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Investment, Dividend, and External Finance Behavior of Firms

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Preliminaries and Summary

The relations among the investment, dividend, and external finance behavior of firms are often alluded to but seldom studied systematically. Quite clearly, given the institutional milieu of the modern corporation, there exists at least a presumption that these three aspects of the firm's decision-making process exhibit some interaction. Yet, in the current literature the view is frequently advanced that investment decisions are taken on solely "real" (nonfinancial) considerations, that dividend policies are characterized by a considerable degree of inertia, and that the financing of investment by internal or external funds is a mere detail.

To our knowledge, an explicit link among these three decisions has not been proposed and econometrically implemented. It is the purpose of this paper to study the question of establishing such a link and to elucidate the extent of the interdependence of these decisions. The

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approach employed makes use of a series of cross sections. Specifically, our sample consists of 181 industrial and commercial firms for which a continuous record exists over the period 1947–60. The "structural" form of this interrelated system will be estimated successively over the period 1951–60 in order to test the stability of structure, especially as it is related to business fluctuations.

Our main findings are the following: (1) A strong interdependence is evident between the investment and dividend decisions; the external finance activities of firms seem to be affected by the other two aspects of the firm's operation but do not seem much to affect them, except possibly during upswings or peaks. (2) There is compelling evidence to suggest that in estimating the structure one ought to use full information methods. (3) Elements of both the accelerator as well as the rate of profit theories of investment seem necessary in order to explain the empirical behavior of investment.

A Brief Review of the Literature

The three aspects of the firm's behavior on which this study is focused have been studied in the literature with varying degrees of intensity. Thus investment behavior has perhaps been studied most intensively.

The integration of investment theory with the neoclassical theory of the firms can be traced to Roos [20], Tinbergen [22, 23], and Klein [21].[1] An extensive survey of the work of the last two authors can be found in Meyer and Kuh [17]. Subsequent contributions have been numerous but are best omitted here since rather recently Eisner and Strotz [7] have provided a very complete review of such works.

It is perhaps accurate to say that the main results of such studies lie in providing tests concerning the empirical relevance of the accelerator, capacity-accelerator, or profits (or rate of profit) theories of investment. The issue is not yet satisfactorily resolved, but it appears that neither the capacity accelerator nor the profits theory is alone sufficient, but rather a combination of elements of both is probably necessary to provide a satisfactory account of the empirical behavior of investment.

In this connection it seems appropriate to cite, in some detail, a very important recent study by Kuh [13], which is, in some respects, similar to the one we propose to pursue here. Kuh investigates the investment, dividend, and external finance aspects of the firm's behavior in the following context. His basic sample consists of sixty industrial firms for which a continuous satisfactory record exists over the years 1935–55.

[1] Numbers in brackets refer to Bibliography at end of paper.

This sample was arrived at from a larger one by a process of selection which eliminated firms that were merged into others over the sample period, as well as those that were "too large"—owning gross assets over $120 million in 1953.

The work is divided in two distinct parts, a theoretical and an empirical one. In the theoretical part the interdependence of the three decisions is quite clearly recognized and an integrated model is presented combining the capacity-accelerator model of investment with the Lintner [16] model of dividend behavior. The empirical part, unfortunately, does not carry out this integration. There, investment is given by the usual capacity-accelerator model, so that it depends on the capital stock and sales, as well as on the observed sales-capital ratio, the latter being an approximation to the desired output-capital ratio of the accelerator theory. In this connection models are also tried in which the sales variable is replaced by a profit variable. It is found, however, that the former models are more in accord with the data than the profit ones. Dividends are explained by the well-known Lintner hypothesis, on which we have commented at length elsewhere [3]. They are thus made to depend on profits and past dividends, the model being essentially an adaptation of the usual flexible accelerator model of investment; here the role of the capital coefficient is played by the desired dividend-payout ratio.

Finally, external finance behavior is derived residually through the budgetary requirement that investment expenditures must equal retained earnings plus depreciation allowances plus external finance.

Thus, in this context there is a certain direction of causality; investment is independent of dividends and external finance; dividends depend only on profits (and lagged dividends) which may depend on investment, although the dependence is not explicit. Finally, external finance is more or less residually derived, and hence would depend on investment and dividends. Although Kuh does not state his model in these terms, the above is, we think, a very plausible interpretation of the spirit in which his econometric investigation is carried out.

His is a penetrating examination of the problems relating to testing homogeneity and stability of structures by an ingenious combination of cross-section and time-series data; the problem of simultaneity and interdependence to which our paper is addressed is, however, entirely overlooked in his econometric investigation. Kuh's estimation is carried out by single-equation methods and his results seem to bear out the capacity accelerator theory of investment and the homogeneous Lintner hypothesis on dividends.

A more recent study of investment behavior is that of Jorgenson [9]. His formal model considers the firm as determining its investment policy through maximization of net worth, defined as the present discounted value of current receipts minus outlays, where the latter includes, in addition to remuneration of the variable factors, expenditures on capital goods. However, his operational model through the convenient assumption of the Cobb-Douglas production function essentially reduces to the accelerator model. His major innovation is the introduction of general lag structures between the demand for additional capital stock, as arising because of a discrepancy between desired and actual capital stock, and the augmentation of the latter through deliveries of capital equipment. Another innovation consists of the systematic treatment of the replacement demand for capital. His sample consists of quarterly observations on certain classes of industrial aggregates.

Concerning the dividend behavior of firms, in addition to the work of Kuh [13] referred to above, one should mention the pioneering work of Lintner [15, 16]. The same approach is more or less followed by Darling [2], whose innovation consists in making the dividend function depend on the change in sales; the apparent success of this is probably a reflection of the type of dependence we wish to investigate here. In this connection it should be pointed out that we [3] have determined a substantial impact of investment on the dividend decision. Another recent study of dividend behavior is that of Brittain [1]. He follows the Lintner model quite closely, but reports that profits gross of depreciation is a better explanatory factor of dividend behavior than is profits net of depreciation.

The question of internal finance has not been systematically treated in the econometric literature, save for the work of Kuh which has a slightly different orientation from the one pursued in this paper. Thus, although frequent allusions are made in the literature to the interdependent character of these three aspects of the firm's behavior, rather little has been done in carrying out the implications of this view to the form of the econometric model to be estimated. One way of rationalizing this is to consider the current view in the literature as holding that the problem is being resolved in a sequential manner. Thus, investment decisions are implicitly viewed as being taken solely (or chiefly) on the basis of "real" considerations, and then once this decision is resolved the question of how to finance this undertaking is considered.

In the case of dividend behavior, the main work on the subject, viz., Lintner's [15, 16], views dividend disbursals as totally divorced from investment considerations. Yet, as noted above, we have determined a significant dependence of the dividend policy of electric utility firms on actual and anticipated investment. As an empirical matter Kuh and Meyer [14] report that 75 per cent of investment in manufacturing is internally "financed." The same authors in a previous work [17] list an impressive catalogue of reasons why such a preference might exist. While this phenomenon may, in some part, be due to the peculiarities of the tax structure of the United States it may also reflect imperfection in the capital market.

The view taken in this paper is rather simply put as follows. Quite generally a firm faces an outflow of funds represented by its variable and fixed costs, tax and dividend payments, as well as by its investment activities. On the other hand, it can rely on an inflow of funds represented chiefly by its sales and the proceeds through various forms of external finance, viz., by bond or stock flotation. To the extent that a plausible objective for a firm is to grow, provided its operations are profitable, and that the capital market is less than perfect, it would follow that investment and dividend outlays are quite clearly competitive.

On the other hand, the rather marked reliance on internal funds signifies a strong aversion to the use of the capital market. Thus, it would seem quite reasonable to suppose that the three decisions—to invest, to pay dividends, and to resort to external funds—are mutually determined. Hence, it is desirable to investigate this problem in the context of a simultaneous-equation model. If our conjecture about the *modus operandi* of the system is correct, then we should expect that the coefficients of the jointly determined variables—investment, dividends paid, and external finance—would be significant, at least in several instances, where they serve as explanatory variables.

The Model

THE STRUCTURE OF THE MODEL

In the discussion of the previous section it was pointed out that in our view a deficiency in the econometric investigations of the investment aspect of the firm's behavior is that the interaction of investment with certain financial variables was substantially overlooked.

Our objective here is to present a somewhat general equilibrium model of the firm's activities which attempts to remedy this deficiency and at the same time is sufficiently simple so as not to obscure the essential elements of the problem. Thus, at this stage, we shall not explicitly consider the technological constraint on the firm's activities in the form of a production function, nor the institutional characteristics of the factor and product market in which it operates, in the form of firm or industry factor supply and product demand functions.

We shall rather assume that production and marketing decisions predate the decision process we wish to study. The view we implicitly take is that investment affects output (and profits) only with a lag so that current investment affects only future output, and hence profits, and that current output and hence current profits are not affected by current investment.

While this may not be a perfectly valid view, it is, we believe, sufficiently accurate to serve at least as a rather useful simplification. We would think that the gains in simplicity obtained thereby more than offset any increased incidence of simultaneous-equation bias. Beyond that, it has of course been traditional to treat sales and profits, both current and lagged, as valid predetermined variables in cross-section studies on investment.

The general (schematic) structure of the model is as follows:

$$\begin{aligned} I_1 &= f_1(I_2, D, EF1, EF2; X_1, X_2, \dots X_n) \\ I_2 &= f_2(I_1, D, EF1, EF2; X_1, X_2, \dots X_n) \\ D &= f_3(I_1, I_2, EF1, EF2; X_1, X_2, \dots X_n) \\ EF1 &= f_4(I_1, I_2, D, EF2; X_1, X_2, \dots X_n) \\ EF2 &= f_5(I_1, I_2, D, EF1; X_1, X_2, \dots X_n) \end{aligned} \qquad (1)$$

Where I_1 is investment in fixed assets; I_2 is inventory and other short term investments; D is common stock dividends paid; $EF1$ is (net) external finance obtained by borrowing; $EF2$ is (net) external finance obtained by stock flotation; the X_i are predetermined variables, $i = 1, 2, \dots$ n. The predetermined variables may include profits, depreciation, sales, long-term debt outstanding, etc., and will be introduced explicitly as the occasion arises.

In addition, the firm faces the "budget constraint"

$$I_1 + I_2 = EF1 + EF2 + P - D + Dep, \qquad (2)$$

where P and Dep denote, respectively, profits and depreciation allowances.

If we use the constraint in (2), we can eliminate one of the (endogenous) variables of the system in (1). We have chosen to eliminate $EF2$; this was done chiefly because data on this variable were very difficult to obtain with any reasonable degree of reliability. At any rate stock flotation as a source of external finance, while not negligible, is

TABLE 1

Sources of Gross External Finance in Manufacturing, Mining, Commercial, and Other Firms, 1954-56

Type of Firm	Bonds		Preferred Stock		Common Stock		Total (million dollars)
	Million Dollars	Per Cent	Million Dollars	Per Cent	Million Dollars	Per Cent	
				1956			
Manufacturing	3,000	80.5	164	4.4	562	15.1	3,726
Mining	300	63.3	17	3.6	157	33.1	474
Commercial & other	259	79.4	8	2.5	59	18.1	326
Total	3,559	78.6	189	4.2	778	17.2	4,526
				1955			
Manufacturing	2,043	68.2	165	5.5	786	26.3	2,994
Mining	198	47.8	10	2.4	206	49.8	414
Commercial & other	340	76.7	21	4.8	82	18.5	443
Total	2,581	67.0	196	5.1	1,074	27.9	3,851
				1954			
Manufacturing	1,877	82.8	228	10.0	163	7.2	2,268
Mining	347	64.4	14	2.6	178	33.0	539
Commercial & other	317	75.3	62	14.7	42	10.0	421
Total	2,541	78.7	304	9.4	383	11.9	3,228

Source: *Statistical Bulletin*, Securities and Exchange Commission, February 1957.

of minor significance compared with bond flotation for most years and industries in our analysis. Table 1 will bear this out. Since our sample will consist largely of manufacturing and retail trade firms with a rather small representation of mining firms, it follows that our selection of bond finance as the principal source of external funds to be studied is not likely to lead to serious deficiencies.

Finally, we have chosen to regard short-term investment as a predetermined variable, so that our final system of equations to be estimated is reduced to three, viz., the dividend, the (fixed) investment, and the external finance equations. This last decision carries with it, in principle, serious deficiencies.

There are, however, several ameliorating circumstances: first, to the extent that a component of short-term investment is unintended inventory accumulation, we are clearly not committing a specification error; secondly, to the extent that the data for this series includes credit advanced to clients in the normal conduct of business (accounts receivable) this does not constitute a misspecification either; similarly for accounts payable; but to the extent that the series contains a component of intended inventory accumulation and short-term securities holdings for other than liquidity-transaction purposes, we are clearly committing a specification error. Unfortunately no detailed breakdown of the short-term investment series was available, so we have chosen to treat it as a predetermined variable. Thus, the model finally estimated is of the form

$$\begin{aligned} D &= g_1(I, EF1; X_1, X_2, \ldots, X_n) \\ I &= g_2(D, EF1; X_1, X_2, \ldots, X_n) \\ EF1 &= g_3(D, I; X_1, X_2, \ldots, X_n) \end{aligned} \qquad (2)$$

GENERAL COMMENTS ON THE FORM OF THE EQUATIONS

The Dividend Equation. One can look upon dividend disbursals as conveying information to the market on the inherent profitability of the disbursing firm as Modigliani and Miller [19] *inter alios* have argued. In fact they would contend that the dividend series contains "more information" than the profit series. Hence, it would appear that it is the policy of firms to maintain a steady dividend per share and to adjust it upward and downward only when a "permanent" change in their economic environment has taken place. As a matter of fact, it is more or less common for firms to maintain a constant dividend *per share.* But this in no way implies constancy in the dividend-profit ratio.

It is reasonable to suppose that dividend disbursals will depend on the rate of profit of the firm, its investment plans, and the external finance obtained through the bond market; the rationale for this last variable would be that external finance will enable the firm to carry out its planned dividend disbursals even when the rate of profit is low and investment programs are extensive.

The Investment Equation. The foundations of investment theory in the theory of the firm are too well-known to require repetition here. Clearly from this point of view investment would depend either on changes in the volume of output or on its rate of profit, which may be taken to lead to changes in the expected profitability of new investment. These two considerations are not totally unrelated, especially if the firm is assumed to operate with a neoclassical production function allowing substitution; if no substitution is allowed, then it is not clear that the rate of profit has any place in the investment function.

Our innovation here consists in introducing the other two jointly dependent variables, viz., dividends and external finance. We have already given some indication as to why we consider these variables relevant.

Clearly dividend disbursals and investment outlays represent competing demands on the resources available to the firm; thus it would be quite plausible to suppose that the investment activities of the firm will be affected by its dividend activities; postponement or curtailment of investment could conceivably result because of inability of the firm to carry out a given investment program, "optimally" determined by some "rational" criteria, and at the same time continue to make "satisfactory" dividend payments. To call such action "irrational" may be giving a correct label to the phenomenon but will not alter the facts—if, indeed, such is the factual state of affairs.

It would also be of interest to inquire whether such variables as depreciation (on this, see Meyer and Kuh [17]) are significant determinants of investment; if depreciation is an accurate index of deterioration of the capital stock due to its employment in the productive process, then depreciation would describe accurately that part of investment undertaken for replacement purposes. There are good reasons to believe, however, that depreciation does not accurately measure the using up of capital, and hence its introduction in the investment equation would only serve to portray more accurately the resources available to the firm for investment and dividend outlays. In addition, there is the question of the proper lags operating in the investment process; thus, it would be of interest to ascertain whether lagged rates of change of sales or past rates of profit significantly affect the decision to invest.

The introduction of the bond finance variable here has a motivation best understood in terms of imperfect capital markets. Thus, if in a given universe all firms belong to more or less the same uncertainty class, then market discrimination might be expected to take the form of restricting the amount a firm can borrow without raising the cost of obtaining long-term funds. Hence, we may conjecture, *ceteris paribus,* that the easier the access to this market—either in the amounts or in the terms on which the loans are granted—the larger the investment program a firm may undertake. Thus, in the investment equation dividends may be expected to have a negative impact, while external finance will have a positive one.

The External Finance Equation. Enough has been said in connection with the other two equations to make the hypothesized form of the external finance equation clear. One would expect to have this variable depend positively on investment, negatively on the market interest rate, and negatively on depreciation and profits. The relationship of external finance to dividends, however, is not very clear-cut. Thus, it is possible to argue that essentially because of a budgetary constraint, more dividends, other things being equal, mean more borrowing. But it is equally plausible to argue that for firms that are no longer growing rapidly more dividends need not induce further borrowing simply because their investment activities are somewhat restricted. Thus, there should not be any feedback from dividends to external finance.

Finally, it would be interesting to inquire whether there is any empirical merit to Kalecki's principle of increasing risk [11], i.e., whether the rate of borrowing depends on the magnitude of long-term debt already outstanding relative to the size of equity claims.

SOME ARGUMENTS FOR SIMULTANEOUS ESTIMATION OF THE MODEL

The question may perhaps arise as to why one might wish to apply simultaneous estimation techniques in estimating the model presented above. It might be argued that, since the firm represents a single unit of decision, the proper manner of looking at its decision-making process is one that views the firm as reacting to its economic environment, i.e., as making decisions in terms of the exogenous variables confronting it. Hence the appropriate econometric model should be a reduced form. After all we do not construct simultaneous-equation models of a household's consumption decisions.

This view, however, overlooks the simple institutional fact that the modern firm is a complex organization with a considerable degree of decentralization. The decisions made by one department have an impact on those made by another. Hence each department may be viewed as operating with certain decision rules which depend not only on exogenous variables but also on decisions arrived at by other departments, i.e., on variables which are endogenous to the firm. But in addition a firm has also a certain cohesiveness and such decisions must in some sense be made consistent, or the organism may not survive.

In this view of the firm's operations, the role of the highest executive echelons, say, the president and the board of directors, is rather unique. Their function is not to be the actual decision makers in the first instance, but rather to receive proposals, examine priorities, attempt to coordinate proposals, and make departmental decisions consistent with each other. In other words, it is their function to set the decision rule for each department and insure the proper and consistent execution of such rules. If one views the firm in this context, then it is quite clear that one should wish to employ simultaneous-equation techniques in estimating the parameters of the model given above. Thus, given that we hypothesize the existence of a meaningful structure of intrafirm decision-making, it is apparent that we should wish to estimate it by the most efficient econometric techniques. Furthermore, in so doing we may gain greater insight into the operations we wish to study, an insight that would be foregone if we simply confined ourselves to what in the context of our model would be reduced-form estimation.

Empirical Implementation

SAMPLE CHARACTERISTICS AND DEFINITION OF VARIABLES

The sample on which our study is based consists of 181 firms for which a continuous satisfactory record exists between 1947 and 1960. These firms are largely manufacturing and retail trade ones, although several are chiefly engaged in mining activities.

The sources of our data are the balance sheets and income statements of individual firms appearing in various issues of Moody's Manuals, although in some cases (about twenty) where data ambiguities or inconsistencies arose, the matter was rectified by direct correspondence with the firms involved.

It seems desirable at this stage to give a brief description of the characteristics of the firms in our sample, in terms of the type of activity pursued and of their size. Because the firms we used belong to numerous industrial subclassifications, we have stratified our sample through reclassification of firms into nine industrial classifications. This was done on the basis of the type of activity pursued by the individual firms.

TABLE 2

Classification Scheme

Variable	Description of Industrial Classification	Number of Firms	Per Cent of Total
C_1	Transportation equipment	17	9.32
C_2	Retail trade stores	21	11.61
C_3	Alcohol, tobacco, and food	21	11.61
C_4	Rubber, petroleum, and chemical products	30	16.58
C_5	Machine tools, agricultural equipment, and accessories	20	11.08
C_6	Electrical equipment and appliances	13	7.19
C_7	Building materials and equipment	18	9.95
C_8	Textiles, glass, pulp, and paper products	25	13.82
C_9	Mining, steel, steel products, and nonferrous metals	16	8.85
	Total	181	100.00

TABLE 3

Size Distribution of Sample Firms, Ranked by Book Value of Capital Stock, 1956

Size of Firm (million dollars)	Number of Firms	Per Cent of Total
0-49.9	18	9.95
50-99.9	41	22.65
100-149.9	26	14.36
150-199.9	15	8.29
200-299.9	18	9.95
300-499.9	17	9.39
500-999.9	20	11.05
1,000 and over	26	14.36
Total	181	100.00

A complete enumeration of the firms in our sample, grouped by industrial classification, as just explained, appears in the Appendix at the end of this paper. To reflect the sample stratification, we resorted to the standard analysis of covariance device of introducing (dummy) variables assuming the value 1 if a firm belongs to, say, the i^{th} classification and zero otherwise. The variables corresponding to these classifications appear in Table 2.

It would appear from Table 2 that we have a very good cross section of mining and manufacturing firms, and quite a number of large retail stores. Our sample does not weigh very heavily any particular classification, although our firms tend to be mostly medium-sized and large ones. This is quite evident from Tables 3 and 4.

Table 3 classifies the sample firms by size of the (book value of the) capital stock. The median firm has capital stock of $160.2 million, the smallest and largest firms having, respectively, $16.5 million and $10,265.2 million. The smallest firms have a rather weak representation (9.95 per cent of the sample), while the largest firms have a somewhat stronger one (14.36 per cent of the sample). Essentially the same situation emerges if we classify the sample firms by size of sales. This classification appears in Table 4.

In this ranking, the median firm has sales of $438.7 million, the smallest and largest firms having, respectively, $38.2 million and $12,736.0 million. Again, the smallest firms are somewhat more weakly

TABLE 4

Size Distribution of Sample Firms, Ranked by Sales, 1956

Size of Firm (million dollars)	Number of Firms	Per Cent of Total
0-99.9	17	9.39
100-199.9	24	13.26
200-299.9	29	16.02
300-499.9	28	15.47
500-749.9	24	13.26
750-999.9	16	8.84
1,000-1,499.9	20	11.05
1,500-	23	12.71
Total	181	100.00

represented (9.39 per cent of the sample) than the largest firms (12.71 per cent). Thus, our sample appears to be well stratified, in terms of size as well as the type of activity pursued.

At this stage it is desirable to catalog and explain briefly the nature of the variables entering into our investigation. We have already given, in Table 2 above, the dummy variables associated with the industrial classifications. In addition, the following basic variables are employed (this list will also serve to define the symbolism employed in the subsequent development of our discussion):

S_t—sales at time *t*, undeflated.

$(EF1)_t$—long-term borrowing-external finance-at time *t;* this is simply the first difference of the book value of long-term debt outstanding and thus represents net current long-term borrowing; it should be remembered that this measure is somewhat biased by the transfer of maturing long-term debt to the short-term category.

D_t—dividends (common) paid at time *t*.

I_t—gross fixed investment at time *t*.

K_t—book value of the capital stock at beginning of time *t*.

P_t—net profits (after taxes) at time *t*, undeflated.

$(LTD)_t$—net long-term debt outstanding at time *t*, in nominal terms.

$(Dep)_t$—depreciation allowances at time *t*.

N_t—net current position of the firm at time *t*, defined as the excess of inventories, cash, short-term securities, and accounts receivable over accounts payable and other short term liabilities.

R_t—interest payments at time *t*, on long-term debt outstanding. This is admittedly a very poor measure of the relevant interest rate but it is the only one available.

In actually carrying out the empirical implementation of the model, we have chosen to normalize the jointly dependent variables by S_t. This was done for two reasons: first, it tends to reduce heteroscedasticity and hence make the stochastic characteristics of our sample correspond more closely to the standard specification of the simultaneous-equation models; second, since our objective is to isolate the determinants of the investment-dividend-external finance decision process, this procedure prevents our results from being unduly influenced by large firms simply because of sheer size. Another related reason is the fact that one would not expect the relation between investment and the appropriate accelerator variable to be identical in the case of a retail store and an aircraft manufacturer. By relying on "intensive" variables, one tends to overcome such problems.

A list of the predetermined variables actually employed is given below:

N/K enters the model as a consequence of the use of the budget constraint to eliminate one of the equations of the system; the normalization employed here is to some extent motivated by portfolio theory considerations.

Dep/K represents the portion of the book value of the capital stock

TABLE 5

Simple Correlation Matrices,[a] *Endogenous Variables, 1951-60*

Variable	D/S	I/S	EF1/S	D/S	I/S	EF1/S
		1951			*1956*	
D/S	1.0000	.3018	−0.0854	1.0000	.3238	.0661
I/S		1.0000	.3735		1.0000	.4932
EF1/S			1.0000			1.0000
		1952			*1957*	
D/S	1.0000	.2906	.0610	1.0000	.3871	.1522
I/S		1.0000	.6649		1.0000	.7414
EF1/S			1.0000			1.0000
		1953			*1958*	
D/S	1.0000	.2793	.1630	1.0000	.4537	−0.0279
I/S		1.0000	.3346		1.0000	.3085
EF1/S			1.0000			1.0000
		1954			*1959*	
D/S	1.0000	.1410	−0.0460	1.0000	.3049	−0.0316
I/S		1.0000	.3361		1.0000	.1012
EF1/S			1.0000			1.0000
		1955			*1960*	
D/S	1.0000	.2816	−0.0499	1.0000	.3752	.0116
I/S		1.0000	−0.0200		1.0000	.0274
EF1/S			1.0000			1.0000

[a] Critical values of $|r|$ for rejecting the hypothesis of zero correlation at the 5 and 1 per cent levels, respectively, are approximately .149 and .218.

written off as depreciation charges; its form is related to the following basic variable.

P/K is the rate of profit; it would have been better perhaps to have defined the numerator of this fraction as profits plus depreciation plus interest charges on the ground that, since it measures the (average) rate of return on the firm's capital resources, this ought to be measured gross of irrelevant bookkeeping items such as depreciation and interest charges.

$S_{-2}^* = (S_t - S_{t-3})/(S_{t-3})$ is the usual accelerator variable except that it is normalized by a lagged value of sales. It was felt, however, that it is the pressure of sustained relative increases in sales that affects investment.

$LTD/(K - LTD)$ is the leverage variable employed to test the principle of increasing risk. It is probably not a very accurate one, the rationale behind it being that businessmen are influenced by book rather than market value considerations.

EMPIRICAL RESULTS

It is instructive before we proceed to have a brief look at the matrix of simple correlation among the jointly dependent variables. This is given in Table 5.

Two features of these results are of particular interest; first, whenever significant, such correlations between dividends and investment are uni-

TABLE 6

Cyclical Peaks and Troughs, Identified by Quarter, 1948-62

Year	Quarter	Peak or Trough
1948	4th	Peak
1949	2nd	Trough
1953	2nd	Peak
1954	2nd	Trough
1957	3rd	Peak
1958	1st	Trough
1960	2nd	Peak
1961	1st	Trough
1962	2nd	Peak

formly positive, a result that is somewhat surprising and difficult to accept at face value. Intrinsically these two quantities would not be expected to vary in the same direction. It will indeed be found that, in the proper structure to be estimated below, the impact of dividends on investment and vice versa is (contemporaneously) a negative one.

Secondly, it turns out that the simple correlation between dividends and investment is insignificant only for 1954 (a trough year as indicated by Table 6), that between investment and external finance is insignificant for 1955, 1959, and 1960 (in Table 6, all upswing or peak years), while the correlation between dividends and external finance is *significant* only for 1953 and 1957 (both peak years).

To the extent that one might wish to generalize on the basis of these results, it would appear that they simply demonstrate the substantial reliance of firms on internal financing. Apparently when profits increase rapidly in an upswing they are quickly absorbed into investment, obviating the need to resort to the capital market. On the other hand, when at the peak profits begin to get squeezed, we get a significant correlation of dividends with external financing, indicating that another sort of pressure is brought to bear on the firm's resources that forces increased reliance on the capital market.

THE SCOPE OF THE INVESTIGATION AND SOME TYPICAL SINGLE-EQUATION ESTIMATES

As stated earlier, it is our purpose to investigate the dividend, investment, and external finance decision-making process of the firm. Our contention is that these decisions are jointly determined and hence that the proper method of estimation is a simultaneous-estimation approach. Moreover, it is desirable to test the stability of structure as estimated. For one may argue that such simultaneity established by means of only one cross-sectional investigation is at best only a weak demonstration (in this connection, see Meyer and Kuh [12]). If, however, the structure so estimated can be shown to persist through time, then this would constitute additional support for our contention. Thus our procedure was to construct a model of this triad of decisions for the year 1956 and, after some experimentation, to decide on the variables that can significantly serve as explanatory variables. Then the model was estimated successively for the years 1951–60.

We first give (Tables 7, 8, and 9) what the statistical results would be if single-equation techniques were employed. Notice that the relationships thus estimated are significant if judged by the conventional F-test, although the correlation coefficients indicate that economically

TABLE 7

Single-Equation Estimates, Dividend Equation, 1951 - 60

Variable	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
C_0	0.157	0.0042	.0030	.0013	–0.0023	.0067	.0023	.0018	.0059	.0081
	(3.254)	(.892)	(.618)	(0.223)	(–0.418)	(1.266)	(.463)	(.352)	(1.003)	(1.576)
C_2	–0.0027	.9969	.9988	.0100	.0109	.0024	.0050	.0043	.0021	–0.0014
	(–0.447)	(1.160)	(1.477)	(1.408)	(1.590)	(.366)	(.803)	(.668)	(.305)	(–0.244)
C_3	.0001	.0121	.0096	.0125	.0145	.0058	.0081	.0039	.0056	.0013
	(.015)	(1.855)	(1.473)	(1.633)	(2.022)	(.833)	(1.232)	(.581)	(.759)	(.210)
C_4	.0156	.0306	.0325	.0355	.0320	.0252	.0250	.0214	.0259	.0192
	(2.594)	(5.397)	(5.679)	(5.486)	(5.030)	(3.865)	(4.056)	(3.353)	(3.688)	(3.127)
C_5	.0028	.0109	.0133	.0178	.0146	.0050	.0081	.0141	.0126	.0131
	(.447)	(1.813)	(2.236)	(2.545)	(2.167)	(.738)	(1.279)	(2.153)	(1.742)	(2.124)
C_6	–0.0028	.0048	.0075	.0123	.0131	.0072	.0061	.0061	.0036	.0004
	(–0.394)	(.723)	(1.134)	(1.578)	(1.741)	(.962)	(.857)	(.833)	(.454)	(.067)
C_7	.0128	.0256	.0302	.0335	.0261	.0220	.0250	.0268	.0277	.0222
	(1.915)	(4.089)	(4.844)	(4.649)	(3.574)	(2.893)	(3.484)	(3.807)	(3.638)	(3.350)
C_8	.0101	.0195	.0213	.0252	.0236	.0180	.0218	.0195	.0163	.0108
	(1.672)	(3.402)	(3.678)	(3.749)	(3.568)	(2.747)	(3.472)	(3.059)	(2.329)	(1.795)
C_9	.0254	.0390	.0367	.0420	.0379	.0342	.0343	.0327	.0338	.0268
	(3.680)	(5.690)	(5.588)	(5.655)	(5.243)	(4.662)	(4.821)	(4.363)	(4.197)	(3.831)
P/K	.0397	0.650	.0473	.0500	.0824	.0567	.0778	.0912	.0716	.0894
	(3.420)	(4.054)	(3.431)	(3.993)	(6.325)	(5.669)	(6.880)	(6.313)	(5.335)	(6.899)
N/K	–0.0023	–0.0043	–0.0022	–0.0017	–0.004	–0.0028	–0.0048	–0.0051	–0.0041	–0.0044
	(–1.217)	(–2.066)	(–1.183)	(–0.886)	(–2.347)	(–1.384)	(–2.188)	(–2.110)	(–1.639)	(–1.771)
I/S	.0737	.0571	.0030	.0265	.0749	.0634	.0871	.1567	.0634	.1027
	(2.648)	(2.212)	(.115)	(0.973)	(2.259)	(2.064)	(3.088)	(4.231)	(1.919)	(2.672)
$EF1/S$	–0.0688	–0.0589	.0863	–0.0014	–0.0127	–0.0171	–0.0646	–0.0749	–0.0330	.0235
	(–2.673)	(–2.611)	(2.611)	(–0.036)	(–0.311)	(–0.390)	(1.532)	(–2.099)	(–0.552)	(.914)
R^2	.2747	.3328	.2972	.2710	.3536	.3720	.4376	.4336	.3083	.4166
F-statistic	6.6823	8.4808	7.3440	6.5767	9.2046	9.8373	12.6705	12.4819	7.6490	11.7029

Note: $F_{.05} \approx 1.28$ $\quad t_{.10} \approx 1.65$
$F_{.01} \approx 1.45$ $\quad t_{.05} \approx 1.97$
$t_{.01} \approx 2.58$

Number in parentheses is t-ratio.

TABLE 8

Single-Equation Estimates, Investment Equation, 1951 - 60

Variable	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
C_0	.0194	.0286	.0254	.0655	.0255	.0407	.0197	.0320	.0370	.0416
	(1.307)	(1.561)	(1.286)	(3.849)	(2.123)	(3.004)	(1.361)	(3.088)	(2.716)	(4.359)
C_2	.0038	–0.0085	–0.0019	–0.0292	–0.0000	–0.0079	.0102	–0.0067	–0.0031	–0.0127
	(.219)	(–0.418)	(–0.087)	(–1.430)	(–0.005)	(–0.458)	(.607)	(–0.521)	(–0.185)	(–1.060)
C_3	–0.0023	–0.0009	.0017	–0.0193	.0049	–0.0018	.0179	–0.0014	.0057	.0003
	(–0.128)	(–0.043)	(.076)	(–0.875)	(.314)	(–0.100)	(1.000)	(–0.109)	(.328)	(.028)
C_4	.0390	.0313	.0603	.0334	.0275	.0338	.0490	.0310	.0449	.0318
	(2.431)	(1.618)	(2.945)	(1.661)	(1.866)	(1.906)	(2.921)	(2.370)	(2.665)	(2.613)
C_5	–0.0099	–0.0176	.0115	–0.0094	.0213	–0.0011	.0035	–0.0071	–0.0023	–0.0013
	(–0.591)	(–0.932)	(.568)	(–0.449)	(1.413)	(–0.070)	(.206)	(–0.545)	(–0.137)	(–0.110)
C_6	–0.0021	–0.0019	.0079	–0.0188	–0.0016	–0.0145	.0191	.0029	–0.0037	.0100
	(–0.110)	(–0.094)	(.353)	(–0.846)	(–0.100)	(–0.764)	(1.013)	(.202)	(–0.198)	(.739)
C_7	.0525	.0388	.0424	.0231	.0556	.0666	.0780	.0281	.0304	.0311
	(2.961)	(1.923)	(1.978)	(1.054)	(3.475)	(3.429)	(4.186)	(1.921)	(1.619)	(2.312)
C_8	.0021	.0191	.0275	–0.0082	.0118	–0.0017	.0390	.0048	.0125	.0131
	(.132)	(1.001)	(1.314)	(–0.407)	(.788)	(–0.092)	(2.326)	(.368)	(.748)	(1.075)
C_9	.0354	.0296	.0743	.0032	.0054	.0195	.0486	.0388	.0358	.0319
	(1.854)	(1.295)	(3.419)	(0.141)	(0.313)	(.956)	(2.490)	(2.502)	(1.808)	(2.241)
$(P/K)_{-1}$	–0.0296	.0148	.0155	–0.0592	–0.0429	–0.0336	–0.0179	–0.0234	–0.0168	–0.0347
	(–1.097)	(.488)	(.309)	(–1.179)	(–1.482)	(–0.918)	(–0.680)	(–0.867)	(–0.377)	(–1.210)
S^*_{-2}	.0329	.0016	.0058	.0264	.0795	.0404	.0216	.0101	.0135	.0305
	(2.157)	(.145)	(.518)	(1.778)	(5.049)	(2.527)	(1.148)	(.926)	(.748)	(2.199)
N/K	–0.0051	–0.0123	–0.0104	–0.0079	–0.0058	–0.0084	–0.0135	–0.0114	–0.0137	–0.0119
	(–1.045)	(–2.407)	(–1.707)	(–1.276)	(–1.303)	(–1.561)	(–2.452)	(–2.508)	(–2.145)	(–2.311)
D/S	.5755	.4598	.0157	.1554	.3460	.4164	.6386	.6599	.3760	.4197
	(2.879)	(2.075)	(.067)	(0.703)	(2.196)	(2.226)	(3.135)	(4.128)	(1.833)	(2.831)
$EF1/S$	.3302	.5540	.4695	.4824	–0.0251	.6579	1.0908	.3197	.2164	.0477
	(5.048)	(10.503)	(5.194)	(4.504)	(–0.283)	(6.942)	(14.556)	(4.582)	(1.569)	(.947)
R^2	.3887	.5616	.3179	.2762	.3738	.5012	.7089	.4639	.2470	.3844
F-statistic	9.8054	18.7331	7.4546	6.2848	9.2636	14.8345	34.7193	12.9828	5.5159	9.6451

Note: Number in parentheses is t-ratio.

TABLE 9

Single-Equation Estimates, External Finance Equation, 1951 - 60

Variable	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
C_0	.0186	.0084	.0336	.0223	.0206	.0132	.0070	.0275	.0114	.0382
	(1.509)	(.702)	(1.509)	(1.177)	(2.367)	(.914)	(.779)	(2.621)	(1.564)	(2.544)
LTD/(K-LTD)	–0.0118	–0.0008	.0360	.0165	.0012	.0105	–0.0008	–0.0000	–0.0022	.0007
	(–2.829)	(–4.551)	(1.704)	(0.924)	(.602)	(.810)	(–0.687)	(–0.056)	(–2.595)	(.544)
R/LTD	–0.1229	–0.0010	–0.0099	–0.1512	–0.1966	–0.1577	–0.0639	–0.1375	–0.0609	–0.9807
	(–0.551)	(–0.006)	(–0.091)	(–1.845)	(–1.435)	(–1.305)	(–0.721)	(–1.245)	(–0.863)	(–7.446)
DEP/K	.2151	–0.2218	–0.0706	–0.1205	–0.1241	.0152	–0.2690	–0.2871	–0.0797	–0.0112
	(1.946)	(–2.105)	(–0.924)	(–1.340)	(–1.310)	(.151)	(–2.737)	(–2.360)	(–0.977)	(–0.069)
P/K	–0.0528	.0438	–0.0091	.0138	–0.0035	–0.0098	.0403	.0229	–0.0045	–0.0049
	(–2.121)	(1.239)	(–0.384)	(0.715)	(–0.182)	(–0.665)	(2.276)	(.937)	(–0.321)	(–0.165)
D/S	–0.5243	–0.6441	.1382	–0.1986	–0.1258	–0.1672	–0.5218	–0.5361	–0.1126	–0.2749
	(–2.532)	(–2.897)	(.859)	(–1.552)	(–0.945)	(–1.286)	(–4.128)	(–3.510)	(–1.265)	(–1.416)
I/S	.3925	.7300	.2193	.2246	.0164	.3048	.4886	.3973	.0672	.0769
	(5.690)	(11.722)	(3.994)	(4.802)	(.277)	(6.997)	(15.175)	(5.487)	(1.736)	(.829)
R^2	.2239	.5138	.1095	.1222	–0.0059	.2392	.5862	.1435	.0340	.2198
F-statistic	9.6527	32.7078	4.6875	5.1756	.8249	10.3788	43.5010	6.0269	2.0490	9.4526

Note: Number in parentheses is *t*-ratio.

the explanatory power of such equations is not very great. The latter, however, is quite common in cross-section investment studies.

Consider the dividend equation first. In this connection, it should be noted that C_0 indicates the constant term, while the C_i, $i = 2, \ldots 9$, indicate the usual analysis of covariance contrasts; thus they may be interpreted as measures of the difference in the constant term among the various industrial classifications. In addition, it should be remarked that at the end of Table 7 we give the critical values of the F and t statistics at various levels of significance; the degrees of freedom of the F-statistic vary from equation to equation ranging from 165 to 180; the critical value for the t-statistic pertains to the conventional two-tailed test and the relevant degrees of freedom are approximately 165, though again this varies moderately from equation to equation. We shall not repeat this information for subsequent tables.

Returning now to the substantive results obtained, it is interesting to note that there is apparently quite a consistent difference in the dividend policies of firms in various industrial classifications as evidenced by the fact that the contrasts C_i, for $i = 9, 8, 7, 4$, turn out to be uniformly significant, while for $i = 6, 5, 3$, and 2 they are nearly uniformly insignificant. Thus the result seems to imply that, *ceteris paribus,* firms in mining, steel, etc. (9), textiles, glass, etc. (8), building materials and equipment (7), rubber, petroleum, etc. (4), tend to pay higher dividends (per dollar sales) than is the case for the remaining firms in our sample. The rate of profit variable, as was to be expected, turns out to be the most consistent factor in explaining dividends over the sample period. Another result of interest is that the investment variable turns out to be significant quite frequently (in eight cross sections) and appears to exert a positive influence on dividends. Now one might argue that investment, with a lag, affects the profitability of the firm's operations and hence would be expected to lead to greater dividend payments. On the other hand, it is difficult to rationalize this result in the context of our present investigation. The sign of the external finance coefficient, whenever significant, turns out to be negative. In both the case of investment and external finance, their coefficients appear to be in conformity with the signs of their respective simple correlations with the dividend variable.

Turning now to the investment equation, four features are worth noting. The rate of change in sales variables turns out to be significant in only five cross sections (1951, 1954, 1955, 1956, and 1960; with the exception of 1954 all are upswing or peak years); the rate of profit variable turns out to be uniformly insignificant. Of the contrasts, only

C_i for $i = 7$ and 4 turn out to be more or less consistently significant; notice, however, that the general constant, C_0, turns out to be more frequently significant in comparison with the general constant of the dividend equation. The external finance variable is nearly uniformly significant and its impact on investment is uniformly positive.

The astonishing result in the investment equation is the sign and nearly consistent significance of the coefficient of the dividend variable. While in discussing the dividend equation one could provide some rationalization for the positive sign of the coefficient of the investment variable, it is difficult to rationalize the positive sign of the dividend coefficient which points to the potential pitfalls of the single-equation approach and the ordinary tests of significance.

The external finance equation displays two interesting characteristics; there is no evidence that the firm's behavior in this aspect is affected by the type of activity it is engaged in, since the contrasts turned out to be uniformly insignificant and thus were omitted from the reported results. There is little evidence for the validity of the principle of increasing risk, although whenever the leverage variable is significant its coefficient turns out to be negative in conformity to the principle's implications. Finally it would appear that the most consistent determinant of external finance is investment, as one might expect.

The single-equation results in this section are quite instructive in a negative way. First, they demonstrate how dangerous it is to use single-equation techniques indiscriminately, when quite clearly the problems under consideration are fundamentally interdependent. Secondly, they show that the criterion of inclusion or exclusion of a variable from a regression based on the magnitude of the resulting multiple correlation coefficient as advocated by Hotelling [5] or Theil [14][2] is a very delicate criterion and should be used very cautiously indeed. In this context, if one is determined to use single-equation techniques, it is best to use as explanatory variables those which are truly exogenous, even though some explanatory power is lost thereby.

Estimation of the Dividend-Investment-External Finance Structure by Simultaneous-Equation Techniques

THE NEED FOR FULL INFORMATION METHODS

We have seen in the previous section that single-equation methods are beset by serious deficiencies in meaningfully tracing the interde-

[2] Pp. 206 ff.

TABLE 10

Correlation Matrix of Two-Stage Least-Squares Residuals, 1951 - 60

	Eq. (1)	Eq. (2)	Eq. (3)	Eq. (1)	Eq. (2)	Eq. (3)
		1951			*1956*	
Eq. (1)	1.0000	.6756	.1366	1.0000	.7517	−0.2722
Eq. (2)		1.0000	−0.1478		1.0000	−0.0492
Eq. (3)			1.0000			1.0000
		1952			*1957*	
Eq. (1)	1.0000	.8470	−0.3927	1.0000	.9099	−0.0384
Eq. (2)		1.0000	−0.7309		1.0000	.2152
Eq. (3)			1.0000			1.0000
		1953			*1958*	
Eq. (1)	1.0000	.8964	−0.5025	1.0000	.8603	.1955
Eq. (2)		1.0000	−0.1663		1.0000	.1191
Eq. (3)			1.0000			1.0000
		1954			*1959*	
Eq. (1)	1.0000	.9030	−0.0715	1.0000	.7608	−0.5608
Eq. (2)		1.0000	−0.4463		1.0000	−0.1303
Eq. (3)			1.0000			1.0000
		1955			*1960*	
Eq. (1)	1.0000	.6996	−0.2867	1.0000	.8682	.0169
Eq. (2)		1.0000	−0.0441		1.0000	−0.2147
Eq. (3)			1.0000			1.0000

pendence of the decision making processes we wish to investigate. Thus, simultaneous-equation techniques are clearly indicated. The question then naturally arises as to whether limited information methods, such as two-stage least squares, are appropriate or whether full information techniques are indicated.

It is, of course, the case that full information methods are more sensitive to errors of specification than limited information methods are. Nonetheless, one may suspect that the information content of the non-estimated equations is sufficiently high so that the gain in efficiency would outweigh the effects of propagating specification errors. This is so since we are dealing with a cross-sectional sample and the three decisions studied here are made more or less concurrently by the same group of people possessing substantially overlapping or similar information.

But, of course, the ultimate test as to whether full information methods are indicated is related to the correlation matrix of the, say, two-stage least-squares residuals of the three equations. In Table 10, we present the relevant correlation matrixes for the years 1951–60.

In Table 10, the dividend equation is termed equation (1), the investment equation is equation (2), and the external finance equation is equation (3). The model on which these correlations are based is that presented in Tables 7, 8, and 9. The impression is unmistakable, from Table 10, that full information methods are indicated in the present case.

The proper significance tests for this type of correlation coefficient are not adequately dealt with in the econometric literature. However, in view of the consistency of the two-stage least-squares estimates, it is not amiss to treat the residuals, at least asymptotically, as observations on the (unobservable) disturbances. This, of course, assumes no specification errors. If we take this view, then the proper test would be based on the distribution of the usual sample correlation coefficient. The appropriate number of degrees of freedom would be the number of observations less the number of estimated parameters in the two equations of interest. In our case, the degrees of freedom are not less than 150. On the basis of these considerations, it would appear that the critical values for rejecting the hypothesis of no correlation are $|r| = .159$ and $|r| = .208$, employing a two-tail test at the 5 and 1 per cent levels of significance, respectively.

Table 10 shows that the hypothesis is to be accepted only in the following instances; between dividend and external finance residuals for 1951, 1954, 1957, and 1960. In addition, the hypothesis is to be accepted also for the years 1955, 1959, and 1960 between the investment and external finance residuals. Interestingly enough, these are years of upswings or peaks. Thus, with the possible exception of upswing years, where apparently profits outrun investment and dividend requirements so that there is no effective (resource) constraint on the firms' operation, it would appear that the correlation coefficients are sufficiently high to warrant the conclusion that the efficiency of the parameter estimators would be appreciably increased by the use of full information methods. It might be instructive, however, before we present the main empirical results of our study, to examine briefly the limited information (two-stage least-squares) estimates of our model. These are presented in Tables 11, 12, and 13.

TABLE 11

Limited Information (2SLS) Estimates, Dividend Equation, 1951 -60

Variable	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
C_0	.0277	.0172	.0157	.0132	.0100	.0196	.0222	.0093	.0094	.0259
	(2.7999)	(1.3136)	(1.0747)	(1.5090)	(1.2304)	(1.8840)	(1.5188)	(1.1085)	(.8668)	(2.1333)
C_2	–0.0047	.0044	.0028	.0042	.0047	.0056	.0095	.0035	.0030	–0.0046
	(–0.6301)	(.4832)	(.2584)	(.5017)	(.5252)	(.4844)	(.7920)	(.5138)	(.3892)	(–0.5898)
C_3	–0.0024	.0135	.0028	.0094	.0085	.0105	.0173	.0045	.0066	.0044
	(–0.3083)	(1.3755)	(.2380)	(.9864)	(.9249)	(.7792)	(1.3271)	(.6377)	(.8160)	(.5461)
C_4	.0289	.0478	.0470	.0417	.0429	.0474	.0641	.0317	.0322	.0378
	(2.4175)	(2.5982)	(2.1911)	(4.7282)	(4.9359)	(3.0207)	(2.8057)	(2.9074)	(2.3465)	(2.8913)
C_5	.0013	.0053	.0160	.0151	.0149	.0082	.0131	.0143	.0149	.0155
	(.1778)	(.5500)	(.9713)	(1.8857)	(1.8003)	(.8785)	(1.1106)	(2.0966)	(1.8820)	(1.9992)
C_6	–0.0018	.0050	.0040	.0104	.0086	.0052	.0179	.0078	.0021	.0069
	(–0.2070)	(.4920)	(.3480)	(1.0810)	(.9121)	(.5018)	(1.2377)	(1.0087)	(.2409)	(.7486)
C_7	.0307	.0456	.0445	.0384	.0434	.0543	.0866	.0370	.0307	.0419
	(2.1275)	(2.3471)	(2.6646)	(4.0349)	(3.9680)	(2.7453)	(2.3678)	(3.2034)	(2.5173)	(3.0755)
C_8	.0150	.0306	.0259	.0234	.0245	.0248	.0522	.0233	.0170	.0212
	(1.8553)	(2.3904)	(2.1047)	(3.0610)	(2.6935)	(2.0607)	(2.7126)	(3.0333)	(1.9699)	(2.2348)
C_9	.0428	.0549	.0650	.0446	.0449	.0524	.0802	.0451	.0352	.0485
	(3.0808)	(2.4140)	(2.4184)	(4.7073)	(4.8429)	(3.6863)	(2.7637)	(3.2743)	(2.5541)	(3.4583)
P/K	.0343	.0787	.0782	.0407	.0769	.0666	.0881	.0988	.0778	.0936
	(2.2171)	(3.0211)	(2.6281)	(2.7568)	(4.834)	(3.1867)	(3.9256)	(5.9616)	(5.1765)	(5.7570)
N/K	–0.0038	–0.0096	–0.0085	–0.0029	–0.0064	–0.0078	–0.0142	–0.0083	–0.0066	–0.0111
	(–1.3856)	(–1.9510)	(–1.7214)	(–1.2093)	(–2.4054)	(–1.8377)	(–2.2689)	(–2.2896)	(–1.6282)	(–2.3144)
I/S	–0.1812	–0.3393	–0.4008	–0.1481	–0.1773	–0.3071	–0.4798	–0.0417	–0.0307	–0.2931
	(–0.9624)	(–1.0504)	(–1.1298)	(–1.5108)	(–1.7433)	(–1.3858)	(–1.6344)	(–0.2445)	(–0.1476)	(–1.2723)
$EF1/S$	–0.0656	.1815	.6296	.1814	.2483	.3505	.4206	–0.0020	.3039	.1151
	(–0.6753)	(1.0781)	(2.1539)	(.8808)	(1.2511)	(.6248)	(1.0836)	(–0.0213)	(1.0728)	(1.7823)

Note: Number in parentheses is t-ratio.

TABLE 12

Limited Information (2SLS) Estimates, Investment Equation, 1951 - 60

Variable	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
C_0	.0362	.0427	.0462	.0636	.0293	.0494	.0574	.0452	.0617	.0466
	(1.7394)	(2.0186)	(1.7199)	(2.0680)	(.0309)	(2.1478)	(2.3086)	(3.1723)	(2.6136)	(4.4204)
C_2	.0025	–0.0073	–0.0097	–0.0019	.0124	–0.0033	.0061	.0013	.0079	–0.0078
	(.1422)	(–0.3503)	(–0.4062)	(–0.0584)	(.6352)	(–0.1396)	(.2726)	(.0797)	(.3275)	(–0.5940)
C_3	–0.0018	.0021	–0.0028	.0329	.0203	.0061	.0197	.0163	.0170	.0089
	(–0.0991)	(.0978)	(–0.1162)	(.8598)	(.9804)	(.2411)	(.8335)	(.8705)	(.6839)	(.6167)
C_4	.0578	.0627	.0803	.1457	.0729	.0777	.1050	.0858	.1196	.0596
	(2.4587)	(2.3626)	(2.7334)	(2.6593)	(3.2030)	(2.3379)	(3.1317)	(3.1028)	(2.3611)	(2.7069)
C_5	–0.0055	–0.0084	.0075	.0311	.0415	.0134	.0144	.0095	.0322	.0114
	(–0.3063)	(–0.4115)	(.3364)	(.8718)	(2.1673)	(.6302)	(.6211)	(.5370)	(.9827)	(.7408)
C_6	–0.0021	.0003	–0.0052	.0279	.0139	.0018	.0267	.0189	.0187	.0156
	(–0.1048)	(.0176)	(–0.2011)	(.7336)	(.6891)	(.0767)	(1.0394)	(.9613)	(.6470)	(1.0566)
C_7	.0745	.0636	.0650	.1367	.0966	.1173	.1585	.0944	.1112	.0615
	(2.9103)	(2.5649)	(2.1877)	(2.4950)	(4.2284)	(2.8252)	(3.5381)	(3.0214)	(2.0827)	(2.5238)
C_8	.0209	.0351	.0357	.0671	.0475	.0416	.0788	.0482	.0598	.0334
	(.9268)	(1.6274)	(1.4860)	(1.5482)	(2.0668)	(1.0849)	(2.7615)	(2.0881)	(1.6871)	(1.8133)
C_9	.0717	0.739	.1082	.1491	.0607	.0748	.1348	.113	.1078	.0665
	(2.0278)	(2.0586)	(2.9748)	(2.2742)	(2.2236)	(1.8251)	(2.9326)	(3.3494)	(2.2296)	(2.3781)
$(P/K)_{-1}$	–0.0119	.0473	.1242	.2040	.0366	.0498	.0973	.1439	.2938	.0458
	(–0.3680)	(1.2614)	(1.2107)	(1.6125)	(.8487)	(.7674)	(1.5277)	(1.9012)	(1.4880)	(.7561)
S^*_{-2}	.0337	.0000	–0.0054	–0.0153	.0725	.0409	–0.0135	–0.0103	–0.0753	.0100
	(2.0252)	(.0071)	(–0.3603)	(–0.5759)	(3.7398)	(2.0248)	(–0.4020)	(–0.4477)	(–1.2534)	(.5051)
N/K	–0.0064	–0.0142	–0.0177	–0.0216	–0.0102	–0.0141	–0.0243	–0.0244	–0.0398	–0.0191
	(–1.2329)	(–2.6378)	(–2.0275)	(–1.9865)	(–1.8737)	(–2.0068)	(2.8265)	(–3.0674)	(–2.1392)	(–2.6342)
D/S	–0.2553	–0.5561	–1.2583	–2.9185	–0.8833	–0.8174	–1.2744	–1.0997	–2.0007	–0.4323
	(–0.3405)	(–0.8720)	(–1.1688)	(–1.9967)	(–1.9263)	(–1.0164)	(–1.4365)	(–1.5189)	(–1.4055)	(–0.7581)
$EF1/S$	.0851	.4695	.8029	1.4809	–0.1375	.2039	.5695	.1650	1.0848	.1295
	(.3719)	(3.4898)	(2.1078)	(2.7006)	(–0.3116)	(.2317)	(.9213)	(.5679)	(.9289)	(1.0516)

Note: Number in parentheses is *t*-ratio.

TABLE 13

Limited Information (2SLS) Estimates, External Finance Equation, 1951-60

Variable	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
C_0	.0186	.0051	.0438	.0259	.0241	.0195	.0213	.0324	.0118	.0728
	(1.0536)	(.2688)	(1.7777)	(1.2361)	(2.2899)	(1.2936)	(1.9536)	(2.6940)	(1.4741)	(3.3261)
$LTD/(K-LTD)$	−0.0118	−0.0005	.0337	.0111	.0011	.0091	−0.0008	−0.0000	−0.0021	−0.0004
	(−2.8772)	(−1.9915)	(1.5071)	(.5996)	(.5416)	(.6755)	(−0.5946)	(−0.0806)	(−2.5168)	(−0.2556)
R/LTD	−0.1489	−0.1611	.0016	−0.1701	−0.2641	−0.1871	−0.1081	−0.1857	−0.0613	−1.1784
	(−0.5681)	(−9.6545)	(.0128)	(−2.0045)	(−1.7469)	(−1.3453)	(−1.1051)	(−1.5837)	(−0.8754)	(−6.8722)
DEP/K	.2030	−0.3540	−0.0327	−0.2035	−0.1772	.0029	−0.3236	−0.3740	−0.0636	−0.3391
	(1.7329)	(−2.2743)	(−0.3177)	(−2.0577)	(−1.6725)	(.0238)	(−2.9077)	(−2.6794)	(−0.7321)	(−1.4703)
P/K	−0.0436	.1607	−0.0434	.0424	.0161	−0.0096	.0445	.0559	−0.0109	.1106
	(−1.3047)	(2.0572)	(−1.0145)	(1.7643)	(.6112)	(−0.4048)	(1.5571)	(1.5578)	(−0.5912)	(1.7708)
D/S	−0.6930	−1.9653	.2750	−0.6788	−0.3843	−0.2618	−0.7463	−0.9394	−0.0437	−1.8134
	(−1.1098)	(−1.9920)	(.4919)	(−2.8479)	(−1.3299)	(−0.7325)	(−2.3016)	(−2.7185)	(−0.2520)	(−2.6671)
I/S	.4710	1.3034	−0.0497	.3455	.1287	.2593	.4516	.5980	.0153	.6065
	(2.4308)	(4.1220)	(−0.1972)	(3.8562)	(1.0669)	(2.2752)	(4.8456)	(3.1997)	(.1486)	(1.9469)

Note: Number in parentheses is t-ratio.

At least two aspects of these results are worthy of comment. First, notice the reversal of sign of the coefficients of the investment variable in the dividend equation and that of the dividend variable in the investment equation. This does indeed demonstrate the type of erroneous conclusions one might be led to by using inappropriate econometric techniques.

The second interesting feature is that the single-equation results seriously understate the role of the rate of profit as a determinant of investment. The two-stage least-squares results show that variable to be occasionally significant in the investment equation, while the single-equation results never show it to be significant (often with an unacceptable sign).

No further comments seem to be warranted at this juncture, since we shall comment at length below on the structure of this triad of decision-making processes, when its parameters have been estimated by the appropriate econometric procedure, which our results so far suggest should be a full information one. The parameter estimates, however, do not differ markedly in two- and three-stage least squares, though the latter results are more efficient.

MAIN EMPIRICAL RESULTS

In dealing with the full information results of our estimation, it is well to bear in mind that while there are cogent a priori reasons why one might expect that such decisions as we are studying here are resolved simultaneously, nonetheless one cannot assert with any confidence that the feedbacks are equally strong in all directions. Hence one of the issues to be resolved by the empirical results is whether a fully simultaneous model, such as the one presented in the previous section, is the most appropriate or whether some other form such as a recursive one would be a more suitable version for the model. Admittedly, there is no clear-cut criterion by which to choose. We have tended to make this determination in terms of the interpretability of the results yielded in the context of the appropriate theoretical considerations. On this basis, it would appear that the fully simultaneous model gives more meaningful results and we shall, therefore, proceed to analyze its empirical implementation in some detail. The empirical results are contained in Tables 14, 15, and 16.

Consider the dividend equation first. One noteworthy aspect is the rather remarkable stability of both the significance pattern and magnitudes of the contrasts. While it might be difficult to argue definitively against the observation that this may be due entirely to the normaliza-

TABLE 14

Full Information (3SLS) Estimates, Dividend Equation, 1951 -60

Variable	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
C_0	.0289	.0268	.0053	.0138	.0087	.0186	.0308	.0147	.0091	.0328
	(3.0240)	(2.6695)	(.4723)	(1.6619)	(1.1179)	(1.8804)	(2.4289)	(1.8858)	(.9025)	(3.3014)
C_2	−0.0049	.0041	.0035	.0041	.0068	.0026	.0075	.0029	.0023	−0.0059
	(−0.6628)	(.4939)	(.3738)	(.4937)	(.7778)	(.2457)	(.6369)	(.4396)	(.3266)	(−0.7700)
C_3	−0.0022	.0129	.0034	.0092	.0106	.0069	.0156	.0055	.0062	.0059
	(−0.2840)	(1.4304)	(.3299)	(.9858)	(1.1872)	(.5564)	(1.2383)	(.7859)	(.8201)	(.7472)
C_4	.0301	.0615	.0309	.0424	.0456	.0435	.0722	.0389	.0301	.0470
	(2.5859)	(4.1939)	(2.1453)	(5.5010)	(5.4389)	(3.1959)	(3.8542)	(3.8722)	(2.3217)	(4.2905)
C_5	.0014	.0110	.0084	.0154	.0171	.0073	.0148	.0134	.0122	.0164
	(.1914)	(1.2358)	(.8782)	(1.9273)	(2.1397)	(.8226)	(1.2704)	(1.9949)	(1.6402)	(2.1344)
C_6	−0.0024	.0065	.0037	.0102	.0104	.0061	.0182	.0089	.0044	.0101
	(−0.2808)	(.6968)	(.3627)	(1.0832)	(1.1384)	(.6222)	(1.3120)	(1.1710)	(.5364)	(1.1361)
C_7	.0315	.0553	.0294	.0388	.0446	.0498	.1039	.0442	.0294	.0503
	(2.2464)	(3.5559)	(2.4216)	(4.5331)	(4.3007)	(2.8570)	(3.5005)	(4.1319)	(2.5438)	(4.3522)
C_8	.0137	.0364	.0173	.0237	.0274	.0267	.0566	.0258	.0168	.0264
	(1.7094)	(3.3604)	(1.7457)	(3.1252)	(3.1130)	(2.2927)	(3.4431)	(3.4683)	(2.0608)	(3.0564)
C_9	.0423	.0767	.0411	.0453	.0479	.0499	.0945	.0542	.0361	.0575
	(3.1025)	(4.2083)	(2.3495)	(5.120)	(5.2868)	(3.8895)	(3.9039)	(4.2770)	(2.7521)	(4.7537)
P/K	.0332	.0491	.0721	.0409	.0819	.0634	.0660	.1012	.0702	.0751
	(2.4752)	(2.3130)	(2.7414)	(2.8356)	(5.2616)	(3.4194)	(3.3412)	(6.3468)	(5.0082)	(5.2006)
N/K	−0.0040	−0.0092	−0.0043	−0.0030	−0.0073	−0.0065	−0.0138	−0.0103	−0.0053	−0.0114
	(−1.6576)	(−2.1927)	(−1.2474)	(−1.4419)	(−2.8687)	(−1.8040)	(−2.5332)	(−3.0666)	(−1.3948)	(−2.8324)
I/S	−0.1900	−0.5752	−0.1106	−0.1625	−0.1996	−0.2727	−0.6100	−0.1663	−0.0124	−0.4518
	(−1.0667)	(−2.3977)	(−0.5001)	(−2.5432)	(−2.1176)	(−1.5124)	(−2.7209)	(−1.1017)	(−0.0633)	(−2.5995)
$EF1/S$	−0.0770	.2646	.6890	.2087	.3604	.3289	.4272	−0.0223	.3128	.1231
	(−0.8388)	(1.9407)	(2.9665)	(1.3556)	(1.8633)	(.6715)	(1.1990)	(−0.2395)	(1.1293)	(1.9467)

Note: Number in parentheses is t-ratio.

TABLE 15

Full Information (3SLS) Estimates, Investment Equation, 1951 -60

Variable	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
C_0	.0562	.0360	.0352	.0779	.0313	.0727	.0463	.0483	.0657	.0493
	(2.9868)	(2.3605)	(1.7951)	(2.9383)	(2.1768)	(3.4825)	(2.0629)	(3.4706)	(2.9005)	(4.8220)
C_2	.0009	.0129	.0076	.0062	.0172	−0.0080	.0072	.0023	.0045	−0.0097
	(.0507)	(.9951)	(.3759)	(.2096)	(.8885)	(−0.3568)	(.3238)	(.1461)	(.1980)	(−0.7771)
C_3	−.0024	.0219	.0133	.0201	.0261	.0032	.0233	.0148	.0220	.0060
	(−.1306)	(1.5934)	(.5967)	(.5855)	(1.2888)	(.1358)	(1.0010)	(.8151)	(.9458)	(.4448)
C_4	.0822	.0958	.1135	.1857	.0918	.1300	.0942	.0989	.1344	.0618
	(3.9719)	(5.1432)	(4.7983)	(4.6702)	(4.6759)	(5.0582)	(3.2104)	(3.9044)	(2.8148)	(3.5059)
C_5	.0014	.0314	.0262	.0604	.0481	.0281	.0146	.0202	.0328	.0119
	(.0849)	(2.2174)	(1.3235)	(1.9267)	(2.5908)	(1.3977)	(.6391)	(1.1669)	(1.0667)	(.8567)
C_6	.0002	.0120	.0098	.0199	.0198	.0217	.0212	.0190	.0261	.0155
	(.0149)	(.8320)	(.4483)	(.5746)	(.9866)	(.9607)	(.8324)	(.9917)	(.9556)	(1.0980)
C_7	.1011	.0781	.0940	.1639	.1147	.1868	.1689	.1196	.1275	.0610
	(4.4527)	(4.7017)	(3.9009)	(3.9948)	(5.6713)	(5.7198)	(4.1568)	(4.1999)	(2.5401)	(3.1452)
C_8	.0462	.0544	.0606	.1014	.0623	.1022	.0709	.0721	.0721	.0298
	(2.2504)	(3.9923)	(2.9593)	(2.9762)	(2.9613)	(3.3186)	(2.7200)	(3.3576)	(2.1713)	(1.9612)
C_9	.1186	.1314	.1413	.1918	.0844	.1422	.1428	.1628	.1528	.0624
	(3.9668)	(4.6803)	(5.0492)	(4.1124)	(3.6545)	(4.5389)	(3.4699)	(5.4355)	(3.3663)	(2.8230)
$(P/K)_{-1}$	.0234	.0042	.1340	.1842	.0806	.1238	.0090	.1402	.2418	−0.0108
	(.4335)	(.2297)	(1.9058)	(2.1315)	(2.4284)	(2.4919)	(.2099)	(2.1097)	(1.3015)	(−0.2809)
S^*_{-2}	.0315	.0071	.0074	.0143	.0627	.0447	.0357	.0403	−0.0076	.0241
	(1.9453)	(1.2251)	(.9380)	(1.4220)	(3.6952)	(2.6648)	(2.2093)	(2.0490)	(−0.1372)	(1.8978)
N/K	−0.0070	−0.0095	−0.0166	−0.0150	−0.0133	−0.0193	−0.0166	−0.0217	−0.0327	−0.0119
	(−1.5260)	(−2.5345)	(−2.3955)	(−1.7010)	(−2.6445)	(−3.0976)	(−2.1921)	(−2.9701)	(−1.8591)	(−2.1800)
D/S	−1.3758	−1.1043	−1.9639	−4.2004	−1.3751	−2.3647	−0.8637	−1.6944	−2.6940	−0.4251
	(−2.3716)	(−2.3017)	(−2.8860)	(−4.9679)	(−3.8710)	(−4.1750)	(−1.2435)	(−2.6593)	(−2.0022)	(−1.0417)
$EF1/S$	−.0943	.3976	1.0322	1.0480	−0.1781	−0.8921	.0912	−0.3760	.4722	.1064
	(−.4472)	(3.1588)	(3.0578)	(2.1296)	(−0.4063)	(−1.1444)	(.1626)	(−1.4426)	(.4246)	(.9507)

Note: Number in parentheses is t-ratio.

TABLE 16

Full Information (3SLS) Estimates, External Finance Equation, 1951 - 60

Variable	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
C_0	.0148	–0.0121	.0250	.0251	.0258	.0174	.0217	.0330	.0091	.0605
	(.8566)	(–0.7917)	(1.0803)	(1.7404)	(2.4713)	(1.2117)	(1.9916)	(2.7485)	(1.1639)	(2.8154)
LTD/(K–LTD)	–0.0115	–0.0008	.0149	.0106	.0007	.0032	–0.0004	–0.0003	–0.0017	.0001
	(–2.8806)	(–3.0161)	(.7424)	(1.1168)	(.3778)	(.2462)	(–0.3631)	(–0.2922)	(–2.1438)	(.0889)
R/LTD	–0.0660	–0.0145	–0.0321	–0.1591	–0.3001	–0.2066	–0.1374	–0.2086	–0.0889	–1.1594
	(–0.2556)	(–0.0857)	(–0.3369)	(–2.1438)	(–2.0968)	(–1.5273)	(–1.4366)	(–1.8885)	(–1.3550)	(–6.7665)
DEP/K	.2191	–0.2285	.0035	–0.2169	–0.1976	–0.0514	–0.3157	–0.3829	–0.0073	–0.2107
	(1.9411)	(–1.9049)	(.0396)	(–2.2400)	(–1.9292)	(–0.4376)	(–2.8443)	(–2.7616)	(–0.0859)	(–0.9338)
P/K	–0.0406	.1246	–0.0701	.0436	.0167	–0.0093	.0430	.0766	–0.0347	.1252
	(–1.2166)	(1.6509)	(–1.7543)	(1.8287)	(.6370)	(–0.3925)	(1.5073)	(2.1475)	(–1.9325)	(2.0083)
D/S	–0.6802	–1.0531	.6903	–0.6702	–0.3956	–0.2575	–0.7333	–1.2043	.3255	–1.8697
	(–1.0940)	(–1.1633)	(1.3617)	(–2.8198)	(–1.3703)	(–0.7254)	(–2.2664)	(–3.5257)	(1.9936)	(–2.7528)
I/S	.4785	1.0682	–0.2174	.3502	.1322	.2596	.4482	.7184	–0.1449	.6608
	(2.4752)	(3.5622)	(–0.9311)	(4.0191)	(1.0985)	(2.2882)	(4.8168)	(3.8733)	(–1.4538)	(2.1242)

Note: Number in parentheses is t-ratio.

tion we have chosen to impose on our endogenous variables, nonetheless such inference does not seem valid to us. It might be observed that the stability in the contrasts just noted seems entirely in accord with the single-equation conclusions based on Table 7. A rather important consequence of this finding relates to the well-known studies of Lintner [15, 16], as well as to those of others. We seem to find that the dividend decision function varies from one industrial classification to another, at least with respect to the constant term. Hence, it would not appear proper to deal with this relationship in simple aggregative terms. At least this aspect of nonhomogeneity must be taken account of.

The coefficients of the exogenous variables exhibit a substantial degree of stability over time. The coefficient of the net current position (N/K) is uniformly small and negative; it turns out to be insignificant for 1953, 1954, and 1959. It may be remarked that these were years of relatively low (corporate) inventory investment, and thus the insignificance of the net current position is best understood in terms of dominance of this variable by its inventory component. The result is then perfectly intelligible in view of the uniformly negative impact of investment on the dividend policy of firms.

The coefficient of the rate of profit variable is consistently positive and significant. There is some slight evidence of an upward trend in its magnitude, and while one might tend to attribute it to the rather prolonged expansionary behavior of the economy in the postwar years, the evidence is too slight to permit this interpretation to be pressed too vigorously.

The behavior of the investment and external finance coefficients is of considerable interest. First, comparing them with the single-equation results, we find a complete reversal of their sign. Beyond that, the full information results appear to indicate an interesting pattern of relationships. Thus, the external finance variable appears to be significant only in periods of upswings (1952, 1955) or peaks (1953, 1960). On the other hand, the coefficient of the investment variable appears to be significant (and negative) chiefly during the upturn and peak years, although this is not a strictly consistent phenomenon. These results clearly demonstrate the significant dependence of the dividend policy of firms on their investment decision, a result obtained also in connection with our study of the dividend policy of electric utility firms [3] in a slightly different context. In the light of these results, one ought to have serious reservations concerning the specification of Lintner's dividend relation. Our findings would lead us to believe that one could best interpret his relation as simply the reduced form of the appropriate dividend function. Thus it would appear that several useful variables have been omitted from consideration and the consequent incidence of specification bias would tend to vitiate his otherwise excellent and pioneering work. Incidentally a similar interpretation of Darling's [2] work would tend to explain why changes in sales tend to serve as a useful explanatory variable for the dividend behavior of firms.

Finally, one might remark generally that the behavior of the estimates of the coefficients of the dividend equation over the entire sample period is rather stable and relatively free of cyclical characteristics.

Turning now to the investment equation, we first note that certain contrasts turn out to be consistently significant, viz., C_i for $i = 9, 8, 7,$ and 4. The remaining contrasts tend, on the whole, to be insignificant. This is a result that departs from the single-equation findings. It might also be pointed out in passing that these are the same industrial classifications for which significant contrasts were also found in the dividend equation. The significance of these contrasts indicates some degree of nonhomogeneity in the investment behavior of firms and hence several cross-section studies, such as those of Eisner [6], commit a specification error when they neglect this aspect. It might also be remarked that the magnitude of these estimates remains relatively stable over the period.

The pattern of influence of the predetermined variables on the investment decision is of considerable interest. First, note that the net current position (N/K) variable is nearly uniformly significant and negative in impact. This is best understood in terms of the cash flow constraint referred to above (equation 2) and the remarks made in connection with this variable when discussing the dividend equation.

Beyond this, the results provide some basis for appraising the "profits" and "accelerator" versions of investment theory. At first glance, the results seem to favor slightly the accelerator version. The (two-year average) change of sales variable (S^*_{-2}) appears to exert a significant influence on investment during the long period of postwar investment boom (following 1955). During that period it is insignificant only for 1959. Its coefficient is also significant in 1951, during the Korean war boom. The (lagged) rate of profit variable (our view of the profits version is somewhat different from the conventional one) appears to be insignificant in upswing (1951, 1952, 1959) and peak years (1957 and 1960). Moreover, the coefficient of this variable, when significant, does not appear to exhibit as much stability as the coefficient of the change of sales variable.

One might be tempted to argue that the "profits" version of investment theory is less pertinent than the accelerator version. This is, e.g., the conclusion of Eisner [6] and Kuh [13], but it is a misleading one. First, their results are based on single-equation techniques and thus do not adequately reveal the structure of the decision-making process they wish to study. (In this respect our own single-equation results tend to corroborate theirs.) Secondly, in choosing between the two alternative versions, it is incorrect to rely only on the direct role each of the relevant variables is empirically determined to play in the investment equation. On the contrary, our results seem to imply that the "profits" version is a very consistent and useful way of looking at the empirical behavior of investment. For the rate of profit variable is a very consistent and very significant determinant of the dividend behavior of firms, while the dividend variable appears also as a very useful and consistent determinant of investment. Thus, profits seem to operate on investment in a rather complex way, both directly and indirectly through the impact they exert on the dividend and external finance behavior of firms. Thus, if we interpret the cross-section studies of investment by recent authors, such as Kuh [13] and Eisner [6], as relating to the reduced form of the investment function, then we can plausibly argue that their generally negative findings with respect to the profits version is simply a reflection of the fact that the reduced form confounds the various links through which the rate of profit affects the investment process, given the structure as set forth in our investigation.

The dividend impact on investment is quite pronounced and consistently negative and significant (except for 1957 and 1960, both peak years). This is again a sharp departure from the results obtained by single-equation methods and supports the interdependent view of this triad of decision processes. In conjunction with the similar situation found for the dividend equation, it demonstrates the competitive character of the investment and dividend demands on the firm's resources.

The external finance variable appears to have been significant only in the pre-1955 period. Its coefficient, however, is not very stable, although it is positive, as one might expect. This might indicate that equity financing has become relatively more significant since 1955. Beyond that, one is hard put to find any other interpretation.

Finally, turning to the external finance equation, we should note that contrasts were determined to be insignificant and hence were omitted from the final form of this equation. Beyond that, the results here provide considerable information on a number of rather minor but still interesting issues. One of these is the empirical relevance of the so-called principle of increasing risk [11]. This has received scant attention in the literature. A recent study that seems to have examined this issue is that of Meyer and Glauber [18]. Unfortunately, however, the manner in which they approach the problem is unsatisfactory; for they merely limit themselves to examining the significance of the simple correlation between investment and an appropriate leverage variable. But, admittedly, the connection between investment and leverage is not a simple and direct one, and conclusions based on so crude a measure as simple correlations are bound to be quite tenuous. When the problem is examined in its proper perspective, viz., as influencing the external finance activity of the firm and only through that its investment decision, then one sees that there is some validity to the notion of increasing risk, especially in periods (the pre-Accord years[3]) when market rationing could not adequately take place through interest rate variation. We see that the leverage variable does turn out to be significant in 1951 and 1952 as well as in 1959, and it is negative in sign. Its numerical coefficient, however, is quite small. In conjunction with this, our interest variable, although quite imperfect in construction, tends to be insignificant in 1951, 1952, and 1953 (a period adjacent to the Accord), while it is consistently significant and negative in impact thereafter. Again this result throws some light on a related question, viz., the impact of the interest rate on investment, to which the traditional single-equation approach has normally answered that the impact of the interest rate on investment is insignificant. In this structural context, however, we do see such an impact in the positive and significant impact of the external finance variable in the investment equation in certain years.

The depreciation variable behaves in the expected fashion in conformity with the implication of the flow-of-funds view. One might ask why depreciation and profits should not be aggregated into one variable when dealing with the external finance equation, again in the context of the flow-of-funds view. As the results indicate, this would have been statistically an unsound procedure since the coefficients of the depreciation and (rate of) profit variables are generally of different sign. Moreover, the sign of the rate of profit variable is not stable and displays a distinctly cyclical character. It tends to be positive during periods when economic activity slows down (1954, 1958), while it tends to be negative during upswing or peak years (1953, 1959). This is quite interesting and seems to be symptomatic of the following type of behavior. It is a well-known and documented fact that firms display marked reliance on internal funds. During the upswing, when profits are rapidly rising, the more profitable a firm is, the less likely it may be

[3] Treasury-Federal Reserve Accord, March 4, 1951.

to rely on external finance. On the other hand, during periods of tight money or during the downswing, when profits are generally squeezed, then firms lacking in internal funds may be more inclined to resort to the capital market. At such periods, however, it is also a well-established fact that noninterest related forms of credit rationing are relatively more prevalent. Hence it is the more profitable firms that tend to have access to the capital market. If we recall that we deal with a cross-sectional sample, the change in sign of the coefficient of the profitability variable is easily understood.

As might have been expected, the investment variable turns out to be a rather consistent determinant of external finance, although its coefficient does not display much stability, even when significant. The dividend variable seems to be a less consistent determinant of the external finance behavior of firms. Its coefficient in 1954, 1957, 1958, and 1960 is significant and negative, while in 1959 it is significant but positive. Although it is difficult to give a useful interpretation to this result, other than the fact that stock flotation is in general an alternative to bond finance, it at least serves to dispel one possible implication of the Lintner view of dividend behavior. Lintner seems to imply that firms manifest a strong desire to maintain a rigid dividend policy. Thus, it would appear that in years when profits are unusually low this alleged rigidity should lead to added borrowing. But in the two recession years of our sample (1954 and 1958) the coefficient of the dividend variable is significantly negative, and hence the rigidity view does not appear to be supported empirically.

Before concluding this section, it might be desirable to give a few negative results. As an alternative to the fully simultaneous model presented above, one might consider a recursive model. Thus, one might postulate that investment is independent of the dividend and external finance decisions, dividend decisions depend only on investment, while external finance depends on both the dividend and investment decisions. The results of this estimation, not presented here in the interest of conserving space, are generally similar to those obtained in the fully simultaneous model, except that in the investment equation the rate of profit variable is frequently insignificant, but whenever it is significant—in three years—it has a negative sign. If we note that the dividend variable in the investment equation has a significantly negative coefficient and that the rate of profit variable in the dividend equation is consistently very significant with a positive coefficient, then the phenomenon described seems to indicate that the simultaneous model is the more relevant of the two.

Another failure worth noting was connected with the introduction of lagged dividends $(D/S)_{-1}$ as an explanatory variable in the dividend equation. Aside from any other problems that might arise when lagged endogenous variables serve as predetermined variables, multicollinearity was so severe as to preclude any meaningful results. Hence this was abandoned. On the other hand, we performed some single-equation computations of the dividend equation using lagged dividends as an explanatory variable. It turns out that its coefficient is highly significant and positive although the remaining explanatory variables still retain their significance. We should point out in this connection that we do not consider very meaningful the introduction of lagged endogenous variables as explanatory variables in cross-section studies of the sort pursued here. Hence we are not particularly concerned with the severe incidence of multicollinearity in these equations.

Conclusion

The objective of this study was to determine the structure underlying the dividend-investment-external finance triad of decision-making processes. The aim was not so much to attain predictive sharpness but rather to aid our understanding of the complex of relations that bind these policies together and, in conjunction with information exogenous to the firm, determine its actions. Moreover, we were concerned with demonstrating the simultaneous character of these decision-making processes.

The sample employed was a cross-sectional one involving 181 manufacturing, mining, and retail trade firms for which we had a continuous record over the period 1947–60. The method of investigation consisted of estimating the structure of our model successively for the years 1951–60. The main findings are in brief the following:

1. The single equation approach obscures the character of these decision-making processes.

2. Full information (three-stage least-squares) estimation methods are indicated since the correlation coefficients of the limited information (two-stage least-squares) residuals turn out to be quite significantly different from zero.

3. There is a significant degree of interdependence between the investment and dividend decision-making processes, with the implication that if dividend policies are very rigid as some allege, then this rigidity may tend to hamper the investment activity of firms. On the other hand, our results tend to show that the investment requirements of firms tend to have a significant effect on their dividend behavior.

This result is in accord with the findings of Dhrymes and Kurz [3], in the case of electric utilities.

4. The external finance activity of firms seems to be strongly affected by their investment policies, but less so by their dividend policies.

5. There is considerable evidence that elements of the accelerator version of investment theory are empirically quite relevant. On the other hand, our results seem to indicate that this should not be interpreted as a denial of the usefulness of the profits (rate of profit in our view) version. The manner in which profits affect investment is quite complex. They may tend to register an impact in several directions through the manner in which they affect directly the investment, the dividend, and the external finance decision-making processes.

6. Although our results differ markedly from the results of several cited studies, nonetheless if we interpret their findings as pertaining to the reduced form of the structure we have estimated here, then their results become compatible with ours. Thus, our results are best understood as generalizing and putting into proper perspective several previous findings pertaining to the investment and dividend behavior of firms.

In conclusion, we should point out that we offer this study by way of a preliminary exploration of our topic. Quite clearly much may be done further to elucidate more clearly the cyclical variation of the structure of these decision-making processes. The rather crude method of successive cross sections used here, while it does very definitely point to the presence of some cyclical pattern, nonetheless does not adequately pinpoint it.

Beyond that there are some data problems relating to the measure of the capital stock, the market value of the firm, and the interest rate variables that might have been handled more adequately. But, despite these reservations, we think that several useful conclusions may be derived from this study.

Appendix

(The list of firms comprising our sample is given below by industrial classification.)

INDUSTRIAL CLASSIFICATION 1

Boeing Airplane Company
Curtiss-Wright Corporation
Douglas Aircraft Company, Inc.
Lockheed Aircraft Corporation
North American Aviation, Inc.
United Aircraft Corporation
American Car and Foundry Co.
Martin Company

INDUSTRIAL CLASSIFICATION 1 (CONT.)

Alco Products Incorporated
Pullman Incorporated
Baldwin-Lima-Hamilton Corp.
Chrysler Corporation
General Motors Corporation
Studebaker-Packard Corp.
American Motors Corp.
The White Motor Co.
Mack Trucks, Inc.

INDUSTRIAL CLASSIFICATION 2

Bond Stores, Inc.
J. C. Penney Company
Allied Stores Corporation
Associated Dry Goods Corp.
City Stores Company
Federated Department Stores, Inc.
Gimbel Brothers, Inc.
R. H. Macy & Co., Inc.
Marshall Field & Company
The May Department Stores Co.
American Stores Company
First National Stores Inc.
The Kroger Company
Safeway Stores, Inc.
W. T. Grant Company
S. S. Kresge Company
S. H. Kress & Company
G. C. Murphy Company
F. W. Woolworth Company
Montgomery Ward & Co., Inc.
Sears, Roebuck and Company

INDUSTRIAL CLASSIFICATION 3

The American Tobacco Company
Liggett & Myers Tobacco Company
R. J. Reynolds Tobacco Company
P. Lorillard Company
U.S. Tobacco Company
Philip Morris, Inc.
The Borden Company
National Dairy Products Corp.
National Distillers Products Corp.
Schenley Industries, Inc.
Hiram Walker–Gooderham & Worts Ltd.
Distillers Corp.–Seagrams Limited
General Mills, Inc.
Pillsbury Mills, Inc.
Penick & Ford, Ltd., Inc.
Armour and Company
The Cudahy Packing Company
Swift & Company
Wilson & Company, Inc.
General Foods Corporation
Standard Brands Inc.

INDUSTRIAL CLASSIFICATION 4

Abbott Laboratories
Merck & Company, Inc.
Parke, Davis & Company
Colgate-Palmolive Company
The Procter & Gamble Company
Gulf Oil Corporation
Phillips Petroleum Company
Shell Oil Company

INDUSTRIAL CLASSIFICATION 4 (CONT.)

Sinclair Oil Corporation
Socony Mobil Oil Company, Inc.
Standard Oil Company of California
Standard Oil Company—Indiana
Standard Oil Company—New Jersey
The Texas Company
The Firestone Tire & Rubber Company
The B. F. Goodrich Company
The Goodyear Tire & Rubber Company
United States Rubber Company
General Tire and Rubber Company
Eagle-Picher Company
American Home Products Corporation
Sterling Drug Inc.
Vick Chemical Company
Allied Chemical & Dye Corporation
American Cyanamid Company
The Dow Chemical Company
DuPont
Hercules Powder Company
Monsanto Chemical
Union Carbide

INDUSTRIAL CLASSIFICATION 5

Allis-Chalmers Manufacturing Co.
Deere & Company
International Harvester Company
J. I. Case Company
American Chain & Cable Company, Inc.
Blaw-Knox Company
Combustion Engineering, Inc.
Fairbanks, Morse & Company
Ingersoll-Rand Company
Link-Belt Company
Worthington Corporation
The Budd Company
Bendix Aviation Corporation
Dana Corporation
Eaton Manufacturing Company
The Electric Auto-Lite Company
Stewart-Warner Corporation
Thompson Products, Inc.
The Black and Decker Mfg. Co.
Ex-Cell-O Corporation

INDUSTRIAL CLASSIFICATION 6

General Electric Company
Westinghouse Electric Corp.
Cutler-Hammer, Inc.
The Electric Storage Battery Co.
McGraw-Edison Company
Minneapolis-Honeywell Regulator Co.
General Cable Corporation

INDUSTRIAL CLASSIFICATION 6 (CONT.)

Admiral Corporation
Motorola, Inc.
Philco Corporation
Radio Corporation of America
Zenith Radio Corporation
Avco Manufacturing Corp.

INDUSTRIAL CLASSIFICATION 7

Johns-Manville Corporation
National Gypsum Company
The Ruberoid Company
United States Gypsum Company
General Refractories Company
Alpha Portland Cement Company
Armstrong Cork Company
Smith-Corona Marchant, Inc.
International Business Machine Corp.
Lehigh Portland Cement Company
American Radiator & Standard Sanitary Corporation
Crane Company
Otis Elevator Company
Lone Star Cement Corporation
Harbison-Walker Refractories Company
Penn-Dixie Cement Corporation
Yale and Towne Manufacturing Co.
United States Pipe and Foundry Co.

INDUSTRIAL CLASSIFICATION 8

American Can Company
Continental Can Company, Inc.
Anchor Hocking Glass Corporation
Owens-Illinois Glass Company
Masonite Corporation
Libbey-Owens-Ford Glass Company
The Champion Paper and Fibre Co.

INDUSTRIAL CLASSIFICATION 8 (CONT.)

Container Corporation of America
Crown Zellerbach Corporation
International Paper Company
Kimberly-Clark Corporation
The Mead Corporation
Rayonier Inc.
St. Regis Paper Company
Scott Paper Company
Union Bag-Camp Paper Corp.
West Virginia Pulp and Paper Co.
Burlington Industries, Inc.
Cannon Mills Company
J. P. Stevens & Company, Inc.
United Merchants & Manufacturers, Inc.
Beaunit Mills, Inc.
American Viscose Corporation
Bigelow-Sanford Carpet Company, Inc.
Simmons Company

INDUSTRIAL CLASSIFICATION 9

The International Nickel Company of Canada, Ltd.
Bethlehem Steel Corporation
Inland Steel Company
Jones & Laughlin Steel Corporation
National Steel Corporation
Republic Steel Corporation
United States Steel Corporation
Armco Steel Corporation
Revere Copper and Brass, Inc.
Aluminum Company of America
Kaiser Aluminum and Chemical Corp.
Olin Mathieson Chemical Corp.
Reynolds Metals Company
The Anaconda Company
Kennecott Copper Corporation
Phelps Dodge Corporation

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COMMENT

On Dhrymes-Kurz and Anderson

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There are two types of analysis used in dealing with the investment and financing decisions of the firm. The first is the standard marginal analysis based on certainty or point estimating models with modifications to reflect uncertainty. The second is to approach the problem from the point of view of the actual decision maker. Dhrymes and Kurz state that the objective of their study was to determine the dividend-investment-external finance triad of decision-making processes, thus apparently attempting to take the second approach. In any event I am going to use this approach in talking about the two papers.

Before making direct comments, I would like to take a few moments to develop a frame of reference. The problem we are dealing with—business fixed investment and the financing and dividend policies of the firm—are directly analogous to the types of decisions faced by the rational portfolio manager in handling financial assets and liabilities. The rational portfolio manager decides how much to withdraw for living and other expenses each year and how much to reinvest. This corresponds to the dividend decision. He also has two different types of problems. In the first place, he must form probability beliefs as to returns from individual assets under various states of nature. In some gambling and insurance situations risk can be virtually eliminated by diversification, but this is not true with most economic assets because of the covariance of yields. If one venture is profitable so will be others and vice versa. Probability beliefs about distributions of returns from various combinations of assets also are needed. In the second place, the portfolio manager must allocate his portfolio in the light of his beliefs about returns from available portfolios. The portfolio manager has the option to borrow and lend within restrictions, and in order to make rational choices he must have some trade-off function between returns and risk.

The rational entrepreneur has virtually the same problems. He must form probability beliefs not only about individual investment opportunities but also about returns to the firm as a whole if various alternative investment policies are adopted and various states of nature occur. He must decide upon proper financing or financial reserves. He too must have some trade-off functions between risk and return in order to make rational decisions.

I will talk first about the variables used by Dhrymes and Kurz, secondly about variables omitted in both papers, and finally about the trend in the cost of funds.

In the Dhrymes-Kurz model sales are used as a deflator for dividends and investment. Dividends divided by sales turn out to be positively correlated with investment divided by sales, and the coefficient of the dividend variable is significantly positive when used as one of the explanatory variables to explain the investment variable. They say "the astonishing result in the investment equation is the sign and nearly consistent significance of the coefficient of the dividend variable . . . it is difficult to rationalize the positive sign of the dividend coefficient which points to the potential pitfalls of the single-equation approach and the ordinary tests of significance." However, there is a plausible rationalization for this positive correlation. It is in the choice of sales as a deflator. Even if there is some small negative correlation between dividends per dollar of book and investment per dollar of book, as indeed would be expected if dividends and investment are accepted as alternative uses of funds, there would be a positive correlation between dividends per dollar of sales and investment per dollar of sales if there are significant differences in sales per dollar of book value. Consider, for example, a meat packer and a public utility. The meat packer pays a dividend equivalent to 5 per cent of book and invests 12 per cent of book, the public utility pays 6 per cent of book and invests 10 per cent of book. The dividend ratio is negatively correlated with the investment ratio. But the meat packer has $10 of sales for each $1 of book, while the public utility has only 25 cents of sales for each $1 of book, so the dividend-sales ratio for the meat packer is .5 per cent and the investment-sales ratio is 1.2 per cent, while the corresponding ratios for the public utility are 24 and 40 per cent. The dividend-sales ratios are positively correlated with the investment-sales ratios. There may well be other reasons for preferring the full information approach to the single equation—indeed I am sure of it—but the positive correlation between the dividends and investment ratios used by Dhrymes and Kurz does not seem to me to be one of them.

Let us now consider the variables omitted from consideration. Possibly the most striking example of this is Anderson's omission of the 1957 data. He says "Since I firmly believe that the continuation of the mid-1950's investment boom into 1957 was collective madness *ex ante,* not to mention *ex post,* I had little compunction about pulling the 1957 observation and refitting the equations without it. The object of this was to increase the accuracy of the parameter estimates and not, of course, to raise the R^2." I too would accept "collective madness" as a useful variable. The airline order curve for new equipment is a classic example of this sort. One airline ordered a new model and the race was on. I might agree with him that, in the absence of a good measure of collective madness, we should omit contaminated data. However, I would hesitate to claim that this procedure increased the accuracy of the parameter estimates unless the limited population about which I was talking were very clearly specified.

Probably a more serious omission in both papers is the omission of lagged variables in the explanatory equations. There are sound econometric reasons for this, but no one can claim that a model without lagged variables adequately reflects the structure underlying the dividend-investment-external finance triad of decision-making processes. This is particularly true as it affects the dividend decision. What the company has been paying in the past is a matter of prime concern to the directors who are deciding what to pay in the future. Not only does the omission of lagged dividends break with the actual decision process, but also it upsets the weights to be used with other estimating variables. For example, I have run simple cross-section regressions to explain the prices of the thirty stocks in the Dow Jones Industrial Average, using dividends and retained earnings only as the explanatory variables—all variables being deflated by book value. The regression coefficients vary widely from year to year, but the median values for the eight years 1956–1963 were as follows:

$$\hat{p} = 4 + 28D_t - 2RE_t.$$

If now we add the price last year to the explanation we get

$$\hat{p} = -2 + 5.6D + 3.0\,RE + .84P_{t-1}.$$

In three out of the eight years retained earnings carry more weight than dividends. Since the lagged price is available to anyone who is interested, it is clear that, in the actual decision-making context, retained earnings carry about as much weight as dividends. In the first equation the dividend variable acts as a proxy to take up the weight which should have been placed on past price.[1]

Finally, Anderson states that there is a secular uptrend in the position of the marginal cost of funds schedule. If he means only the interest rate when he says marginal cost of funds, I would agree. Not only are interest rates relatively high, but firms are economizing on their cash

[1] See Irwin Friend and Marshall Puckett, "Dividends and Stocks Prices" *American Economic Review,* September 1964, pp. 676–677.

balances, thus indicating that the cost of safe capital is relatively high. However, there is another type of capital—risk capital, whether derived from retained earnings or stock issuance—and there is no convincing evidence that the cost of this type of capital has increased. Industrial stock prices now average over twice book value compared with 1.2 times in 1950 and 1.4 times in 1957. Dividend yields have been cut in half. Part of this higher price-to-book ratio and lower dividend yields may have resulted from smaller uncertainty surrounding expected yields, but the reduction in uncertainty hardly has been enough to justify the assumption that the marginal cost of equity capital has risen.

On Dhrymes-Kurz and Anderson

BY R. W. RESEK, UNIVERSITY OF ILLINOIS

In past years economists discussed the problems of business investment which were emphasized in these papers, but when the time came to make empirical estimates they frequently returned to either acceleration or capacity-output theories. This emphasis was not due to a lack of trying to bring in other factors but was largely forced upon them by the lack of data as well as by variables that failed to vary. The authors consistently tried to incorporate more information into the explanations, but the endeavors were generally not too successful.

More recently, empirical studies have been made which significantly extend the evidence supporting alternative theories that improve our explanation of investment. They accomplish this by complementing an already accepted theory—not competing with it.

The papers presented here both emphasize the cost and availability of funds and its effect on investment. A number of possible positions can be taken concerning the cost of funds.

One can say that the cost of funds is fixed for all firms in the economy by the appropriate rate of interest. Jorgenson takes this position in his empirical work[1] and places emphasis on it in his theoretical work as, for example, that presented in this conference. He does find, of course, that investment is a decreasing function of the rate of interest but the rate is not dependent on the internal financial structure of the firm.

Miller and Modigliani have made an important contribution in this area. Earlier in this Conference they attempted to achieve a real mea-

[1] Dale W. Jorgenson, "Capital Theory and Investment Behavior," *American Economic Review,* May 1963, pp. 247–259.

sure of the cost of funds. In their view, this cost may differ from firm to firm. It does however remain constant for any given firm, regardless of financial structure (apart from tax complications).

In contrast to these views, Lintner in his paper indicates the belief that cost of funds is related directly to the internal financial structure of a firm and may change according to the volume of investment being made by the firm.

The two papers presented here are consistent with this latter view. Anderson explicitly introduces an expression for the marginal cost of funds to the firm. His expression relates this cost to the cost of equity and bond financing and to the internal financial position of the firms in the industry. His model is estimated at a very high level of aggregation so the results may be obscured by aggregate relations. However, his lag structure is likely to minimize this problem.

Dhrymes and Kurz construct a model which emphasizes the total volume of funds available and allocation of these funds by the firm. This model does not put specific emphasis on other phases of the cost element but the approach is closely related to Anderson's.

Dhrymes and Kurz build a three-equation model based on the alternative sources and uses of funds for a firm. They depend on the accounting identity:

$$I_1 + I_2 = EF1 + EF2 + P - D + Dep. \tag{2}$$

This equation states that fixed investment (I_1) plus inventory and other short-term investment (I_2) are the uses of funds. These must equal the sources of funds. These are external finance from bonds ($EF1$), external stock finance ($EF2$), and the internally generated funds-profits (P) minus dividends (D) plus depreciation (Dep). They assume short-term investment to be predetermined for the model, as were profits and depreciation. Stock financing is assumed to be residually determined. Thus only three equations must be estimated. These are for fixed investment, dividends, and bond external financing.

Their particular specification of the model was:[2]

$$\frac{D}{S} = g_1\left\{\frac{I}{S}\,\frac{EF}{S}\,\frac{P}{K}\,\frac{N}{K}\right\}$$

$$\frac{I}{S} = g_2\left\{\frac{D}{S}\,\frac{EF}{S}\left(\frac{P}{K}\right)_{t-1}\frac{N}{K}\,\frac{S - S(t-3)}{S(t-3)}\right\}$$

$$\frac{EF}{S} = g_3\left\{\frac{D}{S}\,\frac{I}{S}\,\frac{P}{K}\,\frac{Dep}{K}\,\frac{R}{LTD}\,\frac{LTD}{K - LTD}\right\}$$

[2] Time subscripts are added only when they are not t.

The variables are defined in Dhrymes and Kurz (hereafter referred to as D-K). Several peculiarities in this specification seem immediately apparent. First, the normalization of variables is half related to sales and half to capital stock. One cannot help but wonder what the outcome would have been if capital stock had been used throughout. Since sales are likely to fluctuate more than capital stock, the results may be sizably affected by the sales. For example, if the investment equation is solved to the left,

$$I = h_2 \left\{ D, EF, S \cdot \left(\frac{P}{K} \right)_{t-1}, S \cdot \frac{N}{K}, [S - S(t-3)] \frac{S(t)}{S(t-3)} \right\}$$

Both profits and the net current position of the firm are multiplied by sales. D-K find that both of these variables are frequently significant. Because of their specification, they may be finding the effect of sales rather than profits. The same type of situation exists in each equation of the model. Moreover, the constant term may have a coefficient that is attributable to sales and that explains the variation which otherwise would be explained by the accelerator variable, $[S - S(t-3)]$.

Secondly, one can question the lag structure used in the model. Considerable evidence has been accumulated indicating that there is a sizable lag between decisions to invest and the specific expenditure. The interest and belief in this lag is evidenced by this Conference's specific papers on anticipations and appropriations. Well-known papers by Almon[3] and de Leeuw[4] have made specific estimates of the size of the lag. One conclusion that might be reached from this point of view is that the investment decision is reached first and that the method of financing the investment is subsequently and separately determined. The decision concerning financing would take place when the money was actually spent. This might tend to indicate that a recursive model is called for. D-K indicate they attempted such a model unsuccessfully but since the lags employed in that attempt are unknown, the question remains unsettled.

An alternative approach (which I prefer) would be that, at the time investment decisions are made, tentative plans for financing are also considered. Certainly the variable cost of funds theory requires this view since the type of financing affects the cost of funds. This view says the D-K model is inappropriate because nearly all of the variables are used with no lag whatsoever while they should be lagged.

[3] Shirley Almon, "The Distributed Lag Between Capital Appropriations and Expenditures," *Econometrica*, January 1965, pp. 178–196.

[4] Frank de Leeuw, "The Demand for Capital Goods by Manufacturers: A Study of Quarterly Time Series," *Econometrica*, January 1962, pp. 407–423.

This question about the lags leads to a related problem concerning the identification of the model. P/K appears unlagged in the dividend model but lagged one year in the investment equation. This difference is not explained. Thus profits affect future investment but do not, at that same instant in time, affect the other future uses of funds, e.g., dividends. If the lag structure in the model is inappropriate, in particular if profits appropriately should appear with the same lag in both of the first two equations, then the investment equation is not identified and one will estimate only a linear combination of the first two equations. This problem is particularly troubling because this part of the specification is clearly uncertain, and as a result the investment equation estimates are unreliable.

Finally, the specific choice of variables can be questioned. In justifying the dividend equation, mention is made of the work of Lintner. His principal finding is that present dividends are largely dependent on past dividends. Dhrymes and Kurz did estimate this equation with this variable but they report that, ". . . multicollinearity was so severe as to preclude any meaningful results. Hence this was abandoned." This type of problem is acute whenever it arises, but it does not seem to be appropriate to exclude the single most important explanatory variable when the multicollinearity arises. The resulting misspecification is so severe as to preclude any meaningful results.

This particular problem arises since the lagged endogenous variable is the explanatory variable. Frequently this type of variable is employed to represent the lag structure, as suggested by Koyck and Jorgenson. In this type of usage the lagged endogenous variable serves as a proxy for most of the lagged dependent variables. Instead of such a proxy, it may be argued that it is preferable to avoid using the endogenous variable and to represent the lag in some other fashion. This argument does not apply to the present situation as the lagged dividends are, according to the theory, in and of themselves an important determinant of dividends.

Investment in the D-K model depends on the change in sales, profits, and variables indicating the financial position of the firm. Recent models have, in general, found that capacity adjustment mechanisms were at least as effective as those representing the acceleration principle through change in sales. A model employing sales and capital stock as variables is therefore a strong alternative to the use of change in sales.

The rate of profit is used in this equation as a variable, "which may be taken to lead to changes in the expected profitability of new investment." Generally profit theories depend on the cash flow arising from profits which lead to a lower cost of funds as well as future profits. This is indirectly taken into consideration in this model through the effects of profits on dividends and external finance and the resulting effect on investment. It is generally felt that profits and sales are highly correlated variables. Since sales enters as a first difference $[S - S(t - 3)]$ and profits directly, one cannot help but wonder whether the coefficients measure the relative importance of original variable versus first differences rather than the profits versus sales.

One should also question the information on internal funds of the firm contained in the investment equation. The financial position of the firm is indicated through dividends, external finance, and the net current position of the firm. The quantity of money available for investment is presumably contained in these. The cost of funds seems only to operate in affecting the external funds which in turn affect investment. The implication seems to be that the cost of funds schedule is perfectly elastic at a very low rate up to some critical value where it becomes perfectly inelastic. It seems much more realistic to say that the interest rate affects investment directly through the cost of funds as well as indirectly through the external financing. Even a firm with no external funds would be affected by the interest rate although the model does not allow for it.

Finally, the use of N/K by the authors should be considered. They indicate that this variable, ". . . enters the model as a consequence of the use of the budget constraint to eliminate one of the variables in the system." The nature of this relation and the sign this would imply for the coefficient are somewhat unclear. Anderson employs a similar variable lagged one period and gets a positive relation with investment, indicating that since current funds are available, investment will be higher. Dhrymes and Kurz find a negative value for the unlagged variable. This is somewhat harder to explain, but apparently means that funds have been used for current purposes and therefore investment could not take place during this period.

Up to this point we have commented on four major features of the specification of the D-K model. The normalization provides some question concerning what is being measured; the lag structure was not carefully formulated; the second equation is nearly underidentified; and finally the variables used in the equations certainly are not the only possible candidates for inclusion. These comments are nothing new for econometric work as every author must choose among mutually exclusive alternatives, but in this model specification problems seem particularly severe.

Three alternative sets of results are computed by D-K. These are one-stage, two-stage, and three-stage least squares. They reject ordinary least squares as inappropriate early in the paper. There can be no question but that they are correct in doing this and are providing a step forward, given their particular model. Their use of three-stage least squares is much more to be questioned. They justify it on the grounds that the correlation coefficients between the two-stage residuals are high. This is correct and it is true that this is the type of information that three-stage least squares use effectively.

On the other hand, the model employed may be greatly in error due to specification errors as discussed above. No estimating technique under consideration will provide consistent estimates of parameters under this type of situation. Two-stage estimates may be less affected by the specification errors than three-stage estimates, although true sampling properties are simply not known under this type of error. If this is true, their two-stage estimates may be more reliable than the three-stage values emphasized by the authors.

Let us turn now to the paper by Anderson. He sets up a two equation model explaining the marginal rate of return and the marginal cost of funds for firms. Since these must be equated by a rational investor, he then solves for investment and estimates the reduced form equation.

The marginal rate of return here is dependent on output and capital stock as well as the level of investment. This is reasonable and may be obtained from a capacity adjustment model. Marginal cost of funds depends on the internal financial position and the external cost of funds. The former here is noncapital assets minus liabilities plus retained earnings. This variable then represents approximately what the financial situation would be at the end of the period if all internally generated funds were used to improve this position. This formulation seems to be an excellent way to handle the generally difficult funds problem. In particular, Anderson seems to avoid the problem of collinearity that plagues alternative formulations of this variable.

The external cost of funds is measured by the equity yield and bond yield. However, it is clear that the yield on equities reflects more than the cost of equity funds. It is also greatly affected by the growth expectations of the firm. A firm with great prospects for growth would have a much lower yield than one with low growth prospects. Thus this stock variable reflects both expectations for output and cost of funds. The former, which I consider to be more important, would appropriately be considered as a determinant of the marginal rate of return of the firm. This in no way affects the reduced form model to be estimated but does significantly affect the interpretation to be put on the results obtained.

Anderson's results strongly support the hypothesis being tested and strongly support the cost of funds theories of investment behavior. Clearly, as he points out, the implications for governmental policy may be sizable but are likely to be complex.

Anderson uses very aggregate data, which may lead to problems related to the contrast between macrodata and use of what is essentially a microtheory. Anderson justified his model by saying that, ". . . policy formulation and forecasting often require quick and dirty estimates of economic parameters." Clearly the proof of this model will be in the forecasting ability of the equation obtained.

Together, these two papers provide a great deal of light on the internal financial behavior of firms and the effect of this on investment.

On Dhrymes-Kurz and Anderson

BY WILLIAM VICKREY, COLUMBIA UNIVERSITY

Dhrymes and Kurz examined the concept that in a large firm decisions on investment policy, dividend policy, and external finance are not the components of a single-decision vector arrived at by a unitary management on the basis of exogenous influencing factors; rather they are somewhat independent, though mutually interrelated, decisions arrived at and modified at different times and by different groups. This concept has considerable appeal as an attempt to improve understanding of the large organism. And it is reasonably plausible that this interrelated but nonmonolithic decision process can, to some extent, be represented by a structural model in which these interactions among the dependent variables can be exhibited. However, the results of this experiment do not seem to me to be as conclusive as the authors appear to believe.

The statistical results of their model are summarized in Table 1, in which the entries represent the range of the t-coefficients for the ten single-year cross sections, with some comments on their behavior. It is clear that the equations of the model are formally overidentified, which would provide an opportunity for the use of some test, such as the likelihood ratio, as an indication of whether the model fits the data sufficiently well compared with a less constrained one to maintain the hypothesis that the excluded coefficients are in fact zero. As it is, we are asked to take the stipulated constraints of the model more or less on faith and to suppress any suspicion we may have that knowledge of the leverage position of the firm or the interest rates that it pays might directly influence the decisions of those concerned with dividend policy, or of those concerned with investment.

If the derivation of a specific structure has any usefulness, over and above what can be done with direct least-squares estimation of the endogenous variables in terms of the exogenous ones, it lies in the coefficients in the first three lines, which express the internal structure of the decision mechanism concerning which we are seeking information. Unfortunately the results seem meager. The only coefficient to show a reasonable amount of consistency is the inhibiting influence of commitments as to dividends on investment decisions. Even this is somewhat suspect, inasmuch as current sales used to deflate investment and dividends also occurs as a component of the change in sales variable, which appears as an exogenous explanatory variable. As for taking the coefficients for the individual year structures at face value, it is really hard to believe that the composite internal decision structure of firms changes that much from one year to another. I cannot escape the impression that the model at hand is much too procrustean to provide us with any reliable insights into the internal structure of the firm.

As for the possible uses of the model for forecasting, it is my understanding that, as long as one does not anticipate any exogenously determinable change in the effective structure of the organism whose behavior is being predicted, straightforward least-squares regression of the single endogenous variables on the exogenous variables provides as good predictions as more elaborate methods. It is only when one expects to be able to predict independently some change in the structure that differs in character from changes occurring in the period of observation that knowledge of the specific structure becomes important, as when it is desired to predict the effect of a change in a tax rate that has been stable during the observation period. In the case at hand, I see little likelihood of there being available any such independent information of a general change in the internal organization of large businesses. Accordingly, the usefulness of the results for forecasting purposes would seem to me to reside in the single-equation least-squares results. Unfortunately, even these are not quite of the nature required, since the other endogenous variables are included in each of the single equations as explanatory variables, which makes a consistent forecast difficult.

TABLE 1

Summary of Statistical Results of Dhrymes and Kurz

Variable	Variable Explained by the Equation: Dividends Per Unit of Sales	Investment Per Unit of Sales	Long-Term External Finance Per Unit of Sales
Endogenous Variables			
Dividends per unit of sales	−1	−1.0 : −4.9 small at peaks	−3.5 : +2.0 erratic
Investment per unit of sales	−0.6 : −2.7 erratic	−1	−0.9 : +4.8 erratic; mostly +
Long-term external finance per unit of sales	−0.8 : +2.9 erratic	−1.1 : +3.1 erratic	−1
Exogenous Variables			
Industry dummy variables	4, 5, 7, 8, 9 generally significant	4, 5, 7, 8, 9	excluded
Profits per unit of capital	+2.3 : +6.3 fairly stable	excluded	−1.8 : +2.15 erratic; + at peaks
Net short-term assets per unit of capital	−1.2 : −3.0 fairly stable	−1.5 : −3.1 fairly stable	excluded
Profits this year per unit of capital last year	excluded	−0.28 : +2.5 erratic	excluded
Relative change in sales over the past 3 years	excluded	−.13 : +3.6 mostly +	excluded
Debt-to-equity ratio	excluded	excluded	−3.0 : +1.1 mostly −
Interest rate on debt	excluded	excluded	−.08 : −6.7
Rate of depreciation allowances	excluded	excluded	−2.8 : +1.9 mostly −

By way of contrast, the statistical techniques employed in the Anderson paper are relatively simple-minded, and the results straightforward and convincing. My only comment is that it seems to me that, in attempting to reconcile the timing of variables relating to a whole year and those relating to a point in time, it would be preferable to relate the flow over a given year to an average of the stocks at the beginning and end of the year, rather than, as Anderson does, relate the stock at a point in time to an average of the flows for the preceding and subsequent periods. Not only do the data in the former case span only one year in time rather than two, but the former treatment seems to conform more closely to the data that would be uppermost in the mind of a decision maker at a given time. Even if he does not at a given time have before him the stock figures for the end of the current year, but only the flow data for, say, the first eleven months of the year, it seems plausible to say that he will be more strongly influenced by his rough knowledge of what the probable stock situation will be at the close of the year than he will by what the flow was for the preceding full year. Thus for an output-capital ratio it would seem preferable to use $2Q_t/(K_t + K_{t-1})$ rather than $(Q_t + Q_{t-1})/2K_{t-1}$, and similarly $2R_t/(K_t + K_{t-1})$ rather than $(R_t + R_{t-1})/2K_{t-1}$ as the retained earnings element in the financial position. Otherwise the results seem to speak for themselves.

Reply to Latané, Resek, and Vickrey

by Dhrymes and Kurz

We are indeed very grateful to the discussants of our paper for their detailed comments. We are, however, dismayed that a number of points raised are either adequately covered in our paper or involve an incomplete understanding of our arguments. We hope that the following paragraphs will aid in dispelling much of the misunderstanding and elucidate the issues. We shall examine the points raised by each discussant individually and conclude with some general comments.

It is our understanding that Henry Latané raises two points. First, he questions the omission of lagged dividends in the specification of the dividend equation of our model; this was also raised by other discussants and we shall deal with it below. Second, he maintains that our result relating to the reversal of sign in the coefficient of the dividend variable in the investment equation when one uses single- and simultaneous-equation techniques is the product of our normalization scheme. He goes on to say "The meat packer pays a dividend equivalent to 5 per cent of book and invests 12 per cent of book, the public utility pays 6 per cent of book and invests 10 per cent of book. The dividend ratio is negatively correlated with the investment ratio. But the meat packer has $10 of sales for each $1 of book, while the public utility has only 25 cents of sales for each $1 of book, so the dividend-sales ratio for the meat packer is .5 per cent and the investment-sales ratio is 1.2 per cent, while the corresponding ratios for the public utility are 24 and 40 per cent. The dividend-sales ratios are positively correlated with the investment-sales ratios." While no one will take exception to the arithmetic of the example, Latané appears to have entirely misunderstood the issue. First, it is well known that the fact that the (simple) correlation coefficient between the dependent and one of the explanatory variables in a multivariate regression is of a given sign *does not* imply that the corresponding multivariate regression coefficient *must be of the same* sign. Second, this example is completely irrelevant to the results we cite. What we find is the following. Noting that there is a body of thought which views the dividend policy of a firm as independent, at least in the short run, of its investment policy (and presumably independent of the error term in the relevant equation), we introduced dividends as an explanatory variable in our investment equation. The corresponding regression coefficient turns out to be significant and positive; when the same relation is estimated as part of the larger structure by simultaneous-equation techniques, then this same coefficient turns out to be significant and negative. This is a very important empirical result, which must not be confused with the problems, if any, induced by our normalization.

William Vickrey's two comments are that we have conducted no test for identifiability of the structure we have estimated, and that the results are too unstable to permit us an insight into the complex of the interdependence we seek to estimate. In regard to the first point, Vickrey suggests that we should have employed a likelihood ratio test. While there is no objection to performing such a test, it simply involves the extraction of characteristics roots of a certain matrix, we do not think that this is a particularly useful exercise. There is not much evidence to convince us that the error terms of the equations of our model have a joint normal distribution; if this is not so, then the execution of the likelihood ratio test is an empty exercise, the outcome of which is difficult to interpret.

Concerning the second point, Vickrey apparently bases his conclusion on the first three lines of his Table 1. This criticism, however, seems largely without foundation. A look at our Table 14 will indicate that, in the dividend equation, the investment variable appears uniformly with a negative sign, while the external finance variable, when significant, appears uniformly with a positive sign. Moreover, the contracting influence of investment on dividends is most apparent in peaks and upswings (1952, 1955, 1957, and 1960); the same is generally true of the external finance variable, whose positive influence on dividends is significant in 1952, 1953, 1955, and 1960.

Important conclusions can also be derived from the investment equation, in which the dividend variable is nearly invariably significant with a negative sign. Our results also indicate a sharp dichotomy in the role of the external finance variable; thus in the pre-Accord period this variable is quite significant and positive in its effect, while in the great investment boom of the mid-1950's it appears to have had no influence since its coefficient is uniformly insignificant from 1955 through 1960.

Thus, while not claiming that our paper constitutes the definitive work on this topic, we sharply disagree with Vickrey on his second point.

Our results give us a great deal of insight into the complex of the decision-making process we wish to study and, furthermore, hint at some very interesting cyclical patterns that bear more careful and systematic investigation—obviously the next step in this type of research.

Finally, to the best of our understanding, Resek makes the following points: (1) the "lag structure" in our model is not "properly specified"; (2) the second equation is "nearly underidentified"—whatever that may mean; (3) there is some ambiguity in the interpretation of coefficients in the investment equation; (4) several questions of misspecification are raised, in particular the exclusion of lagged dividends as an explanatory variable in the dividend equation.

In view of the fact that, as they are presented, the first two points are closely related we shall discuss them concurrently. In the first point we are taken to task for ignoring the work of Almon and de Leeuw relating to the lag between appropriations and expenditures in capital investment. On the other hand, in the second point we are taken to task for "underidentification" in that we enter the profit rate in the dividend equation and the lagged (one period) profit rate in the investment equation as explanatory variables without adequate justification.

Now if it is true, and surely one might wish to test it, that both elements of a rate of profit and elements of an accelerator theory govern investment behavior, and if Almon and de Leeuw are correct in pinpointing the specific lag structure between appropriations for investment and expenditures for investment, then it follows that our specification of the lagged rate of profit in the investment equation is a perfectly sensible specification. In particular, Almon's work shows that within a year after appropriation the bulk of it has actually been spent, while within six to eight quarters nearly all appropriations have been expended. Since her sample comprises two-digit manufacturing industries and certain manufacturing aggregates and since our sample consists mostly of firms which can be classed as manufacturing, it would appear that we acted properly in specifying the lagged rate of profit as an explanatory variable in the investment equation. Indeed, this "near underidentifiability" of which our model is accused is the logical consequence of taking into account the very works he urges us to take into account in an earlier passage. In this connection, we should mention that more complicated lag structures were attempted in specifying the role of the profit rate in the investment as well as the dividend equations, but these generally did not perform as well as the ones finally reported. Given the choice between the simple and the complex, other things being equal, we would of course choose the simplest specification possible. One possible explanation for Resek's views is that he may have overlooked the fact that investment in this context means investment expenditures, not appropriations.

We take it that there is no dispute in using the current profit rate as an appropriate explanatory variable in the dividend equation.

In his third point Resek raises a question of interpretation of the coefficients of the investment equation in particular. There appears to be some confusion in his mind about the meaning of the constant term and the coefficient of the rate of profit variable; he claims that "Because of their specification, they may be finding the effect of sales rather than profits." We do not think there is any ambiguity and should be glad to elucidate the matter. If we "solve" the investment equation by multiplying through by sales (S), then the coefficient of the linear term containing sales is, in fact, the decomposition of the constant term in our equation, a decomposition incidentally that reveals highly significant industrial classification contrasts.

The accelerator variable in our version is $S_t - S_{t-3}$. There cannot be any confusion in the manner Resek alleges "Moreover the constant term may have a coefficient that is attributable to sales and that explains the variation which otherwise would be explained by the accelerator variable, $[S - S(t-3)]$." Now, in its usual empirical formulation the accelerator version of investment theory does not attribute investment to "sales" but rather to changes in sales, so it is difficult for us to understand Resek's criticism. The meaning of these two estimates is quite simple. The constant term relays the following information: consider any two firms, which are identical in every other respect except for their volume of sales. Then to the extent that there is a significant constant term, or a significant industrial classification contrast, the two firms would behave differently with respect to investment. Thus, the constant term of the equation captures a purely "size" effect; while the contrasts capture both a size *and* an effect that is to be attributed to the type of activity in which the firm in question engages.

On the other hand, consider any two firms which are identical in every other respect except that they differ in the variable $S_t - S_{t-3}$, i.e., one has grown more rapidly than the other. Then, to the extent that the coefficient of this variable is significant, our model would tell us that investment would differ between the two firms. This is what one customarily takes as the accelerator effect. Thus, far from confounding the issue, our formulation serves to differentiate clearly between effects that are to be attributed to size or industrial classification, and those that are to be attributed to the rapidity with which pressures are registered on the firm's productive capacity-accelerator effects.

There is only one valid criticism that can be made against our formulation, viz., that our accelerator variable is in effect $(S_t - S_{t-3})(S_t/S_{t-3})$. This induces a "bias" on the accelerator coefficient because of the presence of the second term in parentheses, a point not made by Resek. This is, however, innocuous in the present context since we are not particularly interested in the magnitude of that coefficient, nor are we interested in testing any hypothesis concerning its magnitude—other than whether the coefficient is significantly different from zero or not. A similar interpretation is to be placed on the rate of profit coefficient.

Finally, the question of specification raised by Resek concerns chiefly our omission of lagged D/S from the explanatory variables in the dividend equation. In our work with the dividend behavior of electric utilities, cited in our current paper, we showed that in our sample (which was a cross-sectional one) the simple Lintner hypothesis yields an optimal dividend pay-out ratio of 1.22. Since we refused to entertain seriously the notion that firms optimally desire to pay out as dividends $1.22 for every dollar of profits, we proceeded to show that an alternative specification of the dividend behavior of (electric utility) firms relying on essentially the same structure we use in the current study has as much explanatory power as the Lintner formulation. Moreover, in our specification we gain some additional insight into the structure of the dividend decision-making process. It is for this reason that we were not particularly perturbed when multicollinearity forced us to abandon the version Resek refers to, i.e., a specification in which $(D/S)_{t-1}$ appears as an explanatory variable in the dividend equation.

Perhaps it should be noted that the problem of multicollinearity is generally unrelated to the explanatory power of the omitted variable with respect to the explained variable. Here multicollinearity arises, and severely so, because $(D/S)_{t-1}$ is very highly correlated with $(P/K)_{t-1}$ and not because $(D/S)_t$ is highly correlated with $(D/S)_{t-1}$, which is what one might infer that Resek had in mind.

It seems fitting to conclude with a summary of the conceptual framework of this study. We view the firm as making the three decisions under consideration interdependently. The dividend behavior of the firm depends on the profitability of its operation, the type of activity it engages in, and the decisions it takes or reviews concurrently with respect to investment and external finance.

Investment depends on elements of the accelerator and rate of profit theories, perhaps with a lag between the appropriation and expenditure of funds on capital projects. Investment also depends on the decisions taken with respect to dividends and external finance.

Finally, external finance may depend on the interest rate, the leverage position of the firm, and the decisions with respect to dividends and investment.

Our results tend to substantiate this view of interdependence and incidentally show that investment and dividends are relatively little affected by external finance, while the latter is chiefly affected by the decisions of the firm regarding its dividend and investment policies.