CHAPTER I

DESCRIPTION OF THE MODEL. DEFINITIONAL RELATIONS

(1.0) GENERAL INTRODUCTION

The construction of a model such as the one to be described here is, in many respects, a matter of trial and error. Exactly what variables are to be included and what neglected is not known beforehand; it only becomes apparent as the work progresses. Starting with some phenomenon of central importance to cyclical movements — as, for example, investment activity — it will first be asked what factors are important in the explanation of this variable; next, what variables are important in the explanation of these explanatory factors; and so on. This procedure must be continued until a number of relations is obtained equal to the number of variables which are considered to require explanation.

It would not serve much purpose to conduct the reader through all the incidental difficulties and errors, some of them at least unavoidable, which beset the course of the reasoning. It seems better to give a rounded-off picture of what has finally been arrived at as the most concise representation of the model. This picture has to start with a list of the phenomena included—a list which in some sense may seem illogical or arbitrary. The best course, therefore, seems to be to present the material in such a way that the reader can easily pick out any variable or relation in which he is specially interested, and can study in whatever order seems to him logical and useful the relations which are here formulated and tested.

The symbols introduced have as far as possible been chosen according to the following rules:

- (i) All variables representing money amounts are indicated by capital letters.
- (ii) Prices and physical quantities are indicated by small letters.
- (iii) Coefficients in their statistical aspect: regression coefficients; in their economic aspect: elasticity coefficients are indicated by Greek characters.
- (iv) The time period to which a variable relates is indicated by an inferior figure or index t to the right; in so far as no confusion is to be feared, inferior letters are also used for other distinctions, but not figures.
- (v) Value symbols and physical symbols relating to the same sort of commodities, etc., are indicated by the same letter (e.g., V and v).
- (vi) Related variables are indicated by letters close to each other in the alphabet.
- (vii) As far as possible, the same symbols are used as in some previous publications by the author.

A list of variables which may be consulted with any page of the text, will be found in Appendix A. Unbarred symbols represent deviations from the average value of the variable considered over the period 1919-1932; barred symbols represent these averages, and double-barred ones the "natural values" as found in the sources. The symbol \int placed before any symbol indicates that the cumulant of that variable has to be taken. Therefore:

$$\int u_{1927} = u_{1919} + u_{1920} + u_{1921} + u_{1...} + u_{1927};$$

$$\int u_{1921} = u_{1919} + u_{1920} + u_{1921}; \text{ and so on.}$$

The starting-point of the sum is indifferent, provided that it is before the beginning of the period studied; for suppose that, instead of 1919, 1915 were taken as the starting year, this would only increase *every* value of $\int u$ by the constant amount $u_{1915} + u_{1916} + u_{1917} + u_{1918}$.

As the usefulness of the choice of the variables becomes clear only in connection with the relations chosen, the discussion of the latter may be undertaken immediately.

The relations, a summary of which is given in Appendix B, are, according to the subject of each, treated in Chapters I-V.

As the definitional relations are the least doubtful ones, they may be treated first, although they form a rather incoherent group of not very interesting relations. Not all are definitions in the true sense of the word: some are a description of the composition of some average or total; others represent the rule of computation of some variable. They could be called non-causal relations, in contrast with, for example, demand and supply relations. Some of them, with, in each case, one of the variables which they link together, have only been introduced for reasons of convenience.

The relations have, moreover, not always been given in their exact form. Sometimes they have been replaced by a linear approximation, which, for that reason, does not fit exactly; this approximation entails considerable simplification for the calculations in which the relations are ultimately used. In these cases, the "tests" therefore concern the degree of approximation obtained by these linear expressions, rather than the relations themselves, which are self-evident. The equations are given in alphabetical order of the first variable included. Their obvious nature makes a very short treatment sufficient in most cases.

1.1:
$$\Lambda = 1.50C^{i} + 0.90B^{i} + 0.84n - 18.0m_{Lb}$$

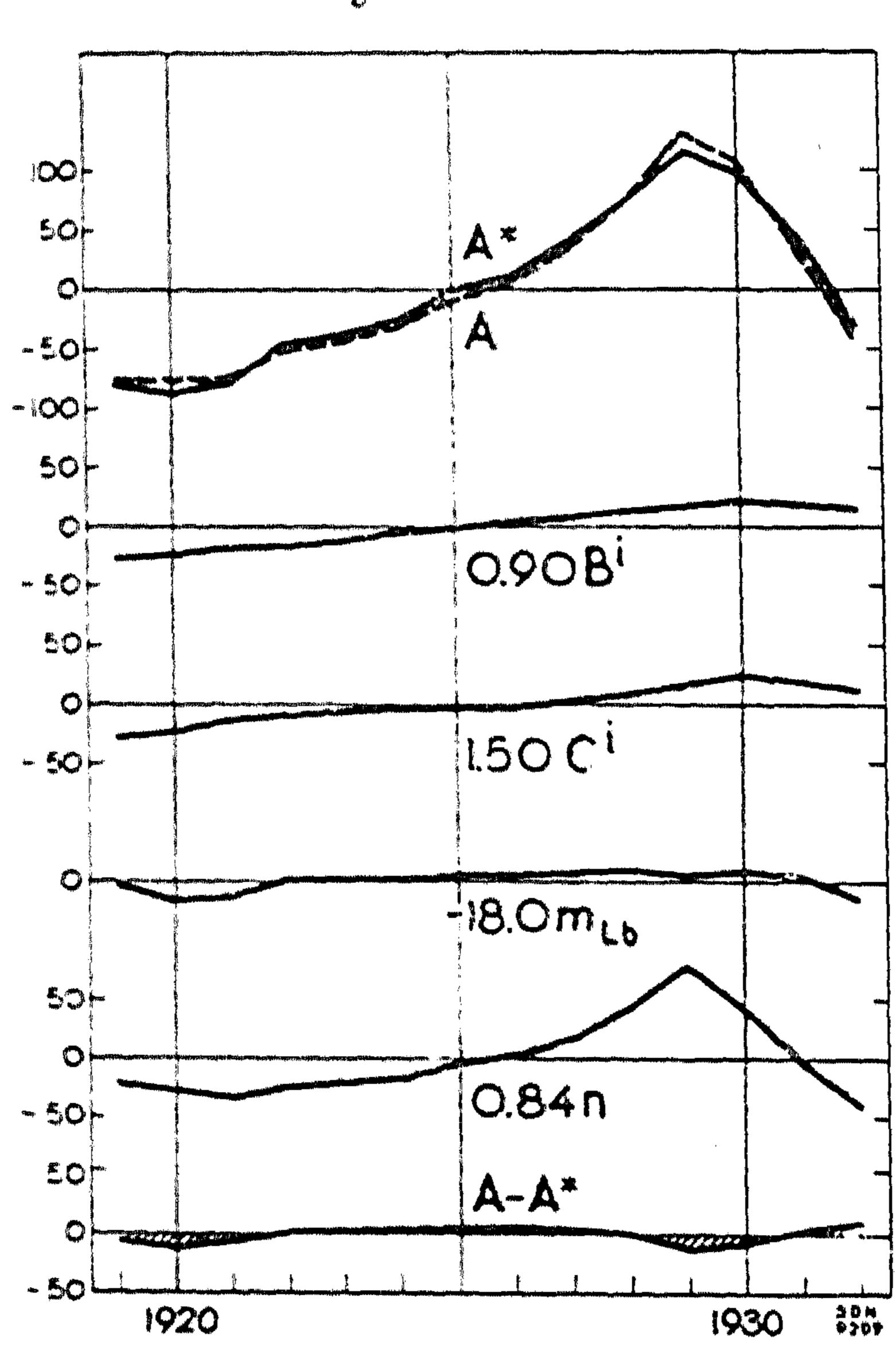
This is an approximation deduced from:

$$A = 0.0156C^{\frac{1}{12}} + \frac{1}{12}$$

where c is a constant. The total value of assets held by individuals is equal to the value of shares + the value of bonds held by them (cf. section (4.7)).

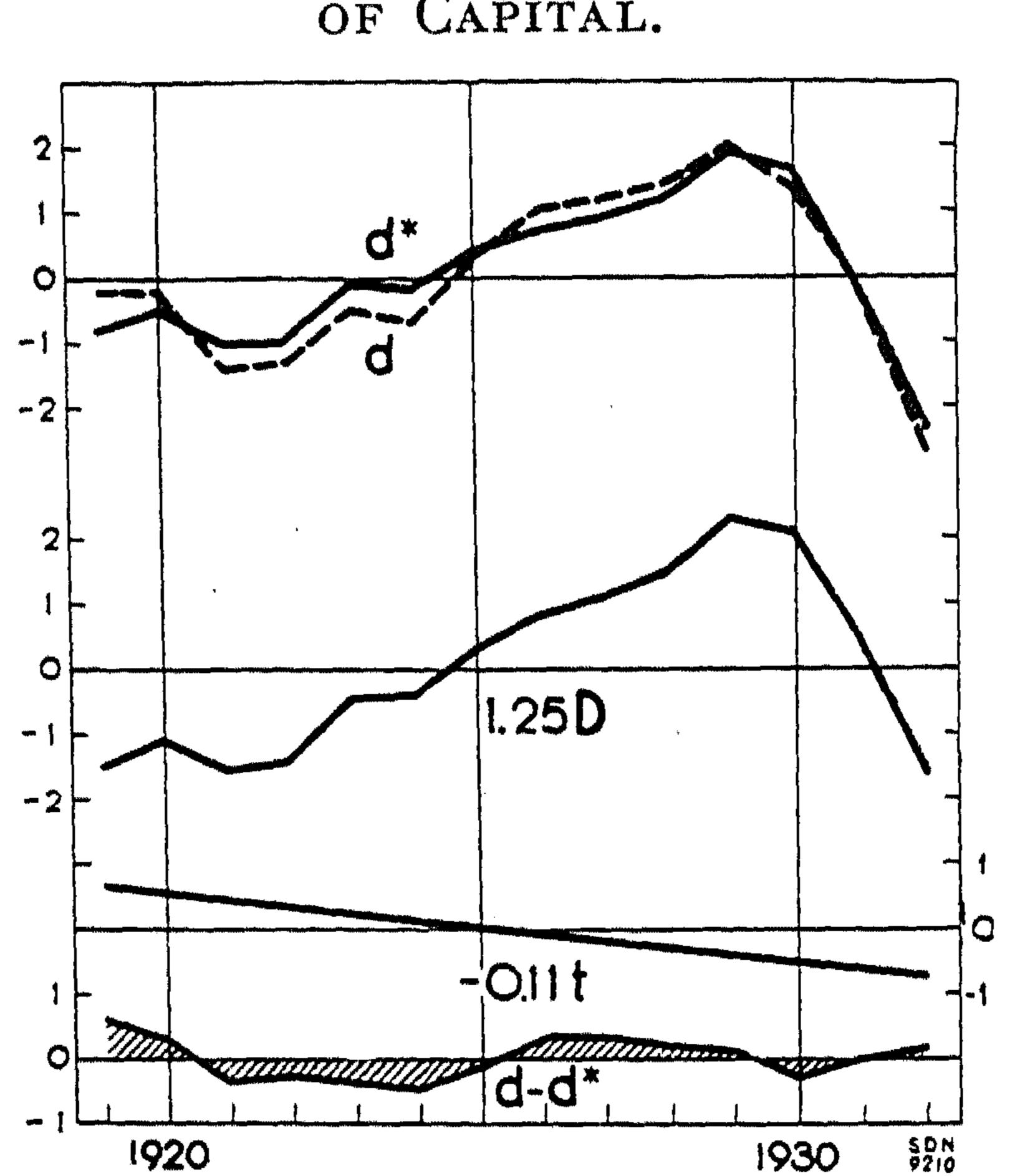
Graph 1.1.

Composition of Fluctuations in Total Value of Assets held by Individuals.



Graph 1.2.

"Explanation" of Fluctuations in Dividends as a Percentage of Capital.



1.2: a 1.25D - 0.11t

Here, d represents all cash dividends as a percentage of capital, and D the amount of cash dividends paid to private shareholders.

This relation has been deduced from

where d is all cash dividends as a percentage of capital;

D' is amount of all cash dividends;

C capital, nominal value.

This relation may be written as

which, by a well-known first approximation, turns into:

$$\frac{1}{d} + d = \frac{100}{C} (D' + D') (1 - C)$$

where the second order term has been omitted, which for our figures is certainly admissible. The constant term $\frac{100 \, \overline{D}'}{\overline{C}}$ being equal to \overline{d} , we are left with

Here, the second term in the right-hand member is almost a trend, because C is nearly so; in addition, it is very small. Further, D' will move parallel to D; hence a regression equation between d, D and t has simply been tried, leading to formula (1.2) above.

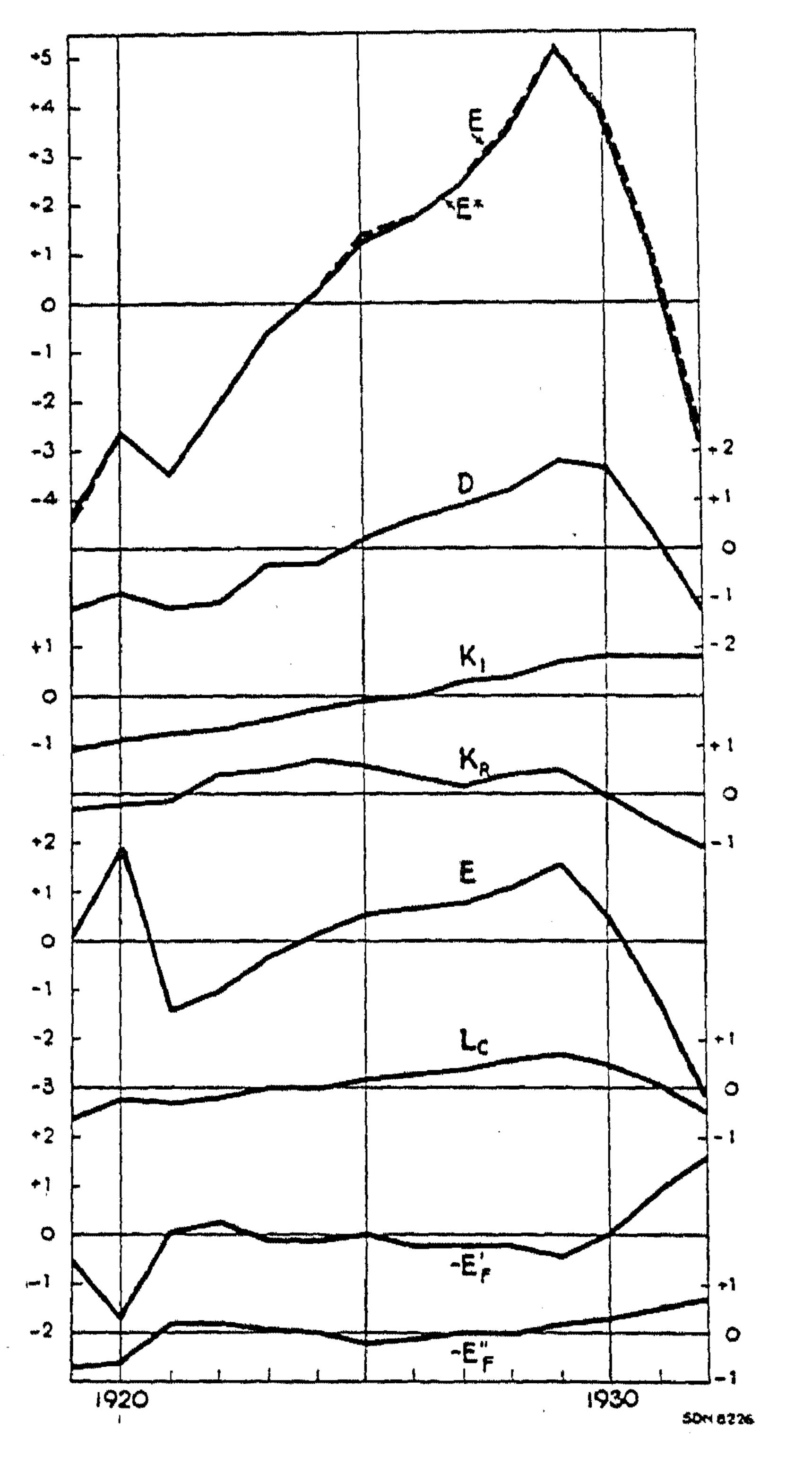
1.3:
$$E = D + L_C + K_T + K_B + (E_E - E_F')$$

Urban non-workers' income consists of dividends, managers' salaries, interest payments, rent incomes and entrepreneurial withdrawals without farmers' income. As the estimate for the latter may (following the National Bureau of Economic Research)¹ be taken equal to farmers' estimated consumption, it is here represented by $E_F' + E_F''$. The small amount of income from abroad has been neglected. The influence of this neglect is seen in the graph as the difference between the dotted and the full line.

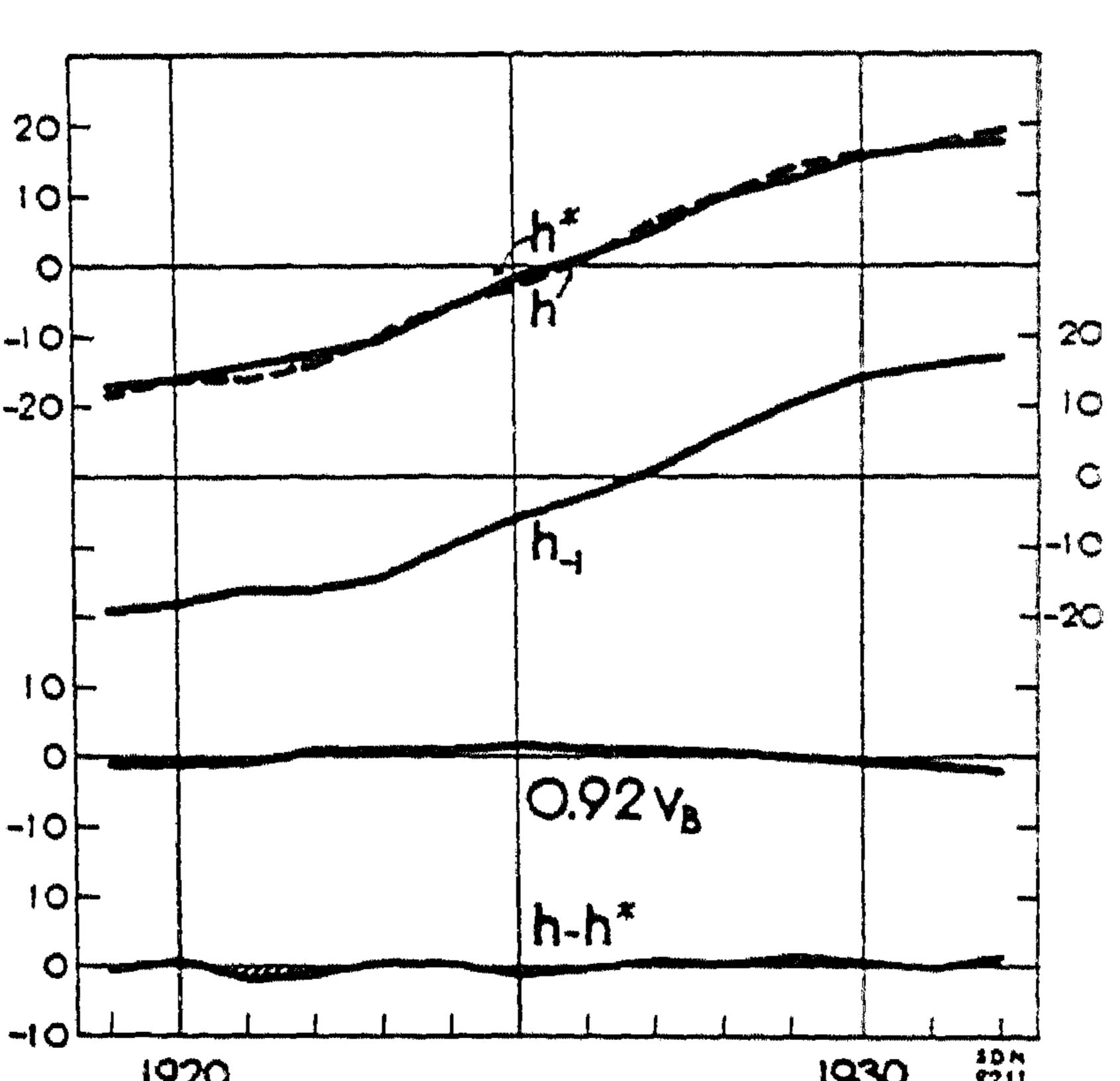
¹ Bulletin 59: "Income originating in Nine Basic Industries, 1919-1934" by S. Kuznets. New York, 1936. All farmers' savings are considered as business savings. Any net investment farmers are performing is supposed to be paid out of business savings.

Graph 1.3.

Composition of Fluctuations of Urban Non-workers' Income.



Graph 1.4
"Explanation" of Fluctuations in Stock of Houses.



$1.4: h = h_{-1} + 0.92v_{\rm B}$

The stock of houses at the end of a year is found by adding to the stock at the end of the previous year 0.92 times the volume of residential building during the year. The remaining 0.08 accounts for replacement (estimated according to the figures of Wickens and Foster for the relation between replacement and total building).¹

^{1 &}quot;Non-Farm Residential Construction, 1920-1936", Bulletin 65, National Bureau of Economic Research, New York, 1937, page 11.

1.5: M = M' + M''.

Total money is equal to the sum of the amount of outside currency (M') + the amount of deposits (M'').

Graph 1.6.

1930 30%

Graph 1.5.

Composition of Fluctuations in

Composition of Fluctuations in Total Money.

Fluctuations in Assets and Liabilities of the Banks.

1.6: $M = B_s + 0.9B^b - 2.93 m_{Lb}$.

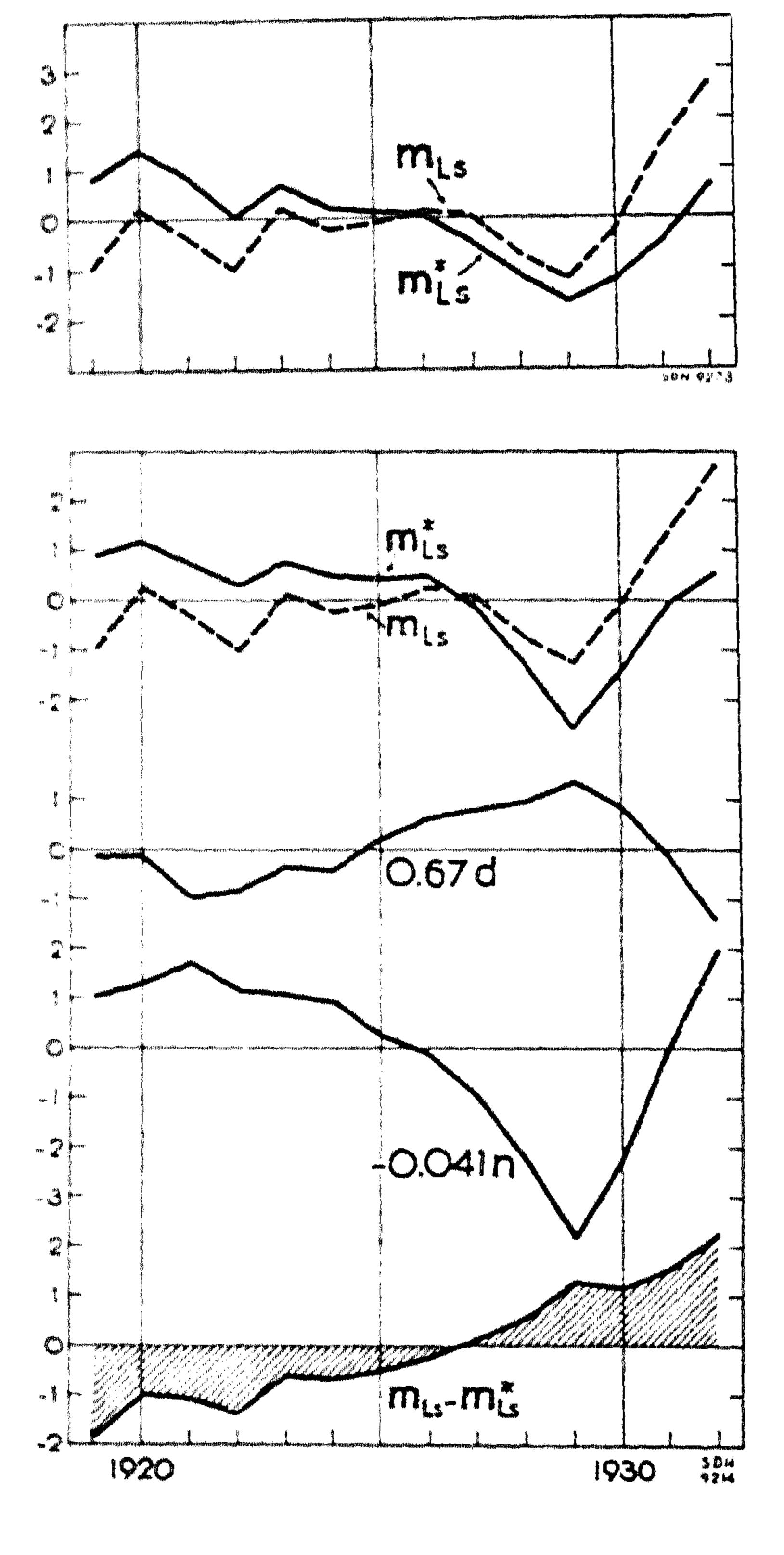
Balance equation for the banks; cf. section (4.5).

 $1.7: m_{Ls} = 0.67d - 0.041n$

1920

This relation is a simplified form of the definition of $\overline{\overline{m}}_{Ls}$:

100d
100d
100d
1105
1156



Graph 1.7.

"Explanation" of Fluctuations in Share Yield.

Upper part: $\frac{100d}{1.56n}$ in deviation from average = m_{r_e}

Lower part: $m_{Ls} = 0.67d - 0.041n$.

Here the factor 1.56 has been added, since in 1926, when the stock price index \overline{n} was 100, the actual stock price level upon which the calculation of the share yield is based was 156.1

The upper part of the graph is to be considered as a test of the compatibility of the series used for m_{Ls} and d; if they were exactly compatible, no deviations should occur. The lower part

shows the combined effect of the lack of compatibility and of the linear approximation. Evidently there is, in this case, a danger in using the linear approximation for extreme values like those in 1928, 1929 and 1932.

$$= \frac{100 \ (\bar{d}+d)}{1.56 \bar{n} (1+\frac{n}{\bar{n}})} = \frac{100}{1.56 \bar{n}} \ (\bar{d}+d) \ (1-\frac{n}{\bar{n}}) = \frac{100 \ \bar{d}}{1.56 \bar{n}} + \frac{100 \ d}{1.56 \bar{n}} - \frac{100 \ \bar{d}n}{1.56 \bar{n}^2},$$

neglecting the second order term.

ቊያት የቃቀት ቀር ያለት ቀር ተለቀቀ ያለም የተናለቸው። ተለያ ትርብ ተዋታ ተመጀመር አውያል እንደመጀመር የተነነበር የተነነበር የተነነበር የተጠቀመ የተመሰው የ

Now
$$\frac{100d}{1.56n}$$
 m_{Ls} ; $\frac{100}{1.56n}$ 0.67, and $\frac{100d}{1.56n^2}$ 0.041.

The calculation runs as follows: $m_{Ls} = m_{Ls} + m_{Ls} =$

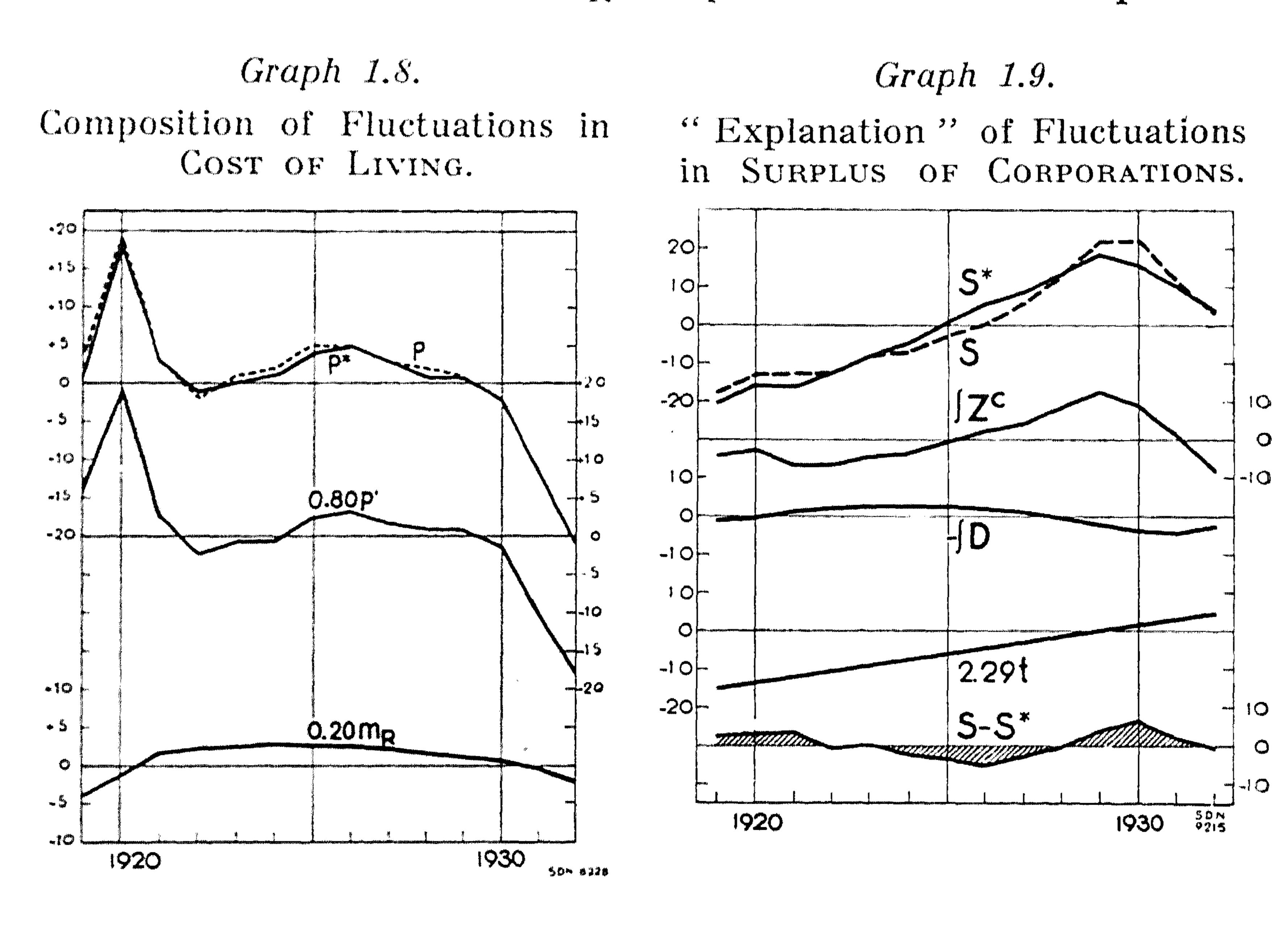
^{*} The actual figures show a difference owing to the independence of the sources from which d, n and $m_{\rm LS}$ haven been taken.

1.8: Composition of cost of living.

Cost of living is made up of two rather heterogeneous elements — viz., rents $m_{\rm R}$ and prices of other services and goods p', with weights of 20% and 80% respectively:

$$p = 0.80 p' + 0.20 m_{\rm B}$$
.

The "explanation" of m_R and p' is discussed in Chapter III.



1.9: $S = \int (Z^c - D) + 2.29t$

Surplus of corporations depends on cumulated profits ($\int Z^c$) minus cumulated dividends ($\int D$). One would expect simply $S = \int Z^c - \int D$; but, it appears, additional reserves — possibly secret reserves — are constituted, so that the yearly increase in S is larger than $Z^c - D$. If we suppose these additional reserves to be constant, they explain part of the trend. Another

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¹ It was found by correlation calculus that they are not correlated with $Z^c - D$.

part, however, stands as a complement to the cumulation terms. For these being cumulations of the deviations of Z^c and D from their averages, cumulations of the constants \overline{Z}^c and \overline{D} have to be added, which evidently are trends. As $\overline{Z}^c - \overline{D} = 0.5$, a term of 0.5t corresponds to $\int (\overline{Z}^c - \overline{D})$. The rest of the trend, 1.8t, represents the unexplained reserves mentioned above.

1.10: U 0.60p + 1.00u

This relation is the simplified form of the relation

value of production equals price times quantity, divided by 100 as the prices are measured in percentages of the level of 1929.

Graph 1.10.

Production of Consumption
Goods.

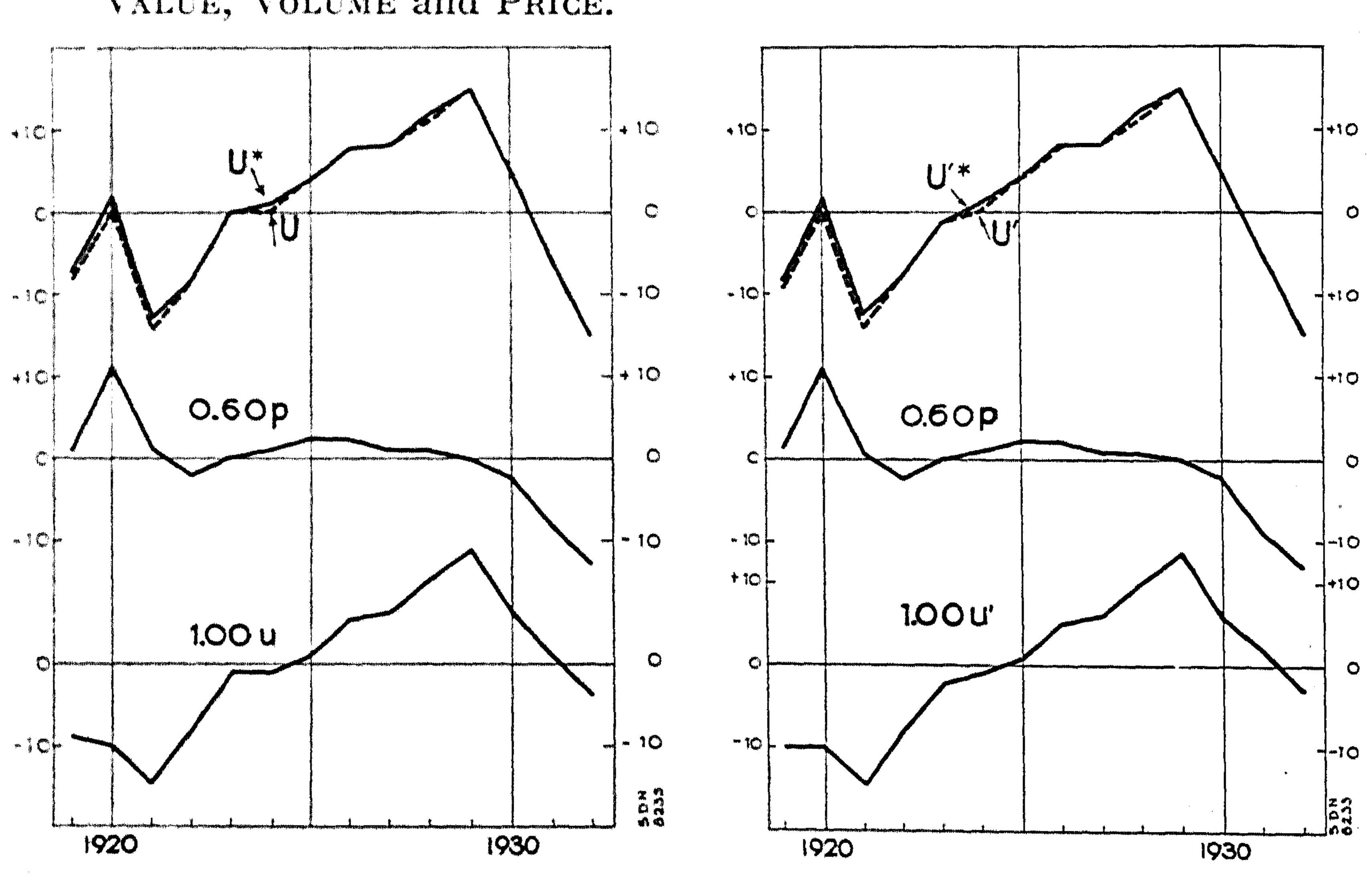
Relation between Fluctuations in Value, Volume and Price.

Graph 1.11.

Consumption.

between Eluctuations in

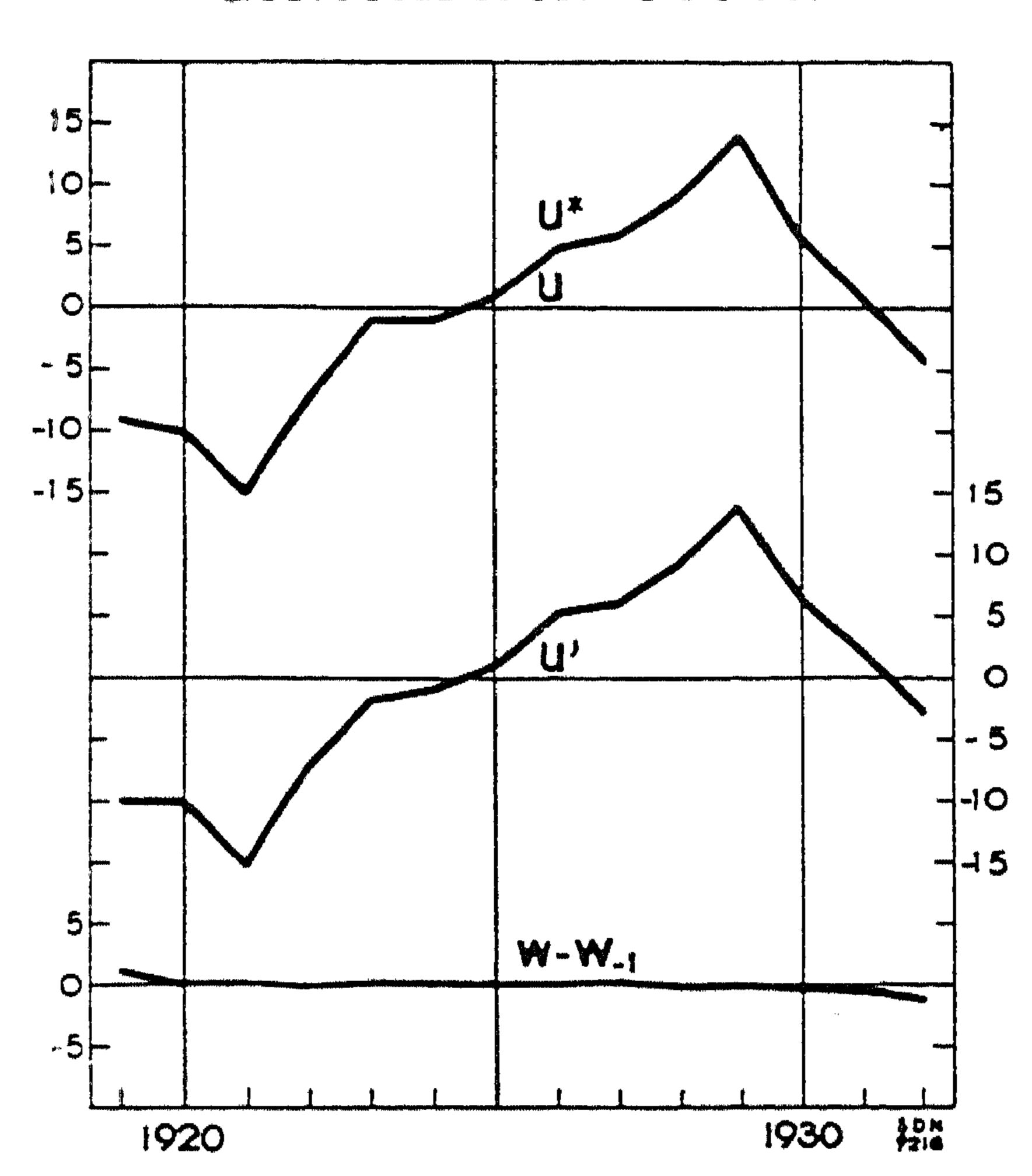
Relation between Fluctuations in Value, Volume and Price.



The calculation runs: $\overline{U} = \overline{U} + U = 0.01 (\overline{p} + p) (\overline{u} + u) = 0.01 \overline{pu} + 0.01 \overline{pu} + 0.01 \overline{up}$, neglecting the second order term; $0.01 \overline{pu} = \overline{U}$; $0.01 \overline{p} = 1.00$; $0.01 \overline{u} = 0.60$.

Graph 1.12.

Relation between Fluctuations in PRODUCTION, CONSUMPTION and changes in Stocks of CONSUMPTION GOODS.



1.11:
$$u = u' + w - w_{-1}$$

Production equals consumption + increase in stocks.

1.12:
$$U' = 0.60p + 1.00u'$$

For explanation, see 1.10.

$$1.13: V = V' + V_{R}$$

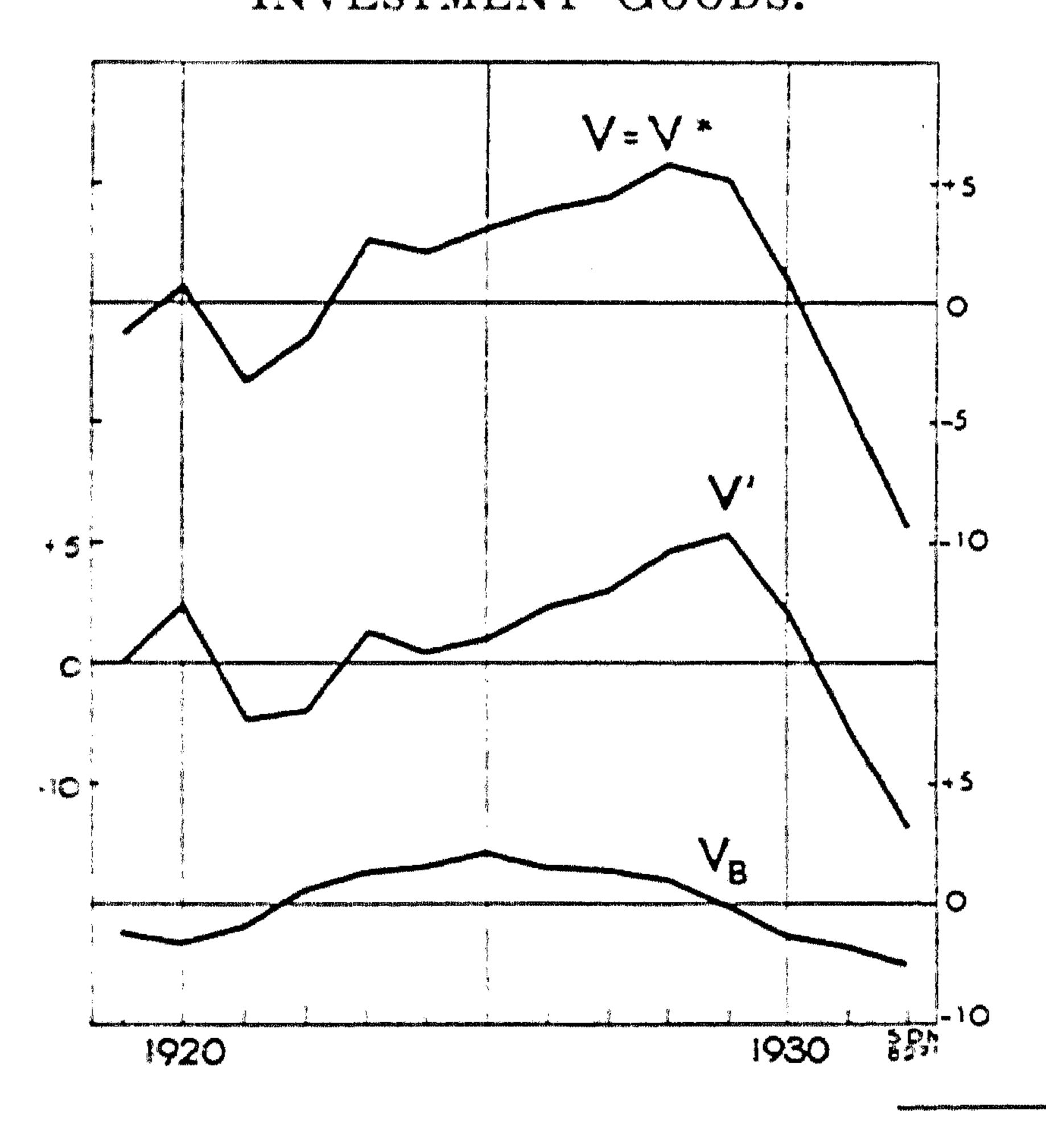
1.13: $V = V' + V_B$ Total value of investment goods produced consists of value of producers' durable commodities, including nonresidential building, and value of residential building.

1.14:
$$v = v' + v_{\rm B}$$

Volume of investment goods produced consists of volume of producers' durable commodities, including non-residential building, and volume of residential building.

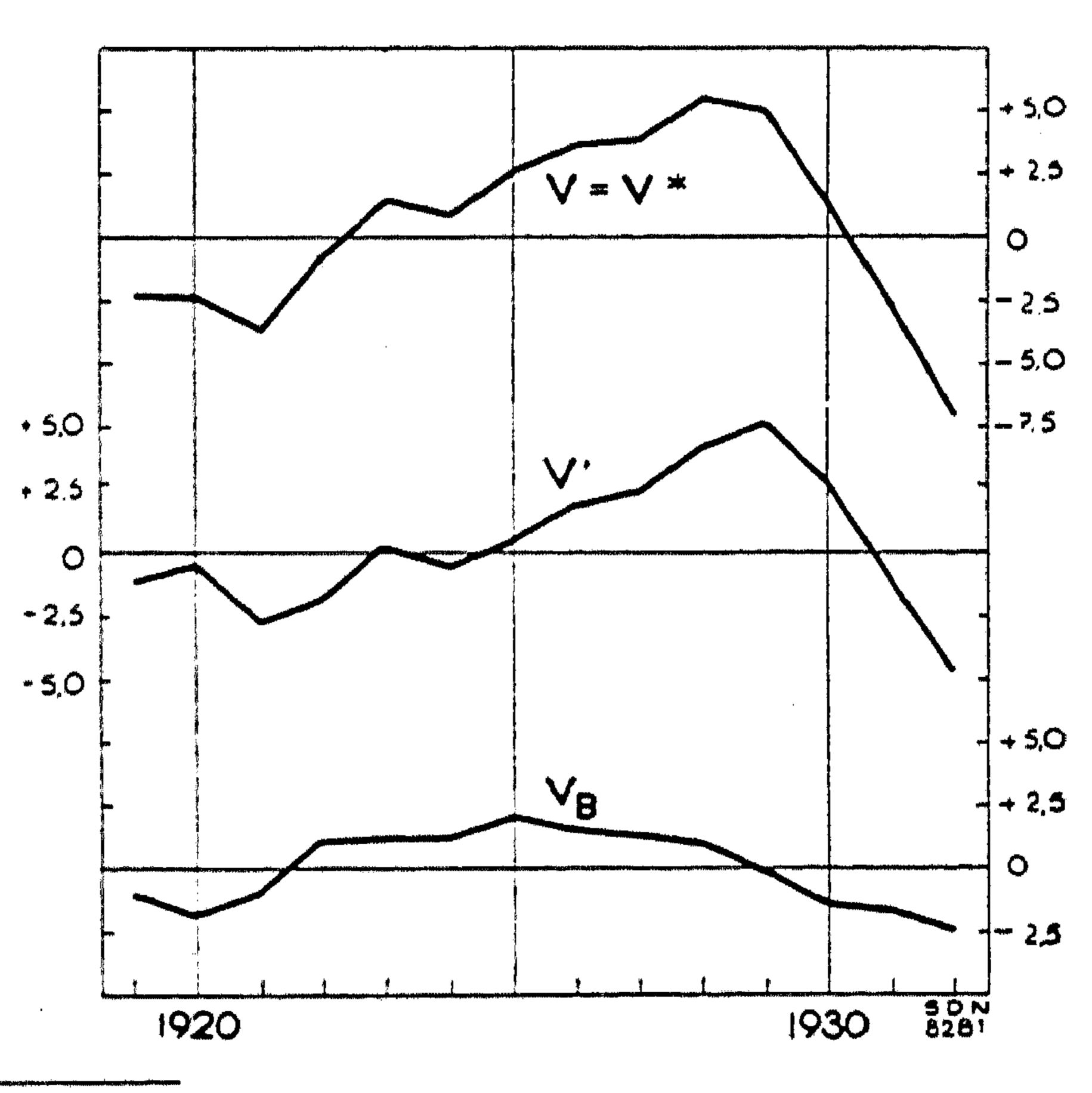
Graph 1.13.

Composition of Fluctuations in Value of Production of INVESTMENT GOODS.



Graph 1.14.

Composition of Fluctuations in Volume of Production of INVESTMENT GOODS.



1.15:
$$V' = v' + 0.15q$$

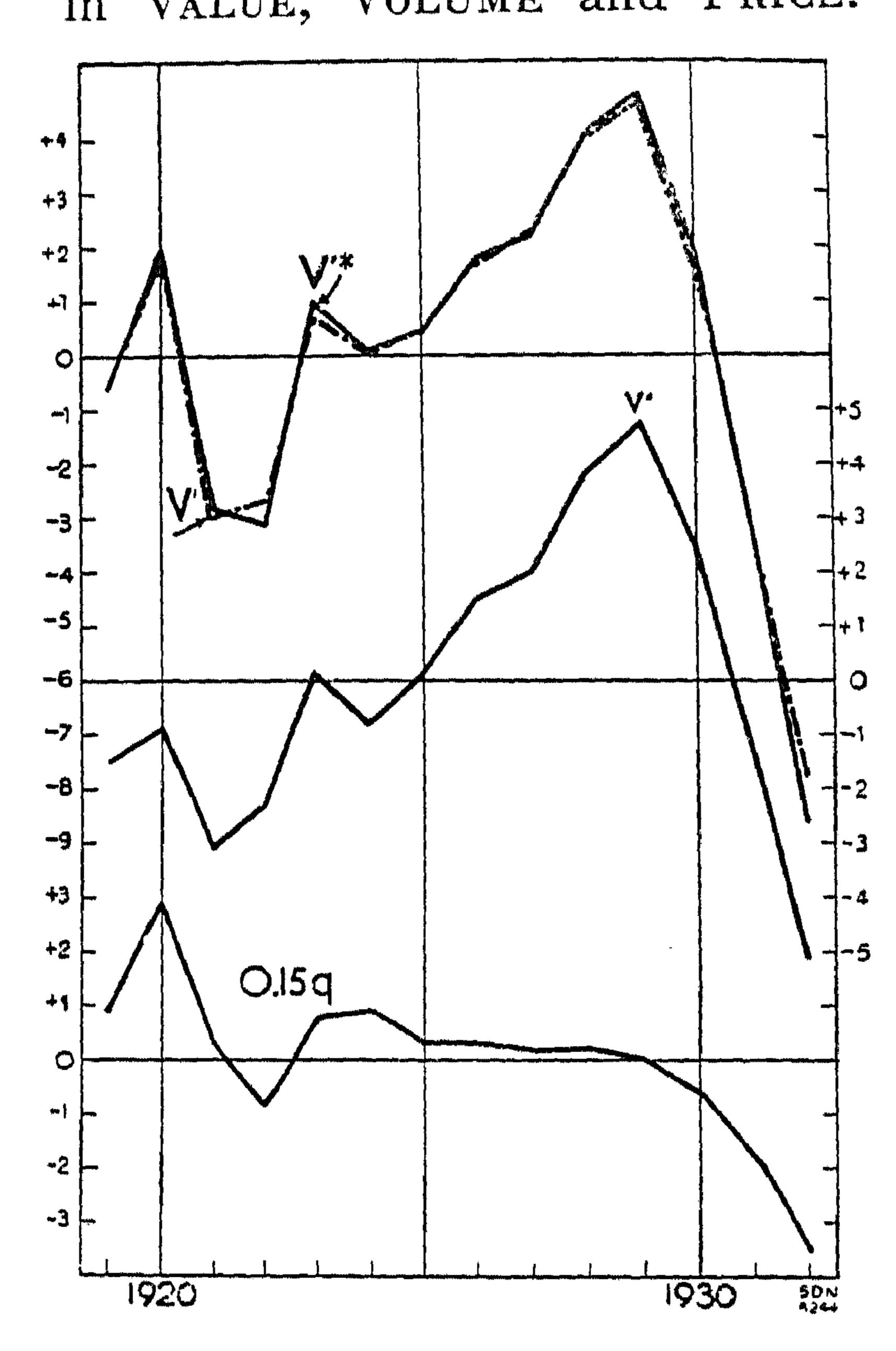
Same explanation as for 1.10.

$1.16: V_B = 0.98v_B + 0.028q_B$

Same explanation as for 1.10.

Graph 1.15.

PRODUCTION OF PRODUCERS'
DURABLE COMMODITIES.
Relation between Fluctuations in Value, Volume and Price.



Graph 1.16.

RESIDENTIAL CONSTRUCTION.

Relation between Fluctuations in Value, Volume and Price.

