Gunnar Eliasson

The Credit Market, Investment Planning and Monetary Policy —an econometric study of manufacturing industries

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Industriens Utredningsinstitut
Artillerigatan 34, Box 5037, S-102 41 Stockholm, Sweden
Tel. 08/63 50 20

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Preface

The survey and analysis of financial patterns within manufacturing industries have long been an important part of the IUI research program. In this study the importance of financial factors in short-run investment spending decisions has been emphasized. Particular stress has been laid on the influence on such decisions of variations in the availability of external funds in the organized credit market and the extent of inter-firm borrowing in the so called "grey" market.

The impact of financial factors on investment planning has been formalized in terms of a realization function which is tested econometrically on annual time-series data for the period 1950–63. Predictive performance of the model is later checked against data for the period 1964 through 1967. Furthermore the financial planning section of the total model more has been used to forecast industrial demands on the organized credit market for the period 1965–70. This forecast has been based on the investment and production plans of the Government Long-term Survey of 1966. The study concludes with an evaluation and a discussion of the potentialities of various monetary policy measures based on the empirical results presented.

This study, a more extensive version of which was published in 1967 in Swedish, is to be viewed as an intermediate report of a more extensive project on factors behind investment and growth in manufacturing industries which is on the research program of the institute. This publication, finally, is he slightly rephrased version of a paper presented to the European Meeting on Statistics, Econometrics and Management Science in Amsterdam in September 1968.

The author of the study is docent Gunnar Eliasson.

Stockholm in December 1968

Lars Nabseth

Contents

Introduction 7

CHAPTER 1. SWEDISH INDUSTRY DURING THE POST-WAR PERIOD 9

1.1 Economic Development and Economic Policy 10
1. Cyclical Pattern 10
2. Expansionary Tendencies 11
3. Economic Policy 13

1.2 Manufacturing Finance 16

CHAPTER 2. A CAPITAL BUDGETING THEORY OF INVESTMENT PLANNING 20

2.1 The Investment Reserve 21
2.2 Outline of the Theory 24
2.3 Formal Structure of our Theory 31
1. Investment Planning Function 32
2. Investment Function 34
3. Realization Function 35
4. Financial Model 35
5. Financial Disequilibrium Variable 36
6. Capital Budget 38
7. Profit Generation and Plow-back 40
8. The Realization Function Reconsidered 43
9. Assumptions as to Expectations 44
10. Exclusion Hypothesis 47

2.4 Causal Structure of the Model 48

CHAPTER 3. APPLICATION OF THE CAPITAL BUDGETING THEORY 51

3.1 Econometric Method 51
3.2 The Financial Model 53
1. Transactions Liquidity and Inventories Functions 54
2. "Grey" Credit Market 54
3. Savings Function 55
4. Capital Budget 55
5. Ex-post Simulations of the Capital Budget 57

3.3 The Realization Function 58
1. Investment Behaviour—Machinery 58
2. Investment Behaviour—Construction 65
3. Regression Experiments 66
4. Residual Analysis 68
5. Ex-post Simulations—Machinery 70

CHAPTER 4. SOME FEATURES OF THE CAPITAL BUDGETING THEORY OF INVESTMENT PLANNING 73

4.1 Structure of the Financial Sector 73
4.2 Implications for Profitability and Growth—Long-run Equilibrium Conditions 76

CHAPTER 5. INTER FIRM BORROWING—THE "GREY" CREDIT MARKET 80
5.1 Trade Credit Flows—Empirical Results 81
5.2 Buffer-Stock Function of the "Grey" Credit Market 82
5.3 Derivation of a Credit Function 85
1. The Individual Credit Function 85
2. Aggregation of Credit Functions 87
3. Some Properties of the Credit Function 88
5.4 A Simple Method of Non-additive Residual Analysis 90

CHAPTER 6. MANUFACTURING DEMANDS UPON THE MONEY MARKETS 1965–70 —A LONG-TERM FORECAST 92
6.1 Method and Background Material 92
6.2 Results of Forecast 95
1. Demand for external funds 1966–70 95
2. Internal Finance—the Savings Investment Ratio 97
3. Credit Market Shares 99

CHAPTER 7. CONCLUSIONS WITH RESPECT TO MONETARY POLICY 102
BIBLIOGRAPHY 106

List of diagrams

1:1. Some indexes on manufacturing industry 1950–65 12
1:2. Manufacturing finance 1950–70 15
2:1. Causal structure of the model 48–49
3:1. Ex-post simulations of the capital budget 1952–65 59
3:2. Goodness of fit by realization function, investment in machinery and equipment, manufacturing total 1950–67 63
6:1. Internal financing ratios, manufacturing 1950–70 97

List of tables

1:1. Sources and uses of funds, manufacturing industries 1950–65 17
1:2. Uses of funds in the organized credit market and investment; percentage distribution by sector 1955–64 18
3:1. Savings function, estimated coefficients by branch 56
3:2. Numerical specification of the capital budget by sub-industry 57
3:3. Basic realization function, investment in machinery and equipment, results from estimation by sub-industry 61
5:1. Function for extended trade credits, estimated coefficients by branch 80
5:2. Function for trade debts, estimated coefficients by branch 81
6:1. Net borrowing by manufacturing industry in the organized credit market 1951–70 96
6:2. Flows of funds in the organized credit market 1955/59, 1960/64 and 1970, percentage credit market shares distributed by sectors 100

Introduction

> A scientific theory cannot
> require the facts to conform
> to its own assumptions.
>
> J. M. Keynes

This study has been devoted to a problem of immanent interest in economic literature. The principal question is the quantitative importance of financial factors in private investment behaviour. A natural sequel to this is an evaluation of the potential influence of monetary policy on investment.

Basically, the Swedish post-war economy has been characterized by long-run expansionary expectations among business firms; expectations which have been often unrealized in the short run, without impairing, —as it seems—the long-run optimistic outlook. This attitude within the private sector has at the same time been accompanied by controls in the organized loan market and a low interest rate policy which has kept the rate of variation in officially recorded rates of interest within very narrow margins. Long-term sources of external finance in particular have been practically closed to industrial firms during most of the fifties.

We are thus faced with partly controlled and partly non-controlled supplies of external finance. The basis of our approach to an investment theory is that the non-availability of long-term external finance to the manufacturing sector has operated as a restriction on investment and growth. The mirror image of this is a current excess demand for funds in the organized credit market at the low and stable disequilibrium interest rates maintained there. In principle, the investment theory to be formulated here has been phrased in terms of a currently unsatisfied stock demand for capital equipment faced with a restricted supply of particular sources of finance.

Current (annual) investment plans are dependent upon the expected availability of such finance, calculated net of a priority claim for funds needed for the current operation of the firms, the accumulation of working capital and dividend payments, etc. Hence the name a *capital budgeting theory of investment planning*. The ex-post availability of such finance determines realized investment. Together, annual plan revisions will be explained in terms of inter alia mistaken expectations as to the supply of funds (the investment *realization function*). Essentially this theory has been designed to explain *short-run* investment behaviour. This allows us to abstract from certain features of the production function, technical progress, etc. mainly characterizing the process of long-run growth.

The main content of this study is a condensed version of an earlier study published in Swedish.[1] The verbal presentation of the theory, however, has been much rephrased and also (I believe) improved. The whole of Section 4.2 and a number of subsections are new. In particular, some model simulations and tests of predictive performance on new data accumulated for the years 1964–67 have been added. Chapter 6 is a condensed and somewhat rephrased version of a long-term forecast of manufacturing demands upon the money markets 1965–70[2] based on the results of the Government Long-term Survey.[3] Our forecasting model and investment theory have been integrated in Chapter 4.

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[1] G. Eliasson, *Kreditmarknaden och industrins investeringar — en ekonometrisk studie av företagens kortsiktiga investeringsbeteende.* (The Industrial Institute for Economic and Social Research, IUI) Uppsala 1967.

[2] G. Eliasson, Industrifinansieringen perioden 1950–70 — kartläggning och prognos, Supplement to Kragh, *Finansiella Långtidsperspektiv.* Stockholm (SOU 1967:6). Kragh's study has also been published in English in Kragh (1967b).

[3] *The Swedish Economy 1966–1970 and the general outlook for the seventies* (published by the Ministry of Finance) Stockholm 1966. The basic data used for the forecast have been drawn from Bentzel–Beckeman, *Framtidsperspektiv för svensk industri 1965–1980* (The Industrial Institute for Economic and Social Research, IUI) Stockholm 1966.

CHAPTER 1

Swedish industry during the post-war period

Two main characteristics of the observation period have been emphasized in the present study; firstly the *expansionary bias* of the manufacturing sector, and secondly the *regulation of capital markets* and almost complete non-availability of cheap bond finance for industrial firms during the fifties. This restrictive policy was reversed during the first half of the sixties leading to a sudden increase in borrowing by manufacturing industry. For this reason, the expansionary bias of the economy and an ample supply of profitable investment opportunities, combined with Government control of the organized credit market, can be said to have resulted in a continuous excess demand for long term external funds at controlled and low disequilibrium rates of interest during the observation period.

The sudden reversal of Government policy in this respect during the years following 1960 has allowed the construction of a rough measure of the availability of bond finance each year conditional upon monetary policy. First of all, this measure will be confronted in this study with data on investment plans and investment realizations in an attempt to ascertain the elasticity of short-run investment spending with respect to changes in the availability of these external funds (Chapters 2, 3 and 4).

Secondly, the possible existence of interaction between money flows in the organized credit market and credit arrangements between firms, the "grey" credit market, will be investigated (Chapter 5).

Thirdly, interaction between long-run investment demand and financial flows will be studied in Chapter 6. The results from the Government long-term "forecast" of manufacturing growth in output and investment 1966–70 (Bentzel–Beckeman [1966]) serve as the basis for predicting consequent demands by firms upon the money markets.

Against the background of these empirical results, the study is then rounded off by an evaluation of the potential impact of monetary policy on investment demand and growth of output (Chapter 7).

This study may be characterized as an inquiry into business behaviour in an economy featuring both controlled and non-controlled sources of finance. Controls instead of the price mechanism govern the allocation of marginal funds channelled through the loan markets. The small variations in *regulated interest rates* recorded in the organized credit market render any attempt to trace interest rate effects on investment demand futile. Rather, the interest rate has been viewed as a variable held constant.

One aim of this first chapter will be to clarify briefly the salient background conditions which make such assumptions and such an approach reasonable. A second aim is to sketch the institutional background for interpreting our test results.[1] Finally we shall clarify some problems of particular interest to be subjected to empirical analysis in later chapters.

1.1 Economic Development and Economic Policy

1. *Cyclical Pattern*

The observation period 1950–63 covers three complete business cycles. The period for which ex-post predictions have been performed with the estimated investment realization function encompasses one additional cycle, i.e. 1964–67.

The observation period begins with the *Korean upswing* during 1950, covering its culmination in 1951 and 1952 and the reversal during 1953. The period was immediately preceded by a substantial depreciation of the Swedish krona in 1949, a circumstance which (it has been argued) substantially improved the profitability of Swedish export industries during at least the first half of the fifties.[2]

The second cycle starts with the upswing in 1954 and extends over the period of prolonged boom during the years 1955–57, followed by the recession of 1958.

The *investment cycle* of 1959–63 originated by a sudden spurt in investment spending already in 1958 which rose steeply, culminating in 1961. Recessionary tendencies dominate during 1962 and the first half of 1963.

The fourth and last cycle covers the sudden and not altogether expected[3] return to boom conditions in 1964 culminating in 1965 and followed by a reversal early in 1966. During the autumn of 1967 there was

[1] A much more elaborate analysis is found in Eliasson [1967b], Chapters 1 and 2. For an excellent survey in English of Swedish economic development, economic policy in general and professional economic debate, the reader is referred to Lindbeck [1968].

[2] See e.g. Lundberg [1966].

[3] Cf. The Swedish Economy (Preliminary National Budget) 1964:1, Chapter 1.

scattered evidence that business expectations were again changing in favour of optimism. The acute deterioration in the international payments' situation late in 1967 and the disparate development of foreign demand for Swedish products seem, however, to have obscured the outlook somewhat. Still there is more or less general agreement that a revival has been under way during 1968.

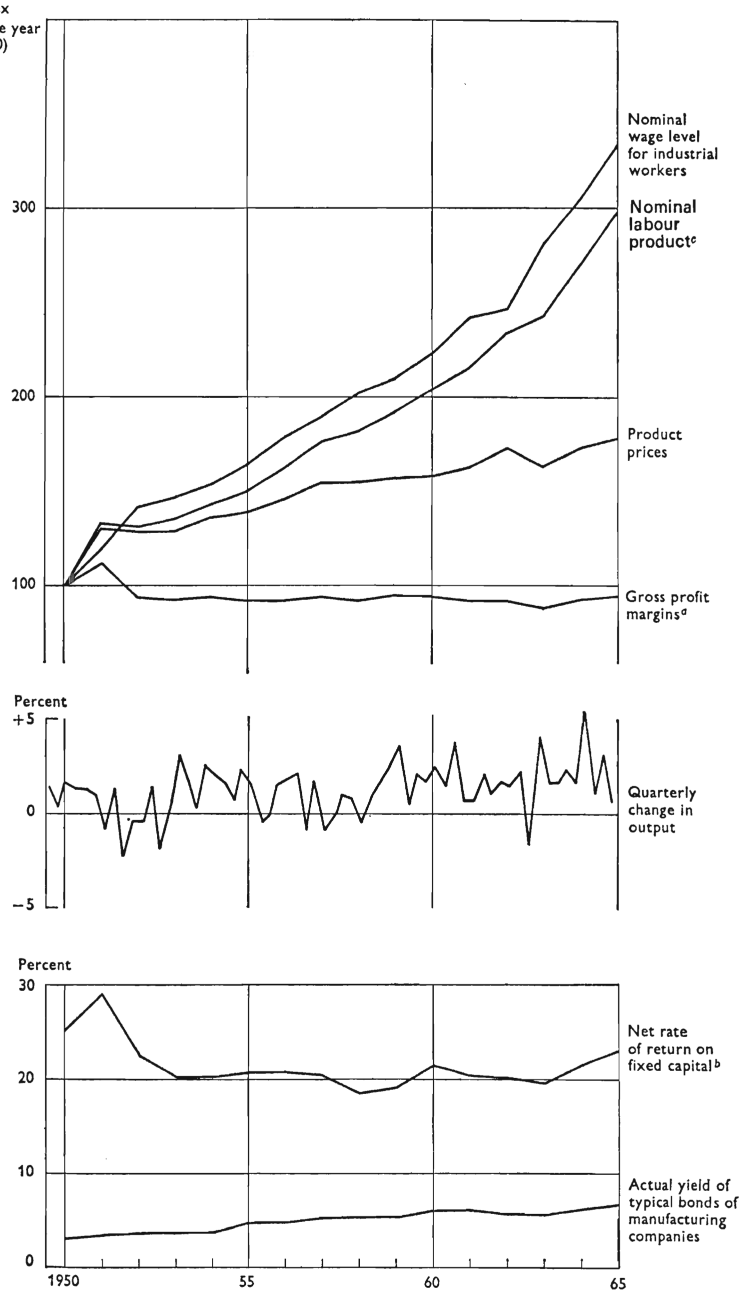
2. *Expansionary Tendencies*

The post-war period has been characterized in Sweden by a steady upward trend in output and productivity. This is illustrated for total manufacturing in Diagram 1:1. Labour input in production has increased only moderately. The origin of productivity growth then has to be traced back to the parallel increase in investment (see Diagram 1:2), capital accumulation and the factor of technological change, which, according to a recent investigation, has explained an increasing relative share of the growth in output during the post-war period.[4] The growth in nominal wages has been much steeper than growth in nominal labor product while product prices have risen, though at a much more moderate rate. Despite this unfavourable development, gross profit margins (see Diagram 1:1) have not shown any tendency to decline during the post-war period, provided we base our comparison on a year after the Korean cycle, i.e. after 1952. The same is true for average net rates of return on capital invested in plant and equipment. Profitability has here been defined net of calculated depreciation charges, and ranges around 20 percent of fixed assets from 1952 onwards. Unfortunately, data on net stocks of working capital are not available for the whole period. Correcting the denominator for stocks of inventories, non-interest bearing liquid assets and net stocks of trade credits would probably reduce the profitability figure by about one half, i.e. to around 10 percent[5]. Even allowing for the uncertain accuracy of these figures they suggest that discrepancies between expected marginal rates of return on investment in expanding industries and the "market" rate of interest charged on controlled funds in the organized credit market (see Diagram 1:1) are probably substantial. Each year we should expect that borrowing such funds to finance investment activities is highly attractive and profitable for a large num-

[4] See Åberg [1969] forthcoming from the Industrial Institute for Economic and Social Research in Stockholm.

[5] Lundberg [1961, p. 149] estimated average net profitability at roughly 8 percent during 1954 and 1957. Lundberg's measure of invested capital is somewhat wider than ours (see the supplement by Järv). Furthermore, the denominator includes also stocks of inventories amounting to about one half of invested capital in 1957.

Diagram 1 : 1. *Some indexes on manufacturing industry 1950–65.*



[a] Value added less the wage sum divided by value added (undeflated yearly figures).
[b] Value added less the wage sum less estimated economic depreciation divided by a measure of capital stock buildings, machinery and equipment (insurance values). The numerator has been deflated by an index of product prices, the denominator by an index of investment goods prices.
[c] Defined as value added in current prices devided by total employment.

ber of firms. Indeed, this is the substance of our argument for the existence of an investment reserve among manufacturing firms to be discussed in the next chapter.

3. *Economic Policy*

We shall discuss here only those economic policy measures which might be expected to have substantially affected the activities of business firms in general and their investment behaviour in particular.

During the Korean cycle effective restrictive measures were late. During 1951 and 1952 special charges to sterilize "excessive profits" in the forest industries were agreed upon between the Government and the industries affected. As a complement to building controls an investment tax was levied on machinery investments during 1951–53. The effectiveness of monetary policy was hampered by the low interest rate policy. In the absence of effective credit market controls before 1952 the rate of credit expansion was indeed very rapid.

Economic policy during the prolonged boom of 1955–57 is interesting from our point of view; the indecisive and tardy measures taken during the first cycle are contrasted with vigorous fiscal and monetary measures to curb inflationary tendencies in the economy. Against the potential threat of the newly enacted law on interest rate control (December 1951), "voluntary" agreements between the Central Bank and major credit institutions were reached, leading to an effective credit control in 1952. In 1955 the doctrinal low interest policy was, however, relaxed (cf. Diagram 1:1). In 1956 a number of temporary restrictions which had been successively introduced in the previously very liberal depreciation rules were made permanent. At the same time the Swedish system of investment funds was reformed to make it a more effective instrument of Government time-controlled internal finance.

In two studies of Arvidsson [1956] and Wickman [1957] some evidence has been presented supporting the hypothesis that the temporary investment tax of 1955 had an immediate impact on manufacturing investment demand *in 1955*. On the other hand, the effects of the overall restrictive monetary policy measures (including "credit ceilings" imposed on the commercial banking system) seem to have hit investment behaviour most severely during the following year 1956.

During the recession of 1958 the Swedish investment funds system was employed for the first time as a counter-cyclical device to stimulate investment in construction. The evidence so far suggests, however, that the timing of its operation was too late.

During the years 1959–63 the manufacturing sector went through an investment boom of a kind not previously experienced during the post-war period. From 1959 to 1961 manufacturing investment was running at more than twice the average level during the earlier years of the fifties. This investment boom might to some extent be explained by the relaxation of controls on industrial construction in 1958, releasing a pent-up excess demand from previous years. At this point, however, we wish to pose the question as to whether this investment boom and the ensuing buoyancy of investment activity could have been financed were it not for the relaxation of Government control in the capital market during the beginning of the sixties.

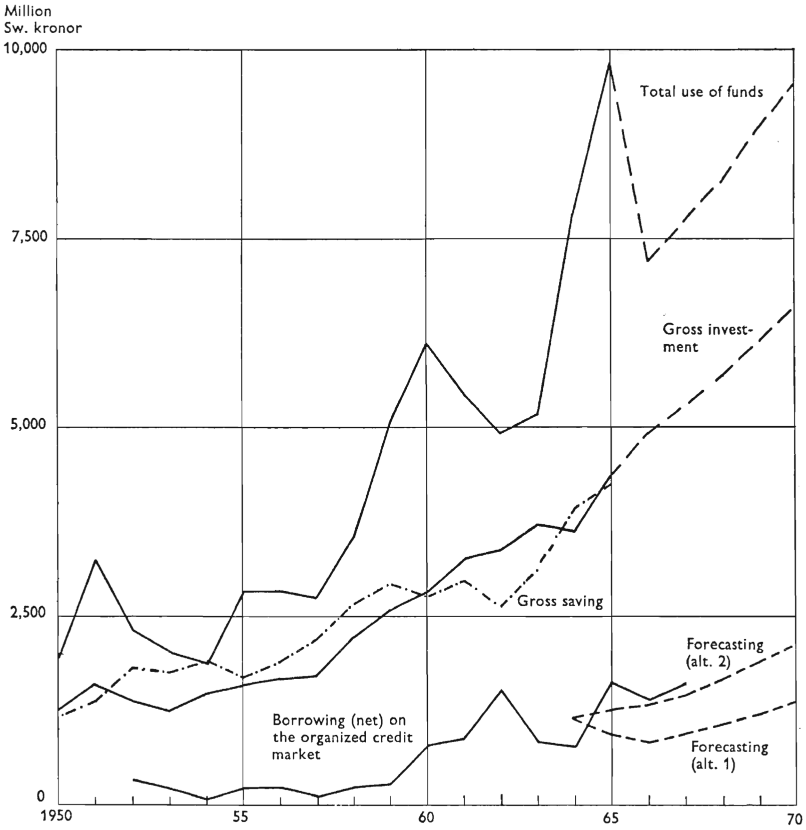
During the peak of this investment boom the investment (IF-)funds system was employed again to induce firms to postpone less urgent investment projects. Thus, firms which temporarily froze 100 percent of appropriations to the fund in the Central Bank instead of the obligatory 46 percent could earn through tax benefits a rate of return far above the current regulated rates of interest in the organized credit market. Large sums of money were in fact transferred from firms' demand deposits in the commercial banks to the Central Bank during these two years.

The recession of 1962 marks the end of the investment boom. It was counteracted by vigorous economic policy measures, the most spectacular features of which were (A) a new release of investment funds for investment in construction and machinery and (B) the sudden relaxation of Government control over the capital market. Evidence from a study of the investment funds[6] by the National Institute of Economic Research points to a well-timed and quite substantial stimulus to investment demand during 1962/63—particularly during the winter season between the two years. The response of investment demand to the Government controlled availability of capital market borrowing is one of the principal objectives of this study.

An apparent desire on the part of the Government not to hamper industrial growth made for a remarkable assymetry of economic policy during the "prediction period" 1964–67. No deliberate measures to curb the sudden expansion of industrial activity were enacted during the boom years of 1964 and 1965. One possible reason might of course have been the collective bargaining settlements in the labour market for a three-year period during 1965 and 1966 which were regarded as favourable for labour. The results were said to have induced a substantial increase in the rate of shut-down of plants and a consequent increase in unemployment. Controlled long-term finance was made available to industrial firms in considerable amounts (see Diagram 1:2). However, positive measures

[6] Eliasson [1965].

Diagram 1:2. *Manufacturing finance 1950–70.*[a]



[a]Broken lines denote forecast figures. See Chapter 6.

to bridge recessionary tendencies were comparatively late. In May 1967 a release of the investment funds was announced for construction and machinery investments followed in October by a first try-out of the special IF-mechanism to stimulate firms to produce temporarily for finished goods inventories.[7] Prolongations of the earlier releases were also enacted as late as December 1967 and April 1968 to make the period of release stretch far into 1968 and for construction to encompass the first quarter of 1969 also. Increased reliance on the investment funds system to stabilize investment and production in industry should be evident from this brief presentation.

One particular feature of economic policy stands out clearly. The *com-*

[7] For particulars on this mechanism see Eliasson [1965, p. 15] or Johansson–Edenhammar [1968, Ch. 7].

position as well as the *intensity* of measures enacted have varied substantially between the early years of the fifties and today. During the Korean cycle economic policy was hesitant—fiscal measures dominated (profit sterilization fees, investment taxes and building control). The middle fifties reveals a more even distribution between fiscal and monetary measures (interest rate policy, bond issues control, credit ceilings for commercial banks, building control, temporary investment taxes, etc.). The recession of 1958 as well as the boom years of 1960 and 1961 saw the first active operation of the reformed investment funds system. Furthermore, investment taxation and building controls were discontinued early in 1958. General monetary policy via the organized credit markets was passive, or of minor importance. Relaxation of credit controls and the release of the investment funds were the principal anti-recession policy measures of 1962 and 1963.

During the boom years of 1964–65 the economic policy pursued was passive with respect to industrial firms. Again relaxations in the control of long-term borrowing and the release of the investment funds were the dominating measures during the ensuing recession.

Thus economic policy during the period under study may be characterized as a series of variously composed "packet solutions". One result to remember in Chapter 5 is that the intensity of monetary action by *itself* has varied substantially over time, but not at all in phase with the business cycle.

1.2 Manufacturing Finance

During most of the fifties the financing of industry is characterized by the almost complete absence of external sources of funds from the organized credit market due in particular to Government control of bond issues. The marked dominance of internal sources is apparent from Diagram 1:2 and Table 1:1. The relaxation of controls during the sixties is accompanied by a simultaneous change in the flow-of-funds pattern for manufacturing industries.

During the fifties gross saving and gross investment parallel each other closely. The volume of new issues of bonds and debentures (besides equity finance, the main source of external long-term finance) is practically nil. During 1961–65 gross investment substantially exceeds gross saving, the difference being accounted for mostly by the proceeds of new bond and debenture issues. As already mentioned, one question to be discussed in this study is whether the pronounced investment boom that

Table 1:1. *Sources and uses of funds, manufacturing industries*[a] *1950–65*

1. Gross investment
2. Net change in inventories
3. Net change in cash-holding incl. short-term demand deposits
4. Net change in other financial assets
5. Total uses (1) + (2) + (3) + (4)
6. Net change in stock of outstanding bonds and debentures
7. Financing in the stock-market (cash-payments)
8. Commercial bank borrowing, net figures
9. Other sources of external finance
10. Gross industrial saving adjusted for inventory valuation[b]
11. Statistical discrepancy
12. Total sources (6) + (7) + (8) + (9) + + (10) + (11)

	Uses of funds					Sources of funds						
Year	1	2	3	4	5	6	7	8	9	10	11	12
1950	1 276	− 45	241	445	1 917	1	39	(21)	570	1 196	90	1 917
1951	1 561	429	550	696	3 236	29	119	(166)	1 563	1 385	−26	3 236
1952	1 397	920	−397	−30	1 890	−9	99	(80)	200	1 836	−316	1 890
1953	1 247	−645	610	163	1 375	62	52	(−6)	−184	1 753	−302	1 375
1954	1 481	88	32	268	1 869	−58	70	(86)	161	1 784	−174	1 869
1955	1 587	586	−394	673	2 452	−6	90	(26)	939	1 671	−268	2 452
1956	1 677	651	−219	495	2 604	−59	150	2	931	1 884	−304	2 604
1957	1 719	772	−224	256	2 523	−85	94	−89	642	2 200	−239	2 523
1958	2 213	−23	883	452	3 525	−25	94	−38	80	2 655	759	3 525
1959	2 567	−299	1 299	1 196	4 763	30	67	−50	1 314	2 927	475	4 763
1960	2 819	1 142	−1 271	2 158	4 848	11	232	369	1 534	2 769	−67	4 848
1961	3 277	1 075	−720	1 073	4 705	127	377	280	658	2 992	271	4 705
1962	3 377	513	672	340	4 902	822	149	489	22	2 623	797	4 902
1963	3 708	−266	249	1 197	4 888	424	130	276	567	3 141	350	4 888
1964	3 636	531	631	3 088	7 886	217	220	273	2 974	3 926	276	7 886
1965	4 390	1 773	−25	3 652	9 790	653	430	433	3 240	4 247	787	9 790

[a] Including mining but excluding power plants. Firms with more than 50 employed workers only.
[b] Gross saving is defined as fiscal depreciation charges plus appropriations to internal pension funds and investment funds (IF) plus reported profits minus declared dividends, all adjusted for inventory valuation.

started *during* the recession of 1958/59 could have been realized in full, were it not for a concurrent relaxation of credit controls.

The pronounced cyclical variations in total uses of funds in Diagram 1:2 are chiefly accounted for by variations in the stock of outstanding trade credits, the peaks coinciding with the peaks of the business cycle when sales reached maximum levels. As is evident from the flow-of-funds, Table 1:1, variations in trade credits are closely matched by concomitant variations in trade liabilities. This pattern is more clearly brought out if total manufacturing is decomposed into sub-industry groups.[8] The nature and importance of such internal borrowing and lending between firms in the "grey" credit market will be subjected to a more detailed theoretical

[8] See Eliasson [1967 *b*, pp. 234f.].

Table 1:2. *Uses of funds in the organized credit market and investment; percentage distribution by sector 1955–64*

	Credit market shares		Gross investment	
	1955/59	1960/64	1955/59	1960/64
Government and municipal authorities	33	11	44	43
Housing	40	41	15	14
Manufacturing	6	15	20	23
Other private firms, households, etc.	21	33	21	21
Total	100	100	100	100

and empirical analysis in Chapter 5. The close association between sales and the stocks of trade credits suggests, however, even at this early stage of analysis, that primary emphasis should be placed on a *transactions* explanation of trade credit flows.

It is also clear from Table 1:1 that borrowing in the commercial banks played a relatively minor role during the fifties. The first half of the sixties, on the other hand, witnessed a sudden expansion of commercial bank credits to manufacturing firms. This expansion was matched by an accompanying increase in total lending by commercial banks, manufacturing loans amounting to a fairly constant share of about 20 percent[9] all through the period 1950–65. In general it may be noted that commercial bank lending to manufacturing firms (normally on a very short term basis) is a quite small share of total lending by commercial banks. In addition, commercial bank loans has been a rather insignificant component in total manufacturing sources of finance—at least during the fifties. This observation will be of importance in our later evaluation of the potential of monetary policy (see Chapter 7). Furthermore from Table 1:1 we can also note that equity finance was a relatively important source of external funds during the entire observation period.

Table 1:2 presents the overall distribution of flows of funds in the organized credit market 1955–64. During the first five-year period the manufacturing sector absorbed only 6 percent of total net flows, increasing to 15 percent during 1960–64. Still this is a small share compared to the relative importance of the total manufacturing use of funds for investment (the left-hand part of the table). Indeed Table 1:2 only presents the mirror image of the high degree of internal financing among

[9] Or rather about 15 percent if the manufacturing sector is restricted to the group of firms with more than 50 employed workers investigated in this study.

manufacturing firms; on the other hand, the housing sector is typified by high external financing ratios. To some extent this is to be attributed to factors unique to the manufacturing sector—corporate taxation rules, the high degree of risk taking normally associated with private investment behaviour, etc. All these factors affect the allocative mechanism in the loan markets and will be discussed in more detail in the final two chapters.

CHAPTER 2

A capital budgeting theory of investment planning

This chapter will be devoted firstly to a verbal presentation of the capital budgeting theory of short-run investment planning as well as to an extensive discussion of its underlying assumptions. The main purpose is to lay bare the principal factors behind the tendency by firms to revise *annual* investment plans. A derived form of the model will be seen to constitute a realization investment function in the sense of Modigliani–Cohen [1958, 1961]. We begin by defining an investment reserve, the existence of which has been postulated. This investment reserve is supposed to express or to measure the degree of current "long-run" disequilibrium in productive capacity given the level of interest rates in the organized credit market. A basic expansionary postulate is that the investment reserve has been positive throughout the observation period.

It is obvious that considerations of a financial nature and the financial riskiness of business ventures are crucial for investment decisions. Even though the theory to be presented in this chapter has borrowed a number of features from other theories of investment behaviour, the particular emphasis placed on the budgeting procedure makes it quite appropriate to label it a capital budgeting theory of investment.

In Chapter 3 the main results from testing the theory econometrically on annual data for the period 1950–63 will be discussed. The numerical properties of our model will be investigated in two simple simulations using partial forms of our model. Its forecasting ability will be tested by comparing simulated values with actual ex-post values of realized investment for the years 1964 through 1967.

Chapter 4 contains some formal investigations into the structure of the model. Particular attention will be paid to the properties of the model when analysed in a long-run growth context.

Chapter 5 contains a separate analysis of trade credit flows. The ultimate purpose is to evaluate the importance for investment behaviour of possible buffer stock variations in inter-firm borrowing due e.g. to a tightening of monetary policies in the organized credit markets.

The first three sections of Chapter 2, the whole of Chapter 3, the first two sections of Chapter 5 and all of Chapter 6 may be read in that order conveying in an easy way the main ideas of the capital budgeting theory and our principal results. In the final chapter (Conclusions with Respect to Monetary Policy) the main implications for the efficiency of monetary policy have been evaluated.

2.1 The Investment Reserve

The "stock of investment opportunities"[1] is a concept often met with in analysing investment and growth. Though loosely defined as a rule, it conveys in a highly intuitive fashion a number of well-known characteristics of firms' investment planning which have so far been only partially incorporated into traditional investment theory. Interview studies with firms and reported accounts of regular and explicit planning procedures within large corporations usually reveal a number of investment projects under consideration for some more or less indefinite future period.[2] The mere fact that such plans are being formulated explicitly, or merely in the minds of business executives would suggest the quite plausible assumption that these projects are expected to become profitable at some future date. As the planning procedure rolls on, some projects prove unable to meet the adopted profitability criteria and are consequently discarded. However, others will meet these criteria and in due course more explicit time planning of these projects will be undertaken. They may then materialize in the form of investment in building and equipment. In the end, quite plausibly, price and cost factors of traditional investment and production theory will determine the outcome. The contention is, however, that the lag between the early initiation of the project and its possible realization is not usually included in theory. This time-period is probably a highly variable factor and affects in an important way the cyclical timing of investment plans as well as realizations.

The main feature of investment planning to be emphasized in this study is that a stock of investment projects which has been "planned" according to some specific criteria can quite realistically be assumed to exist within most firms and (in addition) that the planning procedure is apt to be sensitive to a number of economic stimuli.[3]

[1] The term was originally introduced and discussed by Gordon [1955].

[2] See e.g. Eisner [1956], Bohlin [1962], and others.

[3] For a somewhat formal presentation of this planning procedure, see Eliasson [1965, pp. 45ff.].

Among the factors determining the size of the "stock of investment opportunities", demand and profitability expectations probably figure most importantly. These expectations are of course subject to revision as time passes. The size of the stock will correspondingly vary over time. During the boom when expectations are predominantly optimistic investment opportunities will be ample, while these opportunities might perhaps disappear altogether when economic conditions are extremely depressed. This simple mechanism must be further modified by the addition of limiting factors which restrict the rate at which existing opportunities *can* be exploited; e.g. existing organizational capacity of firms, possible aversion towards the increased risk-taking normally associated with accelerated expansion of output, the availability of particular sources of finance, etc.

We do not propose to present a theory for explaining and measuring this stock of investment opportunities.[4] It will suffice here to present evidence in favour of the hypothesis that such opportunities of a particular kind and volume (and in adequate numbers) currently exist within the groups of firms investigated. This assumption is termed the *expansionary postulate.*

Any investment theory based upon the accelerator principle or the profit-plowback-liquidity hypothesis assumes in one way or another the existence of such investment opportunities in sufficient volume. This has to be so for variations of the "flexible accelerator" theory introduced by Goodwin [1951] or the "capital stock adjustment process". Only when price and cost variables are explicitly introduced together with a production function has a very restricted subset of the stock of opportunities been allowed to figure explicitly as variables in the investment function. This is true e.g. in Jorgenson's [1963, 1965, 1967, etc.] so called "neoclassical" theory of investment behaviour, the rudiments of which can be traced back via Grunfeld [1960] to the simple investment function of classical theory, the sole explanatory factor of which was the rate of interest.

The expansionary postulate on which our capital budgeting theory of investment behaviour has been based combines the hypothesized expansionary conditions underlying the post-war Swedish economy with the concurrent presence of rigorous credit market controls, and a spectrum of disequilibrium market rates of interest in the organized credit market. We define an *investment reserve* as the subset of contemplated

[4] In fact this is one of the objects of a research project by the author at present under progress at the Industrial Institute for Economic and Social Research in Stockholm.

investment projects which are considered profitable and worth undertaking when financed from funds of a particular price and quality—here internal funds and long-term borrowing in the organized markets for credit at controlled disequilibrium rates of interest. In addition, this reserve only includes projects which are at a sufficiently advanced stage of planning as can be put into operation at fairly short notice (in the empirical part of this paper somewhat more than a year).

It is interesting to note that the idea of an investment reserve is implicit in Wicksell's [1906, pp. 184 ff.] analysis of the "cumulative process" arising from a divergence between the "real" equilibrium rate of interest and the actual rate of interest maintained by a conservative pricing policy among banks. In the sense of Dean [1951, pp. 14 ff.] the investment reserve can also be thought of as the total amount of money that can be invested to earn more than the controlled rate of interest in the organized credit market—the "cut off rate".

If the markets for funds were free and fully informed in the absence of uncertainty we should expect a uniform market rate of interest to be established during each period equal to the required marginal rate of return, or the price the marginal investor is willing to pay for credit. Under such perfect conditions the investment reserve is by definition an empty set. If markets for credit are characterized by incomplete knowledge and/or sectorized by controls, or if the rate of interest charged at the last possible source[5] of finance is currently held lower than the rate of return required by investors, excess demand for external funds exists by definition. The back side of this excess demand is the reserve of investment projects which are constantly being postponed due to lack of financial resources at the official and controlled price.

Considering the conditions prevailing during the post-war period in Sweden, it seems quite reasonable to assume that at least some firms in each industry group investigated have experienced such excess demand for funds in each year studied. Our hypothesis is that this continuing excess demand has been sufficiently large to ensure that the investment reserve has never been exhausted during the observation period. This would mean that an increase in the availability of particular funds will induce an increase in current investment spending.

The decision to invest in productive plant and equipment requires at least four considerations; the existence of investment opportunities on the *demand* side, the *supply* of investible funds, the *allocation* of funds to projects and the *timing* of investment activities. The capital budgeting

[5] For a detailed discussion of the "availability of funds" hypothesis see Lindbeck [1963, Section VII:2].

theory of *short-run* investment behaviour to be expounded below does not take the allocation aspect into account. A measure of the demand for funds for a group of firms is confronted with a measure of the supply of funds. The theory purports to explain the rate at which existing divergencies are closed—i.e. the timing aspect. Where short-run variations in aggregate demand and supply of funds are concerned, the allocation of funds between different projects within a firm or between firms is assumed to follow a pattern which is sufficiently stable as not to significantly impair the validity of our theory.

2.2 Outline of the Theory

The following sections contain a simplified statement of the capital budgeting theory of investment behaviour. A more formal discussion of certain theoretical problems follows in Chapter 4.[6]

Using the terminology of Meyer–Kuh [1957] and Meyer–Glauber [1964], the capital budgeting theory may be regarded as a development of their "Accelerator-Residual-Funds" theory of investment here reshaped in terms of a *realization function*, according to the ideas of Modigliani–Cohen [1958, 1961]. Certain features of the Anderson [1964] study have also been incorporated in our investment theory. Lastly, in recognizing explicitly the need for an anticipations structure in a theory of investment planning, we have borrowed some ideas from Eisner [1958, 1960, 1964, 1967, etc.].

Our model represents an elaboration of the Meyer–Glauber [1964] theory in five important respects. *Firstly*, external finance in the organized credit market, as well as, *secondly*, the financing of working capital, have been explicitly incorporated into the theoretical structure. *Thirdly*, investment behaviour has been explicitly integrated with financial management through a rough model of financial planning. *Fourthly*, an investment planning function and an investment function ex post have been synthesized into a realization function, which purports to explain actual plan revisions in terms of the realization of certain expectations variables. A theoretically meaningful as well as empirically feasible separation of long- and short-run investment behaviour is one of the principal advantages to be gained from the realization function approach. We have every reason to expect that, for example, the effects of economic policy measures show up as discrepancies between planned and realized

[6] A number of algebraic derivations contained in the Swedish text have been omitted here. Furthermore, some particular refinements of the theory have only been reported verbally in the present text.

investment. Of course our investment theory like most others is unable to explain all relevant features of post-war investment behaviour in the manufacturing sector. The period for which statistical observations are available is too short to allow construction of a more complex theoretical structure for empirical testing. The inadequate availability of statistical information on some factors known to be important is another reason. Thus, *fifthly*, an attempt has been made to investigate the effects on realized investment of particular events or economic policy measures in terms of a *residual analysis*. The method employed is not the traditional one; instead of regressing the computed residuals of a basic regression equation on new variables, certain hypotheses are tested against the direction of change, the sign and the numerical value of the residual as computed for *one* particular year. This method is necessarily qualitative in character and no precise test criteria can be prescribed. It is regrettable that the impact of the Swedish investment funds system on investment planning has had to be analysed this way; the reason is that due to the timing of announcement of releases as well as the release periods, the effects appear in either of two ways—being incorporated in plan revisions, or concealed in the plan itself. Fortunately, the important release of 1962/63 has been separately investigated by the National Institute of Economic Research the results being accounted for in a report referred to above.

As already stated explicitly in the previous section, the capital budgeting theory to be presented here is based on two principal features of the post-war period—the expansionary bias of the manufacturing sector and the concurrent regulation of the capital market. The principal implications are that firms have always (each year) found it profitable to invest in fixed assets (plant and equipment) from a hypothesized *investment reserve* as soon as finance of a particular *price* and *quality* is available. It should be evident that this assumption does not necessarily imply the existence of the well-known stepwise cost of capital schedule of Duesenberry [1958] and others, but rather the opposite implication. An inelastic cost of capital schedule may be a sufficient but not a necessary condition for this part of our theory to be valid. Furthermore, in the presence of enforced credit controls we have little reason to expect interest rates recorded in the organized credit market to measure the expected marginal cost of funds which is relevant for investment decisions.

There are three main factors determining firms' willingness to plan the maintenance or extension of productive capacity during a future period. The *first* is expected demand for output during that future period, which is assumed to affect investment planning via a flexible accelerator type of mechanism in the sense of Goodwin [1951] and others. Optimal capital stock each period depends on current or expected profits. The *second* is the availability of certain types of finance, introduced in the form of a capital budget. The *third* concerns the equilibrium conditions for the holding of financial stocks prevailing at the date of planning and the corresponding presence of financial risks.

No distinction is made between new and replacement investment. During a period of rapid technological change this distinction is indeed doubtful: only occasionally will new equipment installed to replace older equipment possess the same properties of technical capacity. We assume that as a rule the same considerations of profitability and technical capacity hold in both instances of decision making.

The gross capital budget is defined as the expected current generation of internal funds plus the expected availability of external finance in the organized credit market at a *regulated rate of interest*. In particular, this latter expectation involves permission and feasibility to issue long-term industrial bonds and debentures, as well as the possibilities of borrowing in a commercial bank or an insurance company. On *a priori* grounds we consider commercial bank lending, however, to be normally on a short-term basis and associated with current business operations, or else rather unimportant. Equity issues are not included in the capital budget, nor for that matter explicity incorporated in our theory at all (see below).

The net capital budget for investment appropriations is obtained after deducting the prior claim of transactions balances from the accumulation of working capital. This transactions demand is defined as net receipt of trade credits minus net extension of trade credits, minus increases in cash holdings and in inventories. The transaction components of these "financial" flows are expressed as a percentage of *inter alia* the change in sales, and will be discussed below. A basic assumption for the capital budgeting process is that the net transactions demand from the accumulation of working capital represents a *priority claim* on the current inflow of funds. As we shall see later on, this assumption is critical for the derivation of the net capital budget.

If the stocks of cash, inventories and trade credits outstanding deviate from the transactions levels indicated by the current level of sales then holdings of financial assets and liabilities are no longer in equilibrium. Our approach allows measurement of this disequilibrium. The financial disequilibrium variable so obtained was the third aggregate factor assumed to affect investment planning for the ensuing period (year).

The level of current gross savings has been explained by the current level of, and changes in, sales. This formulation of a fairly simple savings function implies a number of assumptions as to the development of firms' profit margins, their dividend policies and the incidence of corporate taxation which will be elaborated upon below. It will suffice here to point out that the change-in-sales variable is intended to pick up a cyclical pattern which is fairly regularly observed in profit margins. Secondly, this formulation of the savings function precludes the possibility of increasing dividends and/or discontinuing operations when long-term prospects for the firm are depressed and consequently the availability of profitable investment opportunities restricted. At least three arguments may be advanced in support of this approach. First, this conduct is compatible with normally observed business firm behaviour; indeed, there is empirical evidence refuting the hypothesis of a close association between rates of plow-back and profitability and growth.[7] Secondly, this implicit limitation is less restrictive when, as in our case, aggregate behaviour of a group of firms is studied. Thirdly, the traditional, static definition of the firm in textbook theory is not a very adequate representation of the amorphous incorporated business enterprise operating in the dynamic economic environment of today. When the markets for traditional products falter the possibility always exists of entering related markets, of developing quite new products within the same organizational unit, or of acquiring shares in, or merging with, firms with other product lines. Examples of this are manifold.

To be complete, our theory requires an explanation of how expectations in respect of sales conditions for a subsequent year are generated, and the way in which expectations as to the availability of controlled external finance are formed. We have assumed that expected sales are generated as a weighted average of past sales, which implies in principle a distributed lags approach.[8] The short time-series material available precludes, however, quantitative estimation of the lag structure from available empirical data. In this study we have simply assumed as a first approximation that the expected change in sales is an *unweighted* average, or a moving average, of the past five or two years' changes in sales. Alternatively we work with the cautious assumption that the current *level* of sales is expected to persist the next year or the year for which investment plans are drawn up.

Institutional conditions prevailing during the observation period make

[7] See e.g. Little [1962] and Little–Rayner [1966].

[8] Note here the distinction between the traditional distributed lags approach which concerns the time-shape of the installation of plant and equipment rather than the formation of anticipations. Formally the two approaches look the same, but in principle they are not. See further Section 2.3.9.

it quite reasonable to assume that the capital budget should rest on the implicit assumption that *no external* sources of funds of the particular type *included in the budget* will be available. The data on planned investment used are reported in late October or early November for the following year. It seems quite reasonable to assume that the prospects of obtaining permission for a bond or debenture issue during that year are uncertain enough to make this assumption realistic. In fact the existence of issues control should not be a necessary requirement. Also without control the arrangements associated with the floating of bond or debenture issues have to be planned a long time ahead, which should make the success of the issue look quite uncertain at the time of preparations. It seems quite reasonable to assume that a large number of investment projects which are dependent upon such issues for their realization, will not be reported in the plans. In such a case too, null expectations seem a realistic assumption. Furthermore, relaxing the assumption of a closed bond and debenture market should be fairly easy in principle, though difficult in applied work.[9] No anticipations data on financial planning by firms are at present collected in Sweden.[10] However, our empirical results indicate that an unexpected availability of external finance (so defined) induces a revision of planned investment.

We are now ready to outline the mechanism underlying our theory of investment planning. Expected sales, or planned production, together with expected availability of particular sources of controlled external finance, determine the *ex-ante* capital budget as well as the investment stimulus generated by the accelerator mechanism, called the "optimal investment" plan. The existence and extent of disequilibrium in the holding of financial stocks is given at the time of investment planning. *A priori* we have assumed the existence of a sufficiently large reserve of investment projects at a sufficiently advanced stage of planning that can be undertaken at short notice as soon as particular economic stimuli are present. So far, our theory concerns the planned rate of exploitation of the investment reserve. The demand for funds is defined as a *stock* demand; the supply of funds as a flow *restriction*. This mechanism has been described analytically in terms of an *investment planning function*.

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[9] The validity of this assumption for later years is discussed further in Section 3.3.5, where the model has been used for ex-post predictions for the years 1964 through 1967.

[10] In the USA "capital appropriations data" have been collected for a number of years by the National Industrial Conference Board, see e.g. Cohen [1960]. In a sense "capital appropriations" figures may be considered as estimates by firms of the ex-ante capital budget defined above.

The accelerator mechanism may induce a planned investment demand, i.e. "optimal investment level", larger than the capital budget, implying the existence of profitable short-run investment projects contained within the investment reserve. The investment plan will then exceed the net capital budget by a fraction of the difference between the "optimal investment level" and the capital budget and other, non-specified, sources of finance have to be resorted to—for example drawing on fincancial assets, equity issues, and/or expensive borrowing outside the organized credit market. The fraction, or adjustment coefficient, has been assumed constant in our empirical application, but may very well be considered variable.[11] If financial stocks fall short of transactions levels, a corresponding reduction in the investment plan is assumed, amounting again to a constant fraction of the aggregate disequilibrium variable, and vice versa.

The mechanism is reversed if the capital budget exceeds the optimal investment level, as may be expected during recessionary periods. An increase in the availability of particular sources of finance occasioned, for example, by an easy monetary policy, helps to keep the rate at which the investment reserve is being exploited above the level induced by the accelerator mechanism by itself.

The last step in constructing our theory involves a synthesis of investment planning (the *investment planning function*) and ex-post investment behaviour (the *investment function ex-post*). We assume that the numerical properties (coefficients) and explanatory factors of our investment planning model are with three exceptions also applicable to ex-post investment behaviour. First, the anticipations variables now assume the values recorded ex-post. Secondly, an isolated change in the state of financial disequilibrium during the current period is assumed *not* to affect the current realization of investment plans. The third difference is discussed further below.

Subtracting the planned level of investment expenditure from the realized level, we obtain the current revision in plans as a function of a number of expectations and ex-post variables. It will be shown in the next section that this *realization function* exhibits quite convenient properties for the purpose of empirical testing, without at the same time necessitating more restrictive assumptions than those already introduced.

Next, we shall introduce what has been termed the *exclusion hypothesis* to explain the well-known, systematic component of the current underestimation of investment plans which cannot realistically be related to

[11] E.g. one in the upswing and possibly zero during recessions. This idea is implicit in Meyer–Kuh [1957] and explicit in the "Accelerator-Residual Funds Theory" of investment of Meyer–Glauber [1964, Chapter 2].

the explanatory variables listed above. There are a number of factors which may account for a systematic divergence between reported plans and the recorded outcome besides those incorporated in traditional investment theory, varying from pure forgetfulness to rudimentary procedures in investment planning. They are all more or less related to the vague concept of a "stock of investment opportunities" discussed in Section 3.1. Where investment planning is only rudimentary or nonexistent, firms may be expected to report as plans the aggregate value of a number of investment projects scheduled for the immediate future. Obviously a number of projects, particularly small ones, are apt to be forgotten or not "thought of" if reports are compiled in this way. This tendency should be more noticeable the longer the planning period.[12]

Secondly, if the plan consists of a list of projects several of these may be expected not to be *time planned* in the sense of being scheduled for any definite period. It is fairly common among firms, and as should be clear, implicit in the concept of an investment reserve that a large number of investment projects are under consideration for say the coming three, four or five years. Quite reasonably, we would expect firms to report only projects which are more or less definitely scheduled for the planning year and not the entire investment reserve.[13] This problem appears again in more distinct form in Chapter 6 where investment plans for a *five*-year period collected by the Swedish Long-term Planning Investigation are employed to forecast long-term industrial demands upon the money markets. Thirdly, firms basing their reports on explicit capital budgeting procedures are inclined to report the value of the capital budget rather than a list of projects;[14] this reporting behaviour, which seems at present rather uncommon, fits most neatly into our theory of investment planning. To account also for the influence of firms using more rudimentary methods of planning the investment plan itself has been incorporated into the realization function as an additive linear component.

[12] It has been observed in working with investment survey data that firms tend to overestimate investment planned for the immediately ensuing two quarters because the actual construction or installation of capital goods often takes more time than planned for. For longer planning periods, however, the typical underestimating property becomes evident.

[13] This assumption is clearly supported by an interview study of the validity of the Swedish investment survey data carried out jointly by the National Institute of Economic Research and the Central Bureau of Statistics in 1964 (not published), as well as by personal interviews and a large number of telephone interviews carried out by the author for the preparation of Eliasson [1965]. See also Foss–Natrella [1957, 1960]. For a more detailed presentation of the planning procedure implied in the discussion above, see Eliasson [1965, pp. 45ff.].

[14] This behaviour is also supported by the sources reported in the previous footnote.

In this crude formulation the exclusion hypothesis states that the value of excluded projects in the sense discussed above is directly proportional to the investment plan.

Apart from Modigliani–Cohen's [1958, 1961] suggestive exposition of a general theory of economic planning there have, so far, been few attempts to develop their concept of a realization function. However, the basic concept as such is by no means new. Ideas of similar content were already inherent in dynamic sequence analysis and in the ex-ante and ex-post concepts of the Stockholm School economists during the thirties.[15] Some empirical investigations can be referred to, none of which are, however, altogether convincing, due to a large extent of course to lack of experience in working with anticipations data in most countries. An early application using eight annual observations was reported by Modigliani–Weingartner [1958]. In a series of papers [1956, 1962, 1965] Eisner reported on investment realization functions applied to both cross-section and time-series data, where a measure of deviations from sales expectations derived from the unique data on anticipated sales available in the U.S., is included as an explanatory variable. Despite the weakness of the results in terms of statistical tests, the results generally favour variations of the accelerator or capital stock adjustment theories as explanations for plan revisions.

2.3 Formal Structure of our Theory

The investment theory to be formulated here aims at explaining *short-run* private investment planning. A basic idea has been to treat factors determining long-term trends in investment and growth as exogenous; thus, little attention has been paid to the otherwise highly important factor of technical change and the structure of production. This is one of a number of reasons why price variables such as the rate of interest, wages, etc., do not figure explicitly in our model. As will be argued later, except for assumptions concerning cost of capital implied by our budgeting approach, there seems little reason to expect structural changes in production, such as substitution effects or technical change, induced by variations in relative factor prices to show up as revisions in short-run investment planning. Rather we are more interested in factors influencing the timing of exploitation of the investment reserve.

[15] Cf. Lundberg's [1937] discussion (Chapters VI–IX) where expectations are explicitly introduced as factors behind investment behaviour. The idea of a realization function is verbally presented in Palander's [1941] lucid review of Myrdal [1939]. A more elaborate treatment is found in Svennilson [1938].

Ours is a macro investment theory. Its assumptions are thus supposed to be applicable to groups of firms. The implications of these assumptions for individual firms are not relevant to our problem and will not be discussed. It is, however, the author's contention that these assumptions, to be specified below, are also applicable to the individual behaviour unit; i.e. our theory could serve as a micro theory as well, and indeed it has in a variety of partial formulations.

The model to be described here represents a partial form of the model discussed in the Swedish version of this paper. All prices are assumed constant over time, and so have been eliminated from this partial model. Moreover, the presentation here has been considerably condensed. However, some traditional behavioural assumptions from applied investment theory are easily recognized.

1. *Investment Planning Function*

$$I^p = \Phi^e + \xi_1(I^{*e} - \Phi^e) + \xi_2(A^{os}_{t-1}) \qquad (2:1)$$

$$0 \leqslant \xi_1 \leqslant 1 \quad 0 \leqslant \xi_2 \leqslant 1.$$

I^p represents the investment plan for year t reported at the end of year $t-1$. Φ^e stands for what has been called the expected size of the *current net capital budget* for year t. Φ is defined below. I^{*e} signifies planned *optimal investment* ex-ante, given anticipated net profits for year t and other relevant factors.

Thus the investment plan has been assumed to be linearly dependent upon the expected availability of Φ-finance, the difference between the optimal investment level ex-ante and the availability of Φ-finance and a possible disequilibrium in stocks of working capital introduced through A^{os}_{t-1} (see Sections 5 and 6). The optimal investment level ex-ante is defined as:

$$I^{*e} = a(K^{*e} - K_{t-1}) + bZ_{t-1} \qquad (2:2)$$

where

$$K^{*e} = \lambda \, \Pi^{Ne}. \qquad (2:3)$$

The reader should observe that variables without time subscript always refer to the period t. The optimal level of investment for year t as seen at the end of the year $t-1$ is thus assumed to be linearly dependent on the expected *capacity gap* $(K^{*e} - K_{t-1})$ and a vector of other relevant, but unspecified, factors Z_{t-1} (initial conditions). At each level of expected net profits, Π^{Ne}, a unique value of optimal capital stock ex-ante, K^{*e}, for the *current* operation of the firms is assumed to exist. In (2:3) K^{*e} has been assumed to be directly proportional to expected net income or profits Π^{Ne}. Firms are assumed to plan for a partial reduction of the difference between actual and ex-ante optimal capital stock (the capacity gap) each period ahead. a in (2:2) is the constant reaction coefficient designating the rate at which this closing is planned to take place, provided no financial restrictions operate in the opposite direction. Equation (2:2) corresponds to a traditional capital stock adjustment formulation of the flexible accelerator type originally formulated by Goodwin [1951].

A_{t-1}^{os} represents a measure of disequilibrium in the holdings of current assets and liabilities and will be defined below. ξ_1 is a second reaction coefficient showing at what (constant) rate the gap between optimal investment activity and availability of Φ-finance is expected to close during period t; its value is thus expected to lie in the interval $0 \leqslant \xi_1 \leqslant 1$. Similarly ξ_2 is assumed to lie in the interval $0 \leqslant \xi_2 \leqslant 1$.

For one thing, we note that if $a = 1$ and $b = 0$ financial factors are the only ones that prevent firms from planning to close the expected capacity gap during the current planning period. In a restricted sense the definition of optimal investment ex-ante is analogous to the proposition of neoclassical investment theory as e.g. in Jorgenson [1963, 1965] that optimal capital stock depends on the integral of discounted net earnings over a planning horizon (for Jorgenson of infinite length) which maximizes the aggregate present worth of firms. Here optimal capital stock has been made directly proportional to *current* net profits, while other possible factors are contained in the unspecified vector Z. Since e.g. Jorgenson [1963, 1965] assumes expectations as to future relative prices of output, labour, and capital goods, etc. to be a simple projection of today ["stationary market conditions"] the formulation (2:6) may be shown to be very similar.[16] The basic simplification compared to Jorgenson refers to the crude explanation of profits employed here (see formulae (2:18, 20)) and the absence of behavioural assumptions as to profit or value maximization. While recognizing the importance of price variables as well as rational firm behaviour in investment planning, it seems reasonable to assume, however, that such factors are overshadowed in short-run investment behaviour by others, e.g. mistaken expectations. This should apply particularly in the case of current revisions of invest-

[16] The same holds for the approaches of Griliches–Wallace [1965] and Grunfeld [1960]. In the last study optimal capital stock is made dependent upon the stock market evaluation of the firm(s), provided stock market prices reflect current rates of return on equity capital of firms.

ments plans in combination with interest rate control and a restricted availability of particular forms of external finance. Thus the characteristic features usually associated with neoclassical approaches are concealed in the Z-factor and the assumed investment reserve, i.e. the expansionary postulate; this arrangement means that price variables figure as restrictions rather than as explicit arguments.

In a very definite sense the whole matter of defining an optimal or desired capital stock is closely related to the traditional problem of defining capital stock as such. By assuming inter alia that the realized rate of return on investment is constant, a measure of capital stock that is proportional to (net) business income can be derived. The potentialities of this approach in empirical production function analysis has been well demonstrated by Åberg [1969]. By defining optimal or desired capital stock ex-ante as proportional to expected net profits a reversed interpretation is possible; $1/\lambda$ in (2:3) may be said to correspond to a measure of the desired or required net rate of return. Consequently if the ratio between expected net profits (Π^{Ne}) and actual (initial) capital stock (K_{t-1}) is smaller than $1/\lambda$ it might be said to mean that the expected net rate of return is larger than required and firms want to increase profit by investing and adding to capital stock. In Åberg [1969] *employed* capital stock (after correction for excess capacity) is taken as optimal. In this study deviations from optimal capital stock are allowed each period *but* the realized rate of return also varies.

2. *Investment Function*

The investment function which is to explain actual investment as recorded ex-post is defined as:

$$I = \Phi + \xi_1(I^* - \Phi) + \xi_2 A^{os}_{t-1}, \tag{2:4}$$

where

$$I^* = a(K^* - K_{t-1}) + bZ_{t-1} \tag{2:5}$$

and analogously to (2:3)

$$K^* = \lambda \prod^N. \tag{2:6}$$

The disequilibrium variable A_{t-1}, initial conditions Z_{t-1} as well as capital stock at the end of period $t-1$, K_{t-1}, appear in (2:4) and (2:5) as determinants of actual investment. Π^N is realized net profits during period t. Φ is the actual "ex-post" value of the net capital budget in terms of Φ^e. The meaning of this will be clarified below.

It should be noted here that ξ_1 as well as ξ_2 may be interpreted as exogenously determined, dated variables as long as they are identical in (2:1) and (2:4). When the model is estimated on empirical data, however, we have to assume ξ_1 and ξ_2 constant over time. For the sake of simplicity we shall proceed as though they are constants.

3. *Realization Function*

Applying the Modigliani–Cohen [1958, 1961] idea of a *realization function*, (2:1) and (2:4) give:

$$I - I^p = (1-\xi_1)(\Phi - \Phi^e) + \xi_1(I^* - I^{*e}). \tag{2:7}$$

In (2:7) plan revisions during period t are expressed as a linear function of the difference between the actual and expected size of the capital budget and the difference between actual and ex-ante optimal investment.

Owing to the implicit assumption of identical functional forms in (2:1)–(2:3) and (2:4)–(2:6), the disequilibrium variable A^{os}_{t-1} and (as we will show later) the actual capital stock variable K_{t-1} as well as initial conditions Z_{t-1} disappear from the realization function. Obviously this is extremely convenient from the point of view of empirical application. The property of vanishing factors from the component relations also is one of the main advantages to be gained from the realization function approach.

4. *Financial Model*

The Φ variable is defined with the help of a simple model of financial planning. Suppose:

$$\bar{H} = b_1 S + e_1 E^c + f_1 \tag{2:8}$$

$$\bar{D} = b_2 S + f_2 \tag{2:9}$$

$$\bar{L} = b_3 S + e_3 \bar{H} + g_3 \bar{D} + f_3 \tag{2:10}$$

$$\bar{X} = b_4 S + c_4 \Delta S + f_4 \tag{2:11}$$

$$S^{AV} = a_5 S + b_5 \Delta S + f_5. \tag{2:12}$$

The aim of this financial model is to explain the *transactions* component of the stock of current financial assets and trade credits extended ($\bar{H}$), stocks of current trade debts ($\bar{D}$), liquidity (demand deposits plus cash $=\bar{L}$) and inventories ($\bar{X}$). These transactions components have all been assumed linear functions of the current level of sales (S). As for the two *credit functions*, (2:8) and (2:9), the hypothesis implicit in the fixed coefficients b_1 and b_2 is that average credit periods are stable over time (see further Section 5.3). $\bar{H}$ is also assumed to be linearly dependent upon net borrowing in the commercial banks, implying that the receipt of bank loans increases firms' willingness to extend trade credits. Note that the sales variable figures in both (2:8) and (2:9). Certainly we should have preferred to insert the current purchase value instead in the debt function—a variable which was not readily available. However, current purchases of raw materials and intermediate goods may be expected to follow sales rather closely. The same seems to hold for capital goods purchases in the long-run, but not so in the short-run—an unfortunate misspecification that we had to accept. Furthermore, advance payments appear on the selling as well as the purchase side. Consequently an appropriate specification would be to include both sales and purchases together in the two credit functions. In spite of these complications we have considered (2:8) and (2:9) as satisfactory approximations. Besides the sales level transactions liquidity is assumed to be linearly dependent upon stocks of trade credits and debts. We assume of course that $b_3, g_3 > 0$ but $e_3 < 0$. The bar over the dependent variables in (2:8)–(2:11) denotes transactions components, while total actual values of the dependent variables according to collected statistical data appear without the bar (see below).

Finally a savings function (2:12) has been introduced. Industrial saving is supposed to be a linear function of the level of, and changes in the level of sales. The derivation of this savings function from a simple profit-generation function will be given below.

5. *Financial Disequilibrium Variable* (A^{os})

Values of the dependent variables in (2:8)–(2:11) as recorded in statistical time-series data ex-post are denoted by H_t, D_t, L_t and X_t respectively. The financial disequilibrium variable is defined as:

$$A^{os} = \underbrace{X - \bar{X}}_{\text{I}} + \underbrace{L - \bar{L}}_{\text{II}} + \underbrace{H - \bar{H} + \bar{D} - D}_{\text{III}}. \qquad (2:13)$$

For testing the realization function, estimation of transactions components will pose no problem. Transactions components and the financial disequilibrium variable are replaced by their function forms in or eliminated from the realization function (see below). For the residual analysis as well as the estimation of the financial model, to follow in Chapters 3 and 5, we need, however, an empirical specification of the transactions components.

When estimating (2:8–11) in Chapter 3 the transactions components $\bar{H}$, $\bar{D}$, $\bar{L}$ and $\bar{X}$ will be replaced by their corresponding actual values, i.e.

$$H = b_1 S + e_1 E^c + f_1, \text{ etc.} \qquad (2\!:\!14\,\text{a})$$

have been estimated.
Estimates of the transaction components will then be defined as:

$$\hat{\bar{H}} = \hat{b}_1 S + \hat{e}_1 E^c + \hat{f}_1, \text{ etc.,} \qquad (2\!:\!14\,\text{b})$$

where $\hat{b}_1$, $\hat{e}_1$ and $\hat{f}_1$ are least squares estimates of b_1, e_1 and f_1. A straightforward interpretation would be that the "true" explanation to the actual values of H, D, L and X is the left—hand part of (2:14a)—the transactions component—plus an additive linear "shift" factor, say Z_i, plus a random disturbance term ε: the expected value of which equals zero. Thus from (2:8) etc.

$$H = b_1 S + e_1 E^c + f_1 + Z_1 + \varepsilon_1 = \bar{H} + Z_1 + \varepsilon_1, \text{ etc.} \qquad (2\!:\!14\,\text{c})$$

As long as the linear component Z_1 and the disturbance term ε_1 are uncorrelated with S and E^c, least squares estimates of b_1, e_1 and f_1 in (2:14a) will be unbiased estimates of the same coefficients in (2:14c). Then $[H - \hat{\bar{H}}]$, where $\hat{\bar{H}}$ is defined by (2:14b), will also be unbiased estimates of true deviations from transactions components i.e. $[H - \bar{H}]$.

An estimate of the financial disequilibrium variable is thus defined as the sum of computed residuals in the financial model for each period. Particular interest has been devoted in Chapter 5 to the cyclical behaviour of the two components $(H - \bar{H})$ and $(\bar{D} - D)$ in (2:13) called the *financial buffer stock function* of the "grey" credit market.[17]

We note, however, that primary emphasis has been placed there on an alternative way of defining the transactions components of the two credit functions. Deviations of actual stocks around transactions components have been studied in terms of shifts in the coefficients of the linear functions (2:8, 9). It is argued in Section 5:3, however, that as long as the average credit period on the debt as well as asset side is stable over time the above interpretation with an additive shift factor should be quite appropriate.

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[17] See in particular Section 5:4 and the last three paragraphs of Section 1.1.3. The additive residual estimating procedure employed has been treated in detail in Eliasson [1967*b*, pp. 221ff.].

6. *Capital Budget* (Φ)

We define the net capital budget from (2:8)–(2:12) as:

$$\Phi = \underbrace{S^{AV}}_{\text{I}} + \underbrace{\Delta E^L + \Delta E^c}_{\text{II}} - \underbrace{\psi(\Delta S, \Delta^2 S, \Delta E^c)}_{\text{III}}, \tag{2:15}$$

where

$$\psi = \Delta \bar{H} - \Delta \bar{D} + \Delta \bar{L} + \Delta \bar{X}. \tag{2:16}$$

Thus it is the sum of gross industrial savings (S^{AV}) plus net long-term borrowing on the controlled bond market (ΔE^L) and net borrowing in the commercial banks (ΔE^c), less net transactions demand for working capital (ψ).

Differentiating (2:8)–(2:11), it follows immediately from (2:12) and (2:15, 16) that (see further Section 4.1):

$$\Phi = a_5 S + \Delta E^L + N_1 \Delta S - c_4 \Delta^2 S + N_5 \Delta E^c + f_5, \tag{2:17}$$

where

$$N_1 = b_5 - b_4 - b_3 + b_2(1 - g_3) - b_1(1 + e_3)$$

$$N_5 = 1 - e_1(1 + e_3).$$

The current capital budget is seen to be a linear function of sales (S), the first and second differences in sales (ΔS, $\Delta^2 S$), and borrowing in the controlled bond market as well as in commercial banks (ΔE^L, ΔE^c). We expect of course $a_5 > 0$. While the sign of N_1 cannot be specified *a priori*, results from estimating the financial model (2:8)–(2:12), reveal that it is negative for practically all sub-industry groups (see p. 57).

I + III in (2:15) may be labelled the *internal component* of the capital budget, and II the *external component*. A fundamental assumption made in our analysis of financial factors in investment behaviour has been that the negative internal component III (i.e. ψ) represents a *priority claim* on the current inflow of funds.

A prime consideration in financial planning is assumed to be the provision of adequate funds for the current operations of the firm, i.e. for financing net current transactions. When this demand has been met the residual Φ represents current funds available for investment and expansion, hence the name "residual funds theory" of investment as coined by Meyer–Kuh [1957] and Meyer–Glauber [1964]. That a priority ordering of this kind is common procedure among firms has been demonstrated in a number of case studies, e.g. Donaldson [1961, pp. 71ff.].

When investment opportunities are ample, postponing the acquisition of financial assets and inventories required for transaction purposes may appear profitable in order to provide temporary financing of investment in fixed assets. A certain subjective cost in terms of increased risk-taking is assumed to be associated with such behaviour. The larger the gap between transactions demands and actual stock of working capital the greater is the risk that firms might not be able to meet contracted deliveries or to liquidate debts, etc. The opposite argument holds when investment opportunities are not so ample, firms might then want to restore transactions levels in the financial model as an alternative to fixed investment. If transactions levels are initially exceeded, excess stocks of assets would constitute a "cheap" source of finance which might permit the realization of investment projects which would not otherwise be profitable.[18] This is how the financial disequilibrium variable in (2:1) and (2:4) should be interpreted. The factor $(\xi_2 A^{os}_{t-1})$ represents a financial equilibrating mechanism in investment behaviour. Excess stocks of assets $(A^{os} > 0)$ will stimulate investment (*ceteris paribus*) over and above that possible with available current funds (i.e. Φ), thus lowering A^{os}_{t-1}. We note from (2:7) that this mechanism (in the model) does not affect plan revisions; A^{os} disappeared from the realization function, implying that initial disequilibrium in (2:1) has already influenced investment planning. Furthermore, the current change in this disequilibrium position has been assumed not to affect the current realization of plans in (2:4).[19]

As for the long-run equilibrium properties of the investment model (2:4), it will be shown in Section 4.2 that a long-run continuing equilibrium in the financial model defined by $A^{os}_t = 0$ for all t means (under certain simplifying assumptions) that: (A) long-run increases in output are determined by the coefficients of (2:4) and the availability of external funds of type ΔE^L and ΔE^c; (B) in the long-run this growth rate will cause the capacity gap $(K^* - K)$ in (2:5) to converge towards 0 and (C) the growth rate in production realized each period assures equality between I, I^* and Φ in (2:4).

Only one further assumption is needed to ensure consistent behaviour in the long-run also. With regard to the formulation of our savings function (2:12), it might be asked what forces ensure that this equilibrium

[18] In fact, this mechanism is analogous to what has come to be called "proportionate control" in the theory of linear feed-back control systems.

[19] It should be noted that this property is one of the ideas underlying the "disequilibrium approach" of the Stockholm school. See e.g. E. Lindahl [1939, pp. 60ff.].

growth rate is maintained in the long-run. What happens if enough investment opportunities are *not* available to induce sufficient investment in the long-run to exhaust the budget? As the coefficients of the savings function have been assumed constant, there is no possible outlet for excess profits outside the group of firms, via e.g. increased dividends to stockholders or accumulation of financial assets. Evidently both the savings function (2:12) and the investment function (2:4) imply a fundamental *profitability assumption* to be discussed further in Section 4.2.

The implication is that all funds generated via the Φ function (2:15) will be profitably invested by firms each period either in fixed or liquid assets to improve their financial position (the expansionary postulate). Whether this will be the case or not is of no consequence for the functioning or consistency of the model as such. The profitability assumption is in fact a property of the model and can be derived from it. However, when the model is used to test investment behaviour during the post-war period, the relevance of the expansionary postulate becomes crucial, since it is an *a priori* assumption implicit in all our results. As argued in Section 2.1, we believe this *a priori* assertion, which indeed underlies our basic assumption as to the existence of an *investment reserve*, to be borne out by post-war experience.

7. *Profit Generation and Plow-back*

Current profits generated from business operations form the link between optimal capital stock and the internal financing components of the capital budget. Gross profits net of depreciation give optimal capital stock according to (2:6), and net of dividends and taxes equal gross saving by definition. On the basis of results reported from a number of empirical studies of the cyclical behaviour of profits, for annual data in particular,[20] we have not attempted any sophisticated approach to explaining profits—this would require a rather detailed account of possible effects on income distribution of wage determination by manufacturing industries as well as analysis of technological change and the production structure in general. One important reason for keeping such factors outside our theory is that we wish in the final instance to estimate *only* a realization function on annual investment data. The influence on investment of price variables, that operate via the production structure of firms (as for instance variations in the rate of interest) within a neoclassical framework, should in general be of such long-term nature as not to show up as annual revisions of planned investment. If one wishes,

[20] See e.g. Kuh [1960] and Hultgren [1960, 1965].

the influence of such factors may be thought of as operating via the unspecified Z variable in (2:2) and (2:5), or as included in factors determining the investment reserve.

We assume that the generation of gross profits (Π) can be approximated by a linear function of output (Q) and the change in output (ΔQ):

$$\prod = \eta_1 Q + \eta_2 \Delta Q \quad \eta_1, \eta_2 > 0. \tag{2:18}$$

Π is gross profits (deflated by an index of e.g. final product prices), defined as net deflated value added minus deflated current costs including wage payments. The change in output is designed to pick up the rather regular cyclical pattern in gross profit margins observed. (2:18) may be viewed as a *mark-up pricing* explanation to gross profits, the mark-up exhibiting a cyclical variability due to the linear component $\eta_2 \Delta Q$. The quite common practice among firms to apply linear break-even charts in their budgeting procedures points towards a linear specification of the profit function as well as its derivates; the savings function (2:25) below and the capital budget (2:17). In fact, in a recent study on quarterly time-series data Evans (1968) reports on results that lend support to a simple formulation like (2:18).[21]

We, furthermore, assume a constant average life of capital equipment, or (what is the same) a constant depreciation coefficient ϱ giving:

$$D = \varrho K_{t-1} \tag{2:19}$$

and so the net income from total capital may be defined as:

$$\prod^N = \prod - D = \prod - \varrho K_{t-1}. \tag{2:20}$$

It follows from (2:3), (2:18) and (2:20) that:

$$K^* = \lambda \eta_1 Q + \lambda \eta_2 \Delta Q - \lambda \varrho K_{t-1}. \tag{2:21}$$

We assume, furthermore, that firms follow a policy of distributing a constant fraction d of gross profits in dividends. This is also an heroic assumption, although some empirical results suggest that it is a not un-

[21] Evans found current sales and lagged sales (lagged three to eight months) and a capacity utilization variable to be the main factors behind nominal profits. A change-in-price variable did not perform as well, being significant in about half of the 20 sub-industry groups studied. As expected the lagged sales variable appeared with a negative coefficient; Cf. (2:18) which can easily be transformed into:

$$\Pi = (\eta_1 + \eta_2) Q - \eta_2 Q_{t-1}.$$

Premultiplying everywhere by a product price we obtain a slightly truncated version of Evans' profit function.

reasonable approximation in an aggregate context.[22] Gross saving is now defined as:

$$\hat{S}^{AV} = \prod - d\prod - t(\prod - \ddot{O}) \tag{2:22}$$

where deductible expenses other than current costs ($\ddot{O}$) have been defined as a linear function of Q.

$$\ddot{O} = \mu_1 Q + \mu_2 \tag{2:23}$$

and t stands for the corporate income tax rate. $\ddot{O}$ includes both fiscal depreciation charges, appropriations to investment funds (IF), to pension funds and interest costs. Of course (2:23) is a severely simplifying assumption which rids our theory of a number of complications.[23]

Note the circumflex over $\hat{S}^{AV}$ indicating that the variable should be deflated by some suitable price index. We have chosen in this monograph to derive our investment relationship only under the assumption of constant relative prices for investment goods and products. Furthermore, we have (implicitly) assumed product prices to be a relevant measure of consumer prices, i.e. a relevant deflator of money wages and other cost components which are deducted from sales to give a measure of gross profit. Finally, we abstract from intermediate goods in the production process and the difficult problem of involuntary or unexpected variations in stocks of finished goods around desired transactions levels.[24] We may now impose the condition that:

$$S = Q. \tag{2:24}$$

Combining (2:22, 23) and (2:18) we obtain:

$$\hat{S}^{AV} = a_5 Q + b_5 \Delta Q + f_5, \tag{2:25}$$

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[22] See e.g. Lintner [1956] and Brittain [1966]. The ratio of dividends to gross profits for total manufacturing industry in Sweden fluctuated rather narrowly around 20 percent during the period 1950–63. See Eliasson [1967*b*, pp. 206ff.].

[23] A more detailed discussion on this point is found in Eliasson [1967*b*, pp. 206ff.].

[24] We assume quite simply that the *volume* of intermediate goods as well as stocks of finished goods are directly proportional to sales volume. The specification of this assumption in our formal apparatus will only add a number of constant factors of adjustment to our coefficients. There is little need to go through that formally. The assumption as to stocks of finished goods is not necessarily at variance with (2:11). The transactions inventories function explain all kinds of inventories, i.e. stocks of raw materials and goods-in-process also. We might quite well imagine transactions levels in stocks of finished goods to be realized each period as assumed above; however, this is not a very satisfactory assumption in view of the observed behaviour of firms.

where

$a_5 = (1-d-t)\eta_1 + t\mu_1$

$b_5 = (1-d-t)\eta_2$

$f_5 = t\mu_2$.

(2:25) is identical with (2:12) provided (2:24) holds. Then $\hat{S}^{AV} = S^{AV}$. A fundamental assumption in estimating (2:12) or (2:25) is that a_5, b_5 and f_5 can be approximated as constant over time. This is not as unreasonable as it may appear at first sight. The constancy of η_1, η_2 and d is implicit in (2:18) and (2:22). The Government action parameter t has only been varied within narrow limits during the observation period. Similarly output and capital stock have developed approximately parallel. Since depreciation charges for taxation purposes should follow capital stock, this component in $\ddot{O}$ should also vary roughly in proportion to Q over time. Furthermore, we know that the sum of appropriations to pension funds and to investment funds and retained earnings has been a fairly constant fraction of gross saving over time. Thus the constancy of μ_1 in (2:23) does not seem at all implausible. The fact that gross profit margins defined as (Π/S) have shown a slight decline since the end of the fifties while gross savings margins defined as (S^{AV}/S) have remained stable, or rather increased slightly (suggesting a zero or numerically small intercept f_5 in (2:12))[25] may largely be attributed to reduced taxation payments due to increased fiscal depreciation charges.[26]

8. *The Realization Function Reconsidered*

Imposing (2:24) and assuming the coefficients of (2:17) to be identical for both ex-ante planning and ex-post realization, we can write:

$$\Phi - \Phi^e = a_5(Q - Q^e) + (\Delta E^L - \Delta E^{Le}) + N_5(\Delta E^c - \Delta E^{ce}) + \\ + N_1(\Delta Q - \Delta Q^e) - c_4(\Delta^2 Q - \Delta^2 Q^e).$$

This simplifies to:

$$\Phi - \Phi^e = (a_5 + N_1 - c_4)(\Delta Q - \Delta Q^e) + (\Delta E^L - \Delta E^{Le}) + N_5(\Delta E^c - \Delta E^{ce}) \quad (2:26)$$

since by definition:

$$Q_{t+1} - Q^e_{t+1} = Q_t + \Delta Q_{t+1} - Q_t - \Delta Q^e_{t+1} = \Delta Q_{t+1} - \Delta Q^e_{t+1} \quad (2:27)$$

[25] Indeed f_5 turned out to be numerically small and negative in all sub-industry groups. See Table 3:1 in Section 3.2.

[26] This is shown to have been the case in Eliasson [1967 *a*]. See Tables 1:6 on p. 219 and 2:3 on p. 246.

and similarly for $(\Delta^2 Q - \Delta^2 Q^e)$. As before the superscript e denotes an expectations variable.

Similarly we obtain from (2:2), (2:5) and (2:21):

$$I^* - I^{*e} = a\lambda(\Delta Q - \Delta Q^e)\ (\eta_1 + \eta_2). \tag{2:28}$$

Evidently both K_{t-1} and Z_{t-1} [see (2:2) and (2:5)] vanish from the realization function, since they are both assumed identical in the ex-ante and ex-post relationships. This demonstrates one of the principal advantages of the realization function approach noted already by Modigliani–Cohen [1961, p. 119 f.]; namely that the realization function should in general require less explanatory factors than the total number of its component relations.

Combining (2:26) and (2:28) as in (2:7), we obtain quite simply:

$$I - I^p = \alpha_1(\Delta Q - \Delta Q^e) + \alpha_2(\Delta E^L - \Delta E^{Le}) + \alpha_3^0(\Delta E^c - \Delta E^{ce}), \tag{2:29}$$

where

$$\alpha_1 = (1 - \xi_1)\ (a_5 + N_1 - c_4) + \xi_1 \lambda a(\eta_1 + \eta_2)$$

$$\alpha_2 = 1 - \xi_1$$

$$\alpha_3^0 = (1 - \xi_1) N_5.$$

9. *Assumptions as to Expectations*

The realization function (2:29) contains three expectations variables; $\Delta Q^e, \Delta E^{Le}$ and ΔE^{ce}. Lacking statistical data for these entities, we have constructed substitute measures.

As for anticipated output and sales we expect this to be dependent upon past sales experience. In principle the properties of this relationship in the past could have been established by some form of distributed lag approach. The limited number of time-series observations available, however, prevented this approach from being followed through. Further, no relevant data on sales anticipations or production plans were available. In practice, then, we had to impose upon our model *a priori* assumptions as to the anticipations lag structure. More precisely an unweighted measure of changes in output during the past five, and alternatively two, years will be assumed to represent anticipated production changes during the ensuing period. As far as the specification of the model is concerned, this *expectations function* is a special case of the traditional distributed lag approach. The fact that we employ *a priori* an unweighted *moving average* as an expectations variable, i.e. a flat time distribution of the weighting system, frees us from the problem of estimating the weights from the limited time-series data available.

A third alternative was also tried. This amounted to an assumption that anticipations as to production will always be realized up to a constant fraction, i.e.

$$\Delta Q^e = \gamma_1 \Delta Q. \tag{2:30}$$

If $\gamma_1 = 1$ production expectations will always be fulfilled. If $\gamma_1 = 0$ reported plans are based upon a belief that the current level of production will not change during the next period (year). It will not be possible to establish empirically the size of γ_1.

The crudeness of these anticipations alternatives is apparent. However, the work on sales anticipations data which is available for a number of years back in the U.S. has produced results surprisingly favourable to our simple approach. Modigliani–Sauerlender [1957] report that quite "naive" projections of the past may serve as satisfactory measures of sales anticipations. Similar results have been reported by Carlson [1967]. Okun [1962] stresses the observed fact that sales anticipations data collected are only slightly better than "naive" trend projections of last year's sales in the sense of hitting actual sales. Furthermore, he notes that "predictive performance" improves with the level of aggregation. Still revisions in sales anticipations data have proved useful in explaining investment behaviour as well as revisions in investment plans, and indeed this is the kind of proper use to which such data should be put. Because of (2:27) it makes no difference whether such "trend" projections are applied to the level of sales (or output), or first and higher order differences. This is also true if we assume expected sales to be a function of past sales levels as well as changes in sales as proposed by Metzler [1941], Moriguchi [1967] and others. Differences between sales levels ex-post and ex-ante will be the same as differences between changes in the levels of sales ex-post and ex-ante, irrespective of which factors determine expectations. The problem is, however, that use of a more sophisticated anticipations structure than the simple moving average would make the *a priori* numerical specification of the expectations function an indeed questionable task for the investigator.

Alternatively, we may say that the sales expectations variable for inclusion in the realization function *must* be defined in such a way as to operate on plan revisions only. Past experience of any kind, attitudes to risk-taking etc., should quite realistically be expected to affect investment planning. However, such factors do not necessarily have to operate via sales anticipations. Reinterpreting our hypothesis in this manner makes it compatible with the inclusion of any historical datum (initial condition) provided it also affects investment ex-post. The Z-vector of unspecified initial conditions has been included to take care of such contingencies. Indeed, the Fisher [1962, Chapter 2] argument is that the influence of the past does not necessarily have to decline mechanically with time as assumed in traditional distributed lags approaches, but rather that the influence today of some crucial factor from the past, such as a liquidity crisis or an extreme drop in sales, remains intact for a very long period of time. The lasting influence of the Great Depression on business mentality is one example. Such factors may quite realistically be assumed to affect investment directly. The only problem is whether they influence the formation of investment plans as strongly as the realization of plans—as is assumed in this study—or not. If they do, then these factors vanish from the realization function.

It should be evident that all three sales expectations alternatives described above will produce a systematic underestimation of realized sales if sales are monotonically increasing and vice versa. Furthermore, the shorter the past period of influence the more pronounced will the tendency be to underestimate sales in the upswing and vice versa. The hypothesis so often met in business cycle theory that tomorrow will be the same as today ($\gamma_1 = 0$ in (2:30)) is the myopic expectations alternative when this bias will always be present.

The nature of the Swedish credit market controls leads us to believe that investment plans have been drawn up and reported on the assumption that access to the bond market will not be granted. At least, it seems highly probable that projects will not normally be reported if their realization is dependent upon access to such uncertain sources of finance. Thus we assume

$$\Delta E^{Le} = 0. \tag{2:31}$$

The testing of our realization functions rests on the a priori presumption that reported investment plans have been drawn up on the assumption of a "closed" or non-accessible bond market.

As far as the expected availability of commercial bank credit is concerned, we assume (analogously to (2:30)) that expectations will always be fulfilled up to a constant fraction, or:

$$\Delta E^{ce} = \gamma_2 \Delta E^{c}. \tag{2:32}$$

This fraction may well be unity, of course, implying that reported investment projects which are conditional upon commercial bank credit will always be realized, if such credits have been arranged in advance. Then, no disappointments in credit availability as well as no consequent plan revisions will occur. In addition, the previous analysis (Section 1.2) suggests that commercial bank credit should not figure importantly in investment decisions.

10. *Exclusion Hypothesis*

A common experience in working with investment anticipations data is the systematic overestimation of plans for the immediate future. When the planning period exceeds half a year an increasingly downward bias appears in reported plans. The first-mentioned phenomenon of overestimating seems to be the result of frequent delays in the actual erection of buildings and installation of machinery and equipment.

There are many possible explanations for the systematic downward bias for longer planning periods. We have found that the systematic part of deviations between planned and realized investment may realistically be accounted for by the omission of a large number of minor projects or maintenance work which have for some reason been forgotten when plans were reported or simply not considered necessary to plan for. A second (and highly plausible) hypothesis is that a large number of planned investment projects cannot be allocated to a definite time period too far in advance. There are reasons for believing that such investment projects with no precise time-table for their completion will not generally be reported in the questionnaires.[27] These two explanations have been termed the *exclusion hypothesis*. We assume that the systematic deviation between reported plans and realized investment is directly proportional to the size of the investment plan itself. A term $\alpha_4 I^p$ is therefore added to the realization function. Substituting (2:31) for ΔE^{Le} and (2:32) for ΔE^{ce}, (2:29) can be reformulated as:

$$I - I^p = \alpha_1(\Delta Q - \Delta Q^e) + \alpha_2 \Delta E^L + \alpha_3 \Delta E^c + \alpha_4 I^p, \qquad (2:33)$$

where

$$\alpha_3 = (1 - \xi_1) N_5 (1 - \gamma_2).$$

This is in principle the main investment realization function to be subjected to empirical testing in the next chapter. It may be noted now that dropping the assumption of constant prices may be shown (as described briefly in Section 3.3) to yield an additional linear influence from an investment goods price variable. If the influence of product prices on plan

[27] This second hypothesis is elaborated upon in Eliasson [1965, pp. 44–57].

revisions is, furthermore, assumed (for simplicity) to be linearly associated with the plan itself we obtain what has been called basic model [I] in Section 3.3 below.

In (2:33) annual plan revisions are linearly dependent on current deviations from expected output (or sales), current borrowing in the bond and debenture market and in commercial banks, as well as on the investment plan itself. When the simple expectations alternative (2:30) is used deviations from expected output are easily shown to be directly proportional to changes in output which is the case in basic models [II], [III] and [IV] in Section 3.3 below.

2.4 Causal Structure of the Model

The causal structure of our capital budgeting theory of investment planning is illustrated in Diagram 2:1. Planning for period t starts in the upper left-hand corner of the diagram with a number of exogenously given initial conditions; the character of an initial disequilibrium in financial stocks represented by A_{t-1}^{os}, initial stock of capital equipment $(=K_{t-1})$ and a number of past production levels which generate the expected level of output or sales (Q^e) via the expectations function. Expected output gives expected net profits. Expected net profits together with existing productive capacity and the vector of unspecified initial conditions $(=Z_{t-1})$ yield expected optimal investment $(=I^{*e})$ via the accelerator mechanism in the upper middle part of the diagram. Expected profits also give expected gross saving. Expected output when fed into the financial model together with expected availability of controlled external finance and expected gross saving, generates the capital budget ex-ante $(=\Phi^e)$.

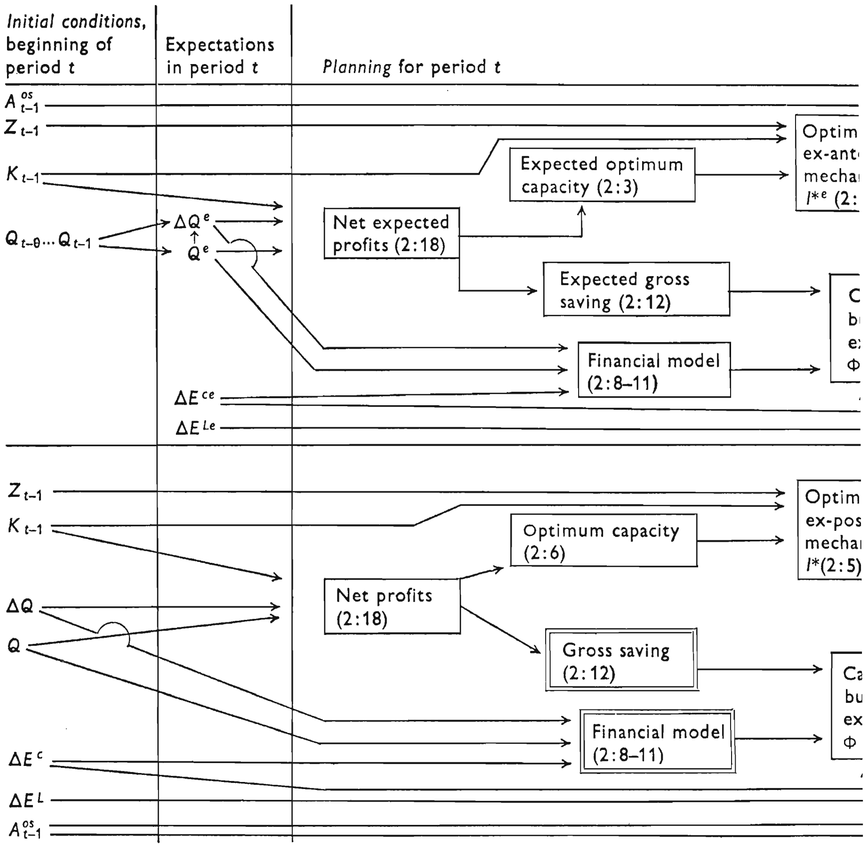
A linear combination of expected optimal investment (I^{*e}), the capital budget ex-ante (Φ^e) and the financial disequilibrium variable, constitutes the investment planning function I^p in the upper right-hand corner of the diagram.

The investment function ex-post, I, is similarly derived in the lower right-hand part of the diagram.

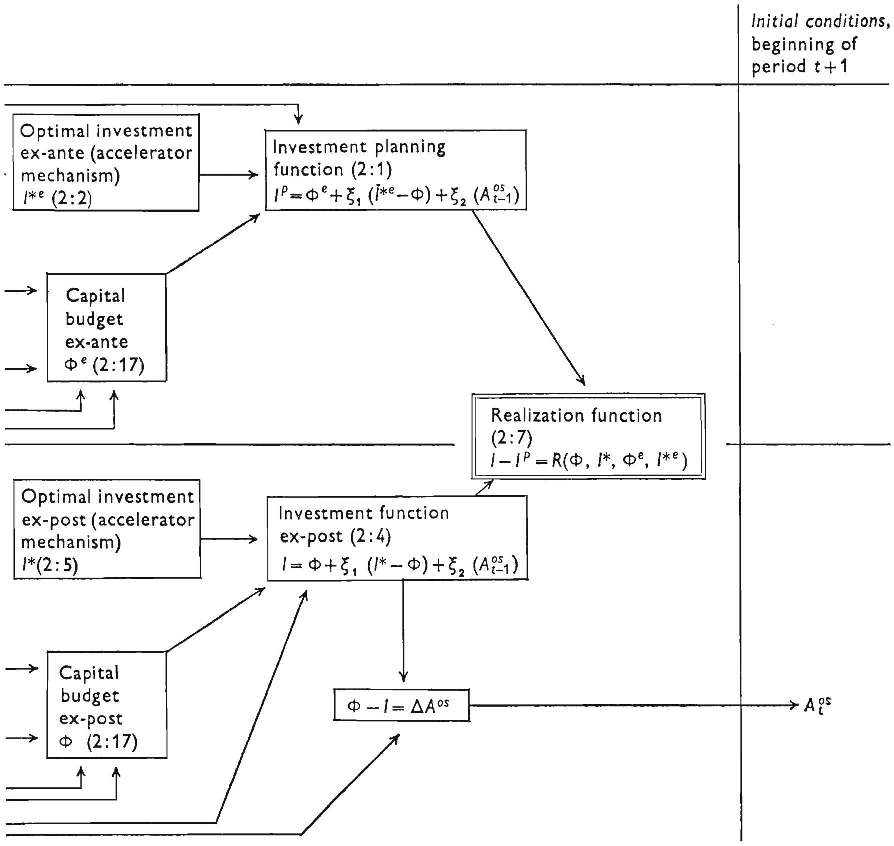
By definition, a derived form of the model, i.e. the realization function R, is obtained as the difference between the investment function and the investment planning function at the far right-hand of the diagram.

By abstracting from all sources of finance (including equity issues) not explicit in the model the financial system may easily be closed. Changes in the financial disequilibrium variable during period t and consequently initial disequilibrium conditions for the following planning

Diagram 2:1. *Causal structure of the model*[a]



[a]Indexes *t* for the planning period have been discarded throughout. Sections of the model shown
Note that the diagram represents the case with constant relative prices on products and investm



ɘl shown in a *double* frame, denote those sections that have been subjected to empirical estimation.
investment goods and no intermediate products, i.e. $Q = S$.

period $t+1$ (see lower right-hand corner of the diagram) are defined as the difference between the capital budget ex-post and gross investment. Similarly, if economic depreciation is subtracted from gross investment I, and the net investment figure so obtained added to initial capital stock K_{t-1}, then initial capital stock for period $t+1$, i.e. K_t, is given by definition. Lastly, feeding realized output during t into the anticipations function generates new sales or production expectations for period $t+1$. A more explicit analysis of this procedure follows in Section 4.2, where the investment model is discussed within the more general context of economic growth.

The recursive property of investment planning assumed should be evident from Diagram 2:1. The recursiveness and consequent causal structure is only partly produced by the lag structure specified *in the model*, the validity of which has been advocated e.g. by Wold;[28] rather it follows from a stepwise process of decision-making and planning where the relationships between the variables, which are not necessarily separated in time, are assymetrical in the sense of Simon [1953]. There is much substance in the argument that decision-making within firms follows a procedure similar to this recursive scheme. The division of a large corporation into a number of functional units each typified by the character of its activities (sales, production, finance, etc.) makes interdependent decision-making very cumbersome and costly. The same should hold also for iterative procedures, where the results of each trial constitute the initial conditions for a new test run in order to reach an "optimal" decision. These considerations suggest that the decentralized decision and planning procedure common within large firms should be characterized by numerous inconsistencies and deviations from "optimal" behaviour. The argument for interdependence, however, is strengthened where realized behaviour and aggregate relationships are concerned, as is the case in this study. Within firms incorrect decisions should be reflected in corrective revisions ex-post among variables, which span over the entire range of action. Unplanned cyclical variations in inventories, for example, are excluded of course from the planning procedure, but ex-post a corrective adjustment has to take place. In our model, this would imply a degree of interdependence, since the prime financial buffer against such variations is cashholding. We have deliberately abstracted from this possibility *in the model*.[29] Finally, the extent of dissemination of information between firms as to the future development of certain anticipations

[28] See e.g. Wold [1952, pp. 49ff.] or Wold [1956]. See also Bentzel–Hansen [1954].

[29] In fact, corrective adjustments in this respect would be concealed as off-setting variations between the two buffer-stock components $(L-\bar{L})$ and $(X-\bar{X})$ in (2:13).

variables is liable to strengthen the impact of incorrect expectations at the aggregate level. Also such factors should show up as interdependencies in a macro theory of firm behaviour.

In conclusion then, there are reasons to believe that the specification of the ex-ante structure should be simpler than its ex-post counterpart. The projection of expectations and the drawing of plans within firms necessarily have to be a not too complicated matter to handle. As I have attempted to indicate scattered evidence available on firm behaviour, support the hypothesis that rather simple rules and conceptions guide firms into an uncertain future.

On the other hand—as we have indicated above and in earlier sections, and will dwell on at length in what follows—by accepting the ex-post part of the model as a relevant explanation of firm behaviour ex-post at a *macro level* we run a risk of misspecification. This is so even though the ex-ante part be correct. One objection indicated is that the ex-post model quite plausibly should be non-recursive. A second objection refers to the linear specification of (2:1) and (2:4) in particular, which contribute importantly to the very simple specification of the realization function obtained. Nevertheless there are means of keeping these problems under at least partial control. Residual testing of the realization function as well as the credit functions (2:8, 9) is one way of taking care of unspecified factors deemed to be important or too rough approximations as to functional form. (Sections 3.2.2, 3.3.4 and 5.2.) The technique of not closing the financial system of the model lessens the risk of misspecification as far as interdependencies are concerned (see e.g. p. 53). The possibility of testing for predictive performance, thirdly, provides a further check on misspecifications. Lastly, the circumstance that more refined theoretical structures have often been reduced to rather crude outlines of the original when confronted with empirical data, provides some reassurance for what follows.

The problems just mentioned need not disturb us as long as we stay within the realm of clean theory. When we now turn to the much harder crux of empirical application and a desire to reach interesting, relevant and hopefully not misleading conclusions, the problem of specification has to be currently kept in mind.

CHAPTER 3

Application of the capital budgeting theory

3.1 Econometric Method

The recursive nature of our theory allows a step-wise testing procedure to be applied. First, the empirical results for the financial model are reported on. These are followed by the empirical results for the realization function, which are in turn based partly on the estimated coefficients in the financial model. Thirdly, a brief account is given of the outcome of the residual analysis mentioned in the previous chapter, and a number of ad hoc regression experiments with new variables. Fourthly, and lastly, two simulations including one ex-post prediction for the years 1964–67 are performed.

The annual time-series material covers the period 1950–63. The tests concern seven sub-industry groups within manufacturing industry (incl. mining). Firms with less than 50 employed workers are excluded from the statistical material. Furthermore, investment data have been subdivided into (1) purchases of machinery and equipment, and (2) construction investment, both exclusive of maintenance. Except for ΔQ all variables, including investment plans and realized investment, are measured at current prices.

A principal objective of this study has been to present a theory able to explain observed phenomena in a positivistic sense. Accordingly, our theory should rest on a set of postulates, or be given a priori an empirical content which is testable. This in turn requires assumptions which are at least approximately supported by empirical evidence—or are in principle believed to be. Following Koopmans [1957, p. 199] we may say that the "'econometric' approach to the measurement of behaviour equations, ..., emphasizes the combination of a priori knowledge or assumptions with observation." As we just said, the a priori knowledge then has to be fairly well supported from empirical sources extraneous to the statistical data used for testing. Refutation of essential parts of our theory would then be a surprising and unexpected turn of events. Still, however, our a priori knowledge or information might very well be open to several interpretations. In principle, such interpretations cannot be made *within* our theoretical framework.

The a priori knowledge implicit in the choice of variables, functional form as well as the overall specification of the causal structure of the system of relationships is fairly well supported in essential parts by institutional evidence and a number of earlier investigations, mainly in the U.S. Some scattered pieces of evidence in this respect have been referred to in the previous chapters; the reader is referred to the Swedish version of this study for a more systematic presentation.[1]

We would expect the *same theoretical structure to hold for each sub-industry group*. The only divergence allowed a priori concerns the numerical values (not signs) of the coefficients. Assuming that the disturbance terms have the conventional properties, and considering the recursive structure of our theory, a traditional one-tail t-test has been applied to each variable in each structural equation (2:7)–(2:12). On the sub-industry level each individual variable was tested at the 15 percent level of significance. By this standard and 14 observations estimated coefficients are not allowed to exceed numerically their standard errors. The overall trial for our theory is a *composite test* for all sub-industry groups. We require acceptance on the sub-industry level in at least four out of the seven cases possible.

Provided the disturbance terms in individual linear relations are independent *between* industry groups the probability of rejecting a correct null hypothesis (in favour of an erroneous alternative hypothesis, the theory) in the composite test is binomially distributed and approximately *one* percent if at least four out of seven industry tests have to be passed.[2] To uphold the independence assumption strictly would be unreasonable. We expect therefore to work with a composite level of significance of unspecified value ranging between one and 15 percent, probably quite far below 15 percent.[3] It should be emphasized that the rejection of a com-

[1] Eliasson [1967 *b*]. See in particular Chapters 1 and 2. Supplement I contains a comprehensive survey of the results to date from applied investment theory.

[2] The composite risk level is then

$$p = \sum_{v=4}^{7} \binom{7}{v} 0{,}15^{v}(1-0{,}15)^{7-v} \approx 0{,}01.$$

Provided we assume a priori that the coefficients of each explanatory variable be numerically equal and of same sign *between* industries a pooling of time-series and cross-section industry data would have been permissible in principle.

[3] We may of course imagine a dependence between disturbance terms of such a nature that the lower significance boundary is lower than one percent and possibly zero percent. This would imply a *specific* pattern of negative covariances between

posite hypothesis concerns all individual sub-industries taken together. We may not accept a hypothesis for a sub-industry group which has been rejected in the composite test. It should be noted explicitly that the principal objective of disaggregating the manufacturing sector into sub-industry groups has been to procure more information for testing our theory, *not* to investigate particular characteristics at the sub-industry level.

This procedure has been adhered to strictly throughout all parts of our theory.[4] A residual analysis, and finally a number of regression experiments follow. The regression experiments do not pretend to constitute theory testing but rather an attempt to screen the statistical material for suggestions to be tested later on fresh data.

We note lastly that the possibility of formally closing the financial system of the total model mentioned in Section 2:4 and to be discussed further in Section 4:2 if maintained a priori as relevant is liable to introduce into the otherwise recursive structure an element of interdependency between disturbance terms. This follows immediately from (2:13) and (4:13). For the testing of the realization function this is of no consequence, since interdependent factors are by then eliminated. (2:13) and (4:13), however, lay a restriction on disturbance terms in the financial model (2:8–11). Since the financial subsection of our model is characterized by numerous open ends (4:13) is by no means a relevant specification for the empirical application. Substantial amounts of finance besides gross saving and what is included in the ΔE^L and ΔE^c variables figure in business finance. We may thus in practice neglect this possible interdependency.

3.2 The Financial Model

The basic assumptions regarding financial behaviour are presented in the form of the financial model (2:8–12). *Actual* stocks of trade debts and trade credits, the actual stock of liquid assets (cash and demand

disturbance terms. Since we expect existing dependencies to figure as positive covariances, we disregard this complication.

[4] In a sense this is not strictly true. The original set of variables included in the realization function to be tested was too large compared to the number of observations to allow simultaneous estimation. In fact, four basic functions were derived from the basic theoretical structure. One of these was presented in the previous chapter, derived in the case of constant prices and including an additive price variable to correct for price changes. For that reason a preliminary step-wise screening of variables was necessary. See further Section 3.3.1 and Eliasson [1967 *b*, pp. 131 ff. and pp. 149 ff.].

deposits) and inventories have all been regressed on inter alia a sales variable. Furthermore, gross industrial saving (i.e. retained earnings and depreciation allowances) was estimated as a linear function of the level of and changes in the level of sales. Note that the dependent variables were those actually measured, not the transactions components (see Section 2.3.5).

1. *Transactions Liquidity and Inventories Functions*

As expected the simple form of the cash-holding and the inventories[5] hypotheses did not fare favourably in our tests. The transactions hypotheses implicit in the sales variable were accepted. However, only a modest fraction of the total variance of the dependent variables (around fifty percent on the average) was explained. Thus, the buffer-stock components [$(X-\bar{X})$ and $(L-\bar{L})$ in (2:13)] were in general substantial, the reason being that a large number of important explanatory factors did not figure in the functions. Essentially these two functions amount to only a more sophisticated form of trend-fitting. The empirical results have not been recorded.[6]

In a study of quarterly time-series data by Anderson [1964] an equally vague result is reported for the sales variable in a liquidity function. Anderson believed this to be a consequence of the strong dependence of cash-holding on daily transactions needs. We used end-of-year figures for liquidity stocks, but a more relevant measure should be an average figure for the year.

Finally, some regression experiments were performed on the liquidity function. Among other variables, we added the change in total inventories as an explanatory factor. As expected, a slight tendency was observed, but not "significant" in terms of our criteria, for liquid assets and inventories to vary anticyclically. There are reasons for believing that some off-setting variations take place between the two buffer-stock components $(X-\bar{X})$ and $(L-\bar{L})$ in (2:13). "Involuntary" accumulation of inventories during the early recession in particular may be expected to be financed through temporary reductions in liquidity below desired transactions levels.

2. *"Grey" Credit Market*[7]

Part of the empirical application of the financial model consisted of investigating trade credit flows. The length of credit periods and their sen-

[5] Due to lack of statistical data the inventories function had to be estimated on a flow basis.

[6] See Tables 4:3 (p. 113) and 4:5 (p. 119) in Eliasson [1967b].

[7] The term has been defined in this study to cover trade credits between firms.

sitivity to monetary policy measures were of particular interest. Since the whole of Chapter 5 has been devoted to a theoretical and empirical investigation of trade credit flows, or—in our terminology—the "grey" credit market, only the main empirical results will be reported here. As expected, the stocks of trade credits and trade debts were found to be highly correlated with the level of sales. Furthermore, the extent of commercial bank borrowing was positively correlated with the stock of trade credits allowed. However, no conclusive statistical evidence has been found to support the hypothesis that a general credit squeeze results in a lengthening of the average credit period and an expansion of the "grey" credit market over and above the increase generated by the growth in sales.

The buffer-stock components $(H-\bar{\bar{H}})$ and $(\bar{D}-D)$ in (2:13) were in general quite small numerically. A test as to sign, magnitude and direction of change for sub-industry groups described in Chapter 5 yielded results which were generally inconclusive or opposite to a priori expectations. Our data do not support the contention that the "grey" credit market constitutes a stand-by resource for investment finance when monetary policy is tight.

3. *Savings Function*

Estimation of the savings function (2:12) lent no statistical support to the hypothesis of cyclical variability in profit margins implicit in the change-of-sales variable. Table 3:1 presents the results of a revised estimate of the savings function with ΔS excluded. As expected, the level of gross industrial saving followed the level of sales rather closely. The numerically small values of the intercepts suggest a relationship quite close to direct proportionality, or rather (since all intercepts except one are negative) that the average savings to sales ratio (the savings margin, S^{AV}/S) increases slightly with sales. On the aggregate industry level gross saving equals 7 percent of sales on average.

4. *Capital Budget*

The regression results from the financial model allow numerical specification of the net capital budget (2:15) or (2:17) in Chapter 2.

$$\Phi = a_5 S + \Delta E^L + \Delta E^c + N_1 \Delta S + N_2 \Delta^2 S + N_3 \Delta E^c + f_5$$

$$N_1 = b_5 - b_4 - b_3 + b_2(1-g_3) - b_1(1+e_3)$$

Table 3:1. *Savings function, estimated coefficients by branch*

$S^{AV} = aS + b$ observation period: 1950–63.

	$\hat{a}$	$\hat{b}$	R
1. Mining, metal- and engineering industries	0.09 (0.01)	− 27	0.889
2. Stone and clay	0.11 (0.02)	− 11	0.868
3. Wood, pulp and paper	0.05 (0.03)	201	0.505
4. Printing and allied industries	0.07 (0.01)	− 22	0.946
5. Food manufacturing industries	0.03 (0.01)	− 71	0.897
6. Textile-, leather- and rubber industries	0.11 (0.01)	− 199	0.925
7. Chemical industries	0.13 (0.02)	− 125	0.863
Total manufacturing	0.07 (0.01)	− 116	0.907

$N_2 = (-1)c_4$

$N_3 = -e_1(1+e_3).$

Table 3:2 gives the results of this computation.[8]

As expected, practically all estimates of N_1 were found to be negative; the accumulation of working capital generates a net demand for funds. Except for the engineering industries and mining in no sub-industry group was borrowing in the "grey" credit market large enough to generate a surplus over and above the extension of trade credit, and increases in the transactions demand for both cash and inventories. In general, the prior claim on funds generated by the accumulation of working capital proved quite substantial, amounting on average to 30 percent of the increase in sales value.

Gross savings have been expressed in (2:12) as a linear function of the level of sales and changes in the level of sales. The coefficients of S, i.e. a_5 in the savings function, turned out to be small compared to the negative coefficients N_1 in the capital budget. The faster the growth in sales, the larger the net demand for funds felt from the accumulation of working capital and the larger (relatively) the drain on internal sources

[8] All variables which did not pass the composite test have been given coefficients equal to zero. The same holds for f_5 in (2:12) and as well for f_4 in (2:11) since this latter equation was estimated on a flow basis.

Table 3:2. *Numerical specification of the capital budget by sub-industry*[a]

Sub-industry	$\hat{a}_5$	$\hat{N}_1$	$\hat{N}_2$	$\hat{N}_3$
1. Mining, metal- and engineering industries	0.09	0.05	—	− 3.9
2. Stone and clay	0.11	− 0.33	—	—
3. Wood, pulp and paper	0.05	− 0.06	0.13	− 2.1
4. Printing and allied industries	0.07	− 0.32	0.07	—
5. Food manufacturing industries	0.03	− 0.01	—	− 2.8
6. Textile-, leather- and rubber industries	0.11	− 0.29	—	− 0.7
7. Chemical industries	0.13	− 0.60	0.13	—
Total manufacturing	0.07	− 0.30	—	− 3.3

[a] For an explanation of symbols, the reader is referred to the formal representation of the capital budget above.

of funds. The opposite holds for a decrease in sales. In general a change in the growth rate of sales generates a numerically smaller growth rate in the capital budget Φ. In principle, a maximum critical growth rate will exist for each industry group at which all internally generated funds have to be allocated to current working capital requirements. As will be shown in Section 4:1, this critical growth rate is determined by the coefficients of the capital budget. For all sub-industry groups it exceeds the rates of change in sales experienced during the post-war period by a substantial margin. However, this mechanism should generate anticyclical variations in investment if *no* accelerator mechanism affects investment spending as in (2:4) and if the size of the capital budget is a principal determinant of investment. An accelerated rate of growth in sales will retard the rate of growth in investment, provided no external funds are available to help maintain investment. It should be evident that the Φ-function is the crucial factor through which monetary policy may influence investment. A numerical simulation at the aggregate industry level is shown below to illustrate the numerical properties of the capital budget. The reader should also be aware of the fact that this same capital budget has been applied in Chapter 6 to forecast long-run manufacturing demands on the money markets for the period 1965–70.

5. *Ex-post Simulations of the Capital Budget*

Diagram 3:1 brings out certain features of the capital budgeting approach to an investment theory. From below are shown the annual percentage change in sales ($\Delta S/S$), the net estimated internal component of the capital budget ($\dot{\Phi}_1$), the estimated total net capital budget ($\dot{\Phi}$),[9] and gross investment (I).[10] It is immediately evident that $\hat{\Phi}_1$, the internal component of the capital budget, varies inversely with the percentage change in sales. The widening gap between I and $\hat{\Phi}$ from the late fifties and onwards is largely made good by increased availability of controlled external funds from the organized credit market, i.e. ΔE^L and ΔE^c. The balance is accounted for by other forms of external finance, mainly equity issues and current deviations from the transactions components of working capital (cash, net trade credits, etc.). Until 1958 the capital budget $\hat{\Phi}$ covered investment spending amply and allowed an increase in liquidity and financial assets which was subsequently depleted during the late fifties and onwards. Quick liquidity, i.e. cash-holding as a percentage of sales also increased substantially during the middle of the fifties, but fell during the sixties. Table 1:1 in the previous chapter reveals that equity issues were unusually large during the years 1961, 1964 and 1965, when business prospects were good, investment opportunities ample, stock prices high and consequently equity finance relatively cheap.

3.3 The Realization Function

1. *Investment Behaviour—Machinery*

Our principal problem has been to investigate the determinants of short-run investment, here defined as annual revisions in reported investment plans.

Due to lack of useful data on planned and realized construction for the whole of the observation period our main interest has been confined to investment in *machinery and equipment* (excl. maintenance). In fact the Government control of industrial construction mentioned earlier makes interpretation of plan revisions before 1958 in terms of a realization function doubtful. Still, a realization function for construction investment has been estimated for the years after 1957, but the results should be interpreted with due caution.

From a general set of assumptions the following realization function was derived in the Swedish version of this monograph:

$$I-I^p=R[(\Delta Q-\Delta Q^e),\ \Delta S,\ \Delta E^L,\ \Delta E^c,\ g(p,\Delta p^I),\ I^p,\ K_{t-1},\ Z_{t-1}].$$

p designates the level of final product prices and p^I the price level of in-

[9] Besides new issues of bonds and debentures, ΔE^L here includes direct net borrowing in insurance companies and commercial banks.
[10] Here from the profit statistics of Sweden.

Diagram 3:1. *Ex-post simulations of the capital budget 1952–65*

$\frac{\Delta S}{S}$ percentage change in sales
I gross investment
$\hat{\Phi}_1$ internal component of capital budget (estimate)
$\hat{\Phi}$ net capital budget (estimate)

vestment goods. The remaining variables were defined in Chapter 2. Imposing a linear functional form on the structural relations of our theory and various simplifying assumptions this general form can be resolved into the four basic realization functions:

$$I - I^p = \alpha_1(\Delta Q - \Delta Q^e) + \alpha_2 \Delta E^L + \alpha_3 \Delta E^c + \alpha_4 I^p + \alpha_5(\Delta p^I I^p) \tag{I}$$

$$I - I^p = \beta_1 \Delta Q + \beta_2 \Delta S + \beta_3 \Delta E^L + \beta_4 I^p \tag{II}$$

$$I - I^p = \gamma_1 \Delta S + \gamma_2 \Delta E^L + \gamma_3 I^p \tag{III}$$

$$I - I^p = \delta_1 \Delta S^{AV} + \delta_2 \Delta E^L + \delta_3 I^p. \tag{IV}$$

Basic model (I) was derived in Chapter 2 and contains our principal hypotheses. Basic model (II) isolates explicitly the influence of the accelerator mechanism from that of the capital budget. α_3 and α_5 were both assumed to be zero. In principle this procedure required that firms expect product prices to increase at a constant rate. Furthermore, only the simple expectations alternative (2:30) was applied. The high degree of collinearity between changes in sales value and changes in output made this approach a priori rather questionable.[11] Basic models (III) and (IV) are variations of the pure capital budgeting case. In (III) the internal component of the capital budget is represented by the change in sales variable, while in (IV) the whole financial model has been discarded except for the savings function. Thus changes in saving (ΔS^{AV}) have been included as an explanatory variable instead of ΔS. The condition $\alpha_3 = \alpha_5 = 0$ as well as (2:30) have been imposed in both cases.[12] Excluding ΔE^L and I^p from (IV) we get a realization investment function, which may be said to correspond to the pure residual funds case of Meyer–Kuh [1957] and Meyer–Glauber [1964].

Basic model (I) still contained too many variables for simultaneous regression on 14 annual observations. Furthermore, our approach involved three alternative hypotheses, as to sales anticipations. The screening procedure adopted was as follows. Firstly, ΔE^c and $(\Delta p^I I^p)$ were excluded from basic model (I) and the truncated function estimated separately for each of the three alternative assumptions as to expectations. Surprisingly enough, only the simple expectations alternative (2:30) i.e. $\Delta Q^e = \gamma \Delta Q$ proved significant in terms of our composite test criteria. Re-

[11] In principle basic model (II) corresponds to the inclusion of one accelerator and one internal finance variable together in a linear investment function, as e.g. in de Leeuw [1962]. De Leeuw also observed a high degree of collinearity between the two variables.

[12] A few additional approximations are also required. See Eliasson [1967 *b*, pp. 146ff.].

Table 3:3. *Basic realization function (I), investment in machinery and equipment (M), results from estimation by sub-industry*[a]

$I^M - I^{pM} = \alpha_1 \Delta Q + \alpha_2 \Delta E^L + \alpha_3 I^{pM}$ observation period: 1950–63

Sub-industry	α_1	α_2	α_3	R
1. Mining, metal- and engineering industries	0.013 (0.037)	0.317 (0.213)	0.082 (0.088)	0.556
2. Stone and clay	0.111 (0.058)	0.001 (0.184)	0.270 (0.079)	0.595
3. Wood, pulp and paper	0.020 (0.019)	0.320 (0.130)	0.114 (0.050)	0.664
4. Printing and allied industries	0.133 (0.074)	2.108 (1.308)	0.191 (0.100)	0.574
5. Food manufacturing industries	0.054 (0.033)	0.369 (1.385)	0.215 (0.079)	0.569
6. Textile-, leather- and rubber industries	0.023 (0.011)	1.749 (1.245)	0.276 (0.046)	0.691
7. Chemical industries	0.029 (0.032)	−1.097 (0.385)	0.274 (0.081)	0.635
Total Manufacturing	0.033 (0.023)	0.175 '0.137)	0.144 (0.044)	0.774

[a] The standard regression programme used calculates *all* moments around zero means, when the regression plane is forced through the origin, as in the case of the realization function. As for the coefficients and standard errors in this case unbiased estimators should be calculated around zero means compared to standard formulae. The multiple correlation coefficient, however, will be too large. For this reason the R's in the table have been adjusted for this bias. This correction was not made in Eliasson (1967 *b*, p. 153).

taining this expectations alternative, the two remaining variables were included stepwise in two separate regressions; neither variable was, however, significant. Thus a basic realization function of the form

$$I - I^p = \alpha_1 \Delta Q + \alpha_2 \Delta E^L + \alpha_3 I^p$$

performed best. The results are recorded in Table 3:3. The superscript M stands for Machinery. Diagram 3:2 compares the aggregated simulated values for individual industries with total manufacturing investment and plan revisions. For ΔQ we observed significant results in five out of seven sub-industry groups, while ΔE^L produced significant results in four industry groups and the exclusion hypothesis in six. This simplified form of the basic model (I) thus passed the composite test by a substantial margin. On average, 60 percent of the variation in the dependent variable could be explained by the three factors ΔQ, ΔE^L and I^{pM}. This should be regarded as quite satisfactory explanatory value considering the very truncated form of the total model estimated in Table 3:3.

On the basis of our results net commercial bank borrowing could not be accepted as an explanatory factor in plan revisions. This result will be discussed in Chapter 7 under the heading of "Conclusions with Respect to Monetary Policy". Neither was the investment goods price variable significant; this variable was included as firms are asked in the questionnaires to state their investment plans in terms of prices prevailing at the time of reporting. Realized investment, on the other hand, is expressed in current prices. Provided price changes could be assumed not to affect the *volume* of realized investment we should expect coefficients larger than zero and close to $+1$. One plausible explanation for the rejection of this price hypothesis is that firms tend to include price expectations in reported *figures for* planned investment.[13] An alternative explanation which would fit the capital budgeting theory of investment neatly is that variations in prices for capital goods lead to variations of opposite sign in the *volume* of investment to keep the *value* of investment unchanged.

Estimates of basic model (II) produced results similar to those in Table 3:3. Basic model (I) passed this additional test in an alternative formulation very favourably. The estimated coefficients of the original variables remained almost the same for the ΔQ variable for the two regressions, while the estimated ΔE^L and I^p coefficients varied somewhat. However, the separation hypothesis implicit in the ΔS variable was rejected by a narrow margin.

As expected ΔS in basic model (III) picked up the explanatory value of ΔQ now excluded. In principle then, the hypothesis of basic model (III) was accepted. Finally, the savings variable did not prove significant in basic model (IV).[14]

Our regression results are not altogether straightforward. Neither of the basic components of our investment theory, that is the capital budget factor and the accelerator component was rejected. The summary results suggest that we should settle for basic model (I) recorded in Table 3:3 as the "best" choice.

In summary, then, according to the capital budgeting theory of investment unexpected availability of bond finance seems to have induced substantial upward revisions in investment plans *during the same period*. On average the plan revisions of *machinery* investment amount to almost

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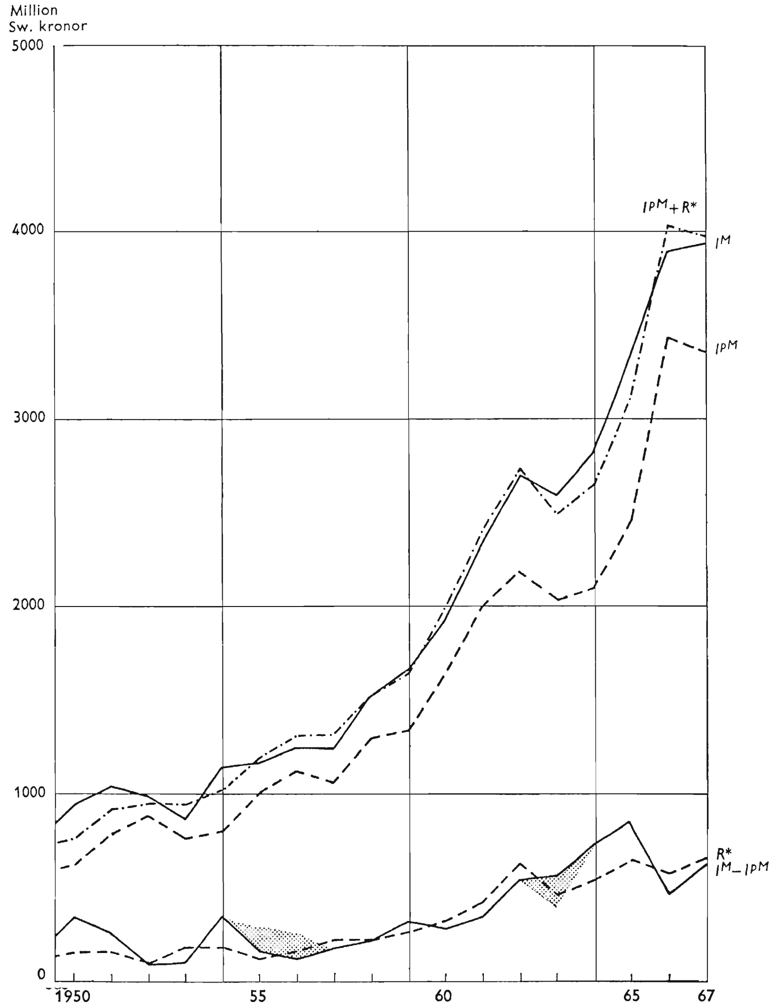
[13] This explanation was proposed by Modigliani–Weingartner [1958, pp. 31ff.] in their early attempt to estimate a simple realization function.

[14] The results of estimating basic models (II), (III) and (IV) have not been recorded. See Eliasson [1967 *b*], Table 5:2 p. 160, Table D:4 p. 249 and Table D:5 p. 250 respectively.

Diagram 3:2. *Goodness of fit by realization function, investment in machinery and equipment, manufacturing total 1950–67*



I^M investment in machinery and equipment
I^{PM} planned investment in machinery and equipment
R^* simulated values of the aggregate realization function

Shaded areas stand for economic policy impacts as measured in the Arvidsson [1956], Wickman [1957] and Eliasson [1965] studies. See further p. 69 f.

20 percent of new borrowing in the capital market (bonds and debentures).

Secondly, plan revisions were found to be positively correlated with current changes in the level of output. According to our theory, this variable was expected to pick up the effects of an accelerator mechanism as well as the influence of unexpected changes in the net generation of internal funds. Inclusion of the ΔQ variable reflected our hypothesis that expectations regarding changes in output or sales were correct up to a constant fraction. The positive coefficients supported our hypothesis of a combined "accelerator-capital-budgeting" theory of investment. The hypothesis that expected changes in output are an unweighted moving average of annual changes in output during the past two, or alternatively five, years was rejected. The estimated ΔQ coefficients turned out to be numerically small; much too small to be compatible with the working of a pure accelerator mechanism.[15] As already argued this result supports the hypothesis that the internal component of the capital budget influences plan revisions and/or that the constant fraction in the anticipations alternative (2:30) is large and fairly close to unity.

Lastly, the *exclusion* hypothesis was significant in six of the seven branches. On average a 14 percent inflation of plan figures corrected for this (assumed) systematic discrepancy. It should be observed in Table 3:3 that this percentage figure was much lower in two branches—engineering and pulp and paper; the nature of production in the former and the predominance of large firms in the latter might suggest that more elaborate and refined methods of planning are adopted in these industries than on average.[16] In fact, much larger figures were recorded in industries characterized by a large number of small firms, e.g. the textile industry. Furthermore, the high degree of correlation between the price of final products and planned investment made it necessary to discard the price variable from the four basic models. In principle, then, the net influence of product prices on plan revisions should have been picked up by the I^{pM} variable.

Since the publication of the Swedish study the simplified form of basic model (I) has been reestimated by the National Institute of Economic Research (Konjunkturinstitutet) for the whole manufacturing sector using data for the period 1950–67. The new results strongly support our

[15] In the pure accelerator case with a reaction coefficient equal to one, i.e. $a = 1$ in (2:2), no intermediate products and $\gamma_1 = 0$ in (2:30), the coefficient α_1 would equal the marginal capital output ratio. The same observation was made also by Modigliani–Weingartner [1958, pp. 48ff.].

[16] The results of Foss–Natrella [1957] support this interpretation. American firms which based their investment planning upon an explicit capital budgeting procedure revealed a much smaller divergence between reported plans and recorded outcomes than other firms. Indeed, this is in accordance with our hypothesis. Scattered evidence of a similar nature comes from the interview study referred to earlier (not published) and carried out jointly by the National Institute of Economic Research and the Central Bureau of Statistics during 1964.

capital budgeting theory, with the exception of the exclusion hypothesis. Larger values for the coefficients of ΔE^L and ΔQ were recorded, while the estimated I^{pM} coefficient was reduced to one third of its previous level and did not pass the 15 percent test criterion at the aggregate industry level.[17] In a sense, this result again raises the question of the most appropriate representation of the exclusion hypothesis. Assuming the value of excluded projects to be proportional to planned investment may be too crude an approximation. As discussed in Section 2.3.9 there could quite possibly be a systematic tendency among firms to substantially underestimate the rate of growth in sales or output in their investment planning; this would lead to the exclusion hypothesis, or part of it, being best represented by $(\Delta Q - \Delta Q^e)$ (cf., however, the results of ex-post predictions for the years 1964–67 in Section 3.3.5).

2. *Investment Behaviour—Construction*

The basic model:

$$I - I^p = \alpha_1(\Delta Q - \Delta Q^e) + \alpha_2 \Delta E^L + \alpha_3 I^p$$

was tested on plan revisions for construction. Because of the Government control of the construction sector mentioned earlier, the observation period this time only covered the years 1958–63—i.e. only 6 observations were available. Total manufacturing was subdivided into three branches. Our results here must be considered highly tentative.

As in the case of machinery investment, the simple expectations alternative $\Delta Q^e = \gamma \Delta Q$ was the only one not rejected by our tests. Thus, plan revisions in construction were found to be positively correlated with changes in the volume of output; in two out of the three branches substantial upward revisions took place in years when firms were allowed to

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[17] The estimated relation was:

$$I^M - I^{pM} = \underset{(0.048)}{0.168}\Delta Q + \underset{(0.132)}{0.353}\Delta E^L + \underset{(0.048)}{0.044} I^{pM} \qquad R = 0.966$$

The larger estimated ΔQ coefficient compared to Table 3:3 is partly accounted for by the fact that changes in deflated net value added were used by the National Institute, instead of the larger changes in deflated sales value used in this study. Partly we may perhaps explain the divergence by reference to the fact that all three expectations alternatives (if true) will produce a systematic underestimating of sales expectations if sales are steadily increasing (cf. p. 46). Thus the ΔQ variable will pick up part of the influence on plan revisions of the "exclusion" hypothesis. Cf. also the non-significant coefficient of I^{pM} in the new regression with Table 3:3.

borrow in the bond market. These two branches (engineering and pulp and paper) furthermore were the dominant bond issuers among manufacturing firms during the early sixties. Our results support the hypothesis that unanticipated access to bond finance stimulated investment in building and construction during the same period. The fact that the investment funds system was in active operation during 1962 and 1963 raises, however, special problems which will be touched upon below. Nevertheless acceptance of our hypothesis about ΔE^L still seems reasonable. The exclusion hypothesis was also accepted by the tests in two of three branches.

The National Institute of Economic Research has recently reestimated basic model (I) for construction investment for all manufacturing. The estimation period 1958–67 now covered 10 annual observations. The results shown below basically support the pure form of the capital budgeting theory (superscript C stands for *construction*):

$$I^C - I^{PC} = -0.026\,\Delta Q + 0.223\,\Delta E^L + 0.110\,I^{PC} \quad R = 0.969$$
$$(0.037) \qquad (0.087) \qquad (0.066)$$

The hypothesis that unexpected access to controlled capital market sources of long-term finance generates upward plan revisions is strongly supported by this new set of data. Support, although less strong, is also found for the exclusion hypothesis. The coefficient for ΔQ was negative and not significant. Within the framework of our theoretical model, this result is compatible with absence of an accelerator effect together with restricted influence of the net internal generation of funds and/or with the impact of the accelerator and net internal funds mechanisms having approximately cancelled each other. Interpretation of this result should not, however, be pushed too far.

Finally, the National Institute's estimates for total investment for the period 1958–67 were:

$$I^{(M+C)} - I^{P(M+C)} = 0.165\,\Delta Q + 0.692\,\Delta E^L + 0.037\,I^{P(M+C)} \quad R = 0.988$$
$$(0.066) \qquad (0.177) \qquad (0.045)$$

ΔQ and ΔE^L were significant but not $I^{P(M+C)}$ or the exclusion hypothesis. This new estimate suggests that plan revisions occasioned by unanticipated access to controlled long-term sources of external finance amount to no less than 70 percent of new borrowing *within the same* year.

3. *Regression Experiments*

The next step in our estimating procedure was to try out new variables which were not included originally in our investment theory. Two of these variables—the rate of interest and liquidity—have figured frequently in pure as well as applied investment theory. Empirical evidence in general has, however, rejected these variables, or else, the interpretations have been somewhat ambigous. In the light of previous experience these variables had been excluded from our total model as practically irrelevant for short-run investment behaviour. The regressions on new variables using only data for investment in machinery must be regarded as explorative.

Variations in official interest rates in the organized credit market were found not to be correlated with revisions in planned machinery investments.

Our purpose was to investigate whether variations in interest costs might produce *time-shifting* effects in investment. The hypothesis (sometimes proposed) that variations in the rate of interest induce substitution effects between capital and labour, leading to *short-run* variations in investment was discarded a priori as unreasonable; rather our position is that firms might in some cases have postponed planned investment projects temporarily when interest costs went up and vice versa. Rejection of this hypothesis was not surprising, despite the fact that a number of recent studies in the U.S. have found interest rates to be significantly (negatively) correlated with quarterly variations in private investment.[18] In fact market rates of interest normally exhibit a quite regular cyclical pattern. By a suitable choice of lag structure it should always be possible to avoid the "perverse" positive estimates of interest rate coefficients sometimes encountered in old time investment functions when yearly investment data only were available and computing facilities less handy. There seems, furthermore, to be no particular reason to expect very small variations in *regulated* interest rates to reflect marginal costs of funds to industrial firms whose major source of finance is internally generated funds. A meaningful measure of the cost of funds relevant for investment decisions should be the cost of financing the marginal project contemplated for the period in question. These costs are not registered in the form of official rates of interest subject to control, nor should we expect them to be highly correlated over time with credit market rates of interest. This picture of the functioning of the organized Swedish credit market is quite evident from a recent study by Hagström [1968].

Investment behaviour has been found in a number of studies[19] to be *in*sensitive to the stock of cash or liquid assets held by firms. In our regression experiments a measure of *excess liquidity*, namely the computed residual of the simple liquidity function (2:10) in which sales and changes

[18] See e.g. Gehrels–Wiggins [1957], de Leeuw [1962], Anderson [1964], and others.
[19] See e.g. Meyer–Glauber [1964, pp. 91ff.].

in sales are the explanatory factors, was tried as an explanatory variable for plan revisions. In fact, our measure of disequilibrium cash-holding was an estimate of the buffer-stock component $(L-\bar{L})$ of the financial disequilibrium variable A^{os} (see (2:13) in Chapter 2). This liquidity measure was added to the variables in the simplified form of the basic realization function (I) which had previously performed best (see Table 3:3). Surprisingly enough, very high positive correlations between plan revisions and this liquidity measure were found. Excess liquidity coincided systematically with upward plan revisions. High multicollinearity between this new variable and the original ones in the basic model made interpretation of this result difficult. Since we are working with plan revisions as a dependent variable, the direction of causality should plausibly be from liquidity to investment (not the other way around), provided the investment liquidity relationship can be assumed to represent a relevant economic mechanism.[20] This being the case, our results in respect of the liquidity variable are of interest from the point of view of monetary policy and particularly the operation of the investment funds system during 1960 and 1961 (see Section 1.1.3).

Finally, a suspicion that revisions in planned machinery investment might be induced by concurrent plan revisions in construction investment was "tested" by including $(I^C - I^{PC})$ as an additional explanatory factor in the simplified form of basic model (I). The result was, however, negative, and we conclude that any "complementarity" in time between the two types of investment is rather loose. On an *annual* basis the influence of different factors seems to be fairly direct on both the investment categories.[21]

4. *Residual Analysis*

The testing procedure was rounded off by an analysis of residuals in order to test additional hypotheses concerning events during particular years during the observation period. Computed branch residuals from basic model (I) in Table 3:3 were compared with an a priori hypothesis as to sign and magnitude.

In principle, this residual analysis is of an *additive* type. The residuals are thought of as being generated by some *excluded* linear component in the basic regression model as well as a random disturbance. A basic requirement is that the *excluded* linear components must be uncorrelated

[20] In fact this result suggests that the ξ_2's might not be equal in (2:1) and (2:4) in Chapter 2.

[21] A similar result was recorded in Eliasson [1965, pp. 77f]. The questionnaires indicated only minor complementary effects *within the same year*.

with variables *included* in the regression model.[22] This method of testing is necessarily imprecise. We require not only a correct sign but also a numerical value for the residual which is "sufficiently large" in at least four out of the seven sub-industries. Diagram 3:2 shows the basic set of data for a residual analysis for total manufacturing.

One general property of the model seems to have been substantial underestimation of upward plan revisions during the early upswing. This happened more or less systematically for all sub-industries during 1950, 1954, 1959 and also 1963. In terms of our model this property can probably be attributed to our linearity assumption and to the fact that the capital budgeting and accelerator components of our model have been combined with constant weights.[23] In accordance with the Meyer–Kuh [1957] and Meyer–Glauber [1964] results, we should expect the accelerator mechanism to predominate during the upswing period and "residual funds" or pure capital budgeting behaviour to be more prevalent during downswings and recessions. Furthermore, this underestimating suggests the importance for investment behaviour of sudden reversals of expectations during the early upswing between the date of reporting and the actual realization of plans.

Secondly, the empirical estimates in the Arvidsson [1956] and Wickman [1957] studies were evaluated in the light of our calculations. For one thing the economic policy effects on machinery investments as measured in these studies proved much too large. This result was to be expected on account of the questionnaire technique used in those studies; entrepreneurs tended to report excessively large reductions in plans. Furthermore, our estimated residuals are of incorrect (positive) sign during 1955 but correct negative sign during 1956 and 1957. To the extent that these residuals can be interpreted as reflecting the effects of the general credit squeeze, the special investment tax and high interest rates during these years, they suggest a *later* policy impact on investment behaviour than do the Arvidsson and Wickman studies. The reductions in investment measured in these studies have been plotted in Diagram 3:2 (shaded areas 1955 and 1956).

The particular liquidity mechanism of the investment funds system

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[22] A formal account of this method is to be found in Eliasson [1967 *b*, pp. 221 ff.]. Though the idea is somewhat different, the formal problems (in this residual analysis) are in principle the same as those met with in what has been called step-wise regression or (also) residual analysis. See e.g. Goldberger [1961, 1964, pp. 194 ff.], Kabe [1963], and others.

[23] I.e. the value of ξ_1 in (2:7) on p. 35 should realistically have been allowed to vary over time. Our empirical data did not allow such a sophisticated approach.

in operation during the peak years 1960 and 1961 would lead one to expect downward plan revisions and negative residuals during these years. This was in fact observed for practically all industry groups, and we are led to accept the hypothesis that some reductions in machinery investments may have occurred in 1960 and 1961 due to the operation of the investment funds system.

Finally, the use of investment funds during the recession of 1962 and 1963 to stimulate investment will be considered. Investment in construction poses particular problems here; for one thing our realization function for construction covers too short a period, and furthermore, the release of investment funds coincided with the easing of controls in the capital market. Both factors have been found to constitute important determinants of investment, and we are unable to isolate the separate influence of these two economic policy measures on *the basis* of our time-series data. In fact ΔE^L may be expected to pick up the additional influence of the investment funds, which was found in Eliasson [1965] to be substantial. The timing of the announcement of the IF-release suggests in fact that the "IF-effects" should figure in plan revisions for 1962 but be included entirely in reported plans for 1963. All this complicates matters in such a way as to make a residual analysis impossible.

Due to the timing of the release of funds for investment in *machinery and equipment* the same statistical problems do not appear in this case. In fact, most of the IF-impact should show up as plan revisions for 1963, since plans had been reported more than a month before announcement of the release and since the timing of this release required delivery before the end of 1963. Furthermore, the fairly long time-series for investment in machinery reduces the risk of upward bias in the regression coefficients of ΔE^L. The residuals were found to be of correct positive sign in practically all branches. Their numerical size agreed well with the corresponding effect as measured in the questionnaires for the investment funds study. This was particularly so for total manufacturing as can be seen from Diagram 3:2 (shaded area 1963).

5. *Ex-post Simulations—Machinery*

Since completion of the empirical work early in 1966 a number of new observations has become available. We shall therefore conclude this chapter with an ex-post "prediction" with the help of the aggregate realization function. The simulated values cover the years 1964–67. The results have been plotted in Diagram 3:2. By and large, the additional years encompass a complete business cycle; the upswing of 1964, culmination of the cycle in 1965, and a marked recession in 1966 stretching far into 1967. Towards the end of 1967 the first indications of a possible revival were apparent. There now seems to be general agreement that a revival, even though slow, has been under way all through 1968, despite the extra uncertainty created e.g. by problems in the international payments sphere and a disparate inprovement in demand for Swedish export industries.

One argument put forward has been that the assumed investment reserve was reduced substantially, or possibly eliminated altogether, as a result of the recessionary conditions prevailing during 1966 and 1967.

Another factor to bear in mind is the relevance for the years 1964–67 of the simple expectations alternative (2:31) as to controlled external sources of finance. The substantial easing of capital market controls since 1962 could mean that some firms have reported investment plans, contingent to some extent upon the availability of long-term bond and debenture finance.

As expected, the goodness of fit for the prediction period is not as good as that for the ex-post period. This is, however, common experience in prediction work. Furthermore, we should remember that the simulated values for the years 1964–67 are based upon the aggregate realization function, while values for the observation period are the annual sums of simulated values for all (seven) sub-industries. Still, the aggregate realization function performs quite satisfactorily for the years 1964 through 1967.

As seen from the diagram, reported plans for 1966 increased very much. The turn of the year 1965/66 was, however, characterized by a sudden reversal of expectations from optimism to pessimism, and consequently a marked reduction in the positive plan revision normally encountered. The model simulation does not properly pick up this variation. The actual plan revision is underestimated in 1965 and overestimated in 1966. The most probable explanation is that the linear structure of the model and the heavy reliance on output expectations do not properly account for such sudden changes in expectations. There seems, however, to be no apparent reason for attributing this less satisfactory performance of the estimated model to a complete disappearance of the investment reserve. Quite the contrary—despite the depressed business conditions prevailing during 1966 a large number of firms went through the recession seemingly unaffected. As noted already in Section 2.1, the only requirement for the existence of a sufficient investment reserve is that *some* firms possess a backlog of planned projects, not necessarily many nor by any means all, firms.

During 1967 the simulated value fits the ex-post value closely. In terms of our theory, furthermore, a substantial part of the upward plan revision during 1964 through 1967 should be attributed to a quite ample supply of controlled external long-term funds (cf. Diagram 1:2 in Chapter 1). There exists, however, a risk that part of the enlarged plan revision in 1967 has in fact been occasioned by the release of investment funds for machinery investment in May the same year. Owing to the timing of the arrangements in connection with this IF-release there are, nevertheless, cogent reasons to believe most of the IF-effect on investment to have materialized during 1968.[24]

In summary, then, we believe that the basic premises of the model and the numerical results for 1950–63 should be considered quite satisfactory for the "forecast" period 1964–67.[25] Indeed, when simulated values of the realization function (R^*) are added to the investment plan itself (I^{pM}) the sum follows actual investment in machinery and equipment very closely (Diagram 3:2).

[24] The effects of the 1967/68 IF-releases are at present being investigated by the National Institute of Economic Research in Stockholm.

[25] Cf. also the reestimation of the machinery function for the entire period 1950–67 in the last paragraph of Section 3.3.1.

CHAPTER 4

Some features of the capital budgeting theory of investment planning

In this chapter certain formal properties of the investment planning model will be made explicit and discussed with a view to empirical application. In particular the ability of the theory to account for investment behaviour and financial flows in a context of long-run economic growth are to be considered. The structure of the financial model will be investigated for the purpose to which it has been employed in Chapter 6, namely to forecast demand by industry upon the money market during 1965–70.

4.1 Structure of the Financial Sector

To derive the capital budget Φ (expression (2:17) in Chapter 2), combine the total differential of equations[1] (2:8–11) with our definition of the capital budget (2:15–16); the structure of the financial model is then given in matrix form by:

$$\begin{bmatrix} 1 & 1 & 1 & -1 & 1 & -1 \\ 0 & 1 & -e_3 & -g_3 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \Phi \\ \Delta \bar{L} \\ \Delta \bar{H} \\ \Delta \bar{D} \\ \Delta \bar{X} \\ S^{AV} \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 & -1 & -1 & 0 \\ 0 & -b_3 & 0 & 0 & 0 & 0 \\ 0 & -b_1 & 0 & -e_1 & 0 & 0 \\ 0 & -b_2 & 0 & 0 & 0 & 0 \\ 0 & -b_4 & -c_4 & 0 & 0 & 0 \\ -a_5 & -b_5 & 0 & 0 & 0 & -f_5 \end{bmatrix} \begin{bmatrix} S \\ \Delta S \\ \Delta^2 S \\ \Delta E^c \\ \Delta E^L \\ 1 \end{bmatrix} = 0 \qquad (4:1)$$

[1] Since all functional forms used are linear difference notation is used for simplicity.

(4:1) can be expressed more compactly by:

$$By + \Gamma x = 0, \tag{4:2}$$

where B and Γ are the two 6×6 coefficient matrixes of the financial model. y and x are vectors of endogenous and exogenous variables respectively.

We note in passing that the B matrix is triangular. This is an expression of the recursiveness of the financial model, a property already observed in Section 2.4. This property combined with the assumption of independent disturbance terms allows application of ordinary least squares to each structural relation in (4:1) or each equation (2:8–12) in Section 2.3.4, yielding unbiased estimates of the structural coefficients which are identical with full information maximum likelihood estimates.[2]

Provided the determinant $|B|$ is nonsingular[3] we can rewrite (4:2) in its reduced form:

$$y = \prod x$$

where

$$\prod = -B^{-1}\Gamma. \tag{4:3}$$

The reduced form of the model expresses each endogenous variable in the vector y as a linear function of the exogenous variables in x. After some algebraic manipulation (4:1) yields:

$$\prod = \begin{bmatrix} a_5 & N_1 & -c_4 & N_5 & 1 & f_5 \\ 0 & N_4 & 0 & e_1 e_3 & 0 & 0 \\ 0 & b_1 & 0 & e_1 & 0 & 0 \\ 0 & b_2 & 0 & 0 & 0 & 0 \\ 0 & b_4 & c_4 & 0 & 0 & 0 \\ a_5 & b_5 & 0 & 0 & 0 & f_5 \end{bmatrix} \tag{4:4}$$

where

$$N_1 = b_5 - b_4 - b_3 + b_2(1 - g_3) - b_1(1 + e_3)$$

$$N_4 = b_3 + b_2 g_3 + b_1 e_3$$

$$N_5 = 1 - e_1(1 + e_3).$$

[2] See e.g. Johnston [1963, pp. 265f.]. Note, however, the fact that disturbance terms will not be independent if the financial system is "closed". See further p. 76.

[3] The triangularity of B and the diagonal of ones immediately give $|B| = 1$.

From (4:4) the capital budget may be easily written as:[4]

$$\Phi = \underbrace{\Delta E^L + \Delta E^c}_{\text{I}} + \underbrace{a_5 S + f_5}_{\text{II}} + \underbrace{N_1 \Delta S - c_4 \Delta^2 S - e_1(1+e_3)\,\Delta E^c}_{\text{III}} \tag{4:5}$$

Thus (I) stands for net borrowing in the organized credit market, (II) for the current generation of internal funds or gross saving ($=S^{AV}$) and (III) for the net transactions demand for funds to finance the current operation of firms.

To make the following exposition simple, the condition is imposed on (4:1) that

$$f_5 = c_4 = e_1(1+e_3) = 0. \tag{4:6}$$

Further, we define:

$$\Delta E = \Delta E^L + \Delta E^c \tag{4:7}$$

and obtain from (4:5):

$$\Phi = \Delta E + (a_5 + N_1\,\delta)S, \tag{4:8}$$

where

$$\delta = \frac{\Delta S}{S}. \tag{4:9}$$

As long as external sources of funds are closed to firms, i.e. $\Delta E = 0$, it follows that:

$$\frac{\partial(\Phi/S)}{\partial\delta} = N_1. \tag{4:10}$$

Estimates of N_1 are negative throughout practically all sub-industry groups (see Table 3:2). Thus, an accelerated growth rate decreases the rate of growth in the capital budget and vice versa. The partial derivate (4:10) thus brings out the anticyclical phasing of the capital budget already discussed in Section 3.2.4.

It follows immediately from (4:8) and the condition $\Delta E = 0$, that the critical maximum growth rate δ^* at which the accumulation of working

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[4] In terms of the capital budget presented in Table 3:2 it is easily seen that

$N_1 = -c_4;\ N_3 = N_5 - 1.$

capital drains firms of all internal sources of funds, (i.e. $\Phi = 0$, $\Delta E = 0$) is the solution to:

$$0 = (a_5 + N_1 \delta^*)S \tag{4:11}$$

or rather

$$\delta^* = (-1)\frac{a_5}{N_1} > 0. \tag{4:12}$$

δ^* can be calculated from Table 3:2. It is 0.23 for the whole manufacturing sector and ranges from somewhat lower values[5] to growth rates far above 100 percent between sub-industries.

4.2 Implications for Profitability and Growth—Long-run Equilibrium Conditions

We propose here to expound in an unmixed fashion the long-run growth and profitability implications concealed within the model structure. In a way this section may be considered a very simple test for consistency. A study of the long-run equilibrium properties of the model necessitates a "closing" of the financial model and the specification of a production function. By assuming away all other sources of external finance (including equity issues) than those already incorporated in the model structure we obtain a closed financial system in the sense that all sources of finance are specified, and that total uses of funds specified equal total sources specified. With the help of (2:4) and (2:13) we thus *define* the following feed-back mechanism.[6]

$$(-1)\Delta A^{os} = I - \Phi = \xi_1(I^* - \Phi) + \xi_2 A^{os}_{t-1}. \tag{4:13}$$

We furthermore introduce a simple "production relationship" represented by a constant marginal capital output ratio X, i.e.

$$Q = \frac{K_{t-1}}{X} \tag{4:14}$$

This is a simple picture of the capital-output relationship of firms. Realized production is always a constant multiple of capital stock at the be-

[5] Note sub-industry (I) for which $N_1 > 0$ and no solution with $\delta > 0$ to (4:11) exists. Obviously this means that Φ in (4:8) is always positive as long as $\delta > 0$. $(a_5 + N_1\,\delta)S$ will always be > 0.

[6] Note the restriction on disturbance terms in the equations of the financial model (2:8–11) implied by (4:13). See p. 53.

ginning of the current period. With some formal complexity the production function and hence the analysis may, however, be extended to include a number of features from traditional neoclassical production theory.[7] However, empirical evidence for the post-war period indicates a rather constant or slightly increasing capital output ratio, when capital is measured from the production cost side.[8] (4:14) will suffice for the following exposition on the principal growth properties of the capital budgeting theory of investment, designed primarily to be a satisfactory but approximate explanation to short-run investment behaviour.

Assuming for simplicity $b=0$ in (2:5) and introducing (2:21) we obtain

$$I^* = a[\lambda\eta_1 Q + \lambda\eta_2 \Delta Q - (1+\lambda\varrho)K_{t-1}].$$

Imposing (2:24) on (4:8) we obtain:

$$\Phi = \Delta E + a_5 Q + N_1 \Delta Q.$$

Substituting $(I^* - \Phi)$ together with (4:14) into (4:13) there emerges:

$$(-1)(\Delta A^{os} + \xi_2 A^{os}_{t-1}) = \xi_1 \left[A + B\frac{\Delta Q}{Q} - \frac{\Delta E}{Q}\right] Q \qquad (4:15)$$

where

$$A = a\lambda\eta_1 - a_5 - a(\lambda\varrho + 1)X$$

$$B = a\lambda\eta_2 - N_1.$$

This is evidently a non-homogenous linear difference equation of first order. The non-homogenous part is a function of the level of production and its change as well as the Government action parameter $G = \Delta E/Q$. The long-run growth rate δ^* compatible with equilibrium in financial stocks is obtained by making $A^{os} = A^{os}_{t-1} = 0$ and solving for δ^*:

$$A + B\,\delta^* - G = 0. \qquad (4:16)$$

Since $\xi_1 \neq 0$, $Q \neq 0$ we obtain from (4:15):

$$\delta^*(G) = \frac{a[(\lambda\varrho + 1)X - \lambda\eta_1] + a_5 + G}{a\lambda\eta_2 - N_1}; \qquad \frac{\partial\delta^*}{\partial G} = \frac{1}{a\lambda\eta_2 - N_1} > 0.^{9} \qquad (4:17)$$

[7] Some attempts in that direction are found in Eliasson [1967*a*, pp. 246ff.]. Basically a derived form of the production structure like (4:14) is compatible with a traditional Cobb–Douglas' production function if we assume $\partial Q/\partial K = \beta Q/K =$ constant, where β is the elasticity of output w.r.t. capital. Of course such a restrictive specification implies a number of assumptions as to the supply of labour, technical progress, etc.

[8] See e.g. Lundberg [1961, pp. 109ff.].

[9] This will always be true if $N_1 < 0$ (cf. Table 3:2), because of (2:18).

The equilibrium growth rate is dependent upon the constant coefficients of the total model plus the ratio of the inflow of government controlled external funds to production volume ($=G$). Clearly δ^* increases with G.

When growth takes place at the constant time rate δ^* it follows immediately from (4:13), (4:14), (2:19) and the definition $I=\Delta K+\varrho K_{t-1}$ (ϱ is the constant depreciation factor) that I, I^*, Φ as well as K all have to grow at the same constant rate.

Since

$$G=\frac{\Delta E}{Q} \text{ and } \delta=\frac{\Delta Q}{Q}$$

(4:16) is easily rewritten as:

$$\Delta E=AQ+B\Delta Q. \tag{4:18}$$

This *equilibrium* relationship clearly brings out the dependence of growth upon the current inflow of ΔE finance. (4:18) is the relationship used in Chapter 6 to predict the requirements on external sources of finance for the Government long-term production and investment plan for the period 1966–70 to be realized "financially". The difference is only that the investment plan (here concealed in the linear relation) has been specified separately in the forecasting equation employed (see Section 6.1).

Implications for *profitability* are easily derived. Using (2:18), (2:20) and (4:14) the net average rate of return on fixed capital before tax is defined as:

$$R=\frac{\prod^N}{K_{t-1}}=\frac{\eta_1 Q+\eta_2\Delta Q}{QX}-\varrho \tag{4:19}$$

$$R=\frac{(\eta_1+\eta_2\delta)}{X}-\varrho. \tag{4:20}$$

We use K_{t-1} in the denominator since capital accumulation has been assumed in (4:14) not to increase productive capacity during the current period. From η_2, $X>0$ it follows immediately that

$$\frac{\partial R}{\partial \delta}=\frac{\eta_2}{X}>0.$$

The rate of return increases with the growth rate δ (*ceteris paribus*). Because of (4:17) an increased supply of ΔE finance consequently enhances profitability as well as growth. A constant rate of growth means a constant rate of return. If the level of gross profits in (2:18) happens to be independent of production change i.e., $\eta_2=0$, also the rate of return R in (4:20) is independent of variations in the rate of growth.

As we have shown already only one particular "optimum" growth rate δ^* is compatible with financial long-run equilibrium at each (constant) choice of government policy $\bar{G}$. The rate of return as well as optimum rate of growth increases with $G=\Delta E/Q$. To be accepted as a reasonable explanation to investment behaviour and growth such a model picture of reality of course requires an economic environment characterized by expansionary tendencies and long-run business optimism. Expected rates of return always exceed by a substantial margin the nominal cost of borrowing in the organized credit market. No restrictions as to *debt capacity* in the sense of Donaldson [1961] are allowed to come into effect within the model specified as far as E finance in the organized credit market is concerned. This is also the idea behind the assumed *existence* of an *investment reserve* discussed in Section 2.1. As an approach to the explanation of short-run investment behaviour, we believe this approximation to be a satisfactory approach. It should be noted furthermore that any pure accelerator or profits—plow-back explanation to investment requires (implicitly or explicitly) the same basic expansionary assumption, which is also implicit in traditional Keynesian theories of growth, based upon the specification of a consumption function and an accelerator induced investment function, as e.g. the Harrod and Domar models.

A fruitful exploration into the factors behind *long-run* investment behaviour and inducements to growth requires *inter alia* a more elaborate specification of the gross profit function (2:18) and the production function (4:14) as well as allowance for the possibility of an overall debt constraint. Such is also the line of approach adopted in the closing part of the study of investment behaviour under way at the Industrial Institute for Economic and Social Research in Stockholm, of which this publication is only one part.

CHAPTER 5

Inter firm borrowing—the "grey" credit market[1]

In this chapter the structure of trade credit flows in the "grey" credit market will be investigated. Firstly, an estimate of the two *credit functions* (2:8) and (2:9) in Chapter 2 will be taken up. Next follows a discussion and empirical analysis of the *buffer stock function* of the "grey"

Table 5:1. *Function for extended trade credits, estimated coefficients by branch*

$H = aS + b\Delta E^c + c$ period of observation: 1950–63

Branch	$\hat{a}$	$\hat{b}$	$\hat{c}$	R
1. Mining, metal- and engineering industries	0.33 (0.02)	3.87 (1.16)	917	0.99
2. Stone and clay	0.47 (0.03)	0.61 (0.89)	−13	0.99
3. Wood, pulp and paper	0.58 (0.16)	2.10 (1.67)	−1 484	0.83
4. Printing and allied industries	0.46 (0.07)	1.75 (4.52)	−180	0.96
5. Food manufacturing industries	0.06 (0.01)	2.82 (0.92)	210	0.93
6. Textile-, Leather- and Rubber industries	0.16 (0.02)	0.72 (0.36)	−74	0.96
7. Chemical industries	0.66 (0.11)	−0.05 (1.77)	−824	0.92
Total Manufacturing	0.33 (0.02)	3.39 (0.78)	−1 532	0.99

[1] The *grey* credit market has been defined to include all credit transactions *outside* the *organized* credit market, which encompass commercial banks, insurance companies, the bond and debenture markets as well as the stock market. So defined, the "grey" credit market is dominated by trade credit flows. The statistical data are not, however, a pure representation of trade credit flows. They also include inter-firm credits not associated with flows of goods and credit transactions within a concern, (provided member firms are separate juridical bodies and keep separate accounts). Furthermore, the asset side of firms also include variations in holdings of financial securities, recorded at book values.

Table 5:2. *Function for trade debts, estimated coefficients by branch*

$D = aS + b$ period of observation: 1950–63

Branch	$\hat{a}$	$\hat{b}$	R
1. Mining, metal- and engineering industries	0.42 (0.03)	−1 762	0.980
2. Stone and clay	0.47 (0.04)	−2	0.955
3. Wood, pulp and paper	0.70 (0.14)	−1 432	0.829
4. Printing and allied industries	0.37 (0.03)	−111	0.973
5. Food manufacturing industries	0.06 (0.01)	135	0.894
6. Textile-, Leather- and Rubber industries	0.18 (0.02)	10	0.962
7. Chemical industries	0.35 (0.07)	−121	0.850
Total Manufacturing	0.39 (0.02)	−3 803	0.988

credit market. Thirdly, the formal derivation of a credit function is carried out. Finally, the conditions necessary for application of the residual analysis to test for the existence of financial buffer stock variations around the hypothesized transactions components in trade assets and debts are presented.

5.1 Trade Credit Flows—Empirical Results

The principal hypothesis implicit in the two credit functions (2:8) and (2:9) was that average credit periods are stable (see further Sections 5.2 and 5.3). Estimated coefficients are recorded in Tables 5:1 and 5:2. Note that the dependent variables are the actually recorded stock entities (H, D), not the transactions components ($\bar{H}$, $\bar{D}$). Estimates of transactions components are defined as the predicted or simulated values of the estimated functions (see Sections 2.3.5 and 5.4).

Clearly stocks of trade assets as well as liabilities are closely correlated with the level of sales. For total manufacturing increases in sales are associated with increases in trade credits extended (*ceteris paribus*) amounting to on average 33 percent of the sales change. Coefficients are significant for all sub-industry groups by a substantial margin.

The hypothesis that increases in commercial bank borrowing induce increases in the volume of trade credits (*ceteris paribus*) is accepted by the composite test. However, the estimated coefficients seem too large on average to represent only this effect. The reader will also be aware of the fact that contrary to the specification of (2:8), the *net changes* in borrowing from the commercial banks (not the stock of outstanding debts) appear as an explanatory variable in Table 5:1. The main reason for this is that the close correlation between S and E^c due to a common trend component prevented simultaneous estimation with both S and E^c included. Secondly, the basic component in commercial bank lending which might be expected to induce increases in the volume of trade credit among firms is the highly variable component of very short term commercial bank loans which revolve a number of times each year. In fact, a gross figure for commercial bank borrowing would be the most appropriate variable in a context of annual time series data. Such figures were not available, however, so that net figures had to suffice, and we would not attach much significance to the size of the estimated coefficients $\hat{b}$.

The debt side of trade credit flows recorded in Table 5:2 reveals a similar pattern. The estimated sales coefficients vary somewhat between the two credit functions on the sub-industry level, but are roughly the same size for total manufacturing, suggesting that an increase in sales should *ceteris paribus* generate a slight credit surplus.[2]

As will be shown in Section 5.3, if credit periods are stable, a steadily increasing volume of sales will produce an unstable intercept in the credit functions, which converges, however, towards a negative value. Evidently this theoretical result conforms well with the large number of negative intercepts estimated in Tables 5:1 and 5:2.

5.2 Buffer-Stock Function of the "Grey" Credit Market

A common argument in Sweden has been that inter-firm borrowing will expand substantially over and above transactions levels when other forms of external finance are not available, e.g. due to a tight monetary policy. In terms of trade credit transactions only, a reasonable hypothesis would be that *individual* firms try to prolong credit periods on the debt side and to shorten credit periods on the asset side when monetary policy is tight and outside financing scarce or unavailable. However, each trade

[2] It might be mentioned that D has also been regressed on H, to give coefficients varying narrowly about unity on the sub-industry level, but equal to unity for total manufacturing. This time the commercial bank variable was excluded. See Eliasson [1967 *b*], Table D on p. 247.

debt has to be matched by an equally large trade asset for some other firm. Within a closed group of firms then, the aggregate value of trade debts must equal the aggregate value of trade assets. Consequently, the same must hold for average credit periods also. Assymetric variations in average credit periods must be defined between two firms, groups of firms, two economic sectors or between the domestic economy and the rest of the world. On the other hand, average credit periods on both sides of the balance sheet might very well vary together within closed groups of firms also. The hypothesized mechanism under tight money conditions would then be a general lengthening of credit periods (on the debt side as well as the asset side) bringing about a more efficient redistribution of excess liquidity within the private sector via the "grey" credit market, or, in other words, an increased velocity of the total money stock.

Since private liquidity is mainly held in the form of demand deposits in the commercial banks such a redistribution would mean that liquid funds are temporarily shifted from the commercial banking system to the "grey" credit market. Because of the extensive function of the commercial banking system as a payments agency, with a time-lag part of this instantaneous liquidity drain will return to the banks.[3] Provided no restrictions are imposed on lending by commercial banks or the organized credit markets in general we should of course expect the allocation mechanism to function more efficiently in the organized markets for credit than in the "grey" market due partly to better information handling and partly to the fact that there are well-known credit channels. Thus a redistribution of liquid funds from the organized market to the "grey" market would tend to reduce temporarily the overall efficiency in the allocation of privately held liquidity. Of course, this reduction in allocative efficiency is one principal aim of a tight credit policy. In a *controlled* credit market, on the other hand, the verdict is not equally evident. If by efficiency we mean the ability of the market to channel funds to their most remunerative uses the hypothesized inflation of the "grey" credit market might as well mean an improvement in overall allocative efficiency; the improvement being evaluated with respect to the non-perfect allocation in the partly controlled market.

As noted, the hypothesized credit functions estimated in the previous section assume that average credit periods are constant over time, in

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[3] We may note in passing that this will not happen in the case of the particular liquidity arrangements of the investment funds (IF) system employed in 1960 and 1961 (see p. 14 and below). Besides the fact that the Central Bank is now the borrower (instead of firms) the mechanism is essentially the same.

other words, that any buffer-stock redistribution of liquid funds between the two markets is either non-existent or negligible. The institutional fact that trade credit financing of e.g. investment expenditure is a very expensive form of borrowing should make such an assumption quite reasonable. We propose in this section, however, to test the assumption of stable average credit periods in the form of a residual analysis.[4]

As will be shown in Section 5.4 a lengthening of average credit periods should increase the "true" sales coefficients in the two credit functions thus producing a positive change in computed residuals, and *vice versa*.[5]

The test applied concerns *each year* and treats the debt and asset sides separately. The criterion is that the residual change should (A) be correct as to sign of direction and (B) be sufficiently large in (C) at least *four* out of the seven branches. Nonfulfillment results in rejection of the hypothesis for the particular year studied. Indeed the residual method adopted is designed to test for the existence of *considerable instability* in average credit periods, not only for the mere existence of instability. Requirement (B) of course introduces an element of arbitrariness into the testing procedure. For a definition of the buffer stock components $(H-\bar{H})$, $(\bar{D}-D)$ and (as well) $(L-\bar{L})$ the reader is referred to the definition of the financial disequilibrium variable in (2:13), Chapter 2. We do not record the statistical data here. The main results will, however, be reported.

Between 1951 and 1952 as well as 1956–58 the residuals gradually fell from positive to large negative values for both the debt and asset sides together. Our test does not support the hypothesis that a lengthening of average credit periods or a shifting of liquid funds from commercial banks to the "grey" market took place these years; in particular during the peak years of 1952 and 1957.

[4] The same hypothesis has been tested on English data in Brechling and Lipsey [1963] and Coates [1967]. Coates studied the development over time of the ratios H/S and D/S. His results support our hypothesis of stable credit periods. Brechling and Lipsey apply a residual analysis similar to ours (see below). Their results contradict our assumption of stable credit periods. As will be demonstrated in the next section B & L seem, however, to have erred in interpretation. A reinterpretation of recorded statistics produces a result basically opposite to theirs and compatible with ours (see below). However, Meltzer's [1960, 1963] results indicate the possibility of a certain sensitivity of credit periods to variations in the rate of interest on short commercial bills.

[5] For this to hold we have to assume that the intensity of credit policy and consequently the variations in average credit periods are *not* correlated with the cyclical pattern of sales. This is a necessary condition for unbiased sales coefficients. If not fulfilled, the sales coefficients instead of the residuals will reflect the influence of variable credit periods. That this assumption is quite reasonable has been indicated already in Chapter 1. A more detailed support is found in Eliasson [1967*b*, p. 45].

The opposite holds for 1959 and 1960. In 1961 credit periods seem to have been shortened on the debt side and possibly lengthened on the asset side. During 1962 an overall shortening of credit periods dominates in terms of our model. As for the boom years 1959 and 1960 as well as for the recessionary year 1962 these observations are compatible with buffer stock behaviour in the "grey" credit market, not so for 1961.

It should be borne in mind though, that 1960 and 1961 are characterized by a substantial reallocation of funds from commercial banks to *blocked investment funds* accounts in the Central Bank, due to the particular method of operating the investment funds system these years (see Section 1.1.3). In our classification these blocked Central Bank accounts have unfortunately been recorded under the heading of trade credits granted. Thus the observed reflection in statistical data will be the same as that expected from the working of the buffer stock mechanism. The mirror image of the investment funds effect was observed also in the form of substantial negative changes in the residuals of the estimated liquidity function (2:10) during 1960 and 1961.

The results from the remaining years are inconclusive. The residual variations are too small to allow any conclusions. Furthermore, these years are not characterized by any particularly easy monetary policy and/or extreme cyclical conditions.

In conclusion, then, the cyclical pattern of observed residuals for both the assets and liabilities sides are closely correlated for the various branches. In general, however, this cyclical pattern is not compatible with the hypothesis of a financial buffer stock function in the markets for trade credits nor with a substantial variability in average credit periods.

The quality of statistical data used left much to be desired; e.g. the data include a number of undesired components which could not be adjusted for. Nevertheless, we are forced to reject our hypothesis of a substantial variability in average credit terms at the sub-industry level. At the same time this conclusion supports the simple approach with linear credit functions in Section 5.1.

5.3 Derivation of a Credit Function

1. *The Individual Credit Function*

Suppose that sales by firm i is a continuous function of time $S_i(t)$. Continuous derivatives of any order are assumed to exist. Let $\alpha_i(r)$ stand for the instantaneous credit period (the average for firm i) between the sales flow $S_i(t)$ and the corresponding flow of payments $P_i(t)$. The credit period has been specified as a function of the variable r; we might think of r as for example an appropriate rate of interest which affects the length of the credit period. A number of additional factors are equally plausible. We need, however, no further specifications for the analysis to follow. r of course varies over time, i.e. $r(t)$. We restrict our analysis to the case $\alpha_i(r) \geqslant 0$. The case of payment in advance is not considered explicitly. $\alpha_i(r)$ is furthermore assumed to possess a continuous derivative of first order.

It follows that the flow of payments during the period $(t, t+\Delta t)$ depends on deliveries during the time interval $[t-\alpha_i(r), t+\Delta t-\alpha_i(r+\Delta r)]$. When $\Delta t \to 0$ the following relationship between the payments flow and the sales flow can be shown to exist:[6]

$$P_i(t) = \left[1 - \alpha_i'(r)\frac{dr}{dt}\right] S_i\left[t - \alpha_i(r)\right]. \tag{5:1}$$

We now define instantaneous trade credit creation as:

$$\frac{dH_i(t)}{dt} = S_i(t) - P_i(t) = S_i(t) - \left[1 - \alpha_i'(r)\frac{dr}{dt}\right] S_i\left[t - \alpha_i(r)\right]. \tag{5:2}$$

$H(t)$ signifies the stock of oustanding trade assets at time t. We want to derive from (5:2) a manageable relationship between H, sales $(=S)$, and the credit period $(=\alpha)$ or what will be called a *credit function*. Expanding $S_i[t-\alpha_i(r)]$ about t according to Taylor and substituting into (5:2) give:

$$\frac{dH_i(t)}{dt} = S_i(t) - \left[1 - \alpha_i'(r)\frac{dr}{dt}\right]\left[S_i(t) - \alpha_i(r)S_i^{(1)}(t) + \sum_{k=2}^{\infty}\frac{[-\alpha_i(r)]^k}{k!}S_i^{(k)}(t)\right]$$

[6] Proof: Using the mean value theorem of integral calculus twice the following equality will hold:

$$\Delta t P_i(t+\eta\Delta t) = \{\Delta t - \alpha_i(r+\Delta r) + \alpha_i(r)\} S_i \ \{[t-\alpha_i(r)] + \xi[\Delta t - \alpha_i(r+\Delta r) + \alpha_i(r)]\}$$

$$0 < \eta < 1, \ 0 < \xi < 1.$$

Dividing through on both sides by Δt and using the definition of a derivative we obtain the following limiting value:

$$P_i(t) = \left[1 - \alpha_i'(r)\frac{dr}{dt}\right] S_i[t-\alpha_i(r)]$$

$\Delta t \to 0.$

An expression similar to (5:1) was obtained by Hansen [1961, p. 34] in his treatment of payments flows connected with import and export transactions and the "errors and omissions" item on the credit side of the balance of payments.

where $S_i^{(k)} = \frac{d^k S_i(t)}{dt^k}$. Rewriting slightly we obtain:

$$\frac{dH_i(t)}{dt} = \frac{d[\alpha_i(r) S_i(t)]}{dt} - \alpha_i'(r) \frac{dr}{dt} \alpha_i(r) S_i^{(1)}(t) + R_i \tag{5:3}$$

where

$$R_i = (-1) \left[1 - \alpha_i'(r) \frac{dr}{dt} \right] \sum_{k=2}^{\infty} \frac{[-\alpha_i(r)]^k}{k!} S_i^{(k)}(t). \tag{5:4}$$

R_i is assumed to be finite. Integrating over the time interval $(0,t)$, we obtain the value of trade credits at time t as:

$$H_i(t) = \alpha_i(r) S_i(t) - \int_0^t \alpha_i'(r) \frac{dr}{d\tau} \alpha_i(r) S_i^{(1)}(\tau) d\tau + \int_0^t R_i d\tau - \alpha_i[r(0)] S_i(0). \tag{5:5}$$

Define

$$a_i(0,t) = \int_0^t R_i d\tau - \int_0^t \alpha_i'(r) \frac{dr}{d\tau} \alpha_i(r) S_i^{(1)}(\tau) d\tau - \alpha_i[r(0)] S_i(0). \tag{5:6}$$

Substituting into (5:5) gives the *individual credit function* for firm i as:

$$H_i(t) = \alpha_i(r) S_i(t) + a_i(0,t). \tag{5:7}$$

2. Aggregation of Credit Functions

Summation of (5:7) over a group of N firms yields the *aggregate credit function:*

$$H(t) = S(t) \underbrace{\sum^N \alpha_i(r) m_i(t)}_{\alpha(r)} + \underbrace{\sum^N a_i(0,t)}_{a(0,t)} \tag{5:8}$$

where

$$H(t) = \sum^N H_i(t), S_i(t) = \sum^N S_i(t) \text{ and } m_i = \frac{S_i(t)}{S(t)}.$$

Obviously $\alpha(r)$ is a weighted *average* of individual credit periods, the weights being the "*market shares*" $m_i(t)$. It follows immediately that variations in the average credit period α depend on changes in the composition of individual sales flows as well as variations in individual credit periods.

Obviously the two aggregate credit functions (2:8) and (2:9) in Chapter 2 imply the a priori assumption that α and a are constant over time.

Overlooking the presence of the commercial bank variable in (2:8) and the bar on top of the dependent variables, both credit functions are based on a number of individual Taylor expansions of the definition (5:1). The level of sales appears as an explanatory variable on the debit as well as the asset sides. This, of course, is not a satisfactory specification of the debt function (2:9). A desirable explanatory factor would have been the value of firms' purchases; a variable that was not readily available. As a substitute, the inclusion of sales (S) in (2:9) has certain merits. Firstly there is a substantial volume of inter-firm deliveries within at least the two largest sub-industry groups (1) and (3) and in particular within the total manufacturing sector. Secondly, and perhaps more important, sales and purchases of intermediate goods are closely associated over time. Of course, irregular variations in stocks of inventories and purchases of investment goods disturb this relationship. Lastly, the absence of time-series data for total firm purchases necessitated the inclusion of a sales variable in both (2:8) and (2:9).

3. *Some Properties of the Credit Function*

An analysis of the credit function requires that certain restrictions be imposed upon the time profile of sales. An extensive analysis would decompose into a number of (hopefully) interesting cases. We confine ourselves here to the case of (a) no change in level of sales and variable credit periods and (b) constant credit periods and exponential growth in sales. A more general treatment will have to await further analysis. Our attention is directed in particular to the impact of variations in α on stocks of credits and the stability properties of $a(0, t)$; they were both assumed constant in the empirical analysis of Chapter 3.

(a) Constant S, variable α

We disregard here the aggregation problem associated with summing over the a_i and assume a to be defined by (5:6) in the absence of indices i.[7] Then all $S^{(k)}=0$ for $k \geqslant 1$, and (5:8) reduces to:

$$H(t)=\{\alpha(r)-\alpha[r(0)]\}S(0).$$

Clearly:

$$\frac{\partial H(t)}{\partial \alpha(r)}=S(0)>0.$$

Increasing the credit period increases the stock of trade credits. The

[7] Actually our investigation refers to the *individual* credit function.

effect may be substantial even where possible variations in the credit period are small. Suppose the credit period is measured in terms of years and furthermore that the average credit period is increased by two weeks or roughly 0.04 year. During 1963 the level of sales for the group of manufacturing firms studied was around Sw. kronor 50,000 million. The level of trade credits extended amounted to roughly 15,000 million Sw. kronor. The assumed change in average credit period would then increase trade credits extended during the year by:

$$\Delta H \simeq 0.04 \times 50{,}000,$$

i.e. roughly 2000 million Sw. kronor or more than 10 percent. Within a closed group of firms a similar increase in the stock of trade debts is to be expected.

(b) Exponential Growth in S, constant α

Our aggregation assumption from the previous case is employed again. In principle we are studying an individual credit function. Now the derivative $\alpha'(r)\ [dr/dt] = 0$. Substituting the exponential sales flow:

$$S(t) = S(0)\, e^{\delta t}$$

into (5:5) or (5:8) it can be shown that:[8]

[8] Proof: Derivation of $S(t)$ several times and insertion into (5 : 4) together with $\alpha'(r)\dfrac{dr}{dt} = 0$ produce:

$$R = (-1)\, S(0)\, e^{\delta t} \sum_{k=2}^{\infty} \frac{(-\alpha)^k}{k!} \delta^k. \qquad \text{(A)}$$

Restricting ourselves to the case $0 < \alpha < 1$, $0 < \delta < 1$ it is easily seen that each term under the summation sign converges individually towards 0, with sign constantly alternating. Furthermore:

$$\left|\frac{(-\alpha)^k \delta^k}{k!}\right| > \left|\frac{(-\alpha)^{k+1} \delta^{k+1}}{(k+1)!}\right|.$$

The absolute values of consecutive terms form a monotonically decreasing series of numbers. Thus the corresponding alternating series also converges towards a finite sum. Consequently:

$$\sum_{k=2}^{\infty} \frac{(-\alpha)^k \delta^k}{k!} = \begin{cases} \dfrac{\alpha^2 \delta^2}{2} + [\text{negative finite term}] \\[2ex] \dfrac{\alpha^2 \delta^2}{2}\left[1 - \dfrac{\alpha\delta}{3}\right] + [\text{positive finite term}]. \end{cases}$$

(5 : 9) then follows immediately from (A).

$$R = (-1)S(0)\frac{\alpha^2\delta^2}{2}\left[1-\eta\frac{\alpha\delta}{3}\right]e^{\delta t} \qquad (5:9)$$

$0 < \eta < 1$

where δ is the constant rate of growth in sales. We consider the case $0 < \delta < 1$ only. Since $0 < \alpha < 1$, R is a function of time characterized by:

$$R(t) < 0 \qquad (5:10)$$

$$\frac{\partial R(t)}{\partial t} < 0.$$

Substituting (5:9) into (5:5) yields:

$$\frac{H(t)}{S(t)} = \alpha - \frac{\alpha^2\delta}{2}\left[1-\eta\frac{\alpha\delta}{3}\right]\left[1-\frac{1}{e^{\delta t}}\right] - \frac{\alpha}{e^{\delta t}} \rightarrow \alpha + \theta; \quad t \rightarrow \infty \qquad (5:11)$$

where θ is a *negative* constant. The ratio between the stock of trade credits and sales flow will clearly always be *smaller* than the average credit period when the credit period is constant and sales are growing exponentially.

Finally we note from the general specification in (5:4, 6, 7) that a depends significantly on the size of initial sales $S(0)$ (which may be considered large) times the initial credit period plus the sum of a series of consequitive time derivatives of the sales level weighted together by inter alia the components

$$\frac{[-\alpha_i(r)]^k}{k!}.$$

These components converge rapidly towards zero, constantly alternating in sign. It seems intuitively true (though it has not been shown here) that minor variations in α have only negligible effects on a. Accepting this conclusion, it would seem that variations in the credit period will (*ceteris paribus*) change the slope of the "linear" function (6:8) while the "intercept" a remains approximately constant. An increasing volume of sales and/or a varying growth rate in sales will *ceteris paribus* affect the credit function only as a parallel shift. Provided the average credit period is constant then, the actual value of H should differ from its transactions component by an additive shift factor as specified in (2:14c).

5.4 A Simple Method of Non-additive Residual Analysis

The purpose of the present section is to investigate the influence of variations in average credit periods on the computed residuals in regression equations (2:8) and (2:9) in Chapter 2. We shall propose a simple method to test for the presence of such variations.

Consider the estimate of the *transactions component* in trade assets:

$$\hat{\hat{H}}(t) = \hat{\alpha}S(t) + \hat{a}, \tag{5:12}$$

where $\hat{\alpha}$ and $\hat{a}$ are the least squares estimators of α and a in (5:8)—α and a are assumed to be constants. Combining (5:8) and (5:12) we define the computed *residual* as:

$$H(t) - \hat{\hat{H}}(t) = [\alpha(r) - \hat{\alpha}]S(t) + [a(0,t) - \hat{a}]. \tag{5:13}$$

Derivating this residual with respect to the average credit period gives:

$$\frac{\partial[H(t) - \hat{\hat{H}}(t)]}{\partial\alpha(r)} = S(t) + \frac{\partial[a(0,t) - \hat{a}]}{\partial\alpha(r)}. \tag{5:14}$$

Our concluding argument in the previous section was that the last partial derivative of (5:14) should be small relatively to $S(t)$ and possibly negligible as to absolute size. Since $S(t)$ is large and > 0, we would expect a lengthening of the average credit period *ceteris paribus* to *increase* the computed residual $[H(t) - \hat{\hat{H}}(t)]$ and *vice versa*. This is the substance of the residual testing procedure employed in Section 5.2. The fact that the sales variable also changes over time and may affect the term $a(0, t)$ substantially introduces an uncontrollable element into this residual analysis.

Besides the term $[a(0, t) - \hat{a}]$ in (5:13), the size and the sign of the residual obviously depends on whether $\alpha(r) \gtreqless \hat{\alpha}$. Consequently $[H(t) - \hat{\hat{H}}(t)]$, by itself gives no information as to possible variations in the average credit period. This seems not to have been noticed by Brechling and Lipsey [1963] who investigated the residual only.

CHAPTER 6

Manufacturing demands on the money markets 1965–70—a long-term forecast

6.1 Method and Background Material

The basis for this forecast is the report of the 1965 Government Long-term Survey which investigates the growth prospects and growth plans for the Swedish economy 1966–70.[1] A report on the manufacturing sector has been published separately by the Industrial Institute for Economic and Social Research (IUI) in Bentzel–Beckeman [1966]. In a parallel study Kragh [1967 *a*, *b*] has analysed the consequences of the total "plan" of production and capacity growth for credit flows in the organized credit market.

In principle, we propose to investigate in this chapter the total demand for external funds in the organized credit market that can be expected to originate if the long-term plan or "forecast" for production and capacity growth in the *manufacturing sector* is realized.[2] This in fact amounts to a reverse application of our investment model. Instead of analysing the impact of unexpected injections of cheap and subsidized finance into the manufacturing sector on investment, we propose to investigate here the "needs" for such finance created by the long-term plan. In this forecasting case planned investment demand—based partly on questionnaires sent to a very large number of firms—may be regarded as a subset of the investment reserve for the five-year period.

The theoretical foundation for the forecast has been expounded already in Chapter 4. It was shown there that the maintenance of financial equilibrium in the long-run requires equality between the capital budget and gross investment. Since output and gross investment for the prediction period is given in the Government investigation we only need to com-

[1] See "*Svensk Ekonomi 1966–1970 med utblick mot 1980*" (SOU 1966:1), or the English translation; *The Swedish Economy 1966–1970 and the general outlook for the seventies*. (Published by the Ministry of Finance) Stockholm 1966.

[2] A more detailed version of this chapter was originally published as a supplement to Kragh [1967 *a*]. See Eliasson [1967 *a*].

pute the necessary inflow of external funds from (4:5). It is assumed that the coefficients of the capital budget as estimated for each sub-industry group for 1950–63 will also be valid for the prediction period 1965–70.[3]

The long-term forecast by Bentzel–Beckeman is to be viewed mainly as a projection of future growth in productive *capacity*. The first years of the forecasting period evolved as we have seen, into the recession of 1966/67. Consequently, the actual rate of growth of output for the years 1965–67 fell substantially below the forecasted exponential growth trend. A comparison in this respect between actual development and the Bentzel–Beckeman results has been made by Ekström [1968]. His analysis, however, results in a quite small revision[4] of B & B's results and rather amounts to an appraisal of what cyclical factors would be required for actual development to coincide with predicted development on average. For that reason, the only additional computations possible on the financial side are comparisons between predicted and realized values for the period 1965–67.

The numerical results to be presented have been based on the application of individual sub-industry capital budgets (4:5) as estimated in Table 3:2. Individual "plans" for production growth or as B & B prefer to call them "calculations as to the most probable maximum growth rates", are available. On average manufacturing output is expected to grow by a maximum of 5 percent each year; this is an adjusted figure compared to the 7 percent average growth expectation quoted in questionnaires by a very large number of firms.

The investment "plan" is very rudimentary. On the basis of a numerical analysis of a production function, the choice fell upon a 7 percent growth rate in investment by manufacturing to secure a 5 percent ex-

[3] This requires inter alia that the production function adopted for the output-investment plan of Bentzel–Beckeman [1966] has to be consistent with the investment-growth model of Chapter 4, which has been applied here to estimate manufacturing demands upon the money markets. For a more extensive analysis in this respect see Eliasson [1967 *a*, pp. 247 ff.]. We also note that Bentzel–Beckeman [1966] are very sceptical about the numerical validity of "plan-data" presented. Often they prefer to refer to the "plan" as an "appraisal" or rather a "calculation". We are *of course* perfectly aware of the deceptive nature of numerical specification in prediction work. Any "plan", "prediction" or "forecast" is by definition an *ex-ante* concept normally to be subjected to substantial revisions. We take the liberty to use here the term "prediction" or "forecast" for our own calculations despite the vagueness of the exogenous input data.

[4] The original estimate of a 5.0–5.5 percent growth in output was reduced to 4.5–5.0 percent. Ekström [1968, p. 28]. Adjustments for this downward revision would change our results only slightly.

pected annual increase in output, capacity, assuming a practically unchanged level of employment and roughly 3 percent annual contribution to the growth rate from technical change.[5] The unadjusted investment plans compiled from the questionnaires were apparently too low for being compatible with 5 percent annual growth in output. According to questionnaires an average investment *volume* exceeding that of the previous five-year period by 6 percent only, was reported to be needed during 1966–70. Most probably this is again a reflection of the "exclusion hypothesis" discussed in Section 2.3.10. The price level of final and investment goods during 1963 was assumed (in the calculations) to remain constant during the remainder of the sixties. A correction has subsequently been made for annual price changes up to and including 1966. The results of the prediction to be presented in the next section are based on 1966 prices.

Assuming for each sub-industry group in (4:5) that:

gross investment $= I = \Phi$,

aggregating over industry groups and substituting the production and investment plans exogenously given from Bentzel–Beckeman [1966] and the report of the long-term survey into the formulas *total manufacturing net demand for funds* (ΔE^D) in the organized credit market is given as:[6]

$$\Delta E^D = I - \Sigma N_{1i} \Delta S_i - \Sigma a_{5i} S_i - \Sigma f_{5i}.$$

The demand for external funds so calculated represents what will be called *forecast alternative* (1) in the next section. For example, we may specify here the following numerical properties for the aggregate forecasting model:

$$\Delta E^D = I + 0.36\,\Delta S - 0.07\,S - 190.$$

Besides the financial requirements arising from investment in fixed assets the accompanying net requirements of working capital for transactions purposes amount to 36 percent of the change in sales or output. Internal financing amounting to on average 7 percent of sales is to be subtracted from this total figure.

[5] A detailed record of the underlying data has not been presented in this monograph. The reader is referred to Bentzel–Beckeman [1966] or, for a convenient summary table to Eliasson [1967*a*], Table 2:1, p. 232.

[6] On the basis of the uncertain empirical results recorded in Table 3:2 we assumed $c_4 = e_1(1+e_3) = 0$ and reestimated equations (2:8, 11) of the financial model exclusive of ΔE^C and ΔS. This also explains the divergence between the coefficients in the numerical example below and those of Table 3:2.

Finally, an estimate of the initial disequilibrium in stocks of working capital at the beginning of the forecasting period can be obtained with the help of (2:13). Deficits in working capital stocks would also have to be made good if financial equilibrium is to be attained by the end of the forecasting period.

One argument during recent years (possibly coloured by the recessionary conditions) has been that the economic environment might quite plausibly change for the worse for business firms during the forecasting period. Excessive wage increases and the additional profit squeeze arising from the increasing contributions to be paid by employers to the new National Pension Fund have combined with apprehension concerning possible faltering demand for Swedish exports to produce a gloomy outlook for the immediate future. *Inter alia* declining savings/investment ratios (see Diagram 6.1) from 1958 and onwards have been presented as evidence in support of this argument. To account for contingencies of this nature a forecast alternative (2) has been computed. Instead of basing the savings projection on the savings-sales relationship for the whole period 1950–63, the somewhat lower average savings margin (S^{AV}/S) observed for the more recent period 1961–63 has been assumed for the prediction period.

6.2 Results of Forecast

1. *Demand for external funds 1966–70*

The basic results of our calculations have already been plotted in Diagram 1:2 in Chapter 1. The steep upward trend in investment and total uses of funds experienced from the end of the fifties is seen to continue all through the sixties. In both prediction alternatives the net demand for funds in the organized credit market has to increase (substantially in alternative (2)) for the long-term "real plan" to be attained. According to alternative (1) a total demand for external funds of about 6300 million Sw. kronor has been calculated for the five-year period 1966–70 (see Table 6:1). This figure lies only slightly above actual borrowing in the organized credit market during the preceding five-year period. About 500 million Sw. kronor of additional external funds would have to be made available to secure equilibrium in stocks of working capital by the end of 1970. The less optimistic savings alternative (2) would require borrowing to increase by more than 50 percent if the expansion plan of the Government investigation is to be realized financially. We regard this alternative as an extreme one, however, despite the fact that actual borrowing during 1965, 1966 and 1967 (see Diagram 1:2) might suggest

Table 6:1. *Net borrowing by manufacturing industry in the organized credit market 1951–70, Sw. kronor, million*[a]

	1951–1955	1956–1960	1961–1965	1966–1970 (forecast)
	1 340	1 640	5 600	6 300 alt. (1) 9 900 alt. (2)
Additional demand to attain financial equilibrium by 1970				500[b]
Short-term borrowing in commercial banks as a percentage of total borrowing	26	12	30	—

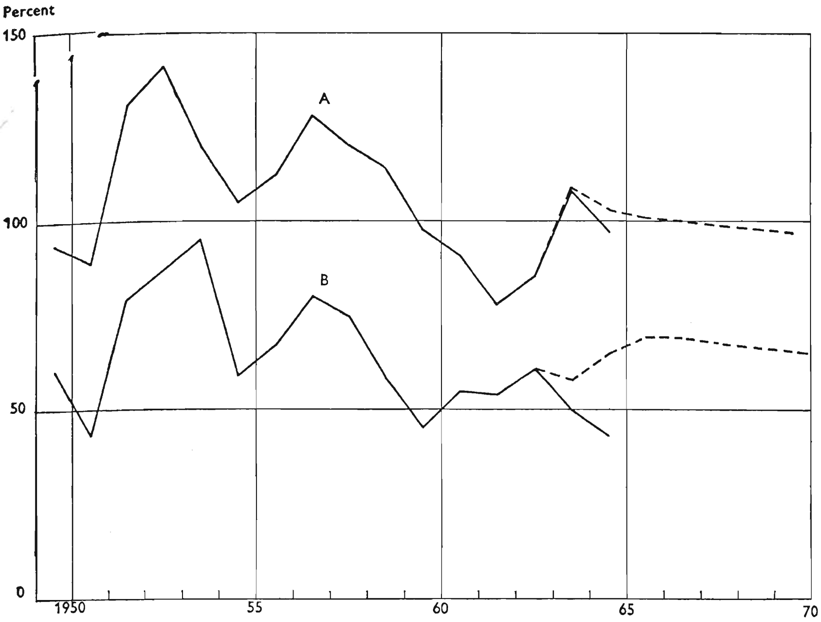
[a] Expressed in current prices each year 1951–65. For 1966–70 the estimate is in 1966 prices. The organized credit market encompasses net borrowing in the bond and debentures market and the stock market, plus direct borrowing in commercial banks and insurance companies.
[b] This figure has been obtained from an estimate of (2:13) by simple summation over sub-industry groups the year 1965.

otherwise. After correction for price changes a calculation in fact suggests that according to alternative (1), financial equilibrium was attained during 1966, and 1967 was characterized by net holdings of working capital (incl. financial assets) slightly in excess of transactions requirements. Towards the end of the year these excess holdings have been estimated to have been somewhat more than 1 000 million Sw. kronor or almost 20 percent of the 1967 gross investment value.

Furthermore, the lower savings margin assumed in alternative (2) implies lower gross profit margins also which is not altogether compatible with actual experience from previous periods (see Diagram 1:1 in Chapter 1). Secondly, lower profit margins might quite well reduce firms' incentive to invest and grow and consequently invalidate the output-investment plan made by the Government Long-term Survey.

The predicted increase in external net borrowing in alternative (1) is basically the result of faster growth in gross investment than in output and saving. The results from Chapter 3 suggest that external finance associated with investment expenditure is dominated by *long-term* borrowing, so that demand should be directed mainly towards long-term sources of funds in the capital market. Consequently, there are reasons for believing that a deliberate tightening of controls on the bond and debenture markets may affect not only the composition of borrowing but also long-run investment plan realizations and hence also planned growth in output with a lag and—closing the circle—the demand for external funds as well. These possibilities will be discussed further below.

Diagram 6:1. *Internal financing ratios, manufacturing 1950–70*



A ratio of gross saving to gross investment
B ratio of gross saving to total uses of funds

2. *Internal Finance—the Savings Investment Ratio*

Diagram 6:1 illustrates the forecast development of the savings/investment and savings/total uses-of-funds ratios. It is evident that forecast alternative (1) (the only one plotted) results in a very modest decline in the savings/investment ratio during the forecasting period. The decline in the savings/total finance ratio practically disappears owing to the large component of working capital accumulation in the denominator, which is more or less proportional to saving when growth is exponential as in the long-term plan. There are no apparent tendencies for either of the two ratios to decline secularly over the whole twenty-year period 1950–70.

The savings/investment ratio has been a topic of current concern in the 1960's. Since the years 1958/59 a systematic decline in this ratio has taken place throughout the sub-industry groups—this is apparent for all manufacturing in Diagram 6:1. A quite in common argument has been that a lowering of the savings/investment ratio is a disquieting sign with regard to future prospects for industrial expansion. The ratio has even been at times loosely identified with the concept of profitability. As the problem is central to our analysis a few words of clarification are in order. Firstly, the savings/investment measure is a ratio of two quantities which by no means have to follow similar time-paths, at least in the short run. Secondly, a profitability measure should relate an income *flow* to the amount invested, which is a *stock* entity and not an internal cash inflow to a current flow of investment spending as is the case of the savings/investment ratio. The savings/investment ratio will only be an adequate indicator of profitability under very particular circumstances; namely when stock and flow components (output, saving, investment and capital) are growing at the same rate. This could be a possibility within a context of very long-run growth only. As a rule, as well as by definition, the savings/investment ratio is a liquidity concept. As such, it is, however, not even a good indicator of current liquidity risks, since the denominator by no means measures, or even indicates, the extent of fixed payments commitments.

Basically, gross savings should be derived from the current income (profits) of past investments, while *expected* future income is an important determinant of investment expenditure. Optimistic expectations as to the profitability of current investment opportunities should stimulate firms to invest and to increase the plow-back of past profits, and as well to increase their willingness to acquire debt. The dependence of expectations on the past (as assumed in our model) will of course introduce a stabilizing factor into the savings/investment relationship. Nevertheless, the numerator and the denominator of the savings/investment ratio do not necessarily have to move in phase. Indeed, observation suggests that the main cause of fluctuations in the ratio is to be found with investment; the sudden decline in the ratio and the marked increase in long-term borrowing in the capital market between 1958 and 1962 was, for example, almost entirely the result of the sharp increase in the level of investment spending. Gross saving followed the growth in sales rather closely at a much slower rate. In general, we observe (from Figure 6:1) pronounced declines in both ratios during business upswings. Since working capital stocks respond much more promptly to increases in sales than do stocks of fixed assets, the savings/total finance ratio is apt to dip earlier and more markedly than the simple savings/investment ratio (cf. the years 1959/60 and 1964/65). It is hard to see why such a development should be a source of apprehension only; on the contrary, the willingness of industrial firms to acquire debt during these years in order to expand productive capacity could be considered an indicator of optimistic expectations as to the future. Stagnating industries, such as the textiles display remarkably *high* savings/investment ratios. This in turn probably reflects the apparent tendency with stagnating firms to accumulate excessively large holdings of liquid assets instead of investing in productive equipment; a phenomenon quite adequately described by Meyer–Kuh [1957, pp. 94ff.] as the "Senility effect".

The high ratios of internal financing among manufacturing firms have led to discussions of efficiency in the allocation of financial resources to investment projects. A high level of past profits might make firms lax in their search for an optimal set of investment projects. Much of this debate has been conducted within a framework of static assumptions—including no uncertainty as to the future. In this world "internal financing" as a concept ceases to be of interest; by merely introducing uncertainty the liquidity risks associated with external financing will lower the relative costs of plow-back. Consequently appraisals of optimality in resource allocation must also consider individual firms' attitudes toward risk taking. The existence of disparate individual estimates as to an uncertain future development of important decision variables, furthermore, makes the mere determination of what precisely is to be meant with "optimality" a questionable matter, indeed.

The taxation system in most industrialized economies provides a further stimulus to plow-back of profits. If the channelling of business saving via the credit market is associated with a taxation drain on profits the relative profitability of internally financed investment might increase with consequent non-optimal allocation of financial resources compared to the case in a taxfree world. Still, this whole argument rests on the definition of a static firm restricted historically to a given and fixed set of productive activities. As mentioned earlier, this is not a fair picture of the modern corporation; the search for new markets and the most profitable investment projects might very well take place *within* a given firm by altering the composition of productive activities and investing accordingly.

3. *Credit Market Shares*

Lastly, we refer to Table 6:2 for the overall allocation of credit flows in the organized credit market expected for the final year of the sixties. The basic data have been compiled from Kragh [1967*a*, *b*] and van der Hoeven [1967]; the total supply of funds in the organized credit market was there derived indirectly from a number of separate projections of GNP components on the income side and observed "preference channels" for savings flows to credit institutions. The relationships are chiefly quantitative.

The calculations are quite complex and based partly upon a credit matrix method of analysis introduced originally by Kragh [1960]. An

Table 6:2. *Flows of funds in the organized credit market 1955/59, 1960/64 and 1970, percentage credit market shares distributed by sectors*

	1955/59	1960/64	1970 (prediction)
A. Government and municipal authorities	33	11	9
B. Housing	40	41	35 (47)
C. Manufacturing	6	15	9
D. Other private firms, households, etc.	21	33	47 (35)
Total	100	100	100

Basic sources for sectors A, B and D: Kragh [1967 *a*, *b*] and Van der Hoeven [1967].

iterative procedure was applied in the calculations to correct for araising quantitative disequilibria. The closing of remaining gaps has been discussed in terms of alternative lines of economic policy action. For details the reader is referred to the sources mentioned. In principle, however, the total supply of funds calculated is not directly dependent upon market rates of interest. A dominating component on the supply side is the projected rapid growth of the Swedish national pension fund (the ATP-system) accounting in 1965 for 22 percent of a total supply of 12 billion Sw. kronor and an estimated 32 percent of 17 billion Sw. kronor (1965 prices) in 1970. This projection depends, however, heavily on growth in the total wage sum and consequently on GNP-growth in general. Employers' contributions to the pension fund is a substantial and increasing cost element for firms which affects, *ceteris paribus*, profitability and indirectly also the incentive for firms to grow. Contrary to our investment theory, this last link or feed-back has not been accounted for explicitly in the financial projection for the total economy, which, in its basic "real" premises, relies entirely on the report of the Government Long-term Survey. Consequently, the "real" and the financial projections viewed together constitute an ex-ante disequilibrium system or plan, the realization of which will require adjustments in some prediction parameters.[7]

Without going too far into the details of Table 6:2 we note that the 9 percent share for the manufacturing sector to be expected in 1970 according to forecast alternative (1) implies in fact a diminished share compared to the previous five-year period of high investment spending.

As for the housing and the residual sectors B and D, two alternatives have been presented. The figures within brackets refer to an estimate

[7] Some of these aspects have been discussed in a recent reexamination by Kragh–Åberg [1968] and van der Hoeven [1968] of the "forecasting" or "planning" results of the Government Long-term Survey.

where the remaining total supply of funds calculated—given the supply to A and C—has been allocated according to the pattern of distribution for the five-year period 1960–64. An excessive supply to the housing sector B compared to the financial "needs" derived from the Long-term Survey emerges. Sector D is assigned a share in 1970 equalling that of the period 1960–64. When account is taken of the more realistic volume of demand for external finance from the housing sector B (35 percent), the whole residual supply has to be shifted to the residual private sector D. A really sharp increase in demand for finance would be needed in this sector to match this supply. Sector D is quite small and its estimated long-term growth only moderately expansive.

Total demand for and supply of funds calculated ex-ante are clearly not consistent. Table 6:2 may serve as the starting point for a number of arguments as to the possible development ex-post, necessary adjustments and economic policy measures needed to close existing gaps between demand and supply. In conclusion, we choose to consider only the case when total supply can be assumed to be realized ex-post (independently of possible parallel adjustments in other variables) under such conditions that rates of interest in the organized credit market are currently kept substantially lower than current rates of return among a sufficient number of firms in the private sector C. This is basically the prerequisite for the expansionary postulate employed in earlier chapters to be satisfied. The more excessive the total outflow or supply of savings in the organized credit market (*ceteris paribus*) the more reasonable this postulate will seem. We assume furthermore that demand from sectors A and B is fixed institutionally at 9 and 35 percent respectively and that sector D will demand a maximum of 35 percent. Evidently an excess ex-ante supply of external funds to the manufacturing sector D will prevail in 1970 amounting to 12 percent of 17 thousand million Sw. kronor, or roughly 2 thousand million Sw. kronor. Our capital budgeting theory of investment planning if combined with the expansionary postulate predicts a considerable growth potential for the manufacturing sector, provided no Government restriction on the supply of funds are imposed. If sufficient investment opportunities are available to manufacturing firms the realization of this indeed hypothetical growth potential would require a substantial and quite implausible upward revision in investment and production plans compared to the figures presented in the Government Long-term Survey.

CHAPTER 7

Conclusions with respect to monetary policy

We notice that our basic capital budgeting theory of investment includes only three financial variables through which monetary policy may influence manufacturing investment—the availability of long-term bond finance (ΔE^L), net commercial bank borrowing and the change in net commercial bank borrowing. ΔE^L can be directly influenced by Government regulation. In the empirical testing of the realization function ΔE^L included new industrial issues in the bond market *only*. Thus ΔE^L was always a positive variable and our hypothesis was that firms at the time of investment planning (late in the autumn) for the next year could not rely upon access to such finance. This was due to Government control as well as to uncertainty in general at this early stage of planning about future floation of bond and debenture issues. Thus our working hypothesis was that investment plans were drawn up and reported on the assumption that *no* such finance would be available.

We found that branches that were granted permission to issue bonds also tended to revise their investment plans upwards *during the same year*. On the basis of our theory we accepted this evidence as support for our hypothesis that unexpected access to bond finance stimulates investment spending significantly and with a short reaction lag. The combined interpretation of the two realization functions for machinery and construction investment indicates that the upward revision in investment during the current year is well over 50 percent of new issues. This interpretation rests, however, on the basic assumption of a reserve of investment projects which can be embarked upon at short notice (the expansionary postulate). The effect of Government controls or uncertainty in this respect has been measured with reference to the complete exclusion of industrial firms from this kind of finance. This was also assumed to be the situation firms counted on when reporting their annual investment plans. Thus, *in our model*, Government control of the capital market cannot induce a downward revision in investment plans.

Our hypothesis about the effects of variations in *commercial bank* *borrowing* on investment had to be rejected. This result stands out in apparent contrast to current opinion on the matter. Furthermore, during our observation period, a general monetary squeeze on the economy has been implemented to a large extent via the commercial banking system, and for that reason our results require close inspection. At least two alternative interpretations are compatible with the data. The first and most straightforward conclusion is that commercial bank loans do not figure as an important source of *investment* finance. The effects on investment of a decrease in bank borrowing will then be only indirect, and not significant enough to take into account. Secondly, commercial bank loans may to a large extent be arranged in advance. Expectations as to the possibilities of obtaining a bank loan will largely be realized, and no correlation between commercial bank borrowing and plan revisions will then be observed. Some support for this latter alternative is found in a recent study by Hagström (1968, Ch. VIII].

Still, whatever importance we attach to these two alternatives, we have to note that manufacturing firms only accounted for a quite small fraction of total commercial bank lending, about 15 percent of total outstanding loans. Inspection of credit market data collected in this investigation did not suggest that manufacturing was one of the first sectors to be hit by a general credit squeeze directed against the commercial banking system. Moreover, during all of the fifties *net* commercial bank borrowing was (on a yearly basis) only a small fraction of the total external finance of manufacturing firms. A significant change, however, occurred during the sixties. Furthermore, net annual changes do not of course reveal important short-run fluctuations *during* the year. Still, if we are to study investment behaviour over 12-month periods it is necessary that the financial statistics be available on a similar time period basis.

Summarizing so far, we may state that our results do not support the efficacy of a general monetary policy directed against the commercial banking system, as long as we confine ourselves to investment behaviour in the manufacturing sector. On the other hand, Government regulation of the bond market seems to be a powerful short-run regulator of investment.

Discussion of monetary policy problems has been focused to a large extent on the restrictive impact on economic activities arising from an increase in the costs of funds. The explorative regression experiments in this study do not suggest any significant causal relationship between the rate of interest and entrepreneurial tendencies to revise investment plans. By interest rates we mean those which are officially recorded in the organized credit markets, which are characterized in Sweden by controls and imperfections. This negative result does not, however, rule out interests rates as a determining factor in investment behaviour; rather our conclusions are that interest rates registered in this organized credit market firstly are not the relevant measures in this respect and secondly have been kept practically constant during the observation period.

Positive correlation between "excess cash holding" and upward revisions in investment plans, and vice versa, has been observed. The causal interpretation of this finding is necessarily uncertain. Still, we found it reasonable not to reject a priori a causality which runs from liquidity to investment. If this interpretation is correct, we might conclude that actual deviations from a desired transactions stock of liquidity will affect investment spending. As implied in our model, these deviations may very well be endogenously determined. Still, the particular operation of the investment funds system during 1960 and 1961 (see Section 1.1.3) resulted in large shifts of liquid balances from firms and the commercial banking system to blocked accounts in the Central Bank. Provided again that the observed relationship between excess cash holding and investment spending is "true", we would expect a slight downward revision in investment plans as a result of the operation of the investment funds system during 1960 and 1961. This conclusion is also supported by the residual analysis of the realization function.

Statistical evidence does not support the widely held opinion that the "grey" market for trade credits serves as a source of reserve finance when the credit market is tight. A sales variable explained most of the variation in the stocks of trade credits and trade debts. However, we found that firms tended to increase the stock of trade credits granted over and above transactions requirements during years in which they increased their net borrowing in the commercial banks.

This evidence combined with rejection of the hypothesized relationship between commercial bank borrowing and short-run investment behaviour, suggests an aversion toward short-term financing of investment expenditure. Our data thus do *not* support the view that increased availability of short-term finance from the commercial banking system and the "grey" credit market will stimulate investment considerably. On the other hand, there is evidence supporting the view that increased availability of long-term bond finance will stimulate investment substantially during the same year.

Within the domain of reasoning bounded by our capital budgeting theory of investment, the empirical results suggest that monetary policy enacted to stimulate business investment can be made effective provided the correct measures are chosen and provided the permissive condition of long-term *expansionary* expectations among a sufficient number of private firms is satisfied. This expansionary postulate has been defined in terms of an investment reserve dependent upon a positive gap between expected rates of return among firms and controlled rates of interest in the organized credit market. No apparent evidence so far suggests that this investment reserve has been sufficiently small any year during the period studied (1950–67) as to make our proposed theory inoperative as a reasonable but approximate explanation of short-run private investment behaviour.

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