CHAPTER IV

DESCRIPTION OF THE MODEL. DEMAND AND SUPPLY IN THE MONEY AND CAPITAL MARKETS

(4.0) Introduction

In this chapter, it is proposed to discuss the price formation of bonds and shares, and some connected problems. This subject belongs to the "Theory of Assets", in which an important development has recently taken place.[1] In this theory the subjects considered are the various holders of assets; and the assets considered are of various types: land, buildings, machines, commodity stocks, securities, short claims and money. Following the principle of this study, we have, in order to make our formulæ manageable, grouped the subjects under three types — *viz.*, banks, other firms, and individuals. Moreover, as physical assets have already been treated separately,[2] we shall be concerned here only with monetary assets.

With regard to the assets which are considered here — viz: bonds, shares, short claims, and money[3] — the simplifying

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[1] J. M. Keynes, *The General Theory of Employment, Interest and Money*, London, 1936; B. Ohlin, "Some Notes on the Stockholm Theory of Savings and Investments", II, *Economic Journal*, 47, June 1937; J. M. Fleming, "The Determination of the Rate of Interest", *Economica* 5, August 1938; H. Markower, and J. Marschak, "Assets, Prices and Monetary Theory", *Economica* 5, August 1938; J. Marschak, "Money and the Theory of Assets", *Econometrica* 6, October 1938.

[2] *Cf.*, on this separation, page 74.

[3] In this chapter, the terms used for monetary assets have the following range:

Bonds: All private and public long-term debt + preferred stock.

Shares: Common stock held by individuals (not by firms).

Short claims: Loans by all banks + Bills discounted and bills bought by the Federal Reserve Banks + Short-term Government debt.

Money: Time + Demand deposits of all banks + Currency held by the public.

(The composition of the series is given in detail in appendix D.)

assumption has been made that each of the three types of subject either demands or supplies each type of asset in the way sketched in the following skeleton table:

	Type of assets			
	Bonds (B)	Shares (C^i)	Short claims (B_s)	Money (M)
Supplied by	Other firms	Other firms	Other firms Individuals	Banks
Demanded by	Individuals (B^i) Banks (B^b)	Individuals	Banks	Other firms Individuals

Banks are supposed to hold only bonds and short claims, the nominal value of which is B^b and B_s respectively; they are the only suppliers of money.

Other (*i.e.*, non-banking) firms supply bonds, shares and short claims, and demand only money; the holding of a considerable part of all shares by these firms seems to be determined rather by the desire for control than by that of earning dividends, and these shares may therefore be altogether eliminated from our collection of assets.

Lastly, individuals exert a demand for bonds and shares (nominal values B^i and C^i respectively) and money; they supply short claims for speculative purposes.

To these simplifications we may further add the assumption that the holding of money is independent of the holding of bonds or shares. The reasons for this are the following:

(1) A considerable part of total money is held by "other firms", which we assumed to hold no securities for investment purposes.

(2) A large class of individuals who hold money are not in the position to hold shares or bonds.

In all other cases where different types of assets are supplied or demanded by one group of subjects, the supply (demand) of various types has been studied jointly. Thus, the supply (demand) of each type of assets has been taken to be dependent on the total supply (total demand) and the prices of all types of assets supplied (demanded) by the group of subjects.

On the other hand, the demand and supply decisions of one group of economic subjects are considered as *independent*. Here a parallel may be drawn with the separate maximisation that is often supposed to exist for the individual's way of earning and spending income: *first* he trives to get the maximum money income, and *then* he seeks the maximum satisfaction from the given amount of money. Likewise, we may assume that firms decide *first* what is necessary for the course of production (the construction of buildings and machines, the holding of commodity stocks and the amount of debt and shares they are prepared to carry), and *afterwards* how much money they need to keep to these plans. Banks *first* decide how much money they will allow to be in existence, and *then* distribute this amount over short claims and bonds. Speculators *first* determine their holdings, and *then*, if necessary, borrow short credits.

It also follows from this division that buildings, machines and commodity stocks do not enter into consideration in this chapter. Their creation and prices have been treated separately in previous chapters.

Summarising, we may divide our task, as set out in the skeleton table on the preceding page, into five parts:

(i) The joint supply of bonds, shares and short claims by other firms and, with regard to the last item, speculating individuals (sections (4.1) to (4.3));

(ii) The supply of money by the banks (section (4.4));

(iii) The joint demand for short claims and bonds by the banks (section (4.5));

(iv) The demand for money by other firms and individuals (section (4.6)).[1]

[1] For reasons that will be explained in section (4.7) it is necessary to treat the demand for money before the demand for bonds and shares by individuals.

(v) The joint demand for bonds and shares by individuals (sections (4.7), (4.8), (4.9)).

(4.1) The Supply of Bonds

The total amount of bonds outstanding at any moment (B_0) may be considered as the sum of the amounts outstanding a year before (B_{-1}) + the increase over that year (ΔB). To "explain" the supply of bonds, it seems statistically most expedient first to "explain" ΔB and then to cumulate the equation found.[1]

It may be remarked that the "explanations" given in this section and the next are rather rough because (i) the material is not good enough to allow of very much refinement and (ii), as will be shown below,[2] we shall, in any case, be obliged to approximate the "explanation" found by a mere trend term.

In view of the difference in determining factors, ΔB has been split into:

ΔB^e: bonds issued by private enterprise, States and local governments;[3]

ΔB^g: bonds issued by the Federal Government.

(4.11) ΔB^e

I. *Theoretical.*

The chief determining factors of changes in the amount of these bonds (and, equally, of shares) outstanding are assumed to be: (i) changes in the value of the stock of capital goods, and (ii) the rates of interest which determine on which market

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[1] Issue figures could not be used instead of ΔB, since, though they are in themselves more certain than the B-figures, they represent only a part of the fluctuations in B. They have, moreover, the disadvantage that they do not cover capital reductions.

[2] *Cf.* section (4.7).

[3] The fluctuations in the increase in debt of States and local governments are too small to justify special treatment. It seemed most logical to combine this debt with that of private enterprise, with which it has in common the important factor of a limited market for its issues. Hence State and local issues fell abruptly after 1930, at the same time as the federal debt heavily increased.

the new capital goods will be financed. In greater detail, this leads to the consideration of the following series:

(1) The value of investment goods delivered (V'). It is possible that there is usually a lag between the production of investment goods and the final financing with long-term capital. Hence V'_{-1} may be included next to V'.[1]

(2) The value of depreciation, as reflected in regular repayments. These repayments have been considered as a constant.

(3) The value of writings-off, as reflected by capital reductions (this factor is probably more important for shares than for bonds). Writings-off may be considered as a readjustment of the value of the capital on a replacement basis; they may therefore be represented by the rate of change in the price of capital goods, Δq. Since writings-up are unusual, only the negative values of Δq should be taken into account; this truncated series may be represented by $(-\Delta q)''$, the sign $''$ indicating that only positive values of the expression between brackets are taken into account.

(4) m_{Lb} and m_{Ls}, the interest rates on the bond and the share market. In the "explanation" of the supply of bonds, the first series may be expected to have a negative coefficient and the second a positive; and inversely in the "explanation" of the supply of shares.[2]

(5) The alternative to issuing bonds or shares consists in (temporarily) financing with short-term credit. The price of

[1] In principle, series for stocks like B and C refer to the average of the year. Consequently, if ΔB and ΔC are to represent the increase during a calendar year, they should be calculated as the difference $B_{+\frac{1}{2}} - B_{-\frac{1}{2}}$, etc., and not as $B - B_{-1}$. For B^g and C, this has actually been done. The series B^e, however, is not accurate enough to be placed at any precise date. Hence, $B - B_{-1}$ has been taken to represent ΔB. It follows that the lag found for this series should be very carefully interpreted.

[2] A parallel may, however, be drawn here with the signs to be expected for the price coefficients of two goods on which a very large part of income is spent (*cf.* section (2.1), page 43). Hence, since a very large part of all investments is financed either by bonds or by shares, the signs for m_{Lb} and m_{Ls} may be different from those to be expected according to the general rules for commodities on which only a small part of income is spent.

this credit (m_S) has not been included in these equations, since its influence must be of minor importance as compared with that of m_{Lb} and m_{Ls} (*cf.* section (4.3)).

II. *Statistical.*

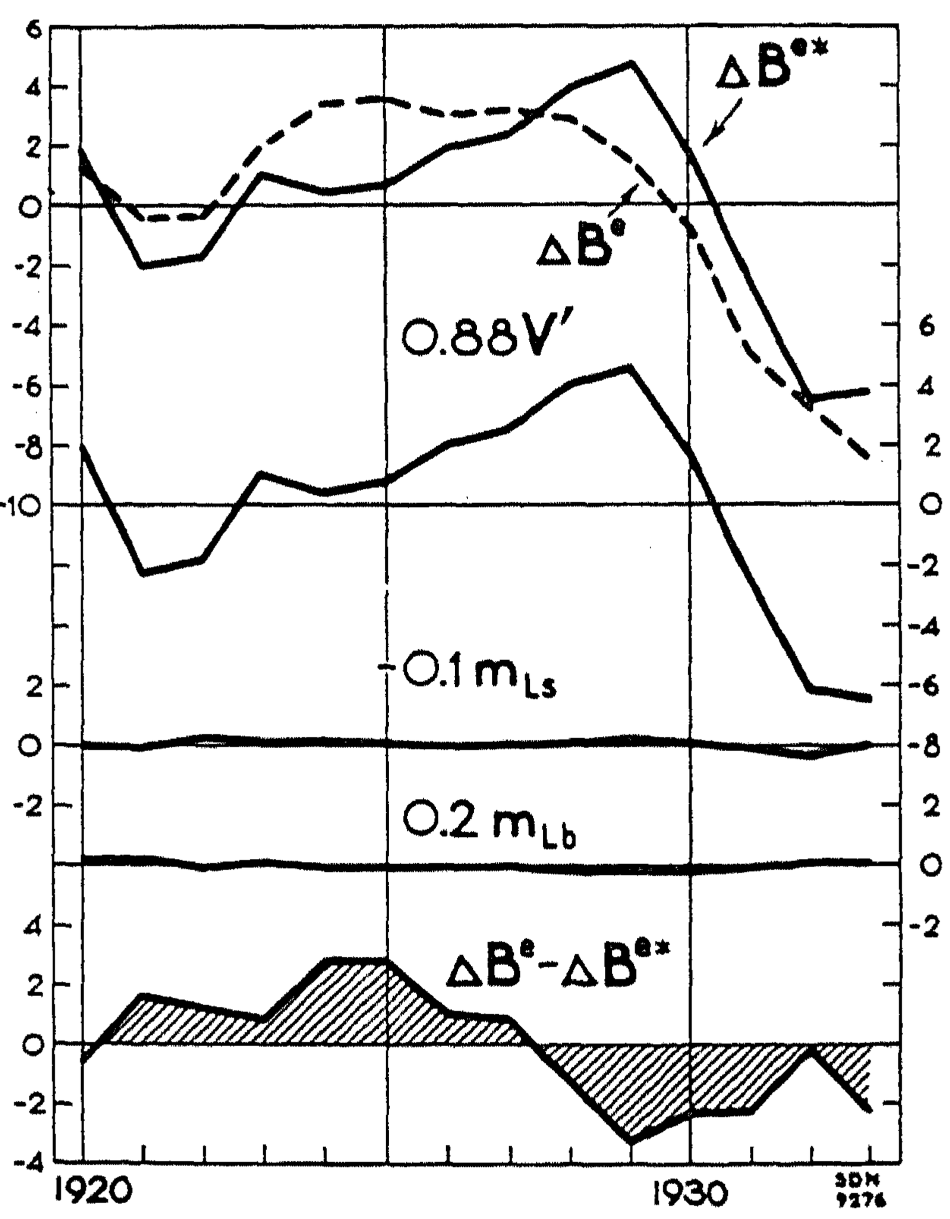
In the "explanation" of ΔB^e by the five series mentioned, a negative coefficient was found for V'_{-1}, which pointed to a lead of some months. Since this does not seem acceptable, and since a fixed combination of V' and V'_{-1}, representing a lag of half a year, gave a much worse correlation, a case without V'_{-1} was finally chosen. Here the coefficient for $(-\Delta q)''$ was so small that it was left out.

The formula finally accepted runs:

$$\Delta B^e = 0.88V' - 0.1m_{Ls} + 0.2m_{Lb} \qquad (4.11).$$

Graph 4.11.

"Explanation" of Fluctuations in the INCREASE OF PRIVATE LONG-TERM DEBT OUTSTANDING.



The signs for m_{Lb} and m_{Ls} are not in accordance with theoretical expectation (in its simplest form); but the coefficients do not seem to be very significant, and the influence of both series is very small (*cf.* graph 4.11).

(4.12) ΔB^g

The total increase in debt of the Federal Government, $\Delta B^g + \Delta B^g_s$,[1] is, by definition, equal to the Government's expenditure minus its revenue. Federal expenditure — in distinction to that of the lower authorities — rises in depressions, when relief payments of different kinds have to be paid, and falls in years of prosperity; revenue,

[1] *I.e.*, the increase in long-term and short-term Government debt.

depending on incomes, imports and similar items, tends to behave in the opposite way. As a result of both causes, the increase in debt will move counter to the cycle. On the basis of these considerations, an attempt is made to " explain" ($\Delta B^g + \Delta B^g_s$) by Z^c and Z^c_{-1} — in order to take account of possible lags — and a trend to represent a possible second-degree trend in Government debt.[1] Over the period 1920-1933, a very satisfactory fit was found with the following formula:

$$\Delta B^g + \Delta B^g_s = -0.115 Z^c - 0.155\, Z^c_{-1} + 0.138t \qquad (4.121).$$

In order to find ΔB^g, the short-term debt may be explained separately. It stands to reason that here considerations with regard to the rate of interest are most important, in such a way that the *amount* of short-term debt outstanding (and not its *increase*) depends positively on the long-term rate of interest.[2] This hypothesis is fairly well confirmed by the facts:

$$B^g_s = 1.7\, m_{Lb} \quad (4.122).$$

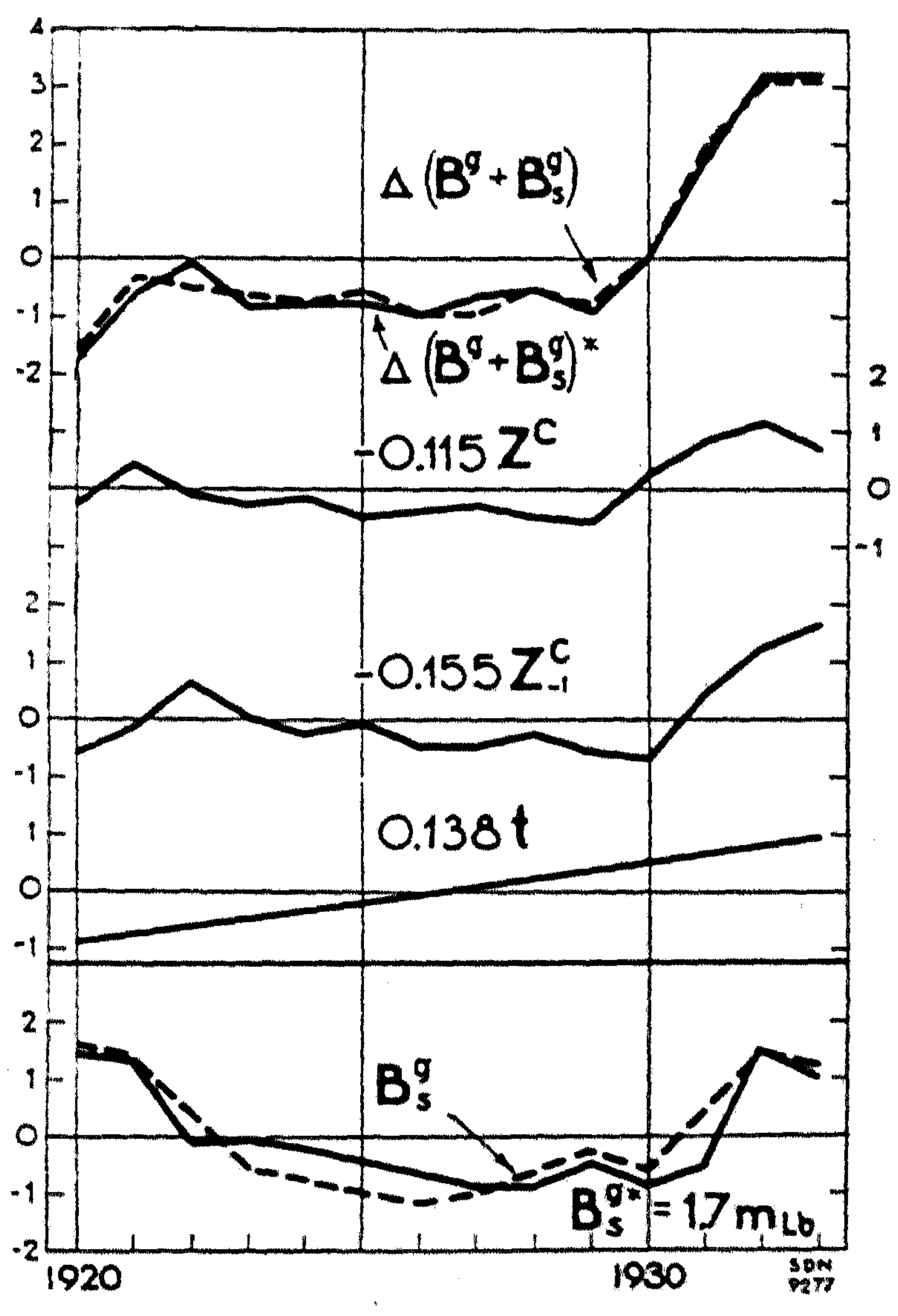
It follows that ΔB^g depends on Z^c, Z^c_{-1}, t and the rate of increase in m_{Lb}:

$$\Delta B^g = -0.115\, Z^c - 0.155\, Z^c_{-1} - 1.7\, \dot{m}_{Lb} + 0.138t \quad (4.123).$$

Graph 4.12.

" Explanation " of Fluctuations in the INCREASE OF FEDERAL GOVERNMENT DEBT.

" Explanation " of Fluctuations in SHORT-TERM FEDERAL GOVERNMENT DEBT OUTSTANDING.



[1] A stable increase (linear trend) in Government debt would mean a constant Δdebt; a linear trend in Δdebt represents a second-degree trend in debt.

[2] The short-term rate of interest, being of minor importance, has not been included.

(4.13) *Cumulation.*

The series B may be found by cumulating $\Delta B^e + \Delta B^g$:

$$B = 0.88\int V' - 0.1\int m_{Ls} + 0.2\int m_{Lb} - 0.115\int Z^c - 0.155\int Z^c_{-1} - 1.7 m_{Lb} + 0.07t^2 + 4.3t \quad (4.131).$$[1]

Cumulations over the period covered come very near to a trend. Hence B may fairly well be approximated by a trend:[2]

$$B = 4.88t \quad (R = 0.99) \quad (4.1).$$

It will be taken in this form in section (4.7).

(4.2) The Supply of Shares

(4.21)

I. *Theoretical. Cf.* section (4.11).

II. *Statistical.*

Here, as with bonds, V' had a tendency to show a considerable lead with regard to ΔC, instead of the expected lag.[3] Hence V'_{-1} was also omitted, and so was $(-\Delta q)''$, which showed a small negative coefficient. The equation chosen runs:

$$\Delta C = 1.64\, V' - 1.1\, m_{Ls} + 8.8\, m_{Lb} \quad (4.21).$$

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[1] The coefficient for t is equal to the average of ΔB; that for t^2 is found by integrating $0.138t$ from (4.123).

[2] The m_{Lb}-term in (4.131), originating with that in (4.122), which is virtually not a cumulant, is small. Moreover, in all correlation calculations where t will be used as representing B, m_{Lb} will also be included as a separate variable.

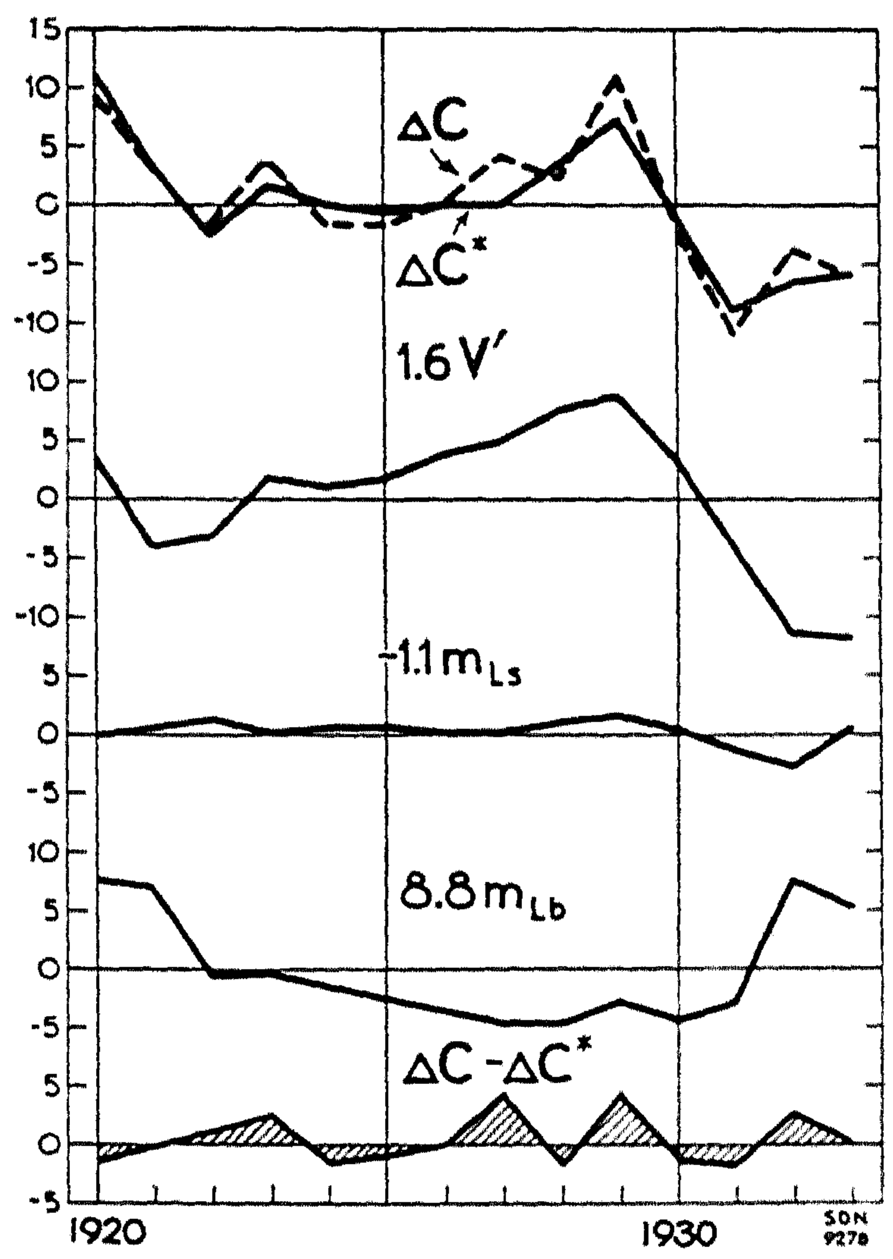
The second-degree trend has a very small influence.

[3] The particular conditions of the country and period under review may perhaps explain why the figures show this lead. In the years 1927 to 1929, part of the receipts of share issues were used on the stock exchange, and were only later taken up by investment.

The signs for m_{Ls} and m_{Lb} are as expected. The coefficient for V′ is very large. Adding that for V′ in (4.11), we find that the fluctuation in the total net increase in long-term capital is about two and a half times as large as the fluctuation in investment. This does not seem reasonable; probably V′ to a certain extent takes the place of another variable not included. In view of the use that will be made of these equations, it is not at present necessary to go deeper into this question.

Graph. 4.21.

"Explanation" of Fluctuation in the Increase of Share Capital outstanding.



(4.22) *Cumulation.*

Cumulating (4.21), we get:

$$C = 1.64\int V' - 1.1\int m_{Ls} + 8.8\int m_{Lb} + 2.4t \quad (4.22),$$

which is again simplified to:

$$C = 3.18\,t \ \ (R = 0.95) \quad (4.2).$$

(4.3) The Supply of Short Claims

The supply of *short-term claims* reacts, by the very nature of these claims, much more quickly to the economic situation than the supply of stocks and bonds. With only a small margin of error, it may therefore be maintained that this supply depends on the variables to be discussed, without any lag. The supply of claims being synonymous with the demand for loans, we have to consider what factors determine this demand. Three seem to be outstanding:

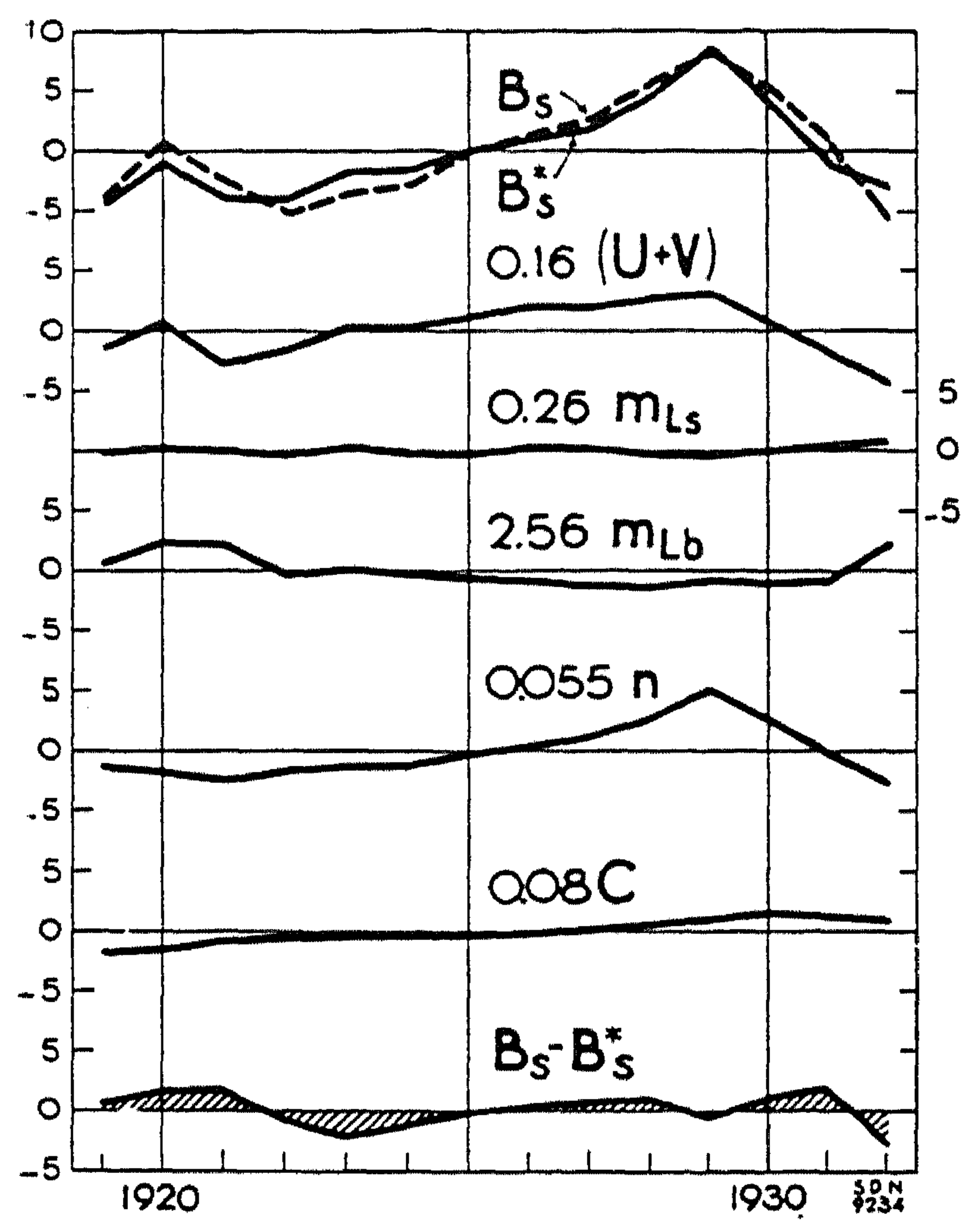
(i) Short-term interest rates (m_S);

(ii) Total value of all shares 0.0156 $\bar{\bar{n}}\ \bar{\bar{C}}$ (*cf.* relation 1.1) representing a demand factor for loans for speculative purposes;

(iii) Total value of production (U+V), representing a demand factor for industrial and commercial loans. This demand is composed of two parts: viz., a demand corresponding to working capital and a demand corresponding to the provisional financing of new investments, which is usually consolidated only after a certain time. The former shows fluctuations which are fairly accurately parallel to U+V, as is seen by inventory statistics, whereas the latter will be parallel to V, as only the new investment of some short period immediately before is financed in this way. Given a high parallelism between U and V and the rather subordinate rôle the present relation is found to play in the whole system, no attempt has been made to distinguish between the influence of U and that of V.

Graph 4.3.

" Explanation " of Fluctuations in SHORT CLAIMS BY SUPPLY FACTORS.



(iv) As competitive "prices", share yield (m_{Ls}) and bond yield (m_{Lb}) may be added.

Using these explanatory variables we find the following regression equation:

$$Bs = 0.16\,(U+V) + 0.26m_{Ls} + 2.56m_{Lb} + 0.055n + 0.08C \qquad (4.3).$$

The variable m_S has been omitted, since it obtained an insignificant positive coefficient, which is not in accordance with theoretical expectations. The value 0 which we have chosen would mean that the elasticity of this supply (which, as has been said already, is equivalent to the demand for short loans) would be *zero*. This is in harmony with our results concerning the low influence of interest rates on investment activity, as well as our hypothesis about the small influence of short-term rates on the share market.

Summary of Results of Correlation Calculations concerning the Supply of Short Claims.

Case	Regression coefficient for:					R
	U + V	C′	m_{Ls}	m_{Lb}	m_S	
1	0.11	0.04	2.27	— 3.93	1.89	0.98
2	0.18	0.05		1.40	— 0.07	0.96
3	0.19	0.05	1.22		0.67	0.98
4	0.21	0.05	0.63	1.25		0.97

The influences found for m_{Ls} and m_{Lb} would indicate that there is a considerable competition between the supply of short claims on the one hand, and the flotation of shares and bonds on the other hand. It is natural that the price to be paid for long-term credits should have much more weight with those who demand these credits than the short-term rate of interest which is to be paid only temporarily.

(4.4) The Supply of Money

The supply of money may be split up into:

(4.41) the supply of currency, and
(4.42) the supply of deposits.

Indicating total money by M, currency outside banks by M′ and deposits by M″, we have

$$M = M' + M'' \qquad (4.40).$$

(4.41). The item "Money in circulation" or "Currency in circulation" of the Federal Reserve Banks balance-sheet covers not only M′, but also the currency held by banks: vault cash (VC). It may be assumed that, for both items, supply follows demand automatically;[1] hence for both we have to consider demand only (*cf.* section (4.6)).

(4.42) In principle, the supply of deposits may be said to be regulated by acts of price fixation — *i.e.*, fixation of the short-term interest rate m_S — by the commercial banks, on the basis of their debt position with the Federal Reserve Banks. The fact that debts (in the form of rediscounts) are permitted to be incurred only for a short period creates a tendency for the banks to fix their interest rates in such a way as to avoid such debts.[2] This means that the higher the net debt position, indicated by bills rediscounted (B*i*) minus excess reserves (R^e), the higher the rate fixed.[3] This may be indicated by a relation:

$$m_S = f\,(Bi - R^e) \qquad (4.420).$$

This relation is shown in graph 4.421. Monthly figures for $Bi - R^e$ (abscissa) are plotted against m_S (ordinate). Where space has allowed, the different months of one year have been connected, and the first and last months indicated. Yearly figures have been plotted on 4.422, with the same scale. It will be seen that, on the right-hand part of the graph, where B*i* outweighs R^e, the rate of interest rises steeply with an increase in indebtedness. More to the left, however, the reaction of the rate of interest to a position of large excess reserves becomes ever fainter; evidently m_S cannot be lower than 0, or a trifle above 0.

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[1] *Cf.* L. Currie, *The Supply and Control of Money in the United States*, Cambridge (Mass.), 1935, Chapter X.

[2] *Cf.* W. W. Riefler, *Money Rates and Money Markets in the United States*, New York and London, 1930.

[3] One might, moreover, have expected to find an influence exercised by the gold stock — viz., a raising of discount rates when the gold cover of the liabilities of the Federal Reserve Banks becomes low. However, no evidence of such an influence is found.

The period considered in this study shows points that are nearly all on the right-hand side of the graph. For this part of the diagram, we may approximate the function of (4.420) by a straight line:

$$m_S = 4\,(Bi - R^e), \qquad (4.421)$$

where the factor 4 indicates that the banks raise their rate of interest by 1% when their indebtedness with the Federal Reserve Banks increases by \$250 million. It will be seen that this line very well fits the scatter in the years 1919-1932.

The original figures on indebtedness, as published by the Federal Reserve Banks, did not follow this pattern for the years 1917 to 1921 (*cf.* the black dots on graph 4.422). In these years, large amounts of United States war paper had to be absorbed by the banking system; this could only take place at the cost of increased indebtedness with the central banks. The special causes that were at work during these years made it reasonable not to include this indebtedness in Bi,[1] but rather to regard it as Federal Reserve Banks holdings of Government paper.

Accordingly, all Bi figures for 1917 to 1921 have been diminished by the amount of bills secured by Government paper each month *minus* the average amount so secured in 1922 (\$230 million) — a year when normal conditions had presumably been restored.

The value of $Bi - R^e$ itself is determined by the other items occurring in the combined balance-sheets of the Federal Reserve Banks, which may be summarised as follows:

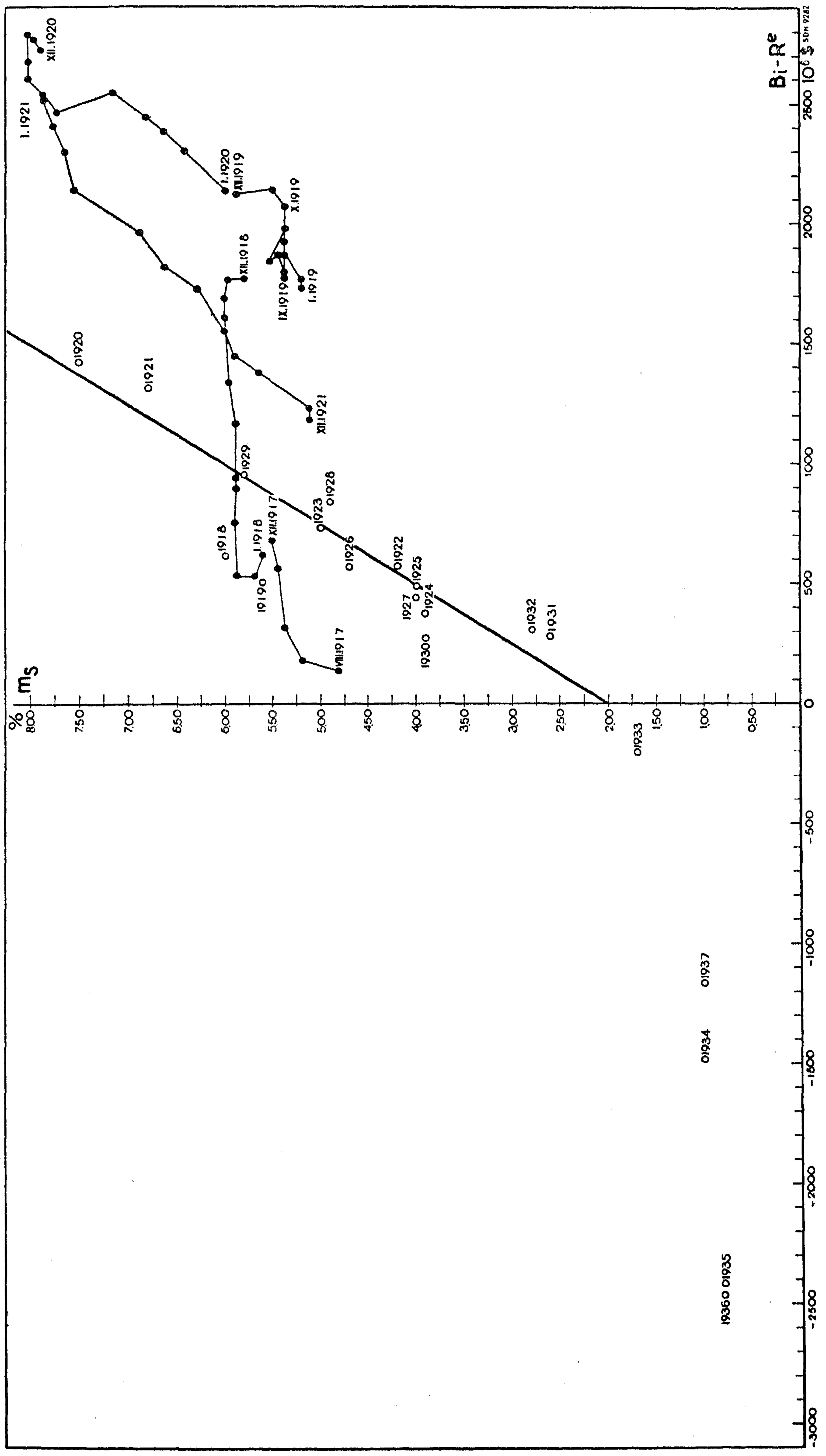
Liabilities		*Assets*	
Member bank reserve balances required	R^r	Gold stock	Au
Member bank reserve balances, excess	R^e	Bills discounted . .	Bi
Currency in circulation	$M' + VC$	Bills bought, Government securities and all other items	P

[1] *Cf.* Riefler, *loc. cit.*, page 158.

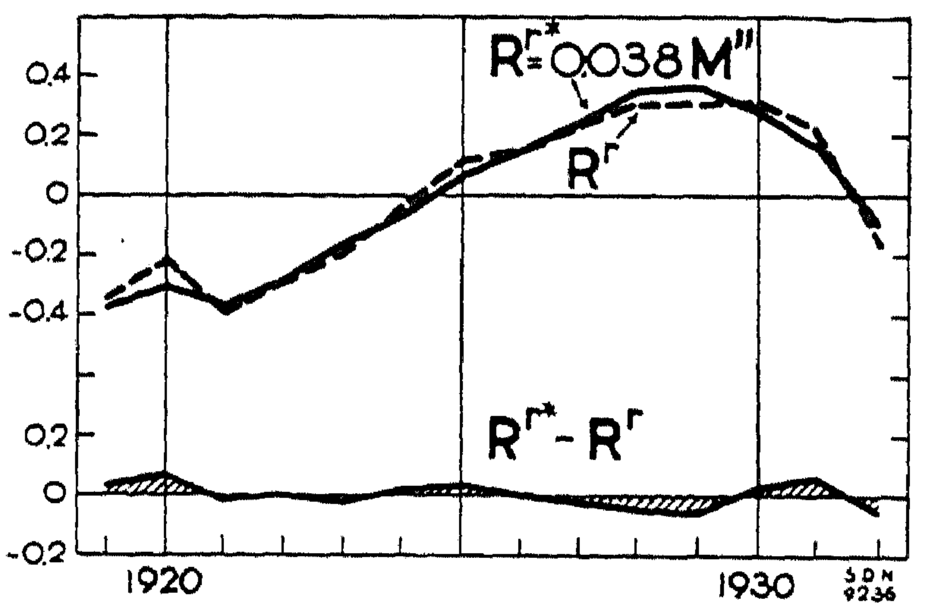
Graph 4.422.

Relation between the Banks' Indebtedness with the Federal Reserve Banks ($Bi - R^e$) and the Short-term Rate of Interest (m_S).

Monthly figures, 1917-1921, uncorrected (....) and yearly figures, 1919-1937 (oooo) (1919-1921 corrected).



The last item includes all small assets minus all small liabilities not elsewhere mentioned;[1] its major constituents, however, are bills bought and Government securities. As these are the chief instruments of open-market policy, the item has been indicated by P, which will be considered as an autonomous (external) variable in the determination of the supply of deposits. So will the gold stock A*u*, whereas currency in circulation ($M' + VC$) is determined by demand, which is also beyond the control of the banking authorities.



Graph 4.43.

"Explanation" of Fluctuations in REQUIRED RESERVES WITH THE FEDERAL RESERVE BANKS by Total Deposits.

From the balance-sheet it follows that

$$Bi - R^e = R^r + M' + VC - (Au + P).$$

Here, R^r is technically connected with the total amount of deposits M'' by the reserve prescriptions. Roughly,[2] these may be assumed to be equivalent to a linear relation between R^r and M'':

$$R^r = \mu M''.$$

[1] In the years 1919-1921, P also includes the amount of rediscounts on United States Government paper, which has been subtracted from B*i* (*cf. supra*).

[2] The constant relation between changes in M'' and changes in R^r exists only if the composition of deposits and their distribution over different types of banks change regularly with changes in all deposits. The percentage distribution of changes in all deposits over different groups, as determined from correlation calculations (taking account of trend changes) is as follows:

It follows that the price fixation equation for m_S may be written as

$$m_S = 4\ [\mu\, M'' + M' + VC - (Au + P)] \qquad (4.422)$$

or, according to (4.40)

$$m_S = 4\ [\mu\, M + (1-\mu)\, M' + VC - (Au + P)] \qquad (4.423).$$

Solving (4.423) with respect to M, we find as a supply equation for money:

$$M = \frac{m_S}{4\mu} - \frac{1}{\mu}\,[(1-\mu)\, M' + VC - (Au + P)] \qquad (4.424).$$

				Required reserves with Federal Reserve Banks 1917-1936
All banks: 100	Member banks: 72	Demand: 39	Central reserve cities: 9	13%
			Reserve cities: 13	10%
			Country: 13	7%
			Other (Government etc.): 4	0%
		Time: 33		3%
	Non-member banks: 28	Demand: 10		0%
		Time: 18		0%

If we weight the required reserve percentages, as indicated in the last column, by this distribution of the changes in deposits, we find an average "marginal reserve percentage" of 4.3 — indicating the possibility of the creation of \$23 million of additional deposits on \$1 million of additional reserves.

Direct correlation of R^r with M'' and a trend gives, however, a marginal percentage of 3.8 (indicating an expansion of 26 times). The difference between the two figures is probably due to the fact that, in a depression, idle money with the country banks is redeposited with city banks; which, according to the existing regulations, obliges both banks to keep reserves against them. In times of prosperity, this money is either used in the country, or directly deposited with the New York banks (1929). For this reason the ratio between reserves required and deposits in the hands of the public tends to be lower in times of prosperity, when M'' is high, and higher when M'' is low (*cf. Member Bank Reserves*, Report of the Committee on Bank Reserves of the Federal Reserve System (1931), pages 9-10). The coefficient found by direct correlation has been taken as μ.

As it has been found by correlation that

$$\mu = 0.038 \ (cf. \text{ graph } 4.43),$$

the following equation is finally taken for the supply of M:

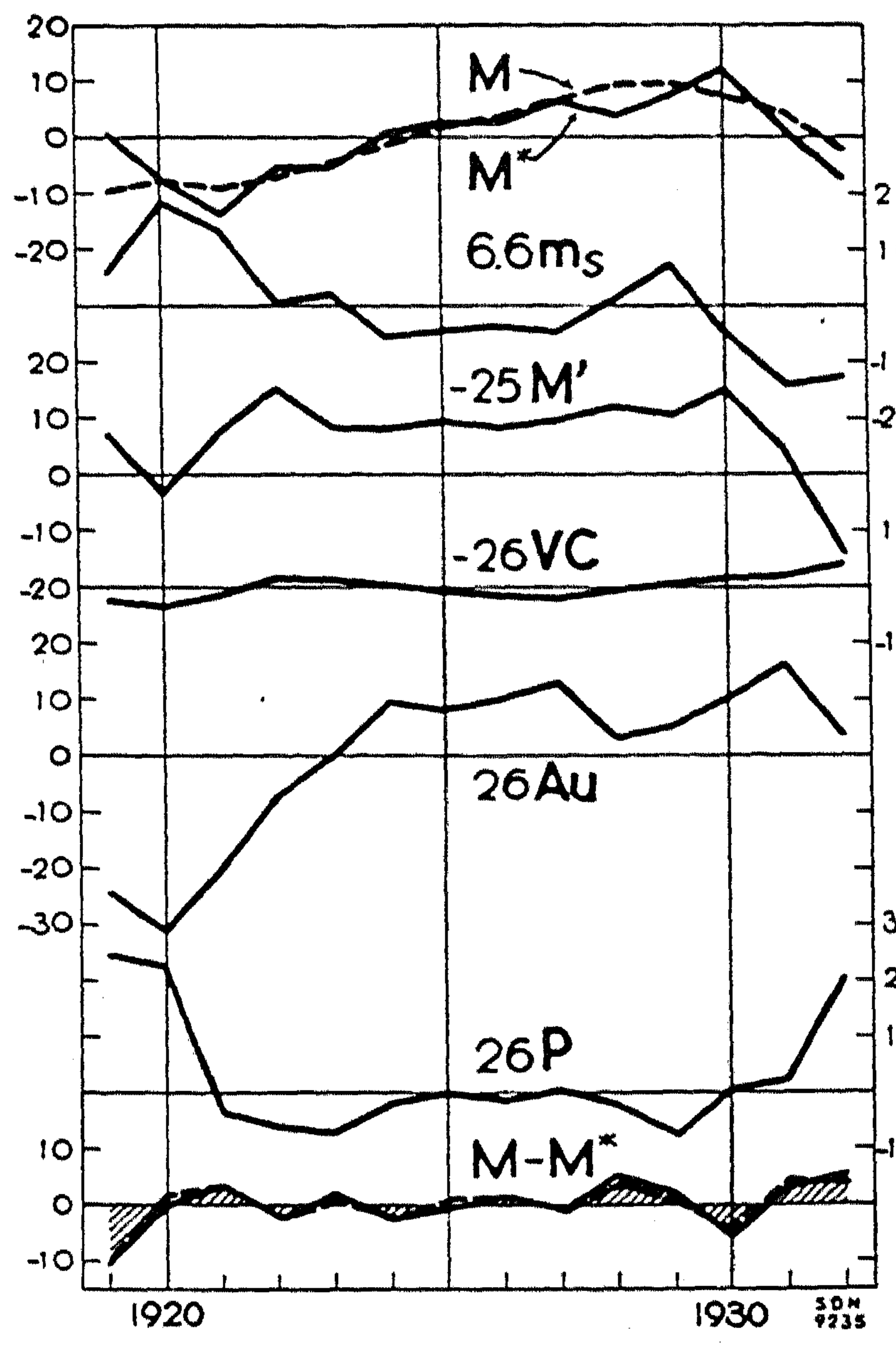
$$M = 6.6\, m_S - 25\, M' - 26\, VC + 26\, (Au + P) \qquad (4.4).$$

Graph 4.4 shows the fit of this relation.[1] It will be seen that M′ has a large *negative* influence on M; the hoarding of some 1 or 2 milliard dollars of currency in 1931 and 1932 must, in particular, have caused 25 times as large a decrease in the supply of money.

Graph 4.4.

"Explanation" of Fluctuations in the Quantity of Money by Supply Factors.

(In the residuals, a dotted line is drawn indicating 26 × the residuals of the yearly figures in graph 4.422.)



(4.5) Demand by Banks for Short Claims and Bonds

As has already been stated, the demand by banks for short claims and for bonds is considered as joint. This means that the total amount which the banks have available to hold assets is distributed over the two categories of assets in a way depending on the price and the attractiveness of each. This amount has been derived from the combined balance-

[1] The fit is not very good. This is due to the fact that (4.4) is found by solving (4.423) with respect to M, which plays a minor rôle in this equation. Hence the residuals have a larger relative importance. Comparison of the residuals with 26 times the residuals in (4.422) shows that the former are almost entirely due to the latter.

sheets of all banks, including the Federal Reserve Banks, which for this purpose may be summarised as follows.[1]

Liabilities			*Assets*	
Outside currency	$\overline{\overline{M}}'$	$\overline{\overline{M}}$	Gold stock . . .	$\overline{\overline{Au}}$
Deposits	$\overline{\overline{M}}''$		Short claims . .	$\overline{\overline{B}}_s$
			Bonds	$\overline{\overline{B}}^b . \frac{c}{\overline{\overline{m}}_{Lb}}$ *

* For explanation of this term, see below.

All other items are either almost constant or unimportant. The amount available for distribution over B_s and B_b may therefore be taken as equal to M — Au, or, since the fluctuations in Au are very small compared with those in M, as equal to M (*cf.* graph 1.6).[2]

The factors determining how this total holding is to be distributed over the two types of assets may be separated into two groups: their prices, and the attractiveness which each asset is expected to have for the holder. The price of short claims is taken as 1. The price of bonds is equal to $\frac{c}{\overline{\overline{m}}_{Lb}}$, where c is the nominal yield (averaged over all bonds in existence) and $\overline{\overline{m}}_{Lb}$ the actual yield. The variations in time of c may be disregarded; it will be taken as a constant with the value 4.5; hence bond prices may be taken to vary inversely with $\overline{\overline{m}}_{Lb}$, and, instead of prices, m_{Lb} may be taken as a variable.

The attractiveness of short claims consists in the interest income they yield; m_S must therefore be included as an "explanatory" variable. Bonds are in the first place attractive on account of the regular income in the form of interest (c) which they yield; but as c is considered as a constant, it need not be included. A second attraction of bonds may consist in

[1] The item "vault cash" cancels out.

[2] An attempt was made to include Au in the explanation of B_s and B^b, but no perceptible influence could be found.

expected price gains at the moment of selling; these gains are supposed to be inversely connected with the rate of increase in m_{Lb} : $\dot{m}_{Lb}$.

The banks' demand for short claims will thus be assumed to be a function $D_1(M, m_S, m_{Lb}, \dot{m}_{Lb})$ of M, m_S, m_{Lb} and $\dot{m}_{Lb}$, and their demand for bonds to be a function $D_2(M, m_S, m_{Lb}, \dot{m}_{Lb})$ of the same variables. These functions must be of such a nature that at any moment the total money value of short claims and of bonds held by the banks equals the value M. Since the price of bonds equals $\frac{c}{\bar{\bar{m}}_{Lb}}$ and that of short claims is unity, the money value of assets held is $\bar{\bar{B}}_s + \bar{\bar{B}}^b \frac{c}{\bar{\bar{m}}_{Lb}}$, where $\bar{\bar{B}}_s$ and $\bar{\bar{B}}^b$ represent the nominal amounts held in absolute values (and not their deviations from average). This money value must be identically equal to $\bar{\bar{M}}$ — *i.e.*, equal to $\bar{\bar{M}}$ for any values of m_S, m_{Lb} and $\dot{m}_{Lb}$:[1]

$$\bar{\bar{B}}_s + \bar{\bar{B}}^b \frac{c}{m_{Lb}} = \bar{\bar{M}} \qquad (4.51).$$

[1] The treatment chosen here can perhaps best be understood by analogy with the demand for n types of consumers' goods on which together all the income of a certain group of persons is spent. (This presupposes that all consumers' goods are included and that either no saving occurs or saving is also considered as a consumers' good). Denoting the quantities demanded of the various goods by u_1, u_2, u_3, etc., their prices by p_1, p_2, p_3, etc., and total income by Y, the demand functions are:

$$u_1 \ (p_1, p_2, p_3 \ \dots \ p_n, \ Y)$$
$$u_2 \ (p_1, p_2, p_3 \ \dots \ p_n, \ Y), \text{ etc.}$$

They will be dependent, since they must fulfil the following relation:

$$u_1p_1 + u_2p_2 + \ \dots \ u_np_n = Y.$$

In our case, assets take the place of consumers' goods and Y is replaced by the value of all assets. In addition, the demand functions depend on other variables, since, unlike consumers' goods, these assets have changing properties which make them in a changing degree attractive to holders.

In ~~deviations from average~~, this identity may be written as [1]

$$B_s + 0.9\,B^b - 2.93\,m_{Lb} \equiv M \; (cf.\text{ graph } 1.6) \qquad (4.52).$$

The identity implies that the two demand functions are not independent of each other. Assuming them to be linear, and of the form:

$$B_s = \Delta_{11}\,M + \Delta_{12}\,m_S + \Delta_{13}\,m_{Lb} + \Delta_{14}\,\dot{m}_{Lb} \qquad (4.53)$$
$$B^b = \Delta_{21}\,M + \Delta_{22}\,m_S + \Delta_{23}\,m_{Lb} + \Delta_{24}\,\dot{m}_{Lb} \qquad (4.54)$$

the coefficients must fulfil certain conditions to guarantee the identity (4.52). It follows that:

$$\left.\begin{array}{lll} \Delta_{11} + 0.9\Delta_{21} & & = 1 \\ \Delta_{12} + 0.9\Delta_{22} & & = 0 \\ \Delta_{13} + 0.9\Delta_{23} & - 2.93 & = 0 \\ \Delta_{14} + 0.9\Delta_{24} & & = 0 \end{array}\right\} \qquad (4.55).$$

The correlation calculation to find these coefficients has been made in such a way that these conditions are automatically fulfilled.[2]

[1] The calculation runs as follows:

(1) $\bar{\bar{B}}_s = \bar{B}_s + B_s$

(2) $\bar{\bar{B}}^b = \bar{B}^b + B^b$

(3) $\bar{\bar{B}}^b \dfrac{c}{\bar{\bar{m}}_{Lb}} = (\bar{B}^b + B^b)\dfrac{4.5}{\bar{\bar{m}}_{Lb} + m_{Lb}} = (\bar{B}^b + B^b)\dfrac{4.5}{\bar{\bar{m}}_{Lb}}\left(1 - \dfrac{m_{Lb}}{\bar{\bar{m}}_{Lb}}\right)$

(approximately) $= 0.9(\bar{B}^b + B^b - 3.26 m_{Lb})$ (neglecting a second order term and using $\bar{m}_{Lb} = 5$, $\bar{B}^b = 16.3$).

(4) $\bar{B}_s + 0.9\,\bar{B}^b = \bar{M}$.

[2] Instead of requiring separately that:

$\Sigma\,(B_s - B_s')^2$ and $\Sigma\,(B^b - B^{b\prime})^2$ be a minimum,

we require that $\Sigma\,(B_s - B_s')^2 + \Sigma\,(B^b - B^{b\prime})^2$ be a minimum.

In this function B_s' and $B^{b\prime}$ are replaced by (4.53) and (4.54), and four of the eight coefficients are eliminated with the help of (4.55). From the function so obtained, four normal equations are derived in the ordinary way. (*Cf.* Vol. I, pages 133-136.)

The numerical results found are

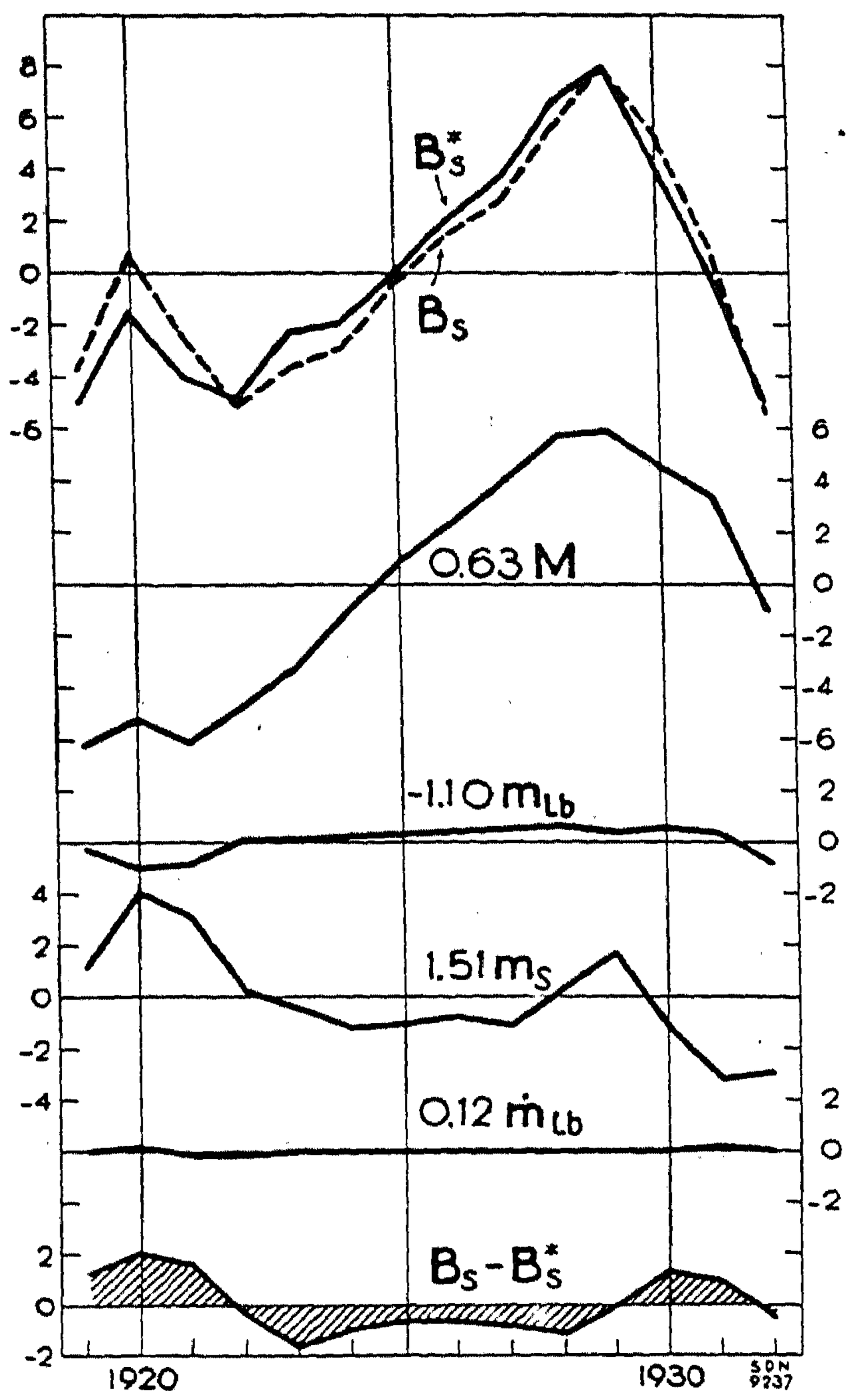
$$B_s = 0.63\ M + 1.51\ m_S - 1.10\ m_{Lb} + 0.12\ \dot{m}_{Lb} \qquad (4.56)$$

$$B^b = 0.41\ M - 1.68\ m_S + 4.48\ m_{Lb} - 0.14\ \dot{m}_{Lb} \qquad (4.57).$$

The fits are good, as is shown by graphs 4.56 and 4.57; the influence of $\dot{m}_{Lb}$ is negligible.

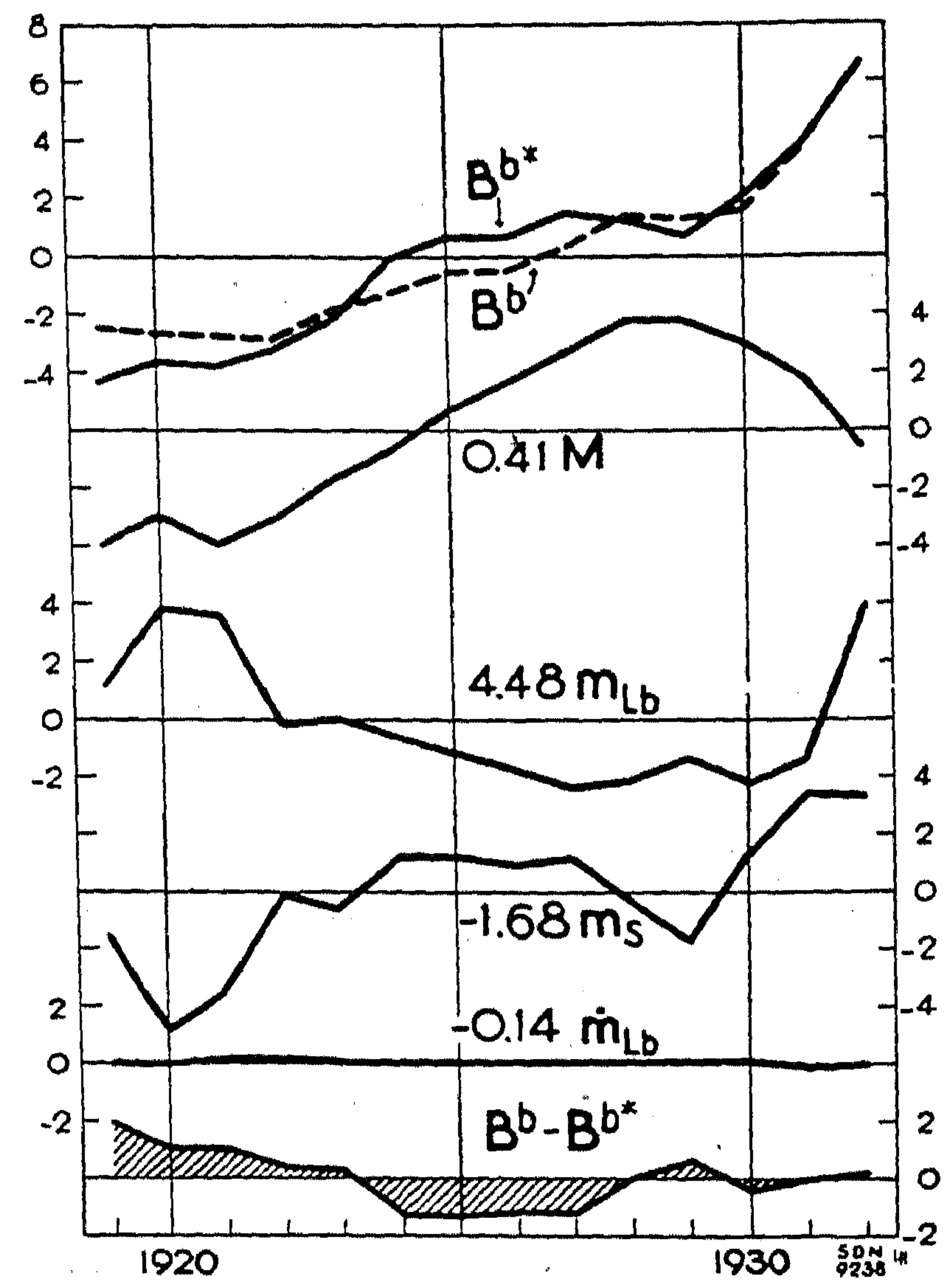
Graph 4.56.

" Explanation " of Fluctuations in the VALUE OF SHORT CLAIMS by Demand Factors.



Graph 4.57.

" Explanation " of Fluctuations in the NOMINAL VALUE OF BONDS HELD BY THE BANKS, by Demand Factors.



(4.6). THE DEMAND FOR MONEY

The demand for money may be split into:

(4.61) Demand for currency by the public (" outside currency");

(4.62) Demand for currency by the banks,[1]

(4.63) Demand for deposits.

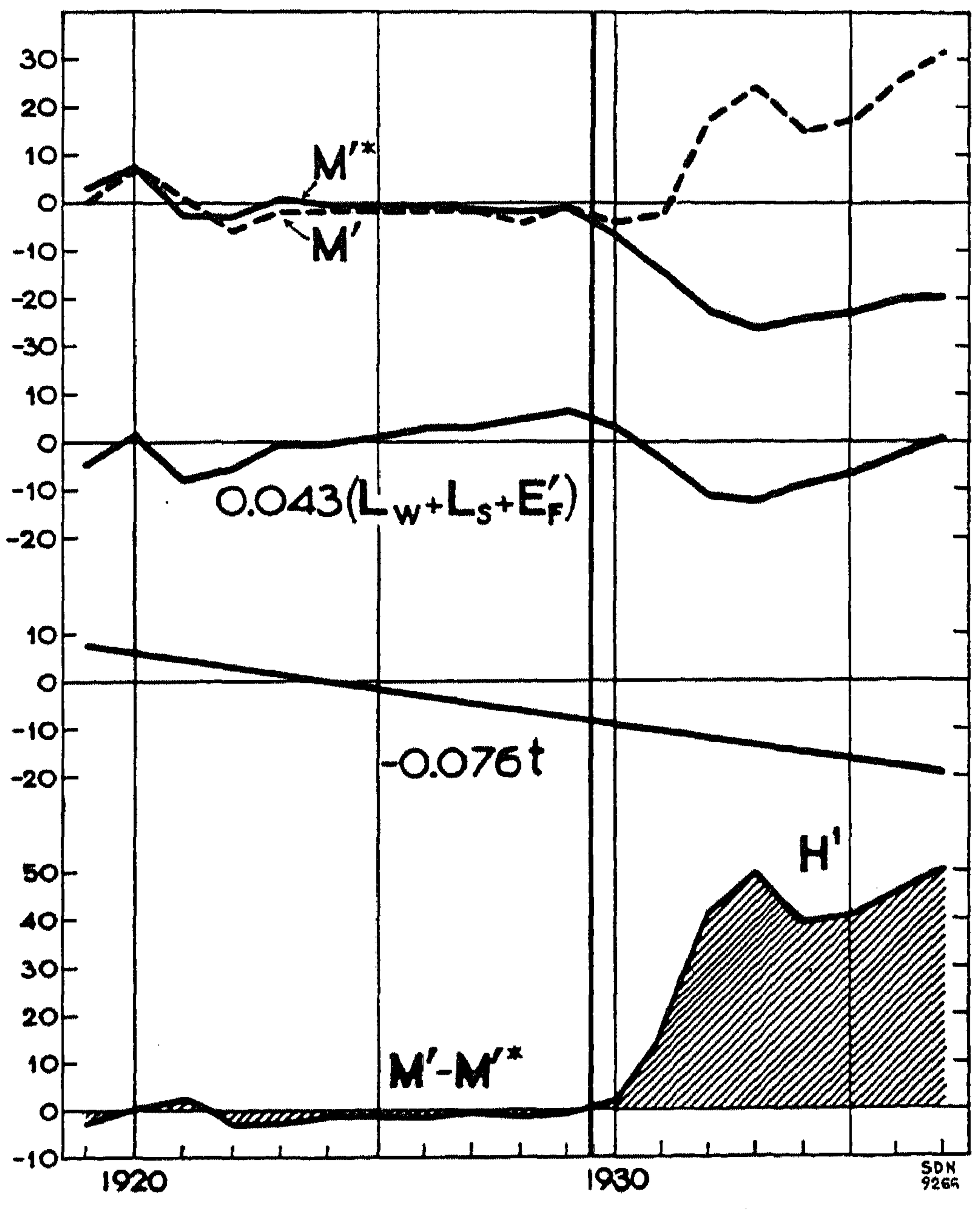
(4.61). M′. The demand for "outside currency" [2] consists of two parts:

(*a*) demand for payments to and by workers and farm population, which may be taken as linearly dependent on total wages and salaries $L_w + L_s$, plus agricultural money income E'_F; and

(*b*) demand for idle money (hoards).

Graph 4.611.

"Explanation" of the Fluctuations of OUTSIDE CURRENCY by Demand Factors, 1919-1929. *Extrapolation*, 1930-1937.



The left-hand side of graph 4.611 shows that for the years 1919-1929, when it may be taken that there was no considerable currency hoarding, the course of M′ may be very well explained by the movement of $L_w + L_s + E'_F$ and a negative trend, indicating the increasing use of cheques instead of currency. The formula runs:

$$M' = 0.043\,(L_w + L_s + E'_F) - 0.076\,t \qquad (4.611).$$

[1] Although we do not include vault cash under the definition of money, we must nevertheless take account of it because it enters as a negative factor into the supply of deposits; *cf.* section (4.4).

[2] J. W. ANGELL, *The Behaviour of Money*, New York and London, 1936.

It has been assumed that the same relation holds good for the demand for currency for payments in the following years, and that the magnitude of the idle hoards may therefore be estimated as the residual between the actual and the calculated M'. To obtain further evidence, the calculation has been continued through 1937 (Hoarding, estimate 1). It is possible that the trend movement in favour of the cheque has not continued at the same rate after 1929 as before that year. A probably extreme alternative has therefore been calculated, where the trend term in (4.611) was supposed to be nil for the period after 1929 (Hoarding, estimate 2).

A third estimate was made according to a principle indicated by Bertrand Fox.[1] Mr. Fox assumes that hoarding started in November 1930 and that it was not effected in $1 notes or coin. So the amount of hoarding may be determined by comparing the variations in the value of outstanding notes of denominations of $5 and over, with those of the $1 notes (Hoarding, estimate 3).[2] The result of the three estimates is shown below and in graph 4.612.[3]

Hoarding	1930	1931	1932	1933	1934	1935	1936	1937
				Milliards of dollars				
Estimate 1 . . .	0.09	0.89	2.08	2.50	1.96	2.02	2.28	2.53
Estimate 2 . . .	0.02	0.74	1.85	2.20	1.58	1.57	1.76	1.93
Estimate 3 . . .	0.03	0.60	1.36	1.50	1.05	1.00	1.13	1.16

[1] "Seasonal Variation in Money in Circulation", *Review of Economic Statistics* XXI, February 1939, pages 21-29.

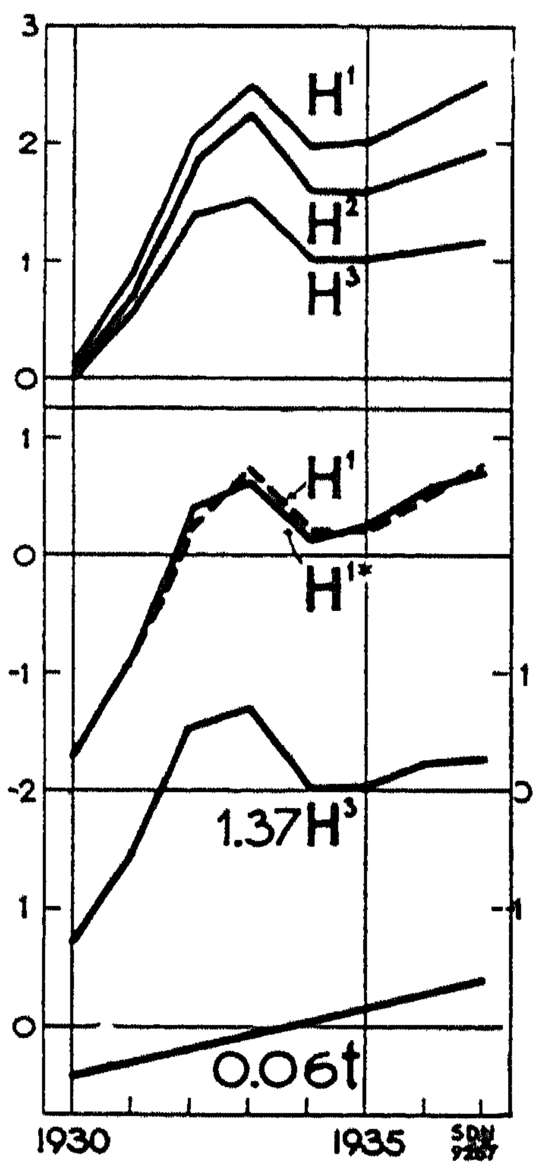
[2] The figures obtained by this procedure differ largely from those given by Mr. Fox, owing to the fact that we do not follow his assumption that hoards had been liquidated by January 1935. The argument offered in favour of this assumption — viz., that after this date "the movements of all denominations conform to the same pattern, and in turn, roughly to that of general business" (page 27) — only proves, it would seem, that there was no more *new* hoarding after that date, but not that the existing hoards had been liquidated.

[3] In an earlier publication of the League of Nations, *Commercial Banks 1925-1933* (Geneva, 1934), the amount of hoarding was estimated according to virtually the same method. The result, that "the actual amount of hoarding in June 1932 was . . . at least $1,600 million and probably more" (page 247), agrees with the present estimates.

It will be seen that the third estimate shows a good correlation with the first and the second, but with a smaller amplitude and a slight trend difference. This would suggest that there was still some hoarding of \$1 notes. On the basis of the correlation between estimate 1 and estimate 3, shown in graph 4.612, lower part, the hoards of \$1 notes may be estimated at about 3% of total hoarding.[1] This would not seem to be unreasonably large, and we may take our estimate 1 as final.

Graph 4.612.

Three Estimates of CURRENCY HOARDING, 1930-1937, and "Explanation" of the Fluctuations of H^1 by those of H^3 and t.



As we shall see in section (4.9), hoarding has a considerable influence on n. It is therefore of importance for the system of equations to include an "explanation" of hoarding.

This, however, raises a number of theoretical and statistical difficulties.

(i) Though there is a certain systematic, cyclical background to the phenomenon of currency hoarding, this variable, perhaps more than any other in our system, will be influenced by incidental factors. Hence we may expect large residuals in any "explanation" that is based only on endogenous factors.

(ii) The number of observations that may serve for the "explanation" is small. Hoarding started in the fourth quarter of 1930. The "explanation" by endogenous factors cannot go, it would seem, beyond the middle of 1933, when, as a consequence of the measures of bank control following the general bank holiday in March of that year, and

[1] In October 1930, the value of \$1 notes outstanding was about one-tenth of the value of all notes. Hence $0.1 \times 0.37\, H^3$, or $0.1 \times 0.37 \times \frac{100}{137} H^1$, or about 3% of H^1, kept in the form of \$1 notes, would be sufficient to explain the difference between the two estimates.

the somewhat improved business situation, the fear of bank failures might have ceased.[1]

The more or less stable amount of hoarding after that date should probably be ascribed to the fact that, possibly under the influence of the New Deal, a new equilibrium situation had developed, where hoards of some 2 milliard dollars were considered as normal. Our explanation must thus be restricted to the last quarter of 1930, the years 1931 and 1932, and the first two quarters of 1933. These five observations [2] clearly do not allow of a choice between different possible explanatory variables on the basis of a correlation calculus.

(iii) Different factors may have co-operated in causing the increasingly difficult position of the banks, and hence a rising distrust and an increasing tendency to hold cash rather than deposits. Apart from withdrawals of deposits by foreigners and hoarding itself, the following factors are mentioned: "the fall in commodity prices, security and real-estate values and personal incomes ".[3]

(iv) Each of these factors may have acted with an unknown but certainly not very large lag.

(v) It is not quite clear whether we must choose, of these explanatory variables, the actual value in any year, or a sum over some preceding period. It may be argued that the position of the banks becomes weaker, the longer bad trade continues — this would be a point in favour of the use of a sum; — or, on the contrary, that at any unfavourable

---

[1] Bank failures, which had involved a yearly loss of deposits of about $100 million to $300 million from 1921 to 1929, reached their peak in 1933 with a figure of $3,600 million of deposits involved. After that year, they were reduced to a negligible amount. Evidently bank failures are closely connected with hoarding, both as a cause and as an effect. But since the explanation of this phenomenon meets with the same difficulties as that of hoarding, it cannot give much help in the explanation of the latter.

[2] Nothing is gained by using eight quarterly figures for 1931 and 1932, because for almost any explanatory variable these eight values lie practically on a straight line. The heavy fluctuations in hoarding from one quarter to another are admittedly not due to the endogenous explanatory factors to be used.

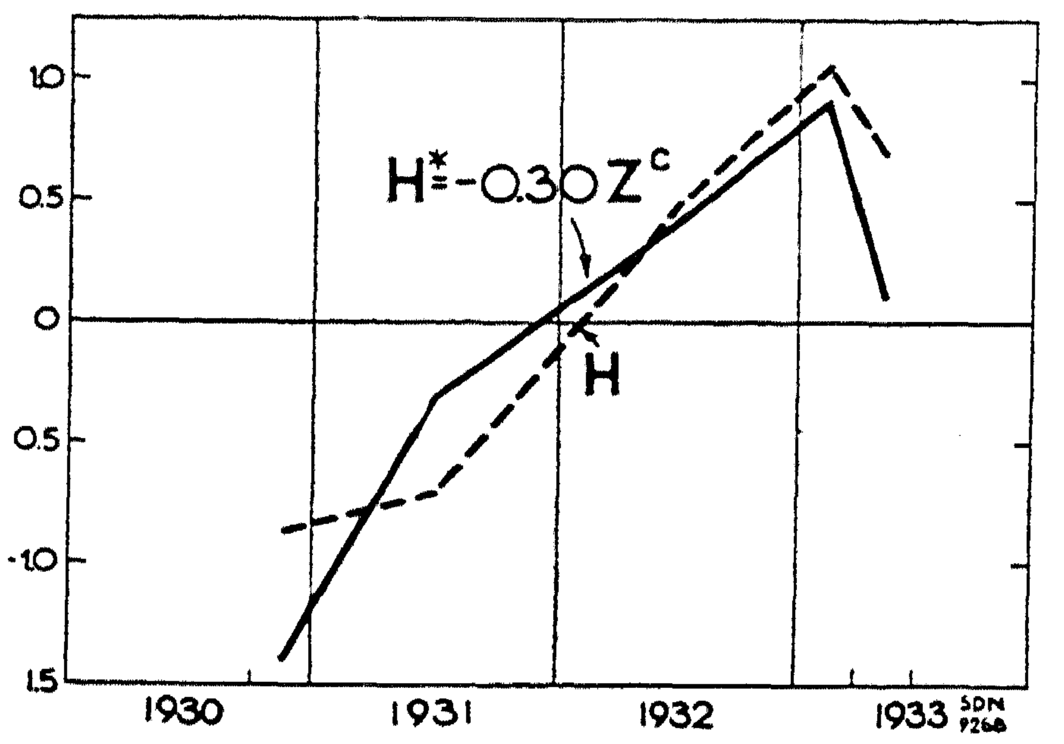
[3] *Commercial Banks 1925-1933*, League of Nations, page 246.

cyclical situation, a certain number of banks fail, but that the others will be able to continue however long this situation may last. Again, hoarding may correspond to the current rate of bank suspensions, or to the cumulated total of such failures over a certain time.

Lacking both theoretical and statistical evidence, the choice may be determined by considerations of a practical nature. Only one explanatory variable will be used — viz., Z^c, corporation profits, which is a good indicator of the business situation and, at the same time, most easy to handle in the elimination process (Chapter VI). A possible small lag is neglected. On practical grounds, too, Z^c rather than $\int Z^c$ (accumulation) is chosen.[1]

Graph 4.613.

"Explanation" of Fluctuations in Currency Hoarding.



It appears from the data before 1930 that relatively small fluctuations in profits do not lead to hoarding or dishoarding. Also, the evidence since 1934 does not suggest, after a period of hoarding, a clear tendency to diminish hoards when business improves. From these facts it would follow[2] (i) that a low value of Z^c entails hoarding, but a high value no dishoarding; (ii) that the depression

[1] We may be pretty certain that the choice of any other possible explanatory variable — *e.g.*, (U + V) — would have given an only slightly different result.

Trials have also been made with the short-term rate of interest as the explanatory factor. The results were less convincing from a statistical point of view than those obtained with Z^c; and since there is no reason to believe that, in this particular country and period, the low rate of interest was the most important factor making for hoarding, the "explanation" by Z^c has been given preference.

[2] It must be admitted that the evidence from these last years, in which external factors may have played a large part, cannot be regarded as very conclusive.

must be rather serious — *i.e.*, that Z^c must have fallen a considerable amount below the preceding boom value, before hoarding starts. If we estimate this threshold value by comparing the profits in 1929 with those in the third quarter of 1930 — when hoarding had not yet appeared — we find that the minimum fall must be about 7 milliard dollars. Indicating by Z^c_m the maximum of the preceding boom, hoarding would occur when

$$Z^c_m - Z^c - 7 > 0.$$

The explanation of hoarding with Z^c over the period indicated yielded:

$$H = -0.30Z^c \quad (cf.\ \text{graph } 4.613).$$

This formula may be generalised so as to cover also years with increased or slightly decreased profits, by writing

$$H = 0.30\,(Z^c_m - Z^c - 7)'', \qquad (4.612)$$

where the sign $''$ indicates that only positive values of the expression between the brackets are to be taken into account.

The general formula for outside currency now becomes:

$$M' = 0.043\,(L_w + L_s + E'_F) - 0.076t + 0.30\,(Z^c_m - Z^c - 7)'' \qquad (4.61).$$

(4.62) Vault cash (VC) is statistically known:

(i) by weeks for reporting member banks in 101 cities;

(ii) on three or four call dates for all member banks; and

(iii) on June call dates for all banks.

As the function of vault cash is that of a small buffer stock, which is liable to relatively heavy fluctuations, not too much evidence can be gained from one, or even four, figures in a year.

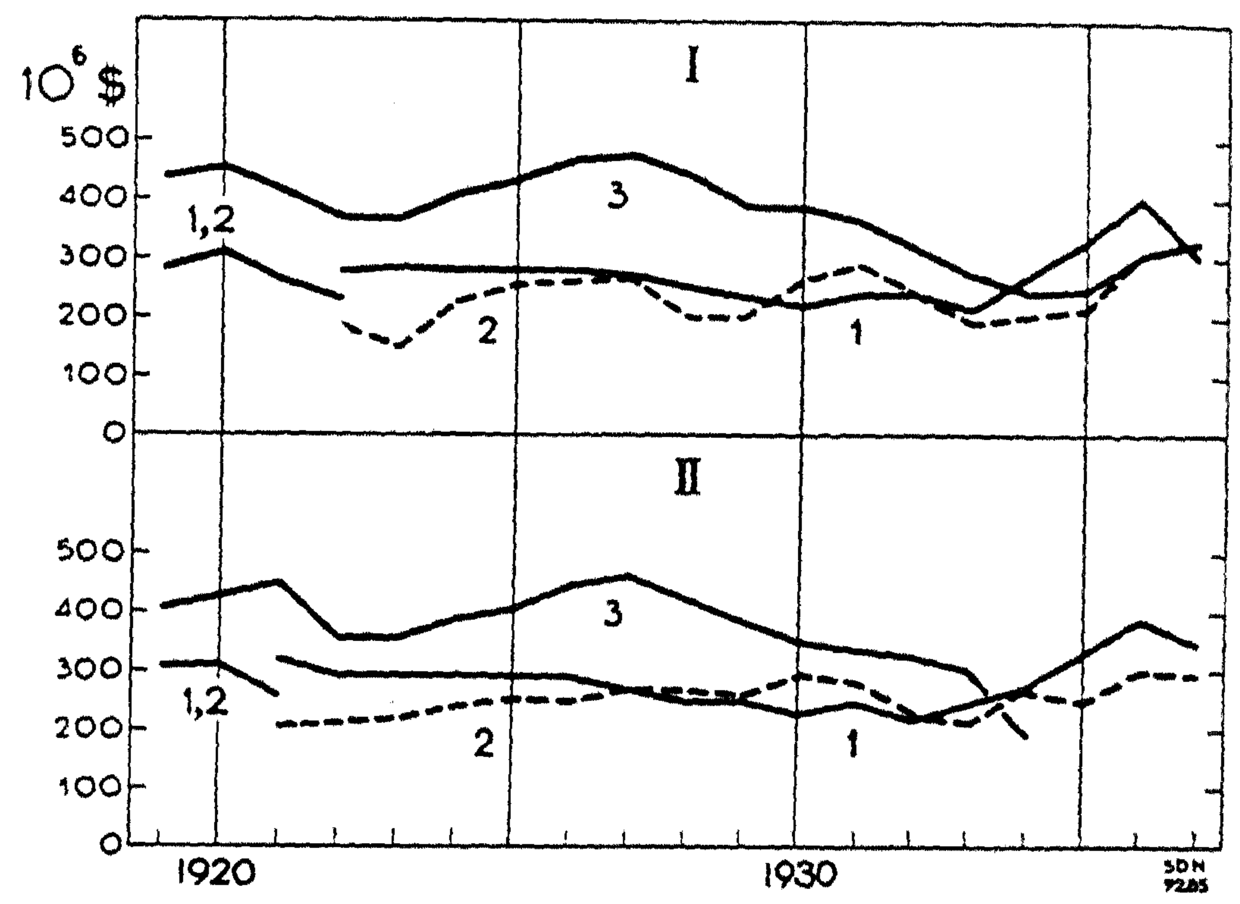
Graph 4.62 shows that the figures (or estimates) [1] that may be given for the three groups, reporting member banks, other member banks and non-member banks, for June call dates (or thereabouts) and for yearly averages are not very parallel. Moreover, the graph does not suggest, as might have been expected, a correlation with deposits. This lack both of reliable data and of a pronounced movement in what material is available, suggests that the variations in VC should be disregarded, and this item should be considered as a constant. This may be done the more readily since the variation of the figures is not large in absolute terms. It is possible that cash in vault had a tendency to be somewhat larger in the years 1934-1937, when the banks' excess reserves with the Federal Reserve Banks made such an increase cost very little. But the amount withheld from the reserves for this purpose was too small to have any influence on the short-term rate of interest (*cf.* section (4.42)).

Graph 4.62.

"CASH IN VAULT" of

1. Reporting member banks.
2. Other member banks.
3. Non-member banks.

I. At June call dates.
II. Yearly average.



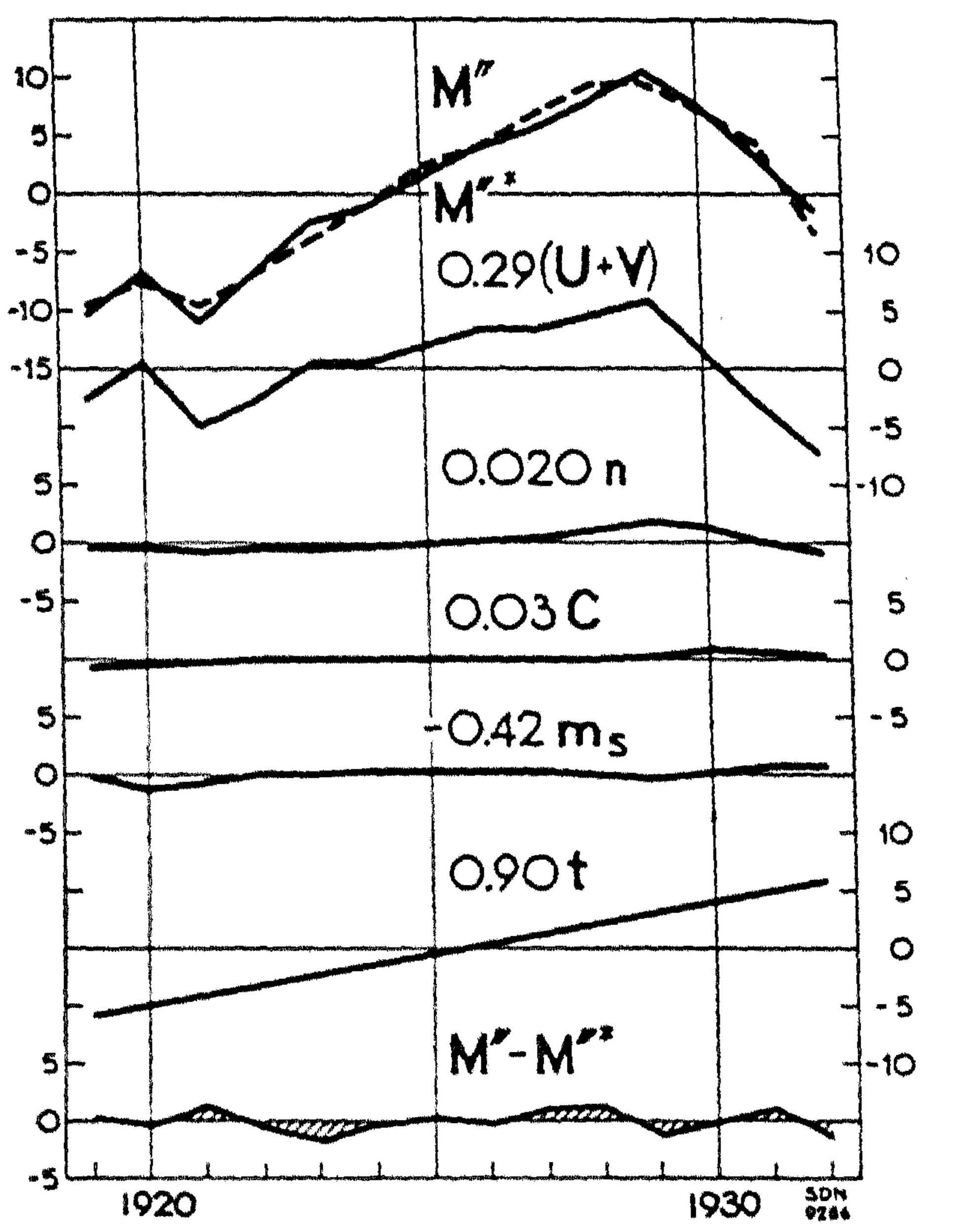
[1] *June call dates.* All banks and member banks given in the report of the Controller of the Currency; the last week in June is taken for the reporting member banks.

Yearly averages. Reporting member banks: average of 12 monthly figures. Member banks: average of three or four call-date figures. Non-member banks: total for all banks (derived from ANGELL, *op. cit.*, page 178: Outside currency, and from the Federal Reserve Banks' balance-sheets: Currency in circulation) minus the figure for member banks. The figures for non-member banks are, by this procedure, also slightly influenced by the difference between Angell's and our way of estimating the yearly figures for member banks.

(4.63) M″. The following factors have been included in the "explanation" of the demand for holding deposits.

Graph 4.63.

"Explanation" of the Fluctuations in Total Deposits by Demand Factors.



(i) (U + V), as an indication of the value of general business activity.

(ii) C′, the total market value of all shares, as an indication of the need for means of payment for speculative purposes.

(iii) t, indicating the net result of the increasing possibility to hold idle money as a consequence of increasing wealth and an increasing efficiency in the use of means of payment.[1] In a more rigorous treatment, the former trend factor might be considered as an accumulation of, say, past profits ($\int Z^c$); but for our knowledge of the system as a whole this further element would not be important.

(iv) m_S, as the cost of holding money.

These factors yield the following regression equation:

$$M'' = 0.29\,(U + V) + 0.018C' - 0.42m_S + 0.90t,$$

or, after substitution of an expression in C and n for C′:

$$M'' = 0.29\,(U + V) + 0.03C + 0.020n - 0.42m_S + 0.90t \qquad (4.63).$$

[1] A positive secular trend is much more characteristic of the older data available for deposits than the cyclical movements. The tremendous secular increase in deposits is shown below (Angell, *op. cit.*, page 175):

1890	4.0 milliard dollars
1900	7.1 ″ ″
1910	14.7 ″ ″
1920	36.7 ″ ″
1930	52.3 ″ ″

The elasticity of demand for deposits with regard to the rate of interest turns out to be very low:

$$0.42 \times \frac{\bar{m}_S}{\bar{M}''} = 0.045.$$

This is comprehensible owing to the fact that the amount of money necessary to effect payments is very inelastic in the short run.

(4.7) Demand by Individuals for Bonds and Shares

The relations determining the demand for holding bonds and shares by individuals are of the same structure as those determining the holding of assets by the banks (*cf.* section (4.5)).

The attractiveness of shares consists of two factors: the expected income (d, the rate of dividend for all companies) and the expectation as to the future course of share prices ($\dot{n}$, the rate of increase in share prices). The attractiveness of bonds consists in c (nominal rate of interest), which we have considered as a constant, and $\dot{m}_{Lb}$, which we shall disregard since we have found this factor to have a negligible influence on the banks' demand. Neither will m_S be taken into account; this implies the assumption that the influence of short-term credit conditions on the stock market is only very secondary. This has been stated by various authors — *e.g.*, Owens and Hardy [1] and Donner [2] — although it must be recognised that some authors — *e.g.*, Carl Snyder [3] — seem to be of a different opinion. The latter, however, only speaks of upper turning-points, and these will be treated in a special manner in our analysis.

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[1] Owens and Hardy, *Interest Rates and Stock Speculation*, Washington, 1930.

[2] O. Donner, "Die Kursbildung am Aktienmarkt", *Vierteljahreshefte zur Konjunkturforschung*, Sonderheft 36, Berlin, 1934.

[3] Carl Snyder, "The Problem of Monetary and Economic Stability", *Quarterly Journal of Economics*, XLIX, February 1935, page 200: "Speculation is acutely sensitive to these high rates of interest (having never survived the equivalent of a 6 per cent discount rate) . . ."

With these considerations, the demand for shares and bonds would depend on:

(i) A, the total wealth available for holding shares and bonds, which equals

$$\frac{c}{\overline{\overline{m}}_{Lb}} \overline{\overline{B}}^i + 0.0156\overline{\overline{n}}\ \overline{\overline{C}}^i;$$[1]

(ii) m_{Lb} and n, representing the prices of bonds and shares;

(iii) d and $\dot{n}$, representing the attractiveness of holding shares.

Thus we have the following demand equations:

$$C^i = \Gamma_1 A - \Gamma_2 m_{Lb} - \Gamma_3 n + \Gamma_4 d + \Gamma_5 \dot{n} \qquad (4.71)$$

$$B^i = B_1 A + B_2 m_{Lb} + B_3 n - B_4 d - B_5 \dot{n}, \qquad (4.72)$$

where the unknown coefficients are represented by the letters $\Gamma_1 \ldots$ and $B_1 \ldots$. These letters represent positive figures everywhere.

To these two equations the definition equation of A may be added, which, in deviations from average, runs as follows:[2]

$$A \equiv 0.90B^i + 1.50C^i - 18.0m_{Lb} + 0.84n \qquad (4.73).$$

It may be useful, at this stage, to give some thought to (*a*) the purpose of the system of monetary equations[3] and (*b*) the way in which this purpose may be attained.

(*a*) The equations discussed in this chapter describe the financial sphere of the economy. The variables explained in these equations enter into the other relations of the system in a few places only: the share price index n in the explanation

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[1] The factor 0.0156 must be included, since the absolute price level of shares in terms of nominal value was 1.56 in 1926, when the share price index stood at 100.

[2] *Cf.* section (4.5). The averages of B^i, C^i, m_{Lb} and n are 100, 54, 5 and 96 respectively.

[3] *I.e.*, the equations with regard to demand and supply in the money and capital markets.

of G (5.3), the share yield m_{Ls} $(=\frac{d}{n})$ in the explanation of v' (2.4) and the bond yield m_{Lb} in the explanation of v_B (2.5); the influence of the short-term rate of interest m_S on stocks was not found to be appreciable (2.6). What is needed, therefore, in order to find the movements of the essential variables of our system, is the expression of n and m_{Lb} in variables not belonging to the monetary sphere. This is, in the frame of our analysis, the *raison d'être* of the present chapter.

(*b*) To find these expressions for n and m_{Lb}, the system of monetary equations must be determined — *i.e.*, must contain as many independent equations as monetary variables. To what extent, and how, is this the case ?

If we disregard, for a moment, the banks' demand for holding bonds, we shall have:

2 supply equations for B^i and C^i;

2 demand equations for B^i and C^i;

1 definition equation for A.

As the right-hand members of the two demand equations must, after multiplication by the corresponding prices, add up to the expression for A, one of the three last-mentioned equations is dependent on the two others; so we have all together four independent equations. With these, we have to determine the five unknowns A, B^i, C^i, n, m_{Lb}: our problem is undetermined. The best thing we can find with our four equations is *one* equation connecting *two* unknowns and containing further some non-monetary variables. For instance, we may find an equation expressing n in m_{Lb} and d, $\dot{h}$, etc.

On second thoughts, there is nothing peculiar in this result. If the subjects of one group hold bonds and shares, and nothing but bonds and shares, they will show a certain readiness to exchange one asset for the other (or, in other words, an indifference curve for the two assets), depending on their relative attractiveness; but there will not be a price in terms of money, since the group is supposed not to change the assets for money.

This isolation of bonds and shares from money and all other goods that are measured in terms of money will be broken if at least one of the two assets is held by at least one group of subjects that also holds money. Under our simplifications, it is the banks which establish this link.

Hence our plan becomes as follows:

(i) Determine the coefficients in one of the two interdependent equations (4.71) and (4.72);

(ii) In equation (4.71), which is then known with numerical coefficients, substitute C^i as given by its supply equation (*cf.* section (4.2));

(iii) Substitute in (4.73) the expressions given by the supply equations for bonds and shares and the definition equation:

$$B = B^i + B^b.$$

This yields, if we take the supply equations in the simplified form of trends:[1]

$$A = 8.0t - 0.9B^b - 18.0m_{Lb} + 0.84n \qquad (4.74).$$

(iv) Eliminate A from (4.71) and (4.74).

In this way we obtain a relation (4.75) between n, m_{Lb} and B^b as monetary variables on the one hand, and the non-monetary variables d, $\dot{n}$ and t on the other hand. The combination of this equation with the four demand equations for M'', M', B^b and B_s and the two supply equations of M and B_s, gives us the seven equations to determine the seven monetary variables they contain: M'', M', B^b, B_s, m_S, m_{Lb}, n.

Unfortunately, in the execution of this plan, we are repeatedly faced with serious multicollinearities which prevent us from determining some of the coefficients with any degree of precision. A way to overcome this difficulty consists in reducing,

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[1] *Cf.* sections (4.1) and (4.2).

$$C^i = 0.755C = 0.755 \times 3.18t = 2.40t.$$

by the combination of a number of theoretical equations, the number of highly intercorrelated variables to only one, and performing the correlation calculation for the equation so found (which is the result of an elimination process) instead of for the elementary equations. We shall have recourse to this procedure every time the difficulty of multicollinearity presents itself.

Equation (4.71) is the first example. During the period studied, the movements of n were so large that they almost entirely determined the fluctuations in A. Moreover, n and a combination of d and $\dot{n}$ are very highly intercorrelated. Hence we jump (i), execute (ii), (iii) and (iv) and find (4.75) with coefficients that still contain the Γ_s' from (4.71):

$$-(\Gamma_3 - 0.84\,\Gamma_1)\,n - (18.0\,\Gamma_1 + \Gamma_2)\,m_{Lb} - 0.9\,\Gamma_1 B^b + \Gamma_4 d + \Gamma_5 \dot{n} + (8.0\,\Gamma_1 - 2.40)\,t = 0 \qquad (4.75).$$

The six coefficients in this equation should now be found by a correlation calculation. But since in this correlation the terms with n, d and $\dot{n}$ are most important and the rôle of B^b and the trend is subordinate, and since, moreover, B^b is highly correlated with t, the determination of the coefficient for B^b is rendered illusory. Hence we provisionally[1] disregard the deviations that B^b shows from a trend, and use the purely statistical approximation:

$$B^b = 0.63t \quad (R = 0.918).$$

Further, to render the interpretation easier, we write the equation obtained by this substitution, with n explicit:

$$n = \frac{1}{\Gamma_3 - 0.84\,\Gamma_1}\,[\Gamma_4 d + \Gamma_5 \dot{n} - (18.0\,\Gamma_1 - \Gamma_2)\,m_{Lb} + (7.4\,\Gamma_1 - 2.40)t] \qquad (4.76)$$

as the "explanation" of the share price.

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[1] *Cf.* page 112 note 1.

(4.8) THE SHARE-PRICE EQUATION

The equation for n derived in the previous section may, with simplified coefficients, be written as follows:

$$n = \nu_1 d + \nu_2 m_{Lb} + \nu_3 \dot{n} + \nu_4 t \qquad (4.81).$$

In this equation, the exact dependence of n on $\dot{n}$ has in particular been studied. It became evident that the fit could be improved by introducing a non-linear and even a third-degree dependence on $\dot{n}$, together with a small lag of about half a year. [1] This function — which at the same time represents the functional dependence between the demand for holding shares and $\dot{n}$ — is represented graphically in graph 4.81. It seems to show that, as long as $\dot{n}$ is not extreme, no large influence on holdings is present; but this influence becomes increasingly large, especially for positive values of $\dot{n}$. This evidently indicates what one might call "the speculative attitude" or "the boom psychology".

The numerical expression for n is:

$$n = 19.5d - 9.1m_{Lb} + 0.025\,(n - n_{-1})^2 + 0.00035(n - n_{-1})^3 + 0.55t \qquad (4.82).$$

The linear approximation is:

$$n = 26.9d + 6.8m_{Lb} + 0.26\,(n - n_{-1}) + 3.88t \qquad (4.83).$$

The approximation without $\dot{n}$ is:

$$n = 29.9d + 4.0m_{Lb} + 5.7t \qquad (4.84).$$

It will be seen that the coefficient for m_{Lb} gets the wrong sign in (4.83) and (4.84); but this sign is not significant, as the

[1] As a first approximation, this lagged value of $\dot{n}$ may be taken equal to $n - n_{-1}$. A still better approximation is of course $n_{-\frac{1}{3}} - n_{-\frac{2}{3}}$, especially as this does not contain n_0 itself, which has to be "explained". See below.

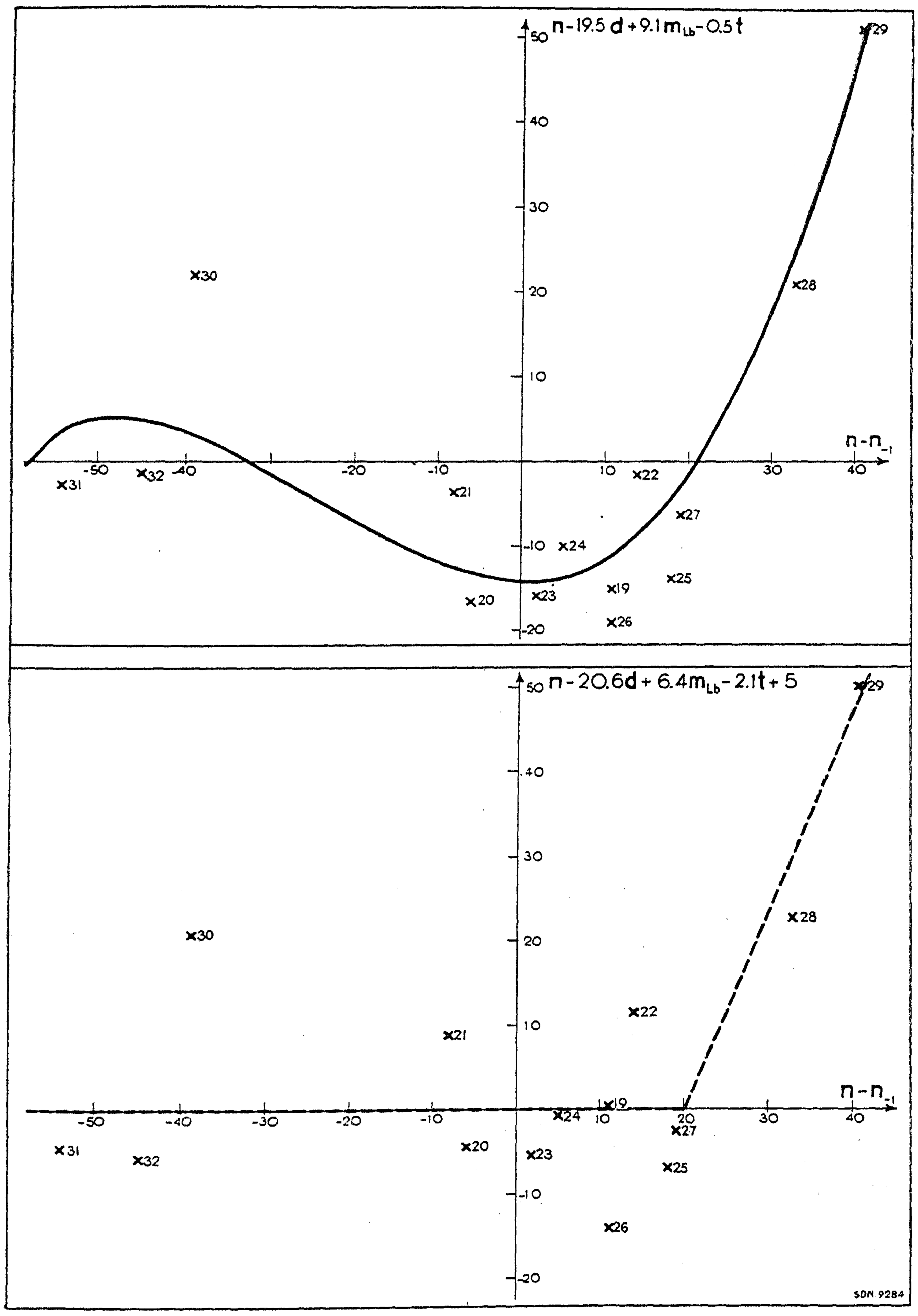
Graph 4.81.

PARTIAL SCATTER DIAGRAM BETWEEN n AND $\dot{n}_{-\frac{1}{2}}$.

× × × Actual values, corrected for influence of d, m_{Lb}, and t;

——— Third-degree curve;

- - - - - Approximation by linear parts.

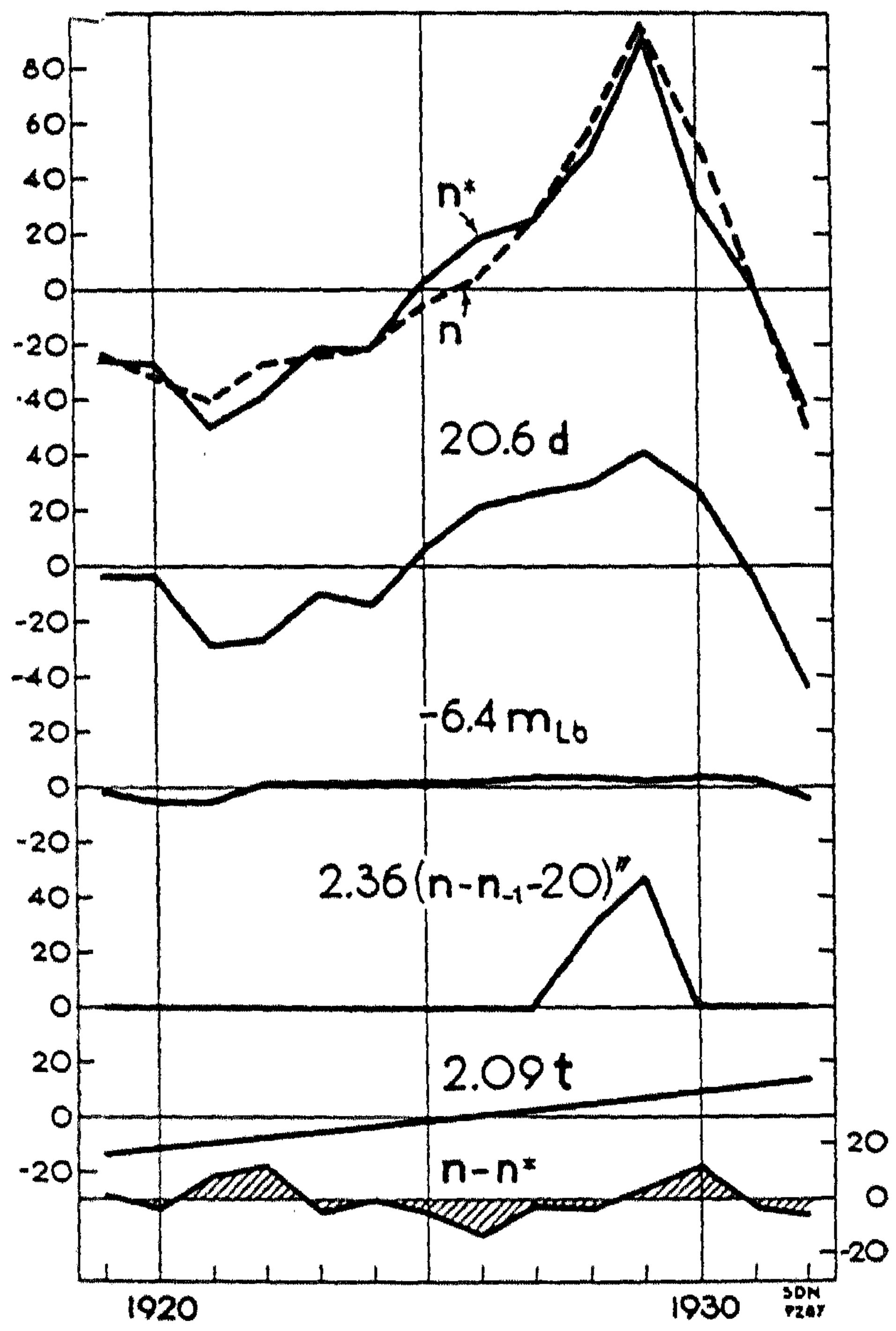


standard error of the coefficient is much larger than the coefficient itself: 12.6 in (4.83) and 12.7 in (4.84).

There is, however, a theoretical objection against the third-degree function used. If extrapolated to the right, it would rise increasingly rapidly, without limit. This does not seem to be a true picture of the attitude of the shareholder. It is more probable that, after some value of $\dot{n}$ or some level of n has been reached, the curve will rise at a decreasing rate and show a tendency to a horizontal movement. In these circumstances, it did not seem desirable to maintain the rather complicated third-degree formula, but rather to choose a simpler approximation. This may be done by distinguishing three parts of the curve separately and assuming these parts to be rectilinear. The scatter diagram between n, corrected for a provisionally determined influence of d, m_{Lb}, t and $n - n_{-1}$ suggested the following approach:

Graph 4.82.

"Explanation" of Fluctuations in SHARE PRICES.



I. For values of $n - n_{-1} < 20$, influence on n: zero.

II. For values of $n - n_{-1} > 20$, influence on n: proportional to $n - n_{-1} - 20$.

The general formula for both parts is:

$$n = 20.6d - 6.4m_{Lb} + 2.36\,(n - n_{-1} - 20)'' + 2.09t - 5^{1} \qquad (4.8).$$

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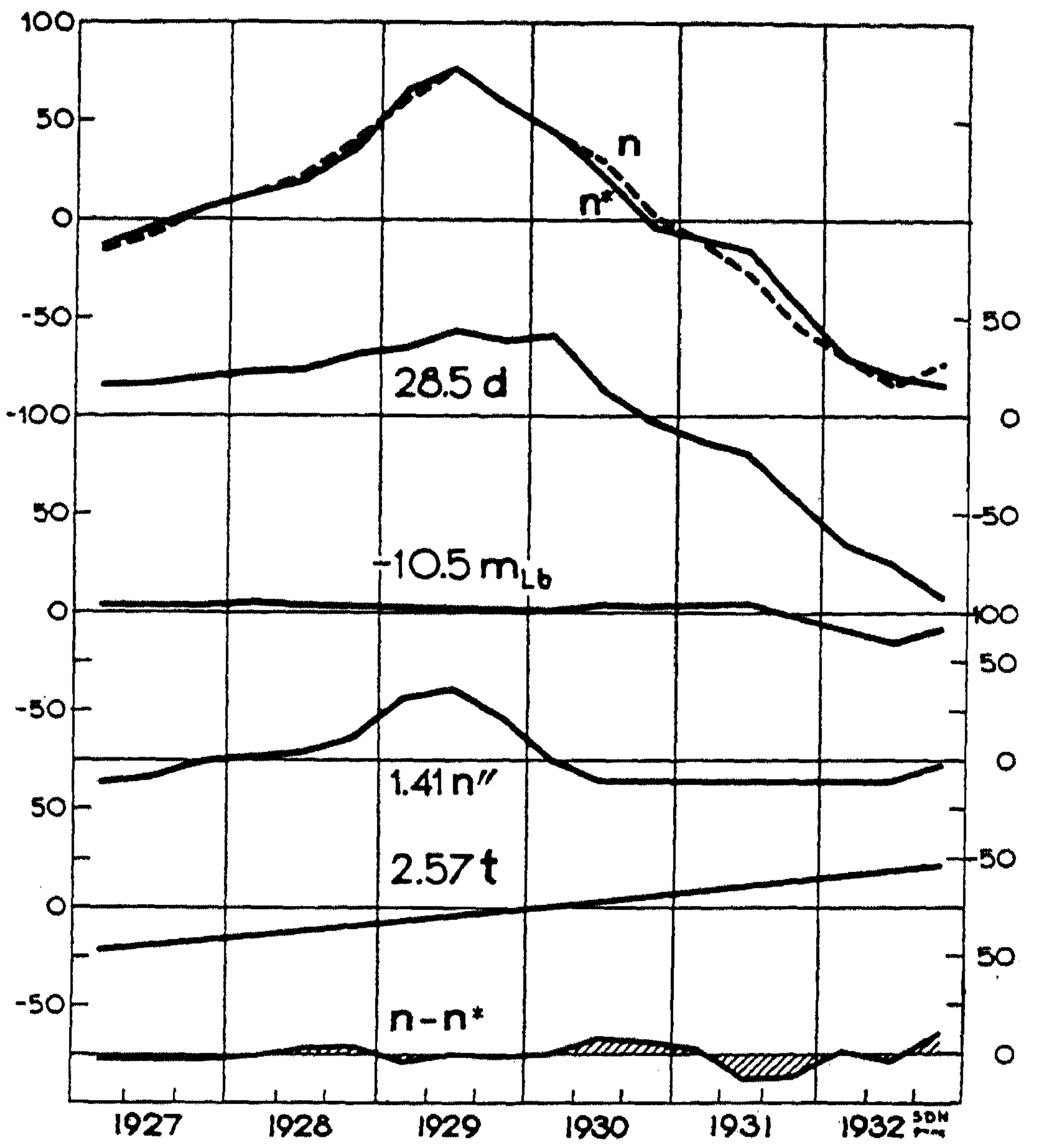
[1] This term must be added as a consequence of a change in averages which has to take place if the calculation is restricted to only a part of the material. For the meaning of ″, *cf.* page 98.

The scatter diagram did not show very clearly on what level the third, horizontal branch should be chosen. As the maximum monthly value for n (corrected for d, m_{Lb} and t) equals about 100, it must have been at about that level or higher. This approximation of the curve by linear parts offers some convenience for the treatment of the problems considered in Chapter VI.



Graph 4.83.

"Explanation" of Fluctuations in SHARE PRICES, 1927-1932 (Four-monthly periods).

The dependence of n on $\dot{n}$ has been tested with shorter time units for the period where the fluctuations of n are particularly heavy: 1927-1932. By the use of time units of 4 months, $n - n_{-1}$ could be replaced by a moving average of the increases in n over these periods:

$$(n_0 - n_{-\frac{1}{3}} - 6.7)'' + (n_{-\frac{1}{3}} - n_{-\frac{2}{3}} - 6.7)'' + (n_{-\frac{2}{3}} - n_{-1} - 6.7)'' = n'',$$

assuming that the different groups of holders of shares react with lags of 2, 6 and 10 months to the increases in n that exceed 6.7 points in four months (20 points a year).

The result of an explanation with d, m_{Lb}, n'' and t c
the eighteen time units considered runs as follows:

$$n = 28.5d - 10.5m_{Lb} + 1.41n'' + 2.57t \qquad (4.\text{‹}$$

The most important difference from (4.8) is the decre in the coefficient for n'' as compared with that for $(n - n_{-1} - 2($ It is largely due to the fact that the fluctuations of n'' are c siderably accentuated (by about 40%) in the figures for shorter period, whereas the fluctuations of n, d and m_{Lb} are o: slightly increased. The difference in the coefficients for latter two variables between (4.8) and (4.85) does not seem be very significant, as may be seen from the standard er: of the coefficients:

Standard error of coefficients

Equation	σ_d	$\sigma_{m_{Lb}}$	$\sigma_{(n-n_{-1}-20)''}$, $\sigma_{n''}$
(4.8)	4.3	8.8	0.63
(4.85)	2.9	5.7	0.22

(4.9) Combination of the Monetary Equations

Equation (4.8) gives one relation between the two monetar variables n and m_{Lb} and some non-monetary variables ($(n - n_{-1} - 20)''$, t. Combining the other monetary equations, a planned in section (4.7), we find another equation between and m_{Lb}, which contains in addition the variables $(U + V)$, (Au, P, $(L_w + L_s + E'_F)$, H, t.[1] (The details of this eliminatio process are shown in Appendix B). These two equations serv to express both n and m_{Lb} in the non-monetary variables:

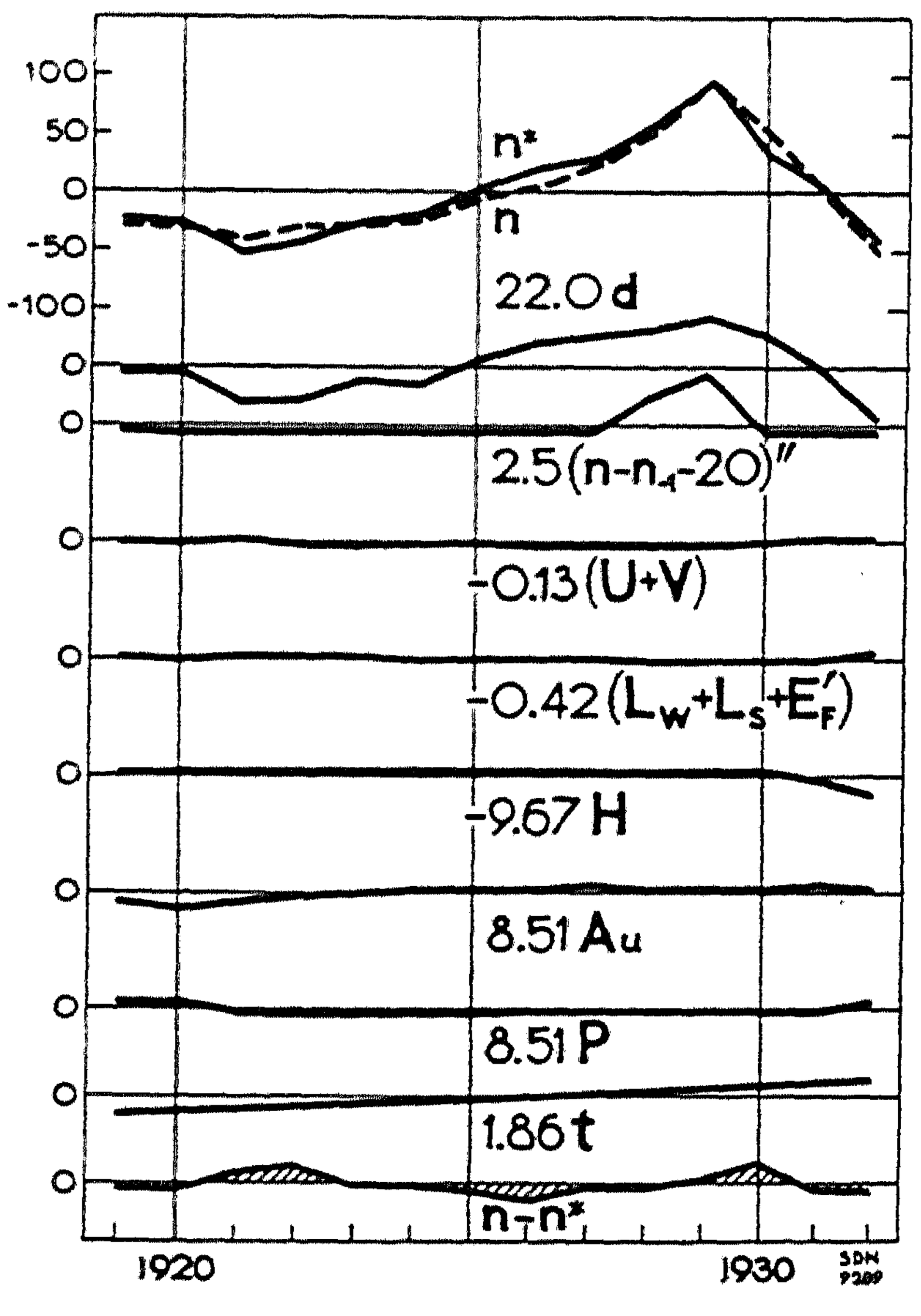
[1] Au and P, though monetary variables, may remain in this elimina tion result because they are considered as data.
H (hoarding) has not yet been reduced to its explaining variabl (4.612), in order to simplify the formula; it is better to do this later

$$n = 22.0d + 2.5(n - n_{-1} - 20)'' - 0.13(\mathrm{U}+\mathrm{V})$$
$$- 0.42(\mathrm{L}_w + \mathrm{L}_s + \mathrm{E}'_{\mathrm{F}}) - 9.67\mathrm{H} + 8.51(\mathrm{A}u + \mathrm{P})$$
$$+ 1.86t \qquad (4.91)$$

$$m_{\mathrm{L}b} = - 0.22d - 0.02(n - n_{-1} - 20)'' + 0.02(\mathrm{U}+\mathrm{V})$$
$$+ 0.065(\mathrm{L}_w + \mathrm{L}_s + \mathrm{E}'_{\mathrm{F}}) + 1.51\mathrm{H} - 1.33(\mathrm{A}u + \mathrm{P})$$
$$+ 0.04t \qquad (4.92).$$

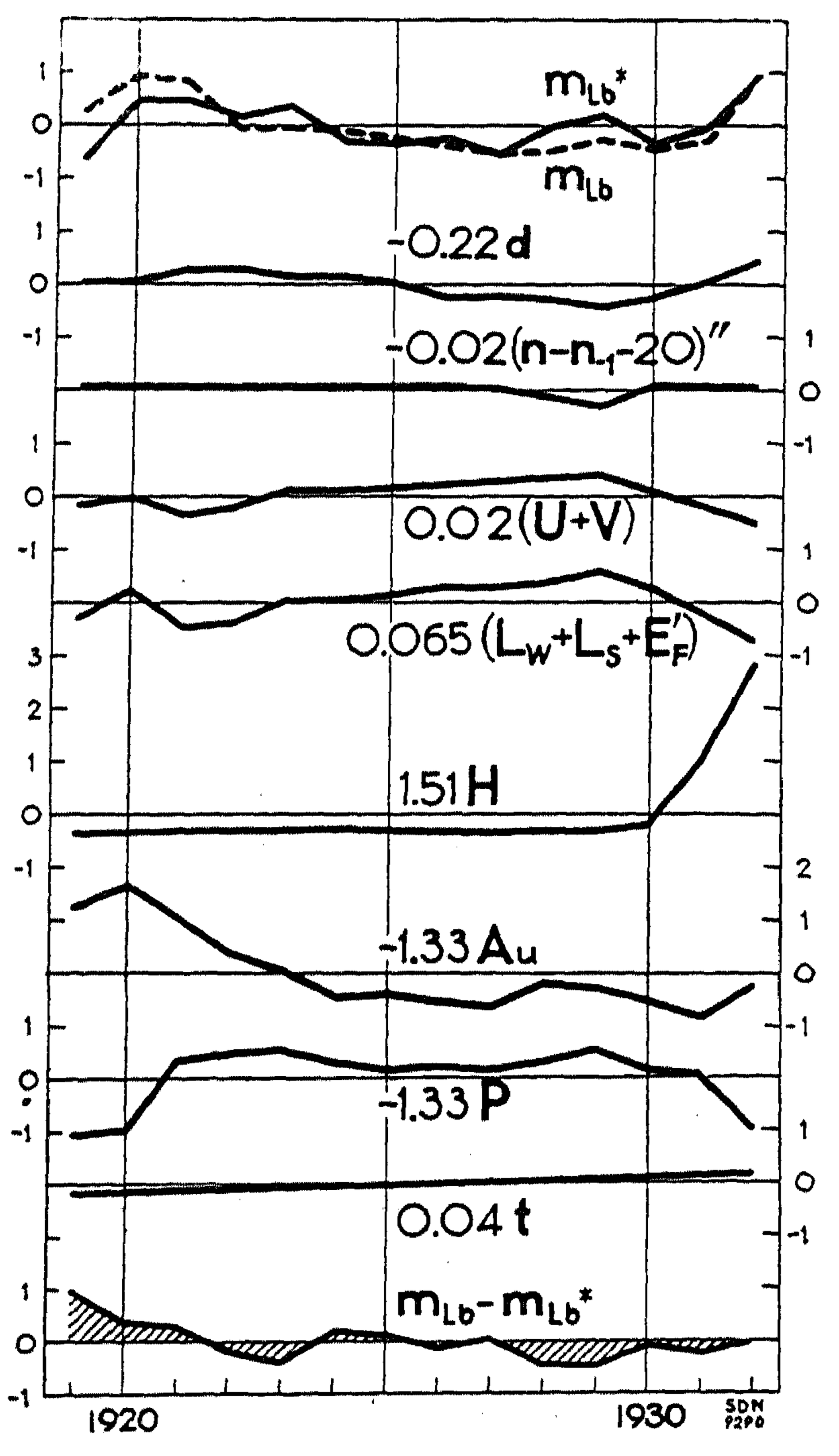
Graph 4.91.

ELIMINATION RESULT (Monetary Equations): n expressed in Non-monetary Variables.



Graph 4.92.

ELIMINATION RESULT (Monetary Equations): $m_{\mathrm{L}b}$ expressed in Non-monetary Variables.



Graphs 4.91 and 4.92 show the fit of the two formulæ. For n the result is satisfactory. For $m_{\mathrm{L}b}$ it is much less good,[1]

[1] Owing to the fact that here the residuals in the elementary relations have been multiplied by relatively large coefficients in the course of the elimination process.

but since m_{Lb} only enters, and with a small coefficient, into the v_B-equation, some uncertainty with regard to the m_{Lb}-equation is not a serious matter for the system.[1]

[1] Two alternatives may be considered.

1. $0.9\,\Gamma_1 B^b$ has been replaced by a trend (*cf.* page 105). We may now determine the possible consequences of this simplification. The numerical value of the coefficient that B^b ought to have in (4.76): $\dfrac{-0.9\,\Gamma_1}{\Gamma_3 - 0.84\,\Gamma_1}$ may be known within certain limits, given:

(i) the coefficient found for t in (4.8), which yields:

$$\frac{7.4\,\Gamma_1 - 2.4}{\Gamma_3 - 0.84\,\Gamma_1} = 2.09; \text{ and}$$

(ii) $1.00 > \Gamma_1 > 0.35$. An increase in wealth will be distributed partly in shares, partly in bonds; hence Γ_1 cannot be > 1. When the total wealth becomes greater, there will be a tendency to increase the holding of shares by a larger percentage than that of bonds; in the average, $\overline{C}^i$ was 35% of $\overline{C}^i + \overline{B}^i$, so Γ_1 should be > 0.35.

From (i) and (ii) it follows that

$$3.5 > \frac{0.9\,\Gamma_1}{\Gamma_3 - 0.84\,\Gamma_1} > 0.37.$$

The extreme value of $-3.5B^b$ has been tried out as *a priori* value, and yielded

$$n + 3.5B^b = 20.4d - 1.9m_{Lb} + 2.37\,(n - n_{-1} - 20)'' + 4.52t \quad (4.9^*).$$

Elimination with the help of the other monetary equations in the way indicated yields variants (4.91*) and (4.92*) for n and m_{Lb} respectively.

2. The other alternative is based on the well-known view that the share price depends on the *ratio* between the rate of dividend and the long-term rate of interest: $\dfrac{\overline{\overline{d}}}{\overline{\overline{m}}_{Lb}}$. This variable has therefore been included instead of d and m_{Lb} separately. The resulting equation for n, after a linear approximation of the ratio $\dfrac{\overline{\overline{d}}}{\overline{\overline{m}}_{Lb}}$, runs:

$$n = 16.0d - 18.9\,m_{Lb} + 2.64\,(n - n_{-1} - 20)'' + 1.53t \quad (4.9^{**}).$$

In combination with the other monetary equations, this gives (4.91**) and (4.92**) for n and m_{Lb}.

To facilitate the comparison of the coefficients of these alternatives with those of (4.91) and (4.92), the former are expressed as percentage deviations from the coefficients in these latter cases. Since, however, the influence (= standard deviation × coefficient) of the various explanatory variables is very unequal — as the graphs show — a like percentage deviation is not equally important for all variables. As an indication of these differences, the influence of each explaining variable in (4.91) and (4.92) is added, expressed as a percentage of the standard deviation of the "explained" series (table 4.9).

The results are satisfactory in that the series with the largest influence, both for n (d; $(n - n_{-1} - 20)''$) and for m_{Lb} (Au, P; $L_w + L_s + E'_F$, H), show rather stable coefficients. Again, the results are less good for m_{Lb} than for n.

Note continued on page 113.

From the m_{Lb}- equation, the effects of open-market policy on the long-term rate of interest may be determined. The factor —1.33, which multiplies P, indicates that a \$1 milliard increase of the Federal Reserve Banks' holdings of bonds or acceptances leads, *ceteris paribus*, to a fall in the long-term rate of interest of 1.33%. The two alternatives treated give coefficients for P quite near to this value: —1.37 and —1.48.

Table 4.9.

"Explained" variable	Equation	Unit	Coefficients for: d	$(n - n_{-1} - 20)''$	U + V	Au+P	$(L_w+L_s+E'_F)$+H	t
n	(4.91*)	Percentage deviations from coefficients in (4.91)	+ 10	+ 9	+ 328	—125	— 69	— 6
	(4.91**)		— 10	+ 26	+ 257	+ 236	+ 234	— 83
	Influence of variables, in % of standard deviation of n							
	(4.91)	$\sigma_n = 100$	63	36	— 4	20	— 19	18
m_{Lb}	(4.92*)	Percentage deviations from coefficients in (4.92)	—632	—784	—140	+ 3	— 14	+ 725
	(4.92**)		— 8	+ 26	+ 15	+ 11	+ 11	0
	Influence of variables, in % of standard deviation of m_{Lb}							
	(4.92)	$\sigma_{m_{Lb}} = 100$	— 50	— 22	52	—258	242	32

These figures point to the conclusion that the Federal Reserve Banks are able, in view of the small year-to-year changes in m_{Lb},[1] to control to a large extent the fluctuations of the long-term rate of interest by means of not excessively large open-market purchases or sales (in a period when there are no large excess reserves).

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[1] Distribution of year-to-year changes in m_{Lb}, in percentages, 1920-1937:

0 to $\frac{1}{4}$	$\frac{1}{4}$ *to* $\frac{1}{2}$	$\frac{1}{2}$ *to* 1	*Over* 1
11	3	3	1