need of empirical evidence. Such evidence can come from two directions: detailed case studies of the price, quantity, demand, and supply fluctuations of particular commodities; and from cross-commodity studies where a single, simple approach is applied simultaneously to a variety and number of primary products. This paper attempts the latter. On the basis of explicit supply-and-demand assumptions (Section I), the actual fluctuations since World War II in the prices and quantities of 46 commodities (Section II) are converted into estimates of the implied fluctuations in the underlying supply and demand curves (Section III). Finally, how much price fluctuation would have occurred in the absence of the demend fluctuation or in the absence of the supply fluctuation is estimated (Sections IV and V).

The basic conclusion is that, for a great many commodities, it is incorrect to blame price fluctuations on either demand or supply unless very specific assumptions can be made about the short-run price elasticities of demand and/or supply. For broad ranges of these elasticities, however, two generalizations are suggested. One, if these short-run price elasticities are typically low, as current convention claims, then the fluctuations of supply and demand are highly (positively) correlated for many commodities, with the result that removal of one *or* the other source of instability fails to reduce the price fluctuation much—and in fact often increases it. Under the circumstances, for over half the commodities studied, price instability has been caused by *both* supply *and* demand instability and in such a manner that the "blame" cannot be allocated between them. And two, if the correlation between demand and supply fluctuations is believed to be typically near zero, then either or both of the short-run price elasticities of supply and demand must be well above unity for many commodities. Under these circumstances, for about half-the commodities studied, supply fluctuations have been the dominant cause of price fluctuations, and for most of the remaining commodities neither supply nor demand is the clear dominant cause of instability.

I. Technique

The procedure used here to move from knowledge of price and quantity fluctuations to estimates of demand and supply fluctuations is simple.[4] It is based upon an assumption that the demand (or supply) function for a primary product can be separated into two components, one of which depends solely upon trend characteristics and the other solely upon deviations from trend characteristics—this latter component including both the economically explicable *and* the residual (i.e., random or inexplicable) influences. The demand function of some primary product can then be expressed:

$$(1)\quad Q_t = \left\{\bar{Q}_t\right\} \left\{Q_t/\bar{Q}_t\right\}$$
$$= \left\{f_d\,[\bar{P}_t, \bar{Y}_t,...]\right\} \left\{g_d\,[P_t/\bar{P}_t]\cdot e^{d_t}\right\}$$

where P_t represents the price of product in time t, Y_t real income of those countries which demand the product, and the bars over the variables indicate trend values (somehow estimated) of the variables. The function, f_d [...], is the trend component, and it "explains" the trend levels of demand (i.e., Q_t); only the components in the second brackets—whose contents will be discussed shortly—are relevant for explaining a deviation of the quantity demanded from the trend (i.e., $Q_t/\bar{Q}_t$). It is this deviations-from-trend component will be analysed in this paper. The basic demand equation is:

$$(2)\quad Q_t/\bar{Q}_t = g_d\,[P_t/\bar{P}_t]\cdot e^{d_t}$$

where the function, g_d [...], captures the short-run influence of price changes upon demand, and where the second term, e^{d_t} is the residual demand-curve-shift element which summarizes all causes of demand-curve deviations from trend other than own price deviations.

Thus, in the short run, all influences upon the demand curves other than short-run price elasticity reactions are relegated to the "residual" (i.e., e^{d_t}). This is *not simply a matter of convenience*. It would be quite unfair to blame demanders for instigating instability in a primary product market if the quantity demanded changed as a reasonable response to a price change. The cause of instability must be a shift in the demand (or supply) curve and not merely a movement along it. Equation (2) captures this distinction: the function, g_d [...], treats short-run movements along a demand curve, while the other elements, e^{d_t}, comprises all the forces which bring about short-run shifts in the demand curve. The precise composition of these forces need not be studied since, however dissimilar they are

[4] The procedure is not so original as I once thought. It was developed, for somewhat different purposes and in a somewhat different way, in an unpublished paper by S. J. Prais [5].

from some viewpoints, they are identical for present purposes in that all tend to "cause" price fluctuation by shifting the demand curve.

Taking the natural logs of equation (2) yields:

(3) $d_t = q_t + \eta p_t$

where:

$d_t = (\ln Q_t - \ln \bar{Q}_t)$

$p_t = (\ln p_t - \ln \bar{P}_t)$

η = short-run price elasticity of demand (defined positive).

d_t = the residual short-run demand-shift element.

Similarly, it is possible to derive a short-run supply curve relation:

(4) $s_t = q_t - \varepsilon p_t$

where ϵ is the short-run price elasticity of supply, and s_t the residual short-run supply-shift element.

Equations (3) and (4) provide the basis of the paper. The procedure is as follows. In Section II, the deviations of (the natural logs of) quantity and price from their trends (q_t and p_t) are calculated for each product. In Section III, various values are assumed for the short-run price elasticities of demand (η) and supply (ϵ); with these values for q_t, p_t, η, and ϵ, estimates of the residual elements of the demand curve (d_t) and the supply curve (s_t) are made. And in Sections IV and V, again for various values of the short-run price elasticities (η and ϵ), estimates are made of the extent to which price would have deviated from its trend value if various hypothetical (i.e., other than actual) demand or supply shifts had occurred. This last method is more clearly seen once equations (3) and (4) are solved explicitly for p_t:

(5) $p_t = \dfrac{d_t - s_t}{\eta + \varepsilon}$.

Just as actual fluctuations in price (p_t) and quantity (q_t) imply something about demand (d_t) and supply (s_t), given assumptions about price elasticities (η and ϵ), so also do hypothetical values for d_t and/or s_t imply something about p_t, again given assumptions about η and ϵ.

It will be convenient to refer to p_t, q_t, d_t and s_t as "percentage deviations from trend," althongh this is not strictly accurate. For example, q_t can be expanded:

(6) $q_t = \ln Q_t - \ln \bar{Q}_t$

$$= \left(\frac{Q_t - \bar{Q}_t}{\bar{Q}_t} \right) - \frac{1}{2} \left(\frac{Q_t - \bar{Q}_t}{\bar{Q}_t} \right)^2 + \frac{1}{3} \left(\frac{Q_t - \bar{Q}_t}{\bar{Q}_t} \right)^3 - \ldots$$

Since, for most commodities, the deviations from trends (of q_t, p_t, d_t or s_t) are generally small, it introduces little more than semantic inaccuracy[5] to refer to them as the "percentage deviations from trend" of quantity (q_t), price (p_t), demand curve intercept (d_t), and supply-curve intercept (s_t). The use of the word "intercept" in the preceding sentence (and hereafter) is also not strictly accurate, since constant-elasticity functions do not reach the axes.[6] For small deviations, however, d_t (or s_t) does represent the percentage by which actual Q_t demanded (or supplied) will differ from what would have been demanded (or supplied) if d_t (or s_t) had been zero.

There are almost as many ways of measuring the trend implicit in a collection of time-series data as there are economists to attempt the measurement. Without pretense that the techniques are in some way better than possible alternatives, two measurements of trend (i.e., of $\bar{Q}_t$ and $\bar{P}_t$) will be used throughout this paper. One, the least-squares regression of the natural logs of Q_t or P_t on t, and two, the three-year moving average of Q_t or P_t.[7] Both procedures have the basic advantage that they prevent the attribution of secular rises and falls to instability of schedules. One reason for considering two fairly different kinds of trend-removal is simply to gain reassurance that the results of the paper are not completely dependent upon the form chosen for the trend.[8] The other reason is more concerned with economics. The simple least-squares trend *must* relegate to the residuals any short-term cyclical variation in price or quantity, while the three-year moving average will label as trend at least some of such cyclical movements.

The concern of this paper is with the allocation of blame for *price* fluctuations. To many people, the real villain is revenue fluctuations, and these latter are a compound of price and quantity fluctuations. Blame for revenue fluctuations falls quite heavily upon demand—almost inevitably—since demand fluctuations move price and quantity in the same direction while supply fluctuations cause partially offsetting movements of price and quantity.

[5] The true percentage deviation will always be somewhat higher because of the neglected terms; for example, if q_t were 0.200, $[(Q_t - \bar{Q}_t)/\bar{Q}_t]$ would actually be 0.221.

[6] Except under special circumstances.

[7] This latter procedure causes the loss of two observations. Since there are never more than 17 annual observations, the possible use of a longer moving average was rejected.

[8] There is also the danger that the results are highly dependent upon the choice of years. Sufficient cases of dropping the initial and/or terminal year, or years, were examined to indicate that this is not so.

In summary, it is important to keep in mind throughout the paper what is being implicitly included in these residual demand-shift and supply-shift elements (d_t and s_t): for demand, all erratic (i.e., non-trend) changes owing to business conditions, technology (as concerns raw material use), consumer taste, inventory policies, import restrictions, speculation, erroneous price forecasts, etc.; and for supply, all erratic changes owing to weather, supplier irrationality, government policies (including any distortion of the relation between internal and world prices), lagged or unsystematic supply responses, unjustified price expectations, etc. Also, it must be realized that many of the ingredients of these residuals are susceptible to neither private nor public remedy, nor are they necessarily the result of error or design, so even a successful allocation (between the demand residuals and the supply residuals) of the "blame" for price instability does not necessarily imply anything about the best way to reduce this instability. Finally, it must be remembered that the measurement of these residuals depends upon the accuracy of the two basic assumptions, of separability and of the constancy of short-run price elasticities. The measured residuals will be rendered incorrect by the failure of either,[9] and the results of the paper must be accordingly discounted—though by how much cannot be known.

II. The Price and Quantity Fluctuations

The fluctuations of 46 commodities were studied over the post-World War II years.[10] After two trends (i.e., least-squares regression and three-year moving average) and the deviations of price and quantity from them were calculated, the average absolute deviation (hereafter AAD) of price and quantity from each trend was derived, along with the correlation between these price and quantity deviations. This information is presented in Table 1.[11]

For over half (i.e., 25) of the 46 commodities, the price fluctuations (AAD_p) exceed the quantity fluctuations (AAD_q), but this outcome is very dependent upon the data for minerals. Typically, both AAD_p and AAD_q are around 10% when deviations from the least-

[9] Only the separability assumption is critical if we are willing to consider the effects of a fluctuating short-run price elasticity as properly belonging in the residual.

[10] The 46 commodities are those for which price and quantity data were given in [7]. The data were supplemented at both ends of the series whenever additional comparable data could be located in [2] or [1]. The "quantity" is world export volume and the "price" is unit value of world exports.

[11] Throughout, the dispersion of variables is usually summarized by means of the AAD rather than by variance or standard deviation. The analytical virtues of these latter two (of which occasional use will be made) are more than offset by the ease with which one can draw meaning from the AAD.

squares trend are considered and around 5% when deviations from the moving average are considered. This result is plausible since cyclical movements are more fully captured in the deviations from a least-square trend.[12] The size of the fluctuations seems generally less, even for the least-squares trend, than is commonly thought, although for some commodities either or both of AAD_p and AAD_q are quite large.

The coefficients of correlation between the deviations of price and quantity (R_{pq}) have been calculated because they are believed by the U.N. to indicate whether demanders or suppliers are primarily responsible for the fluctuations.[13] Although the U.N. technique is correct only under special conditions,[14] it should be noted that, for over two-thirds of the primary products, R_{pq} is negative, suggesting that supply-curve fluctuations are the dominant cause of instability. In fact, as will be seen in the next section, when supply-curve fluctuations "clearly" exceed demand-curve fluctuations, R_{pq} will be negative, but the converse is not generally true.

The commodities in Table 1 are listed, for each of the three groups, in increasing order by the fraction of the total world exports made by Western Europe and North America (over 1959-61). There is little tendency for either AAD_p or AAD_q to change systematically as one moves down the commodities of Table 1 (within each group) from the primary products largely exported by the less advanced countries to those largely exported by the more advanced countries. There is, however, a strong tendency for AAD_p to exceed AAD_q among the products chiefly exported by the less advanced countries, and *vice versa* among those of the more advanced. For 22 of the 32 commodities principally exported by countries other than those of North America and Western Europe,[15] AAD_p exceeds AAD_q, while for 11 of the other 14 commodities, the reverse is true. A complete explanation of this phenomenon is beyond the scope of this paper, but it suggests either greater short-run price elasticity of supply (and possibly demand) of the primary products of advanced countries or that the Prebisch center-periphery dichotomy—whereby it is mainly the periphery's primary product prices and the center's manufac-

[12] Of course either AAD_p or AAD_q *may* be smaller for the least-squares trend than for the moving average. In fact, however, only for the AADq of sugar and of tea is this so.

[13] See, for example, [8], p. 58 or [9], p. 147.

[14] These conditions are spelled out in [4].

[15] In Group I, the products down through oranges and tangerines; in Group II, through linseed; and in Group III, through cotton; source : [7], p. 11. "Principally exported by" means over half the total world exports.

TABLE 1

Price and Quantity Fluctuations

AAD = Average Absolute Deviation
R = Correlation Coefficient
(p,q subscripts refer to price and quantity deviations, respectively)

Commodity	Years of Data Coverage	Least-Squares Trend			3-Year Moving Average		
		AAD_q	AAD_p	R_{pq}	AAD_q	AAD_p	R_{pq}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I. Food, Beverages, and Tobacco							
Coffee	1947-63	5·23%	27·89%	—·67	4·25%	5·01%	—·83
Cocoa	1947-63	7·46	20·29	—·62	4·63	11·18	—·75
Tea	1947-62	5·29	7·80	—·02	5·46	4·29	·08
Bananas	1947-63	4·30	4·42	·29	1·53	1·16	—·08
Mutton & Lamb	1947-62	8·34	12·42	—·07	8·28	4·54	—·31
Sugar	1947-62	4·22	5·88	—·18	4·32	3·83	·08
Rice	1947-62	9·92	8·53	—·14	4·10	4·16	—·06
Beef & Veal	1947-62	17·78	7·33	—·79	3·70	4·29	—·51
Tobacco	1947-62	4·04	3·08	—·32	3·60	1·60	·45
Oranges & Tang.	1948-62	8·19	8·07	—·83	4·20	4·22	—·71
Maize	1947-63	20·35	8·57	—·14	5·88	5·84	—·54
Wheat	1947-62	9·89	7·08	·36	6·87	3·31	·52
Barley	1947-63	20·39	12·39	—·33	6·59	6·25	·36
Pork	1950-61	14·52	6·34	·02	13·03	3·48	·42
Median (Group I)		8·26%	7·94%	—·16	4·48%	4·26%	—·07
II. Oils and Oilseeds							
Sesame Seed	1950-61	16·53%	9·74%	—·08	12·72%	4·64%	—·73
Palm Oil	1947-62	9·81	10·56	·05	2·75	6·88	—·14
Copra, Coconut Oil	1947-62	8·67	11·98	—·48	4·47	9·19	—·16

Groundnuts, Oil	1947-62	11·96	8·58	·04	4·12	6·22	—·40
Palm Kernels, Oil	1947-63	9·60	12·24	·14	2·86	6·65	—·43
Butter	1950-62	6·37	10·24	—·08	3·92	4·62	·18
Linseed, Oil	1947-62	19·18	17·77	—·64	15·13	8·92	—·69
Cotton Seed, Oil	1950-62	31·27	8·56	—·58	14·94	7·01	—·37
Oliver Oil	1947-63	21·88	14·81	—·61	21·28	7·13	—·51
Rapeseed, Oil	1950-61	21·66	8·03	·30	11·40	6·68	—·27
Soya Beans, Oil	1947-62	29·94	10·35	—·54	17·99	8·01	—·23
Tallow	1950-60	11·99	14·77	—·70	6·58	10·37	—·72
Lard	1950-62	10·49	12·41	·24	7·11	10·98	·30
Median (Group II)		11·99%	10·56%	—·08	7·11%	7·01%	—·37

III. Industrial Materials

Natural Rubber	1947-62	5·47%	21·37%	·79	3·76%	12·60%	·51
Tin Concentrates	1950-62	9·42	9·97	—·20	5·30	4·32	—·07
Abaca	1950-62	7·77	16·76	—·13	5·80	6·89	·71
Jute	1947-62	15·29	14·29	·08	7·78	7·96	—·36
Crude Petroleum	1950-62	3·08	2·70	·03	1·48	1·34	—·09
Sisal, Other Agaves	1950-61	5·33	24·20	—·13	3·08	8·39	·09
Bauxite	1950-61	5·48	1·72	—·01	2·80	1·13	—·28
Wool	1950-63	5·99	12·05	—·73	5·46	10·54	—·65
Tungsten Ore, Conc.	1950-61	22·29	33·25	·71	7·25	11·98	—·31
Lead Ore	1950-62	10·19	12·69	·25	3·05	6·77	—·51
Tin Metal	1950-62	5·82	10·85	—·56	4·30	4·48	—·48
Lead Metal	1950-62	5·39	11·58	—·62	3·73	6·34	—·63
Copper Metal	1950-62	4·33	12·55	—·44	3·79	6·43	—·28
Zinc Ore	1950-62	5·73	11·73	·48	2·66	7·10	·75
Cotton	1947-63	9·14	11·64	—·23	5·13	10·02	—·82
Solid Fuels	1950-62	7·74	5·52	·18	3·57	2·06	—·52
Zinc Metal	1950-62	5·40	15·64	—·42	3·41	7·98	·07
Aluminum	1950-62	6·44	5·61	—·37	5·64	2·07	—·15
Synthetic Rubber	1950-62	15·75	6·64	—·83	8·06	2·29	—·72
Median (Group III)		5·99%	11·73%	—·13	3·79%	6·77%	—·28
Median (All Commodities)		8·91%	10·71%	—·14	4·55%	6·30%	—·28

tured quantities that fluctuate cyclically[16]—rests on something more basic than the difference between industrial and primary production.

Most studies of primary product prices either stop at this point or analyse further these or similar statistics about the fluctuations of prices and quantities. Such studies have value for many purposes, but nothing really interesting can be said about the sources of price fluctuations until the price and quantity (or earnings) fluctuations are linked—as they will be in the next section—to underlying demand and supply movements.

III. The Implied Demand and Supply Fluctuations

The deviations of price and quantity from trend, together with an assumption about short-run demand (supply) price elasticity, permit an estimate of the deviation from trend of the demand (supply) curve intercept. These intercept-deviation estimates are, however, extremely sensitive to the demand elasticity (η) or supply elasticity (ϵ) assumed. When zero elasticities are assumed, the estimated average absolute deviation of the demand curve intercept (AAD_d) or of the supply curve intercept (AAD_s) is simply the average absolute deviation of quantity (AAD_q),[17] as given in Table 1. As the assumed values of η and ϵ are raised, generally the estimate of either AAD_d or AAD_s declines initially and later rises, while the other rises continually.[18] Almost any large value of AAD_d (or AAD_s) can be estimated if a sufficiently large η (or ϵ) is assumed.

16 For example, "The prices of primary products rise more rapidly than industrial prices in the upswing, but also they fall more in the downswing..." [6], p. 6.

17 As inspection of equations (3) and (4) shows.

18 This phenomenon is more easily explained in terms of variance. From equation (3), the variance of d_t can be derived:

$$(7)\quad \sigma^2_{dd} = \sigma^2_{qq} + 2\eta\, \sigma^2_{qp} + \eta^2\, \sigma^2_{pp}$$

Where σ_2 represents variance (or covariance) of the subscript variables. When $\eta = 0$, $\sigma^2_{dd} = \sigma^2_{qq}$. As η rises from zero, σ^2_{dd} rises or falls depending on whether $\sigma^2_{qp} \gtrless 0$, or in other words, depending on whether the correlation between p and q (i.e., R^2_{pq} in Table 1) is positive or negative. If R^2_{pq} is negative, σ^2_{dd} will fall until:

$$(8)\quad \eta = -kR_{pq}$$

where $k^2 = \sigma^2_{qq} / \sigma^2_{pp}$ Thereafter (i.e., for further increases in η), σ^2_{dd} will rise. The same holds for the supply curve, *mutatis mutandis*, with the relevant sign of R_{pq} reversed. The AAD behaves in the same fashion as the standard deviation.

As a result, if one cannot specify the plausible range of the short-run price elasticities of supply and demand beyond "zero to infinity," almost nothing can be said about the implied values of AAD_d and AAD_s. The more narrowly the ranges of η and ϵ can be specified, the more narrow the implied range of AAD_d and AAD_s. The analyst's problem is to choose (for η and ϵ) a sufficiently small range to permit meaningful conclusions about AAD_d and AAD_s but a sufficiently large range that the true values of η and ϵ are contained. Since detailed analysis of the demand and supply conditions of each of the 46 primary products is beyond the scope of this paper, we will consider the same (and hopefully, to the reader a plausible) range for all products. Basically, both the short-run price elasticities of demand and of supply are assumed to be between 0.2 and 1.0 for each product. A narrower range, between 0.2 and 0.6, is also considered (parenthetically in columns (10) and (11) of Table 2).

The range of implied values of AAD_d and AAD_s (for η and ϵ between 0.2 and 1.0) are given in Table 2, in columns (2) through (5) for deviations from the least-squares trend and in columns (6) through (9) for deviations from the three-year moving average. In columns (10) and (11), a dash (—) indicates that no definite statement can be made about the relative magnitudes of AAD_d and AAD_s; a $>$ or $<$ sign indicates, for any values of η and ϵ within the assumed range, that the AAD_d is definitely greater than or definitely less than AAD_s respectively.[19]

The range of implied values of AAD_d and AAD_s is, not unexpectedly, much lower for deviations from the moving average than for deviations from the least-squares trend. Moreover, the implied values of AAD_s are typically larger than the implied values of AAD_d. Thus the fluctuations in supply curves, from either trend, have generally been larger than fluctuations in demand curves. But not by very much. The range of implied values of AAD_s typically begins and ends about 1% higher than that of AAD_d, but there is usually a great deal of overlap.

In fact, for the larger range (i.e., $0.2 < \eta, \epsilon < 1.0$), there are only 12 products (for the least-squares trend) and 18 products (for the three-year moving average) for which it can be established that AAD_s is *definitely either larger or smaller* than AAD_s. If the narrower range (i.e., $0.2 < \eta, \epsilon < 0.6$) is acceptable then it can be established for about two-thirds of the commodities that demand

[19] When the $>$ or $<$ sign is enclosed in parentheses, it is definite only for the narrower range (i.e., $0.2 < \eta, \varepsilon < 0.6$). The range of implied values of AAD_d and AAD_s for this narrower range of η and ε is not shown in Table 2.

Table 2

Implied AAD of Demand and Supply

(d, s subscripts refer to demand and supply, respectively)

Commodity	*Least-Squares Trend*				*3-Year Moving Average*				*Definitely AAD_d > / < AAD_s*	
	Implied AAD_d		Implied AAD_s		Implied AAD_d		Implied AAD_s		L-Sq.	3-Yr.
	From	To	From	To	From	To	From	To	Trend	M.A.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I. Food, Beverages, and Tobacco										
Coffee	4·29%	28·44%	10·03%	32·34%	2·25%	3·47%	5·11%	8·57%	—	<
Cocoa	6·34	15·03	10·47	26·22	2·99	8·26	6·87	15·81	(<)	(<)
Tea	5·41	9·24	5·18	9·27	5·51	6·47	5·42	5·81	—	(>)
Bananas	4·57	6·43	4·11	5·43	1·53	1·86	1·53	2·00	(>)	—
Mutton and Lamb	7·84	13·59	9·72	16·94	7·02	7·96	8·70	11·67	(<)	<
Sugar	4·50	6·61	4·82	8·84	4·62	6·83	4·14	6·05	—	—
Rice	8·81	11·16	10·75	14·04	4·29	5·80	4·27	5·97	(<)	—
Beef and Veal	13·49	16·82	18·74	23·12	3·36	3·60	4·05	6·68	<	<
Tobacco	8·70	4·27	4·27	6·15	3·90	5·09	3·17	3·41	(<)	>
Oranges and Tang	4·31	6·63	9·74	15·97	2·92	3·60	4·80	7·83	<	<
Maize	20·48	20·76	20·22	23·03	4·73	5·29	6·52	9·77	—	<
Wheat	9·82	13·83	8·83	9·92	7·49	9·95	6·18	6·43	(>)	>
Barley	18·07	19·52	21·27	25·53	7·04	10·64	6·02	7·27	<	(>)
Pork	14·45	15·34	14·96	17·02	13·38	15·18	12·59	12·81	—	>
Median (Group I)	7·09%	13·46%	9·88%	16·46%	4·46%	6·06%	5·26%	6·98%		
II. Oils and Oilseeds										
Sesame Seed	16·32%	19·40%	17·16%	20·67%	10·40%	12·20%	13·25%	15·50%	—	<
Palm Oil	9·80	12·17	10·26	14·54	3·16	7·19	3·85	8·30	(<)	—
Copra, Coconut Oil	3·45	9·15	10·03	16·20	4·49	9·08	5·37	10·96	<	—

Groundnuts, Oil	12·30	14·66	11·97	13·73	3·34	5·82	4·72	8·23	—	(<)
Palm Kernels, Oil	10·08	16·09	9·93	14·10	2·65	7·04	3·50	8·16	—	—
Butter	6·59	10·85	6·84	11·38	4·29	6·29	3·87	5·98	—	—
Linseed, Oil	13·84	17·01	21·71	34·33	10·18	13·96	16·31	21·17	<	<
Cottonseed, Oil	26·04	30·22	32·31	37·40	14·03	14·64	15·48	18·89	<	<
Olive Oil	19·26	21·05	22·97	31·19	17·93	20·31	22·31	26·43	<	<
Rapeseed, Oil	22·41	25·72	20·34	21·08	11·15	12·53	12·40	16·38	>	(<)
Soya Beans, Oil	24·44	28·71	31·16	36·07	16·93	17·78	18·25	19·78	<	<
Tallow	8·82	13·26	13·36	22·64	4·38	8·67	7·92	15·60	(<)	(<)
Lard	11·65	17·15	10·10	14·12	7·48	12·47	6·85	11·45	(>)	—
Median (Group II)	12·30%	17·01%	13·26%	20·67%	7·48%	12·20%	7·92%	15·50%		

III. Industrial Materials

Natural Rubber	9·08%	25·74%	3·24%	17·01%	5·64%	15·04%	3·44%	10·72%	(>)	—
Tin Concentrates	8·51	11·62	10·73	16·00	5·10	7·33	5·85	8·31	(<)	—
Abaca	8·39	15·56	8·34	19·37	6·96	12·21	4·05	5·29	—	>
Jute	16·46	24·91	14·92	22·34	6·89	9·07	8·34	13·76	—	(<)
Crude Petroleum	3·17	4·43	2·97	4·37	1·42	2·02	1·54	2·12	—	—
Sisal, Other Agaves	5·45	23·83	7·45	25·27	3·49	8·91	3·32	9·40	—	—
Bauxite	5·51	6·20	5·59	6·22	2·30	2·76	2·84	3·09	—	<
Wool	4·24	10·24	7·44	16·26	4·26	9·09	6·86	13·73	(<)	(<)
Tungsten Ore, Con.	27·70	50·68	12·80	19·39	7·33	14·20	7·91	14·79	>	—
Lead Ore	10·74	16·17	9·54	11·88	2·83	6·80	3·89	8·81	(>)	—
Tin Metal	4·50	8·70	7·40	14·90	3·73	5·35	4·70	7·05	(<)	(<)
Lead Metal	4·38	9·81	7·01	15·22	3·09	5·11	4·50	8·65	(<)	(<)
Copper Metal	4·04	12·42	5·51	13·95	3·69	6·14	4·60	8·74	—	(<)
Zinc Ore	6·85	14·24	4·93	9·96	3·62	8·29	1·71	6·13	(>)	(>)
Cotton	9·00	12·84	9·67	15·72	2·91	6·89	6·72	14·47	—	(<)
Solid Fuels	7·64	9·49	7·86	8·98	3·22	3·47	3·77	5·12	—	<
Zinc Metal	4·74	14·53	6·43	17·47	4·11	9·11	3·36	7·49	—	—
Aluminum	5·91	6·92	7·03	10·34	5·44	5·60	5·68	6·13	<	<
Synthetic Rubber	10·01	14·42	17·08	22·39	6·04	7·66	8·46	10·07	<	<
Median (Group III)	6·85%	12·84%	7·44%	15·72%	3·73%	7·33%	4·50%	8·65%		
Median (All Comm.)	8·66%	14·33%	9·00%	16·10%	4·39%	7·50%	5·24%	8·61%		

or supply definitely fluctuated more.[20] Whenever this analysis establishes that the AAD_d of a commodity is definitely larger than the AAD_s, it is also always true that the R_{pq} (in Table 1) is positive; and for the AAD_d definitely smaller than the AAD_s, the R_{pq} is always negative. Nevertheless, a very narrow (and possibly quite implausible) range of values of η and ϵ may be implied if the sign of R_{pq} is to be always interpreted as saying something definte about relative sizes of AAD_d and AAD_s. For more than a dozen commodities, even the narrower η-ϵ range is insufficiently small to permit such conclusions.

For purposes of assessing blame, however, magnitudes must be known as well as signs. Even when the narrow η-ϵ range is assumed, there is not a single product for which one can say that AAD_d is at least twice or less than half AAD_s If any simple generalization comes out of Table 2, it is that large supply fluctuations and large demand fluctuations go together—differences between AAD_d and AAD_s are difficult to ascertain.

On a methodological level, the moral of the exercise so far is that it is not easy to assess accurately the "blame" for primary product price fluctuations. It requires a very specific set of assumptions (whether implicit or explicit) about the trend around which fluctuations are to be measured and about short-run price elasticities. On an economic level, the conclusion is that even after these specific assumptions are made, there are few commodities for which either demand or suply has clearly fluctuated more than the other.

IV. Effect of Removing Demand or Supply Fluctuations

While rough knowledge of the relative magnitudes of the fluctuations of supply and demand is not easily acquired, even precise knowledge of AAD_d and AAD_s would be insufficient to allocate the blame for price fluctuations. To do that requires the answer to the question: How large would the price fluctuations have been if either the demand or the supply fluctuations could have been removed? The answer to this depend not only upon the AAD_d and AAD_s but also upon the extent to which demand and supply fluctuate directly or inversely.

[20] It is reassuring that for only 3 of the 46 products do the definite results about one trend's deviations flatly contradict those of the other (i.e., tobacco, barley, and rapeseed). This may result from (1) statistical aberration, (2) an assumed range of η and ε that fails to contain the true values, and /or (most likely), (3) the fact that different meanings should be given to deviations from different trends.

This relationship is more readily seen in terms of variance rather than AAD. The variance of prices can be derived from equation (5):

$$(9)\quad \sigma^2_{pp} = \frac{\sigma^2_{dd} - 2R_{ds}\,\sigma_{dd}\,\sigma_{ss} + \sigma^2_{ss}}{(\eta + \varepsilon)^2}$$

where σ^2 refers to the variance of the subscript variables (and σ to the standard deviation), and R_{ds} is the correlation between the demand-intercept and supply-intercept fluctuations. Inspection of equation (9) shows that, if R_{ds} is negative, removal of either demand or supply fluctuations (i.e., setting σ^2_{dd} or σ^2_{ss} equal to zero) will definitely reduce the variance of prices (i.e., σ^2_{pp}). If R_{ds} is positive on the other hand, it is possible that the removal of either demand variance or supply variance would not reduce the variance of prices. Thus, upon the value of R_{ds} depends greatly the extent to which demand (or supply) fluctuations cause price fluctuations which would not have occurred had the demand (or supply) fluctuations not occurred.

Because of the visual convenience, we now return to the AAD from of reporting data.[21] From equation (5), it is clear that:

$$(10)\quad AAD_p \ (\text{when } AAD_d = 0) = \frac{AAD_s}{\eta + \varepsilon}$$

and

$$(11)\quad AAD_p \ (\text{when } AAD_s = 0) = \frac{AAD_d}{\eta + \varepsilon}.$$

These hypothetical values of AAD_p will clearly be different for every different assumed value of η or ϵ. In Table 3, the hypothetical values of AAD_p are reported, for each of the two trends and for each of two sets of values of η and ϵ: $\eta = \epsilon = 0.6$ and $\eta = \epsilon = 1.0$. In almost all cases, the hypothetical AAD_p rises as either lower values of η *and/or* lower values of ϵ are considered.[22] Thus, the hypothetical values of AAD_p given in Table 3 essentially represent the lowest values AAD_p could reach if demand (or supply) fluctuations were entirely removed and if the short-run price elasticities were each no greater than 0.6 (or 1.0).[23]

[21] All computations were actually done for both AAD and σ. None of the conclusions of this section would be much altered were the findings reported in terms of σ.

[22] And the exceptions rarely differ by more than one percentage point. For price variances (i.e., σ^2_{pp}) it can be proven that lower values of ε necessarily raise the hypothetical σ_{pp} when σ_{ss} is assumed zero (and that lower values of η necessarily raise it when σ_{dd} is zero).

[23] No figures are given for price elasticity assumptions lower than $\eta = \varepsilon = 0.6$ because, with very few exceptions, the resulting hypothetical values of AAD_p are above, and frequently greatly above, the actual values of AAD_p.

The most basic conclusion to be drawn from Table 3 is that—as expected—the fluctuations in price (AAD_p) would have typically been reduced at least somewhat had either demand fluctuations (AAD'_d) or supply fluctuations (AAD_s) been removed. Nevertheless, two less expected results also appear. One, for relatively few commodities would the removal of either demand or supply fluctuations reduce the price fluctuation by as much as one-half. At most (where the least-squares trend and the $\eta = \epsilon = 1.0$ assumption were used), for only 17 of the 46 commodities would a complete removal of demand *or* supply fluctuations have reduced AAD_p by one-half of the actual level.[24] And two, for a great many commodities, by either trend assumption and especially if price elasticities less than 0.6 are considered, price fluctuations are increased by removal of the demand fluctuation and also by removal of the supply fluctuations. In other words, removal of *either* source of price fluctuations would have increased the price fluctuations for 17 (by the least-squares trend) or 19 (by the three-year moving average) commodities, provided price elasticities were less than 0.6. All this implies that, for a large number of products, the correlation between demand and supply shifts must be significantly positive in the ranges studied.

For the primary products largely exported by advanced countries, there is a possible explanation of this phenomenon along the lines that the same factors which increase advanced countries' demands for products in general simultaneously increase supplies of products in general. And indeed there is some tendency in Table 3, especially in Groups I and II, for the products largely exported by North America and Western Europe (i.e., farther down the list[25]) to be the ones with asterisks. But one cannot easily make such an argument for exports going predominantly from other regions to North America and Western Europe.[26] Higher assumed values of the price elasticities will lower these observed positive correlations between demand and supply fluctuations.[27] It is hard to resist wondering

[24] 13 by removal of supply fluctuations, 4 by demand.

[25] Recall that the products are listed (in Tables 1, 2, and 3), within each group, in increasing order by the fraction of total world exports made by North America and Western Europe.

[26] The argument would require an assumption of price-stabilizing speculative activities in these markets. However, in a simple model such as that used here, where stocks are not explicitly considered, consistent speculative responses to price changes are more correctly handled in higher price elasticities than in shifts of the curves.

[27] This fact can be seen intuitively by examination of equations (3) and (4). When η and ε are assumed zero, R_{ds} is plus one, and as η and ε tend to infinity, R_{ds} approaches minus one. There always exist values of η and ε for which R_{ds} is zero.

TABLE 3

AAD of Price If Demand or Supply Fluctuations Were Removed

Commodity	For Least-Squares Trend					For 3-Year Momving Average				
	Actual AAD_p	AAD_p If Demand Fluctuations Were Removed		AAD_p If Supply Fluctuations Were Removed		Actual AAD_p	AAD_p If Demand Fluctuations Were Removed		AAD_p If Supply Fluctuations Were Removed	
		When $\eta = \varepsilon =$ 0·6	1·0	0·6	1·0		When $\eta = \varepsilon =$ 0·6	1·0	0·6	1·0
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I. Food, Beverages and Tobacco										
Coffee	27·89%	17·65%	16·17%	10·41%#	11·72%#	5·01%	5·69%*	4·28%	1·89%#	1·62%#
Cocoa	20·29	15·27	13·11	7·08 #	7·52#	11·18	9·45	7·90	3·58#	4·18#
Tea	7·80	5·63	4·63	5·82	4·62	4·29	4·57*	2·90	4·94*	3·24
Bananas	4·42	3·72	2·71	4·46*	3·21	1·16	1·45*	1·00	1·35*	0·93
Mutton and Lamb	12·42	10·96	8·47	7·70	6·79	4·54	8·31*	5·83*	6·11*	3·69
Sugar	5·88	5·57	4·42	4·47	3·31	3·83	4·07*	3·03	4·47*	3·17
Rice	8·53	10·35*	7·47	7·85	5·58	4·16	4·14	2·99	3·93	2·90
Beef and Veal	7·33	17·44*	11·56*	12·42*	6·74	4·29	4·23*	2·34	2·84	1·78#
Tobacco	3·08	4·24*	3·07	3·11*	2·13	1·60	2·64*	1·64*	3·75*	2·55*
Oranges and Tang.	8·07	10·71*	7·98	3·96 #	2·19 #	4·22	5·12*	3·92	2·50	1·56#
Maize	8·57	17·76*	11·51*	17·16*	10·38*	5·34	6·49*	4·89	3·95	2·62#
Wheat	7·08	7·49*	4·96	9·36*	6·66	3·31	5·25*	3·09	7·27*	4·98*
Barley	12·39	19·18*	12·76*	15·06*	9·08	6·25	5·21	3·64	7·20*	5·32
Pork	6·34	13·21*	8·51*	12·54*	7·82*	3·48	10·49*	6·41*	11·85*	7·59*
Median (Group I)	7·94%	10·84%*	8·22%*	7·78%	6·70%	4·26%	5·16%*	3·49%	3·94% [illegible]	3·04%

Commodity	*For Least-Squares Trend* Actual AADp	AADp If Demand Fluctuations Were Removed		AADp If Supply Fluctuations Were Removed		*For 3-Year Moving Average* Actual AADp	AADp If Demand Fluctuations Were Removed		AADp If Supply Fluctuations Were Removed	
		When $\eta = \varepsilon =$ 0·6	1·0	0·6	1·0		When $\eta = \varepsilon =$ 0·6	1·0	0·6	1·0
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
II. Oils and Oilseeds										
Sesame Seed	9·74%	15·64%*	10·34%*	14·50%*	9·70%	4·64%	11·92%*	7·75%*	9·31%*	5·20%*
Palm Oil	10·56	10·30	7·27	8·22	6·09	6·88	5·05	4·15	4·16	3·60
Copra, Coconut Oil	11·98	10·76	8·10	5·51 #	4·58 #	9·19	6·37	5·48	5·03	4·54 #
Groundnuts, Oil	8·58	10·27*	6·86	11·03*	7·33	6·22	5·24	4·12	3·19	2·66
Palm Kernels, Oil	12·24	9·53	7·05	10·30	8·05	6·65	4·72	4·08	3·74	3·52
Butter	10·24	6·81	5·69	6·90	5·43	4·62	3·79	2·99	4·21	3·14
Linseed, Oil	17·77	22·86*	17·16	11·88	7·50 #	8·92	15·55*	10·59*	9·67*	5·09
Cottonseed, Oil	8·56	28·86*	18·70*	23·44*	13·02*	7·01	14·28*	9·41*	11·84*	7·32*
Olive Oil	14·81	22·29*	15·60*	16·36*	9·82	7·13	20·21*	13·22*	15·52	8·97*
Rapeseed, Oil	8·03	17·04*	10·45*	20·05*	12·86*	6·68	11·99*	8·19*	9·43*	6·27
Soya Beans, Oil	10·35	28·01*	18·03*	21·94*	12·22*	8·01	15·82*	9·89*	14·46*	8·46*
Tallow	14·77	14·20	11·32	7·78	6·68 #	10·37	9·80	7·80	4·59 #	4·34 #
Lard	12·41	9·27	7·06	11·73	8·57	10·98	6·68	5·72	7·97	6·23
Median (Group II)	10·56%	14·20%*	10·34%	11·73%*	8·05%	7·01%	9·80%*	7·75%*	7·97%*	5·09%

III. Industrial Materials

Natural Rubber	21·37%	7·06%#	8·50%#	14·33%	12·87%	12·60%	5·24%#	5·36%#	8·34%	7·52%
Tin Concentratés	9·97	11·14*	8·00	7·88	5·81	4·82	5·90*	4·15	4·96*	3·66
Abaca	16·76	10·81	9·68	9·29	7·78#	6·89	3·52	2·65#	7·98*	6·10
Jute	14·29	14·43*	11·17	16·91*	12·46	7·96	9·07*	6·88	5·95	4·54
Crude Petroleum	2·70	2·86*	2·19	3·14*	2·21	1·34	1·50*	1·06	1·39*	1·01
Sisal, Other Agav.	24·29	13·34	12·68	11·76#	11·91#	8·39	5·07	4·70	4·72	4·46
Bauxite	1·72	4·88*	3·11*	4·87*	3·10*	1·13	2·43*	1·54*	2·23*	1·30*
Wool	12·05	9·65	8·13	4·90#	5·12#	10·54	8·58	6·86	4·88#	4·55#
Tungsten Ore, Con.	33·25	10·71#	9·69#	32·66	25·34	11·98	8·95	7·40	8·39	7·10
Lead Ore	12·69	8·11	5·94#	9·96	8·08	6·77	5·28	4·41	3·51	3·40
Tin Metal	10·85	9·29	7·45	4·43#	4·35#	4·48	4·83*	3·53	3·11	2·68
Lead Metal	11·58	8·86	7·61	5·10#	4·91#	6·34	5·40	4·33	3·08#	2·56#
Copper Metal	12·55	7·88	6·97	6·29	6·21#	6·43	5·56	4·37	3·52	3·07#
Zinc Ore	11·73	5·48#	4·98#	8·42	7·12	7·16	2·72#	3·06#	4·71	4·14
Cotton	11·64	9·78	7·86	8·23	6·42	10·02	8·83	7·24	3·01#	3·44#
Solid Fuels	5·52	6·86*	4·49	6·76*	4·75	2·06	3·62*	2·56*	2·74*	1·67
Zinc Metal	15·64	9·75	8·74	7·26#	7·27#	7·98	3·80#	3·75#	5·12	4·55
Aluminum	5·61	7·17*	5·17	5·19	3·46	2·07	4·83*	3·06*	4·60*	2·72*
Synthetic Rubber	6·64	16·44*	11·20	9·98*	5·01	2·29	7·72*	5·04*	5·71*	3·02*
Median (Group III)	11·73%	9·29%	7·86%	7·88%	6·21%	6·77%	5·24%	4·33%	4·71%	3·41%
Median (All Comm.)	10·70%	10·32%	8·05%	8·32%	6·76%	6·30%	5·26%	4·30%	4·66%	3·63%

Meaning of Symbols in Columns (3) — (6) and (8) — (11):

* Means the hypothetical AAD_p is larger than the relevant actual AAD_p (in column (2) or (7)).

Means the hypothetical AAD_p is less than half the relevant actual AAD_p (in column (2) or (7)).

whether the assumption of 0.6 or 1.0 for the short-run price elasticities of many of these products is on the low side. It is to an investigation of this possibility that the next section is devoted.

If, on the other hand, consideration of short-run price elasticities higher than traditional wisdom allows is rejected, then one conclusion seems inescapable: neither supply nor demand fluctuations can be justly blamed as principal causes of price fluctuations for most commodities. Only for a few commodities would complete removal of supply fluctuations or complete removal of demand fluctuations have reduced the fluctuations of price around trend (AAD_p) by as much as one-half of the actual. For neither trend and for neither elasticity assumption ($\eta = \epsilon = 0.6$ or 1.0) is the number of such products ever above 17. For the other 29 of the 46 commodities studied, the *interdependency* of the fluctuations of demand and supply is the basic cause of price fluctuation. Under the circumstances, efforts to blame demanders or suppliers for causing price fluctuation are to a great extent misdirected from the beginning; and more importantly, efforts to cure the price fluctuations by attempting to remove either supply fluctuations or demand fluctuations *alone* would have met with mild success at best during the post-War period.

V. Uncorrelated Demand and Supply Fluctuations

While there are many economic links between the different countries of the world, it is difficult to explain the frequently large positive implied correlations (found in Section IV) between demand-shifts and supply-shifts for primary products. In this section, we will begin by assuming that the demand and supply fluctuations for each product are completely uncorrelated; we can then find out something about the price elasticities (η and ϵ) that this assumption implies and finally, we can again attempt to allocate the blame for price destabilization.

This procedure will, the reader should be warned, force frequent consideration of short-run price elasticities of supply and demand greater than unity—and often much greater. Those who find this absurd are stuck with the findings of Section IV. But the situation is not clearly so absurd as it may at first seem. It must be remembered that we are dealing here with traded quantities, and to the extent that exported products are partly self-consumed and imported products partly self-produced, the demand and supply schedules refer to *excess* demand (above own production and *excess* supply (above own consumption). Even where short-run total production elasticities and total demand elasticities are low, excess supply and excess demand elasticities may be high.[28]

From equations (3) and (4), it is possible to derive an expression for the covariance of demand-shifts (d_t) and supply-shifts (s_t):

(12) $\sigma^2_{ds} = \sigma^2_{qq} + (\eta - \varepsilon) R_{pq} \sigma_{qq} \sigma_{pp} - \eta \varepsilon \sigma^2_{pp}$.

Since the variance of quantity fluctuations (σ^2_{qq}), the variance of price fluctuations (σ_{pp}), and their correlation (R_{pq}) are known from the data, the assumption of a zero correlation between demand-shifts and supply-shifts (i.e., $R_{ds} = \sigma^2_{ds} = 0$) implies a relationship between η and ϵ:

(13) $$\eta = \frac{k^2 - k \varepsilon R_{pq}}{\varepsilon - k R_{pq}}$$

where k is, as earlier, σ_{qq}/σ_{pp}. These implied values of η, for two values of ϵ (i.e., 0.6 and 1.4) and for each of the two trend elimination schemes, are given in Table 4, in columns (2), (4), (6), and (8). Asterisks in those columns—there are 13—indicate that the implied η is negative.[29] Inspection of equation 13 shows that this can only happen if R_{pq} is positive,[30] and if k $R_{pq} > 0.6$ (which would cause a negative η at $\epsilon = 0.6$) or if k/ $R_{pq} < 1.4$ (which would cause a negative η at $\epsilon = 1.4$). Such results, if frequent, would suggest the error of either the zero R_{ds} assumption or the 0.6—1.4 range of ϵ. Since the asterisks are, however, few, they are considered aberrations and ignored throughout the remainder of this section.

There is a smooth (hyperbolic) relation between η and ϵ in equation (13); thus, moving from lower to higher values of ϵ implies steadily decreasing values of η.[31] The technique cannot tell us which point on the hyperbola represents the "true" set of price elasticities;[32] the range, $0.6 < \epsilon < 1.4$, is chosen partly arbitrarily, partly because it seems plausible, and partly because it tends typically to yield values of η in the same range. (This choice will be discussed again later.) Table 4 presents the implied range of values of η when ϵ is between 0.6 and 1.4.

[28] Consider for example the elasticity of export supply (i.e., excess supply) of a product which a country produces and partly self-consumes. If the shortrun price elasticity of production is 0.4, that of domestic demand is 1.0 and half of total production is exported, the shortrun price elasticity of export supply is 1.8. See [10], pp. 43-45, for a derivation of the intrrelation of these elasticities.

[29] Recall that η is defined positive, so a negative η imples an upward-sloped short-run demand schedule.

[30] True for less than half the products. See Table 1, columns (5) and (8).

[31] Provided the asymptote is not crossed.

[32] "True," provided the assumption of a zero correlation between demand and supply is correct.

TABLE 4

Percent of Price Variance Due to Demand (DBP) If R_{ds} is Zero

Commodity	Least-Squares Trend				3-Year Moving Average			
	If $\varepsilon = 0{\cdot}6$		If $\varepsilon = 1{\cdot}4$		If $\varepsilon = 0{\cdot}6$		If $\varepsilon = 1{\cdot}4$	
	Implied η	DBP	Implied η	DBP	Implied η	DBP	Implied η	DBP
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
I. Food, Beverages, and Tobacco								
Coffee	0·18	4·62%	0·17	1·12%	0·78	10·90%	0·72	4·29%
Cocoa	0·35	11·62	0·30	3·33	0·37	7·73	0·33	2·28
Tea	0·56	47·07	0·25	14·34	2·87	85·58	1·04	46·78
Bananas	2·61	90·35	0·52	42·20	2·61	77·77	1·29	43·76
Mutton and Lamb	1·12	61·80	0·53	24·71	2·57	65·36	1·69	38·69
Sugar	0·71	45·36	0·40	15·67	1·60	75·95	0·59	53·31
Rice	1·75	68·04	0·93	33·34	1·51	68·67	0·72	30·99
Beef and Veal	2·73	25·33	2·52	16·25	1·18	37·38	0·90	16·83
Tobacco	1·78	58·07	1·17	29·91	*	*	10·67	97·00
Oranges and Tang.	1·01	13·16	0·93	5·78	1·06	22·20	0·92	9·80
Maize	5·44	85·14	3·01	61·55	1·17	35·12	0·91	15·81
Wheat	5·26	96·64	0·72	52·90	*	*	3·76	90·74
Barley	2·73	65·55	1·83	39·76	2·88	92·68	0·43	42·49
Pork	13·35	96·15	5·33	80·12	*	*	*	*
Median (Group I)	1·76	59·94%	0·82	27·31%	1·51	65·36%	0·91	83·31%
II. Oils and Oilseeds								
Sesame Seed	5·02	86·67	2·50	60·32	3·67	34·63	3·34	24·24
Palm Oil	1·57	74·66	0·61	32·87	0·23	21·57	0·13	5·23
Copra, Coconut Oil	0·75	30·21	0·56	11·22	0·33	28·19	0·19	7·53
Groundnuts, Oil	3·77	87·68	1·48	53·51	0·76	35·02	0·54	12·95
Palm Kernels, Oil	1·45	76·60	0·47	31·55	0·31	16·11	0·23	4·36
Butter	0·70	50·13	0·34	16·79	0·82	66·34	0·23	21·67

Linseed, Oil	1·16	28·29	0·97	12·89	1·84	30·87	1·60	17·04
Cotton Seed, Oil	4·32	52·41	3·66	37·94	3·66	67·52	2·61	45·49
Olive Oil	2·27	41·43	1·89	24·51	4·47	59·14	3·64	42·97
Rapeseed, Oil	*	*	9·55	94·40	4·19	75·32	2·73	52·05
Soya Beans, Oil	4·19	55·50	3·46	39·73	5·40	80·45	3·45	59·27
Tallow	0·68	16·75	0·59	6·18	0·50	11·75	0·44	3·84
Lard	1·51	81·23	0·36	32·16	0·90	73·86	0·16	23·29
Median (Group II)	1·54	53·96%	0·97	32·16%	0·90	35·02%	0·54	21·67%
III. Industrial Materials								
Natural Rubber	*	*	*	*	0·01	28·46	*	*
Tin Concentrates	1·33	58·62	0·76	26·09	2·91	80·23	1·40	46·68
Abaca	0·39	33·29	0·21	9·30	10·87	99·76	*	*
Jute	3·36	87·62	1·21	50·56	1·20	47·37	0·81	20·88
Crude Petroleum	1·60	74·09	0·65	33·13	1·45	66·38	0·72	29·73
Sisal, Oth. Agaves	0·11	11·13	0·07	2·38	0·20	28·93	0·06	6·55
Bauxite	18·36	96·63	8·18	84·97	4·58	76·00	3·04	53·98
Wool	0·43	9·88	0·38	3·06	0·40	12·10	0·34	3·64
Tung. Ore, Conc.	0·51	83·75	*	*	0·45	28·34	0·30	8·49
Lead Ore	1·12	76·08	0·26	26·86	0·35	15·43	0·28	4·40
Tin Metal	0·57	21·38	0·45	7·22	1·01	36·14	0·75	15·17
Lead Metal	0·50	16·32	0·41	5·28	0·78	22·75	0·64	8·75
Copper Metal	0·22	11·34	0·17	2·81	0·59	35·76	0·37	11·75
Zinc Ore	0·22	54·33	*	*	*	*	*	*
Cotton	0·86	47·21	0·51	17·70	0·45	6·79	0·42	2·16
Solid Fuels	6·22	95·19	1·62	62·61	2·14	48·02	1·67	27·47
Zinc Metal	0·26	13·88	0·20	3·58	0·36	40·96	0·13	10·70
Aluminum	1·60	53·08	1·09	26·42	8·22	88·46	4·79	70·62
Synthetic Rubber	2·53	20·62	2·38	12·95	3·73	35·82	3·38	25·18
Median (Group III)	0·72	50·14%	0·48	15·32%	0·90	35·98%	0·68	13·46%
Median (All Comm.)	1·39	53·70%	0·65	26·09%	1·18	36·76%	0·74	21·38%

Meaning of Symbols in Columns (2) — (9) :
* indicates that the implied value of η is negative. Such estimates are ommitted in the calculations of the medians.

As inspection of Table 4 shows, rarely is the sum of the short-run price elasticity of supply and the short-run price elasticity of demand as low as unity, and the medians suggest that the sum of η and ϵ is around 2.0 for the typical primary product.[33] Even when ϵ is as high as 1.4, barely one-half of the implied values of η are less than unity[34] and almost one-fourth exceed two.[35] A belief in near independence of demand and supply fluctuations forces one to consider short-run price elasticities of demand and supply of primary products in the neighbourhood of unity.

When the correlation between demand and supply fluctuations is assumed zero, it is possible to allocate the full blame for price fluctuations without the possibility that interdependence will prove important. At $R_{ds} = 0$, equation (9) becomes:

$$(14) \qquad \sigma^2_{pp} = \frac{\sigma^2_{dd} + \sigma^2_{ss}}{(\eta + \varepsilon)^2} \,.$$

The percentage of the price variance which is attributable to demand fluctuations (i.e., the "demand blame percentage"; hereafter DBP) is then:

$$(15) \qquad DBP = \frac{\sigma^2_{dd}}{\sigma^2_{dd} + \sigma^2_{ss}}$$

where σ^2_{ss} is estimated for some arbitrary value of ϵ, and σ^2_{dd} is then evaluated at the implied value of η (from equation (13)). The DBP's are presented in Table 4, in columns (3), (5), (7), and (9), for two values of ϵ (i.e., 0.6 and 1.4) and for each trend-removal schema. This DBP may also be interpreted as the ratio of hypothetical price variance, if supply fluctuations were removed, to actual price variance.

Even under the assumption that $R_{ds} = 0$, it is impossible to place this blame for price instability without an assumption about the short-term price elasticities (i.e., explicitly about one of ϵ or η, and implicitly about the other). Although again the selection of this assumption is arbitrary, let us consider the DBP's over the range of values of ϵ from 0.6 to 1.4.[36] Consideration of values of ϵ lower than 0.6 would raise DBP's and of values of ϵ higher than 1.4 would lower DBP's (although of course differently for different products).

[33] In the ranges being considered here (i.e., $0.6 < \varepsilon < 1.4$).

[34] 27 of 43 (by least-squares trend) or 26 of 42 (by 3-year moving average), neglecting commodities with negative implied values of η.

[35] 9 by least-squares trend and 10 by 3-year moving average (though not always the same commodities).

[36] And the implied range of η values shown in Table 4. For all products considered, the DBP declines steadily as the assumed value of ε rises (and hence the assumed value of η falls). When $R_{pq} > 0$, DBP falls from 1.00 (when $\varepsilon = kR_{pq}$) to R^2_{pq} (when $\varepsilon = k/R_{pq}$); when $R_{pq} < 0$, DBP falls from $(1 - R^2_{pq})$ (when $\varepsilon = 0$) to zero (as ε approaches zero).

There are several aspects of these DBP's in Table 4 worth noting. One, for about half the products, by either trend, supply is definitely the dominant cause of price fluctuations.[37] Two, for very few commodities is demand definitely the dominant cause of price instability.[38] Three, for the rest (i.e., about one-third) of the products, a narrower range of assumed ϵ (and hence η) values is needed in order to know definitely the dominant cause of price instability. And four, demand is typically less to blame for price deviations from the three-year moving average than for price deviations from the least-squares trend. This is not unexpected, since the moving average removes at least some of the cyclical elements which are more likely to have increased demand fluctuations than supply fluctuations.

Although one must keep in mind all the assumption upon which the work of this section is founded, the essence of the results is that supply, more often than demand, has been the dominant cause of the price fluctuations of primary products in the post-War years. The more relevant lessons are, however, two. One, for many commodities clear attribution of blame cannot be made without very specific knowledge of the short-run price elasticities of demand and supply. And two, in order to place confidence in the blame-allocations of this section, one must first accept the sizeable short-run price elasticities that are implied.

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[37] I.e., for 19 of 42 products by the least-squares trend and for 24 of 40 products by the three-year moving average. "Dominant cause" means that DBP is less than 50% for all values of ε between 0.6 and 1.4.

[38] I.e., for 8 products by the least-squares trend and for 4 products by the three-year moving average. The numbers would be somewhat greater if one considered the asterisked commodities of Table 4 (in those regions of values of ε where a positive η is implied).