CHAPTER III

DESCRIPTION OF THE MODEL. SUPPLY OR PRICE EQUATIONS FOR GOODS AND SERVICES

(3.0) General Introduction

Using the language of static economic theory, the relations to be considered here may be of either of two types. In the first place, they may be *supply relations* which connect up price, quantity sold and certain "supply factors" of which the characteristic is that they act only on the supply side, all "demand factors" being excluded. Let p be the price, u_S the quantity supplied, F_S a supply factor — *e.g.*, unit cost — then a supply relation will be of the form: $u_S = f_1 (p, F_S)$. A linear approximation will be of the form:

$$u_S = \omega_{1p} p + \omega_{1S} F_S \qquad (3.01).$$

The relations to be considered here, however, may also result from the combination *of a demand and a supply relation*, which is obtained by putting equal to each other the quantity demanded and the quantity supplied, and then eliminating this quantity.

Calling F_D any demand factor — *e.g.*, income — the demand relation will be of the form: $u_D = f_2 (p, F_D)$; with a linear approximation:

$$u_D = \omega_{2p} p + \omega_{2D} F_D \qquad (3.02).$$

To apply both relations to the price actually prevailing and the quantity u actually sold, we have to put the quantity demanded u_D equal to the quantity supplied u_S, and we get, in the case of the linear approximations:

$$\omega_{1p} p + \omega_{1S} F_S = \omega_{2p} p + \omega_{2D} F_D$$

which may be written

$$(\omega_{1p} - \omega_{2p})\ p + \omega_{1S}F_S - \omega_{2D}F_D = 0$$

or $p = \dfrac{\omega_{2D}F_D - \omega_{1S}F_S}{\omega_{1p} - \omega_{2p}}$ (supposing $\omega_{1p} \neq \omega_{2p}$).

In general:

$$p = f_3\ (F_D,\ F_S) \qquad (3.03).$$

Such a relation, which may for shortness be called a *price equation*, connects the price with supply factors and demand factors, but does not contain the quantity sold. It will be clear that a system of two relations consisting of a demand equation (3.02) and a supply equation (3.01) is equivalent to a system of two relations consisting of a price equation (3.03) and either the demand or the supply equation, since the third equation in each case may be deduced from the two others. It will therefore simply depend on the circumstances which of these three systems will be given. In general the demand equation will be given as such (*cf.* Chapter II), but either the supply or the price equation will also be given (in this chapter).

This procedure is only completely valid for some special types of market which exhibit freedom of supply and — as a necessary counterpart — absolute adaptability of prices. In many modern markets, this is no longer the case. Prices are "sticky" and supply is not entirely free. The demand relation in general remains in existence, although it, too, may, for psychological reasons, not react to prices immediately, but only with a lag. The supply relation takes rather the form of a "price fixation relation" — *i.e.*, of a relation telling on what factors producers or sellers base themselves when fixing the price. This relation contains the same variables as the old supply relation, but price is effect rather than cause and may therefore be lagged behind quantities and supply factors.

Using the symbols just introduced, it could be written in the form

$$p = f'_1 (F_S, u_S) \text{ or}$$
$$p = \pi_F F_S + \pi_u u_S \qquad (3.04)$$

which replaces (3.01).

The fixing of price may also be effected by negotiations with the demand side (*e.g.*, the labour market) and thus depend also on demand factors; but in this case demand factors can always be eliminated again by using the demand equation, and therefore the price fixation equation in its first form may still be used.

Some applications of these notions are to be found in the following sections.

(3.1) "Explanation" of Wage Rate

The equation introduced here is a price fixation equation which, as has already been said, may be considered as a supply equation for labour, although serious objections can be raised against this terminology, in as much as it presupposes a free market. It has been assumed that wages, if looked at from the workers' standpoint, will depend on —

(i) employment,

(ii) cost of living,

(iii) labour productivity,

(iv) institutional factors, such as the changing strength of trade unions, legislation, etc.

Employment is, as far as its fluctuations are concerned, intimately correlated with volume of production. Therefore $u + v$ has been taken for the first series.

Cost of living p has also been included, whereas, for the period 1919-1932, the two remaining factors are considered as trend factors. (For the extrapolation through 1934, this hypothesis would no longer be valid.)

In view of the stickiness of wages, a lag has been introduced — though this procedure increases the difficulty of applying the ordinary concept of "elasticity of supply". The length of the lag is established by correlation analysis in introducing the wage rate of the following year l_{+1} as one of the "independent" variables.[1] This leads to a regression equation

$$l = 0.52(u + v) + 0.67p - 0.72l_{+1} + 0.89t,$$

which may be written in the form

$$l + 0.72l_{+1} = 0.52(u + v) + 0.67p + 0.89t,$$

or, combining the two terms in the left-hand member of the equation and dividing by 1.72:[2]

$$l_{+0.42} = 0.30\,(u+v) + 0.39p + 0.51t. \qquad (3.1).$$

The lag in wages would thus be about five months. The average "elasticity of the supply of labour" (using this term with the reservations just mentioned) would be $\frac{1}{0.30} \times \frac{\bar{l}}{\bar{u} + \bar{v}}$ = about 4.0.[3]

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[1] It may be added that almost the same result is obtained if one starts with a calculation "explaining" l_{+1} by l, $u + v$, p and t (*i.e.*, when another elementary regression is used).

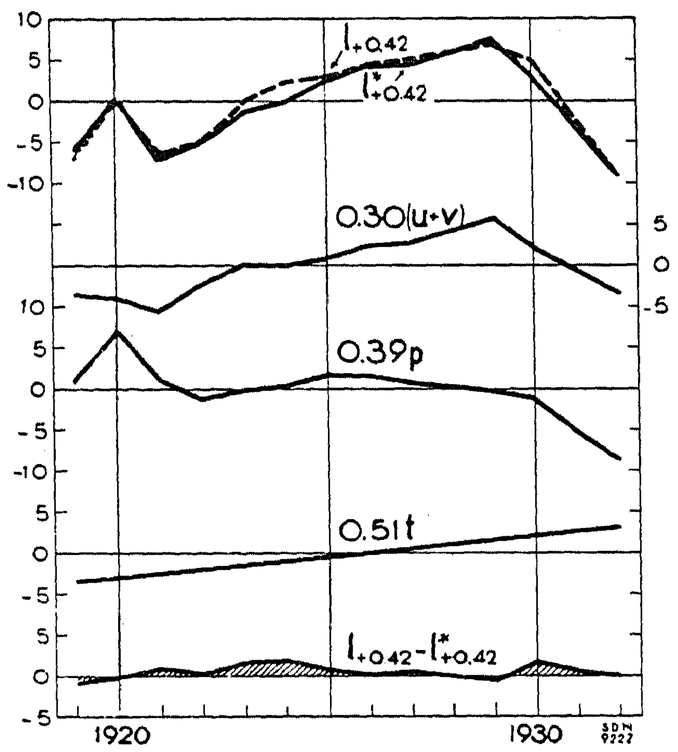
[2] The formula used is

$$\alpha_1 l + \alpha_2 l_{+1} = (\alpha_1 + \alpha_2)\, l_{+\frac{\alpha_2}{\alpha_1+\alpha_2}}$$

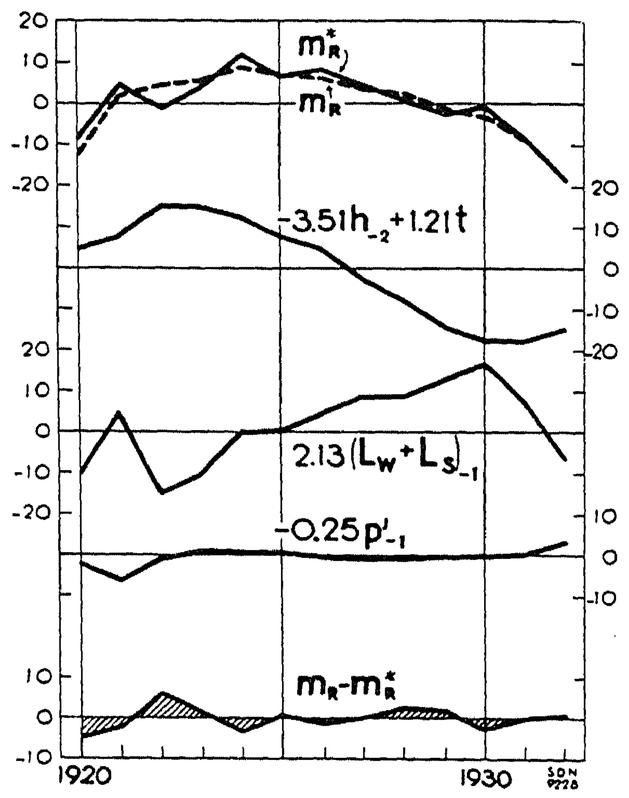
which is strictly valid only for a rectilinear development of l during any two consecutive years. For this rather small interval, this approximation is justified.

[3] Here it has been assumed that volume of production $u + v$ and employment vary proportionately; if account is taken of the discrepancy, one must deduct about 20% at most from the above figures.

Graph 3.1.
"Explanation" of Fluctuations in Wage Rate.



Graph 3.2.
"Explanation" of Fluctuations in Rent Level.



(3.2) "Explanation" of Rent Level

Here a "price equation" has been chosen for the explanation. Rents have been assumed to depend on:

(i) The stock of houses h as a supply factor;

(ii) Labour income, L_w+L_s, being the income of the large mass of tenants, as one demand factor;

(iii) Cost of living without rent (p'), the price of the other goods and services competing for the income, as a second demand factor;

(iv) A trend, in a fixed combination with h, as an indication of the normal need for houses (*i.e.*, h is included in the calculation in deviations from its trend over the period 1910-1935, which is $2.44t$).

A lag of one year and a half for the stock of houses [1] and of one year for the other variables has been found to

[1] As in our system these are counted at the end of each year, we have to take h_{-2}.

give the best explanation. The following relation has been obtained:

$$m_R = -3.51\,h_{-2} + 2.13\,(L_w + L_s)_{-1} - 0.25\,p'_{-1} + 1.21\,t \quad (3.2).$$

(3.3) "Explanation" of Prices of Consumers' Goods and Services, excluding Rent (p')

Here a price fixation equation has been chosen. The variables included are:

(i) Farm prices, as a cost element of special behaviour to be explained afterwards;

(ii) Wages, as a direct cost element;[1]

(iii) A trend representing changes in labour productivity, which are largely secular.

There might have been reason to include a fourth variable — viz., quantity produced u. This was in fact tried in several ways (with and without a lag), but the results were not significantly different from those without u. As an extremely small influence of u was found in similar researches made for Holland[2] and for the United Kingdom (pre-war period), u was left out entirely, and the fit was still good. This would mean that, in the period considered, the elasticity of supply of manufactured consumers' goods and of consumers' services was infinite. This does not seem unrealistic in view of (a) the overcapacity which

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[1] Assumed to reflect also mineral raw-material cost. In fact, there is a very close correlation between non-farm raw-material prices and wage rates with a trend (for changing productivity). The chief reason why these other raw materials are not treated separately is that their prices show almost no autonomous fluctuations, as is the case for agricultural products. The general laws of price formation adhered to in this study are also applicable to them.

In addition, their importance to the total cost of living is only very small; food, clothing and services, which account for about 75% of non-rent expenditure, being practically independent of non-agricultural raw materials.

[2] *Cf.* J. Tinbergen: *An Econometric Approach to Business Cycle Problems*, Paris, 1938.

seemed to exist [1] and (*b*) the tendency to fixed prices (trade marks, etc.).

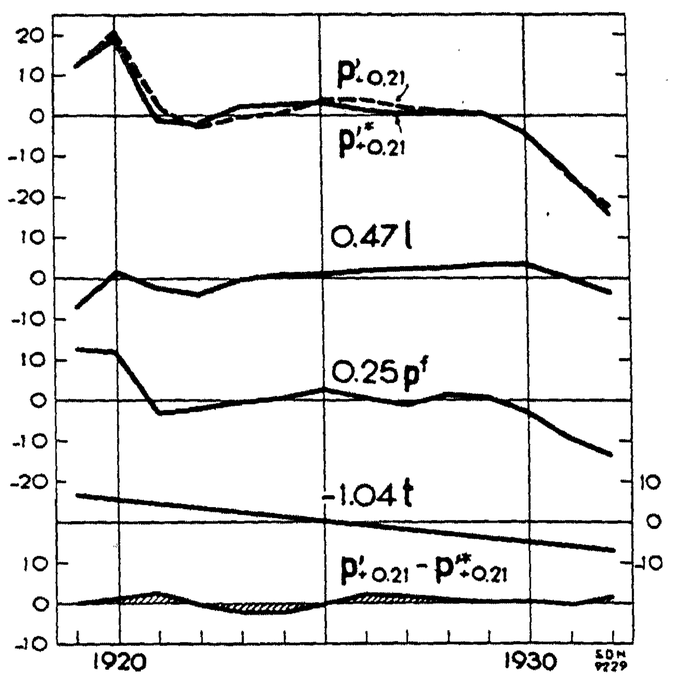
The relation found with the variables left is:

$$p'_{+0.21} = 0.47l + 0.25p^f - 1.04t \qquad (3.3).$$

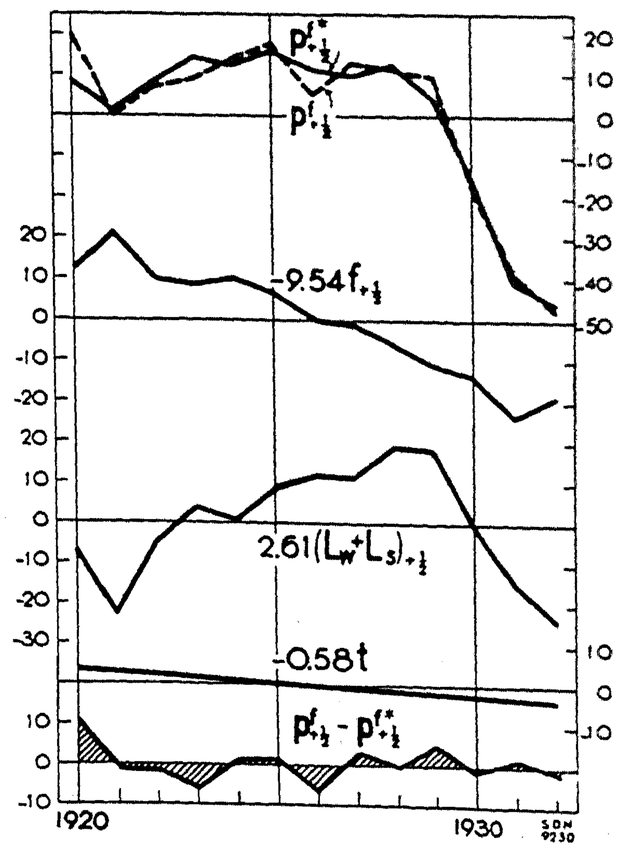
The lag was determined in the same way as for wage rates (*cf.* section (3.1)).

The coefficients obtained for l and p^f are very satisfactory; they correspond fairly exactly to the proportion of direct labour cost and of agricultural raw-material cost in consumers' goods prices. The coefficient for t would seem rather low, corresponding to an annual increase in efficiency of about 1 %, but it is quite possible that other elements work in the opposite direction (such as increasing capital costs, which, in the long run, are reflected in the price).

Graph 3.3.
"Explanation" of Fluctuations in Cost of Living, excluding Rent.



Graph 3.4.
"Explanation" of Fluctuations in Farm Prices.



[1] *Cf. America's Capacity to Produce*, Brookings Institution, Washington, 1935.

(3.4) "Explanation" of Farm Prices

For the explanation of farm prices, a price equation (*cf.* general introduction to this chapter) has been used. The following elements were included:

(i) f, the volume of agricultural supply available for the United States market[1], *i.e.*, crops + carry-over — exports.[2] No account has been taken if the world supply of agricultural products, since the greater part of United States farm products are not subjected to competition in the world market; as regards cotton, an important exception, the share of the United States in the world supply is very large.

(ii) Total wages bill ($L_w + L_s$) as a demand factor.

(iii) A trend, representing the rationalisation in farm production (and other possible trend influences).

No factor was included for direct costs, which are very low in agriculture.

The following regression equation was obtained for the period 1920-1932:[3]

$$p^f = -4.77f + 2.66\,(L_w + L_s) - 2.23t \qquad (3.41).$$

As however, f is highly correlated with t, the coefficients for both factors are very uncertain, as is shown by their standard errors:

$$p^f = -(4.77 \pm 3.67)\,f + (2.66 \pm 0.27)\,(L_w + L_s) - (2.23 \pm 1.37)\,t.$$

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[1] To be distinguished from the actual market supply, from which it differs by the amount added to stocks.

[2] Imports should not be added here, because they are of a special character and not competitive with United States production (coffee, rubber, etc.).

[3] For all series, crop year figures are used; they are therefore indicated in the graph by the suffix $+\frac{1}{2}$. It seemed expedient not to start the calculation before the middle of 1920, as the guaranteed minimum price for wheat instituted in August 1917 was not repealed until July 1st, 1920 (*Yearbook of Agriculture*, 1921, page 141).

Hence it seems useful to consider these coefficients in the light of knowledge from other sources.[1]

As indicated under (3.0), a price equation may be considered as the result obtained by eliminating from a demand equation and a supply equation the quantity exchanged. Denoting this quantity, which is equal to the market supply, by x^f, we can write these two equations:

$$\left.\begin{array}{ll} \textit{Demand:} & x^f = -\varphi_1 p^f + \varphi_2 (L_w + L_s) \\ \textit{Supply:} & x^f = +\varphi_3 p^f + \varphi_4 f + \varphi_5 t, \end{array}\right\} \text{(all } \varphi\text{'s} > 0), \quad \begin{array}{l}(3.42)\\(3.43)\end{array}$$

from which we eliminate x^f:

$$p^f = \frac{-\varphi_4}{(\varphi_1 + \varphi_3)} f + \frac{\varphi_2}{(\varphi_1 + \varphi_3)} (L_w + L_s) - \frac{\varphi_5}{(\varphi_1 + \varphi_3)} t, \qquad (3.44)$$

which is the general form of (3.41).

If we express all series in percentage deviations from their average, we may describe the φ's as follows:

φ_1 : price elasticity of demand;
φ_2 : income elasticity of demand;
φ_3 : elasticity of supply;
φ_4 : proportion of a positive or negative excess of available supply reflected in the actual market supply;
φ_5 : percentage cost decrease *p.a.*, divided by 100.

In order to reduce the limits of the coefficients for f and t, additional information on $(\varphi_1 + \varphi_3)$ and φ_4 *or* φ_5 is sufficient; of the latter two, φ_4 may be chosen as the coefficient on which most knowledge is available.

The fluctuations in market supply differ from those in available supply by changes in stocks. Graph 3.41 compares the latter two series for three cereals and cotton, the major United States farm products for which changes in stocks are important. It is seen that there is a rather close correlation between both

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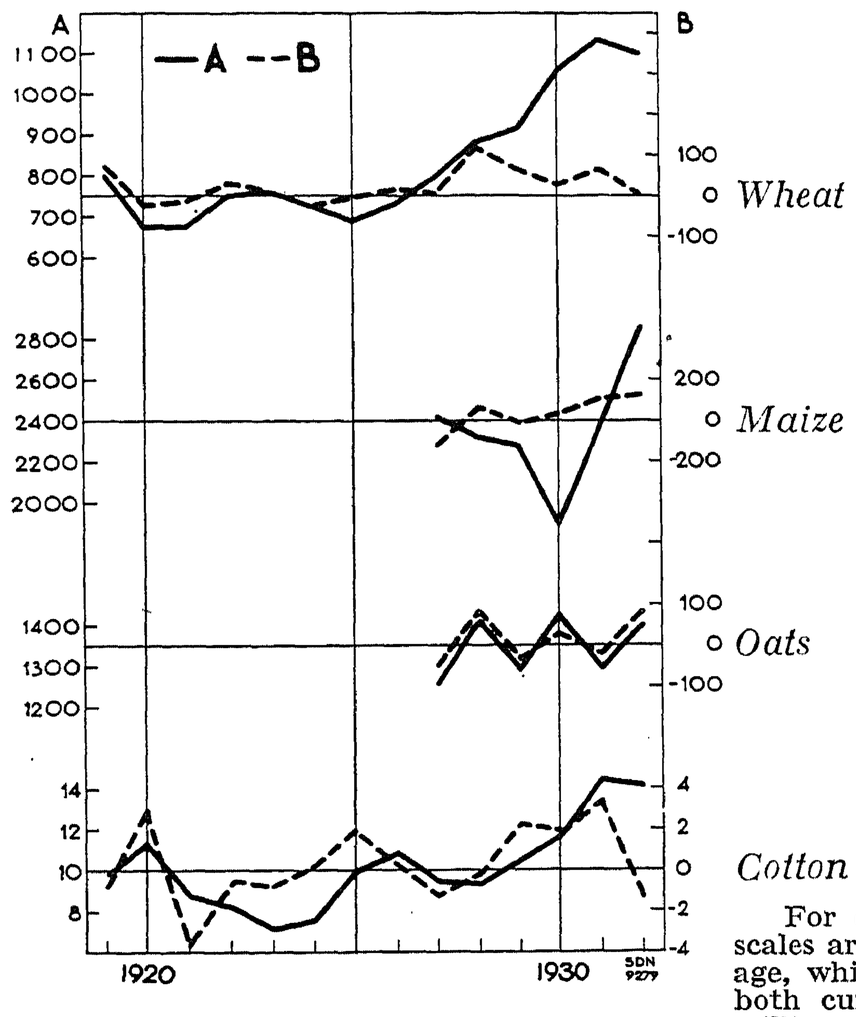
[1] Since $L_w + L_s$, which is the only endogenous variable in the explanation of pf, has a fairly certain coefficient, this supplementary analysis is not necessary from the point of view of the systematic cyclical forces; it is only necessary to estimate correctly the influences of changes in crops on the other variables of the system.

series for wheat (up to 1928),[1] oats and cotton, but hardly any for maize (corn). From these data it was deduced that the fluctuations in market supply constitute, on an average, the following percentages of the fluctuations in available supply:

Wheat [2]	40 %
Maize	100 %
Oats	33 %
Cotton	0 %
All other farm products . . .	100 %

Graph 3.41.

Changes in STOCKS OF FARM PRODUCTS compared with AVAILABLE SUPPLY.



A. Available supply : crop + carry-over — exports. Left-hand scale.

B. Increase in stocks. Right-hand scale.

For each commodity, the A and B scales are the same, except for the average, which is taken at the same level for both curves. Cereals are expressed in millions of bushels; cotton, in millions of bales.

In order to obtain an average value for φ_4, these values for the individual commodities are weighted according to the relative amplitude of the available supply of each commodity

[1] From then on, the very large and — until 1933 — increasing stocks presumably could not react to the increased available supply in the same way as before 1929, when stocks fluctuated around a constant level.

[2] 1919-1928; *cf.* note 1.

(in values, at the price of the base year 1927).[1] This yields a value of 0.8 for φ_4.

Similarly, an average elasticity of demand has been calculated [2] on the basis of the elasticities found for twelve important agricultural commodities by Professor SCHULTZ,[3] supplemented by estimates for fruits and nuts, vegetables, poultry and eggs, and dairy products. An average of about 0.5 was found for φ_1.

The elasticity of supply (φ_3) of agricultural products must be very low in relation to the short-term reactions of suppliers that are considered here; it may be taken at 0 or, say, 0.20.

To be able to make use of these more direct estimates for φ_1, φ_3 and φ_4, we convert the coefficients of (3.41) to a basis which corresponds to the series measured in *percentage* deviations from average:

f	$L_w + L_s$	t
— 0.62	1.18	— 2.52

If we take, on the basis of the above:

$$\varphi_1 + \varphi_3 = 0.5 \text{ to } 0.7,$$

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[1] Calling the base-year value of (production − export) of a commodity j, U_j; the percentage fluctuation of its production σ_j; and its coefficient for the relation between market supply and available supply φ_j, we find the average value for φ_4:

$$\varphi_4 = \frac{\Sigma_j U_j \sigma_j \varphi_j}{\Sigma_j U_j \sigma_j}.$$

The σ_j measure has been based on the production indices of each product or group of products, which are all on the basis 1924-1929 = 100. Calling the value of this index for a certain product in year i, u_i, σ_j is calculated with the formula:

$$\sigma_j = \sum_{1920}^{1932} i \left| (u_i - u_{i-1}) \right| - (u_{1932} - u_{1919})$$

where the second term represents a rough correction for the trend in u.

[2] The formula for averaging the individual elasticities η_j must take account of the degree of fluctuation of the market supply (at the base year value). It runs:

$$\varphi_1 = \frac{\Sigma_j U_j \sigma_j \varphi_j \eta_j}{\Sigma_j U_j \sigma_j \varphi_j}.$$

No account has been taken, in this formula, of cross elasticities (*cf.* section (2.1)). But most of Professor SCHULTZ's elasticities are also found without taking account of other prices than that of the particular commodity studied.

[3] H. SCHULTZ, *op. cit.*

we find (*cf.* (3.44)):

φ_4	φ_2 [1]	φ_5
0.31 to 0.43	0.59 to 0.83	1.26 to 1.76

It follows that the coefficient for f in (3.41) is much too low. As, however, its standard error is large, we may attribute to f in (3.41) a considerably different coefficient without really impairing the degree of correlation.[2] A value at twice the coefficient [3] found in (3.41) would be about the minimum compatible with the value of 0.8 for φ_4. The introduction into the correlation calculus of this fixed coefficient for f leaves that for $(L_w + L_s)$ practically unchanged:

$$p^f = -9.54f + 2.61(L_w + L_s) - 0.58t, \qquad (3.4)$$

which we accept as the final formula.

Owing to the relatively small influence of f on farm prices and the small weight of exports in f, we may disregard the cyclical element which is contained in these exports, and the more since it is not very pronounced. The demand for farm products has not been considered separately, it being assumed that this demand varies parallel to the variations in demand for all consumers' goods.

(3.5) "Explanation" of Fluctuations in Prices of Investment Goods

I. *Theoretical*

Here, as in the case of section (3.3), a price fixation equation (*cf.* section (3.0)) has been chosen for the explanation.

The chief variables included are:

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[1] On the basis of data from M. Leven, *c.s.*, *America's Capacity to Consume* (the Brookings Institution, Washington D.C., 1934, pages 87-88), an elasticity of the demand for food of about 0.5 could be calculated for the lower income classes (which consumed, in 1929, 84% of all food). This figure roughly tallies with the value found for φ_2, and so confirms the estimates for $(\varphi_1 + \varphi_3)$.

[2] In the case chosen, R is 0.975 as compared with 0.979 in case (3.41).

[3] Or 1.3σ above that coefficient.

(i) The variable cost per unit of product, represented by wage rate l;

(ii) The volume of production v';

(iii) A trend, representing the course of overhead cost, technical development, etc.

Since we are considering all enterprises, which are here regarded as being vertically amalgamated, practically the only element in variable cost will be variable labour cost. Its influence on price may be estimated on *a priori* grounds, which in general seem safer than any other basis. Labour cost may be estimated at about 50% of prices of investment goods. This does not correspond, however, to direct labour only, but to all labour. From the figures of the Federal Reserve Board, it may, moreover, be estimated that a 10% increase in production of durable goods is accompanied by a 7% increase in hours [1] of work. Marginal labour cost seems, therefore, to be about seven-tenths of average labour cost for average production. The price increase corresponding to a 10% increase in wages will therefore, in the short run, be equal to $5 \times 0.7\% = 3.5\%$.

The volume of production may represent, in the language of the more "practical" investigator, the strength of the seller in the market.[2] The higher the sales, the larger the addition to direct cost which the seller is able to charge. It is a well-known fact that, in times of severe depression, many enterprises in these branches are making prices only a little above variable cost, while it is only in better times that they are able to earn their overhead cost and profits. The coefficient with which volume of production enters into the equation is closely related to the elasticity of supply, which will be calculated later.

No special attention has been given to the price movements of individual metals. It is not impossible that these movements

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[1] Hours being estimated by multiplying the employment index by the quotient, weekly wages over hourly wages (National Industrial Conference Board figures). *Cf.* J. TINBERGEN, "Profit Margin, Investments and Production" (Dutch), *De Nederlandsche Conjunctuur*, November 1935.

[2] Especially since in these markets most production is to order and over-production therefore practically impossible.

are in part also due to changes in world stocks, but since these stocks themselves depend on production with a certain lag,[1] which is already included in the explanation, it seemed advisable not to take stocks as a separate variable. Moreover, the individual fluctuations in the prices of particular metals practically disappear in a weighted average of these prices (*cf.* graph 3.51;[2] the weight chosen is the value of the world production of each metal in 1930). The average shows practically the same movements as *q*.

For the "explanation" of *q*, the period 1919-1932 cannot be considered as a whole, owing to a marked difference in market organisation between the years 1919 to about 1923 on the one hand, and the period after that year on the other. Not until about 1923 could the iron and steel industry, which had been very strongly organised many years before the war, again effectively control the price fluctuations of its products.[3] In the first five years after the war, the price formation of *q* may have shown other characteristics than in the more monopolised period. The following differences might be expected:

(1) The re-monopolisation may have effected a higher general level of *q*;

(2) It has very probably diminished the amplitude of the cyclical fluctuations;

(3) It may, in particular, have prevented very rapid price rises when production has been very near to capacity; *i.e.*, it may have prevented bottle-necks.

On the other hand, it is reasonable to assume that the price formation of *q* has not changed, from the one period to the other, with regard to:

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[1] *Cf.* L. M. LACHMANN and F. SNAPPER: "Commodity Stocks in the Trade Cycle", *Economica* V, pages 435-454, November 1938.

[2] Page 66.

[3] *Cf.* A. R. BURNS, *The Decline of Competition*, New York and London, 1936, page 211: "After the general disruption of prices owing to the war of 1914 to 1918 (*i.e.*, mainly after 1922), the prices of a number of steel products . . . again showed periods of unchanging prices for considerable periods."

(4) The reaction to changes in wages;

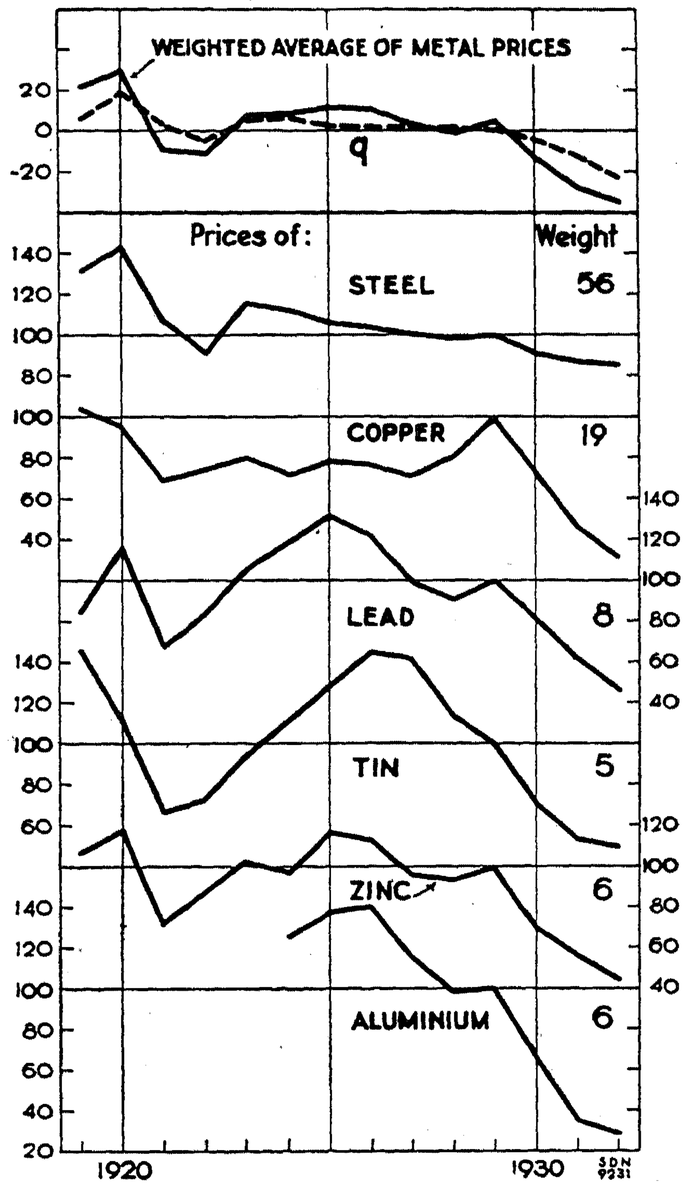
(5) The secular decline in prices as an effect of technical development;

(6) The lag between a change in activity (v') and a change in q. With regard to this lag, however, slightly different assumptions may easily be tried out.

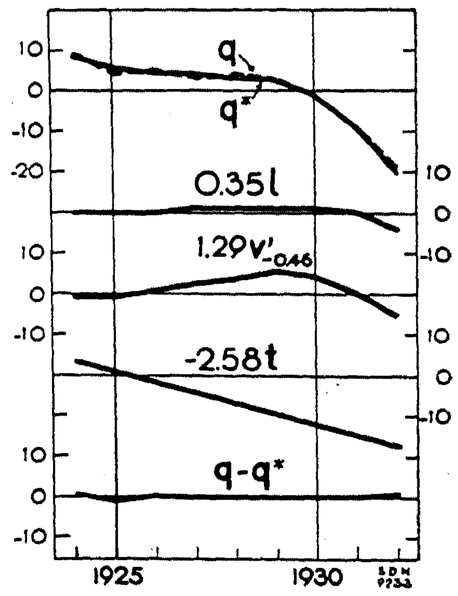
For reasons mentioned under (1) to (3), the correlation calculation has been restricted to the years 1924-1932. An almost perfect correlation was obtained with the formula:

$$q = 0.35l + 0.70v' + 0.59v'_{-1} - 2.58t,$$

Graph 3.51.
PRICES OF METALS.
Indices on the base 1929 = 100.



Graph 3.52.
"Explanation" of Fluctuations in PRICES OF INVESTMENT GOODS.



where the coefficient for l had been taken fixed. The two terms with v' may be combined in one, with an average lag of slightly under half a year:

$$q = 0.35l + 1.29\, v'_{-0.46} - 2.58t \text{ (graph 3.52)} \qquad (3.5).$$

The elasticity of supply (with the qualifications given in the general introduction to this chapter)[1] is about 5.

With the help of this formula, the possible differences between this period and the years 1919-1923 may be tested. For this purpose, we compared, in a scatter diagram (3.53)[2] $q - 0.35l + 2.58t$ with $1.29v'$, using different lags of 0.46, 0, and 1 year, in parts II, III and IV. Part I shows the points 1924-1932, which lie nearly on a straight line, at 45°.[3]

If we look at II, we see that 1919, 1921, 1922 are on a straight line with a slope of $3 \div 1$. Considering this line as the regular supply curve for this period, we may deduce that the price was three times as flexible before 1923 as after that year. A conclusion as to a possible difference in level brought about by re-monopolisation may be derived from the point of intersection of the supply line with the q-axis. In I, this point lies at about $q = 1$; in II at $q = 0.5$. This difference is too small to support the evidence that the organisation of the market has had a tendency to raise the level of q.

The points for 1920 and 1923 show a q which is definitely above the supply line. During both years there occurred, as is well-known, a bottle-neck, which was more pronounced in 1920 than in 1923. The two deviations are therefore quite acceptable. It may be seen that the price in 1920 was higher than in 1923, though production (v') was slightly lower. But certainly capacity was higher in 1923, causing bottle-necks to develop only at a

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[1] *I.e.*, the figure is rather an inverted measure of the flexibility of prices, but it may, in the long run, be an indication of the real elasticity of supply as well.

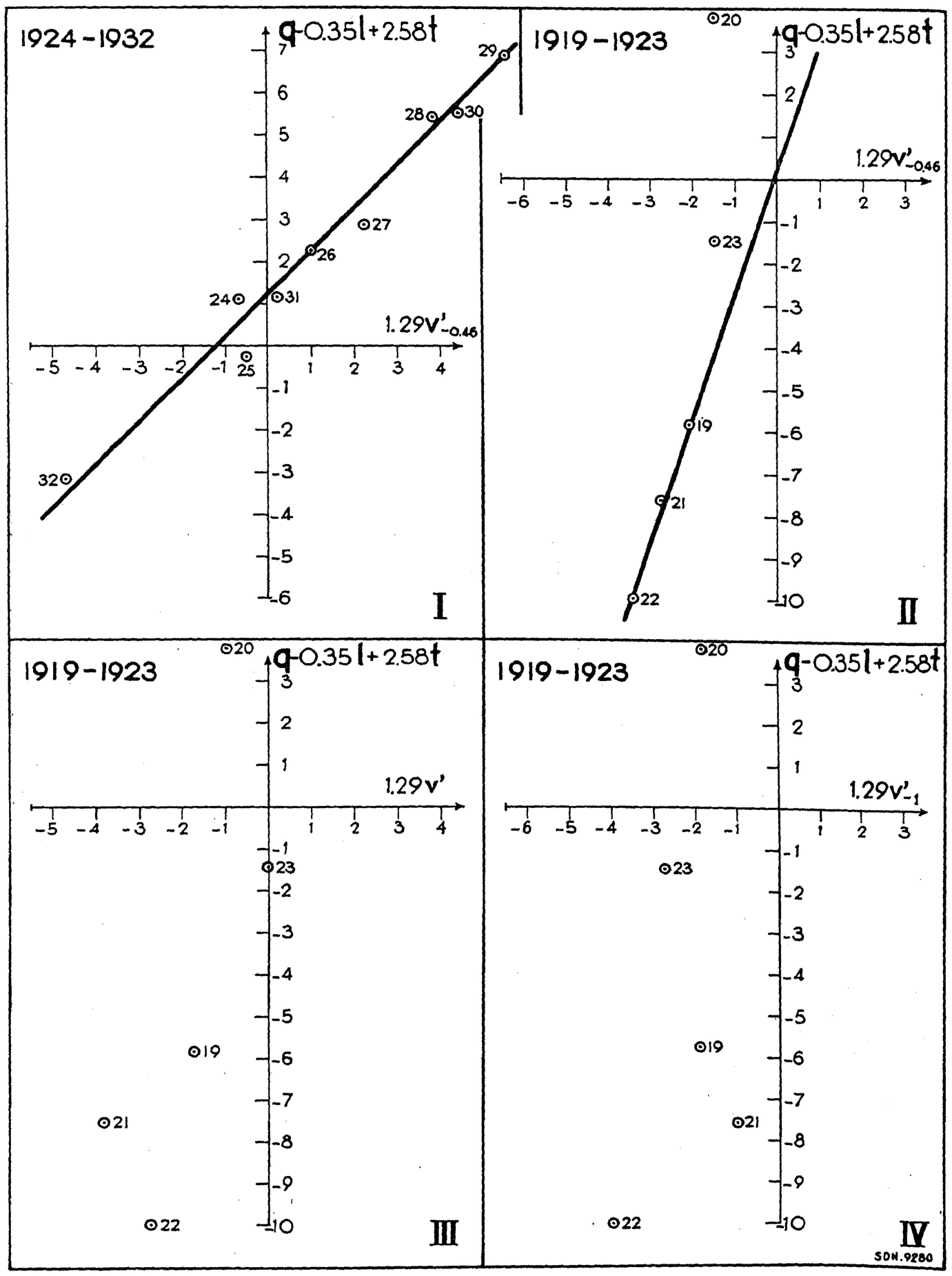
[2] This diagram may be considered as a supply schedule, since it compares the quantity supplied (v') with the price q, corrected for other influences.

[3] The line does not pass through the origin, since the series are measured from their averages over 1919-1932.

Graph 3.53.

PARTIAL SCATTER DIAGRAM
between q (corrected for other influences) and v'.

I 1924-1932, lag 0.46 year
II, III, IV 1919-1923, lag { 0.46 ,, ; 0 ,, ; 1 ,, }



somewhat larger production. The figures do not show, of course, that these bottle-necks could have been prevented, had the industry been as strongly organised as was the case after 1923. In fact, production has probably never since been so near the limits of capacity.

The alternative cases III and IV are much less satisfactory. In neither case do the points 1919, 1921, 1922 clearly determine the supply line. In IV, moreover, the point 1923 lies to the left of those of 1919 and 1921, which would suggest a bottle-neck in the former year at both lower production and — presumably — higher capacity than the latter two. Thus, the material would seem to confirm the assumption made under (6) above.

Equation (3.5) is the "quasi supply relation" for investment goods — a price fixation equation solved for the quantity supplied, where the lag involved may be in contradiction to the Walrasian interpretation of a supply function. It may be written:

$$_{S}v' = 0.78\, q_{+0.46} \qquad (3.51)$$

where $_{S}v'$ indicates the quantity supplied, corrected for the factors making for shifts of the supply curve:

$$_{S}v'_{-0.46} = v'_{-0.46} + 0.27l - 2.00t \qquad (3.52).$$

For the years 1919-1923, the equations are:

$$_{S}v'_{-0.46} = 0.26q \qquad (3.51')$$

and

$$_{S}v'_{-0.46} = v'_{-0.46} + 0.09l - 0.67t. \qquad (3.52').$$

It may be interesting to compare this "quasi supply equation" with the demand equation for investment goods:

$$v' = 0.66\, Z^{c}_{-\frac{1}{2}} - 0.94\,(m_{Ls})_{-\frac{1}{2}} - 0.03\, q_{-\frac{1}{2}} + 0.12\,(p - \tfrac{1}{2}l)_{-\frac{1}{2}} + 0.63t \qquad (2.4).^{1}$$

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[1] Replacing $0.33\,(Z^{c} + Z^{c}_{-1})$ by $0.66\, Z^{c}_{-\frac{1}{2}}$, etc.

This equation may be written in a form similar to (3.51):

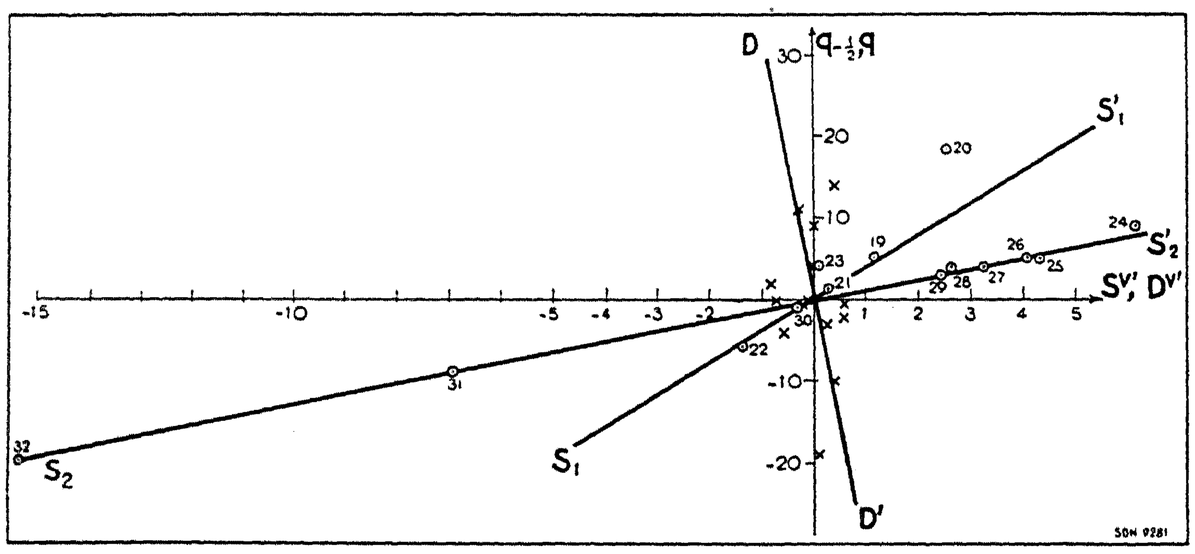
$$_{D}v' = -0.03q_{-\frac{1}{2}}\ ^{1} \qquad (3.53)$$

where

$$_{D}v' = v' - 0.66\,Z^{c}_{-\frac{1}{2}} + 0.94\,(m_{Ls})_{-\frac{1}{2}} - 0.12(p - \tfrac{1}{2}\,l)_{-\frac{1}{2}} - 0.63t \qquad (3.54).$$

Graph 3.54.

Scatter Diagram of
DEMAND AND SUPPLY RELATIONS for CAPITAL GOODS.



Graph (3.54) shows the supply relation (3.51) and the demand relation (3.53) in one diagram. The values for q (with the appropriate lag or lead) are measured along the vertical axis, those for $_{S}v'$ and $_{D}v'$ along the horizontal axis. The dots indicate the supply relation (3.51); they show — except for the bottle-neck values of 1920 and 1923 — only small deviations from the two supply curves $S_1S'_1$ for 1919-1923 and $S_2S'_2$ for 1924-1932. The demand relation (3.53) is plotted by little crosses; here the points fit the demand curve DD′ less well. The scale has been chosen in such a way that the 45° lines represent an elasticity of unity.

This diagram illustrates the possibility, in this case, of deriving both the supply relation and the demand relation from one set of price and quantity data, since (i) the lag (lead) between v' and q is different in both relations; and

[1] It follows that the elasticity of demand is $(0.03 \times \bar{q}/\bar{v}') = 0.2$.

(ii) the other factors entering into the supply equation are different from those entering into the demand equation.[1]

The demand and supply equations for labour and consumption goods might be analysed in much the same way; the present case has been singled out only because it provides the clearest example.

(3.6) "Explanation" of Building Costs

For our purpose, it has not been necessary to give much attention to this equation. In the elimination process, the product of v_B and q_B is the only instance where q_B is used.[2] As the elasticity of demand for v_B is not far from 1,[3] this product is only slightly dependent on q_B; and as, moreover, the absolute value of building is rather small, the dependence of V_B on q_B may be neglected altogether. Hence, for the system of equations as a whole, we do not need to have an equation "explaining" q_B.

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[1] *Cf.* Vol. I, pages 62-64.
[2] *Cf.* Appendix B, Table III, equation (5.10)'.
[3] $0.031 \times \bar{q}_B / \bar{v}_B$.