CHAPTER IV

RESIDENTIAL BUILDING

§ 12. The Relation tested

Only private building studied.

The example to be considered next relates to a special type of investment activity—namely, the construction of dwelling-houses. So far as possible, the investigation has been confined to private activity in this field, as building by public authorities and societies may be governed by different considerations.[1]

Two groups of "explanatory" variates.

The "explanatory factors" included may be separated into two groups. The first group consists of some factors which roughly determine the profitability of owning houses. In a perfect market, this would be the most natural incentive to build. The second group forms, in a sense, a corrective to the first group, necessary because of the imperfection of the market.

First group of variates.

The profitability of owning houses depends chiefly on:

(*a*) The rent level;
(*b*) The cost of maintenance;
(*c*) Interest payments and
(*d*) Amortisation.

The amounts of interest payments and amortisation will first of all depend on the level of building costs; amortisation may be

[1] In pre-war time, building of dwellings by public authorities was non-existent or insignificant. For the post-war period, no detailed figures are available for the United States, but State intervention started only in 1933 and was rather indirect. For Sweden, the data for 296 cities cover all residential building, but those for Stockholm relate to private building only.

said to be a fixed percentage of the latter—which will be not far from 1 %,[1] whereas interest will be the product of three factors, viz.:

(1) building costs;
(2) the percentage of building costs which on the average will be covered by mortgages; and
(3) the interest rate for mortgages.

It is rather difficult to get exact series on the cost of maintenance, but in general it will move about parallel to building cost, as it includes many elements also included in the latter. Its level may be roughly estimated to be about 1% of building cost per annum.

Series included.

It follows from the above that the following series should, first of all, be included in the " explanation ":

(1) The rent level;
(2) The cost of construction; and
(3) The rate of interest on mortgages.

Their relative " influence " may be deduced from the regression coefficients which will be calculated.

A priori determination of relative influence.

It may, however, also be determined by *a priori* considerations, based upon the structure of the profit account for holding houses.

Indicating the construction costs of a certain house by 100, this account will approximately show items of the following order of magnitude:

Receipts: rent	8
Deductions: amortisation and maintenance	2
interest on mortgage . . .	$0.7\overline{\overline{m}}_{Lb}$, where $\overline{\overline{m}}_{Lb}$ represents the interest rate.

If rents are measured by an index $\overline{\overline{m}}_R$, with average $\overline{m}_R = 100$, construction costs by an index $\overline{\overline{q}}_B$ with average $\overline{q}_B = 100$, and

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[1] This figure may be somewhat too low in some cases; what matters, however, for the calculations is the total of amortisation and maintenance, which has been taken at 2% (see below).

interest rates $\overline{\overline{m}}_{Lb}$ in natural units (per cents), then profits, in per cents, from the holding of houses will be represented by

$$0.08\overline{\overline{m}}_{R} - 0.02\overline{\overline{q}}_{B} - 0.007\overline{\overline{q}}_{B}\overline{\overline{m}}_{Lb} = \overline{\overline{z}}$$

This expression may be also written as

$$0.08\,(\overline{m}_{R} + m_{R}) - 0.02\,(\bar{q}_{B} + q_{B}) - 0.007\,(\bar{q}_{B} + q_{B})\,(\overline{m}_{Lb} + m_{Lb})$$

where the unbarred minuscules indicate deviations from average or from trend. These deviations will, in general, be small in comparison with the average values, and therefore their mutual products may be neglected. We then get:

$$\overline{\overline{z}} = (6 - 0.7\overline{m}_{Lb}) + 0.08m_{R} - (0.02 + 0.007\overline{m}_{Lb})q_{B} - 0.7m_{Lb}.$$

The first term in brackets is a constant, the average value of the expression: $\bar{z} = 6 - 0.7\overline{m}_{Lb}$. The deviations may as usually be indicated by z:

$$z = 0.08m_{R} - (0.02 + 0.007\overline{m}_{Lb})\,q_{B} - 0.7m_{Lb}.$$

The value of $\overline{m}_{Lb}$ will change from case to case, but usually it is of the order of magnitude of 5, which leads to

$$z = 0.08m_{R} - 0.055q_{B} - 0.7m_{Lb}.$$

Two sorts of calculation.

Two sorts of calculation have been made; calculations using m_{R}, q_{B} and m_{Lb} as separate variates (Table IV. 1), and calculations using z in their place (Table IV. 2).

Second group of variates.

Apart from these variates, a second group has been included. Their inclusion is due to the imperfection of some of the markets which play a rôle in our problem.

The variates of the second group are:

(4) The number of unoccupied houses (h') or the total number of houses present (h);
(5) Some income series (E).

Imperfection of market for housing services.

The reason for including the number of unoccupied houses is that it may directly discourage building, even if rents, building costs and interest rates are in a favourable relation to each other. In a perfect market for housing services, such a situation would not occur: rents would fall. The stickiness of rents, closely connected with the long duration of letting contracts and further imperfections in this market, prevents such a rapid adaptation and, consequently, the number of unoccupied houses is a largely independent factor which also influences building activity.

In one of the cases where no series for empty houses was available, the total number of houses could be included, after elimination of its trend. The trend elimination, together with the inclusion of an income series, forms a rough correction for the need for dwellings in that case.[1]

Income series are also included with another intention: they represent a demand factor, in so far as a number of houses are not built for letting at all, but by their future occupants. In the United States, about 50% of all inhabitants live in owned houses; it was estimated that about 75% of the new dwellings built during the last building boom in England were not for letting. Again this may be called an imperfection of the market for housing services.

Imperfection of credit markets.

In some investigations by other authors, explanatory series have been included which are connected immediately with the imperfection of credit markets. An extreme case is the one treated by Professor C. F. Roos,[2] concerning St. Louis, where, for the period studied, mortgage rates had not moved at all. Professor Roos includes instead the " foreclosure rate ", giving the number

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[1] The number of family units is often used as an indication of the " need " for dwellings. As long, however, as family incomes are not taken into account, the number of family units reflects potential rather than actual demand; although the distribution of income over the various items of the budget is of course influenced by the number of families. For long-term investigations, it may be a useful guide; for an analysis of fluctuations it seems less important, as the number of family units usually develops smoothly. An exceptional growth of the number of family units is, however, regarded as one of the causes of the " building boom " in the United Kingdom from 1933 to 1936.

[2] *Dynamic Economics*, Bloomington, 1934, pages 69-110.

of foreclosures per 100,000 families. This rate he considers as a good inverse index of the willingness of banks to grant credits. A closer investigation shows that it is highly correlated with the number of unoccupied houses a short time before, which seems quite natural. In a sense, therefore, this factor is already included in our series h', provided we take the right lag.

A number of authors lay stress on the general state of confidence as a factor of importance, because of its close relation to the willingness to grant credits. This factor may be introduced in two different ways. As far as the fairly systematic changes in confidence during the business cycle are concerned, the income series will be a good index; and it has already been included. As far as acute and specific confidence crises occur, the years in which they have presented themselves may perhaps best be excluded. As a test, it may be investigated afterwards whether or not these years show, as compared to "calculated" building activity, an abnormally low level.

Profits of owning houses and of constructing houses.

Finally, it may be stated that the selection of the explanatory series, based as it is upon the profitability of owning houses, presupposes that the market for houses so nearly approaches perfection that the builder acts in the same way as the future owner of houses would have done: *i.e.*, it is assumed that his behaviour is not deflected by imperfect foresight with regard to the possibilities of selling the houses which he builds. This assumption cannot easily be avoided, as the statistical material available for prices of houses—and it is prices, not rents, which directly influence the mind of the builder—is very scanty.

Long and short waves. Trend elimination.

Several authors have pointed out the existence of a specific building cycle of fifteen to twenty years duration,[1] on which fluctuations of lesser duration would be superimposed. The present investigation has not been directed specially to the study of these long waves. For post-war years, the actual movement of building activity, without any correction for trend or long

[1] *Cf.*, *e.g.*, C. F. Roos, *loc. cit.*; J. R. Riggleman, "Building Cycles in the United States 1875-1932", *Journal of the American Statistical Association*, Vol. 28, pages 174-183.

cycle, has been explained. For pre-war, the secular trend has been eliminated, leaving both long and short waves to be studied. In the case of Sweden, however, satisfactory results were only obtained when the long cycle was in turn eliminated, by the use of moving averages of variable length. In this case, therefore, conclusions apply solely to short waves.

§ 13. The Statistical Material

The countries and periods studied are:

Countries and periods.

Pre-war: Germany (Hamburg) 1878-1913 (thirty-six years);
Sweden (Stockholm) 1884-1913 (thirty years).

Post-war: United Kingdom 1923-1935 (thirteen years);
United States 1915 or 1919-1935 (twenty-one or seventeen years);
Sweden 1924-1936, 1933 excluded * (twelve years).

In addition, extrapolations for 1936 and 1937 have been made for the United States and the United Kingdom.

Description of series.

The following table indicates the series which have been used to represent: (i) the volume of building and (ii) the explanatory factors mentioned above.

Volume of Building.

Country and period	Description of series	Source
Germany, pre-war	Net increase [a] in total number of "rooms" [b] in Hamburg.	Hunscha, *Die Dynamik des Baumarkts*, *Vierteljahreshefte zur Konjunkturforschung*, Sonderheft 17.
Sweden, pre-war	Total number of newly built rooms or kitchens in Stockholm.	*Statistisk Årsbok för Stockholms Stad.*

* The year 1933 has been excluded in all calculations owing to big strikes in the building industry.

[a] Gross increase was only available for a shorter period, and referred to the number of dwellings without regard to their size.

[b] Lokalitäten.

Country and period	Description of series	Source
United Kingdom, post-war	Number of houses built by private enterprise without State assistance.	*Statistical Abstract for the United Kingdom.*
United States, post-war	(i) Estimated total value of non-farm residential construction in 1923/25 dollars. [a]	National Bureau of Economic Research, *Bulletin* No. 65, and *Statistical Abstract.*
	(ii) Contracts awarded, residential building, floor space of building.	*Statistical Abstract* (data from Dodge Co.).
Sweden, post-war	(i) Gross increase in number of rooms or kitchens in 296 cities.	*Sveriges Statistisk Årsbok.*
	(ii) Number of dwellings built in Stockholm by private enterprise.	*Stockholm Stadskollegiets utlåtanden och memorial.* Bihang No. 10 A, 1935.
	Rent.	
Germany, pre-war	Average annual rent of occupied houses in Hamburg.	HUNSCHA: see under *Vol. of building.*
Sweden, pre-war	Average rent per room of houses to let in Stockholm.	MYRDAL, *The Cost of Living in Sweden.*
United Kingdom, post-war	Rent index of the Ministry of Labour cost-of-living index. [b]	*Abstract of Labour Statistics.*
United States, post-war	Rent index of the Bureau of Labor Statistics cost-of-living index.	*Statistical Abstract.*
Sweden, post-war	Rent index of the cost-of-living index.	*Sveriges Statistisk Årsbok.*
	Construction Costs.	
Germany, pre-war	Prices of building materials. [c]	JACOBS und RICHTER, *Grosshandelspreise, Vierteljahreshefte zur Konjunkturforschung*, Sonderheft 37.
Sweden, pre-war	Index of building costs.	MYRDAL, *loc. cit.*

[a] *I.e.*, value at current prices deflated by index of construction costs, 1923-1925 = 100.
[b] Up to 1928, the index relates to controlled rents; from 1929 onwards, to controlled and uncontrolled rents combined. No better index is available.
[c] When reckoning the "profitability" of holding houses, allowance was made for wage costs: these were supposed to have been constant throughout the period and to account for 35 % of total construction costs.

Country and period	Description of series	Source
United Kingdom, post-war	Index of building costs.	COLIN CLARK, *Investment in Fixed Capital in Great Britain*, Special Memorandum No. 38, London & Cambridge Economic Service.
United States, post-war	Index of construction costs of *Engineering News Record.*	*Statistical Abstract.*
Sweden, post-war	(i) Index of building costs.[a]	*Svenska Handelsbanken:* "Index".
	(ii) Index of building costs in Stockholm.	*Statistisk Årsbok för Stockholms Stad.*
	Interest Rate.	
Germany, pre-war	Average rate on mortgage banks' new issues.	HUNSCHA: see under *Volume of building.*
Sweden, pre-war	Savings banks' rate.	LINDAHL, etc.: *The National Income of Sweden.*
United Kingdom, post-war	Yield on 2½% Consols.	*Statistical Abstract.*
United States, post-war	Yield on 60 bonds.	*Statistical Abstract* (from Standard Statistics).
Sweden, post-war	Savings banks' rate.	*Sveriges Statistisk Årsbok.*
	Index of Housing Needs.[b]	
Germany, pre-war	% of vacant dwellings in Hamburg.	HUNSCHA: see under *Volume of building.*
Sweden, pre-war	% of vacant dwellings in Stockholm.	*Statistisk Årsbok för Stockholms Stad.*
United States, post-war	Stock of houses,[c] deviations from trend.	*Statistical Abstract.*
	Profits or Income.	
Germany, pre-war	Dividends in % of capital.	DONNER, *Die Kursbildung am Aktienmarkt, Vierteljahreshefte zur Konjunkturforschung*, Sonderheft 36.
Sweden, pre-war	Total real income.[d]	*Sveriges Statistisk Årsbok.*

[a] The figure for 1923 was obtained by combining the index of prices of building materials *(Statistisk Årsbok)* and the index of hourly wages in building (BAGGE: *Wages in Sweden*) with the same weights as in index for subsequent years— *i.e.*, materials 60%, wages 40%.

[b] No data are shown for the United Kingdom. An attempt at computing the stock of houses, in deviations from its trend, led to unreliable results.

[c] Census data, interpolated on the basis of floor space of buildings for which contracts have been awarded.

[d] Total assessed income of following year deflated by cost-of-living index (MYRDAL: *The Cost of Living in Sweden*, 1830-1930).

Country and period	Description of series	Source
United Kingdom, post-war	Real income from wages and salaries. [a]	CLARK, *National Income and Outlay*.
United States, post-war	(i) Net income of corporations.	*Statistical Abstract.*
	(ii) Urban non-workers' income.	Estimates based on S. KUZNETS: *National Income.*
	(iii) Capital gains.	Estimates based on WARBURTON: *Journal of Political Economy*, Vol. 43.
Sweden, post-war	Total real income. [b]	*Sveriges Statistisk Årsbok.*

[a] Money income deflated by cost-of-living index (Ministry of Labour).
[b] Total assessed income of following year deflated by cost-of-living index.

Lags used. A uniform lag of one year has been assumed to exist between the series showing completed building and both the explanatory factors of the first group —rent, construction costs, interest rate—and the income series. In the case of the United States, where the series representing building is based either on contracts awarded or building permits delivered, the lag zero indicated in brackets after the regression coefficients corresponds to a real lag of probably not far from one year between the explanatory factors and the end of the building process.

As regards the total number of houses, or the number of vacancies, the lag was chosen between one-half and three and a-half years, according to the best result yielded.

§ 14. RESULTS

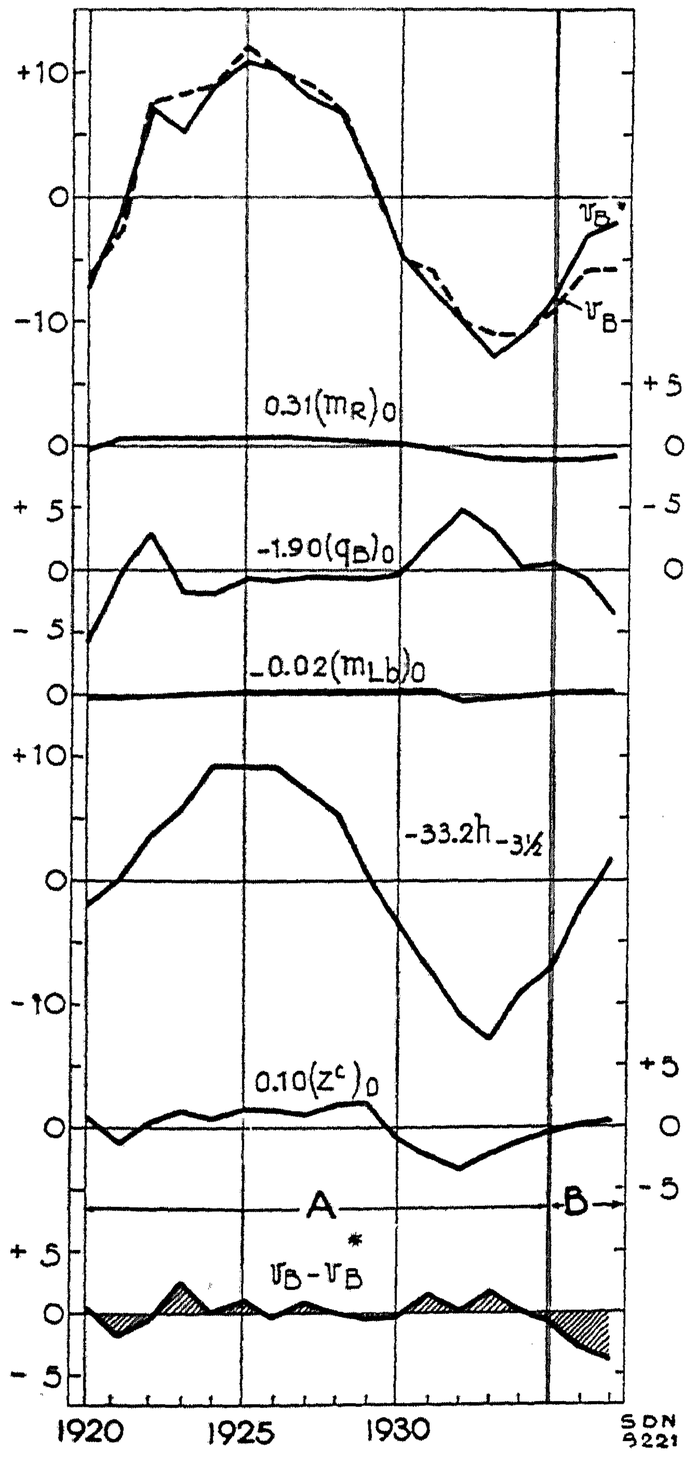
Chief results. The explanatory factors mentioned above permit, when rightly combined, of a good explanation of the movement of building activity, more especially after the war. But for each country, the respective influence of the various factors in the best combination varies greatly, as may be seen from the accompanying graphs. In the United States, the movement is dominated by the available stock of houses lagged over three and a-half years, while the influence both of the rate of interest and of income is almost negligible.

Graph IV. 1.

"EXPLANATION" OF BUILDING.
UNITED STATES 1920-1937.

(Free calculation.)

A = Calculated.
B = Extrapolated.

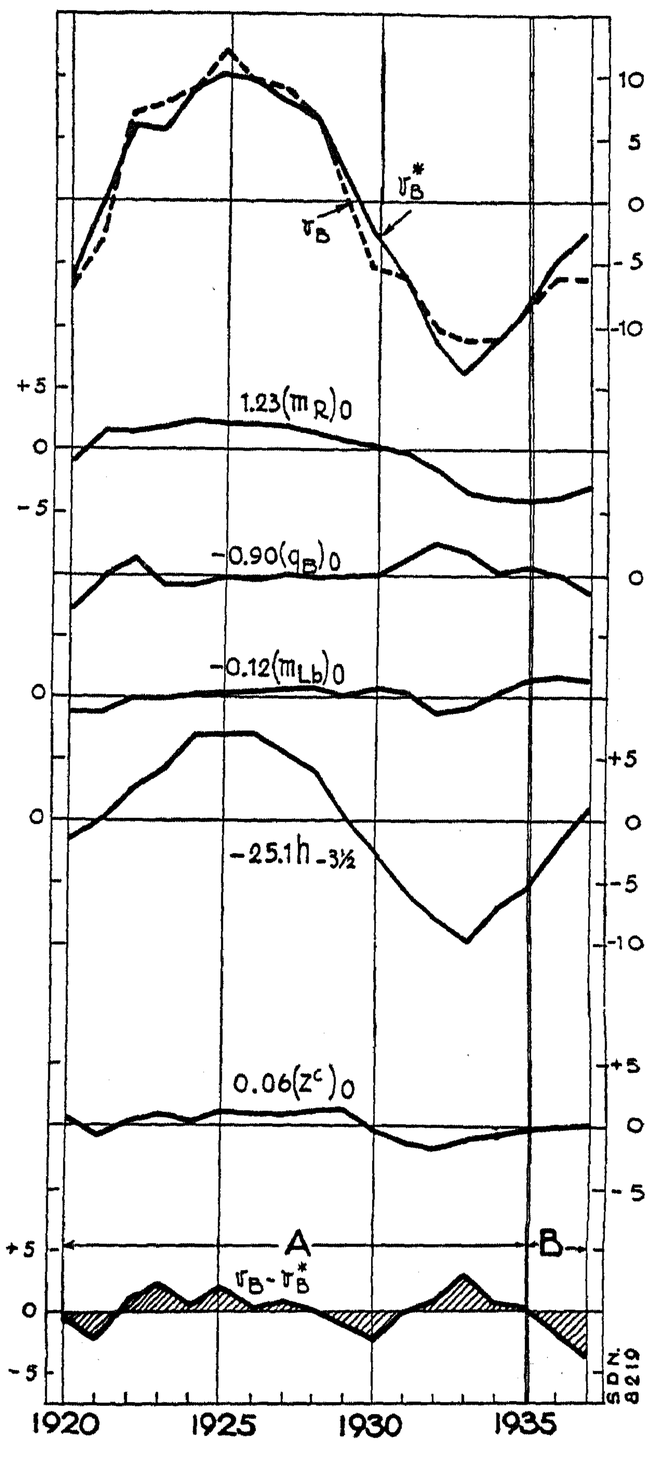


Graph IV. 2.

"EXPLANATION" OF BUILDING.
UNITED STATES 1920-1937.

(Rent, building costs and interest rate combined *a priori*.)

A = Calculated.
B = Extrapolated.



v_B : building activity, actual.

v_B^* : building activity, as explained by :

$(m_R)_0$: rent
$(q_B)_0$: building costs } not lagged (see remark on p. 98);
$(m_{Lb})_0$: bond yield

$h_{-3½}$: number of houses (in deviation from trend), lagged 3½ years.

Z_0^c : profits, not lagged.

Graph IV. 3.

"EXPLANATION" OF BUILDING.
UNITED KINGDOM 1923-1937.

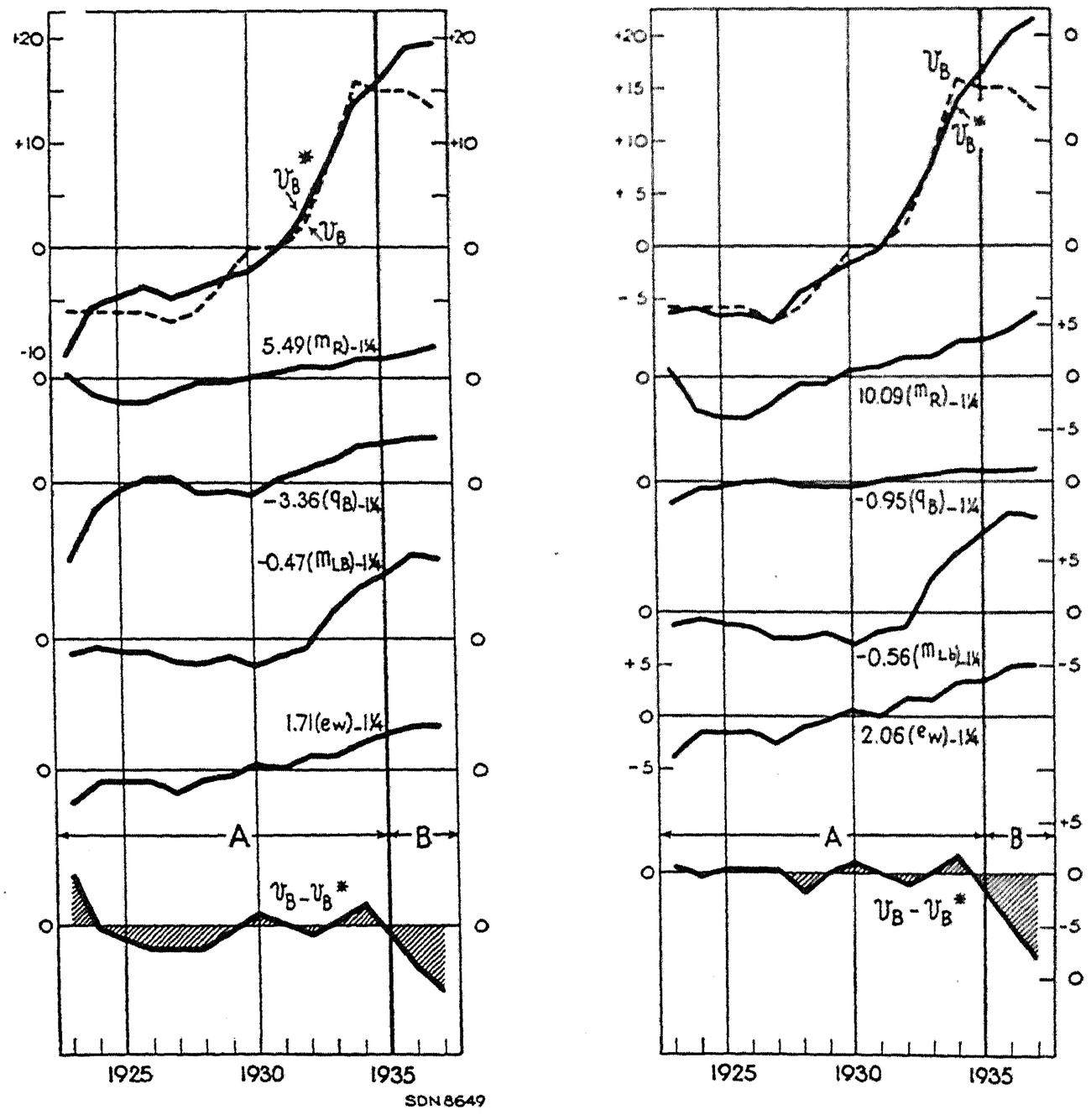
(Free calculation.)

Graph IV. 4.

"EXPLANATION" OF BUILDING.
UNITED KINGDOM 1923-1937.

(Rent, building costs and interest rate combined *a priori*.)

A = Calculated. B = Extrapolated.



v_B: building activity, actual.

v_B^*: building activity, as explained by:

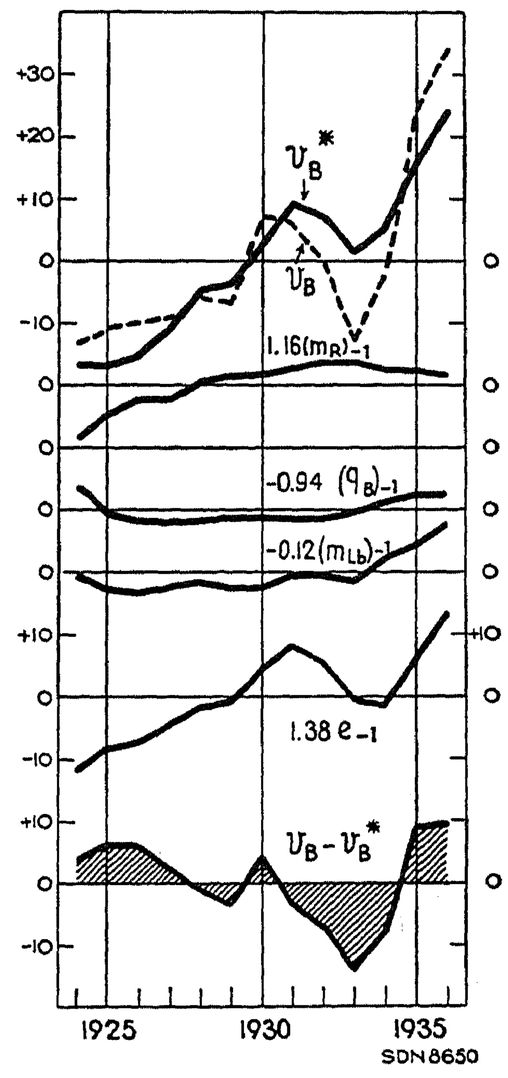
$(m_R)_{-1\frac{1}{4}}$: rent
$(q_B)_{-1\frac{1}{4}}$: building costs
$(m_{Lb})_{-1\frac{1}{4}}$: bond yield
} lagged 1¼ years;

$(e_w)_{-1\frac{1}{4}}$: real labour income, lagged 1¼ years.

Graph IV. 5.

"EXPLANATION" OF BUILDING.
SWEDEN 1924-1936.

(Rent, building costs and interest rate combined *a priori*.)



v_B : building activity, actual.

v_B^* : building activity, as explained by:

$(m_R)_{-1}$: rent
$(q_B)_{-1}$: building costs
$(m_{Lb})_{-1}$: interest rate
e_{-1} : real income

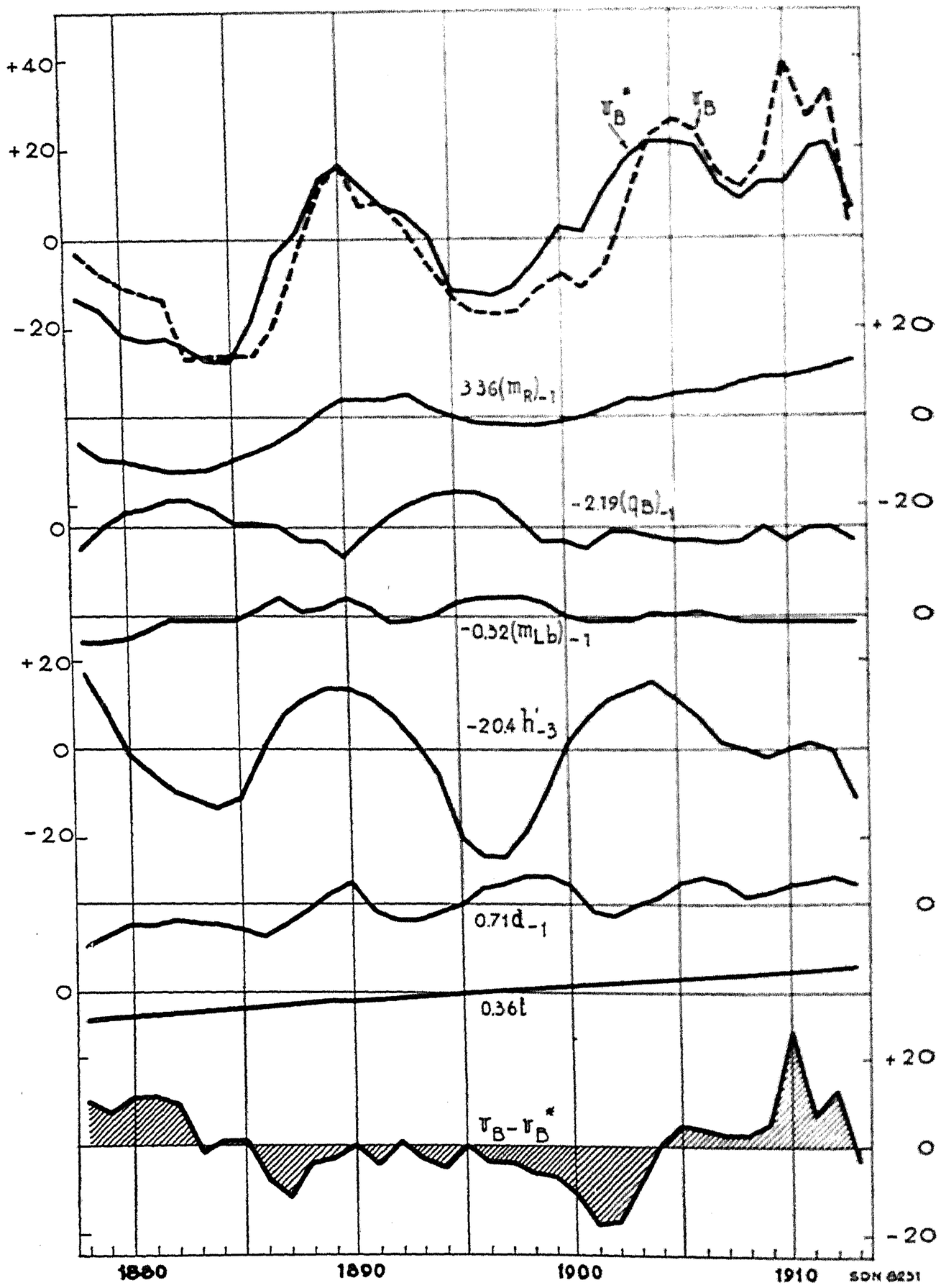
} lagged 1 year.

In the United Kingdom and Sweden, on the other hand, the greatest importance seems to attach to the interest rate and real income.

For before the war, the results are more doubtful and will be discussed in the next section.

Graph IV. 6.

"EXPLANATION" OF BUILDING. GERMANY (HAMBURG) 1878-1913.
(Rent, building costs and interest rate combined *a priori*.)



v_B : building activity, actual.

v_B^* : building activity, as explained by:

$(m_R)_{-1}$: rent
$(q_B)_{-1}$: building costs
$(m_{Lb})_{-1}$: interest rate
} lagged 1 year;

h_{-3} : number of houses (in deviation from trend), lagged 3 years;

d_{-1} : dividends in % of capital, lagged 1 year;

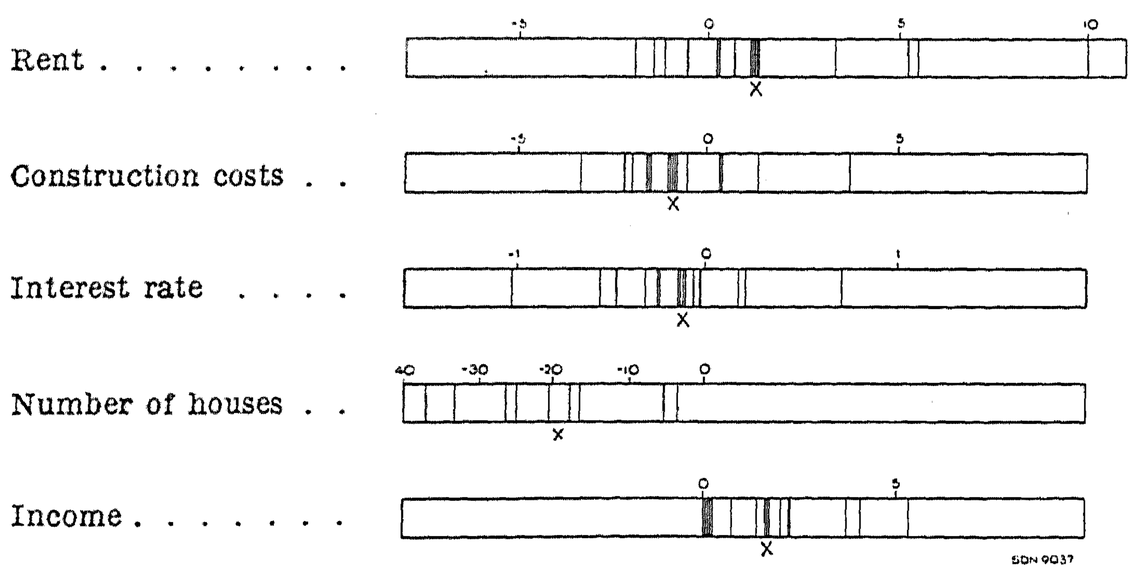
t : trend.

The following graph affords a comparison of all the regression coefficients found in the calculations comprised in the summary Tables IV. 1 and IV. 2. While the range of variation is rather wide, there is for all variates except the number of houses a well-defined mode which coincides with the median in three cases out of four.

Graph. IV. 7.

DISTRIBUTION OF REGRESSION COEFFICIENTS.

(Tables IV. 1 and IV. 2.)



(The × indicates the median.)

The values of the medians are roughly as follows: rent + 1; construction costs — 1; interest rate — 0.1; number of houses —20; income + 1½. Owing to the choice of the units, these figures represent the various elasticities, except in the case of interest rates. In this case, the figure indicates that an increase of 0.01% in the rate of interest will produce a decrease of 0.1% in the volume of building.

Extrapolations.

The equations found for the United States and the United Kingdom for the period up to 1935 have been applied to the data (or estimates) for 1936 and 1937.

For the United States, the volume of building thus calculated reflects the actual movement of building as shown by current statistics: both the free and the *a priori* calculations point

Building. Table IV. 1. Explanation

Note. — Unless otherwise stated, the units used are: for pre-war, % deviations from trend; interest rate, the deviations of which are expressed in units of 1 % and 0.01 % respectively. each series, see table on pages 95 *et seq.*

Country	Period	Series explained	Correlation coefficient R
Germany (Hamburg)	1878-1913	Net increase in number of rooms.	0.92
Sweden (Stockholm)	1884-1913	Number of new rooms built.	0.68
United States	1920-1935	Total volume of non-farm residential construction.	(i) 0.99 (ii) 0.99
United Kingdom	1923-1935	Number of houses built by private enterprise without State assistance.	0.99
Sweden	1924-1936*	Number of houses built in 296 cities.	(i) 0.97 (ii) 0.97
Sweden (Stockholm)	1924-1936*	Number of houses built without State assistance.	0.95

Building. Table IV. 2. Explanation of and Interest Rate

Note. — See note to Table IV. 1.

Country	Period	Series explained	Correlation coefficient R
Germany	1878-1913	Net increase in number of rooms.	0.87
Sweden	1884-1913	Number of new rooms built.	0.59
United States	(i) 1915-1935 (ii) 1920-1935 (iii) 1920-1935	Floor space of contracts awarded. Volume of non-farm residential construction.	0.96 0.98 0.99
United Kingdom	1923-1935	Number of houses built by private enterprise without State assistance.	0.96
Sweden	1924-1936	Number of dwellings built in 296 cities.	(i) 0.89 (ii) 0.91

a % vacant houses.
b Net income of corporations.
c Total urban non-workers' income plus capital gains.
* 1933 excluded.

of Building: Free Calculations.

for post-war, % deviations from average, except for the "profitability of building" and the The lag, in years, is indicated in brackets after each coefficient. For a detailed description of

Regression coefficients and lags of:				
Rent	Construction costs	Interest rate	Number of houses	Income or profits earned
5.20 (1)	— 1.54 (1)	0.72 (1)	— 16.5[a] (3)	1.71 (1)
1.14 (1)	— 1.59 (1)	— 1.03 (1)	— 3.7[a] (1½)	3.75 (1)
0.31 (0)	— 1.90 (0)	— 0.02 (0)	— 33.2 (3½)	0.10[b] (0)
0.23 (0)	— 1.56 (0)	— 0.03 (0)	— 37.0 (3½)	0.16[c] (0)
10.09 (1¼)	— 0.95 (1¼)	— 0.56 (1¼)	*f*	2.06 (1¼)
— 1.16 (1)	0.34 (1)	— 0.24 (1)	*f*	2.22 (1)
— 1.43 (1)	0.39 (1)	— 0.24 (1)	*f*	2.25 (1)
— 0.52 (1)	3. 74 (1)	0.21 (1)	*f*	4.12 (1)

Building: Rent, Construction Costs combined a priori.

Regression coefficients and lags of:					
Profitability of building				Number of houses	Income or profits earned
Total	Rent	Construction costs	Interest rate		
48.2 (1)	3.36 (1)	—2.19 (1)	—0.32 (1)	— 20.4[a] (3)	0.71 (1)
—19.0 (1)	—1.93 (1)	1.31 (1)	0.17 (1)	— 5.2[a] (1½)	5.34 (1)
13.3 (0)	1.21 (0)	—0.93 (0)	—0.12 (0)	— 17.8 (3½)	0.14[b] (0)
12.3 (0)	1.23 (0)	—0.90 (0)	—0.12 (0)	— 25.1 (3½)	0.06[b] (0)
11.9 (0)	1.19 (0)	—0.87 (0)	—0.11 (0)	— 26.5 (3½)	0.26[c] (0)
69.0 (1¼)	5.49 (1¼)	—3.36 (1¼)	—0.47 (1¼)	*f*	1.71 (1¼)
4.5 (1)	0.69 (1)	—0.52[d] (1)	—0.06 (1)	*f*	1.66 (1)
7.5 (1)	1.16 (1)	—0.94[e] (1)	—0.12 (1)	*f*	1.38 (1)

d Index of construction costs of Svenska Handelsbanken.
e Index of construction costs of Stockholm Statistical Office.
f Series not included.

Building. Table IV. 3. Explanation of Building: Combination with Rent and

Note. — See note to Table IV. 1.

Country	Period	Series explained
Germany (Hamburg)	1878-1913	Net increase in number of rooms.
Sweden (Stockholm)	1884-1913	Number of new rooms built
United States	1920-1935	Total volume of residential construction
United Kingdom	1923-1935	Number of houses built
Sweden	1924-1936*	Number of houses built in 296 cities

Building. Table IV. 4. Influence of Number

Note. — See note to Table IV. 1.

Country	Period	Series explained
Germany	1878-1913	Net increase in number of rooms
	”	” ” ”
	”	” ” ”
United States	1920-1935	Volume of non-farm residential building
	”	” ” ”
	”	” ” ”
	”	” ” ”
	1920-1932	” ” ”
United Kingdom	1923-1935	Number of houses built without State assistance
	”	” ” ”
Sweden	1924-1936*	Number of rooms built in 296 cities
	”	” ” ”
	”	” ” ”

a Number of vacant houses, in %.
b Net income of corporations.
c Series not included.
* 1933 excluded.

Calculations using Interest Rate in a priori. Construction Costs, and also freely.

Correlation coefficient R	Regression coefficients and lags of:			
	Profitability of building	Interest rate	Number of houses	Income or profits earned
0.93	76.8 (1)	1.04 (1)	—20.1 [a] (3)	1.72 (0)
0.65	1.1 (1)	— 0.70 (1)	— 4.4 [a] (1½)	4.29 (1)
0.98	12.5 (0)	0.02 (0)	—25.1 (3½)	0.06 [b] (0)
0.97	20.5 (1¼)	— 0.56 (1¼)	[c]	3.11 (1¼)
0.97	— 5.3 (1)	— 0.35 (1)	[c]	2.02 (1)

Explanation of Building. of Variates included.

Correlation coefficient R	Regression coefficients and lags of:			
	Profitability of building	Number of houses	Income or profits earned	Capital gains
0.66	3.8 (1)			
0.82		—15.5 [a] (3)		
0.87	48.2 (1)	—20.4 [a] (3)	0.71 (0)	
0.78	33.0 (0)			
0.97		—36.0 (3½)		
0.98	10.5 (0)	—29.8 (3½)		
0.98	12.3 (0)	—25.1 (3½)	0.06 [b] (0)	
0.99	11.6 (0)	—22.5 (3½)	— 0.06 [b] (0)	0.003 (0)
0.96	88.8 (1¼)			
0.96	69.0 (1¼)		1.71 (1¼)	
0.82	11.9 (1)			
0.87			2.36 (1)	
0.89	4.5 (1)		1.66 (1)	

to a slackening of residential building in 1937 as compared with 1936. For the United Kingdom, on the other hand, the extrapolations of both calculations point to a continuous rise through 1936 and, in a somewhat lesser degree, 1937, which does not agree with the actual stability in 1936 and decline in 1937. The explanation of this difference seems to lie in the special fact that the building boom, which consisted largely in the construction of small houses for the upper working-class and the lower middle class, had, round about 1935, attained a limit, which could only have been surpassed by making these owner-inhabited houses accessible to the earners of smaller incomes.

Details of results. Tables IV.1-IV.4. In Tables IV. 1-IV. 4 the results of the principal calculations are set out. In Table IV. 1, all the explanatory factors enumerated above have been included separately in the correlation calculations; in Table IV. 2, the three factors of the first group have been combined *a priori* so as to reflect the profitability of building. In Table IV. 3, the interest rate has been added as a separate factor in addition to entering into the "profitability"; this is a way of introducing interest rates with a free coefficient—in order to find whether there is accordance with the *a priori* case—without increasing by two the number of variates, as is the case in Table IV. 1. Table IV. 4. shows the influence of the number of variates included.

Correlation coefficients. With the exception of the case of Sweden, pre-war, all correlation coefficients in Tables IV. 1 and IV. 2 —the most important ones—vary between 0.87 and 0.99; for post-war, the median is even as high as 0.97.

Signs of regression coefficients. All coefficients in Table IV. 1 have the right sign except the interest rate in the case of Germany, pre-war, which is positive instead of negative and all coefficients but two of the components of profitability for Sweden, post-war.

For Sweden, pre-war, the regression coefficient of profitability is negative in Table IV. 2, but it is reversed in Table IV. 3, which seems to point out that the influence of the rate of interest is much higher than assumed when

calculating the "profitability".[1] Table IV. 3 is otherwise not very satisfactory: two of the columns contain coefficients with a wrong sign.

In Table IV. 4, on the other hand, all signs are right.

Comparison between countries.

The main divergencies between countries as regards the order of magnitude of the regression coefficients of Tables IV. 1 and IV. 2—leaving aside those with a wrong sign[2]—may be briefly summarised:

Table IV. 1: In the United States, interest rate and rent have a much smaller coefficient than the average, while in the United Kingdom the coefficient of the latter is much greater. The coefficients of construction costs, in so far as they have the right sign, are rather close to each other; the coefficients of the number of houses, on the other hand, show a very wide spread.

In the United States, post-war, the coefficients for the income series are almost negligible.[3]

Table IV. 2: the coefficient of profitability is much larger than the average in Germany, pre-war, and the United Kingdom, post-war, and smaller in Sweden, post-war.

The coefficients for the number of houses are not very different from those in Table IV. 1. The coefficient of profits in the United States is, again, very small.

Comparison of Tables IV. 1 and IV. 2.

A comparison of the coefficients of rent, construction costs and interest rate in Tables IV. 1 and IV. 2 should make it possible to test the assumptions made when combining these factors into an index of profitability. To facilitate this comparison, the coefficients have been inserted in the following table. Unfortunately, the results show a rather wide range of variation.

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[1] This might be explained by the fact that the interest rate is, at the same time, a measure of the desirability of investing in bonds, and that this desirability influences the incentive to build.

[2] It may, in this connection, be noted that both the rent index and the construction costs index for Sweden, post-war, which obtain only wrong signs in Table IV. 1, are not very representative.

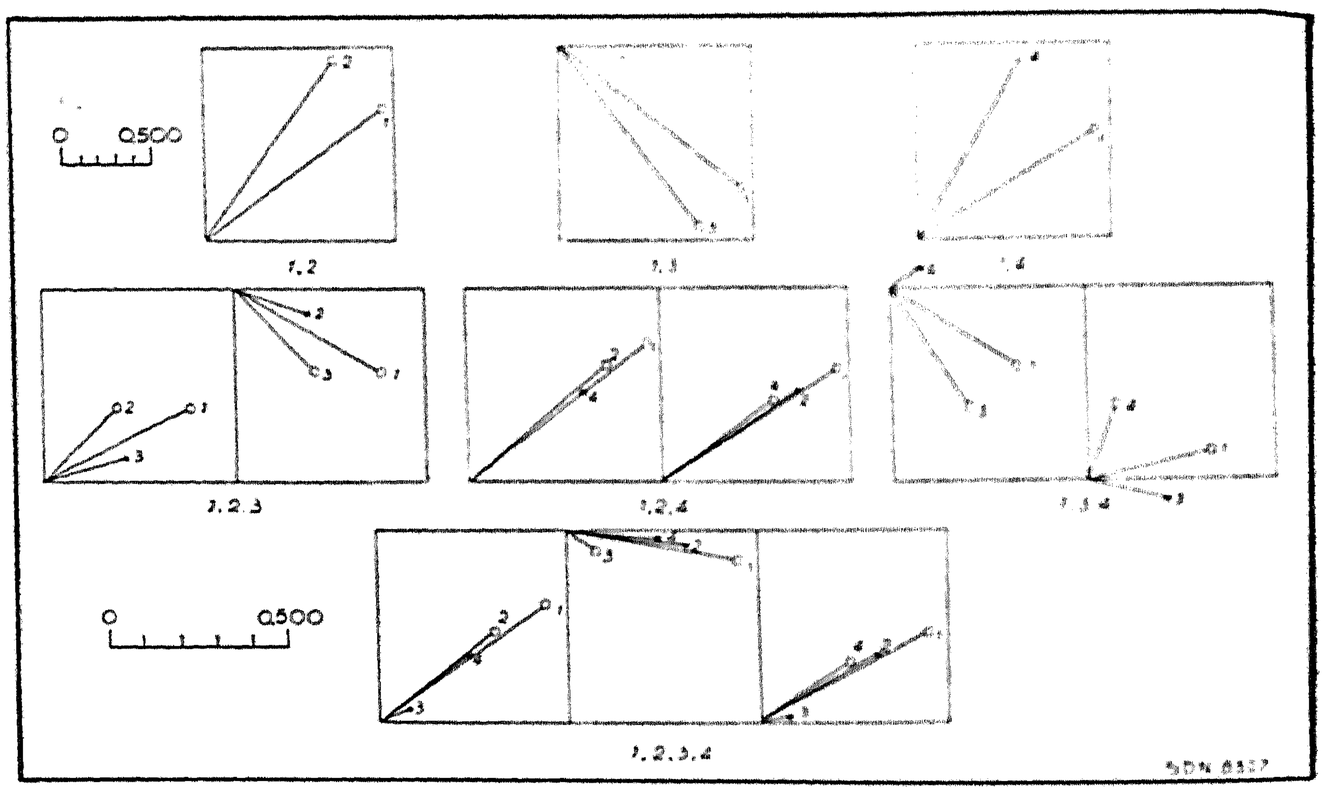
[3] These coefficients were somewhat raised when real instead of money income was used, but they still remained very low.

Graph IV. 8.

Bunch Map.

BUILDING: UNITED STATES 1915-1935.

1 = Building (contracts awarded). 2 = Profitability of building.
3 = Number of houses$_{-3^1/_2}$. 4 = Profits.

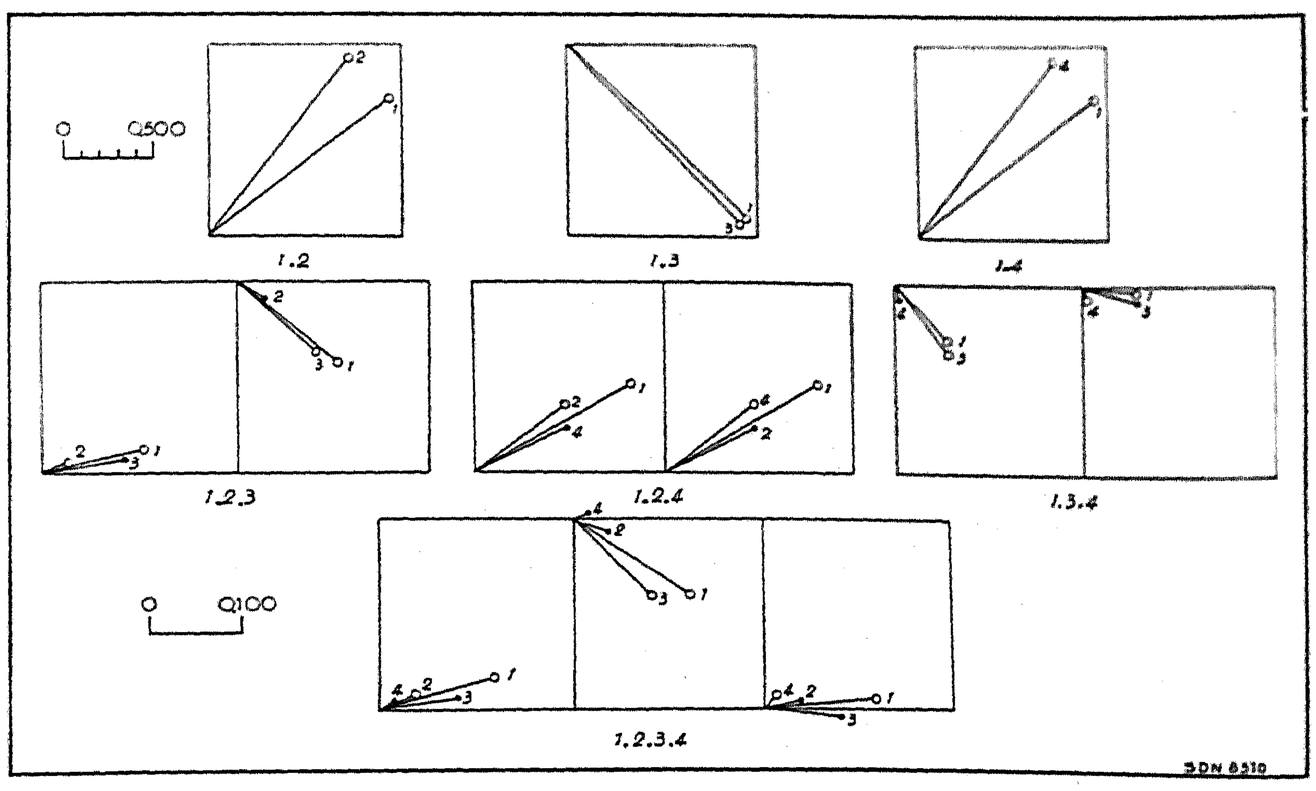


Graph IV. 9.

Bunch Map.

BUILDING: UNITED STATES 1920-1935.

1 = Building (total non-farm residential construction). 2 = Profitability of building.
3 = Number of houses$_{-3^1/_2}$. 4 = Profits.



In the German pre-war case, the coefficients of rent and construction costs are not too dissimilar. For after the war, the coefficient for rent is greater and that for construction costs smaller for the United Kingdom in the free calculation; but the reverse is true for the United States.

The two factors of the second group, on the other hand, have fairly stable coefficients.

Tables IV. 1 and IV. 2 combined.[a]

A = Free calculations. B = *A priori* calculations.

Country	Regression coefficients of:									
	Rent		Construction costs		Interest rate		Number of houses		Income	
	A	B	A	B	A	B	A	B	A	B
Germany 1878-1913	5.20	3.36	—1.54	—2.19	[b]	[b]	—16.5	—20.4	1.71	0.71
Sweden 1884-1913	[b]	[b]	[b]	[b]	[b]	[b]	— 3.7	— 5.2	3.75	5.34
United States 1920-1935	0.31	1.23	—1.90	—0.90	—0.02	—0.12	—33.2	—25.1	0.10	0.06
Utd. Kingdom 1923-1935	10.09	5.49	—0.95	—3.36	—0.56	—0.47	[c]	[c]	2.06	1.71
Sweden 1924-1936	[b]	[b]	[b]	[b]	—0.24	—0.06	[c]	[c]	2.22	1.66

[a] For the sake of clearness, the description of series, the indication of lags, and all footnotes have been omitted.
[b] Cases including wrong signs have not been included.
[c] Series not included.

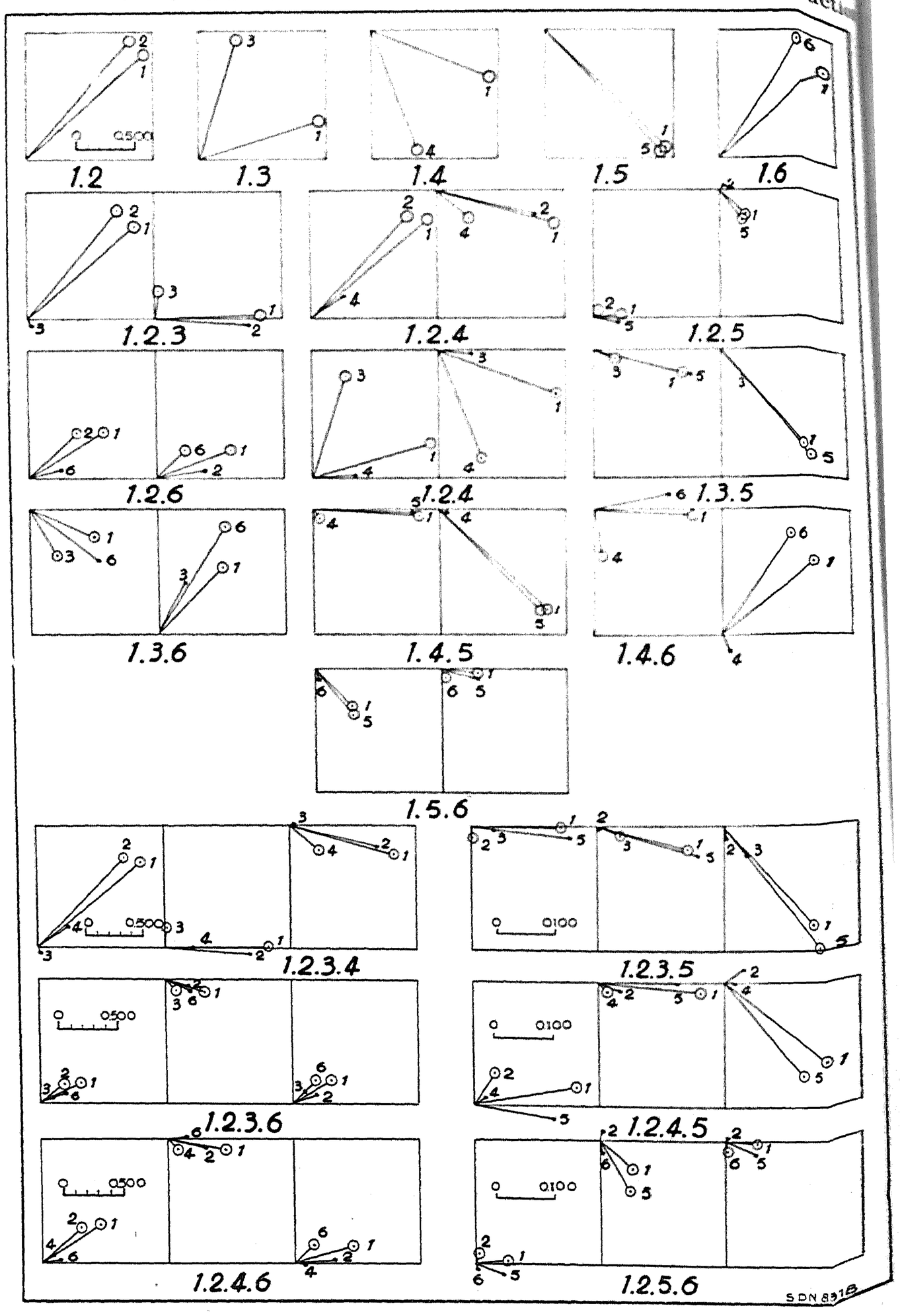
For the United States, three bunch maps have *Significance* been drawn, two representing *a priori* calculations. *calculations.* and the third the free calculation for 1920-1935.

As regards the first *a priori* calculation (Graph IV. 8, contracts awarded, 1915-1935), the final set (1234) is very satisfactory as to variate 2 (profitability). It is somewhat less satisfactory as to variates 3 (number of houses) and 4 (profits), the coefficients of which are not to be determined with the same degree of exactness, the angles between the beams being larger.

Bunch Map

BUILDING: UNITED STATES 1920-1935.

1 = Total non-farm residential construction. 2 = Real. 3 = Construct

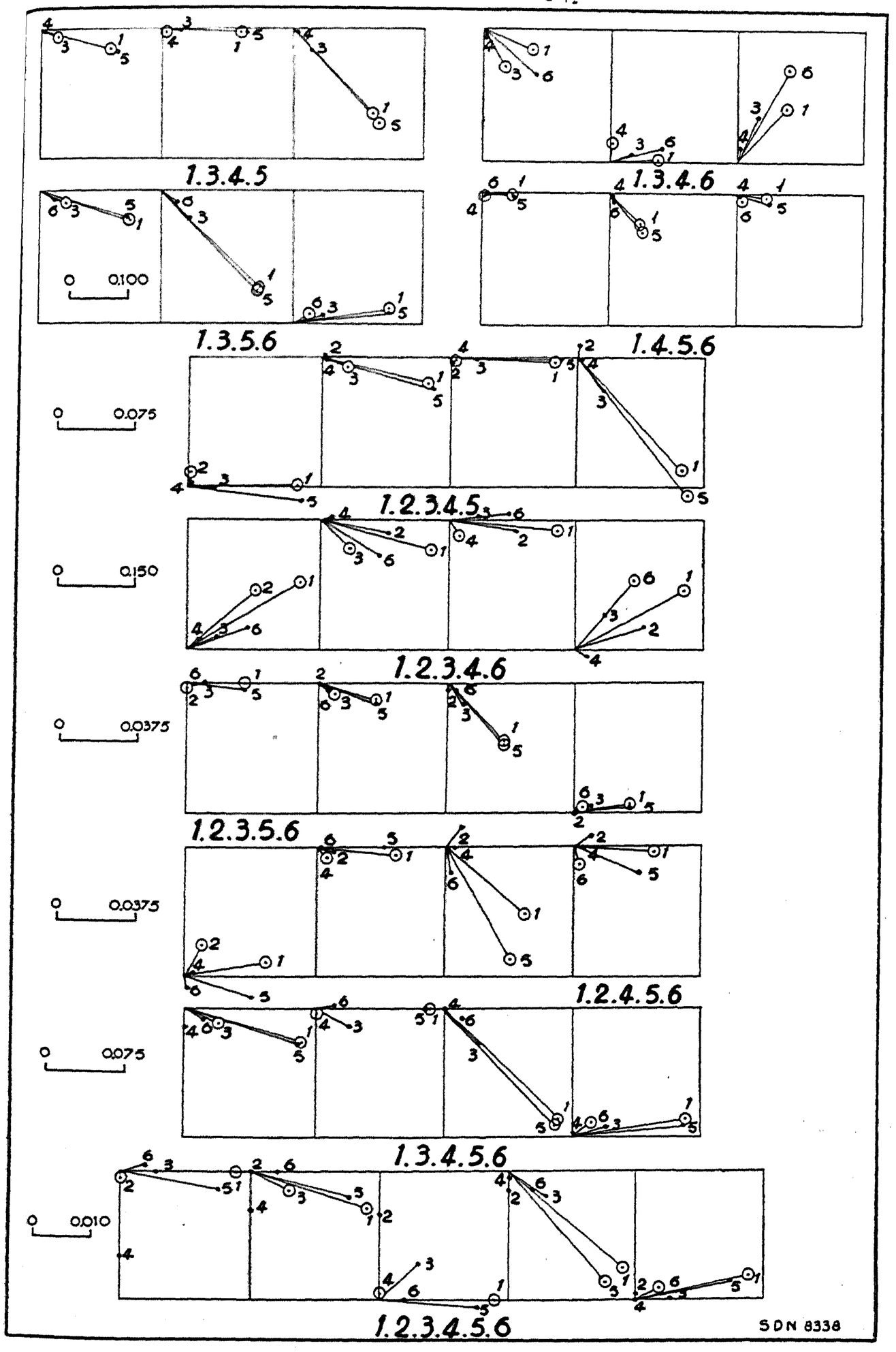


V. 10.

Bunch Map.

BUILDING: UNITED STATES 1920-1935.

)sts. 4 = Interest rate. 5 = Number of houses – 31/2. 6 = Profits.



Taking account of the fact that, in this case, variates 2 and 4 appear to be the more important ones, one may, however, disregard beam 3 in the middle and right-hand parts of set 1234; the regression coefficients for 3 and 4 then become more certain, though that of 3 is small (small inclination of beams).

For the other *a priori* calculation (total non-farm residential construction, 1920-1935), the bunch map (Graph IV. 9) is less good; here the regression coefficient of 3 (the number of houses) is found to be both important and well determined if the two other variates, the coefficients of which are found to be small, are disregarded.

The bunch map (Graph IV. 10) for the free calculation over this period shows, in its final set (123456), a tendency to explosion, but nevertheless the variates 3 (construction cost), 5 (number of houses) and 6 (profits) are found to have well defined and important influences, especially 5. From the "best" sub-sets ("best" from the point of view of determinateness of regression coefficients)—viz., (135), (145), (1345), (12345)—similar conclusions are to be drawn.